18 March 2022

COASTAL WALKWAY UPGRADE, GREY ROAD GULLY AND KURNABINNA GULLY, HALLETT COVE, SA 5158

BRIDGE FOOTINGS DESIGN REPORT

ASPECT STUDIOS

ADL2022-0050AD Rev0

ADL2022-0050AD		
Date	Revision	Comments
18 March 2022	0	For Comment
18 March 2022	1	Appendices updated for 40mm bar

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EXECUTIVE SUMMARY

This report presents CMW geotechnical design advice for the Grey Gully North bridge anchor, landing and portal structures. In addition, there is also design advice for the Grey Gully South, North and South Kurnabinna Gully bridge anchor, landing and portal structures for the City of Marion's Coastal Walking Upgrade Project.

Based on the design assessment a modular footing system has been designed for the three structures. In all cases a 40mm steel bar sheathed in a plastic corrosion protection layer installed in a 120mm OD boreholes is required as the dowel socketed into bedrock. Lengths, orientations, and connections to above ground structures are detailed herein.

Grey Gully North, South and North, South Kurnabinna Gully bridge anchor, landing and portal structures are assessed to be founded in similar geotechnical units but the orientation, depth and position of these geotechnical units along with the surface topography are unique at each site. CMW however have assessed these conditions and provide similar design advice. In short, it is the anchor block that needs to be sized given the depth to reach competent bedrock as founding the block upon soil will result in long term consolidation of the soil and therefore a lack of tension in the anchor, leading to uneven stress loads in the anchors which is not allowed for in this design. This condition of the varied foundation conditions requires a geotechnical engineer familiar with the design to be present during each foundation excavation.

Also, the excavation of each structure footing is substantial and is expected to be undertaken by mechanical devices as bedrock is expected at shallow depths. For example, the design for Kurnabinna South requires excavation of a 1mW x 2mD anchor block, landing 450mmW x 1mD strip footing and for the portal 1.2mW x 1.2mD.

It is highlighted that during the first 12 months of construction/maintenance period that lift off testing may be required to ensure design capacity of the anchor's conditions are meet. With each test personnel trained and skilled in working at heights are to undertake this work and an engineer is to certify construction meet compliance with the design.

In all cases the same methodology of construction has been adopted as requested by Council in which a small percussion rig mounted on a tripod frame is able to drill all the bored holes for anchors or vertical piles. All holes with be infilled with the same grout mix and the same reinforcement bar. All in ground structures are to be installed by personnel trained and skilled in working at heights and installing such heavy awkward structures upon high-risk steep slopes.

All in ground structures are to be connected to above ground structures by anchor or pile caps designed by others.

In all cases Council are to continuously assess the anchor bars for conditions of load capability and physical conditions of the bars. This periodic assessment (at a minimum of once per 5 years) will require personnel trained and skilled in working at heights to undertake this work. In addition, the design must allow for access to the anchor bars for testing and any repairs of the anchor bars (noting this certified assessment would be required by a structural engineer).

In support of this report, are two CMW reports; a geotechnical factual report (ADL2022-0050AB Rev0 dated 16/3/2022) and a pull anchor test report (ADL2022-0050AC Rev0 dated 9/3/2022). Both reports cover subsurface conditions and trial anchor testing at all the bridge abutment sites.

1 INTRODUCTION

CMW Geosciences (CMW) was authorised by Aspect Studios to undertake a geotechnical assessment and design for the Grey Gully and Kurnabinna Bridges, as part of the Walkway Upgrade Project.

This report provides the results of the abutment foundation design parameters and rock anchor design based on provided loads from Bridge Designer.

2 INFORMATION PROVIDED

Following information have provided to CMW for this task by way of email communications in 2022:

- Design long and cross sections providing topographic setting and structure locations J0439-CIV-DRG-1065[B], J0439-CIV-DRG-1066[B], J0439-CIV-DRG-1067-2[], and J0439-CIV-DRG-1068-2[]
- Design loads per structure from document Kurnabinna Response ie Geo locations AC on 17 feb. Noting the 30-degree angle of cable stay is a key aspect of this design advice.

3 PROJECT BACKGROUND

The Marion Coastal Walkway covers an 8km section from Marino to Hallett Cove and was constructed in the mid-late 1990's. The City of Marion's Coastal Walkway Plan provides a renewal plan that prioritises sections for upgrade and repair. A high priority has been placed on Cell 5 (Grey Rd Gully), Cell 6 (Kurnabinna Gully) and Cell 10 (Field River).

This walkway has strategic importance as a key link in the 70km Coast Park Trail from North Haven to Sellicks Beach. The upgrade works will enable it to become an important and iconic connecting piece to other major open space networks, including Marino Conservation Park, Hallett Cove Conservation Park and Glenthorne National Park.

CMW has previously undertaken geotechnical assessments for these two locations to assess the stability of the areas of the existing boardwalks for the construction of an elevated boardwalks. During detailed design it has been identified that suspension bridges are the preferred construction method to traverse these two locations and geotechnical information is required to inform foundation designs.

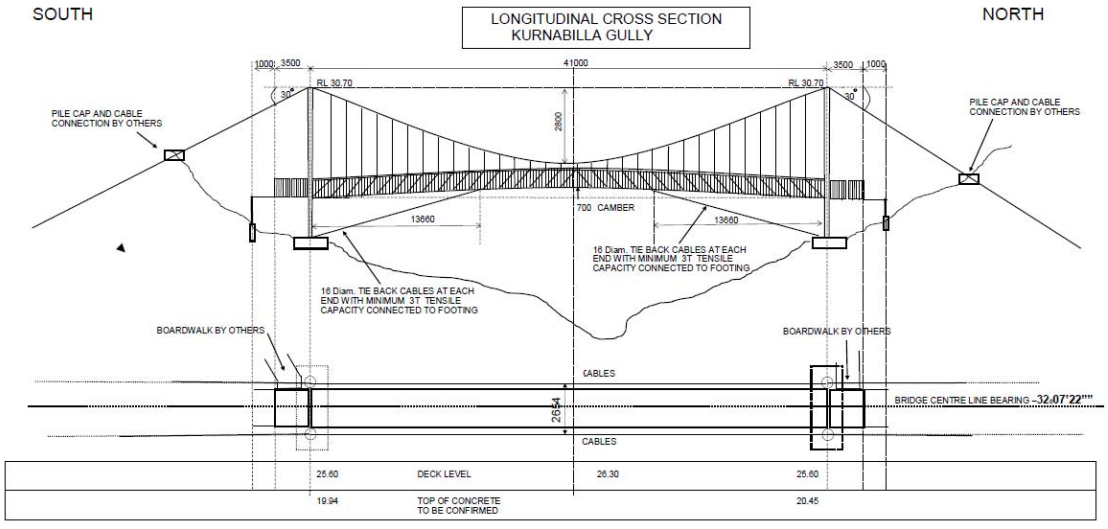


Figure 1: Layout of the Kurnabinna Gully Bridge

This report provides geotechnical design advice for the proposed bridge abutment structures (Anchor, Portal and Landing Footings) at Grey Gully and Kurnabinna Gully. Figure 1 provides an illustration of the bridge design layout. See Appendix A for design sections, topography, and bridge layouts.

4 SCOPE OF WORK

The scope of works has been to provide abutment foundation design parameters and rock anchor design based on provided loads from Bridge Designer and Drawings provided by others.

Herein is a response to this scope.

5 ASSESSMENT METHODOLOGY

5.1 Assessment Criteria

The following assessment criteria has been applied to the design.

- The subsurface conditions are assessed under drained condition and lower quartile of bond strength given a grouted element in soil or rock.
- Bored piles for the anchor, portal and landing structures in accordance with AS2159 2009.
- Subsurface parameters for vertical and lateral resistance parameters are as per Bridge code AS5100 2004.
- Pull out resistance as per FHWA/IF/99/05
- Under static loading a Factor of Safety (FOS) of 1.5 is present at all sites for the global slope prior to loading.
- Under dynamic loading a Factor of Safety (FOS) of 1.1 is present at all sites for the global slope prior to loading.
- Under static and dynamic loads and a bored pile and spread footing system is required. There has been no separation of the live and dead loads.
- Reinforcement elements are able to be placed only a maximum borehole size of 120mm to a maximum depth of 20m on an inclined angle and 10m on a vertical angle.
- Reinforcement elements to be designed to Tensile Yield strength not Ultimate Tensile strength.
- Reinforcement elements to have a maximum of 9 to 12% elongation of the element during pre-yield force.

5.2 Loadings

All loads are assumed as uniformly distributed from the structure to the foundation. These loads are tabulated in Table 1.

Table 1: Summary of Bridge Loads

Mark	Description	X (kN)	Y (kN)	Z (kN)
KP-S-E	Kurnabinna Gully South Portal - East	2	23.3	415.04
KP-S-W	Kurnabinna Gully South Portal - West	2	23.3	415.04
KA-S-E	Kurnabinna Gully South Anchor - East	446.78	0	257.95
KA-S-W	Kurnabinna Gully South Anchor - West	446.78	0	257.95
KE-S-E	Kurnabinna Gully South Extension - East	0	2.14	16.34
KE-S-W	Kurnabinna Gully South Extension - West	0	2.14	-11.07

Table 1: Summary of Bridge Loads				
Mark	**Description**	**X (kN)**	**Y (kN)**	**Z (kN)**
KP-N-E	Kurnabinna Gully North Portal - East	2	23.3	415.04
KP-N-W	Kurnabinna Gully North Portal - West	2	23.3	415.04
KA-N-E	Kurnabinna Gully North Anchor - East	446.78	0	257.95
KA-N-W	Kurnabinna Gully North Anchor - West	446.78	0	257.95
KE-N-E	Kurnabinna Gully North Extension - East	0	2.14	16.34
KE-N-W	Kurnabinna Gully North Extension - West	0	2.14	-11.07
KP-S-E	Grey Gully South Portal - East	2	23.3	415.04
KP-S-W	Grey Gully South Portal - West	2	23.3	415.04
KA-S-E	Grey Gully South Anchor - East	446.78	0	257.95
KA-S-W	Grey Gully South Anchor - West	446.78	0	257.95
KE-S-E	Grey Gully South Extension - East	0	2.14	16.34
KE-S-W	Grey Gully South Extension - West	0	2.14	-11.07
KP-N-E	Grey Gully North Portal - East	2	23.3	415.04
KP-N-W	Grey Gully North Portal - West	2	23.3	415.04
KA-N-E	Grey Gully North Anchor - East	446.78	0	257.95
KA-N-W	Grey Gully North Anchor - West	446.78	0	257.95
KE-N-E	Grey Gully North Extension - East	0	2.14	16.34
KE-N-W	Grey Gully North Extension - West	0	2.14	-11.07

Notes:
X longitudinal, Y Lateral Z vertical, All loads are working loads (unfactored) DL+LL+WL source Kurnabinna Response ie Geo locations AC on 17 feb.pdf

CMW have then distributed 120% of the loads in Table 1 into group anchor or pile footings via anchor block, pile cap or strip footing.

5.3 Services

It is understood that there are no buried services within the vicinity of these structures.

5.4 Methodology

Geotechnical design has aimed to assess bearing, sliding, overturning and vertical and lateral movement for each of the structures given the loads provided.

To begin the design process the geotechnical investigation data has been collated into geotechnical units of similar characteristics at each site. The integration of these results and the site topography into a 2D section was undertaken for the purpose of creating a ground model for each bridge abutment. In the ground models these geotechnical units were correlated with site mapping results and the schematic distribution of the units projected under each bridge abutment structure.

This 2D section/model has then been used in numerical models for the geotechnical design.

The steep valley is considered to be metastable in the long term and unable to bear large vertical or lateral loads from the bridge structures. As such piled with strip or pad footings have been designed for the project.

Each footing will be required to be embedded into the steep slopes to ensure a specific geotechnical unit is founded upon to ensure bearing requirements are met. Excavation of the slopes will require land above the area also to be excavated to stable slopes.

With respect to the geotechnical design of embedded anchors and piles, key empirical input parameters assigned were:

- Grout to bedrock bond strength given the geological origin, strength and weathering of the bedrock.
- Grout to anchor bond strength given the tensile, shear and compression strength of the steel element
- Corrosion resistance, installation method and consideration of damage to the element during transport and installation.
- The selection of an off the shelf quality reinforcement element and plate that met the design life requirement and the installation in a 120mm hole.
- The yield and ultimate tensile strength of this element.

Analysis methods undertaken to assess geotechnical design parameters included:

- Assignment of Elastic modulus using an inhouse spreadsheet and above reinforcement and borehole constraints.
- RS pile software to assess pile groups load distribution and lateral resistance given the vertical, ending bearing loads in accordance with AS5100 and the site topography.
- Plaxis2D software a finite element package, that can assess the site topography and all the structures.
    - Assessments included stability of overall slope was undertaken. Factor Strength(s) method, also known as “Phi/c’ Reduction” method, is used to determine the FOS.
    - Pile movements and bending moments. Including the Prop modelled as a uniformly distributed load applied in normal direction to the face of the rigid pile cap.
    - Anchor loading including the embedded rigid anchor block.
- Movement (mm) correlation with manufactures bar specifications.

CMW consider the bond strength to a be key limitation to the design of the anchor. As such the following design consideration have been implemented. For the Anchor Bar design CMW have allocated the following loadings being imparted to the bond strength (which is a much lower order strength compared to the reinforcement bar strengths):

Design Working Load: The long-term load (in kN) which is required in the anchor bar. In this project the load specified by Moodie is the combined load (620kN). CMW have distributed this load into 4 anchor bars (i.e. 155kN per anchor bar). CMW have an inbuilt redundancy by designing for a load distribution over 4 bars distributed by the anchor block.

Minimum Breaking Load: The minimum breaking load (in kN) has been assigned as the bond stress of grout to bedrock (not the grout to anchor bar). This is calculated from the lower quartile of CMW empirical assessment of the geotechnical data available for this project. This load is 360kN for a 120mm hole annulus. Given the 620kN design working load in order to meet a FoS of >1 a minimum of 2.2 anchor bars is required.

6 ANALYSIS RESULTS

6.1 Ground Model and Geotechnical Parameters

The ground model adopted for the analysis is presented below. With each site model the lateral thickness and inclined angles of the units was incorporated.

Grey Gully and Kurnabinna Gully

CALCRETE	An inconsistent layer but hard and dense
Unit 1: CLAY	Gravelly clay of hard consistency and medium plasticity.
Unit 2: GRAVEL (GP)	Medium to coarse grained, sub-angular to angular with fine to coarse grained sand, red brown, with grey; Residual Soil to extremely weathered siltstone.
Unit 3: SILTSTONE	Fine grained, laminated, red brown, highly weathered, very low strength siltstone.
Unit 4: SILTSTONE	Fine grained, laminated, red brown, low to medium strength moderately weathered siltstone.
Unit 5: SILTSTONE	Fine grained, laminated, red brown, medium to high strength slightly weathered siltstone.

Note thinly layers of sandstone were encountered but difficult to locate. Typically, the sandstone layers were of lower strength and higher weathering than the adjacent siltstone rock.
Kinematic Analysis: the following notes describe the rock mass characteristics for the site:

- Bedding - projects into the slope dip direction NW at 35 degrees. Ground Anchor will cut across this fabric obliquely. In both the north and south bridge abutments.
- Joint - main toppling defect set. Will be like a tension crack and release the back of the wedge away from the valley side. This is a main issue for this design.
- Cleavage is at 90 degrees to the valley slope but cuts the rock mass into blocks.

Kinematic failure mode is a combination of the joint and cleavage defect sets being the release defects for a block/wedge failure. Bedding will limit sliding in Grey Gully North and Kurnabinna North but will be a disadvantage in the Grey Gully South and Kurnabinna South Bridge Abutments.

Given these aspects of the kinematics and limited site information, conservative designs should avoid near surface loading and therefore embedment depths need to be founded into competent bedrock (unit 4 to 5 at a minimum).

Geotechnical parameters for the project are provided in Table 2.

Table 2: Adopted Geotechnical Design Parameters per Geotechnical Unit

Unit	Stratum	Jn	Jr	Ja	UCS	GSI Range
0	Top soil	NA	NA	NA	NA	NA
1	Clay					
2	Res Soil	3+		clay <10mm	2	28 to 17
3	VLS	3+	St + Ro	clay <1mm	4	40 to 25
4	LS	3+	St + Ro	veneer	8	40 to 55
5	MS	3+	St + Ro	veneer	12	50 to 65

Table 2: Adopted Geotechnical Design Parameters per Geotechnical Unit						
Unit	**Unit weight g (kNm-3)**	**cu (kPa)**	**c' (kPa)**	**Φ´ (deg.)**	**v'**	**Young's Modulus, Ev´ (MPa)**
0	To be removed during construction to landscaping only					
1	18	75	5	28	0.35	20
2	18	150	15	26	0.35	35
3	19	-	40	32	0.3	70
4	20	-	80	39	0.3	600
5	22	-	180	44	0.25	1600
Where; Φ' = angle of internal friction, c' – drained cohesion, c_u = Undrained shear strength, γ = bulk unit weight, Ev' = Youngs Modulus, v – Poisson's ratio						

6.2 Design Advice

6.2.1 Excavations

Excavations are required for each of the anchor, portal and landing pad or pile cap footings. These excavations upon steep slopes create instabilities below and above the structure. To meet the design criteria under static loading of a Factor of Safety (FOS) of 1.5 for global stability local excavation is required to slopes 1V:2H or as close to this batter angle as possible above the slope. Under dynamic loading a Factor of Safety (FOS) of 1.1 achieved if the same upslope batter treatment is to be undertaken.

Each excavation is to be witnessed by a geotechnical engineer to ensure design foundation conditions are met.

With respect to the slopes below the structures, mitigation of instabilities is not required but mitigation of erosion is required. The piles designs are considerate of the slope stability, but they do not consider long term erosion of the slope and scour due to rainfall events. This mitigation design is a part of the civil design undertaken by others.

6.2.2 Anchor

It is understood the cable stay at 30 degrees to the horizontal meets the ground surface at the anchor point. The anchor point is embedded into the soil and rock mass of the bridge abutment by an anchor block. This anchor block is to be design by others.

CMW design advice includes the anchoring of the anchor block into the valley subgrade rock mass. The results of CMW load analysis indicates a reinforcement bar element Dywidag WR DCP Anchor 01 (Double Corrosion Protected (DCP) Permanent Ground Anchor) or similar is required with the details listed in Table 3. Refer to Appendix B for the specification of this reinforcement element. Appendix C contains the layout of each bar within the anchor block and the design details for each bar and the anchor block.

4 anchor bars to be installed at 0.8m centres, 2 bars at 30 degrees to horizontal and 2 bars at 50 degrees to horizontal. Each bar to have 500mm cover from the perimeter of the anchor block. Each bar to have a Load transfer block. Load transfer block allows for testing of each anchor bar at specific inclinations and orientations (see item 5 in image adjacent in Appendix C).

Depth of anchor block to be assessed on site to be founded in Geotechnical Unit 3 or better conditions. With each excavation is to be witnessed by a geotechnical engineer to ensure design foundation conditions are met.

Table 3: Bar Details for Anchor Reinforcement								
Borehole Depth (m)	**Borehole Diameter (m)**	**Bar length (m)**	**Bar Diameter (mm)**	**Free Length (m)**	**Bond Length (m)**	**Bearing plate (mm)**	**Hex Nut**	**Anticorrosion Compound**
15	0.12	15.6	40	5	10	240 x 55	Yes	Yes
Note: 600mm extra length required to be protruding above the anchor block to allow for future lift off testing Multiple pretension phases are expected during the 12-month construction period to ensure pretension loading (50kN). All bars to be pretensioned to 50kN and lift tested periodically (every 5 years). The design of fittings to secure cable stays to be undertaken by Innovis. Structural engineer's design for cable stay fastening to not impact on the ground anchor design. Protective caps are required. Protective caps are to be replaced at every testing or pre-tensioning of the bar. Refer to manufacturer's specifications for installation. Refer to manufacturer's specifications for testing.								

6.2.3 Portal

To meet the design load requirements bored pile footing details (micropiles) are required as listed in Table 4. A reinforcement element Dywidag WR DCP Anchor 01 (Double Corrosion Protected (DCP) Permanent Ground Anchor) is suitable to meet the project's design requirements noting that the anchor bar is to be connected/integrated into the pile cap of the portal structure (therefore no plate, cap and corrosion elements required). Connection of the bar to the pile cap to be designed by others.

Refer to Appendix B for the specification of this reinforcement element. Appendix C contains the layout of each bar within the pile cap and the design details for each bar.

Depth of pile cap to be assessed on site to be founded in Geotechnical Unit 3 or better conditions. Each excavation and micro pile are to be witnessed by a geotechnical engineer to ensure design foundation conditions are met.

Table 4: Bar Details for Portal Reinforcement								
Number	**Inclination**	**Borehole Depth (bottom of strip footing) (m)**	**Borehole Diameter (m)**	**Bar length (m)**	**Bar Diameter (mm)**	**Bond Length (m)**	**Bearing plate (mm) and Hex Nut**	**Anticorrosion Compound**
6	Vertical	7	0.12	7	40	7	no	no
4	Vertical	5	0.12	5	40	7	no	no
Note: Refer to manufacturer's specifications for installation.								

6.2.4 Landing

The landing footing has been designed to support the loads but also to reinforce the soil and rock mass above the portal and below the anchor structures. This is very important for the Grey Gully South and Kurnabinna South bridge abutments due to the inclination of the bedding planes out and down the valley slope. This inclination in combination with variable strength thin sandstone units create a potential for sliding wedge rock mass failures to dominate.

The depth of the strip footing aims to embed the structure to limit lateral and longitudinal loading and the depth of piles aim to provide regional stability.

The depths to a competent bedrock unit 4 varies at each bridge abutment varies along with the inclination of the slope. Design depths have been assigned based on the above considerations not the single structure footing.

To meet the design load requirements bored pile footing details (micropiles) are required as listed in Table 5. Refer to Appendix B for the specification of this reinforcement element. Appendix C contains the layout of each bar within the pile cap and the design details for each bar.

Table 5: Bar Details for Landing Reinforcement

Number	Inclination	Borehole Depth (bottom of strip footing) (m)	Borehole Diameter (m)	Bar length (m)	Bar Diameter (mm)	Bond Length (m)	Bearing plate (mm) and Hex Nut	Anticorrosion Compound
2	Vertical	6	0.12	6	40	6	no	no
Note: Refer to manufacturer's specifications for installation.								

Each excavation and pile are to be witnessed by a geotechnical engineer to ensure design foundation conditions are met.

6.3 Specifications

6.3.1 General

Refer to Appendix B for the manufacturer's specification of steel bars, plates and jacks recommended in this design report to be installed and utilized for this project. Appendix B also contains a recommended procedure for onsite assembly and installation for the anchor. An alternative to the specified reinforcement bar must be approved by the Contract Superintendent prior to use in the project.

6.3.2 Rock Anchor Systems

The Contractor shall plan on constructing the number and arrangement of structural footings as shown in the Drawings unless an alternative has been accepted by the Principal.

Where any modifications are necessary to suit a particular construction methodology for an approved anchoring system (for the number and arrangement of reinforcement bars as shown in the Drawings), the Contractor shall submit to the Superintendent, working drawings (to the same scale as the Drawings) of all modifications necessary together with design calculations carried out and certified by a practising Engineer who is experienced in this type of work. All such modifications, calculations and drawings shall be carried out at no cost to the Principal.

6.3.3 Grout

Grout will be required to secure the reinforcement bar into the ground.

Batching into mixers shall be carried out by measuring the water by volume and using whole bags of cement. Any additives shall be premeasured into individual doses per batch.

The grout shall be mixed in a high-speed mixer (minimum 1000 rpm) capable of imparting a high shear to the grout components so that a colloidal grout of uniform consistency is produced in a mixing time of less than five minutes.

The grout mixing process shall utilise a recirculating system where the grout is continuously discharged and recharged into the mixing unit during the mixing period. After mixing, the grout shall be kept continuously agitated. The grout shall be passed through a nominal 1.2 mm sieve prior to injection. The grout shall be used as soon as possible after mixing and in any case within 30 minutes of adding cement.

Grout pumps shall be efficient and capable of running continuously for the duration of grouting of each anchor bar. They shall be capable of pumping the grout specified at a rate appropriate to the planned rate of rise of grout in the holes as set out in the method statement.

Grouting shall be carried out by use of supply lines directly connecting the pumps to the down-hole tubes.

Grout fittings shall be appropriately located to control the injection of grout to the down-hole tubes. Fittings at the tops of holes shall include a valve discharging to waste and a pressure gauge. Pressure gauges shall be maintained in calibration.

Prior to grouting, the grout tubes shall be checked individually to ensure that they have not been compressed or blocked.

Grouting shall proceed by injection through the feeder tube to the bottom of the anchor bar. Grouting shall be continuous until all the ground water is displaced from the hole and the emerging grout is the same consistency as the grout entering the feeder tube.

Once the emerging grout has reached the specified consistency, observation shall be continued by an experienced operator, and the grout discharge shall be allowed to continue until there is no reasonable doubt that all zones of low quality grout have been displaced.

The grout which has over-flowed from the hole shall be discarded to waste and disposed of. The anchor shall be supported for a minimum of 24 hours following completion of grouting.

Within 30 minutes of completion of grouting the top of the grout column shall be flushed out to sufficient depth so that at the upper end of the free length the anchor bars can accommodate the anchor head.

Test samples of the grout mix are to be completed per batch of grout created or at a minimum of 1 grout sample tested per day of bar reinforcement placement. Grout test samples should be submitted to the NATA concrete testing approved laboratory for testing on the day of grout sample collection.

6.3.4 Steel Bars and Plate

Refer to Appendix B for the manufacturer's specification of steel reinforcement bars and plates (Dywidag WR DCP Anchor 01 (Double Corrosion Protected (DCP) Permanent Ground Anchor). It is understood from discussions that:

- The internal grouting of the bar element (within the sheath to the bar) is undertake by the manufacturer. As such Quality Control of the bar element will be required. Refer below for these requirements.
- The installation method will be unable to be installed the bar as one length. An alternative is available from the manufacturer that is acceptable to the design. This process includes:
    - The manufacturing of shorter length or bar. Increments of bar lengths can be connected by couplers (in both the bond and free length). These couplers are to be installed as per the manufacturer's specification. Corrosion protection of this join is achieved by applying anticorrosion compound to the bar and coupler and covering the splice with a heat shrink sleeve. For couplers in the free length an additional debonding tube is inserted over the DCP couplers.
    - Any alternative to the above installation method must be approved by the Contract Superintendent and CMW Geosciences the Geotechnical Designer.

All purchase, delivery and installation steps of the steel bar and plate are to be supervised and documented by a Supervisor. The Supervisor is responsible for the following activities:

(a) Checking upon delivery to each bridge abutment site, the receipt of anchors are in good working order as per the specifications.

(b) drilling and cleaning of drillholes.

(c) placing of bar components.

(d) grouting of bar anchors and

(e) testing and stressing of bar anchors.

The Supervisor shall certify that the following work conforms to this specification:

(i) information listed to be supplied herein.

(ii) manufacture, installation and stressing of test anchors.

(iii) the grease proposed for use conforms with the requirements.

(iv) all plastic sheathing proposed for use conforms with the requirements.

(v) assembly of bar including the marking of anchor bars prior to installation and provision of the listed data.

(vi) submission of conformance records for the manufacture of bars.

(vii) submission of conformance records for the hole preparation prior to installing a bar in the hole, and

(viii) submission of records of the monitoring of each bar placement within three days of completion of monitoring.

In addition, prior to construction as part of the Project Quality Plan method statements must be provided covering the following:

a) Manufacture, installation and stressing of test anchors

b) Procedures for preparation of anchor, portal and landing holes

c) Procedure for installing the grouted bar reinforcement.

d) Technical procedure for the grouting operation in Clause 3.6. The personnel required to carry out the operations together with proof of any relevant training and experience shall be included.

e) Technical procedures for the stressing operation in Clause 3.7. The personnel required to carry out the operations together with proof of any relevant training and experience shall be included; and

f) A copy of the proposed prototype record forms.

Following construction, for each of the above construction operations or activities, sample record sheets which show full conformance of the grouted bar reinforcement after final installation and or stressing shall be provided.

6.3.5 Jack

To undertake the testing requirements of this design a 600kN jack is required to test to a maximum of 500kN. It is highlighted the jack is a 36 kilogram weight and therefore manual handling issue may prevail.

6.3.6 Anchor Bar Acceptance Testing

Purpose:

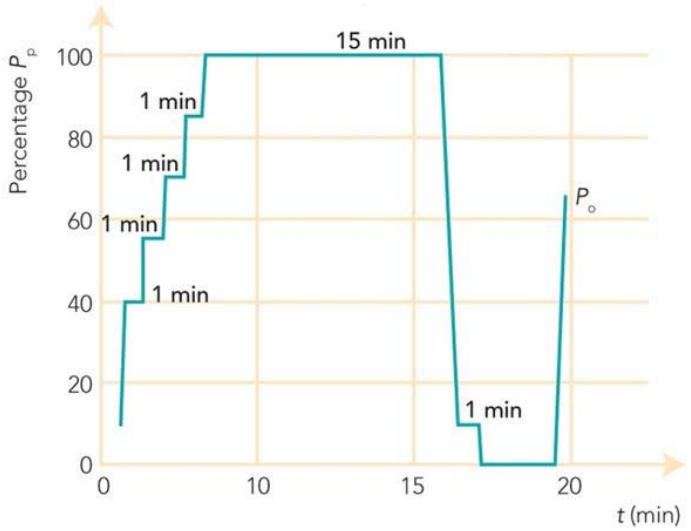
Each ground anchor bar is tested after installation and prior to being put into service to tensile loads that exceed the design load. This load testing methodology, combined with specific acceptance criteria is used to verify that the ground anchor can carry the design load without excessive deformations.

Method:

Following a period of 7 days after installation of the reinforcement bar and grout placement. All grouted anchor bars are pull tested using a jack. This testing will require the cap to be removed from the bar.

This test must be undertaken by a suitable trained person and the results assessed and certified by a structural engineer. Testing of the anchors bars should be undertaken in accordance with BS8081 & EN1537:2000, Section 9.7 & Annex E.

An example of the pull testing process is provided in Picture 1. In this example the anchor bar is loaded stepwise by load cycles increasing from the datum load to the proof load. At each load step, the displacement of the tendon end is measured during a fixed time period.



Picture 1. Example loading sequence for acceptance test in fine soil

This design requires the same load cycles steps but each load step to be held until there is a stable measurement in the displacement of the bar over a 5-minute period. Only once this stable movement is achieved can a next loading stage be undertaken. At the peak test load the load must be held for a minimum of 1 hour.

All bars must be tested to this process to the Peak Test Load.

Peak Test Load: The maximum load 500kN to which an anchor bar is subjected in the short term as an Acceptance Tests. With a maximum of 0.2 to 1% elongation of the free length steel element. This load test allows for a method of Acceptance Testing of all anchors.

6.3.7 Prestressing Anchor Bars

Following testing of the bar prestress the bar to a Lock-off Load or Residual Load. This load (in kN) is the required prestress plus an allowance for loss of prestress (i.e. 50kN plus 10% loss of prestress, a 55kN load per anchor bar.

Following prestressing the anchor bar is required to be regreased (with an anti-corrosion compound) and a cap placed on all anchors.

6.4 Anchor Construction Records

Prototype record forms shall be submitted with the relevant technical procedures prior to the commencement of anchor and mesh installation. The data to be recorded shall include the following:-

a) Rock anchor No.

b) Rock anchor type (type, number and size of anchor bars, etc) and nominal minimum breaking load.

c) Design working load, lock-off load and test load (actual values and as % of minimum breaking load).

d) Nominal bond length and free length of anchor bar.

e) Grout mix details, estimated rock/grout bond stress at minimum breaking load.

f) Location, diameter of hole and total drilling depth (depth in overburden and depth in rock also recorded separately).

g) Times at start and finish of drilling.

h) Time of installation of rock anchor.

i) Times and details of any interruption to grouting.

j) Times at start and finish of grouting.

k) Age of grout at stressing and 7 day grout strength.

l) Average grout injection pressure.

m) Volume of grout injected.

n) Batch No(s) from which anchor bar was cut, together with estimated breaking load and elastic modulus.

o) Stressing records, to include:

    (i) Identification number of jacks, gauges and pumps.

    (ii) Initial force (or pressure).

    (iii) Final force (or pressure).

    (iv) Elongation remaining after release of jacks.

    (v) Effective free length.

    (vi) Graph showing elongation versus force for the cyclic loading required.

    (vii) Lift-off test results.

p) Details of any unusual events relating to the drilling and installation of the rock anchor.

q) Details of any unusual events relating to stressing.

r) Monitoring records (if applicable), to include:

s) Identification number of anchor, type, ultimate capacity, test load, design working load, lock-off load and residual load immediately after locking-off.

t) Identification number and calibration reference of jacks, gauges, pumps and load cells.

u) A set of fully completed records shall be supplied to the Superintendent for the use of the Principal, within one month of stressing having been completed.

6.4.1 Periodic Testing Anchor Bars

Following the peak test load, lift off testing and prestressing is required for all anchors. This testing is to be undertaken at the period of 12 months following peak test load, and every 5 years thereafter.

This testing will require the bar cap to be removed from the bar. This test must be undertaken by a suitable trained person and the results assessed and certified by a structural engineer.

Lift-off Test: Test to determine the residual load in the anchor bar and is the maximum load 500kN to which an anchor bar is subjected in the long term as an Acceptance Tests. With a maximum of 0.2 to 1% elongation of the free length steel element.

Following lift off testing of the bar, prestress the bar to a Lock-off Load or Residual Load. This load (in kN) is the required prestress plus an allowance for loss of prestress (i.e. 50kN plus 10% loss of prestress, a 55kN load per anchor bar.

Following prestressing the anchor bar is required to be regreased (with an anti-corrosion compound) and a cap placed on all anchors.

All engineers' reports are to be submitted to City of Marion Council for verification that the foundation is meeting the design intent. It is highly recommended a geotechnical engineer support the City of Marion Council when reviewing these results.

7 CONSTRUCTION ISSUES

7.1 Trafficability

Trafficability for tyred vehicles on the natural soils is expected to become poor when wetted. Trafficking platform composed of well graded quarry aggregates are recommended. Where trafficking occurs adjacent to slopes the access tracks are to be designed and certified by a qualified engineer.

7.2 Water Management

Based on the subsurface conditions and groundwater anticipated surface water flow is expected to result in scour of the near surface soils and gravels. Some form of erosion protection and mitigation of erosion is required above and below each of anchor, landing and portal structures.

Care should be undertaken during construction to prevent water from ponding in the base of any excavation. The ponding of water could result in softening and potentially lead to additional post-construction settlement.

7.3 Excavatability

The soil profile encountered in the borehole locations to a depth of at least 1.0m are expected to be excavatable using conventional earthmoving equipment such as backhoes and excavators. Beneath a 1m depth, gravels, boulders, and bedrock are only expected to be excavated using conventional earthmoving equipment with hydraulic rock breakers.

7.4 Excavation Stability

Unsupported excavations deeper than about 0.8m should be assessed on site by a geotechnical engineer for slope instability risk. Excavations exceeding 0.8m depth should be continuously battered back at slopes no greater than 1V:2H. Use of heavy machinery adjacent to open excavations must be avoided. Permanent cut and fill batter slopes of 1V:2H may be adopted noting erosion of the slope by water flow and rainfall must be mitigated.

7.5 Site Conditions

Based on the results of analysis of permanent design structures, the following conditions are recommended to be implemented by the civil designer and constructor:

- During construction of the proposed spread footings and piled system, daily stability check shall be undertaken whilst works are being undertaken by competent personnel for sign of instability (tension cracks, fallen material, or seepage). Should any instability features be identified, work must be suspended immediately, and personnel must evacuate, and CMW Geosciences notified.
- No water should pond in or at the crest or at the bottom of the excavation.

8 LIMITATIONS

The findings contained within this report are the result of limited discrete investigations conducted in accordance with normal practices and standards. To the best of our knowledge, they represent a reasonable interpretation of the general surface condition of the site. Under no circumstances, can it be considered that these findings represent the actual state of subsurface ground conditions away from our investigation locations.

If any of the assumptions used in this analysis are found to be inaccurate, if there are any changes contrary to the assessment provided or ground conditions encountered during construction are significantly different from those described in this report and on which the conclusions and recommendations were based, then CMW must be notified immediately.

This report has been prepared for use in the Coastal Walkway Project located in Hallett Cove SA, in accordance with generally accepted consulting practice. No other warranty, expressed or implied, is made as to the professional advice included in this report. Use of this report by parties other than City of Marion and their respective consultants and contractors is at their risk as it may not contain sufficient information for any other purposes.

9 CLOSURE

CMW register our interest in being involved in the future construction verification of this project.

Should there be any questions in relation to this request for report, please contact the undersigned.

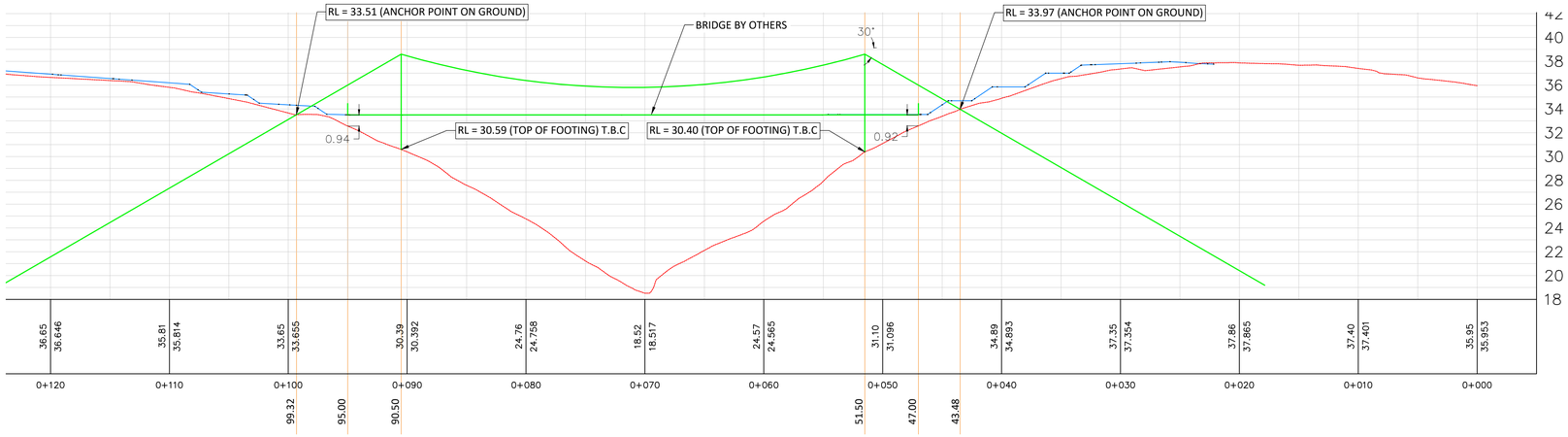
For and on behalf of CMW Geosciences

Prepared by:	Reviewed and authorised by:
Yan Wang	John Slade
Project Geotechnical Engineer	**Principal Geotechnical Engineer, CPEng**

Distribution: 1 electronic copy to Aspect Studio via email
Original held at CMW Geosciences

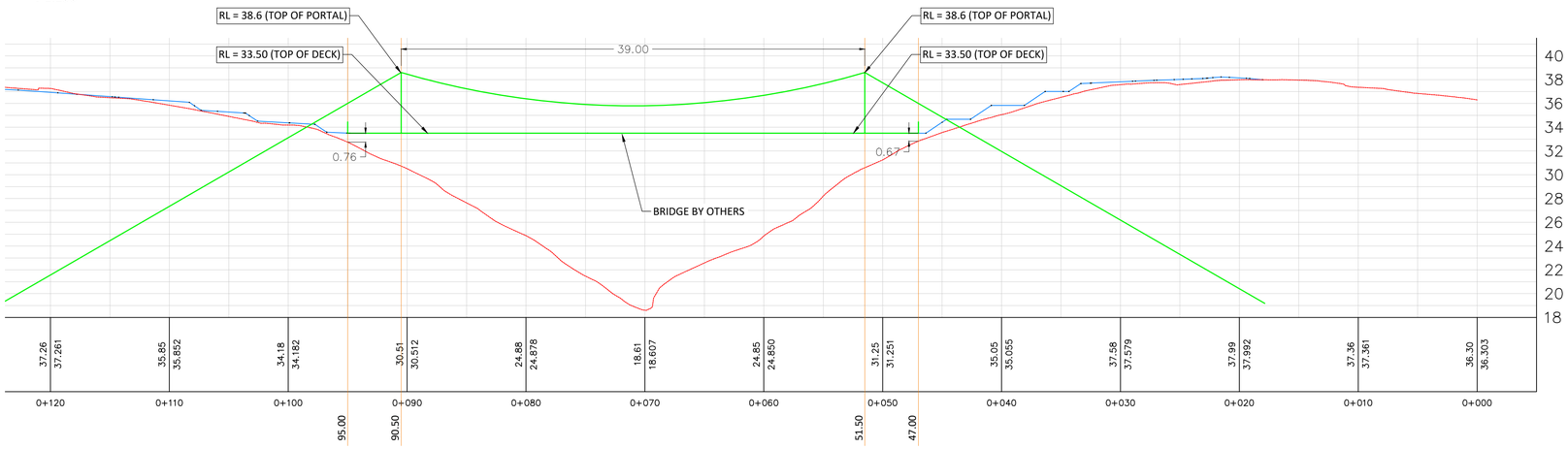
Attachments: Appendix A – Design Drawings
Appendix B – Anchor Specifications
Appendix C - Analysis Results

Appendix A
Design Drawings



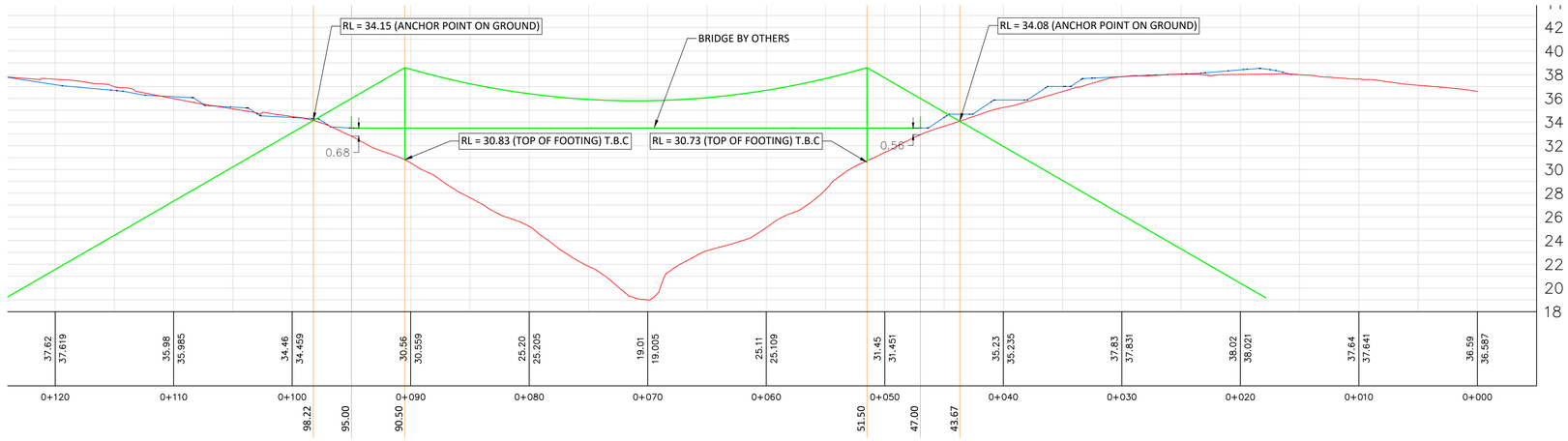
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LONGITUDINAL SECTION - BRIDGE 1 CENTRE LINE

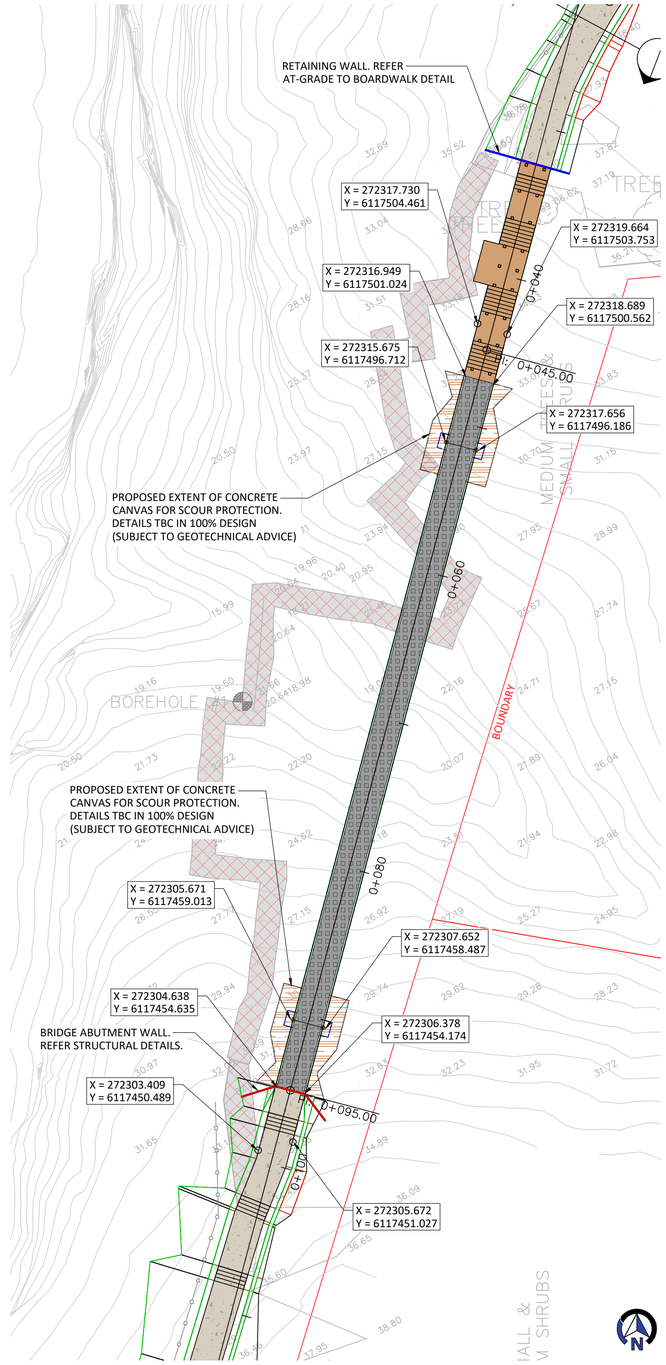
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LONGITUDINAL SECTION - BRIDGE 1 EAST EDGE

SCALE: H 1:250
V 1:250

NOTE:
1. FOR GENERAL NOTES REFER TO DRAWING J0439-CIV-DRG-1001
2. ALL DIMENSIONS TO BE CONFIRMED PRIOR TO CONSTRUCTION.
3. ALL DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ARCHITECTURAL, SERVICES AND OTHER CONSULTANTS DRAWINGS.
4. REFER STRUCTURAL DRAWINGS FOR DETAILS OF BOARD WALK AND SUSPENSION BRIDGE.



BRIDGE 1 GREY ROAD PART PLAN

SCALE: 1:200

NOTE: BRIDGE FOOTINGS TBC IN 100% DESIGN ISSUE SUBJECT TO GEOTECHNICAL INVESTIGATOINS

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REVIEW

CLIENT:	REV:	DATE:	DESCRIPTION:	IVR:	APR'D:	TITLE:	NAME:
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						DRAFTING CHECK	TM
						DESIGNER	JSH
	B	18/02/2022	ISSUED FOR 90% DD		JCA	DESIGN CHECK	JCA
	A	08/02/2022	ISSUED FOR REVIEW		JCA	PROJECT MANAGER	JSH

MARION COSTAL WALKWAY UPGRADE
CELL 5: GREY ROAD GULLY
HALLETT COVE, SA 5158
BRIDGE 01 - ELEVATIONS

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REVISION: B

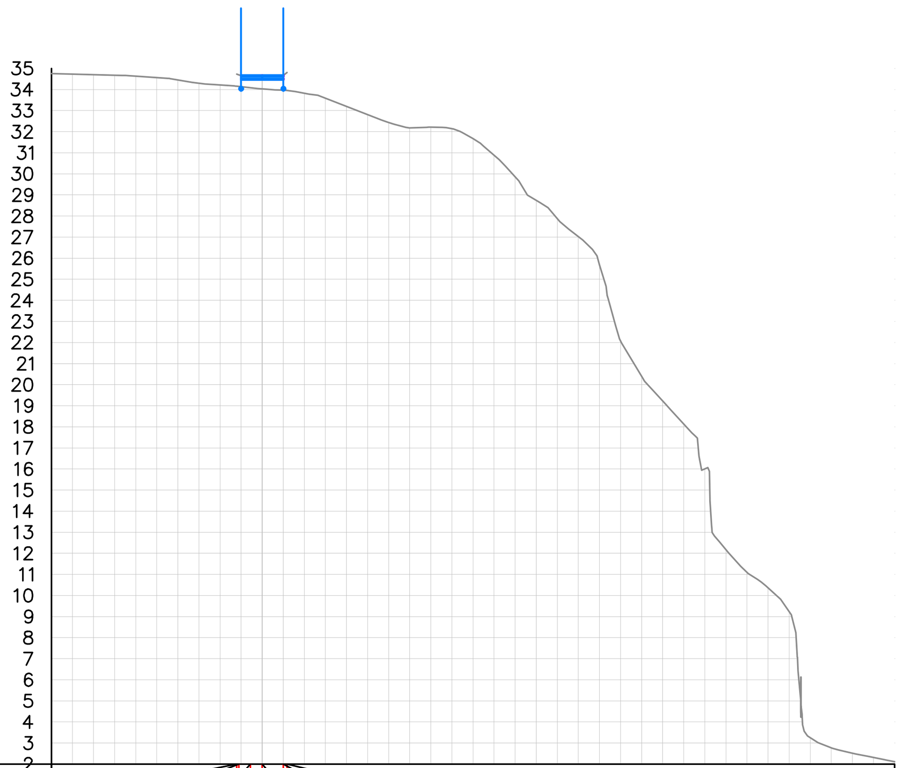
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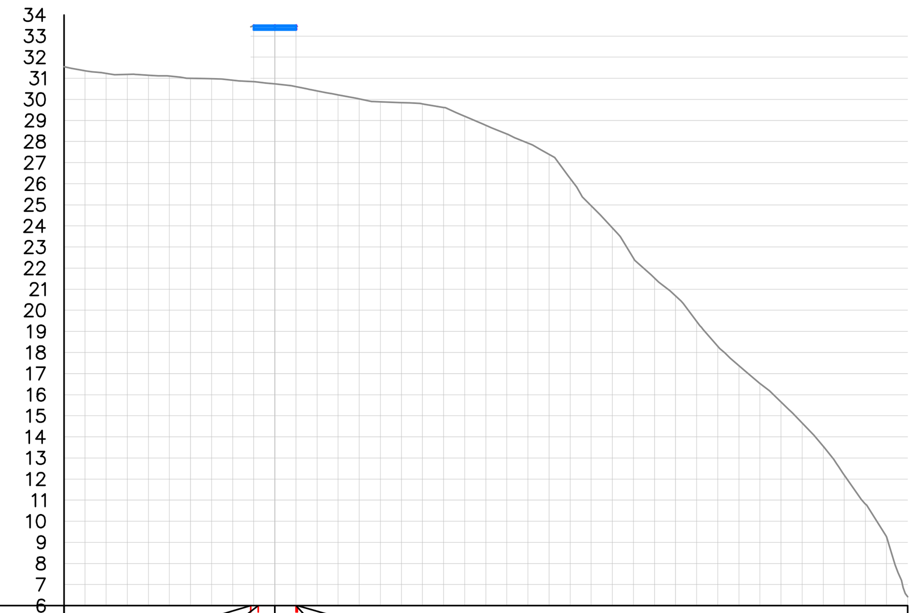
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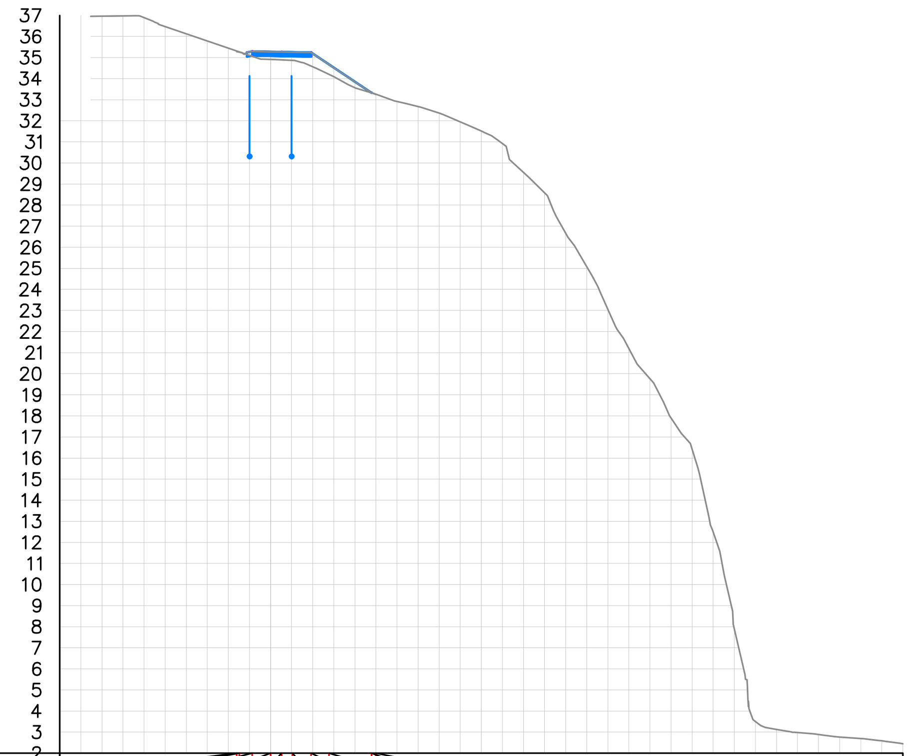
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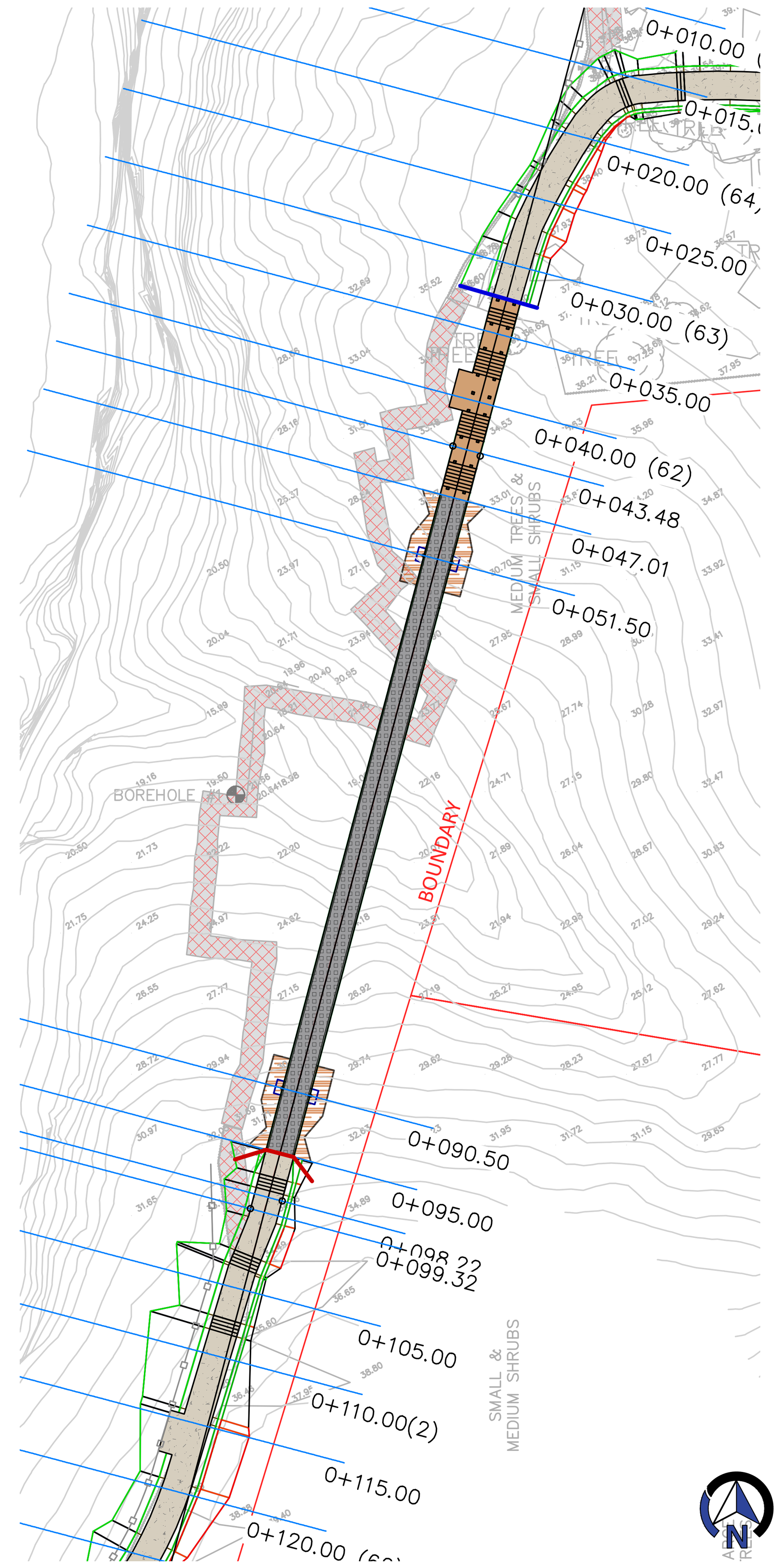


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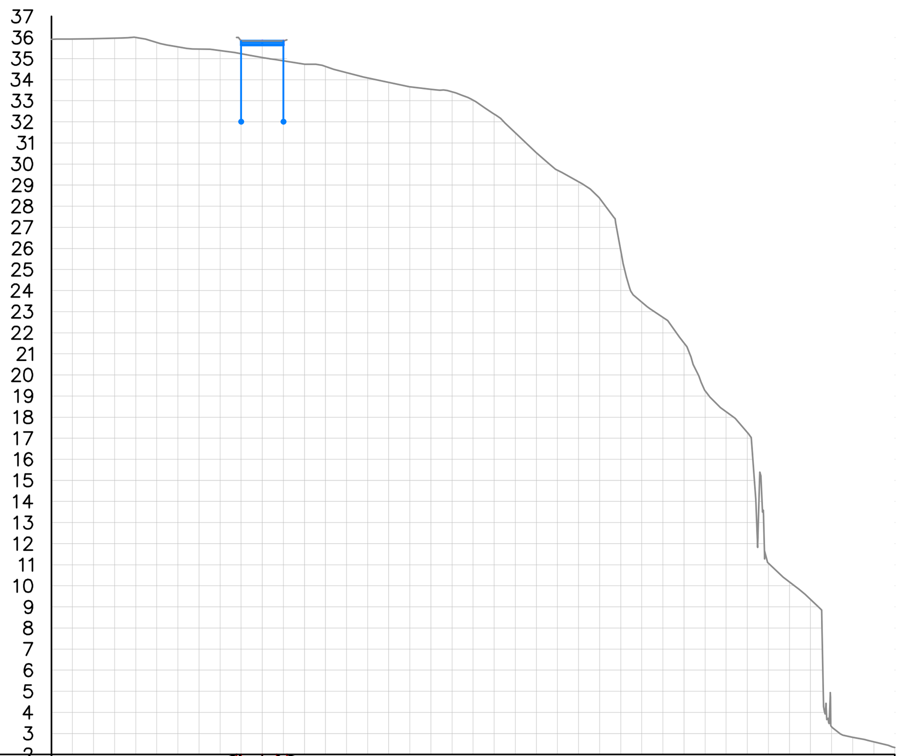
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BRIDGE 1 GREY ROAD KEY PLAN

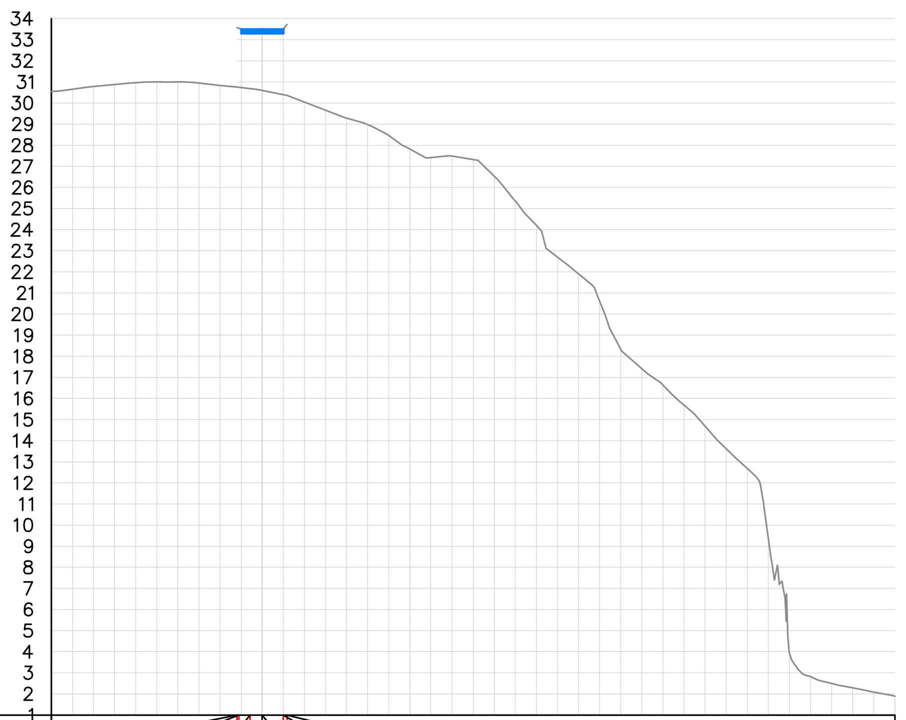
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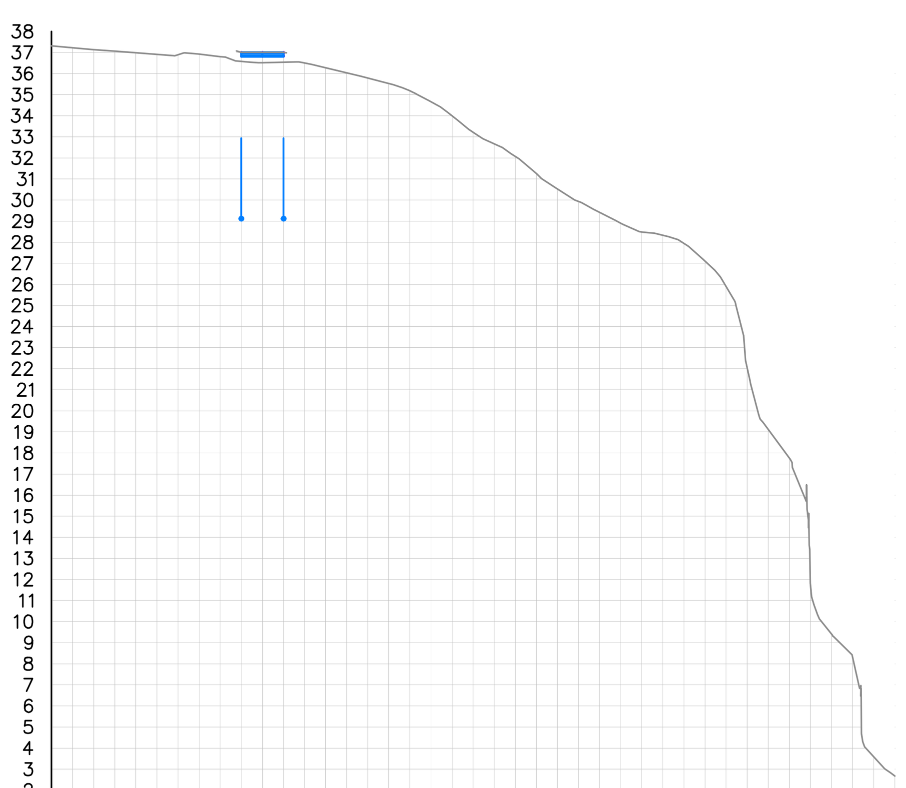
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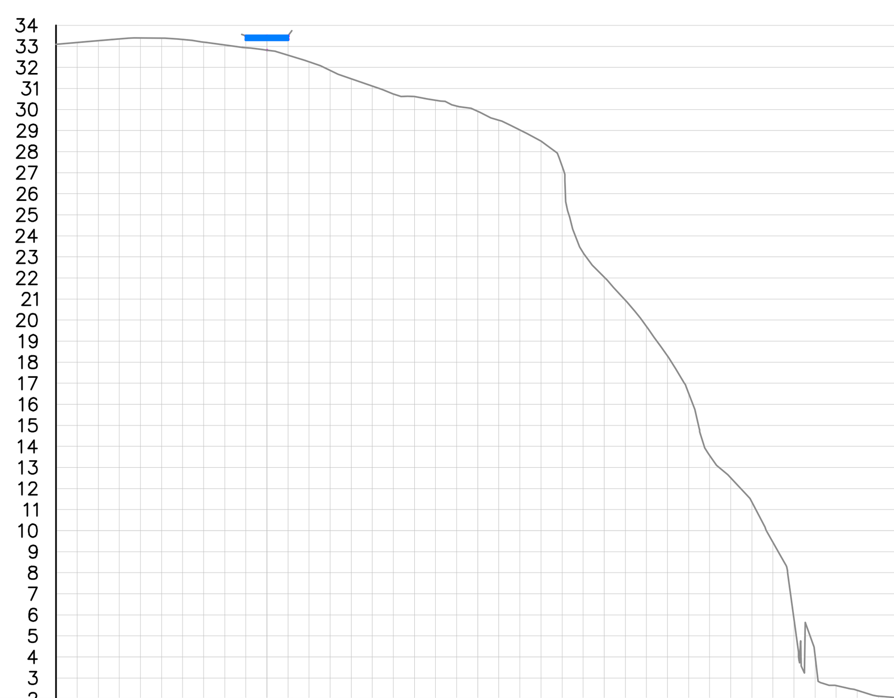
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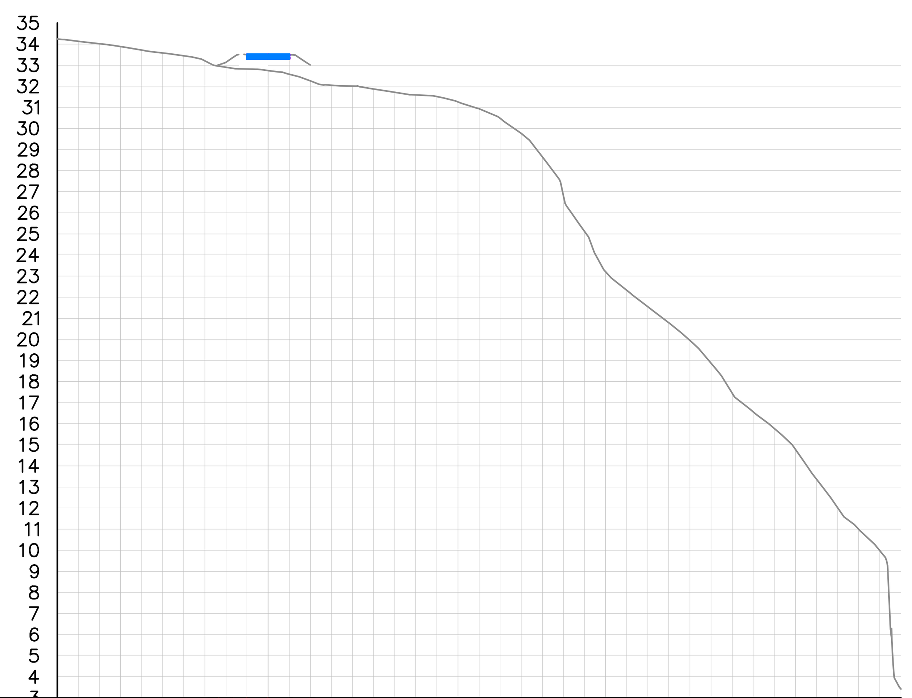
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EXISTING ELEVATIONS	33.10 33.18 33.27 33.35 33.40 33.39 33.33 33.21 33.06 32.93 32.82 32.58 32.27 31.86 31.46 31.12 30.73 30.62 30.44 30.17 29.92 29.49 29.03 28.50 27.32 23.20 22.03 20.94 19.70 18.30 16.53 13.56 12.51 11.37 9.44 5.80 4.09 2.64 2.42 2.14 2.04
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PROPOSED ELEVATIONS	33.00 32.99 33.35 33.50 33.50 33.50 33.00
EXISTING ELEVATIONS	34.24 34.13 34.02 33.88 33.71 33.58 33.45 33.20 32.90 32.81 32.74 32.57 32.25 32.05 32.01 31.87 31.71 31.59 31.51 31.26 30.93 30.47 29.76 28.65 26.82 25.12 23.21 22.32 21.55 20.78 19.95 18.86 17.45 16.56 15.78 14.77 13.37 12.01 10.99 9.98 3.42
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0+110.00



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EXISTING ELEVATIONS	37.69 37.70 37.14 36.78 36.39 35.97 35.85 35.79 35.46 34.85 34.38 33.99 33.56 33.12 32.73 32.31 31.76 31.23 30.06 28.44 26.10 23.54 21.63 19.47 14.68 13.10 11.15 6.45 5.35 3.91 3.37 3.11 2.93 2.78 2.61 2.43 2.21
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NOTE:

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4. REFER STRUCTURAL DRAWINGS FOR DETAILS OF BOARD WALK AND SUSPENSION BRIDGE.

VERTICAL AND HORIZONTAL SCALE 1 : 100

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10mm AT A1

DD

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A	08/02/2022	ISSUED FOR REVIEW		JCA

TITLE:	NAME:
DRAFTER	ESA
DRAFTING CHECK	TM
DESIGNER	JSH
DESIGN CHECK	JCA
PROJECT MANAGER	JSH

MARION COSTAL WALKWAY UPGRADE
CELL 5: GREY ROAD GULLY
HALLETT COVE, SA 5158
BRIDGE 01 - CROSS SECTIONS

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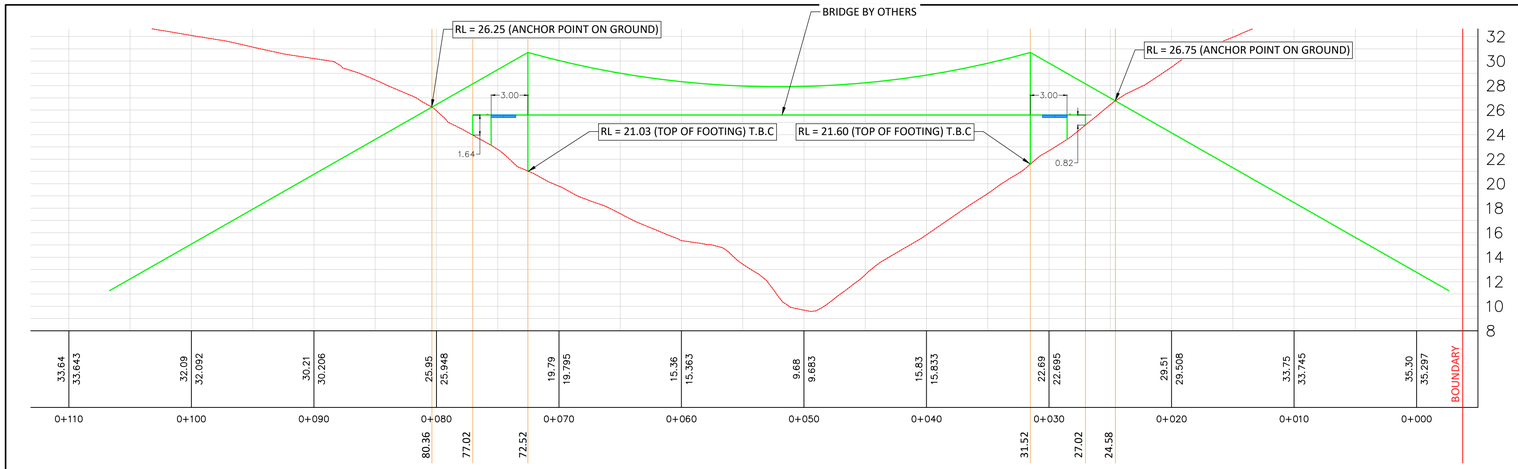
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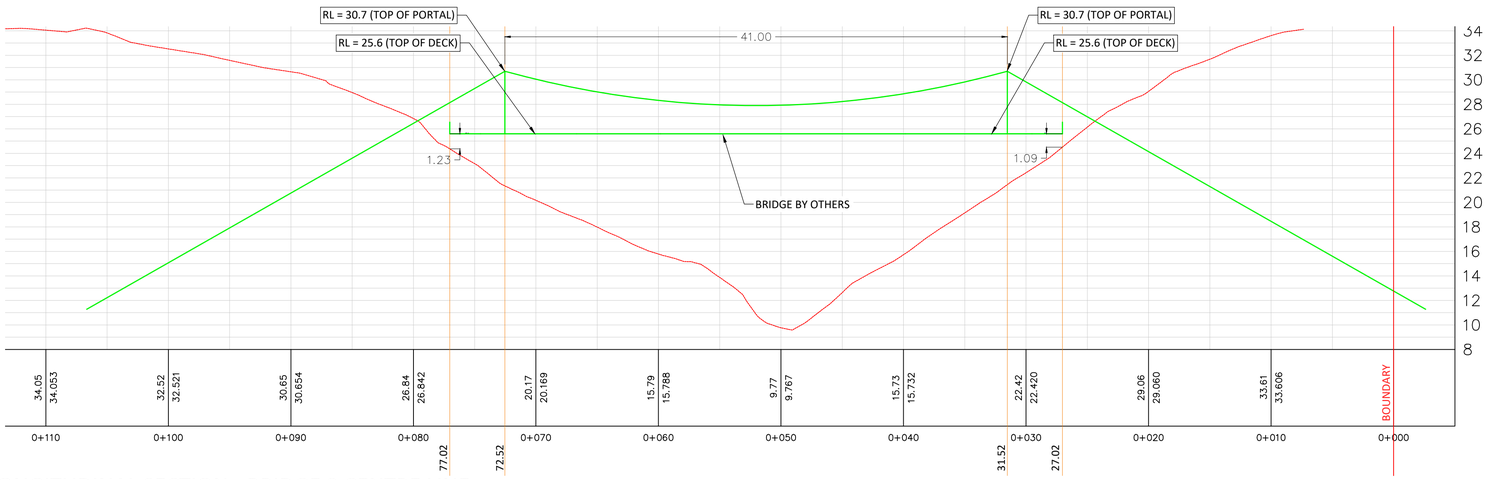
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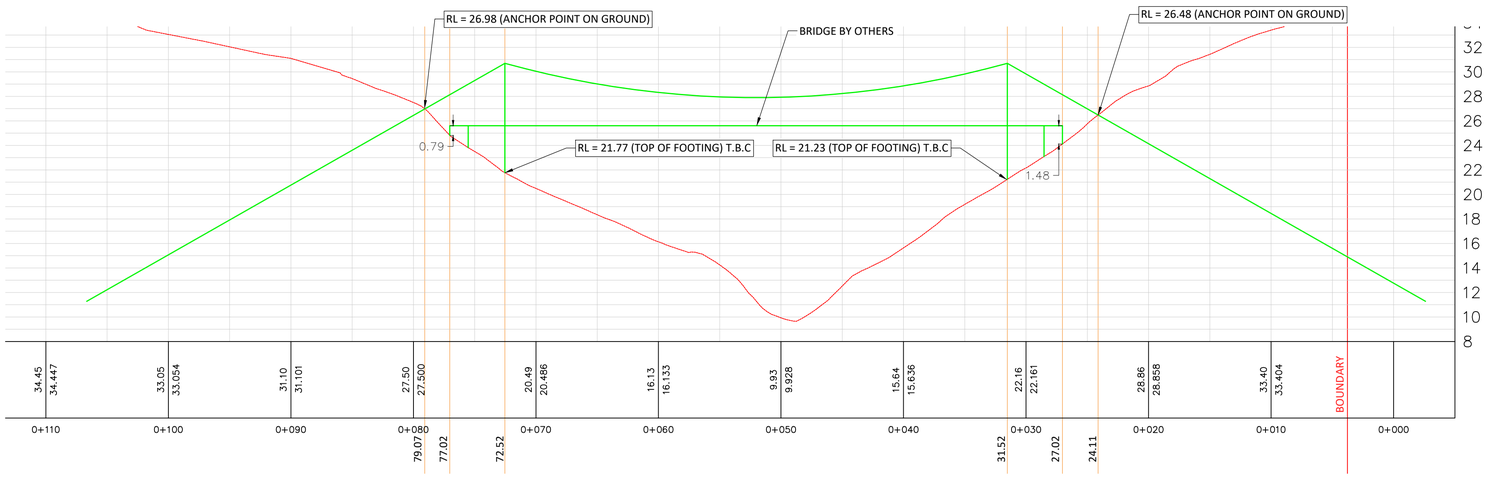
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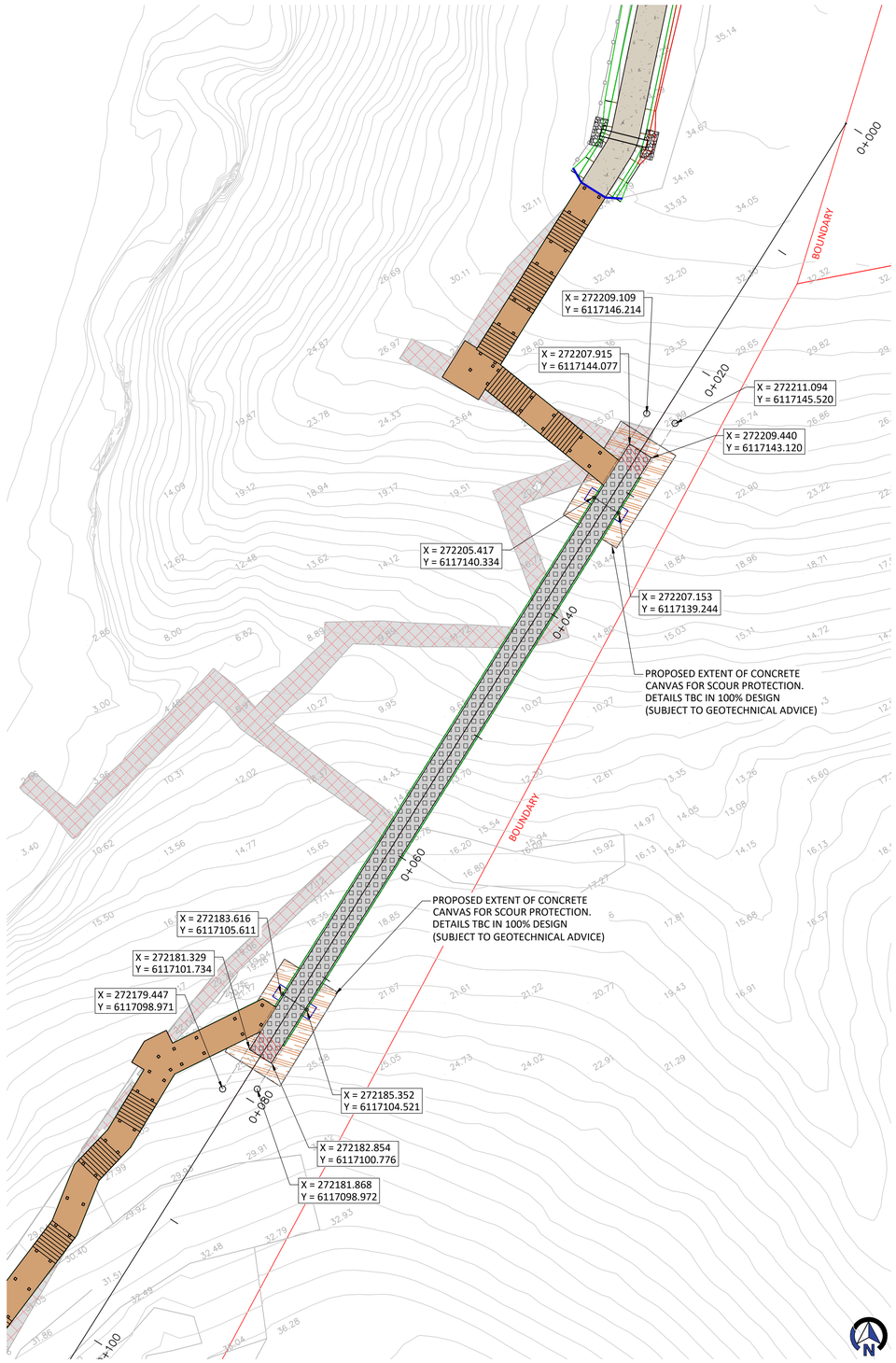
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SCALE: H 1:250
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LONGITUDINAL SECTION - BRIDGE 2 EAST EDGE

SCALE: H 1:250
V 1:250



NOTE: BRIDGE FOOTINGS TBC IN 100% DESIGN ISSUE SUBJECT TO GEOTECHNICAL INVESTIGATOINS

BRIDGE 2 KURNABINNA GULLY PLAN

SCALE: 1:200

NOTE:
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4. REFER STRUCTURAL DRAWINGS FOR DETAILS OF BOARD WALK AND SUSPENSION BRIDGE.

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10mm AT A1

REVIEW

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	A	08/02/2022	ISSUED FOR REVIEW		JCA

TITLE:	NAME:
DRAFTER	ESA
DRAFTING CHECK	TM
DESIGNER	JSH
DESIGN CHECK	JCA
PROJECT MANAGER	JSH

MARION COSTAL WALKWAY UPGRADE
CELL 6: KURNABINNA GULLY
HALLETT COVE, SA 5158
BRIDGE 02 - ELEVATIONS

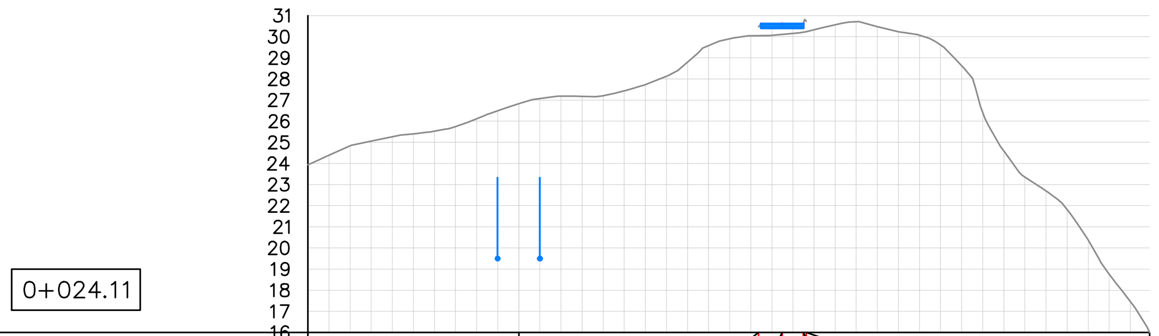
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SCALE:	DATE:	PHASE:	SHT SIZE:
1:250	18/02/2022	REVIEW	A1

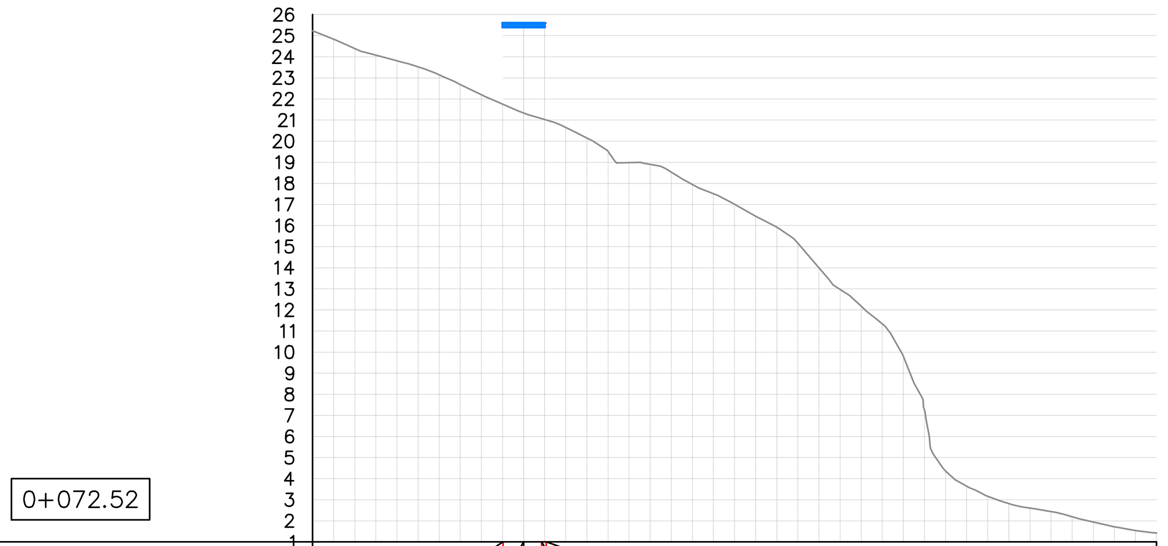
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REVISION: B

PRINT DATE:
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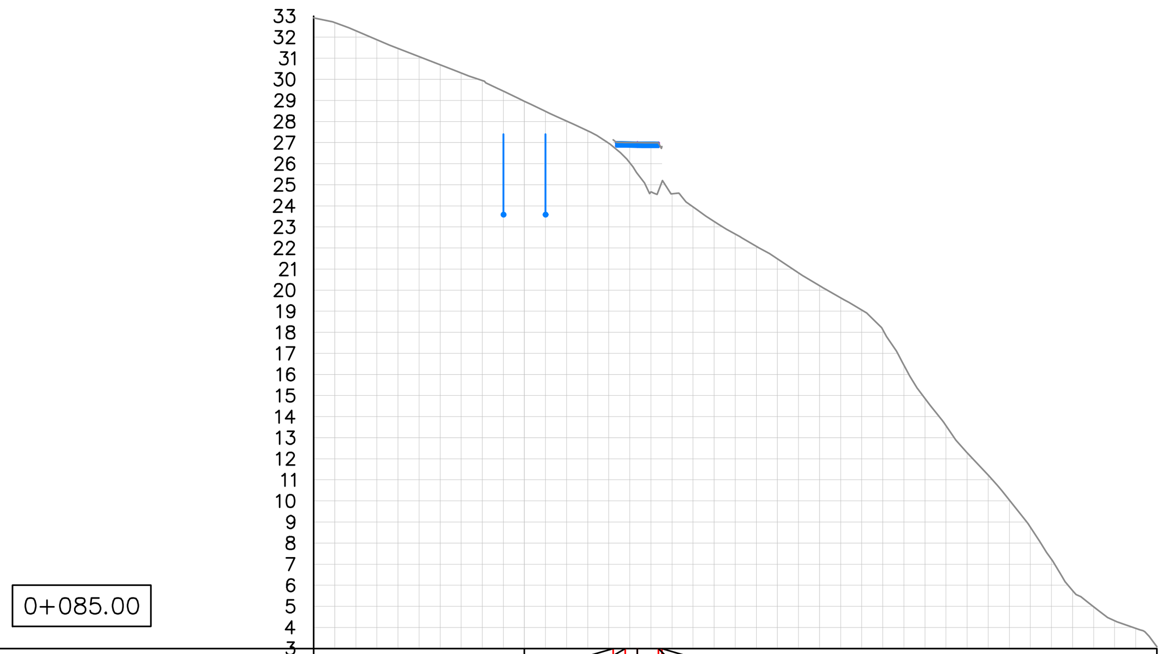
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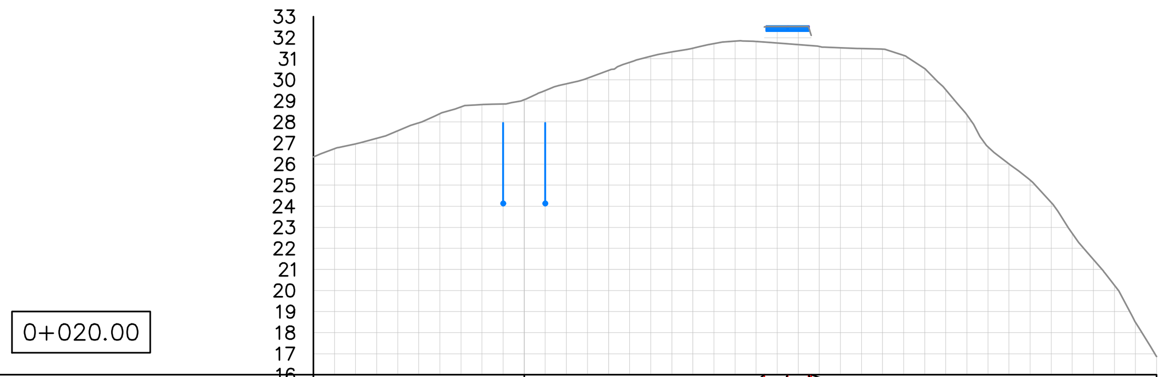
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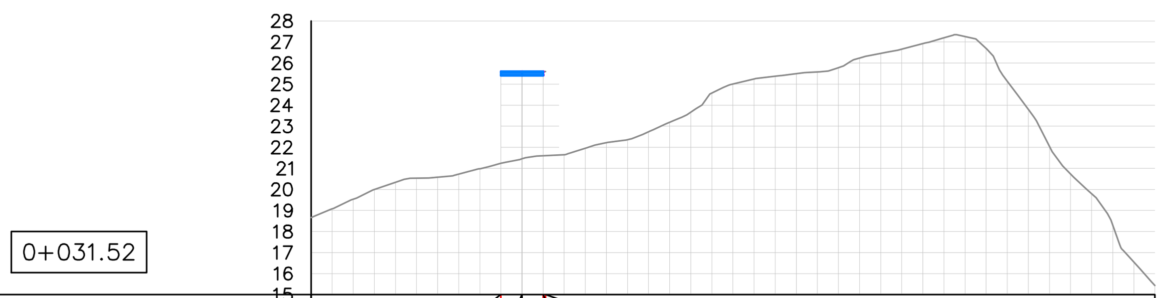
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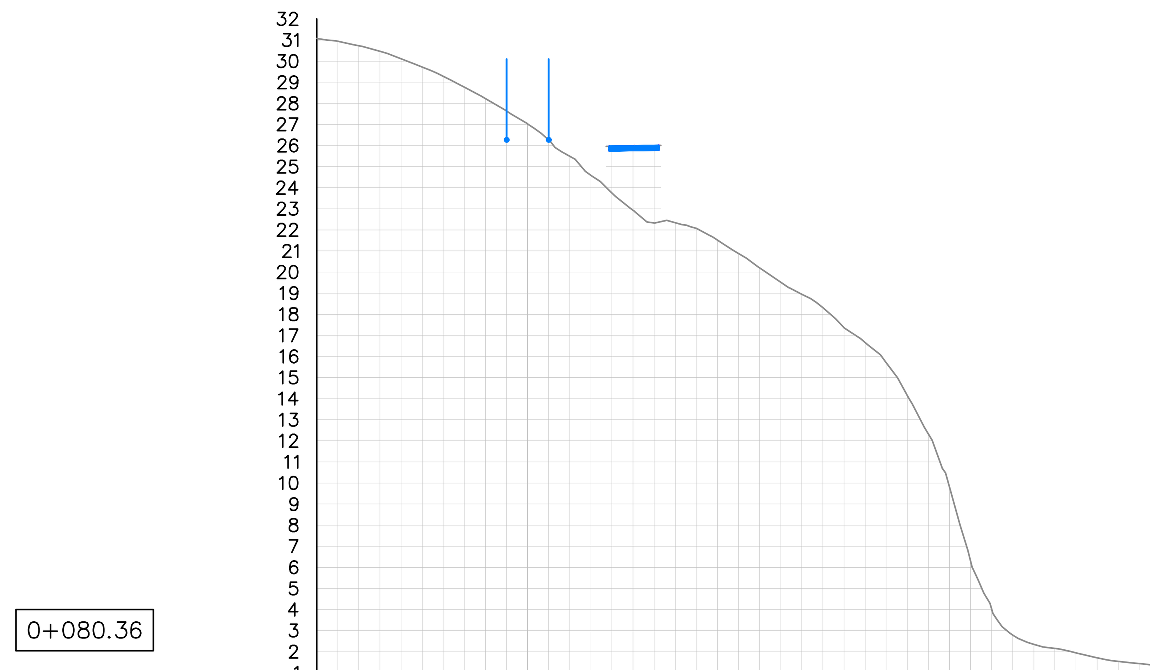
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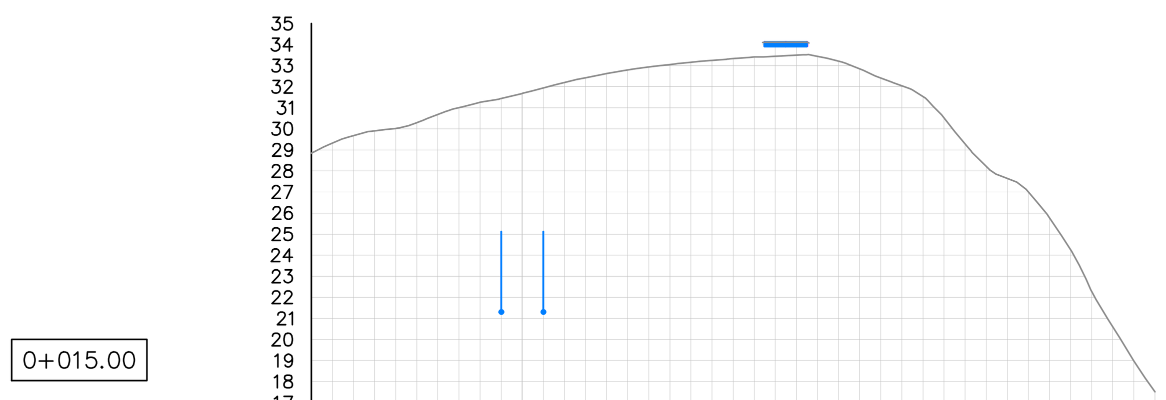
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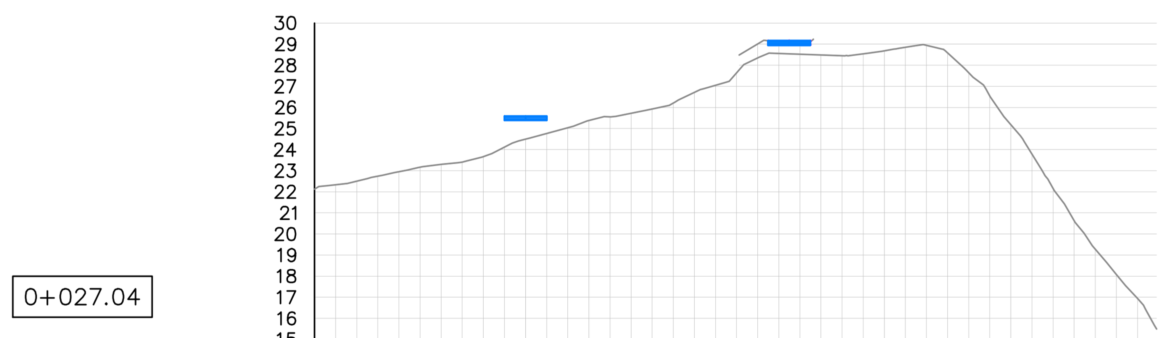
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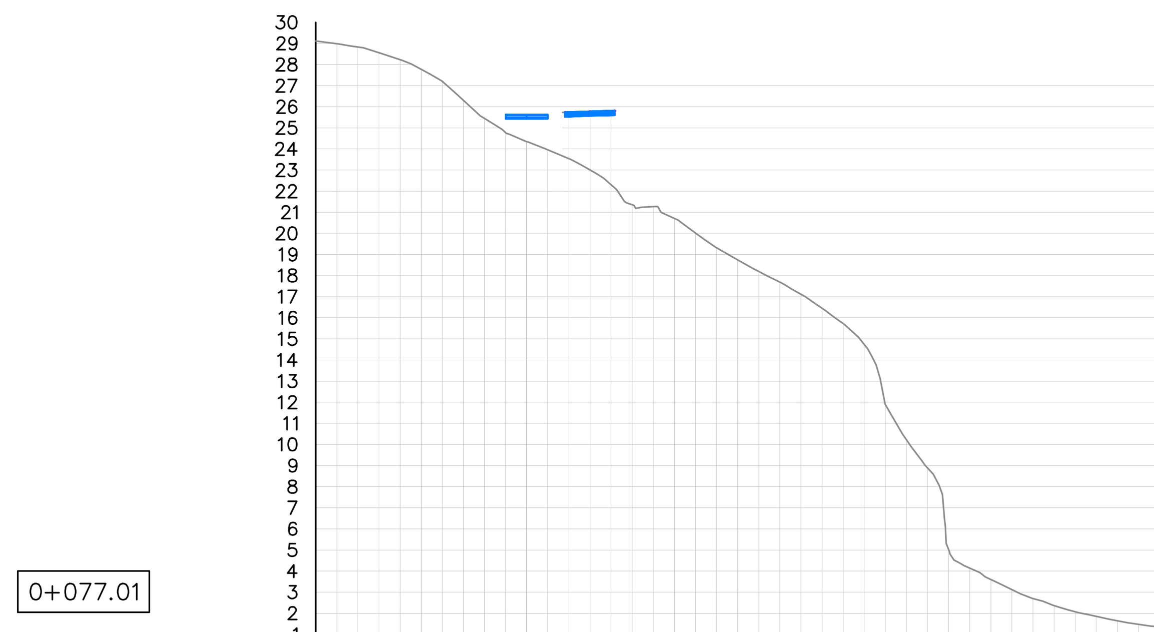
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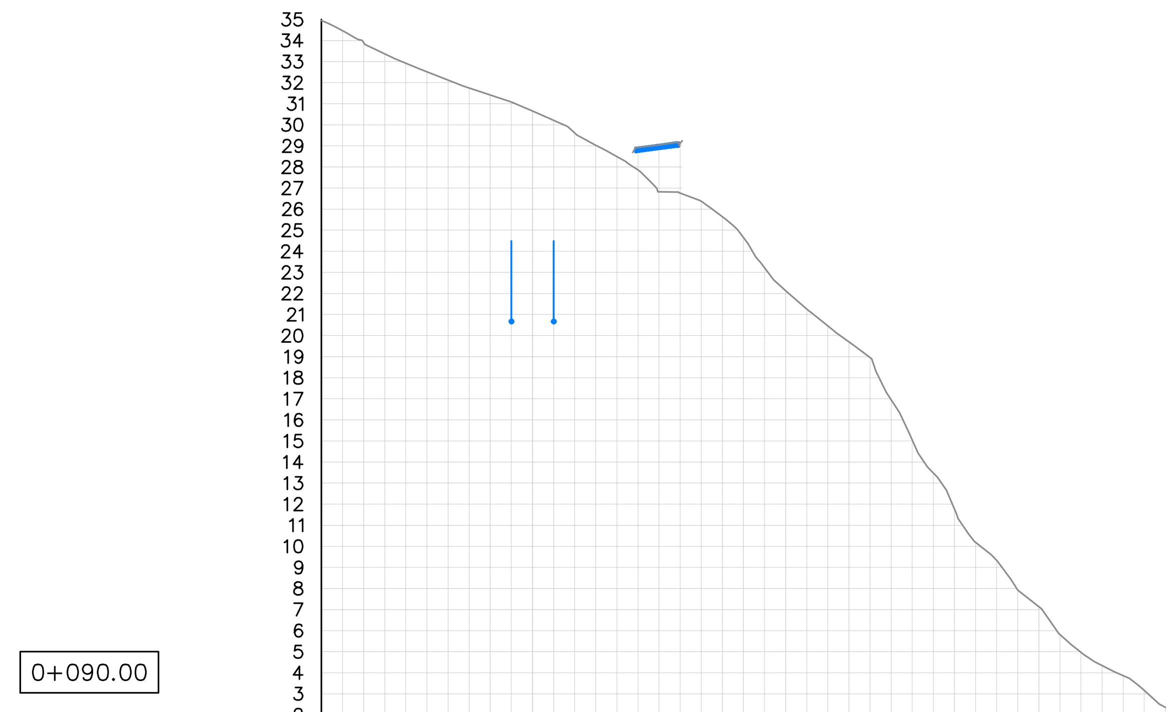
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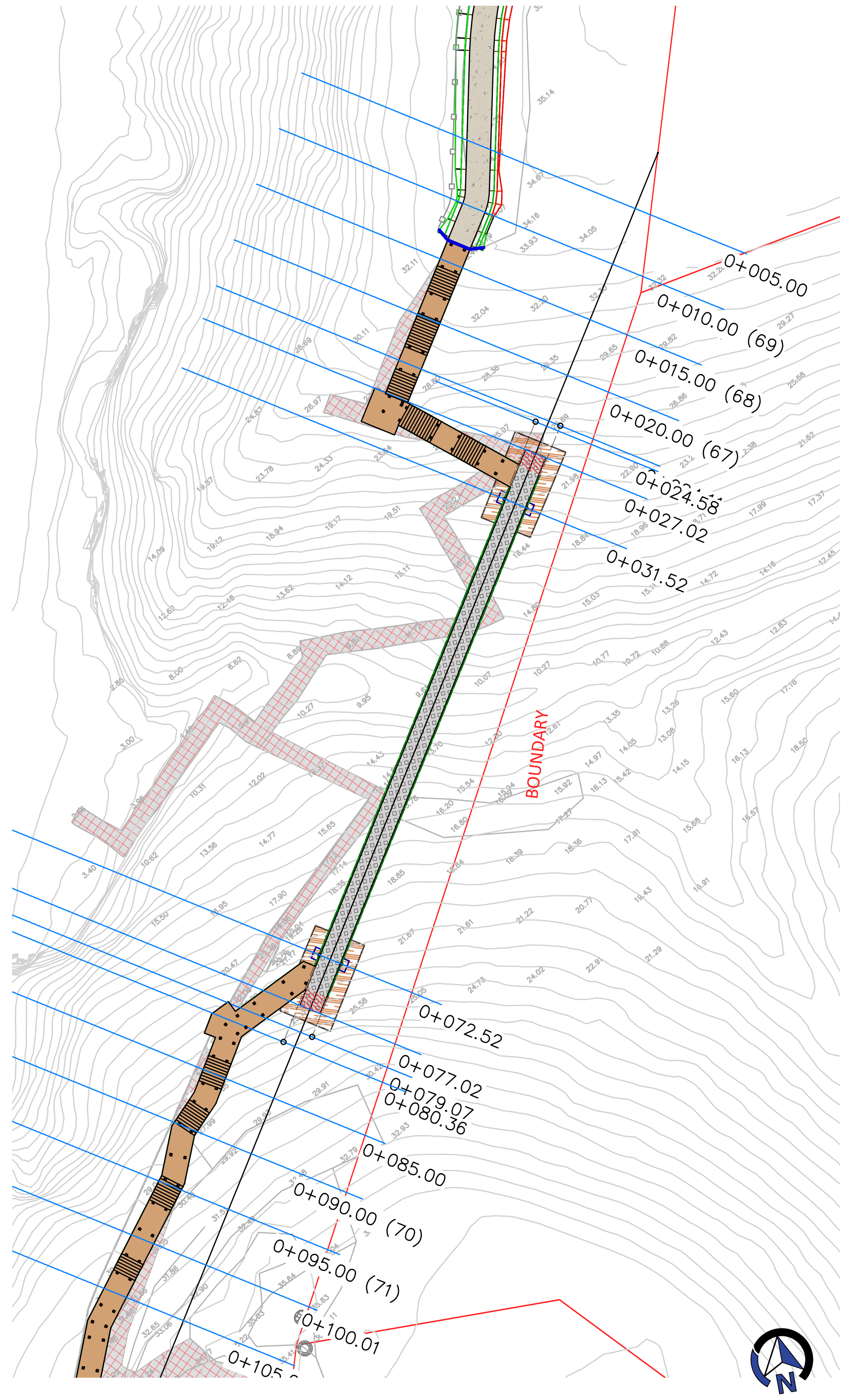
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LEVEL DIFFERENCE	0.66, 2.06, 2.34, 2.53
OFFSET	0.00, 4.75, 5.90, 6.78, 7.11



BRIDGE 2 KURNABINNA KEY PLAN

SCALE: 1:200

NOTE:
1. FOR GENERAL NOTES REFER TO DRAWING J0439-CIV-DRG-1001
2. ALL DIMENSIONS TO BE CONFIRMED PRIOR TO CONSTRUCTION.
3. ALL DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ARCHITECTURAL, SERVICES AND OTHER CONSULTANTS DRAWINGS.
4. REFER STRUCTURAL DRAWINGS FOR DETAILS OF BOARD WALK AND SUSPENSION BRIDGE.

VERTICAL AND HORIZONTAL SCALE 1 : 100
0 1 2 3 4 5 10 m

DD

CLIENT:	REV:	DATE:	DESCRIPTION:	IVR:	APR'D:	TITLE:	NAME:
ASPECT Studios™						DRAFTER	ESA
						DRAFTING CHECK	TM
						DESIGNER	JSH
						DESIGN CHECK	JCA
	A	25/02/2022	ISSUED FOR REVIEW		JCA	PROJECT MANAGER	JSH

MARION COSTAL WALKWAY UPGRADE
CELL 6: KURNABINNA GULLY
HALLETT COVE, SA 5158
BRIDGE 02 - CROSS SECTIONS

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SCALE:	DATE:	PHASE:	SHT SIZE:
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DRAWING NUMBER: J0439-CIV-DRG-1068-2			REVISION: A

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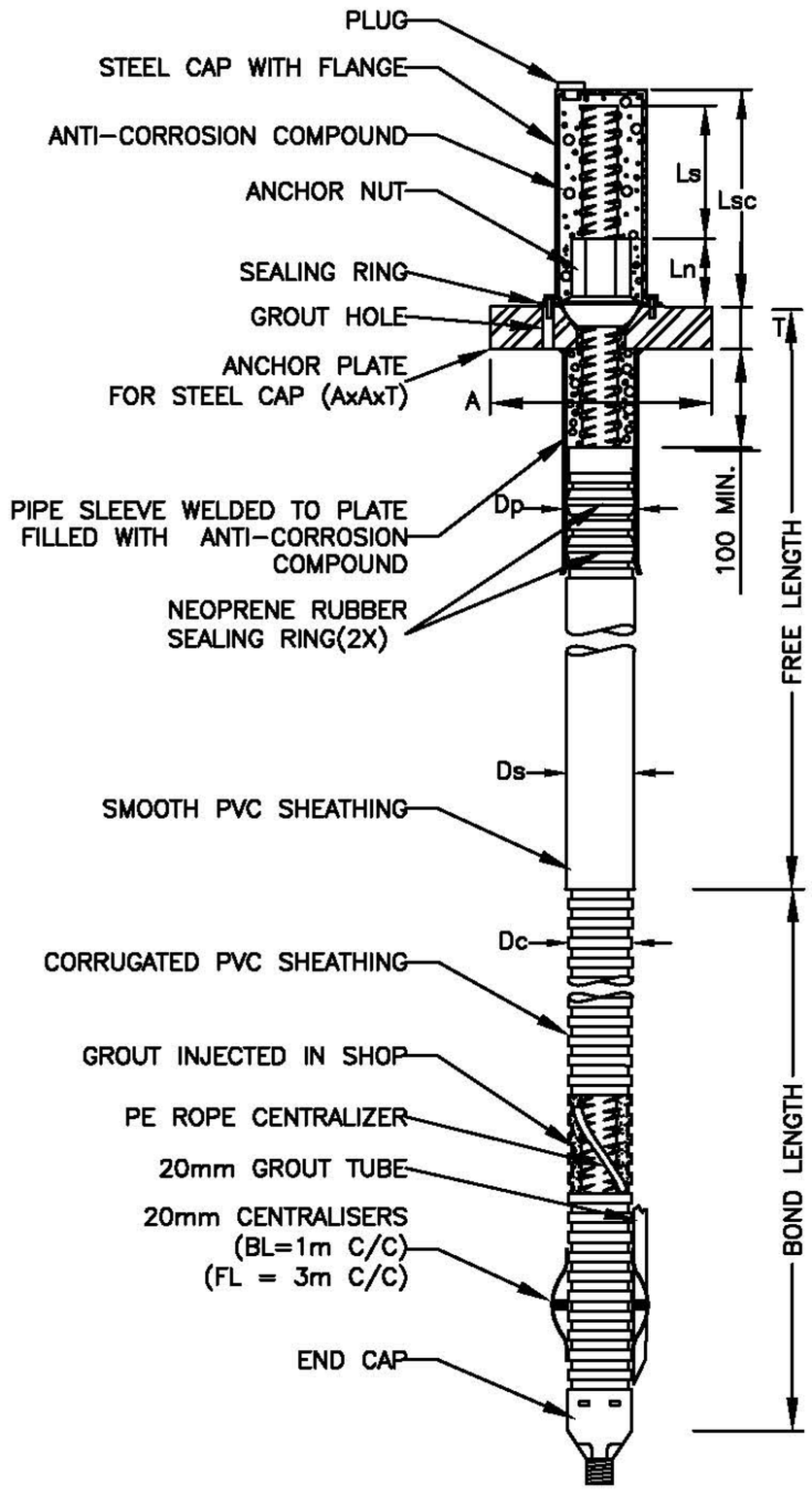
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Appendix B
Anchor Specifications

No.	REVISION	DATE	ECN
A	Update Document	27/3/15	024
B	Add 57, 65 & 75mm Details	11/11/20	



ANCHOR–DETAILS

Physical Properties

Grade	(Mpa)	WR (950 / 1050)					E (835 / 1035)		
Diameter	(mm)	26.5	32	36	40	47	57	65	75
Ultimate	(kN)	579	844	1069	1319	1820	2671	3447	4572
Yield	(kN)	524	764	967	1194	1652	2155	2780	3690
Area	(mm2)	552	804	1018	1257	1735	2581	3331	4418

Dimensions (mm)

Bar Diameter		26.5	32	36	40	47	57	65	75
Bearing plate	A x T	180x40	20x45	220x50	240x55	260x50	330x70	370x75	420x85
Pipe OD	Dp	64	70	76	76	114	127	127	168.3
Nut Length	Ln	60	72	75	83	105	120*	130*	145*
Stressing Length	Ls	90	100	110	130	135	120	130	145
Capped Length	Lsc	210	210	210	240	280	280	280	280
Smooth Sheat OD	Ds	58	63	73	76	85	110	110	125
Corrugated Sheath OD	Dc	50	56	65	65	80	100	100	114

* Hex Nut

CHARACTERISTICS

1) POST–TENSIONING TENDONS ARE DSI THREADBAR, DOUBLE CORROSION PROTECTED SYSTEM, SHOP ASSEMBLED AND GROUTED.
2) THREADBARS ARE PROOF STRESSED AND STRESS RELEIVED.
3) SHOP GROUT: CEMENTITIOUS NEAT LEAN GROUT W/O AGGREGATES, MAXIMUM WATER CEMENT RATIO=0.36 (BY WEIGHT), CEMENT: GENERAL PURPOSE TYPE GP ADDITIVE: VISCOCRETE 10, 0.25% (BY WEIGHT).
4) DURING TENSIONING, DRAW IN AT NUT=1mm & COUPLER SLIP=1.5mm.

INSTALLATION PROCEDURE

1) DRILL HOLE; GROUT AND RE–DRILL IF REQUIRED.
2) ASSEMBLE PRE–GROUTED BARS WITH PLATES, NUTS, GROUT TUBES, CENTRALISERS AND COUPLERS (IF APPLICABLE) AND INSERT ANCHOR IN HOLE.
3) TREMIE GROUT ALONG ENTIRE ANCHOR LENGTH.
4) ONCE GROUT REACHES REQUIRED STRENGTH, TEST ACCORDING TO SPECIFICATIONS.
5) INSTALL PROTECTIVE CAPS (IF REQUIRED).

CAUTION

DO NOT WELD TO BAR
DO NOT USE BAR AS GROUND FOR WELDING
DO NOT ALLOW HOT SLAG OR SPARKS TO TOUCH BAR
DO NOT DAMAGE BAR SURFACE
DO NOT USE BARS WITH KINKS OR SHARP BENDS
FAILURE TO HEED THIS WARNING COULD CAUSE BAR TO BREAK RESULTING IN INJURY OR DAMAGE.

WARNING

AT NO TIME DURING STRESSING AND REMOVAL OF THE JACK, SHALL PERSONS STAND IN LINE WITH THE TENDONS OR BEND OVER ALREADY STRESSED TENDONS.

DYWIDAG-Systems International Construction P/L
ABN: 23 630 281 615
PO Box 2034
Gateshead, NSW, 2290
Ph: +61 2 4081 5501
www.dsicivil.com.au
Office Address:
24 Groves Road,
Bennetts Green, NSW, 2290
Australia
DYWIDAG
civil.sales@dywidag-systems.com.au

PROJECT	A4	PRODUCT CODE	DATE JUL '10	DRAWN	MV
			SCALE NTS	CHECKED AUTH	SD
DESCRIPTION DOUBLE CORROSION PROTECTED (DCP) PERMANENT GROUND ANCHOR SYSTEM		DWG No. WR DCP Anchor 01		REV. B	

24 Groves Rd, Bennetts Green,
NSW, Australia, 2295
Tel.: 02 4947 5527
www.dsicivil.com.au

The DSI THREADBAR is a steel bar with continuous coarse threads hot rolled on two opposite sides. The continuous threads allow for anchorage and coupler installation anywhere along the bar. The coarse threads provide excellent bond to grout and are insensitive to dirt and damage. In addition, there is no loss of strength due to thread cutting.

Post-Tensioning Threadbar: WR & E Grade

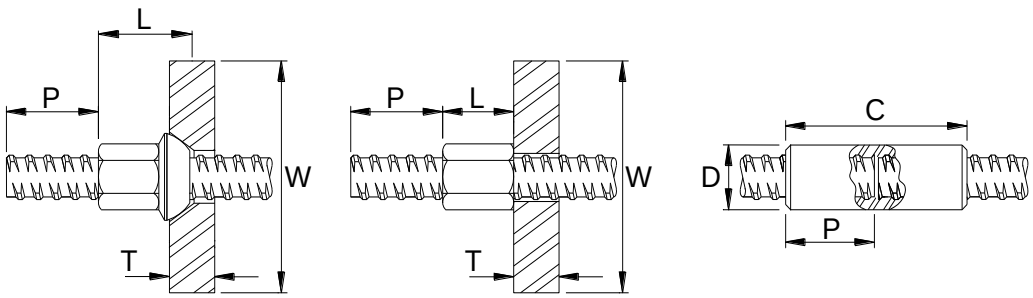
Designation		WR	WR	WR	WR	WR	E	E	E
Minimum Ultimate Grade (MPa)		1050	1050	1050	1050	1050	1035	1035	1035
Minimum Yield Grade (MPa)		950	950	950	950	950	835	835	835
Nominal Diameter (mm)		26.5	32	36	40	47	57	65	75
Minimum Breaking Load (kN)		579	844	1069	1319	1820	2671	3447	4572
Minimum Yield Load (kN)		524	764	967	1194	1650	2155	2780	3690
Cross-section Area (mm^2)		552	804	1018	1257	1735	2581	3331	4418
Maximum Thread Diameter (mm)		30.5	36.3	41.4	45.3	53	64	72	82
Unit Weight (kg/m)		4.48	6.53	8.27	10.21	14.10	20.95	27.10	35.90
Minimum Bar Protrusion: $P_{1)}$ (mm)		85	100	105	125	135	120	130	145
Dome Nut p/n: D 2001	L (mm)	75	90	100	115	135	-	-	-
	$A/F_{2)}$ (mm)	50	60	65	70	80	-	-	-
Hex Nut p/n: WR 2002	L (mm)	80	90	110	120	140	120	130	145
	$A/F_{2)}$ (mm)	46	55	60	70	80	90	100	105
Coupler p/n: D 3003	C (mm)	170	200	210	250	270	240	260	290
	D (mm)	55	65	72	71	83	95	105	114
Typical Plate	W (mm)	180	200	220	240	260	330	370	420
	T (mm)	40	45	50	55	50	70	75	85

Typical applications: Prestressed soil and rock anchors, concrete prestressing, tie-rods, tie-downs and rock bolting.

Specifications: Threads are right hand. Threadbars are proof stressed to 80% of their ultimate strength and stress relieved at the mill.

Notes

1) Minimum Threadbar protrusion to accommodate tensioning or coupling; P=½C (mm).
2) Width measured across flats of nut.
3) Other hardware available not shown.
4) Corrosion protection available: pre-grouting in sheathing (DCP), hot dipped galvanising or thermal diffusion galvanising & epoxy coating.
5) Hot dip galvanziing of high tensile steels could induce hydrogen embrittlement, which can directly affect the capacity of the Threadbar.



THREADBAR Anchors with Double Corrosion Protection (DCP)

DCP anchors are recommended for anchors with a long service life and for an environment where aggressive materials are expected.

The DSI permanent THREADBAR anchors use a double corrosion protection system to fully encapsulate the steel bars over their entire length. It consists of cement grout injected into the annular space between the centralised THREADBAR and the high strength corrugated PVC sheathing over the bond and free lengths. The cement grout inside the corrugated sheathing acts as the first level of protection embedding the bar in an alkaline environment.

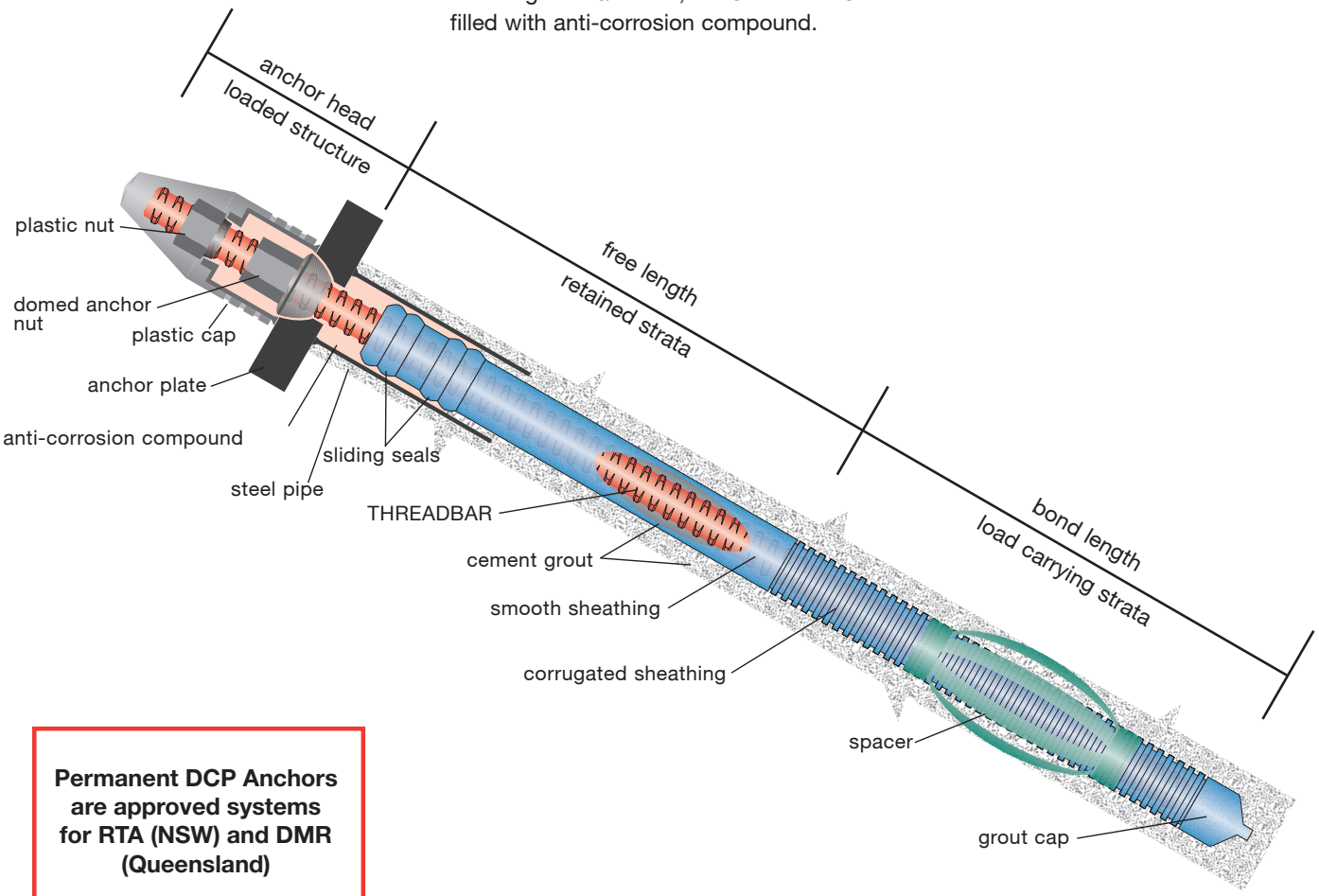
The corrugated PVC sheathing is impermeable to any corrosive substances such as ground water and gases and acts as the second level of protection. Permanent anchors are pre-grouted in a controlled factory environment to ensure adequate corrosion protection during transport, storage, installation and design life.

In the bond length, the corrugations of the sheathing transfer the load to the grout in the drilled hole. In the free length, the load transfer is prevented by inserting smooth sheathing over the corrugated sheathing.

In order to accommodate for elongation of the anchor during tensioning, a short segment of the THREADBAR remains ungrouted underneath the anchor plate. Full encapsulation is provided at this location by a steel tube welded to the underside of the plate and fits tightly over the sliding seals at the top of the free length. In addition, the steel tube is filled with anti-corrosion compound.

The anchor nut and the bar above the anchor plate are covered by removable protective caps filled with anti-corrosion compound. Caps can be made of either plastic or hot-dipped galvanised steel. This design permits re-stressing, de-stressing and load monitoring at any time.

The two levels of corrosion protection for couplers in both the bond and free lengths are achieved by applying anti-corrosion compound to the bar and coupler and covering the splice with a heat-shrink sleeve. For couplers in the free length, an additional debonding tube is inserted over the DCP couplers to ensure free movement of the couplers during stressing.



Permanent DCP Anchors are approved systems for RTA (NSW) and DMR (Queensland)

THREADBAR Anchor Hardware

Domed Nut
- The spherical sheathing allows for small angle compensation (3-4°)
- The width across the flat of the hex portion matches the tightening socket inside the DSI jack
- Protective caps are available.

Flat Plate for Rock Anchors
- Installed on flat bearing surfaces
- Various dimensions and grouting hole positions are available
- Hot-dipped galvanising is required for permanent applications.

Coupler
- Used for extending to the desired length
- Double corrosion protection is required for permanent applications
- Couplers are designed and produced to exceed the tensile capacity of the bars

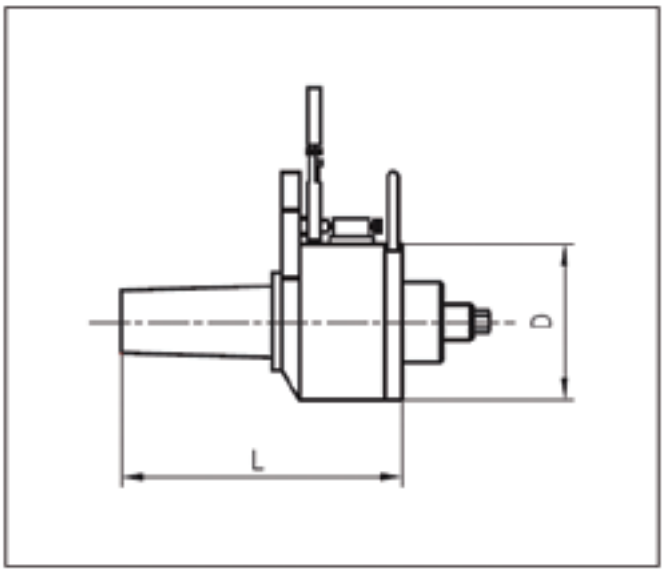
Slip-on or Segment Spacers
- Installed on the anchors to ensure a grout cover around the anchor inside the drilled hole.

Grout Tube
- Grout tube is used to inject cement grout
- Grout tubes are manufactured from polyethylene material.

THREADBAR Anchor Tensioning Equipment

Tensioning jacks are available for customer hire. Every DSI tensioning jack is calibrated with its corresponding hydraulic gauge.

During bar tensioning, the operater tightens the nut by pulling on a ratchet handle linked to a socket which fits over the anchor nut.





Jack 600kN Series 04

Jack Type	Length L	Diameter D	Stroke	Piston Area	Weight
	(mm)	(mm)	(mm)	(cm^2)	(kg)
600kN	400	190	50	132.5	36
1,100kN	494	267	50	235.6	46
1,100kN	594	267	150	235.6	54
1,500kN	870	336	250	302.4	125

On-site Assembly and Installation Instructions for DCP Threadbar Anchors

1. Receiving the anchors
- Check for possible transportation damage.
- Do not use anchors that have been bent or that have any surface damage, do not use bars as ground for welding, do not allow hot slag to touch the bars, do not weld to bars.
- Handle anchors with care using nylon lifting slings (2 legs minimum).
- Upon unloading, protect the bars from dirt and mechanical damage.
- Important: the bars must not be dropped, thrown or dragged.

2. DCP couplers in the bond and free lengths
- Grease both bar ends thoroughly.
- Install coupler, bar ends must be centred inside coupler.
- Torque bar against each other.
- If applicable, tighten set-screws against flat side of the bar.
- Grease coupler thoroughly.
- Install heat-shrink sleeve. Important: do not burn the heat-shrink sleeve nor the plastic sheathing.

3. DCP couplers in the free length only
- Centre coupler tube over the heat-shrink sleeve (refer to 2. above) allowing for displacement of the heat-shrink sleeve during stressing.
- Secure coupler tube firmly by taping both end to the smooth sheathing.

4. Grout tube and outer spacer assembly
- Install outer spacers (alternatively: segment spacers) within the bond length using adhesive tape and/or wire at the required spacing.
- If applicable, install grout tube using adhesive tape. The grout tube must start 50 to 100mm from the bottom of the anchor and extend at least 1 metre above the anchor head.

5. Installing the bar plates and bar nuts
- Install anchor plates pre-filled with anti-corrosion compound over the bar leaving enough bar protruding behind the plate for the anchor nut and the stressing coupler. Also, ensure that there is sufficient bare bar (typically 100 mm) inside the steel tube welded to the steel plate to allow for free movement of the vent cap during tensioning of the anchor.
- Screw anchor nut tight against the bearing plate making sure that the spherical end of the nut contacts the plate.

6. Installing the bearing & wedge washer and anchor nut
- Install the wedge washer (2 pcs maximum) followed by the bearing washer with welded steel tube prefilled with anti-corrosion compound over the bar leaving enough bar protruding behind the plate for the anchor nut and the stressing coupler. Also, ensure that there is sufficient bare bar inside to steel tube welded to the steel plate to allow for free movement of the vent cap during tensioning of the anchor.
- Screw anchor nut hand tight against the bearing plate making sure that the spherical end of the nut contacts the plate.

7. Inserting the anchor into the borehole
- If necessary, water-test the borehole according to the project specifications.
- Using a lifting eye or another equivalent attachment, lift the anchor from the anchor head end, Important: do not drag.
- Insert the anchor into the borehole gradually making sure that it does not get damaged.

8. Grouting the anchors with plates and nuts installed
- Grout the anchor along its entire length in one stage according to the project specifications.

9. Grouting the anchors without plates and nuts installed
- Ensure that the anchor is centred in the borehole.
- Leave enough bar protruding behind the plate for the anchor nut and the stressing coupler. Also, ensure that there will be sufficient bare bar inside the steel tube welded to the steel plate to allow for free movement of the vent cap during tensioning of the bar. Grout the entire anchor in one stage according to the project specifications.
- While the grout is still wet, wash-out half a metre below the location of the anchor plate.
- Install the anchor plate and nut as instructed above (Installing the anchor plates and anchor nuts).
- Tremmie grout the entire void behind the plate.

10. Testing and stressing
- Stress the bars according to project specifications and contract drawings. CAUTION: the stressing equipment is capable of developing very large forces. Read the safety and operating instructions.

11. Installing protective caps
- Pre-fill the caps with anti-corrosion compound and install it over the anchor nut with corresponding seals.

Appendix C
Analysis Results

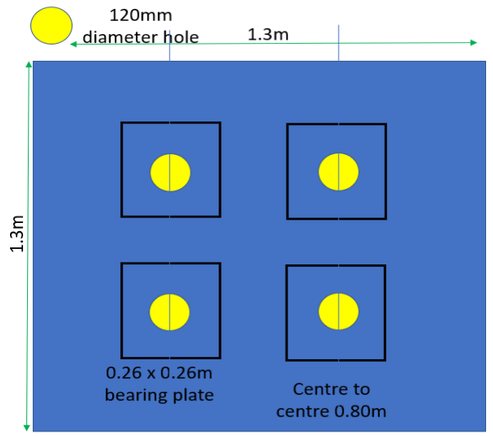
Client: Aspect Studio
Project: Coastal Walk Way - Bridge Foundation Design
Project No: ADL2022-0050 Rev0
Engineer: JVS
Subject: Grey Gully North Anchor Foundation Details

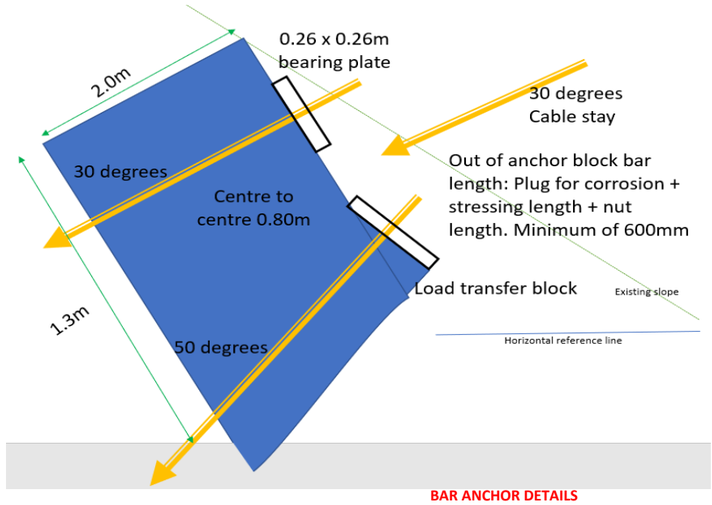
Anchor Block

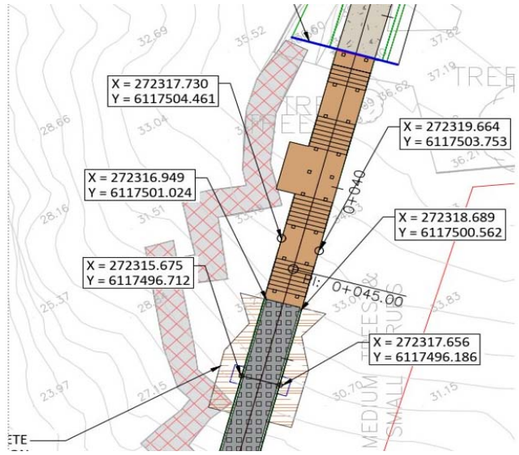
Length (m)	Width (m)	Depth (m)	Steel Reinforcement kg/m3
1.3	1.3	2	180

Average Excavation Depth
2m 1.5m depth into Unit 2
Noting excavation depths require witnessing by a geoengineer
Anchor Bars per Anchor Block
4

Number of anchor plates and load tranfer blocks for testing
4
Anchor Bar Inclination
2 bars at 30 degrees to horizontal
2 bars at 50 degrees to horizontal
Anchor Bar Orientation
2 bars at parallel to cable stay
2 bars at 20 degrees away from pedestrain path
Spacing of Bars: minimum 0.8m centre to centre







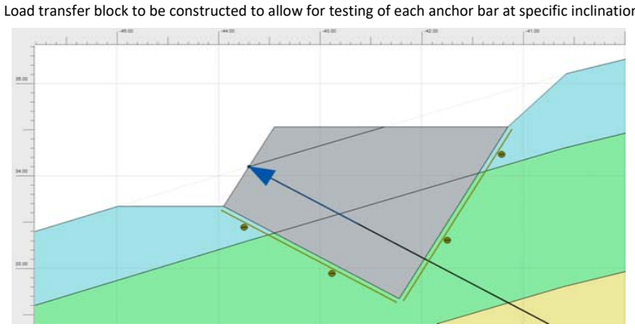
Note:
Refer to Geotechnical report for depth of geotechnical units at this site.
Allowanace is to be made for the orientation and inclination of the cables through the Anchor Block. See illustrations above.
All bars to be pretensioned and load tested periodically.
The design of fittings to secure cable stay to be undetaken by Innovis. Structural engineer's design for cable stay fastening to not impact on the ground anchor design

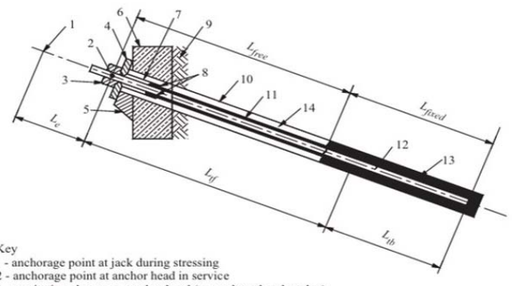
Anchor Bars

Product Dywidag WR DCP Anchor 01
Double Corrosion Protected (DCP) Permanent Ground Anchor

Borehole Depth (m)	Borehole Diameter (m)	Bar length (m)	Bar Diameter (mm)	Free Length (m)	Bond Length (m)	Bearing plate (mm)	Hex Nut	Anticorrosion Compound
15	0.12	15.6	40	5	10	240 x 55	Yes	Yes

Notes:
Protective caps are required. Protective caps are to be replaced at every testing of the anchor.
Multiple retension phases are expected during the 12 month construction period to ensure pretension loading (50kN).
Periodic lift tests will be required per 5 years of installation.
Refer to manufacturers specifications for installation.
Refer to manufacturers specifications for testing.
testing
Load transfer block to be constructed to allow for testing of each anchor bar at specific inclinations and

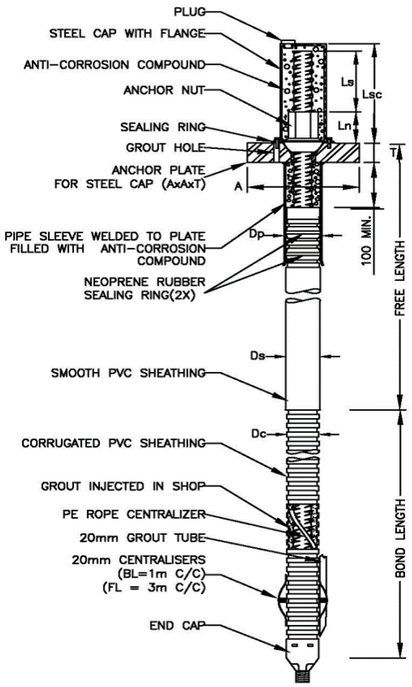




Key
1 - anchorage point at jack during stressing
2 - anchorage point at anchor head in service
3 - tensioning element at anchor head (nut or barrel and wedge)
4 - bearing plate
5 - load transfer block
6 - structural element
7 - trumpet or anchor head tube
8 - O-ring
9 - soil/rock
10 - borehole
11 - debonding sleeve
12 - tendon
13 - fixed length grout body
14 - free length filling where appropriate

Source: Sketch of a bond type ground anchor (EN 1537:2013; ISO 22477-5:2018)

BAR ANCHOR DETAILS



BAR ANCHOR, PLATE AND NUT DETAILS

Physical Properties

Grade	(Mpa)	WR (950 / 1050)					E (835 / 1035)		
Diameter	(mm)	26.5	32	36	40	47	57	65	75
Ultimate	(kN)	579	844	1069	1319	1820	2671	3447	4572
Yield	(kN)	524	764	967	1194	1652	2155	2780	3690
Area	(mm2)	552	804	1018	1257	1735	2581	3331	4418

Dimensions (mm)

Bar Diameter		26.5	32	36	40	47	57	65	75
Bearing plate	A x T	180x40	20x45	220x50	240x55	260x50	330x70	370x75	420x85
Pipe OD	Dp	64	70	76	76	114	127	127	168.3
Nut Length	Ln	60	72	75	83	105	120*	130*	145*
Stressing Length	Ls	90	100	110	130	135	120	130	145
Capped Length	Lsc	210	210	210	240	280	280	280	280
Smooth Sheat OD	Ds	58	63	73	76	85	110	110	125
Corrugated Sheath OD	Dc	50	56	65	65	80	100	100	114

* Hex Nut

CHARACTERISTICS

1) POST–TENSIONING TENDONS ARE DSI THREADBAR, DOUBLE CORROSION PROTECTED SYSTEM, SHOP ASSEMBLED AND GROUTED.
2) THREADBARS ARE PROOF STRESSED AND STRESS RELEIVED.
3) SHOP GROUT: CEMENTITIOUS NEAT LEAN GROUT W/O AGGREGATES, MAXIMUM WATER CEMENT RATIO=0.36 (BY WEIGHT), CEMENT: GENERAL PURPOSE TYPE GP ADDITIVE: VISCOCRETE 10, 0.25% (BY WEIGHT).
4) DURING TENSIONING, DRAW IN AT NUT=1mm & COUPLER SLIP=1.5mm.

INSTALLATION PROCEDURE

1) DRILL HOLE; GROUT AND RE–DRILL IF REQUIRED.
2) ASSEMBLE PRE–GROUTED BARS WITH PLATES, NUTS, GROUT TUBES, CENTRALISERS AND COUPLERS (IF APPLICABLE) AND INSERT ANCHOR IN HOLE.
3) TREMIE GROUT ALONG ENTIRE ANCHOR LENGTH.
4) ONCE GROUT REACHES REQUIRED STRENGTH, TEST ACCORDING TO SPECIFICATIONS.
5) INSTALL PROTECTIVE CAPS (IF REQUIRED).

ANCHOR–DETAILS

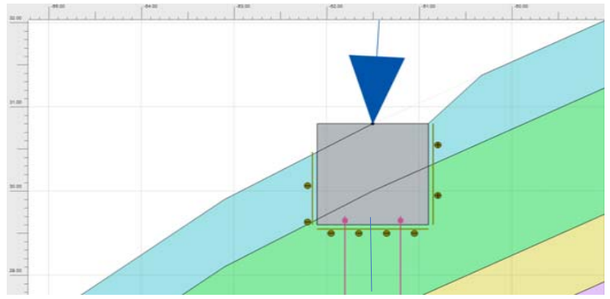
Client: Aspect Studio
Project: Coastal Walk Way - Bridge Foundation Design
Project No: ADL2022-0050 Rev0
Engineer: JVS
Subject: Grey Gully North Portal Foundation Details
Note: Plaxis analysis has identifed that the existing slope is unstable under a 0.1g horizontal seismic acceleration.

Portal Embedded Strip Footing Block

Length (m)	Width (m)	Depth (m)	Steel Reinforcement kg/m3
2.8	1.2	1.2	180

Average Excavation Depth
2m 1.5m depth into Unit 2 Noting excavation depths require witnessing by a geotechnical engineer

Note:
Refer to Geotechnical report for depth of geotechnical units at this site.



Anchor Bars as Reinforcement to Micropiles

Product Dywidag WR DCP Anchor 01
Double Corrosion Protected (DCP) Permanent Ground Anchor

Number of micro piles 10

Connection of micropiles to strip footing by Innovis
Spacing of Bars = 0.8 centre to centre
Strip footing structural design by Innovis

Borehole Number	Borehole Depth (bottom of strip footing) (m)	Borehole Diameter (m)	Inclination	Bar length (m)	Bar Diameter (mm)	Free Length (m)	Bond Length (m)	Bearing plate (mm)	Hex Nut	Anticorrosion Compound	Plug
6	7	0.12	vertical	7	40	0	7	no	no	no	no
4	5	0.12	vertical	5	40	0	5	no	no	no	no

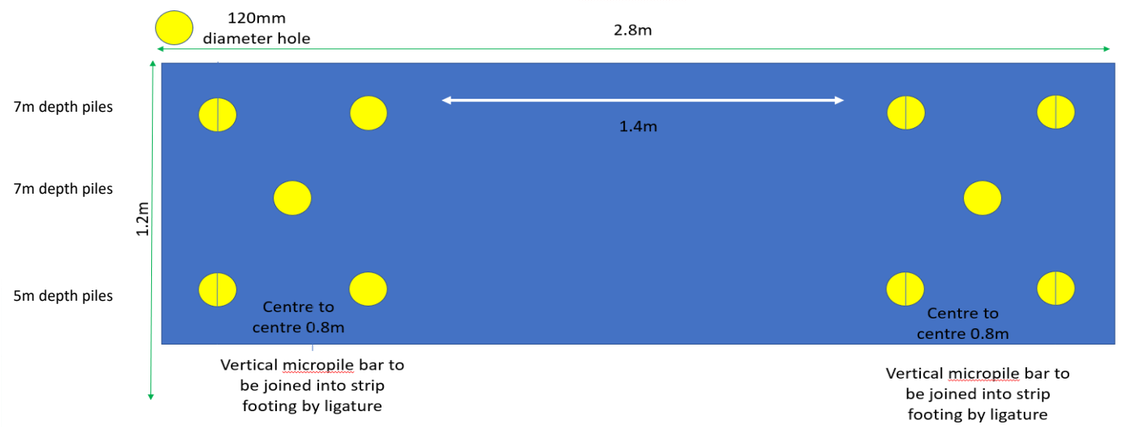
Portal Bar Reinforcement

Physical Properties

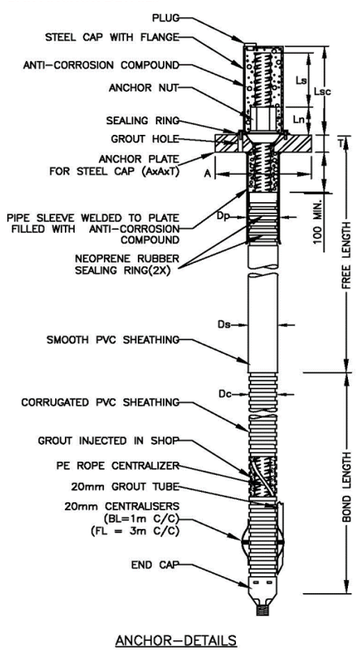
Grade	(Mpa)	WR (950 / 1050)					E (835 / 1035)		
Diameter	(mm)	26.5	32	36	40	47	57	65	75
Ultimate	(kN)	579	844	1069	1319	1820	2671	3447	4572
Yield	(kN)	524	764	967	1194	1652	2155	2780	3690
Area	(mm2)	552	804	1018	1257	1735	2581	3331	4418

INSTALLATION PROCEDURE
1) DRILL HOLE; GROUT AND RE–DRILL IF REQUIRED.
2) ASSEMBLE PRE–GROUTED BARS WITH PLATES, NUTS, GROUT TUBES, CENTRALISERS AND COUPLERS (IF APPLICABLE) AND INSERT ANCHOR IN HOLE.
3) TREMIE GROUT ALONG ENTIRE ANCHOR LENGTH.
4) ONCE GROUT REACHES REQUIRED STRENGTH, TEST ACCORDING TO SPECIFICATIONS.
5) INSTALL PROTECTIVE CAPS (IF REQUIRED).

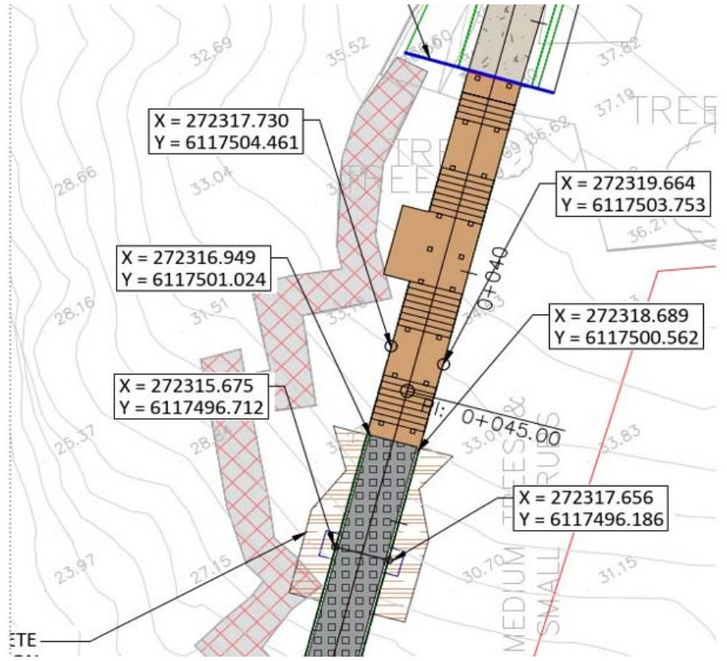
Portal - MicroPiles



BAR ANCHOR DETAILS



ANCHOR–DETAILS

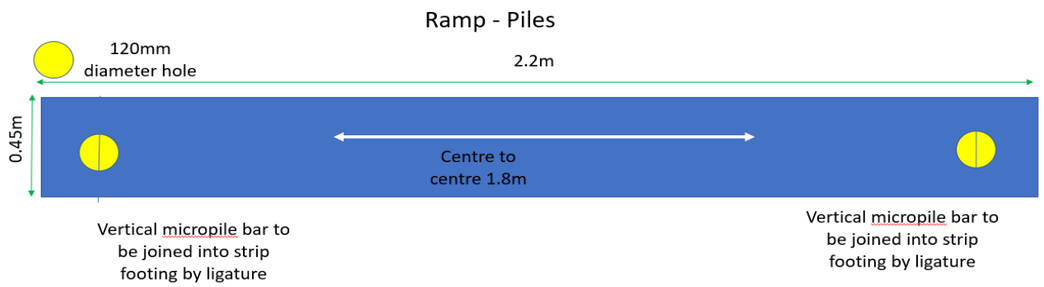


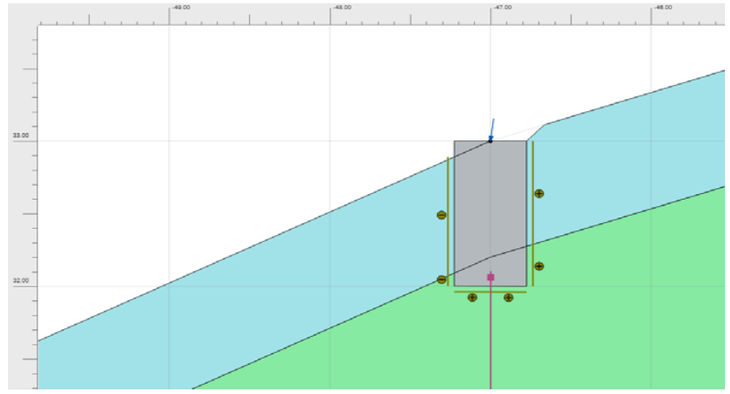
Client: Aspect Studio
Project: Coastal Walk Way - Bridge Foundation Design
Project No: ADL2022-0050 Rev0
Engineer: JVS
Subject: Grey Gully North Ramp Foundation Details
Note: Plaxis analysis has identifed that the slope is unstable under a 0.1g horizontal seismic acceleration.

Ramp Embedded Strip Footing Block

Length (m)	Width (m)	Depth (m)	Steel Reinforcement kg/m3
2.2	0.45	1	180

Average Excavation Depth
1m 0.5m depth into Unit 2
Noting excavation depths require witnessing by a geotechnical engineer





Number of micro piles 2
Connection of micropiles to strip footing by Innovis
Spacing of Bars = 1.8 centre to centre
Strip footing structural design by Innovis

Anchor Bars as Reinforcement to Micropiles
Product Dywidag WR DCP Anchor 01
Double Corrosion Protected (DCP) Permanent Ground Anchor

Borehole Number	Borehole Depth (m)	Borehole Diameter (m)	Inclination	Bar length (m)	Bar Diameter (mm)	Free Length (m)	Bond Length (m)	Bearing plate (mm)	Hex Nut	Anticorrosion Compound	Plug
2	6	0.12	vertical	6	40	0	6	no	no	no	no

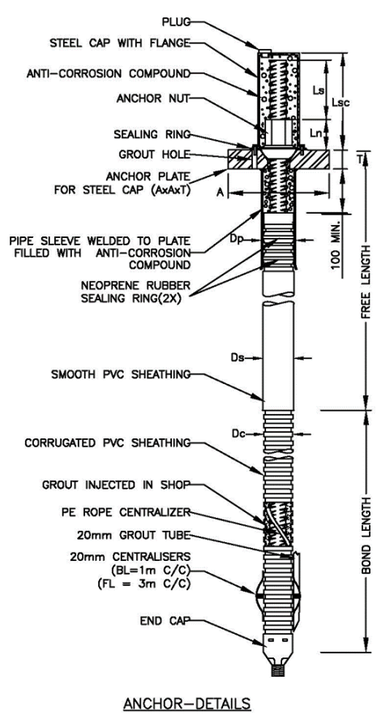
Portal Bar Reinforcement

Physical Properties

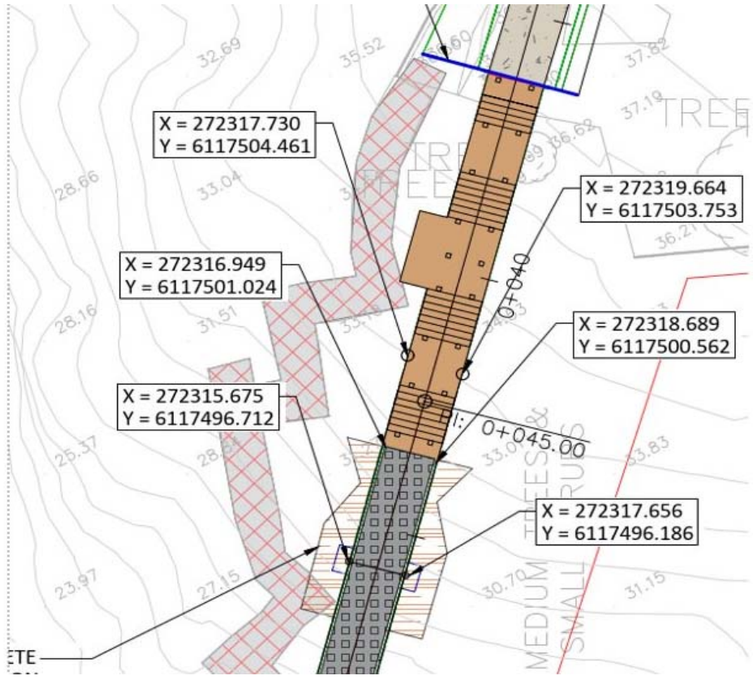
Grade	(Mpa)	WR (950 / 1050)					E (835 / 1035)		
Diameter	(mm)	26.5	32	36	40	47	57	65	75
Ultimate	(kN)	579	844	1069	1319	1820	2671	3447	4572
Yield	(kN)	524	764	967	1194	1652	2155	2780	3690
Area	(mm2)	552	804	1018	1257	1735	2581	3331	4418

INSTALLATION PROCEDURE
1) DRILL HOLE; GROUT AND RE-DRILL IF REQUIRED.
2) ASSEMBLE PRE-GROUTED BARS WITH PLATES, NUTS, GROUT TUBES, CENTRALISERS AND COUPLERS (IF APPLICABLE) AND INSERT ANCHOR IN HOLE.
3) TREMIE GROUT ALONG ENTIRE ANCHOR LENGTH.
4) ONCE GROUT REACHES REQUIRED STRENGTH, TEST ACCORDING TO SPECIFICATIONS.
5) INSTALL PROTECTIVE CAPS (IF REQUIRED).

BAR ANCHOR DETAILS



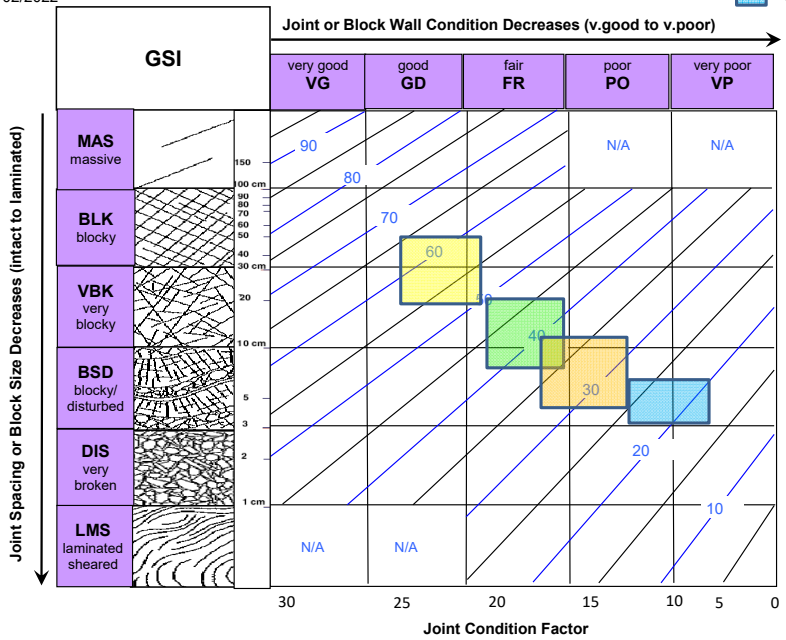
ANCHOR-DETAILS



Client	Aspect Studio
Project	Coastal Walk Way - Bridge Foundation Investigation
Project #	ADL2022-0050 Rev0
Topic	Existing Slope - Rock Mass Mapping
Author	John Slade
Date	21/02/2022

CMW Overall General Assessment

Type	Weathering	Strength	Unit
Slate	SW	H/M	5
Slate / Sandstone	SW, MW	M	4
Slate	XW / HW	L	3
Slate	RS/XW	VL	2



Structure Descriptions

MAS : intact rock with no or only a few widely spaced joints.
joint spacing >100cm

BLK : well interlocked, relatively undisturbed rock consists of cubical blocks formed by 3 intersecting joint sets.
joint spacing 30 - 100cm

VBK : interlocked, partially disturbed rock with multi-faceted angular blocks formed by 4 or more joint sets
joint spacing 10 - 30cm

BSD : folded rock with angular blocks formed by many intersecting joint sets. Persistence of foliation.
joint spacing 3 - 10cm

DIS : disintegrated, poorly interlocked, heavily broken rock with a mix of angular and rounded fragments.
joint spacing <3cm

LMS : no blockiness, close spaced schistosity or shear planes.
joint spacing <1cm

Surface Condition Descriptions

VG : very rough, fresh unweathered
GD : rough, slightly weathered, Fe stained
FR : smooth, moderately weathered and altered
PO : slickensided, highly weathered, with compact coatings, fillings or angular fragments
VP : slickensided, highly weathered, soft clay coatings or fillings

Project	COASTAL TRAIL – GREY GULLY AND KURNABINNA FOOTINGS DESIGN REPORT
Location	**Grey Gully North, South and Kurnabinna North, South**
Client	Aspect Studio
Project No.	ADL2022-0050
Date	17/03/2022

Weathered shale (Elias and Juran 1991)	ULT bond stress (lower), kN/m2	ULT bond stress (upper), kN/m2			
	100	150			
diameter (mm)	120	120			
perimeter (m2)	0.38	0.38			
bond length (m)	5	5	lower q	median	upper q
pull-out resistance (kN/m)	38	57	42	47	52
pull-out resistance (kN)	188	283			

Soft shales (Table 7, FHWA-IF-99-015)	ULT bond stress (lower), kN/m2	ULT bond stress (upper), kN/m2			
	200	800			
diameter (mm)	120	120			
perimeter (m2)	0.38	0.38			
bond length (m)	5	5	lower q	median	upper q
pull-out resistance (kN/m)	75	302	132	188	245
pull-out resistance (kN)	377	1508			

Slate and hard shales (Table 7, FHWA-IF-99-015)	ULT bond stress (lower), kN/m2	ULT bond stress (upper), kN/m2			
	800	1400			
diameter (mm)	120	120			
perimeter (m2)	0.38	0.38			
bond length (m)	10	10	lower q	median	upper q
pull-out resistance (kN/m)	302	528	358	415	471
pull-out resistance (kN)	3016	5278			

Table 8.3 *Ultimate bond stress for drilled and grouted soil nails in soil and rock for various construction methods and soil types (adapted from Elias and Juran (1991) and from FHWA (1998 and 2003))*

Construction method	Soil type	Ultimate bond stress (kN/m²)	Source
Augered	Loess	25–75	2
	Soft clay	20–30	1
	Stiff to hard clay	40–60	1
	Clayey silt	40–100	1
	Calcareous sandy clay	90–140	1
	Silty sand fill	15–20	1
Open hole	Non-plastic silt	20–30	2
	Medium-dense sand and silty sand/sandy silt	50–75	2
	Dense silty sand and gravel	80–100	2
	Very dense silty sand and gravel	120–240	2
	Stiff clay	40–60	2
	Stiff clayey silt	40–100	2
	Stiff sandy clay	50–100	3
Rotary-drilled	Marl/limestone	300–400	1
	Soft dolomite	400–600	1
	Weathered sandstone	200–300	1
	Weathered shale	100–150	1
	Weathered schist	100–175	1
	Basalt	500–600	1
	Silty sand	100–150	1
	Silt	60–75	1
Driven casing	Dense sand/gravel	180–210	3
	Sandy colluvium	70–150	3
	Clayey colluvium	40–75	1
Jet-grouted	Sand	380	1
	Sand/gravel	700	1

Sources

1 Elias and Juran (1991)

2 FHWA (1998 and 2003) installed using tremie and low-pressure grouting

3 Suggested values for preliminary design – values from original FHWA (1998), which have been reduced based on authors' experience.

THE DATA IN THE ABOVE TABLE ARE FOR GUIDANCE ONLY – SITE-SPECIFIC INVESTIGATION AND TESTING NEED TO BE CARRIED OUT

Table 7. Presumptive average ultimate bond stress for ground/grout interface along anchor bond zone (after PTI, 1996).

Rock		Cohesive Soil		Cohesionless Soil	
Rock type	Average ultimate bond stress (MPa)	Anchor type	Average ultimate bond stress (MPa)	Anchor type	Average ultimate bond stress (MPa)
Granite and basalt	1.7 - 3.1	Gravity-grouted anchors (straight shaft)	0.03 - 0.07	Gravity-grouted anchors (straight shaft)	0.07 - 0.14
Dolomitic limestone	1.4 - 2.1	Pressure-grouted anchors (straight shaft)		Pressure-grouted anchors (straight shaft)	
Soft limestone	1.0 - 1.4	• Soft silty clay	0.03 - 0.07	• Fine-med. sand, med. dense – dense	0.08 - 0.38
Slates and hard shales	0.8 - 1.4	• Silty clay	0.03 - 0.07	• Med.–coarse sand (w/gravel), med. dense	0.11 - 0.66
Soft shales	0.2 - 0.8	• Stiff clay, med. to high plasticity	0.03 - 0.10	• Med.–coarse sand (w/gravel), dense - very dense	0.25 - 0.97
Sandstones	0.8 - 1.7	• Very stiff clay, med. to high plasticity	0.07 - 0.17	• Silty sands	0.17 - 0.41
Weathered Sandstones	0.7 - 0.8	• Stiff clay, med. plasticity	0.10 - 0.25	• Dense glacial till	0.30 - 0.52
Chalk	0.2 - 1.1	• Very stiff clay, med. plasticity	0.14 - 0.35	• Sandy gravel, med. dense-dense	0.21 - 1.38
Weathered Marl	0.15 - 0.25	• Very stiff sandy silt, med. plasticity	0.28 - 0.38	• Sandy gravel, dense-very dense	0.28 - 1.38
Concrete	1.4 - 2.8				

Note: Actual values for pressure-grouted anchors depend on the ability to develop pressures in each soil type.

Project	COASTAL TRAIL – GREY GULLY AND KURNABINNA FOOTINGS DESIGN REPORT
Location	**Grey Gully North, South and Kurnabinna North, South**
Client	Aspect Studio
Project No.	ADL2022-0050
Date	17/03/2022
Subject	Pile Parameters

120mm hole	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
fs (kPa)	27	54	600	850	1000
fb (kPa)	68	1350	9600	13500	16500
py (kPa)	675	1350	2400	6750	8250
diameter (mm)	**120**	**120**	**120**	**120**	**120**
perimeter (m)	0.38	0.38	0.38	0.38	0.38
area (m2)	0.01	0.01	0.01	0.01	0.01
axial skin resistance (kN/m)	10	20	226	320	377
lateral resistance (kN/m)	81	162	288	810	990
base resistance (kN)	1	15	109	153	187

100mm hole	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
fs (kPa)	27	54	600	850	1000
fb (kPa)	68	1350	9600	13500	16500
py (kPa)	675	1350	2400	6750	8250
diameter (mm)	**100**	**100**	**100**	**100**	**100**
perimeter (m2)	0.31	0.31	0.31	0.31	0.31
area (m2)	0.01	0.01	0.01	0.01	0.01
axial skin resistance (kN/m)	8	17	188	267	314
lateral resistance (kN/m)	68	135	240	675	825
base resistance (kN)	1	11	75	106	130

Project COASTAL TRAIL – GREY GULLY AND KURNABINNA FOOTINGS DESIGN REPORT
Location **Kurnabinna Gully South**
Client Aspect Studio
Project No. ADL2022-0050
Date 17/03/2022

Anchor, 15m

Options	FOS, phi/c reduction	N, rock bolt (kN)	FOS, yield strength	Tskin (kN/m/m)	Tskin (kN/m)	FOS, bond strength	Disp (mm)
Existing Slope_ST	**3.8**	N/A	N/A	N/A	N/A	N/A	N/A
Existing Slope_DYN	**3.4**	N/A	N/A	N/A	N/A	N/A	N/A
4x47/120_ST		57	**29.2**	7	20	**17.8**	0
4x47/120_DYN		57	**28.8**	7	20	**18.0**	1
4x36/100_ST		54	**17.8**	7	22	**13.3**	0
4x36/100_DYN		55	**17.7**	7	22	**13.5**	1

Ramp Landing, 6m

Options	M (kNm/m)	Q (kN/m)	N (kN/m)	M (kNm)	Q (kN)	N (kN)	Disp, v (mm)	Disp, h (mm)
47/120_ST	0	0	0	0	0	**1**	0	0
47/120_DYN	0	0	0	0	0	**1**	0	1
36/100_ST	0	0	1	0	0	**2**	0	0
36/100_DYN	0	0	1	0	0	**2**	0	1

Portal, 5m

Options	M (kNm/m)	N, rock bolt (kN)	N (kN/m)	M (kNm)	Q (kN)	N (kN)	Disp, v (mm)	Disp, h (mm)
47/120_ST	0	0	8	0	0	**23**	1	0
47/120_DYN	0	0	8	0	0	**23**	1	1
36/100_ST	0	0	6	0	0	**18**	1	0
36/100_DYN	0	0	6	0	0	**17**	1	1

Portal, 7m *optional

Options	M (kNm/m)	Q (kN/m)	N (kN/m)	M (kNm)	Q (kN)	N (kN)	Disp, v (mm)	Disp, h (mm)
47/120_ST	0	0	9	0	0	**27**	1	0
47/120_DYN	0	0	9	0	0	**27**	1	1
36/100_ST	0	0	7	0	0	**20**	1	0
36/100_DYN	0	0	7	0	0	**20**	1	1

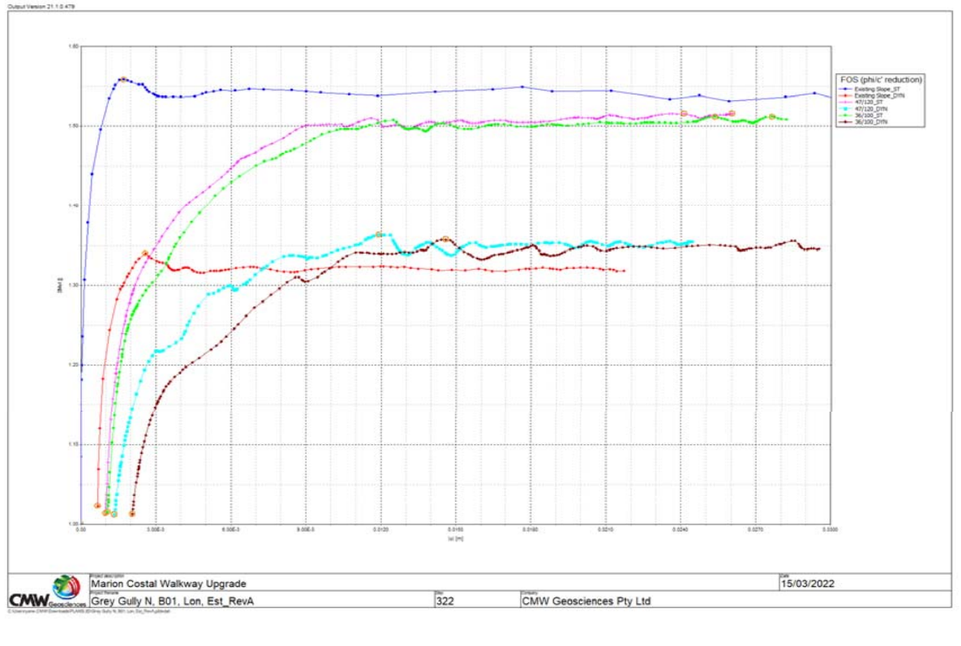
Pull-out resistence (kN/m)		Weathered shale	Soft shales	Slate and hard shales
120mm	lower q	42	132	**358**
	median	47	188	415
	upper q	52	245	471
100mm	lower q	35	110	**298**
	median	39	157	346
	upper q	43	204	393

Table 8. Presumptive ultimate values of load transfer for preliminary design of ground anchors in rock.

Rock type	Estimated ultimate transfer load (kN/m)
Granite or Basalt	730
Dolomitic Limestone	580
Soft Limestone	440
Sandstone	440
Slates and Hard Shales	360
Soft Shales	150

Grout Cover Thickness (mm)	47mm	36mm
120mm	36.5	42
100mm	26.5	32

Material Properties	47mm	36mm	26.5mm
ULT (KN)	1820	1069	579
Ys (kN)	**1652**	**967**	524



Project COASTAL TRAIL – GREY GULLY AND KURNABINNA FOOTINGS DESIGN REPORT
Location **Kurnabinna Gully North**
Client Aspect Studio
Project No. ADL2022-0050
Date 17/03/2022

Anchor, 15m

Options	FOS, phi/c reduction	N, rock bolt (kN)	FOS, yield strength	Tskin (kN/m/m)	Tskin (kN/m)	FOS, bond strength	Disp (mm)
Existing Slope_ST	**1.8**	N/A	N/A	N/A	N/A	N/A	N/A
Existing Slope_DYN	**1.6**	N/A	N/A	N/A	N/A	N/A	N/A
4x47/120_ST	**1.5**	79	**21.0**	17	52	**6.9**	1
4x47/120_DYN	**1.3**	82	**20.0**	18	54	**6.7**	1
4x36/100_ST	**1.5**	69	**13.9**	17	52	**5.8**	1
4x36/100_DYN	**1.3**	72	**13.4**	18	53	**5.6**	1

Ramp Landing, 6m

Options	M (kNm/m)	Q (kN/m)	N (kN/m)	M (kNm)	Q (kN)	N (kN)	Disp, v (mm)	Disp, h (mm)
47/120_ST	0	0	1	0	0	**4**	0	0
47/120_DYN	0	0	1	0	0	**4**	0	0
36/100_ST	0	0	1	0	0	**3**	0	0
36/100_DYN	0	0	1	0	0	**3**	0	0

Portal, 5m

Options	M (kNm/m)	N, rock bolt (kN)	N (kN/m)	M (kNm)	Q (kN)	N (kN)	Disp, v (mm)	Disp, h (mm)
47/120_ST	0	0	5	0	0	**15**	0	0
47/120_DYN	0	0	5	0	0	**14**	0	0
36/100_ST	0	0	4	0	0	**11**	0	0
36/100_DYN	0	0	4	0	0	**11**	0	0

Portal, 7m

Options	M (kNm/m)	Q (kN/m)	N (kN/m)	M (kNm)	Q (kN)	N (kN)	Disp, v (mm)	Disp, h (mm)
47/120_ST	0	0	6	0	0	**17**	0	0
47/120_DYN	0	0	6	0	0	**17**	0	0
36/100_ST	0	0	4	0	0	**12**	0	0
36/100_DYN	0	0	4	0	0	**12**	0	0

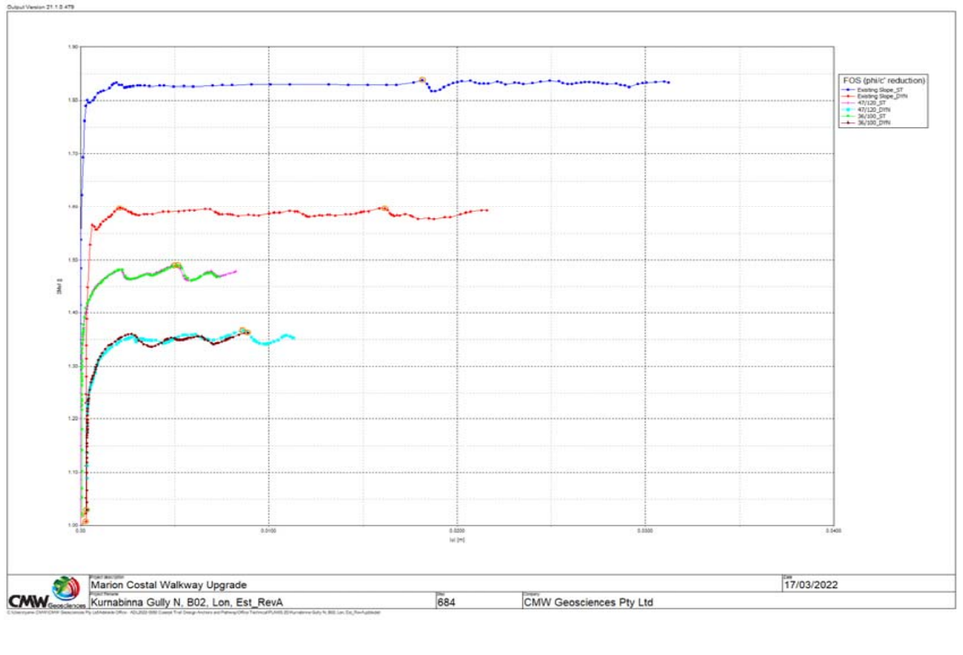
Pull-out resistence (kN/m)		Weathered shale	Soft shales	Slate and hard shales
120mm	lower q	42	132	**358**
	median	47	188	415
	upper q	52	245	471
100mm	lower q	35	110	**298**
	median	39	157	346
	upper q	43	204	393

Table 8. Presumptive ultimate values of load transfer for preliminary design of ground anchors in rock.

Rock type	Estimated ultimate transfer load (kN/m)
Granite or Basalt	730
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Slates and Hard Shales	360
Soft Shales	150

Grout Cover Thickness (mm)	47mm	36mm
120mm	36.5	42
100mm	26.5	32

Material Properties	47mm	36mm	26.5mm
ULT (KN)	1820	1069	579
Ys (kN)	**1652**	**967**	524



Project COASTAL TRAIL – GREY GULLY AND KURNABINNA FOOTINGS DESIGN REPORT
Location **Grey Gully South**
Client Aspect Studio
Project No. ADL2022-0050
Date 17/03/2022

Anchor, 15m

Options	FOS, phi/c reduction	N, rock bolt (kN)	FOS, yield strength	Tskin (kN/m/m)	Tskin (kN/m)	FOS, bond strength	Disp (mm)
Existing Slope_ST		N/A	N/A	N/A	N/A	N/A	N/A
Existing Slope_DYN		N/A	N/A	N/A	N/A	N/A	N/A
4x47/120_ST		201	**8.2**	26	78	**4.6**	3
4x47/120_DYN		213	**7.8**	27	82	**4.4**	3
4x36/100_ST		173	**5.6**	25	76	**3.9**	3
4x36/100_DYN		183	**5.3**	27	80	**3.8**	4

Ramp Landing, 6m

Options	M (kNm/m)	Q (kN/m)	N (kN/m)	M (kNm)	Q (kN)	N (kN)	Disp, v (mm)	Disp, h (mm)
47/120_ST	0	0	11	0	0	**34**	1	1
47/120_DYN	0	0	12	0	0	**37**	1	2
36/100_ST	0	0	10	0	0	**30**	1	1
36/100_DYN	0	0	11	0	0	**33**	1	2

Portal, 5m

Options	M (kNm/m)	N, rock bolt (kN)	N (kN/m)	M (kNm)	Q (kN)	N (kN)	Disp, v (mm)	Disp, h (mm)
47/120_ST	0	0	56	1	1	**168**	3	0
47/120_DYN	0	0	56	1	1	**169**	3	1
36/100_ST	0	0	48	1	1	**143**	3	0
36/100_DYN	0	0	48	1	1	**145**	3	1

Portal, 7m

Options	M (kNm/m)	Q (kN/m)	N (kN/m)	M (kNm)	Q (kN)	N (kN)	Disp, v (mm)	Disp, h (mm)
47/120_ST	0	1	75	1	2	**226**	3	0
47/120_DYN	0	1	76	1	2	**228**	3	1
36/100_ST	0	1	65	1	2	**196**	4	0
36/100_DYN	0	0	66	1	1	**198**	4	1

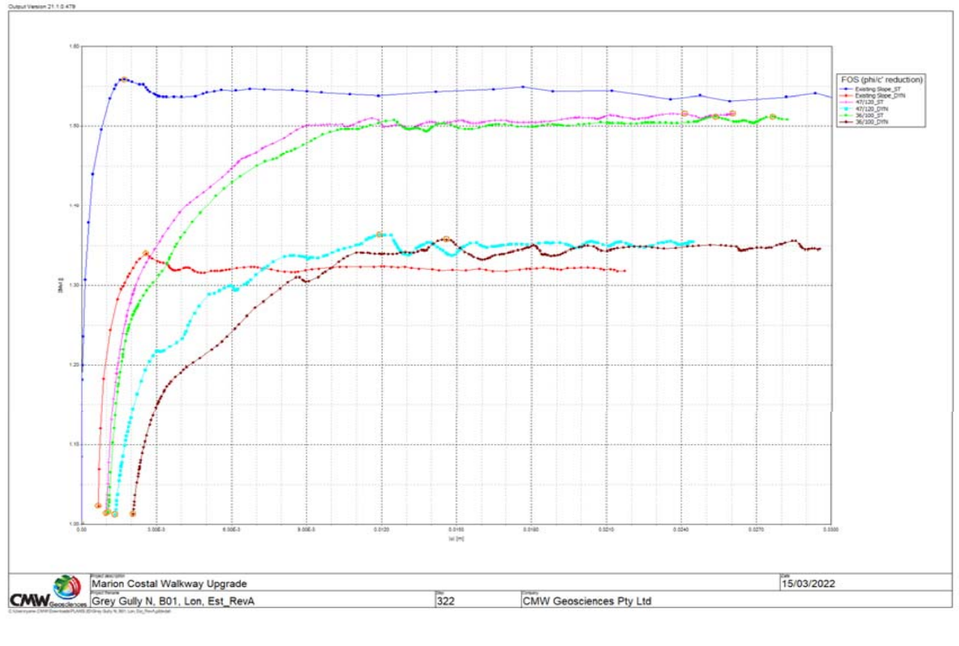
Pull-out resistence (kN/m)		Weathered shale	Soft shales	Slate and hard shales
120mm	lower q	42	132	**358**
	median	47	188	415
	upper q	52	245	471
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	median	39	157	346
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Soft Shales	150

Grout Cover Thickness (mm)	47mm	36mm
120mm	36.5	42
100mm	26.5	32

Material Properties	47mm	36mm	26.5mm
ULT (KN)	1820	1069	579
Ys (kN)	**1652**	**967**	524



Project Name: Coastal Trail Design
Description: Model Layout
Date: 18/03/2022

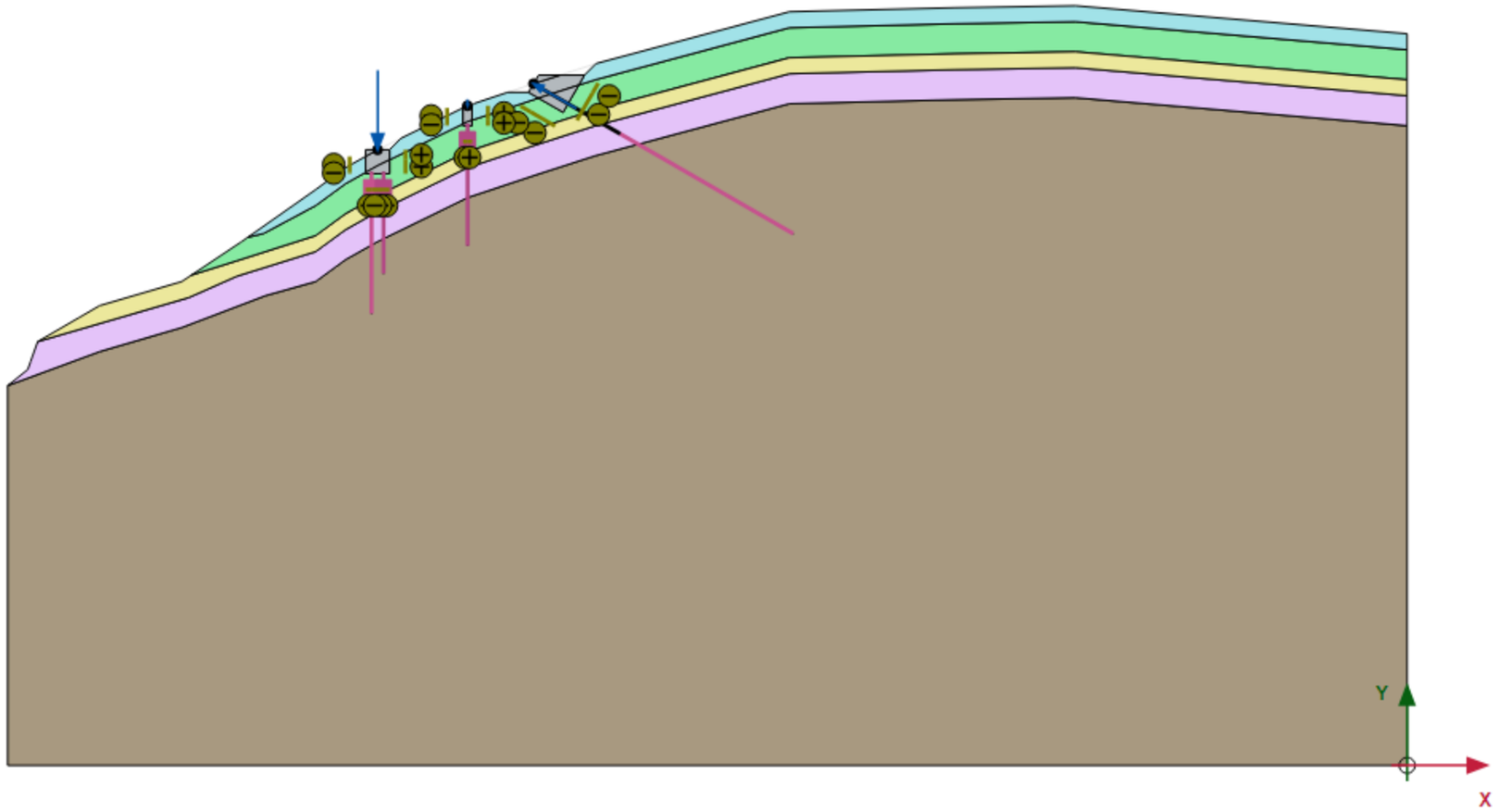
Drawn by: YW
Checked by: JVS

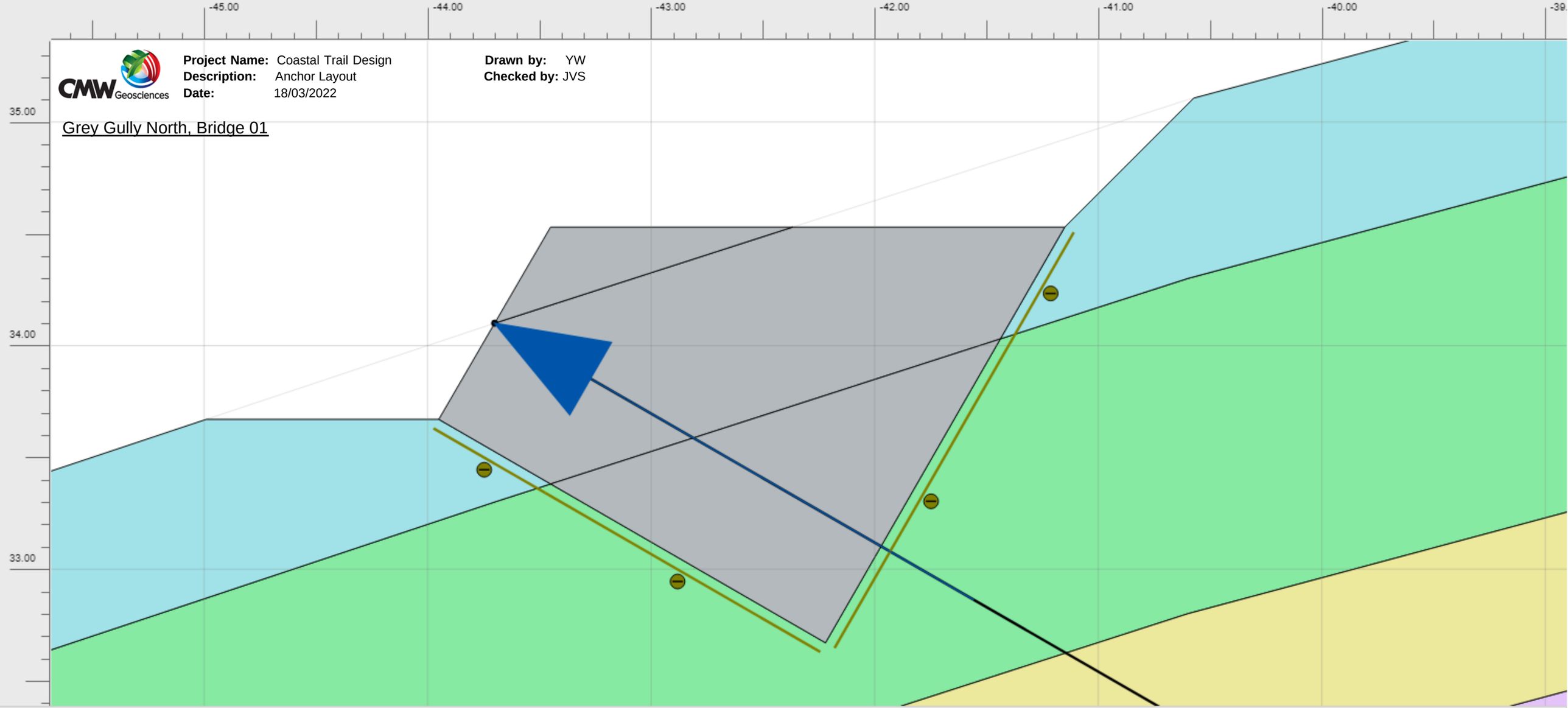
Grey Gully North, Bridge 01

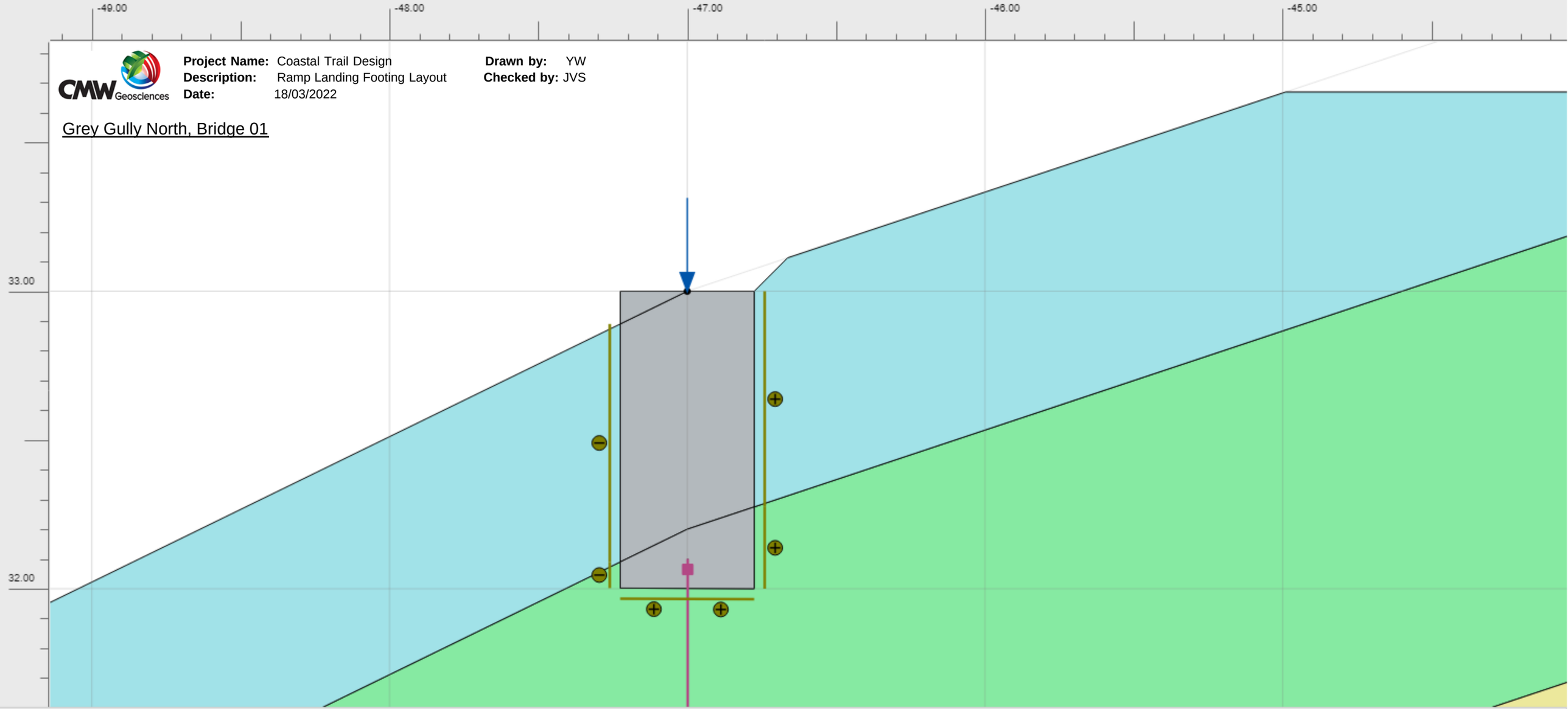
- Anchor Block
- Unit 1: Clay
- Unit 2: Res
- Unit 3: VLS
- Unit 4: LS
- Unit 5: MS

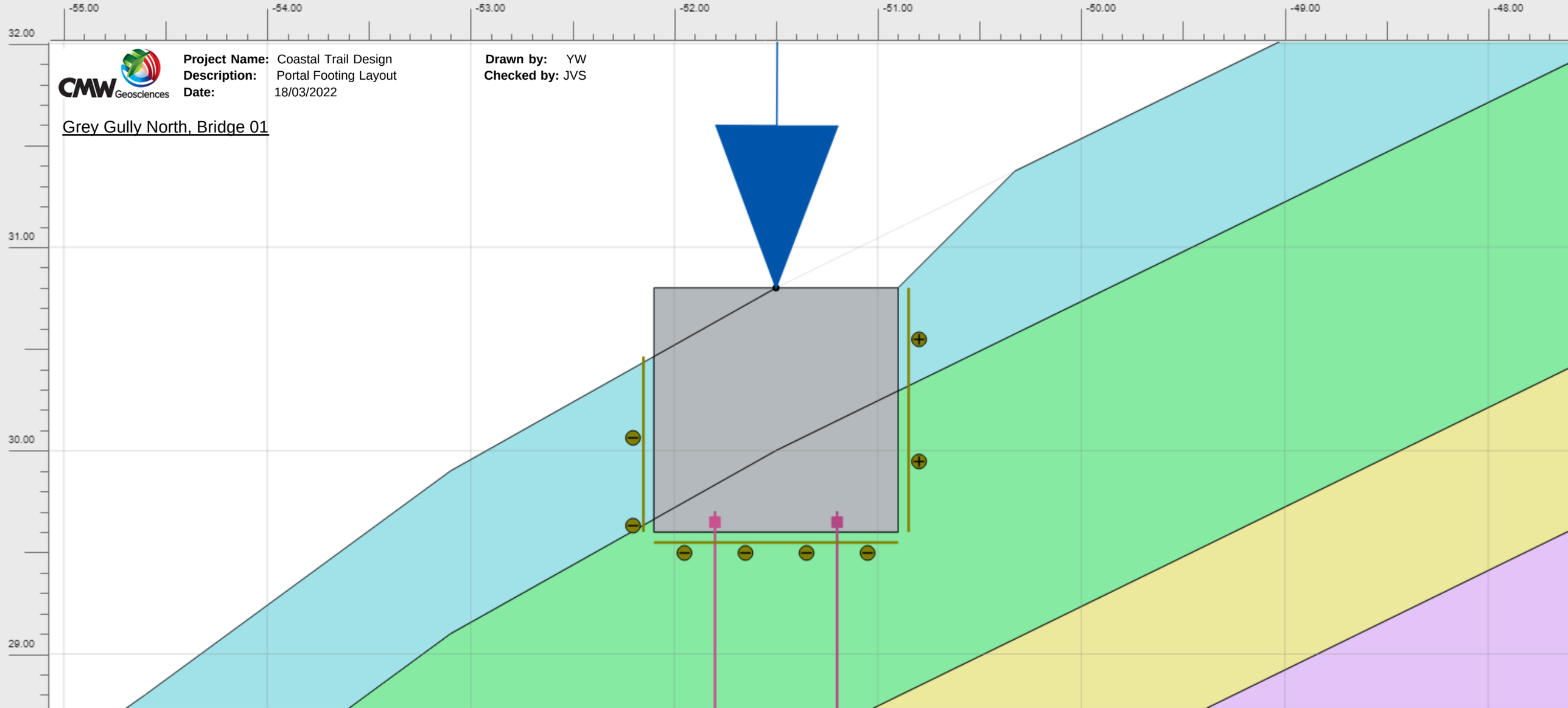
- Grout Anchor (100mm)
- Grout Anchor (120mm)
- Micro Pile (Landing, 100mm)
- Micro Pile (Portal, 100mm, 5m)
- Micro Pile (Portal, 100mm, 7m)
- Micro Pile (Portal, 120mm, 5m)
- Micro Pile (Portal, 120mm, 7m)
- Mircro Pile (Landing, 120mm)

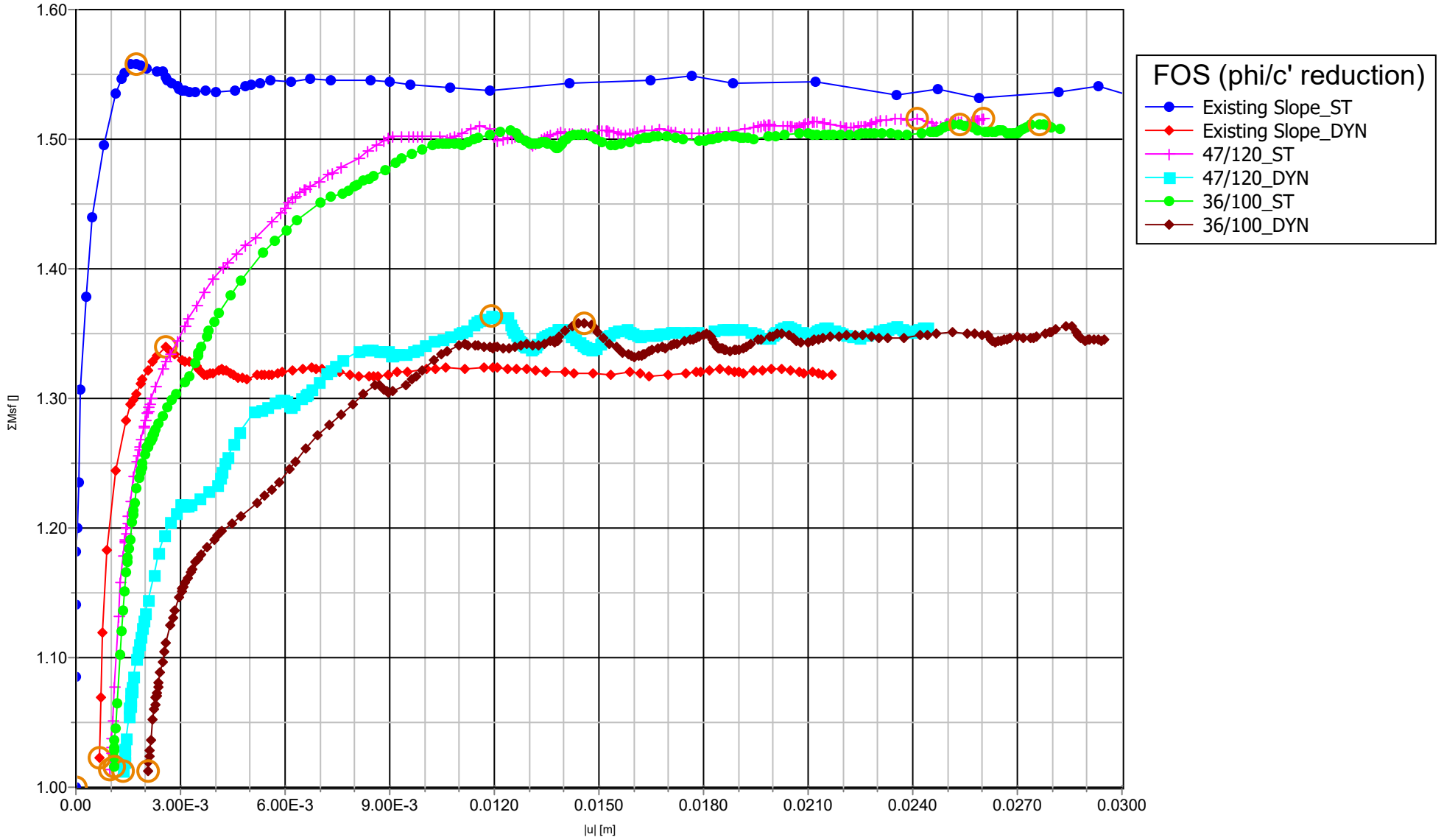
- Node to Node Anchor (36mm)
- Node-to-Node Anchor (26.5mm)
- Node-to-Node Anchor (47mm)



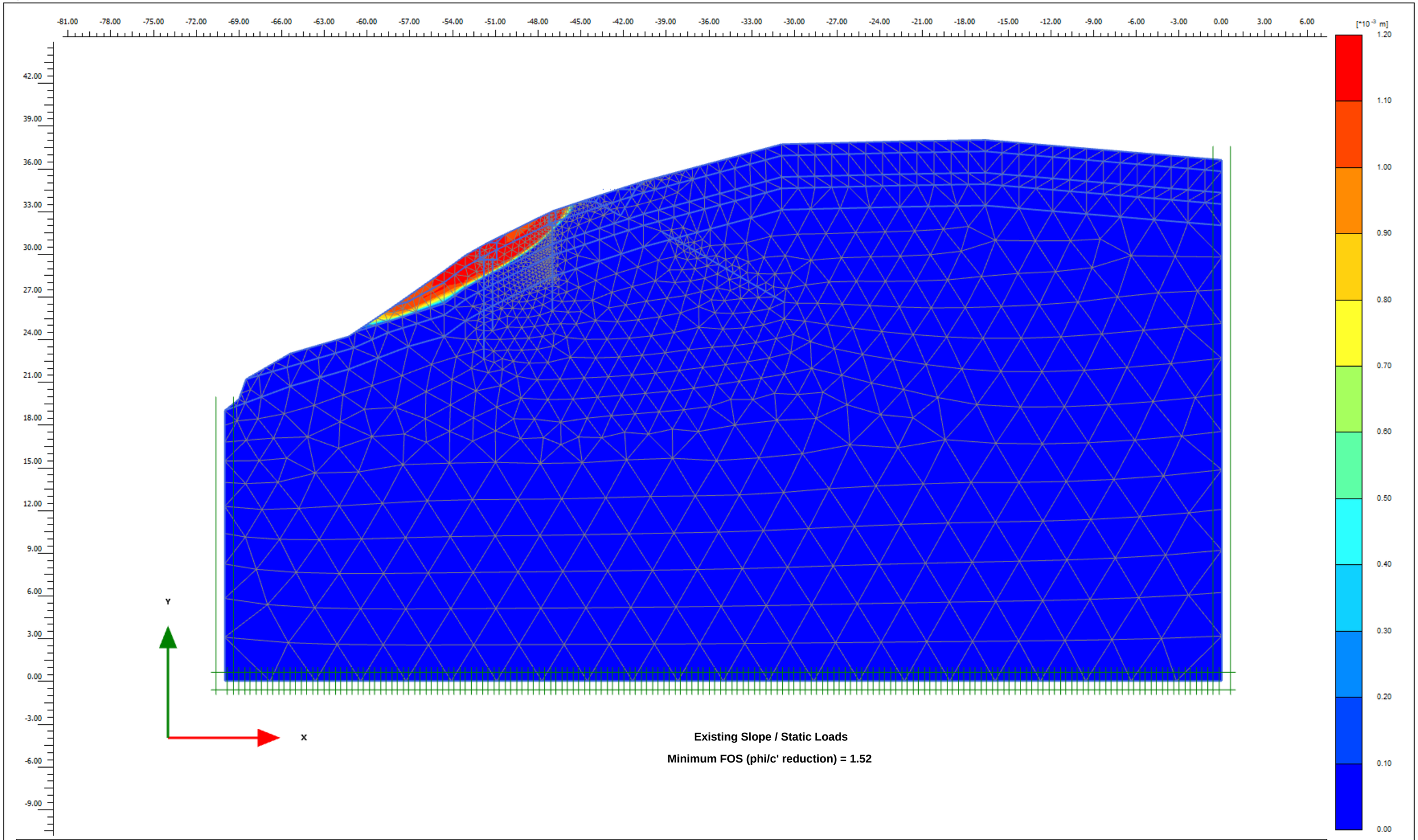

-45.00
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-42.00
-41.00
-40.00
35.00
34.00
33.00
Project Name: Coastal Trail Design
Description: Anchor Layout
Date: 18/03/2022
Drawn by: YW
Checked by: JVS
Grey Gully North, Bridge 01


-49.00
-48.00
-47.00
-46.00
-45.00
33.00
32.00
Project Name: Coastal Trail Design
Description: Ramp Landing Footing Layout
Date: 18/03/2022
Drawn by: YW
Checked by: JVS
Grey Gully North, Bridge 01


-55.00
-54.00
-53.00
-52.00
-51.00
-50.00
-49.00
-48.00
32.00
31.00
30.00
29.00
CMW Geosciences
Project Name: Coastal Trail Design
Description: Portal Footing Layout
Date: 18/03/2022
Drawn by: YW
Checked by: JVS
Grey Gully North, Bridge 01



CMW Geosciences	*Project description* Marion Costal Walkway Upgrade		*Date* 18/03/2022
	Project filename Grey Gully N, B01, Lon, Est_R ...	*Step* 1253	*Company* CMW Geosciences Pty Ltd



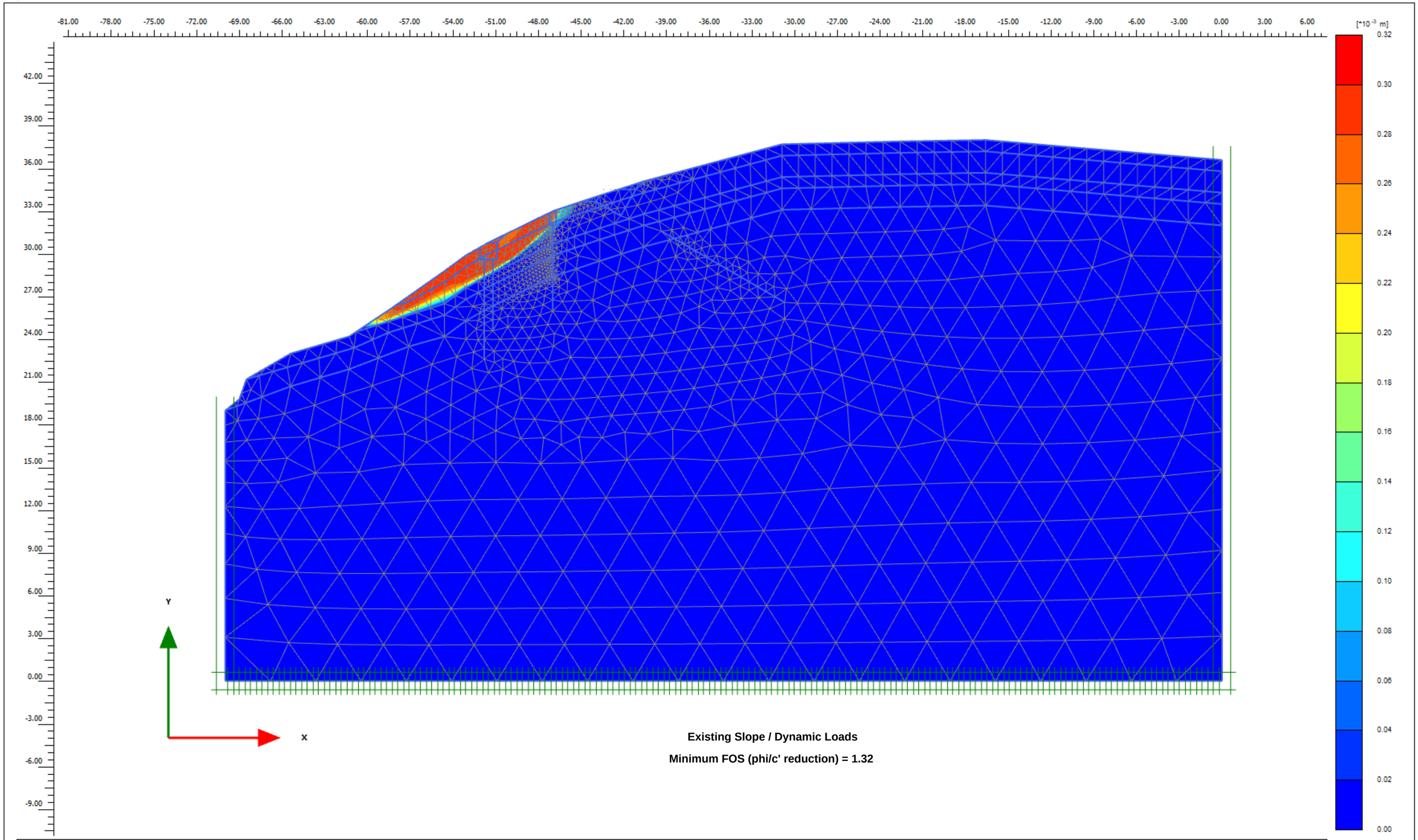
Existing Slope / Static Loads

Minimum FOS (phi/c' reduction) = 1.52

Incremental displacements |Δu| (scaled up 2.00*10 3 times)

Maximum value = 1.183*10 -3 m (Element 908 at Node 2591)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 102	Company: CMW Geosciences Pty Ltd	



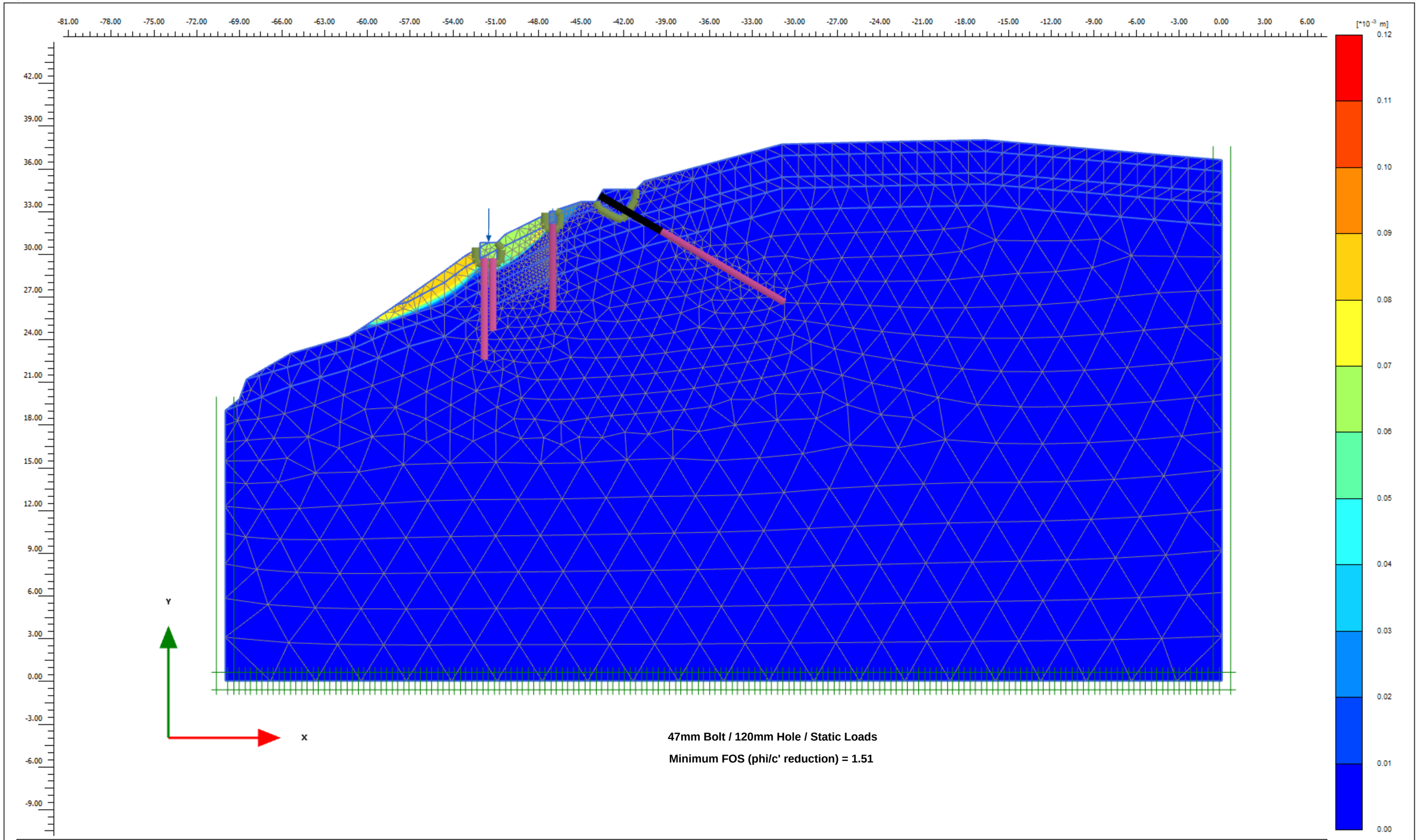
Existing Slope / Dynamic Loads

Minimum FOS (phi/c' reduction) = 1.32

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

Maximum value = $0.3051*10^{-3}$ m (Element 447 at Node 3306)

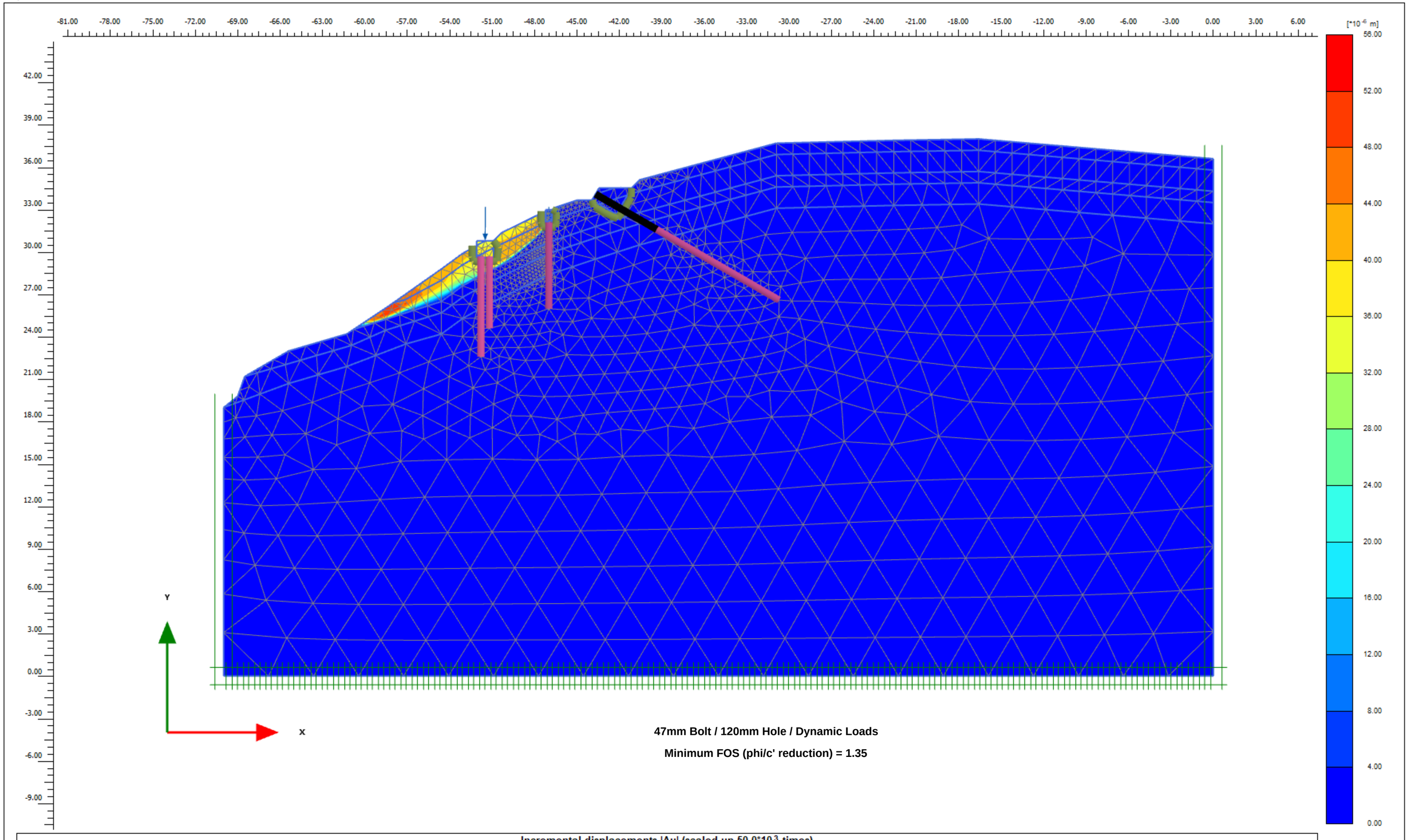
Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 204	Company: CMW Geosciences Pty Ltd	



Incremental displacements |Δu| (scaled up 20.0*10 3 times)

Maximum value = 0.1122*10 -3 m (Element 925 at Node 1295)

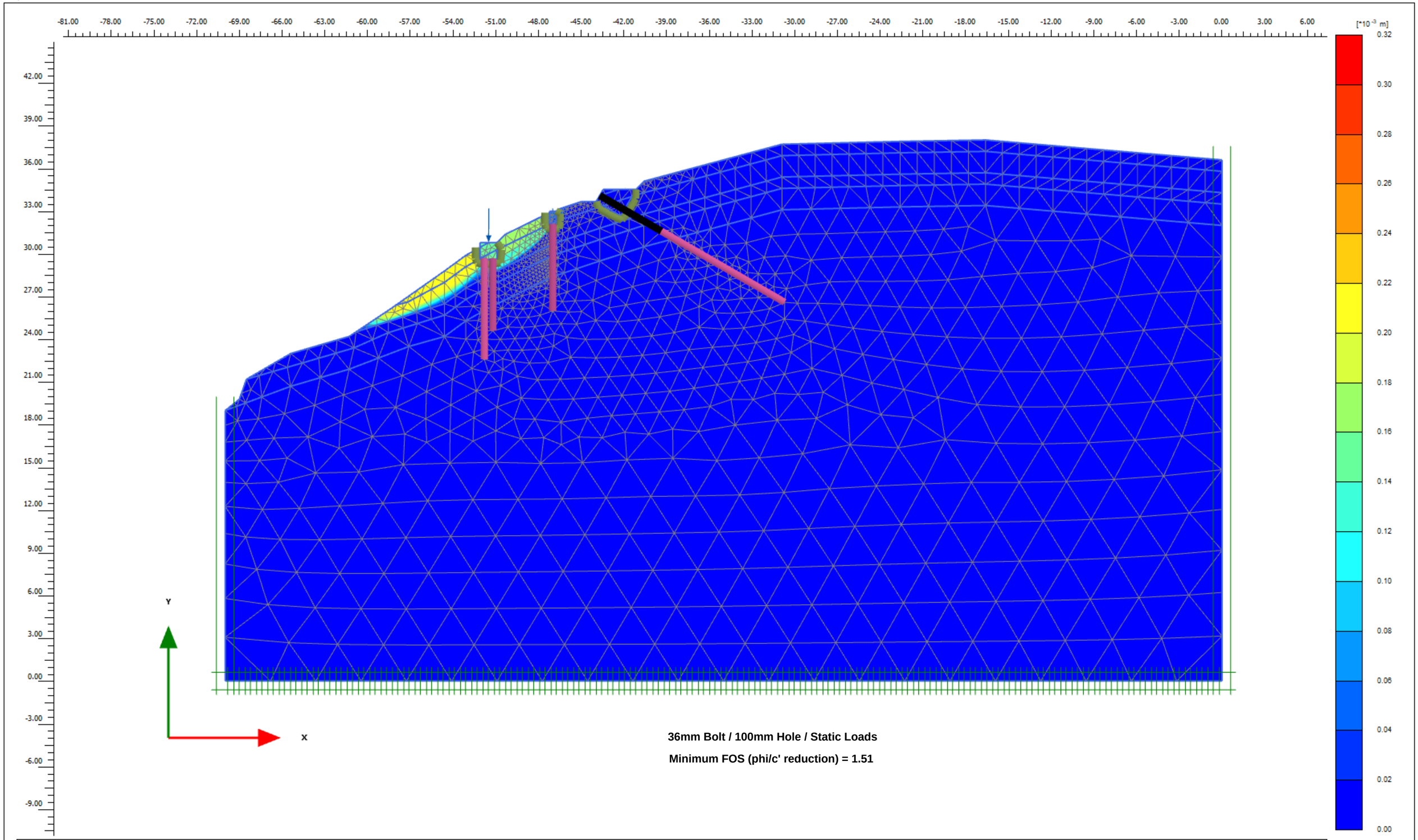
Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 737	Company: CMW Geosciences Pty Ltd	



Incremental displacements |Δu| (scaled up $50.0*10^{3}$ times)

Maximum value = $0.05336*10^{-3}$ m (Element 925 at Node 1295)

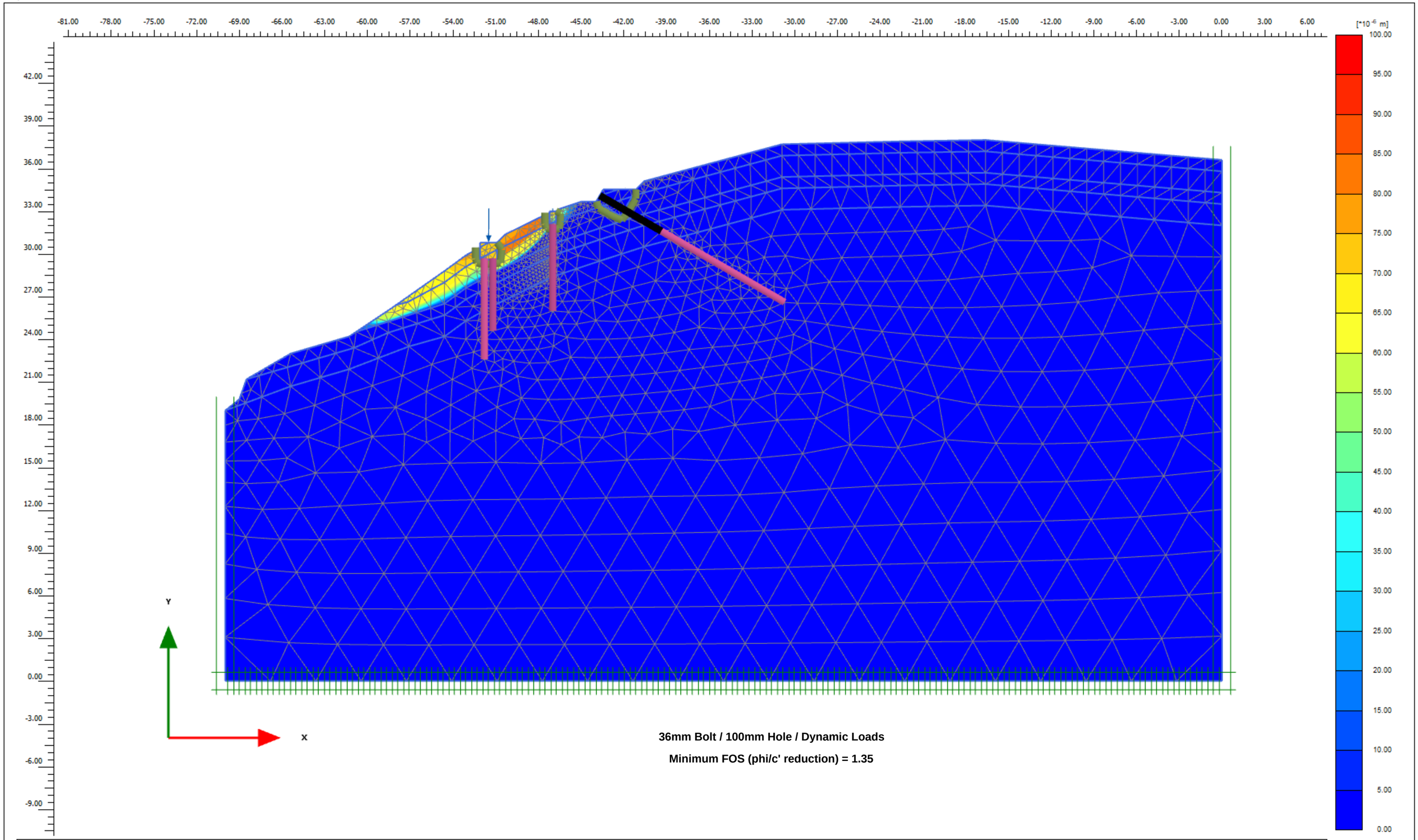
Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 516	Company: CMW Geosciences Pty Ltd	



Incremental displacements |Δu| (scaled up 5.00*10 3 times)

Maximum value = 0.3092*10 -3 m (Element 925 at Node 1295)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 989	Company: CMW Geosciences Pty Ltd	



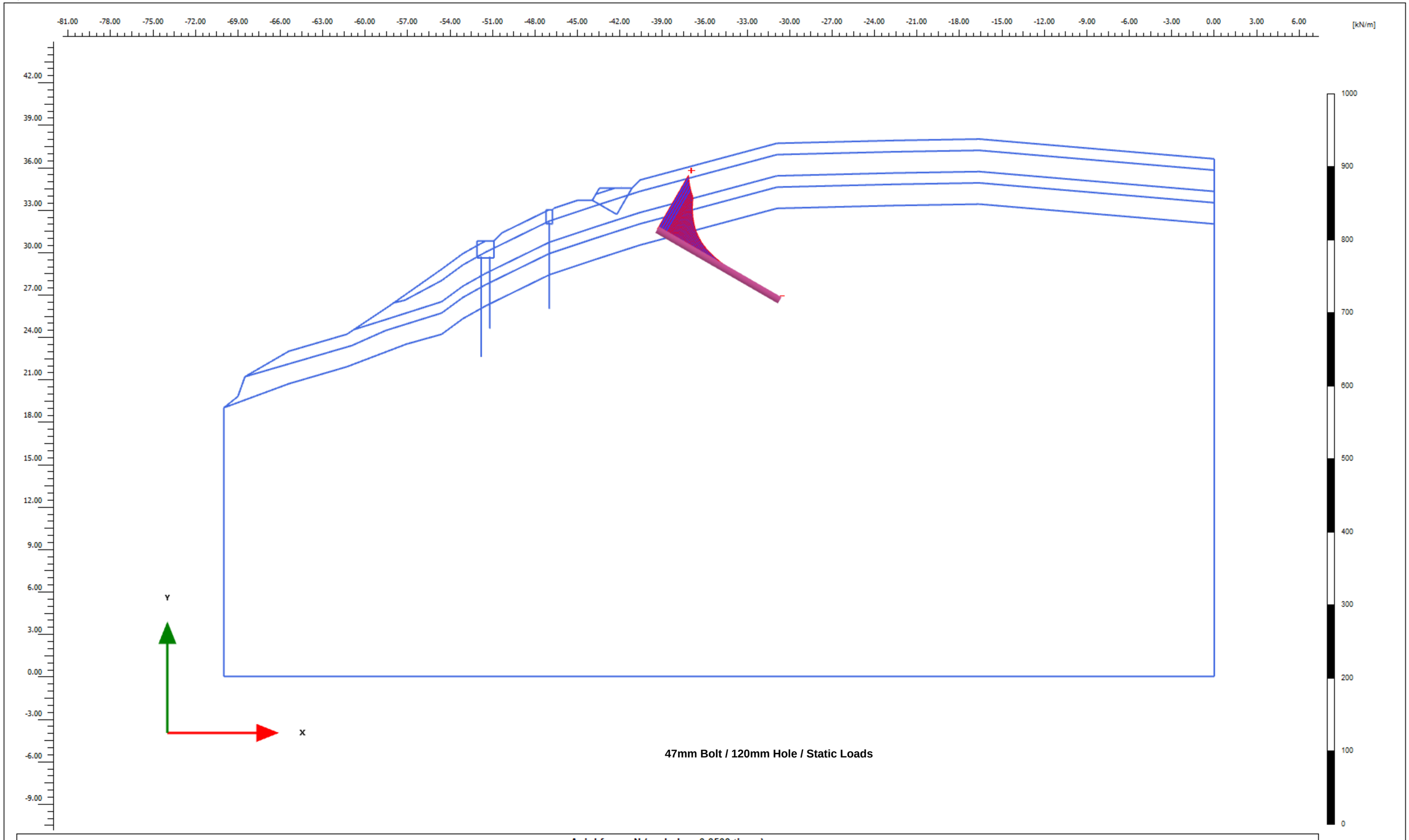
36mm Bolt / 100mm Hole / Dynamic Loads

Minimum FOS (phi/c' reduction) = 1.35

Incremental displacements |Δu| (scaled up $20.0*10^{3}$ times)

Maximum value = $0.09534*10^{-3}$ m (Element 925 at Node 1295)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 1253	Company: CMW Geosciences Pty Ltd	

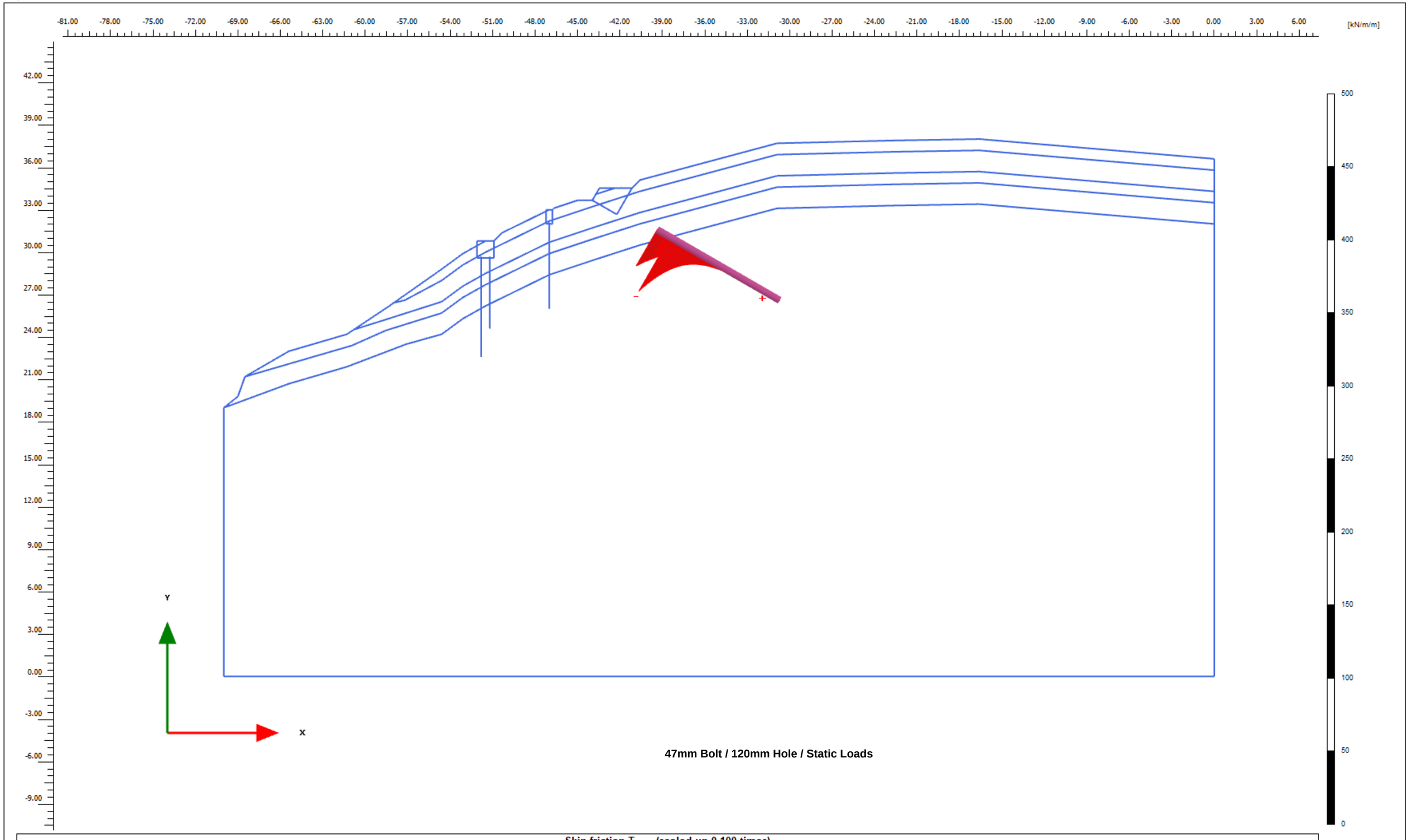


Axial forces N (scaled up 0.0500 times)

Maximum value = 88.67 kN/m (Element 30 at Node 19149)

Minimum value = $0.9207*10^{-3}$ kN/m (Element 47 at Node 19221)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 266	Company: CMW Geosciences Pty Ltd	

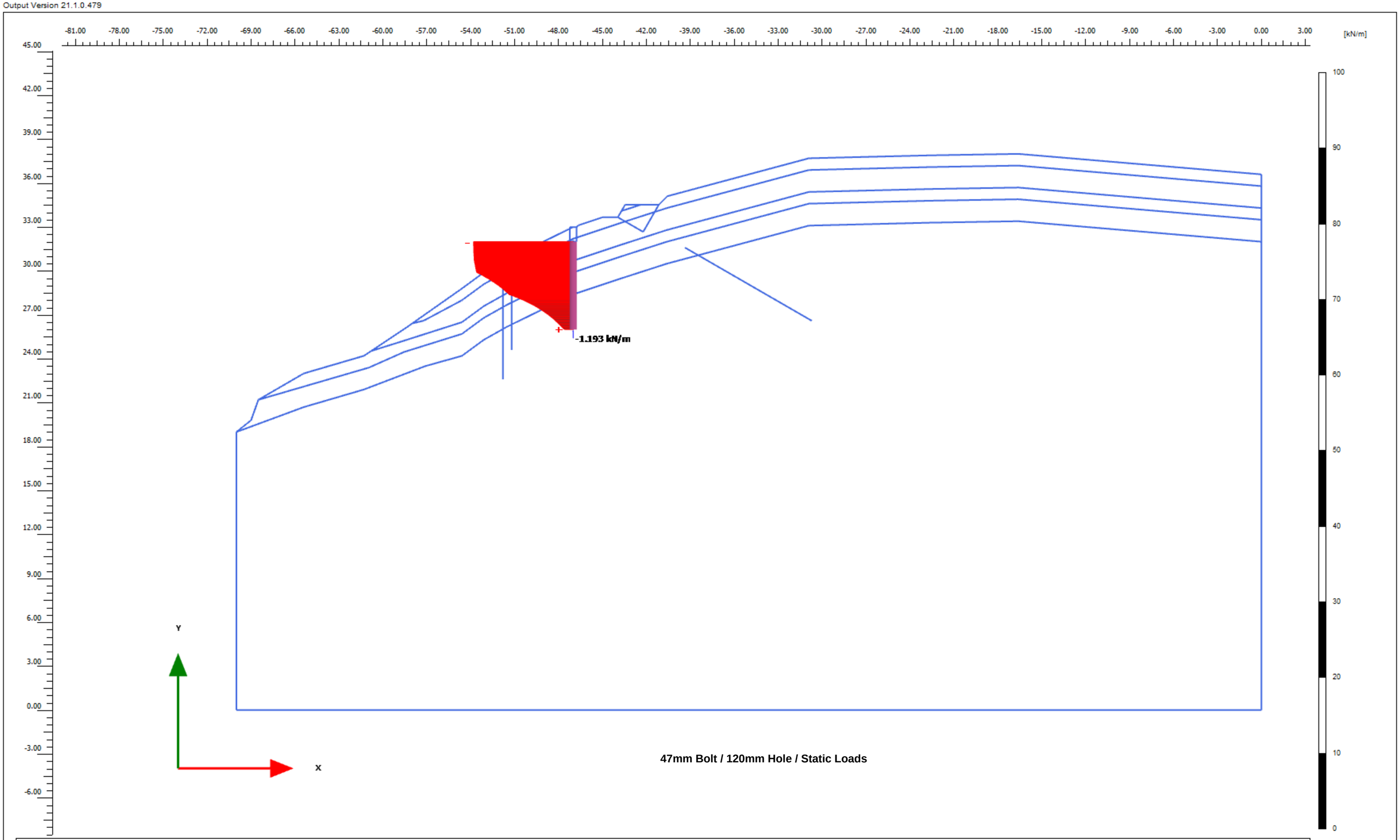


Skin friction T_{skin} (scaled up 0.100 times)

Maximum value = -0.4627 kN/m/m (Element 46 at Node 19215)

Minimum value = -44.28 kN/m/m (Element 32 at Node 19157)

Project description		Date
Marion Costal Walkway Upgrade		18/03/2022
Project filename	Step	Company
Grey Gully N, B01, Lon, Est_RevA	266	CMW Geosciences Pty Ltd

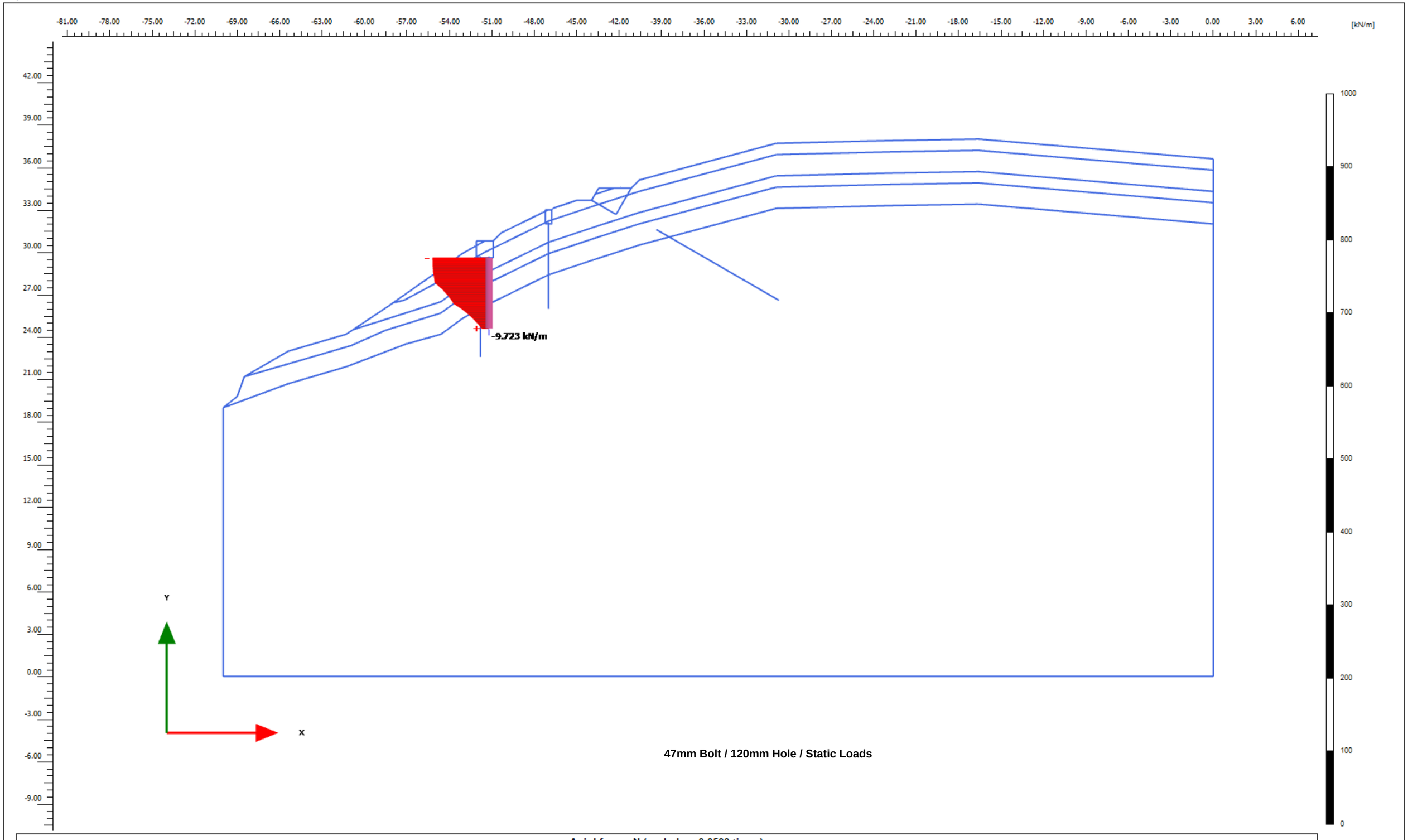


Axial forces N (scaled up 0.500 times)

Maximum value = -1.195 kN/m (Element 29 at Node 19148)

Minimum value = -13.60 kN/m (Element 2 at Node 19038)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 266	Company: CMW Geosciences Pty Ltd	

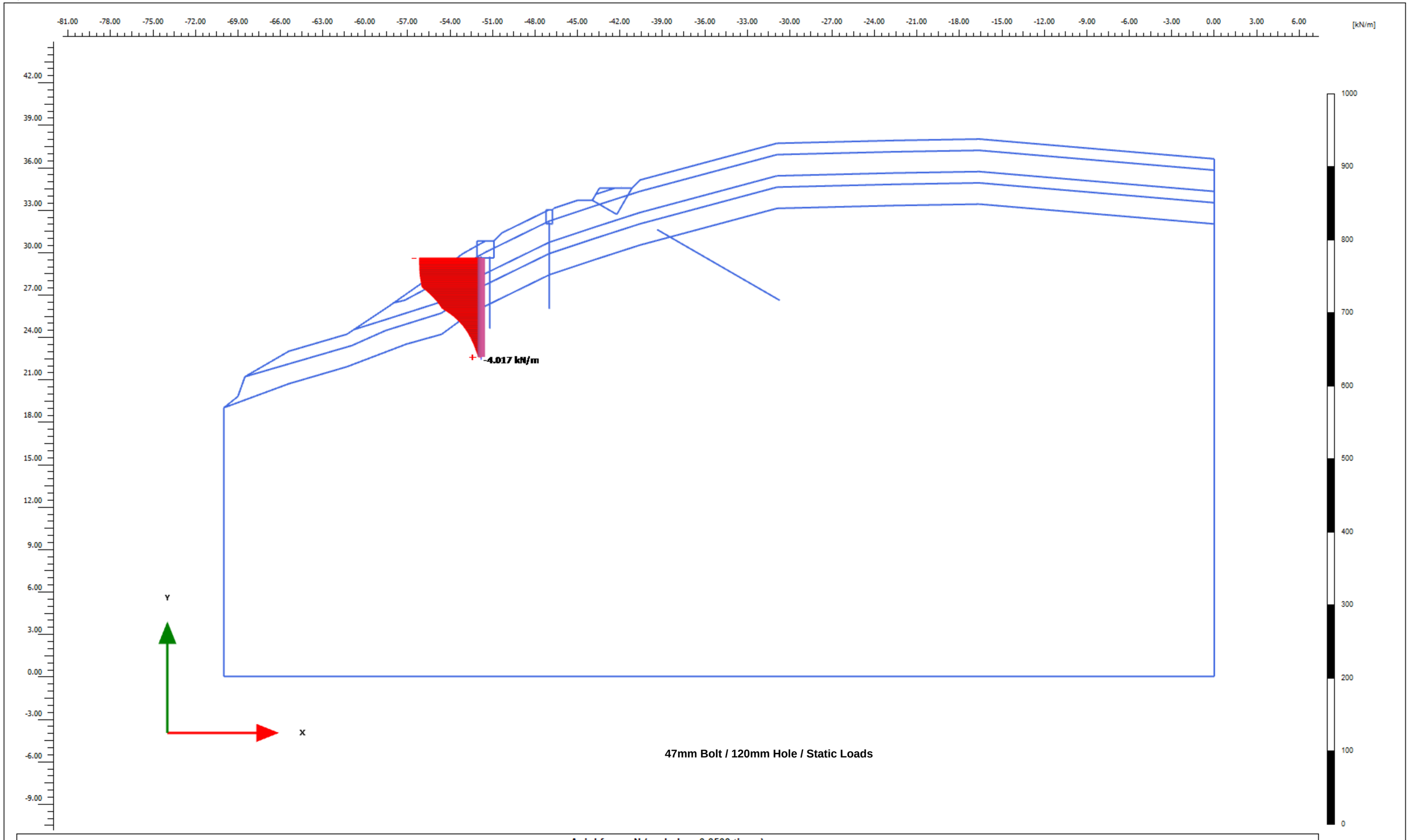


Axial forces N (scaled up 0.0500 times)

Maximum value = -9.741 kN/m (Element 75 at Node 19337)

Minimum value = -79.48 kN/m (Element 65 at Node 19292)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 266	Company: CMW Geosciences Pty Ltd	

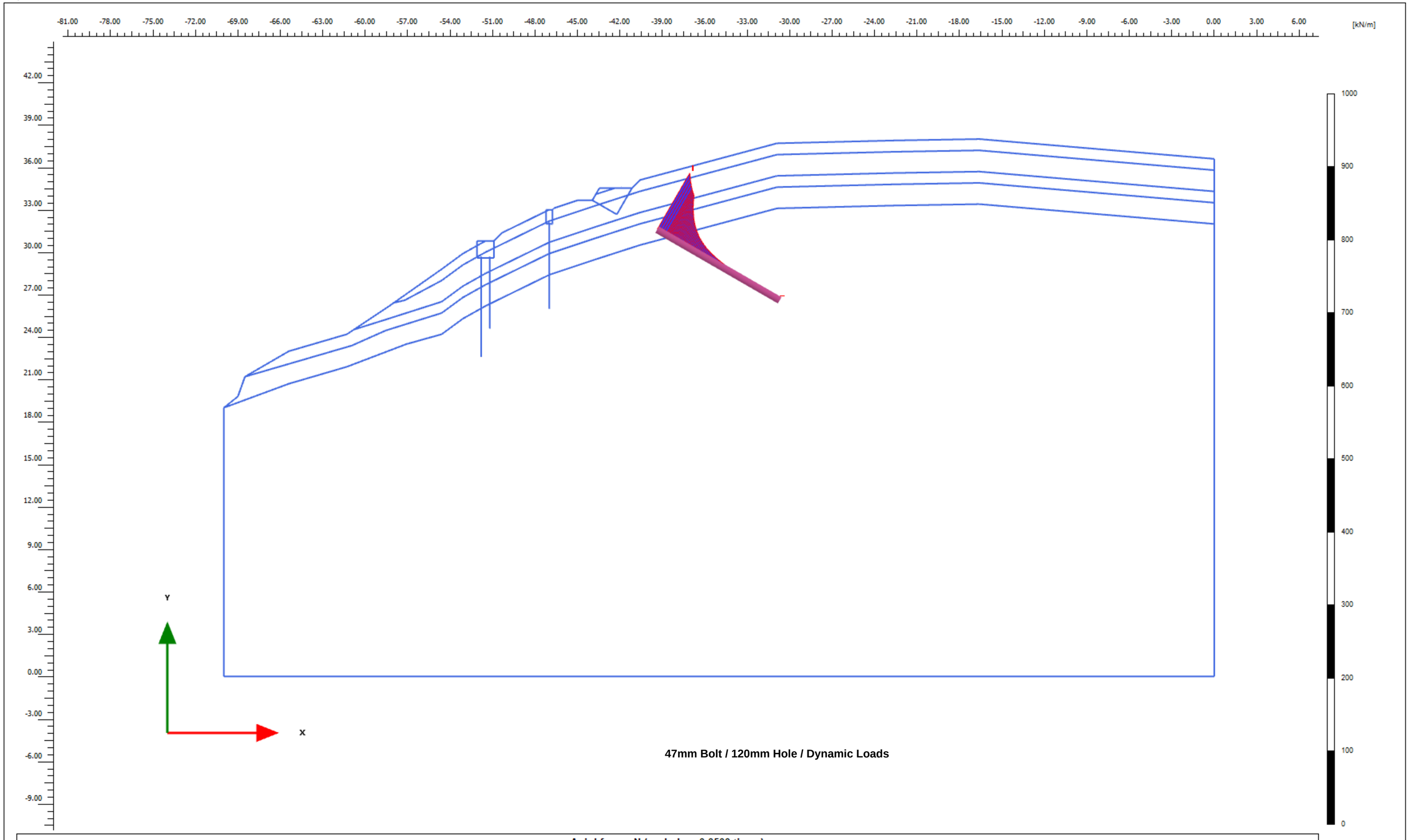


Axial forces N (scaled up 0.0500 times)

Maximum value = -4.023 kN/m (Element 63 at Node 19287)

Minimum value = -87.44 kN/m (Element 49 at Node 19226)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 266	Company: CMW Geosciences Pty Ltd	

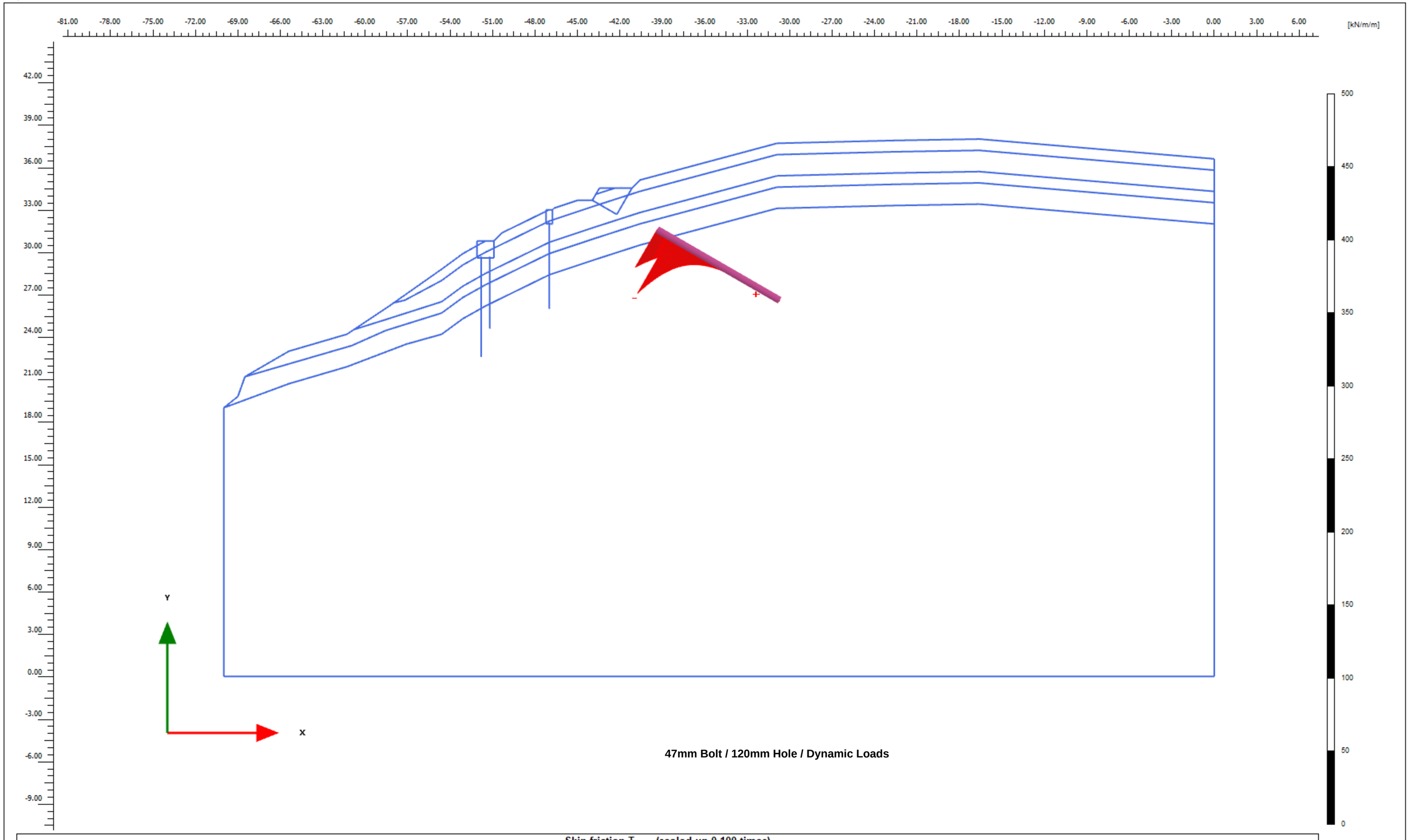


Axial forces N (scaled up 0.0500 times)

Maximum value = 92.36 kN/m (Element 30 at Node 19149)

Minimum value = $1.531*10^{-3}$ kN/m (Element 47 at Node 19221)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 316	Company: CMW Geosciences Pty Ltd	

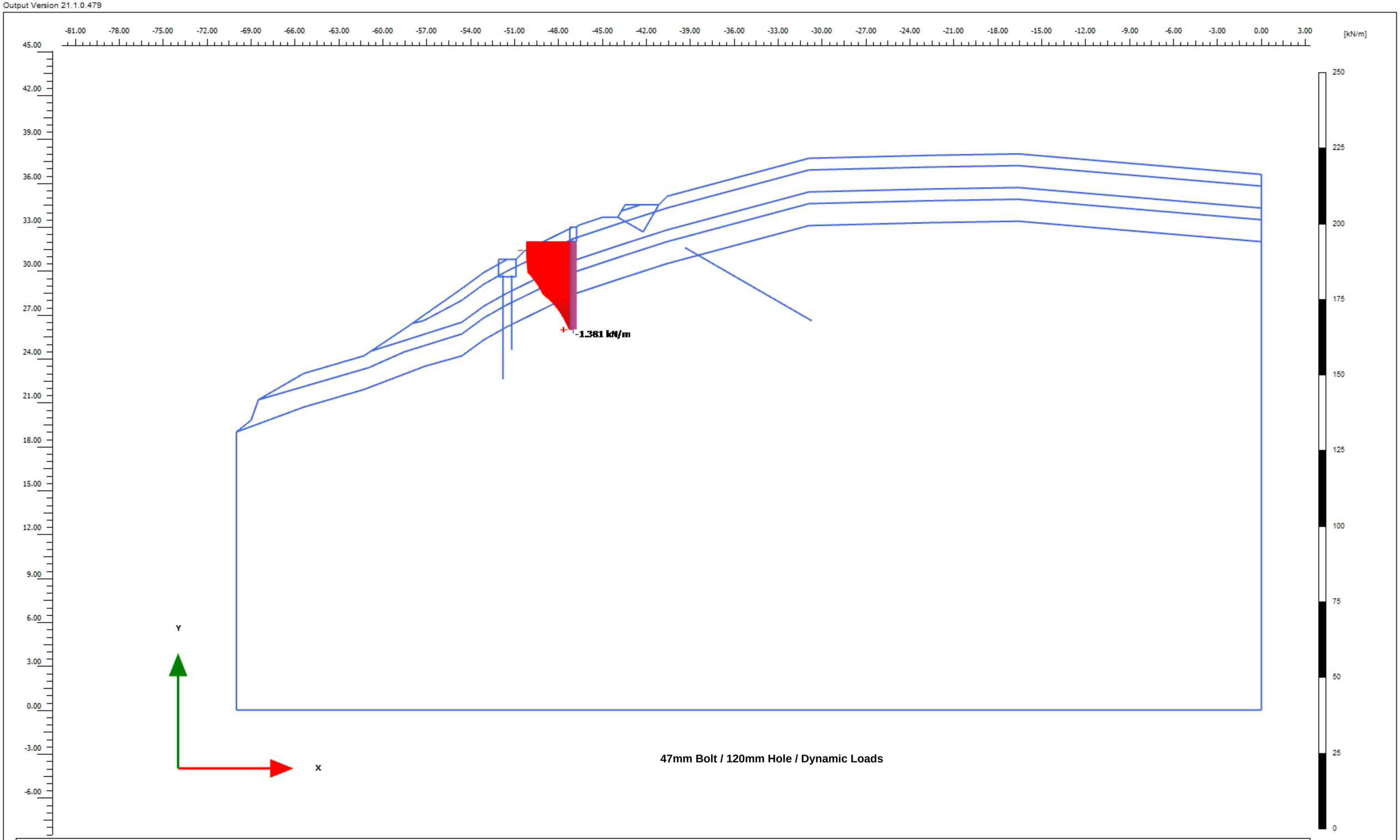


Skin friction T_{skin} (scaled up 0.100 times)

Maximum value = -0.6015 kN/m/m (Element 45 at Node 19212)

Minimum value = -46.00 kN/m/m (Element 32 at Node 19157)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 316	Company: CMW Geosciences Pty Ltd	

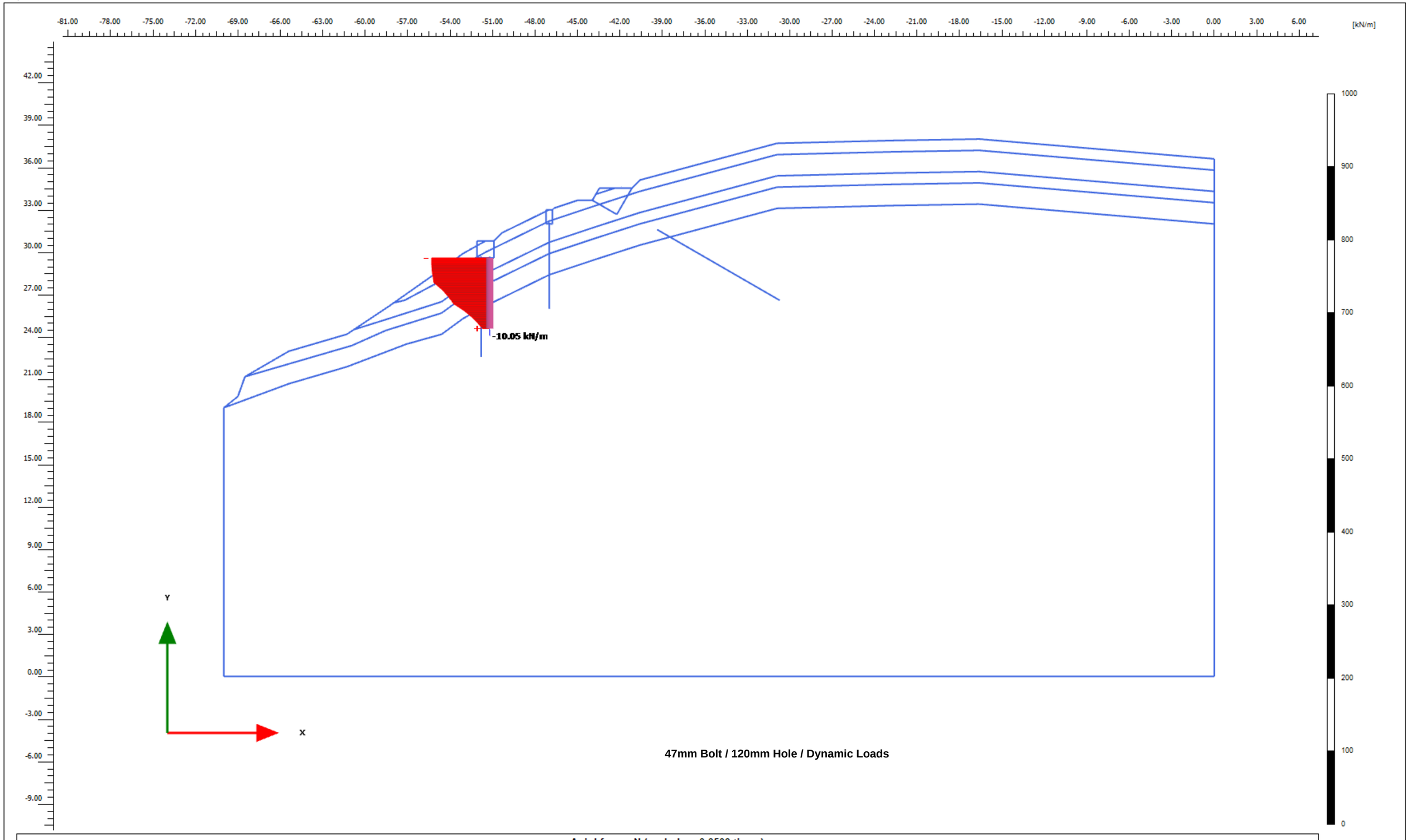


Axial forces N (scaled up 0.200 times)

Maximum value = -1.383 kN/m (Element 29 at Node 19148)

Minimum value = -15.92 kN/m (Element 5 at Node 19050)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 316	Company: CMW Geosciences Pty Ltd	

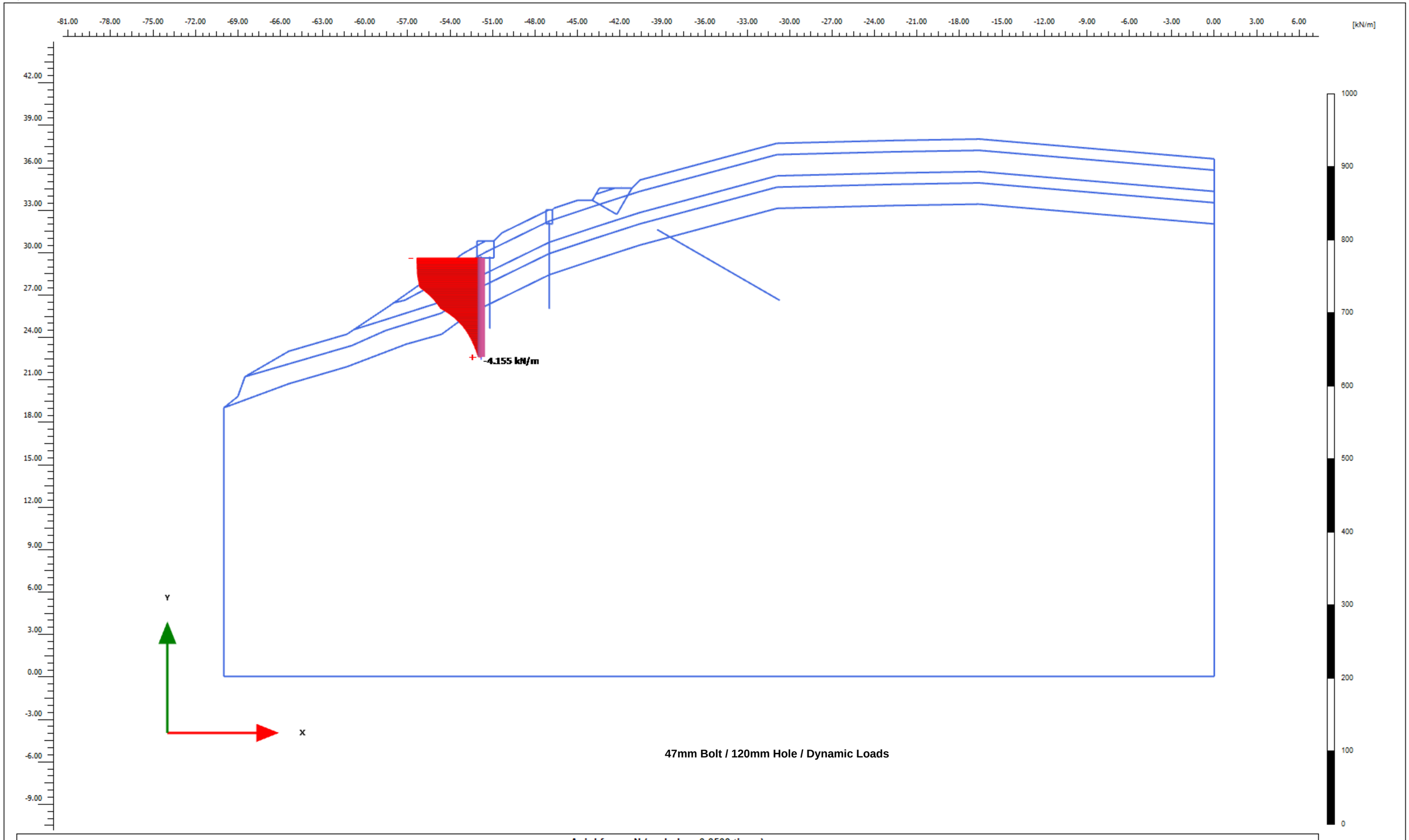


Axial forces N (scaled up 0.0500 times)

Maximum value = -10.07 kN/m (Element 75 at Node 19337)

Minimum value = -82.17 kN/m (Element 65 at Node 19292)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 316	Company: CMW Geosciences Pty Ltd	

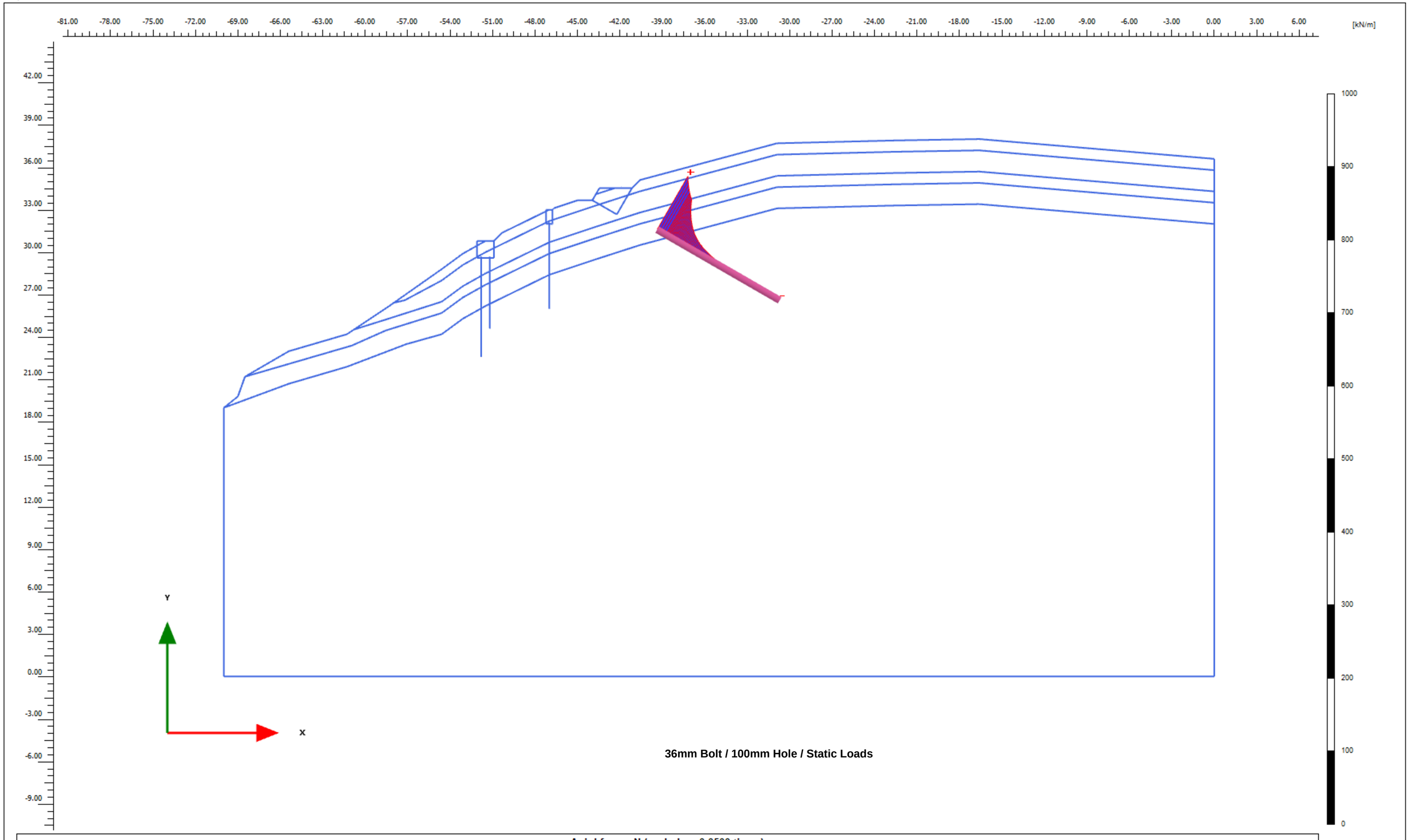


Axial forces N (scaled up 0.0500 times)

Maximum value = -4.161 kN/m (Element 63 at Node 19287)

Minimum value = -91.01 kN/m (Element 49 at Node 19226)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 316	Company: CMW Geosciences Pty Ltd	



Axial forces N (scaled up 0.0500 times)

Maximum value = 87.03 kN/m (Element 30 at Node 19149)

Minimum value = $0.7445*10^{-3}$ kN/m (Element 47 at Node 19221)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 789	Company: CMW Geosciences Pty Ltd	

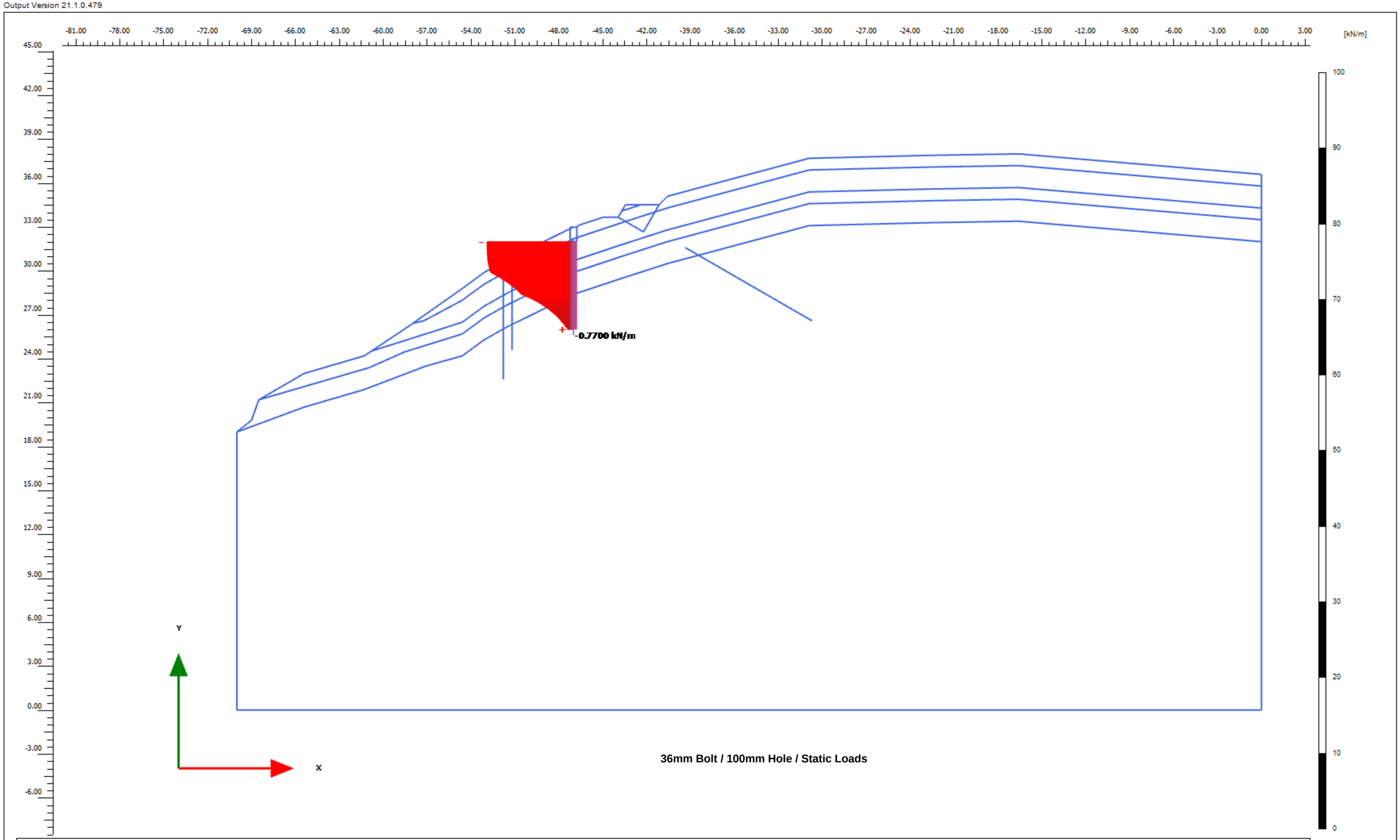


Skin friction T_{skin} (scaled up 0.100 times)

Maximum value = -0.2807 kN/m/m (Element 46 at Node 19214)

Minimum value = -46.84 kN/m/m (Element 32 at Node 19157)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 789	Company: CMW Geosciences Pty Ltd	

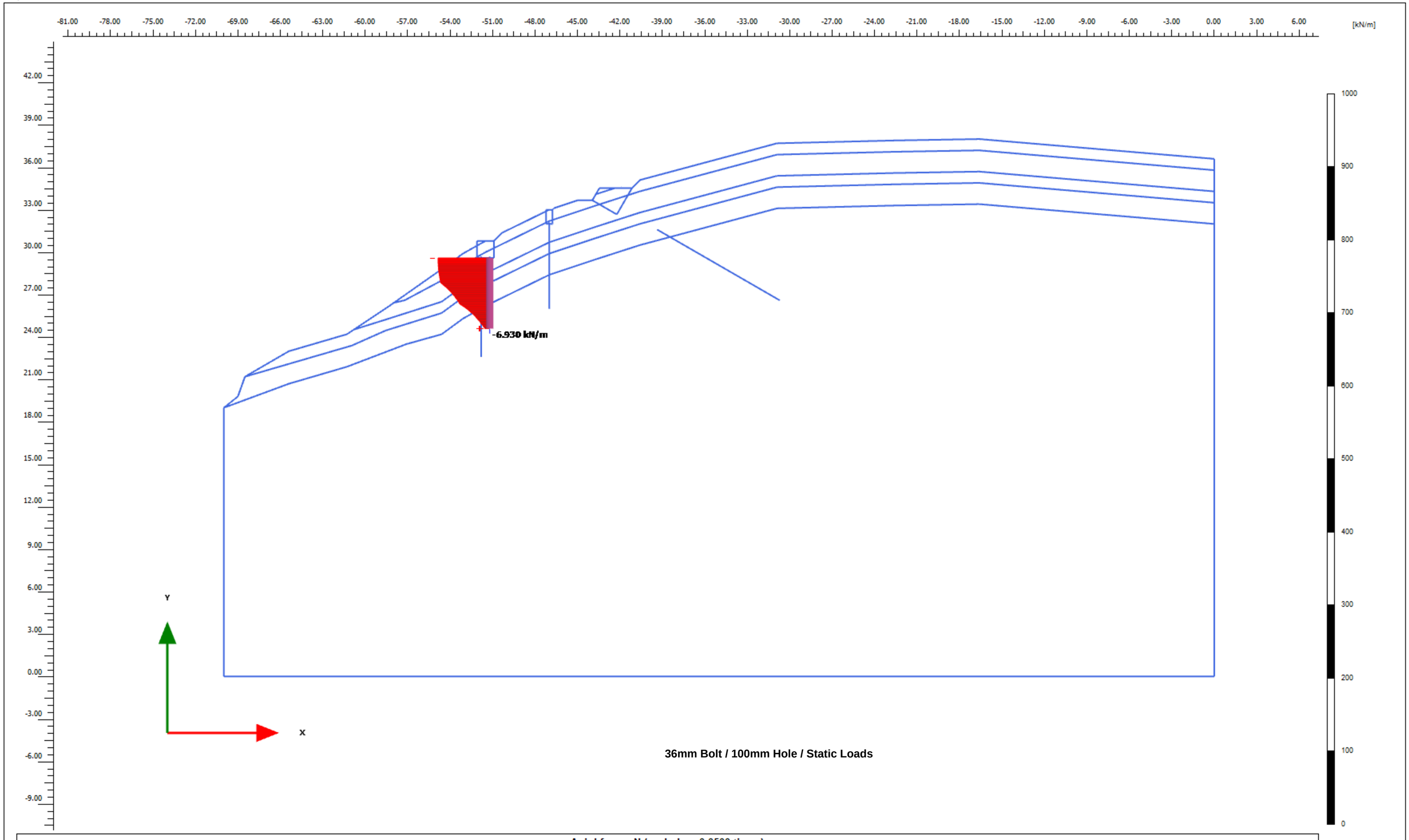


Axial forces N (scaled up 0.500 times)

Maximum value = -0.7722 kN/m (Element 29 at Node 19148)

Minimum value = -11.83 kN/m (Element 2 at Node 19035)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 789	Company: CMW Geosciences Pty Ltd	

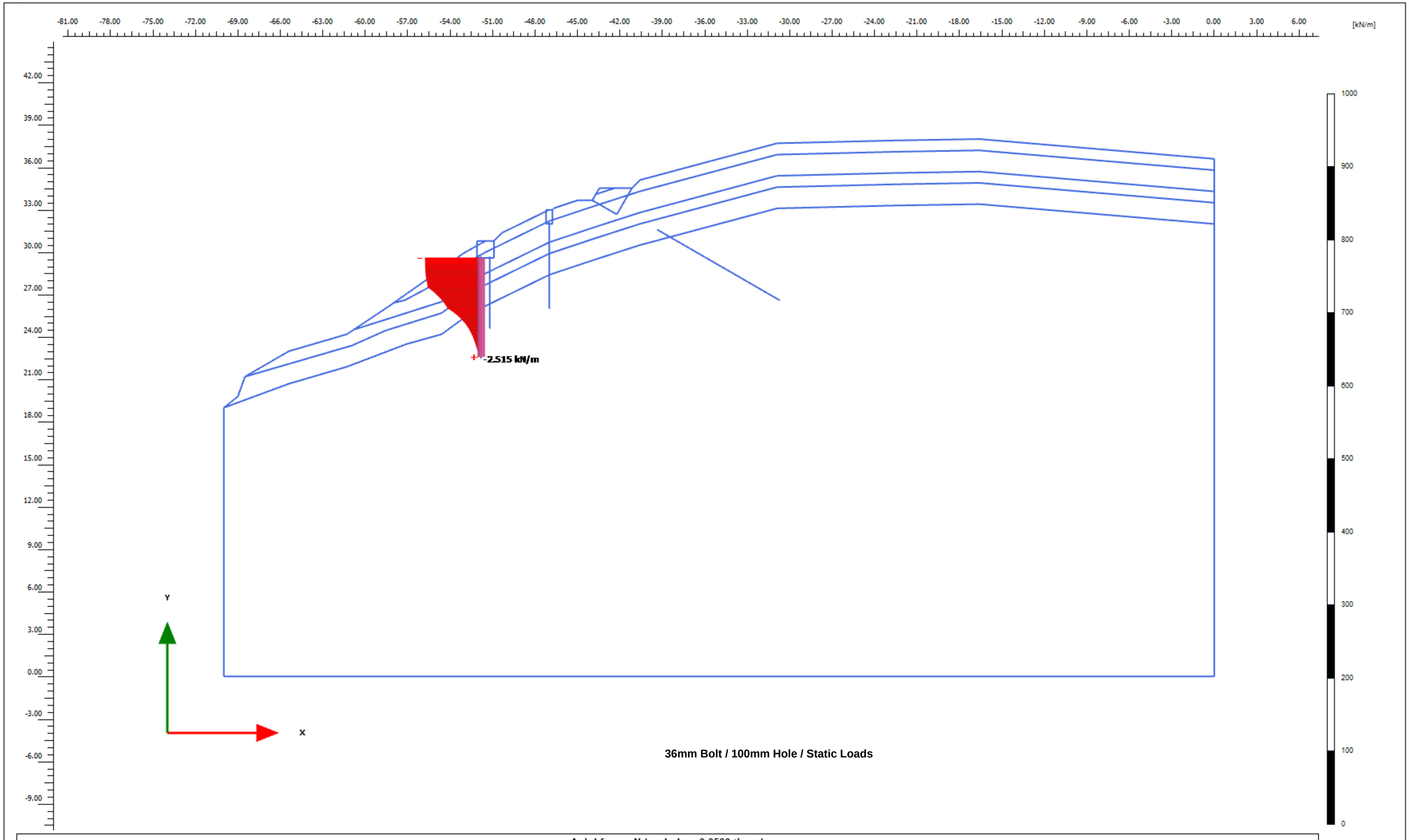


Axial forces N (scaled up 0.0500 times)

Maximum value = -6.951 kN/m (Element 75 at Node 19337)

Minimum value = -73.08 kN/m (Element 65 at Node 19292)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 789	Company: CMW Geosciences Pty Ltd	

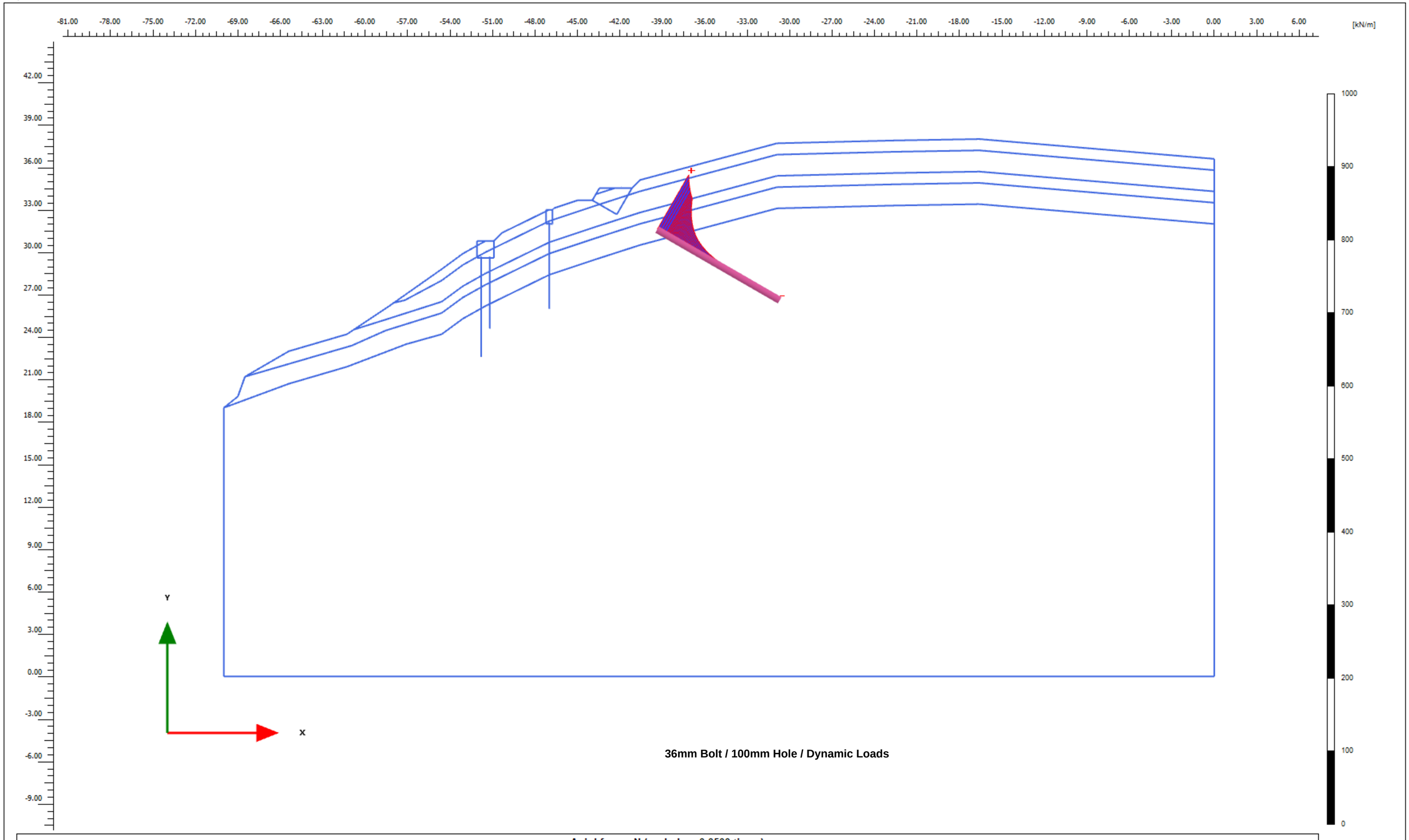


Axial forces N (scaled up 0.0500 times)

Maximum value = -2.521 kN/m (Element 63 at Node 19287)

Minimum value = -79.08 kN/m (Element 49 at Node 19226)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 789	Company: CMW Geosciences Pty Ltd	

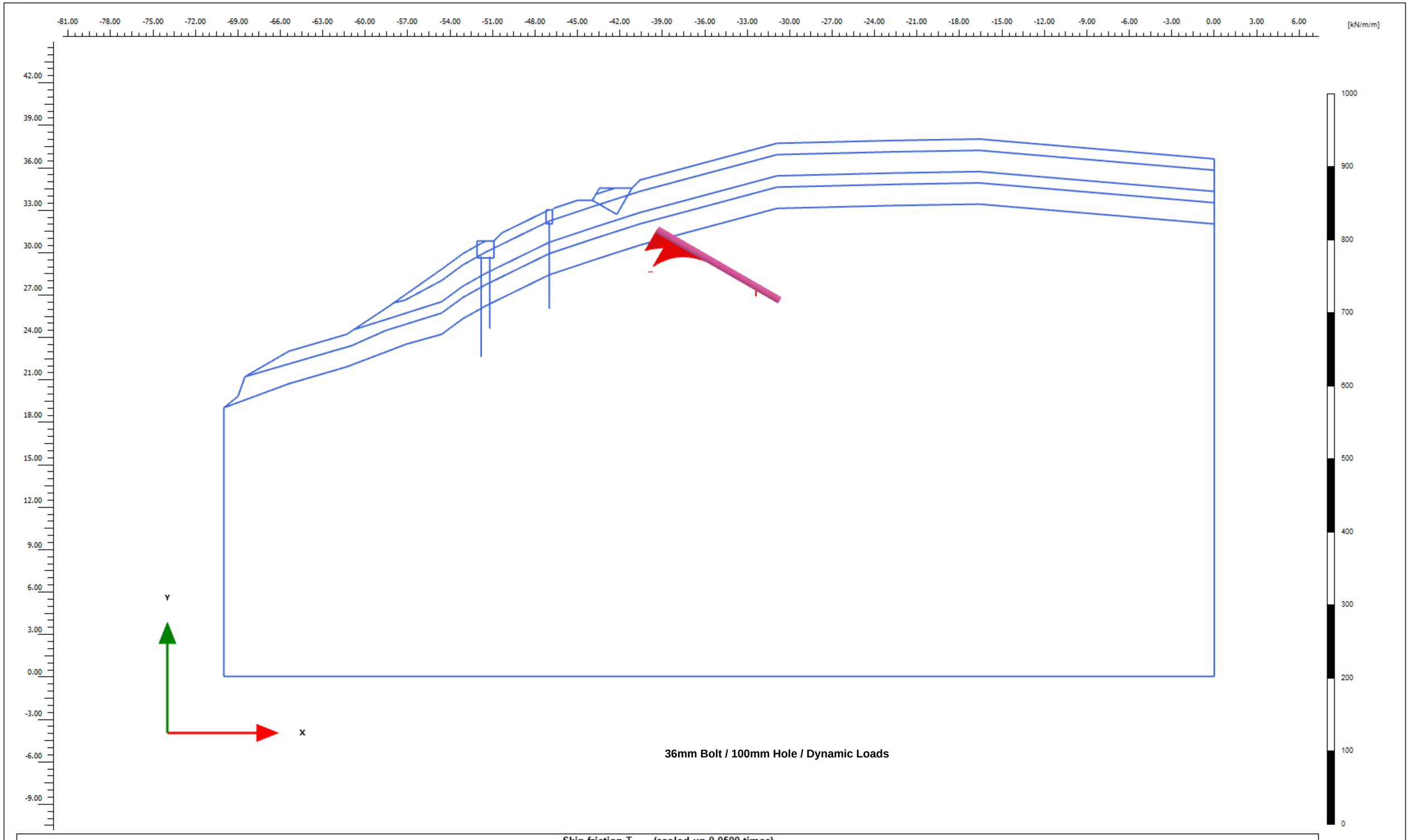


Axial forces N (scaled up 0.0500 times)

Maximum value = 89.44 kN/m (Element 30 at Node 19149)

Minimum value = $1.301*10^{-3}$ kN/m (Element 47 at Node 19221)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 1053	Company: CMW Geosciences Pty Ltd	

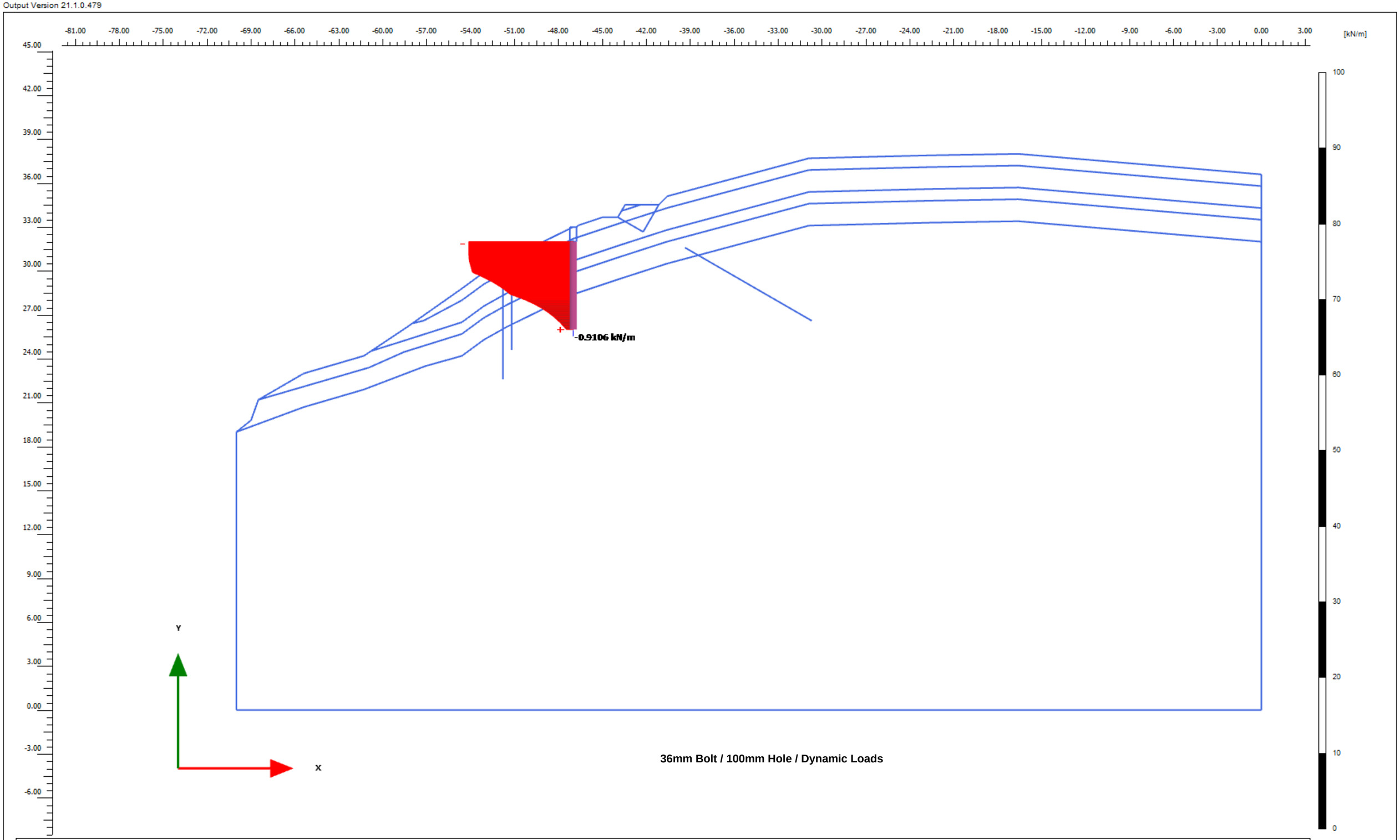


Skin friction T_{skin} (scaled up 0.0500 times)

Maximum value = -0.3651 kN/m/m (Element 45 at Node 19212)

Minimum value = -48.05 kN/m/m (Element 32 at Node 19157)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 1053	Company: CMW Geosciences Pty Ltd	

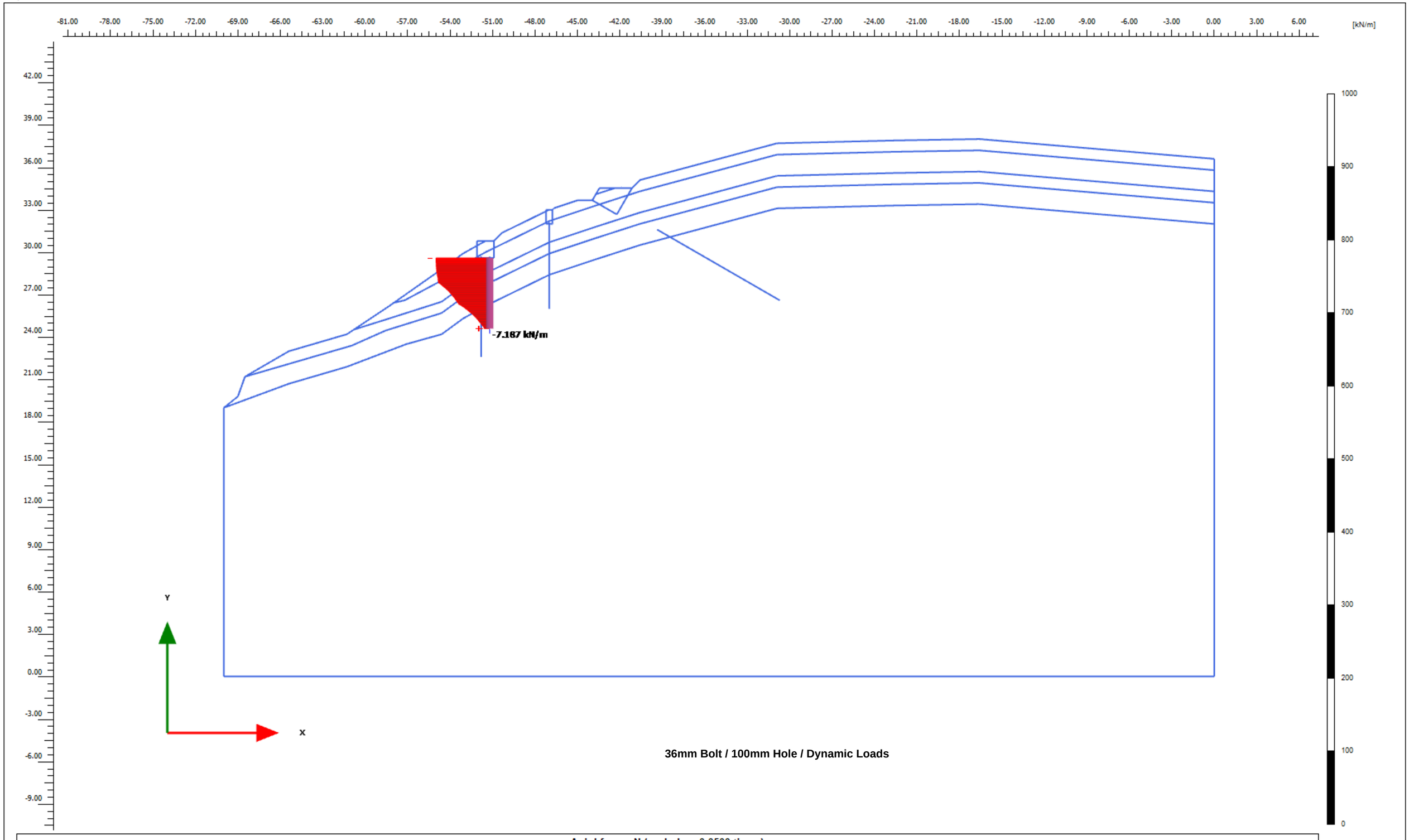


Axial forces N (scaled up 0.500 times)

Maximum value = -0.9133 kN/m (Element 29 at Node 19148)

Minimum value = -14.26 kN/m (Element 2 at Node 19039)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 1053	Company: CMW Geosciences Pty Ltd	

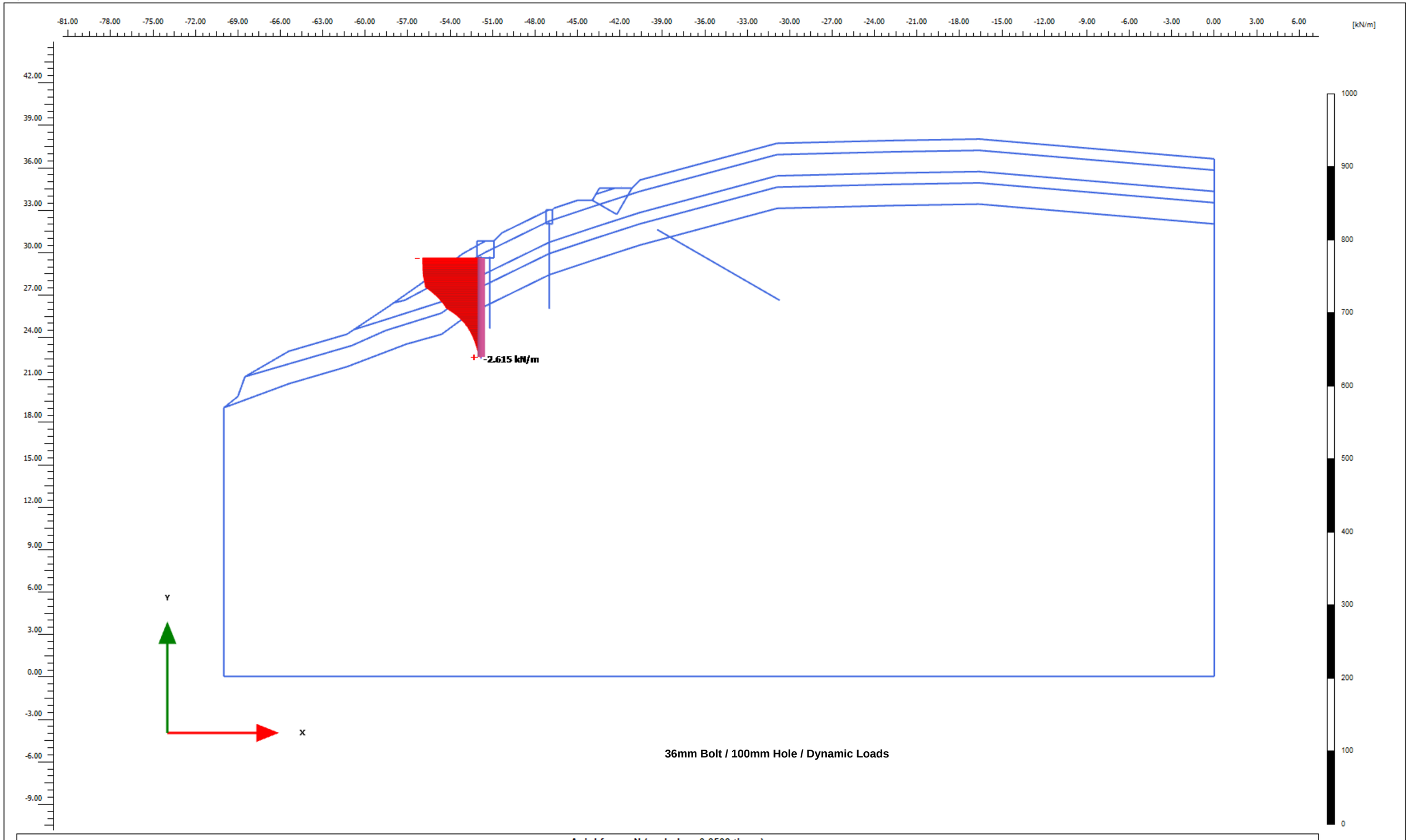


Axial forces N (scaled up 0.0500 times)

Maximum value = -7.209 kN/m (Element 75 at Node 19337)

Minimum value = -75.87 kN/m (Element 65 at Node 19292)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 1053	Company: CMW Geosciences Pty Ltd	



Axial forces N (scaled up 0.0500 times)

Maximum value = -2.621 kN/m (Element 63 at Node 19287)

Minimum value = -82.89 kN/m (Element 49 at Node 19226)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully N, B01, Lon, Est_RevA	Step: 1053	Company: CMW Geosciences Pty Ltd	

-160.00 -140.00 -120.00 -100.00 -80.00 -60.00

Project Name: Coastal Trail Design
Description: Model Layout
Date: 18/03/2022

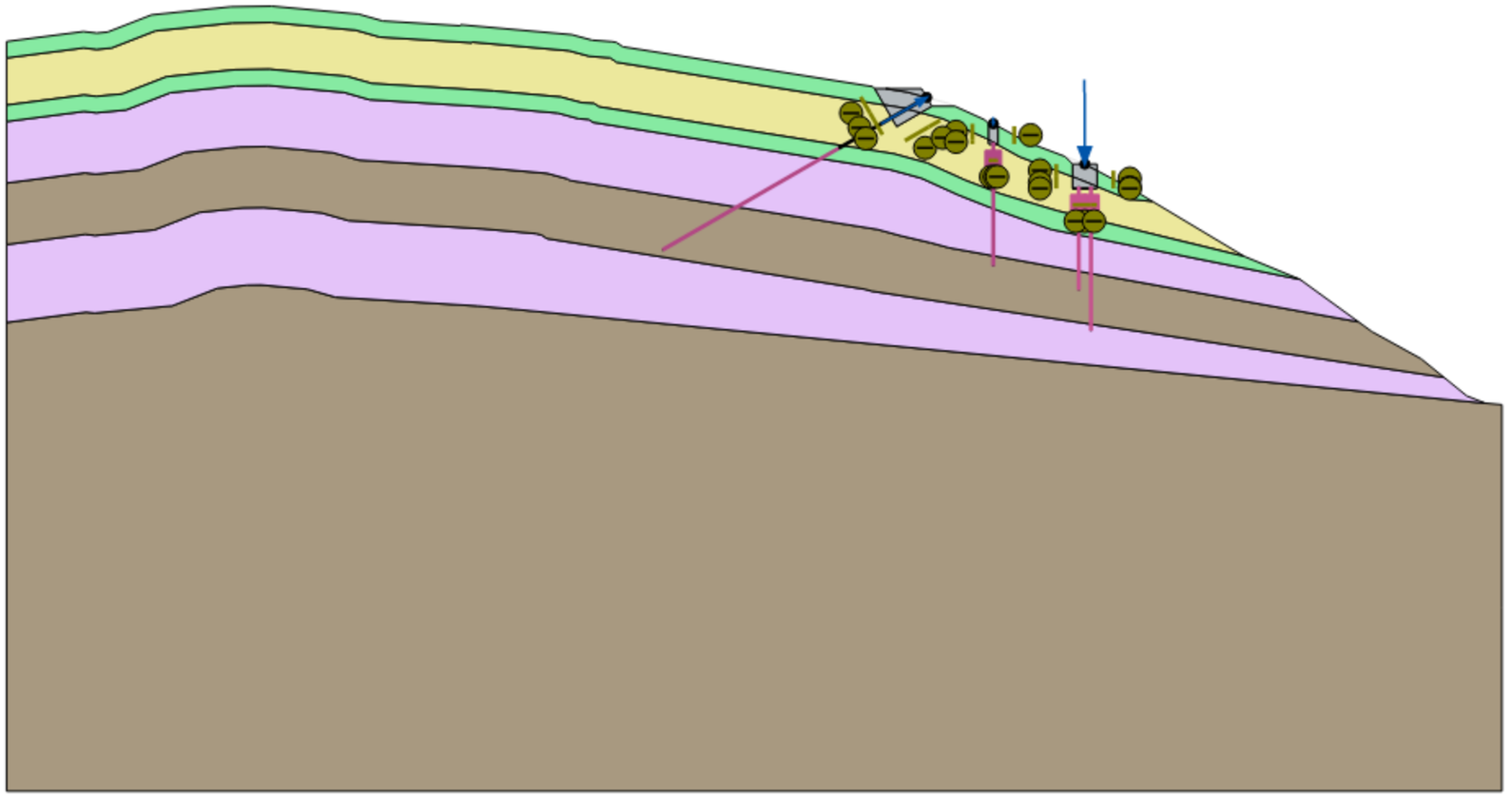
Drawn by: YW
Checked by: JVS

Grey Gully South, Bridge 01

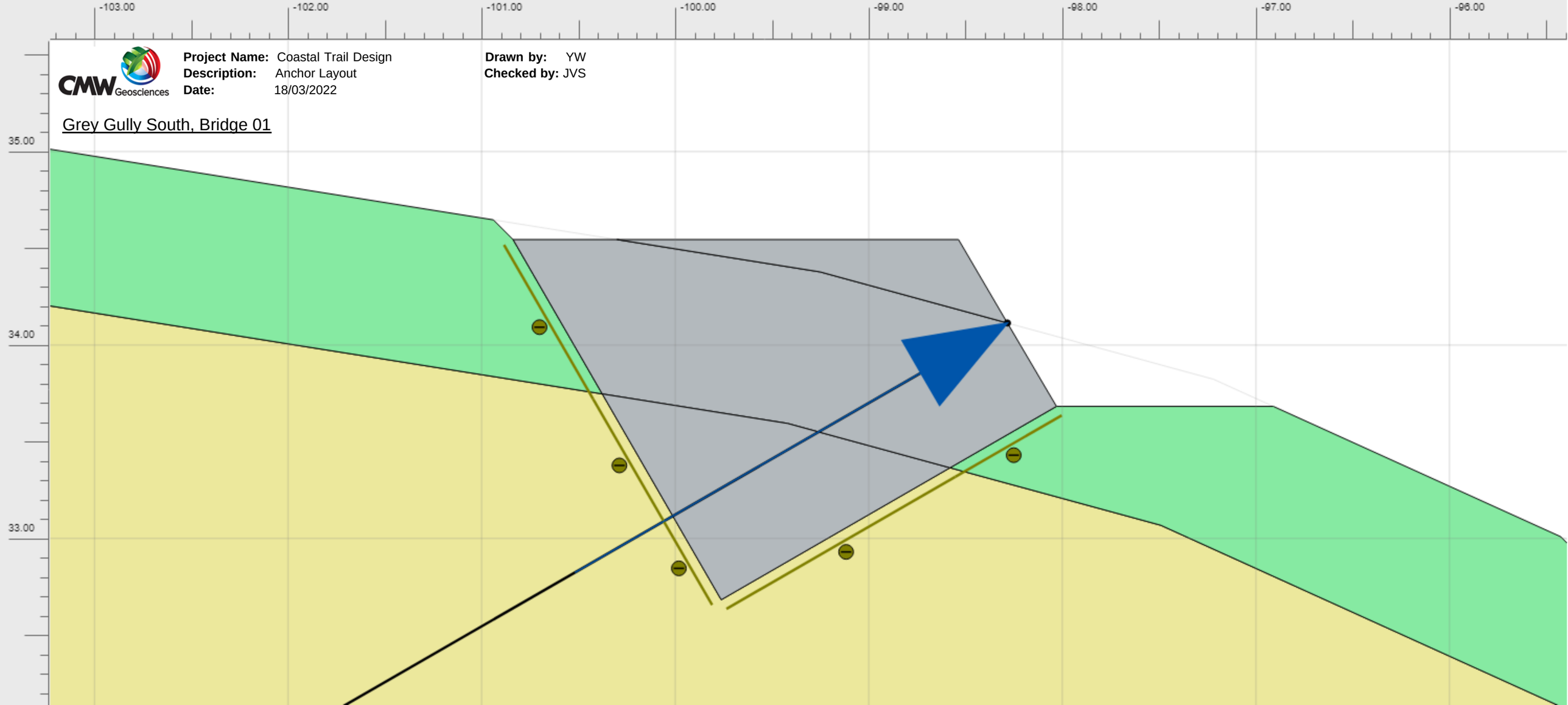
- Anchor Block
- Unit 1: Clay
- Unit 2: Res
- Unit 3: VLS
- Unit 4: LS
- Unit 5: MS

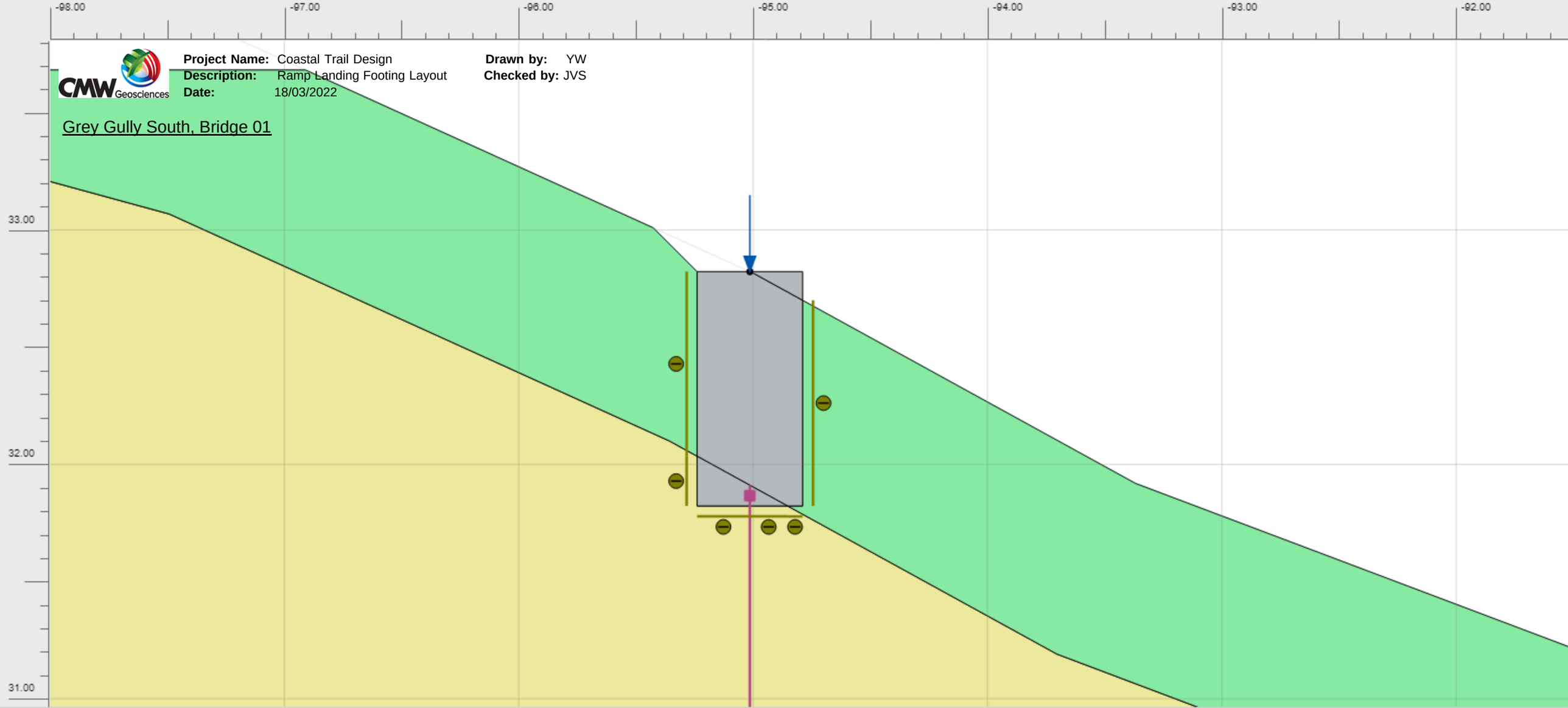
- Grout Anchor (100mm)
- Grout Anchor (120mm)
- Micro Pile (Landing, 100mm)
- Micro Pile (Portal, 100mm, 5m)
- Micro Pile (Portal, 100mm, 7m)
- Micro Pile (Portal, 120mm, 5m)
- Micro Pile (Portal, 120mm, 7m)
- Mircro Pile (Landing, 120mm)

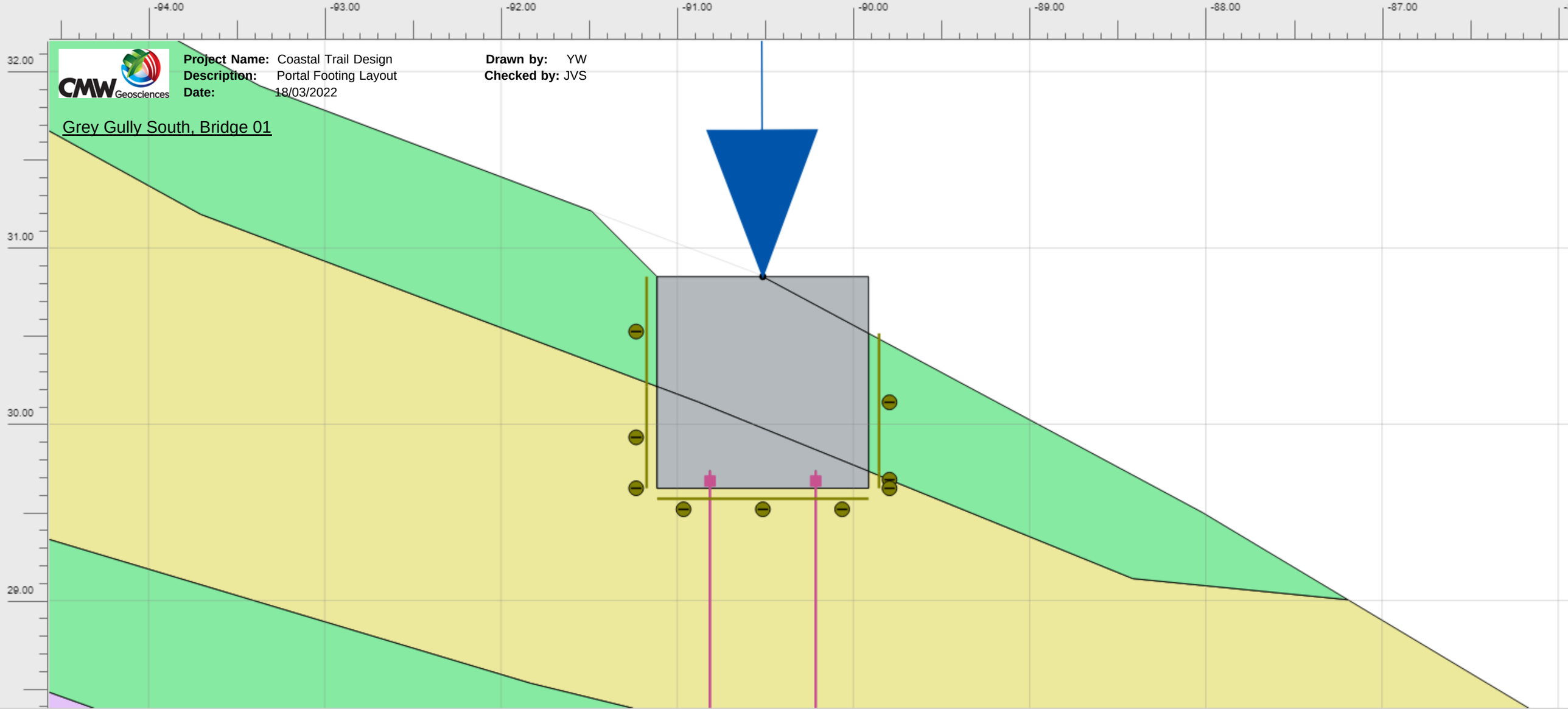
- Node to Node Anchor (36mm)
- Node-to-Node Anchor (26.5mm)
- Node-to-Node Anchor (47mm)

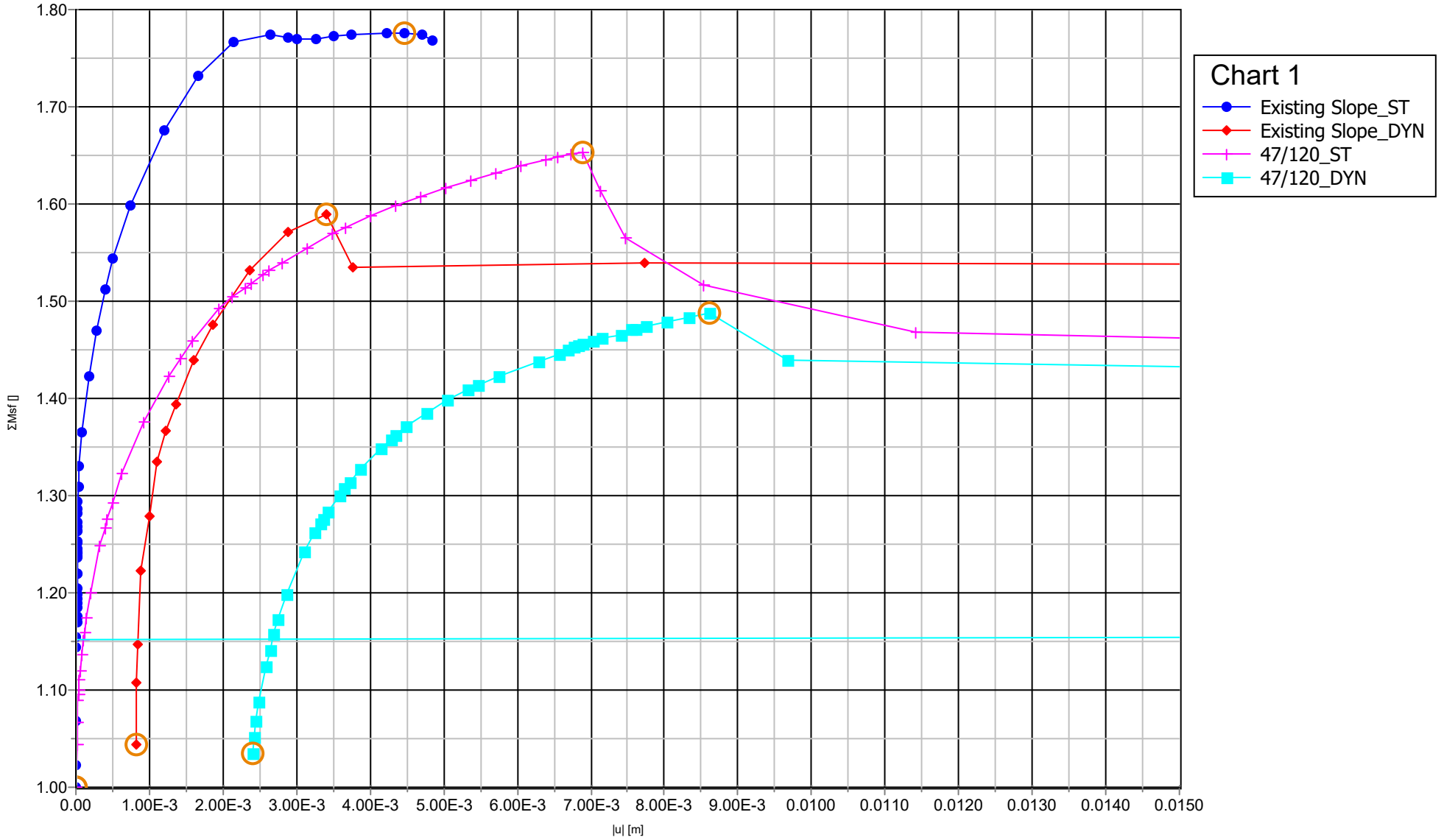


40.00
20.00
0.00

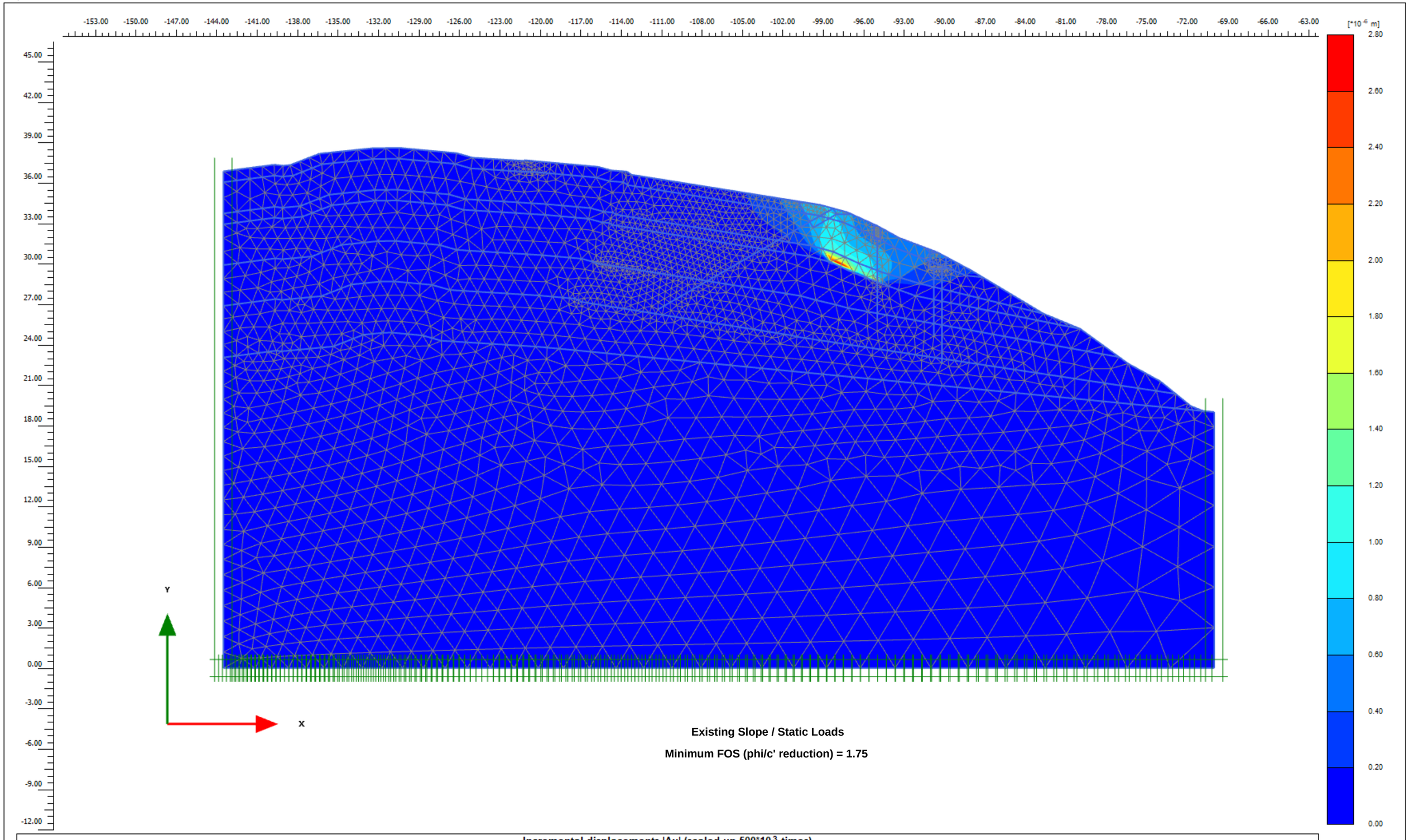

-103.00
-102.00
-101.00
-100.00
-99.00
-98.00
-97.00
-96.00
CMW Geosciences
Project Name: Coastal Trail Design
Description: Anchor Layout
Date: 18/03/2022
Drawn by: YW
Checked by: JVS
Grey Gully South, Bridge 01
35.00
34.00
33.00


-98.00
-97.00
-96.00
-95.00
-94.00
-93.00
-92.00
33.00
32.00
31.00
Project Name: Coastal Trail Design
Description: Ramp Landing Footing Layout
Date: 18/03/2022
Drawn by: YW
Checked by: JVS
Grey Gully South, Bridge 01


-94.00
-93.00
-92.00
-91.00
-90.00
-89.00
-88.00
-87.00
32.00
31.00
30.00
29.00
CMW Geosciences
Project Name: Coastal Trail Design
Description: Portal Footing Layout
Date: 18/03/2022
Drawn by: YW
Checked by: JVS
Grey Gully South, Bridge 01



CMW Geosciences	*Project description* Marion Costal Walkway Upgrade		*Date* 18/03/2022
	Project filename Grey Gully S, B01, Lon, Est_R ...	*Step* 380	*Company* CMW Geosciences Pty Ltd



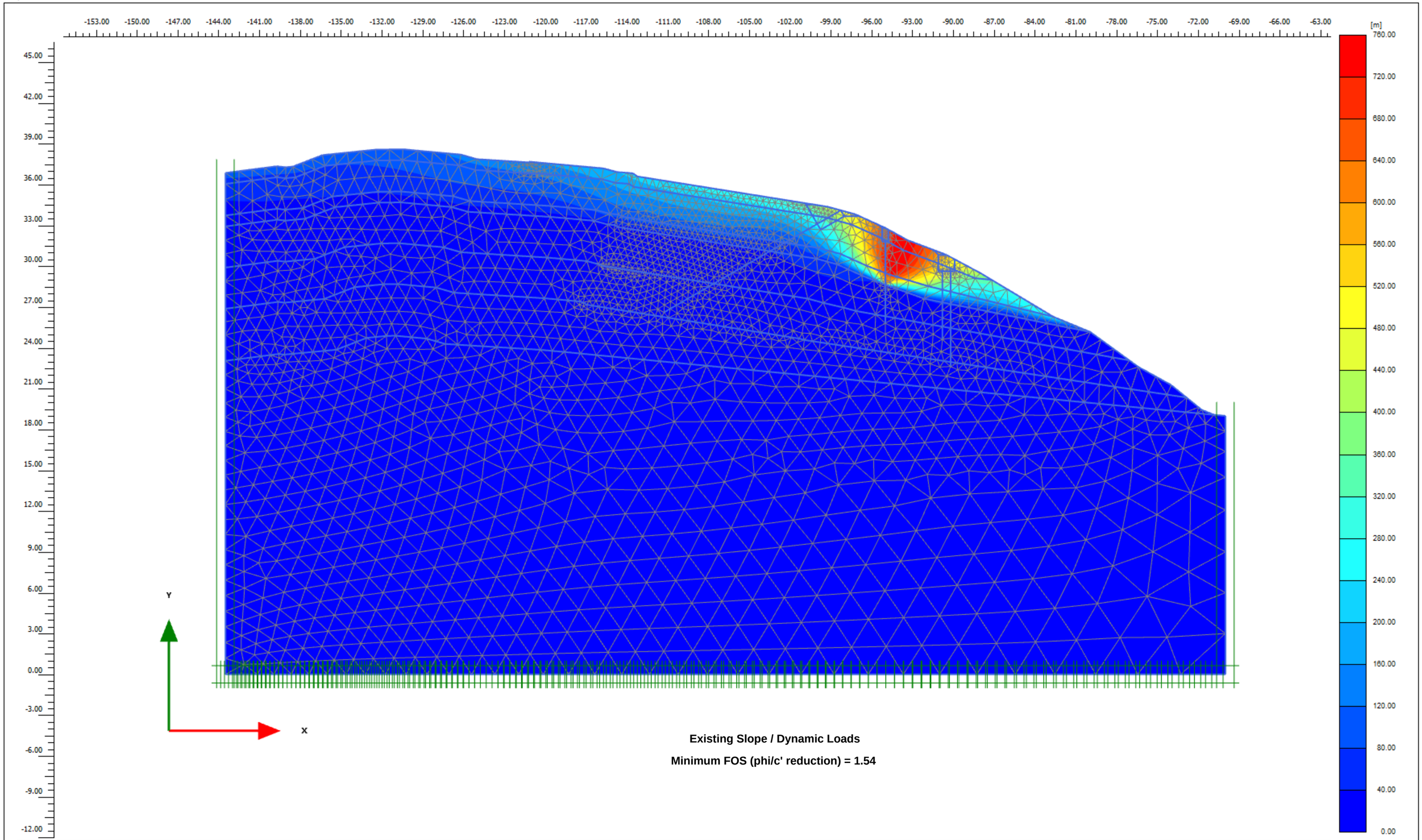
Existing Slope / Static Loads

Minimum FOS (phi/c' reduction) = 1.75

Incremental displacements |Δu| (scaled up 500*10 3 times)

Maximum value = 2.753*10 -6 m (Element 1687 at Node 7843)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully S, B01, Lon, Est_RevA	Step: 280	Company: CMW Geosciences Pty Ltd	



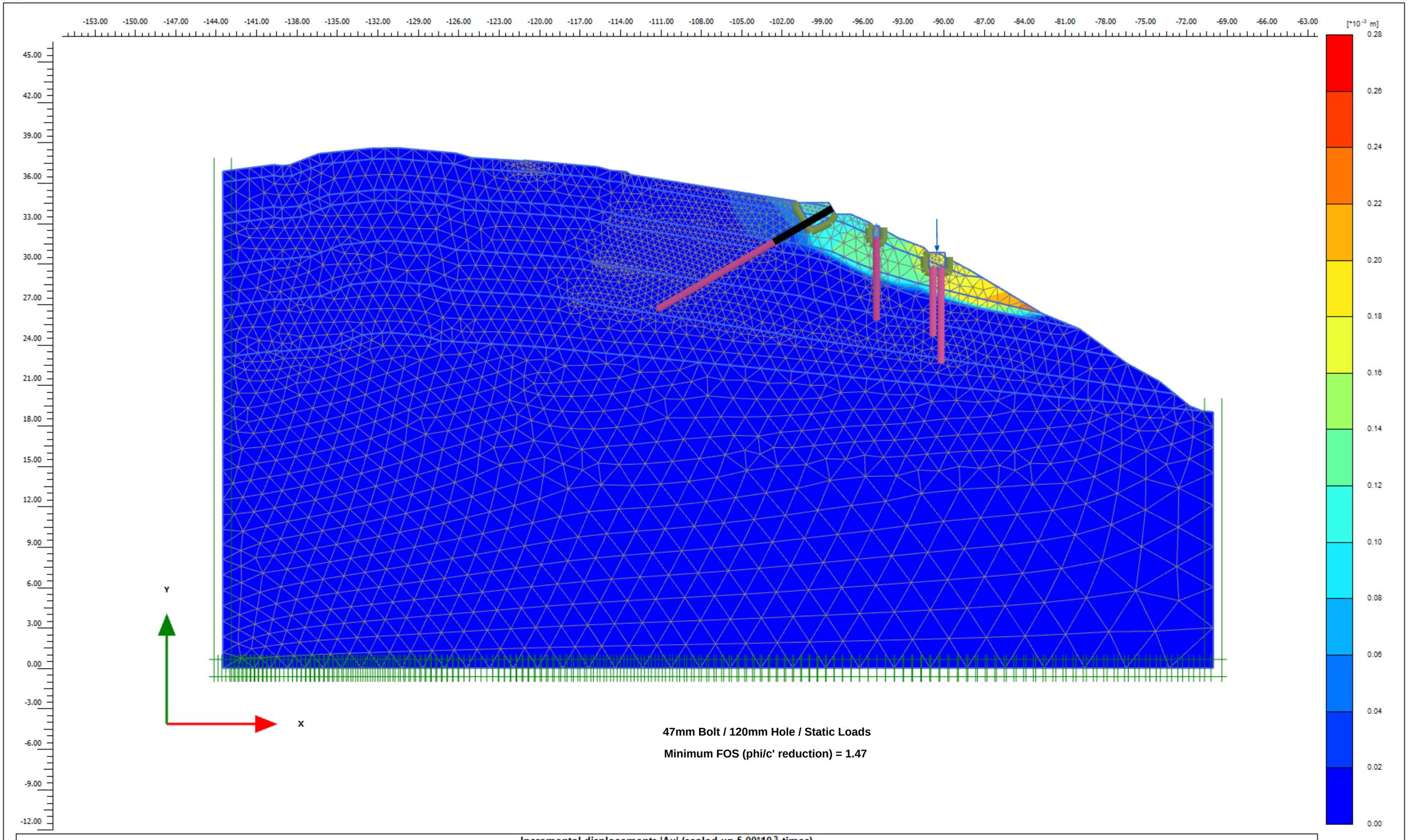
Existing Slope / Dynamic Loads

Minimum FOS (phi/c' reduction) = 1.54

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

Maximum value = 739.2 m (Element 1748 at Node 2938)

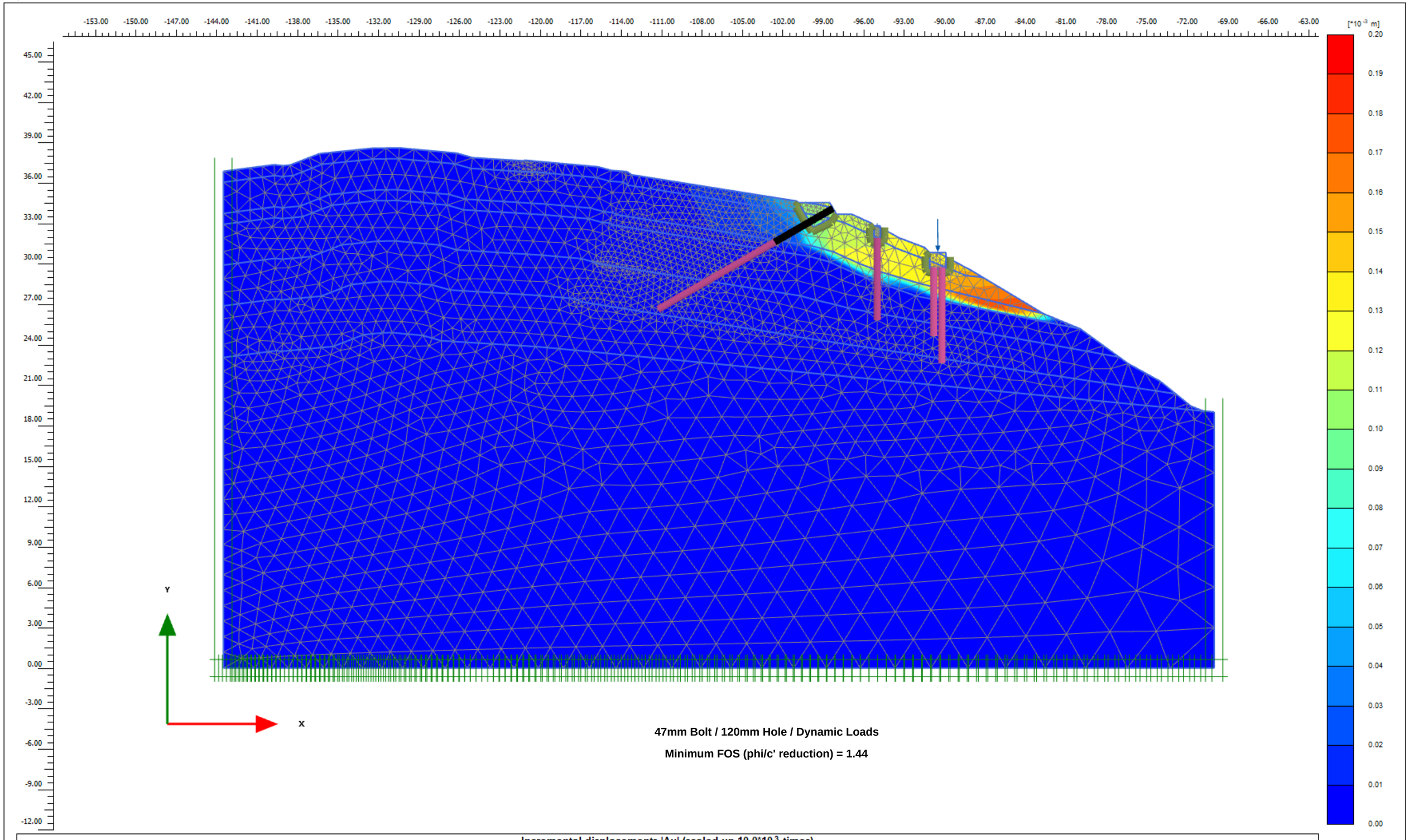
Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully S, B01, Lon, Est_RevA	Step: 300	Company: CMW Geosciences Pty Ltd	



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

Maximum value = $0.2712*10^{-3}$ m (Element 2017 at Node 2408)

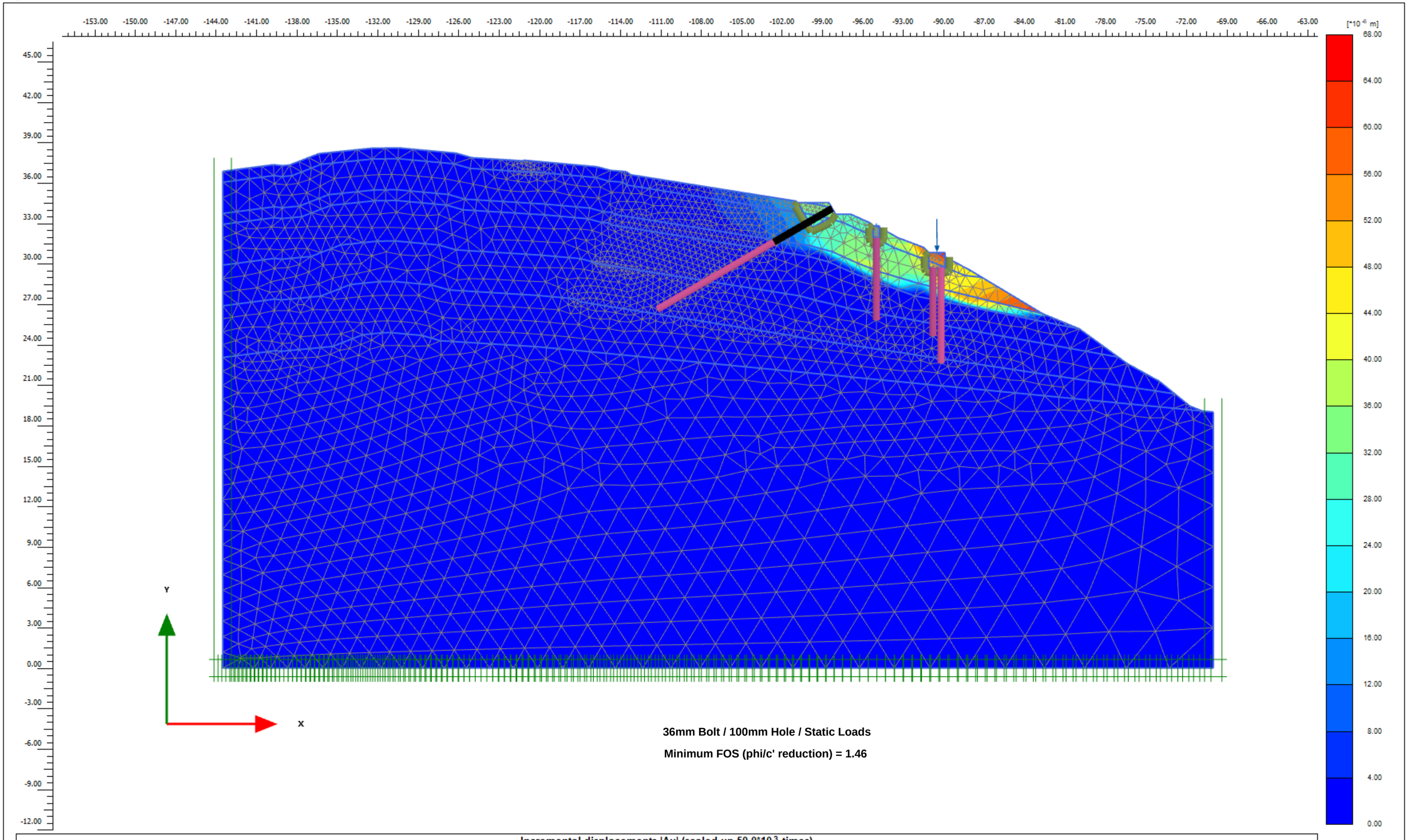
Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully S, B01, Lon, Est_RevA	Step: 320	Company: CMW Geosciences Pty Ltd	



Incremental displacements |Δu| (scaled up $10.0*10^{3}$ times)

Maximum value = $0.1930*10^{-3}$ m (Element 2017 at Node 2408)

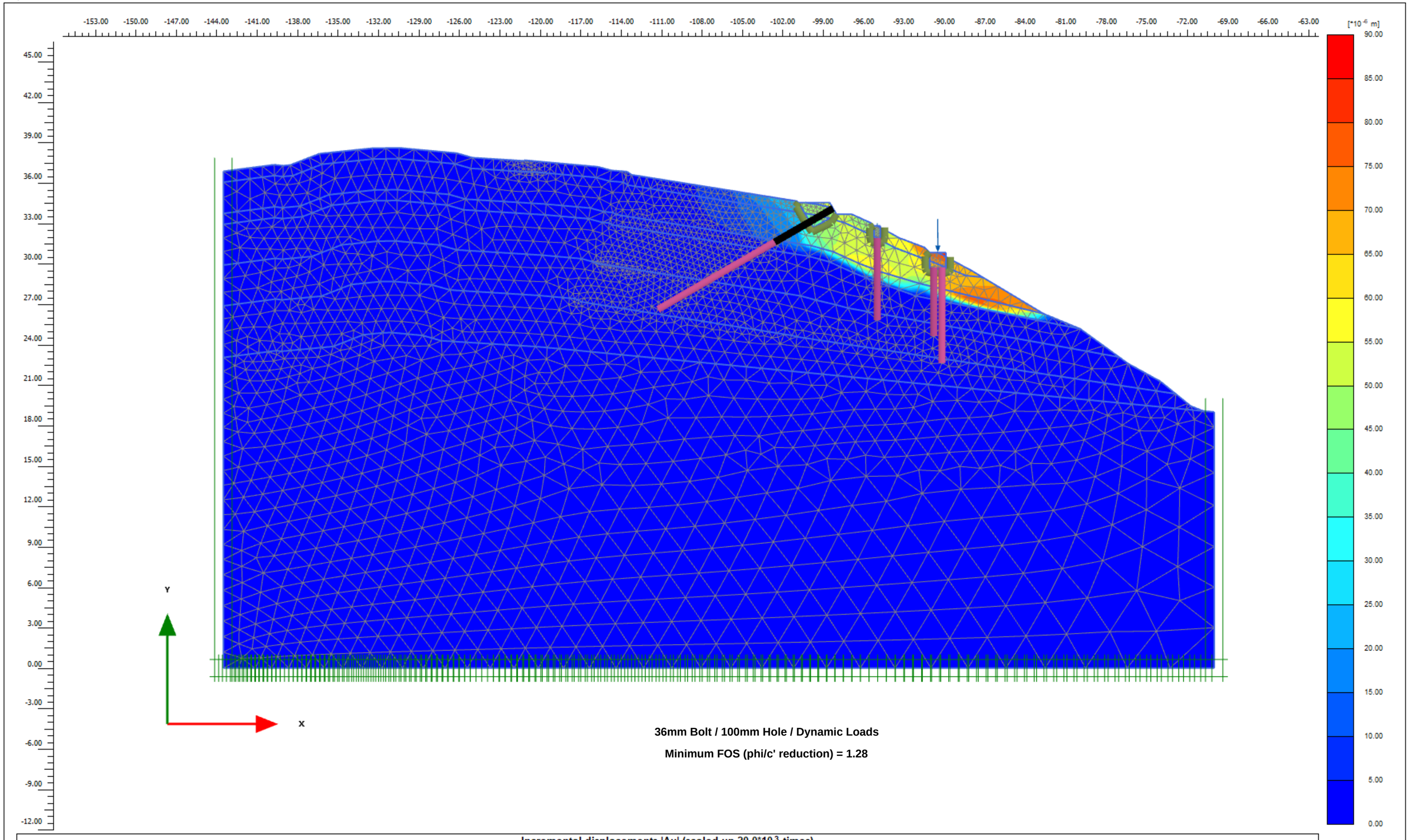
Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully S, B01, Lon, Est_RevA	Step: 340	Company: CMW Geosciences Pty Ltd	



Incremental displacements |Δu| (scaled up $50.0*10^{3}$ times)

Maximum value = $0.06790*10^{-3}$ m (Element 2017 at Node 2408)

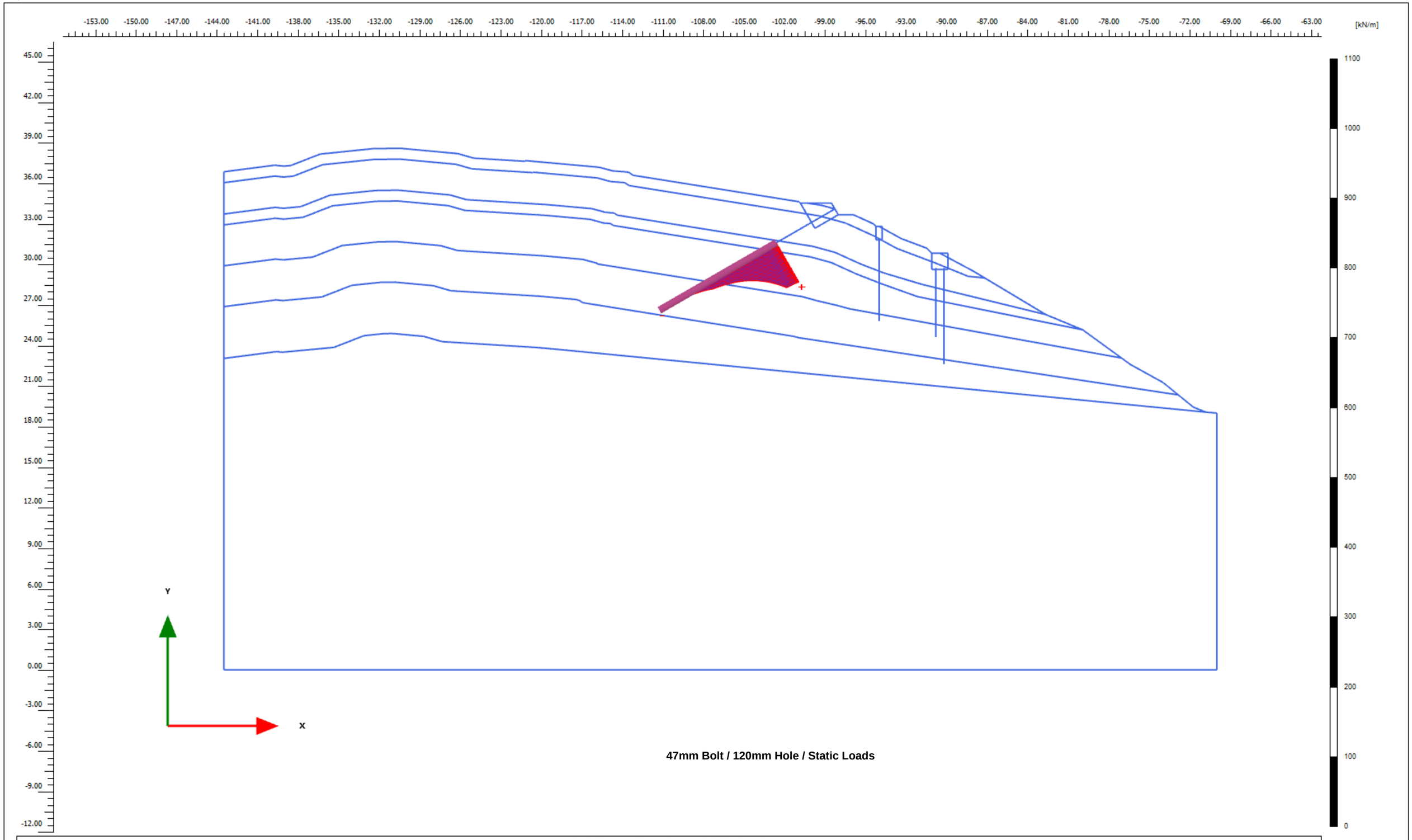
Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully S, B01, Lon, Est_RevA	Step: 360	Company: CMW Geosciences Pty Ltd	



Incremental displacements |Δu| (scaled up $20.0*10^{3}$ times)

Maximum value = $0.08610*10^{-3}$ m (Element 397 at Node 4702)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully S, B01, Lon, Est_RevA	Step: 380	Company: CMW Geosciences Pty Ltd	

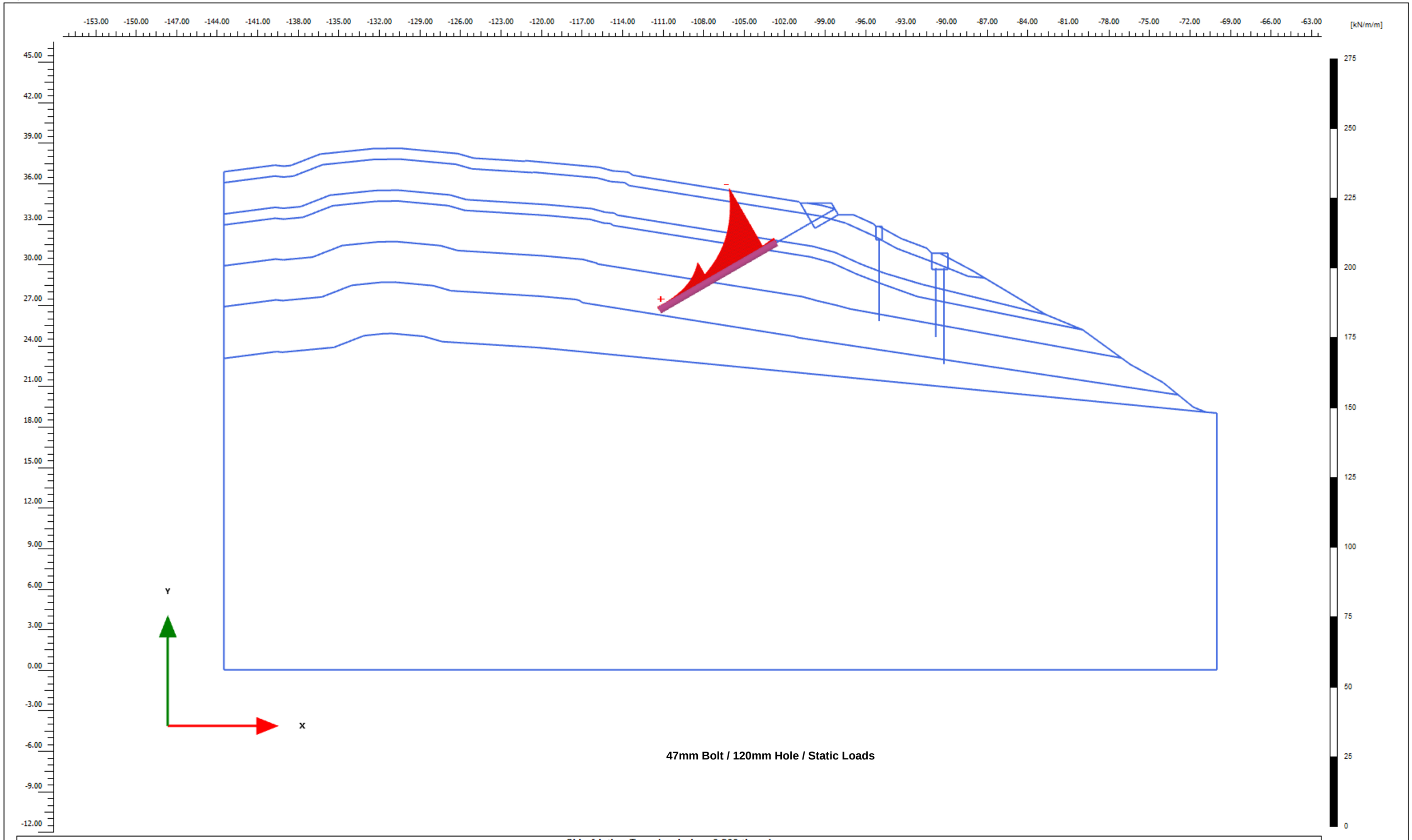


Axial forces N (scaled up 0.0500 times)

Maximum value = 67.08 kN/m (Element 20 at Node 39905)

Minimum value = $0.7013*10^{-3}$ kN/m (Element 43 at Node 40001)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully S, B01, Lon, Est_RevA	Step: 59	Company: CMW Geosciences Pty Ltd	

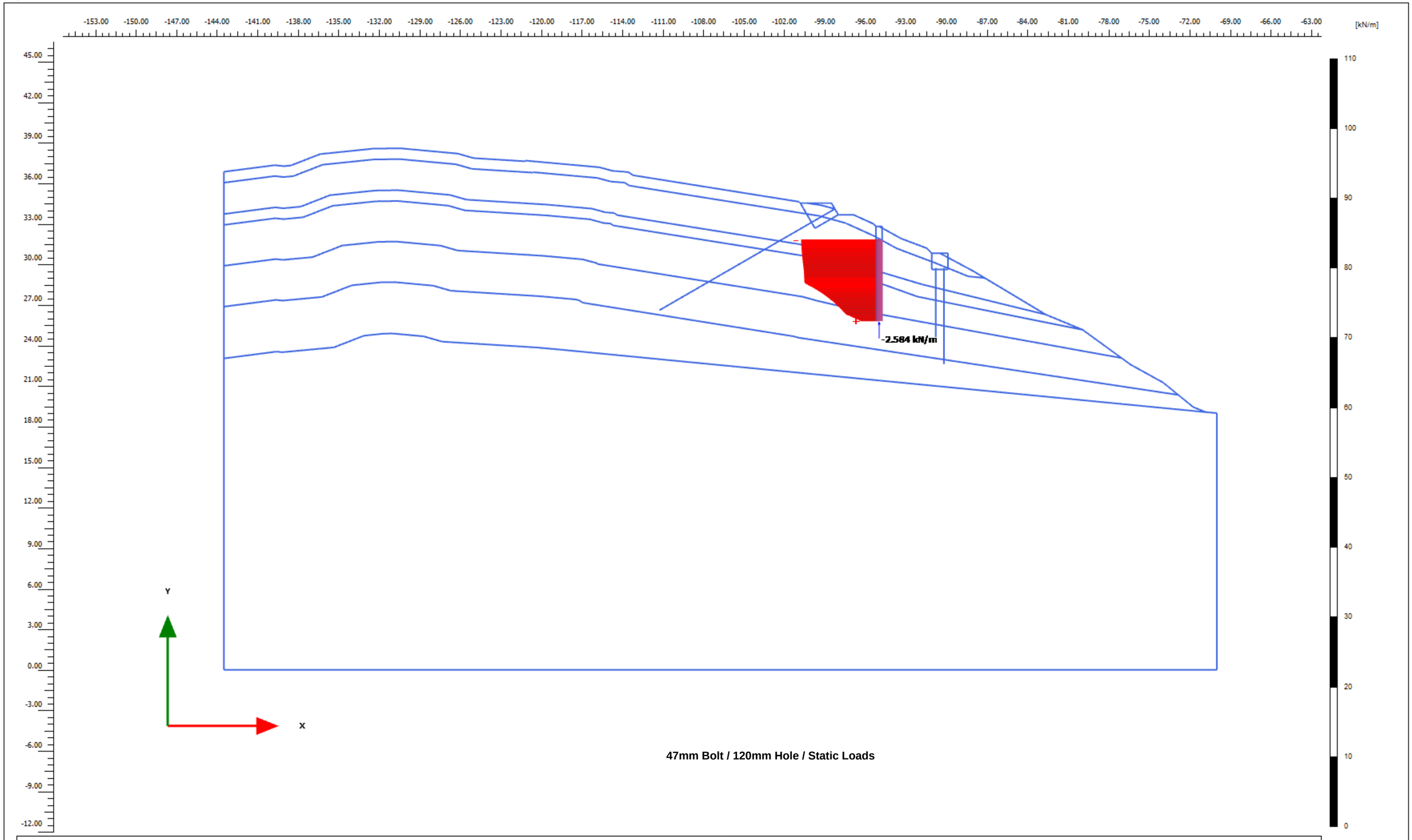


Skin friction T_{skin} (scaled up 0.200 times)

Maximum value = -1.272 kN/m/m (Element 43 at Node 39997)

Minimum value = -26.03 kN/m/m (Element 23 at Node 39917)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully S, B01, Lon, Est_RevA	Step: 59	Company: CMW Geosciences Pty Ltd	

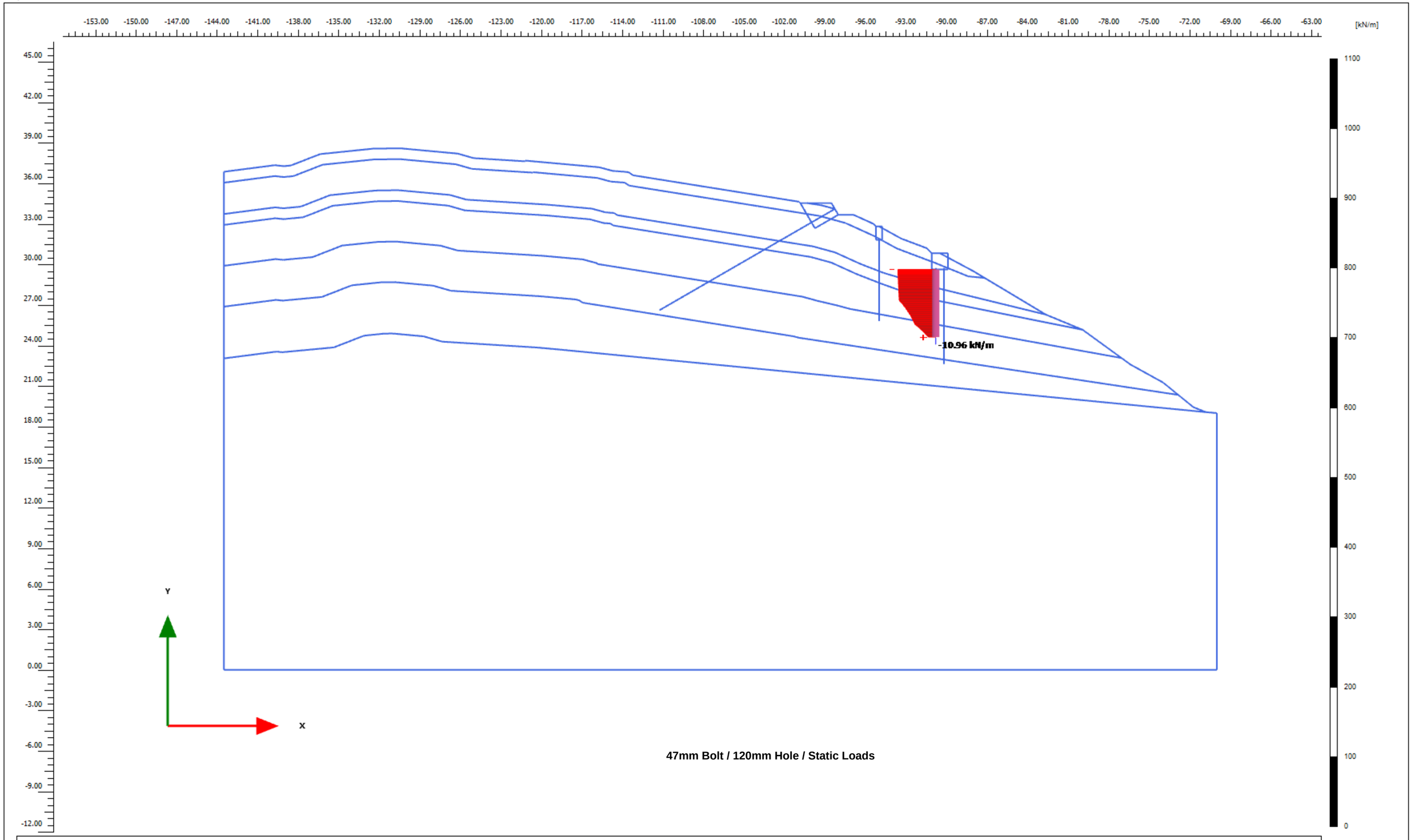


Axial forces N (scaled up 0.500 times)

Maximum value = -2.586 kN/m (Element 19 at Node 39904)

Minimum value = -11.47 kN/m (Element 2 at Node 39831)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully S, B01, Lon, Est_RevA	Step: 59	Company: CMW Geosciences Pty Ltd	

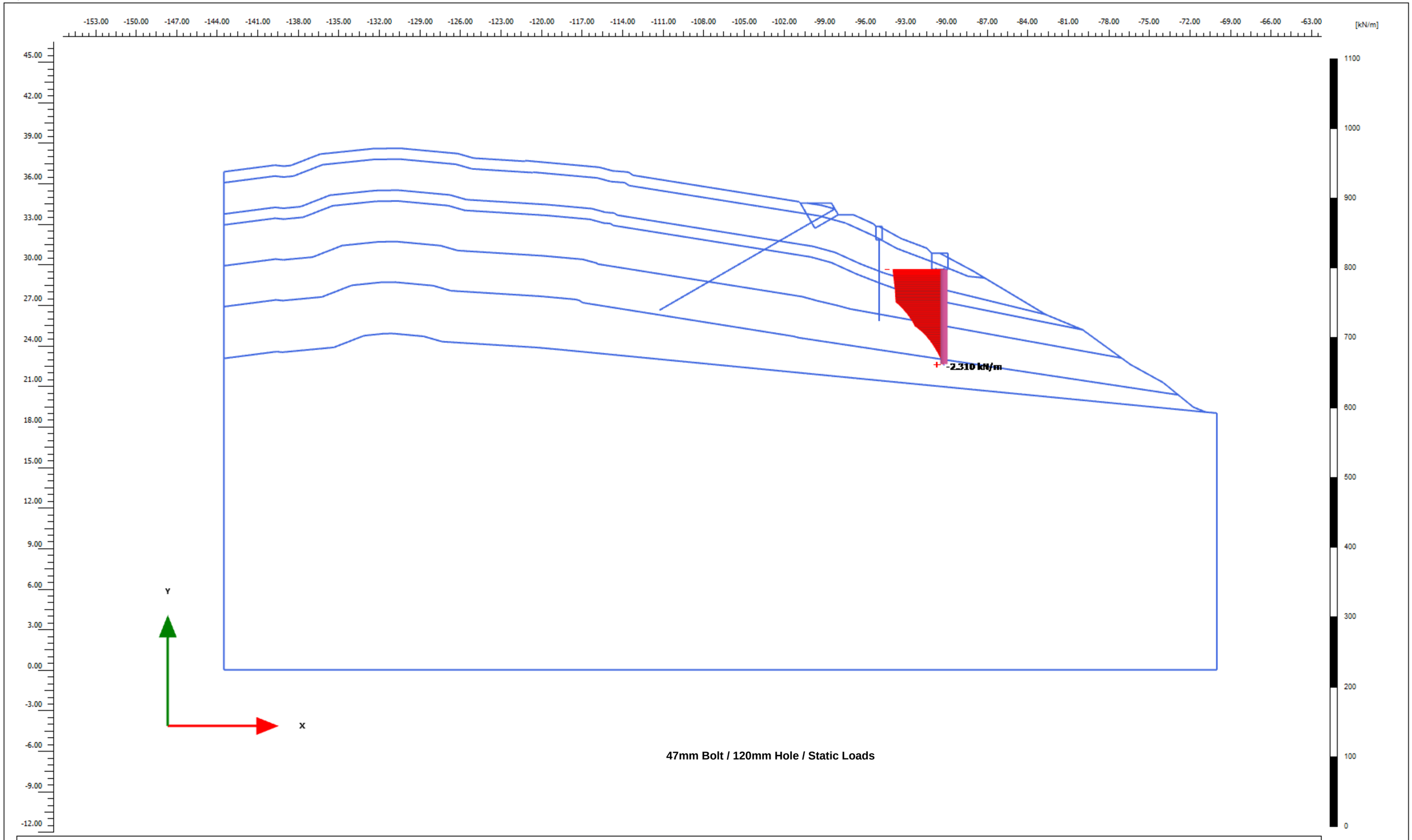


Axial forces N (scaled up 0.0500 times)

Maximum value = -10.99 kN/m (Element 54 at Node 40047)

Minimum value = -56.12 kN/m (Element 46 at Node 40010)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully S, B01, Lon, Est_RevA	Step: 59	Company: CMW Geosciences Pty Ltd	

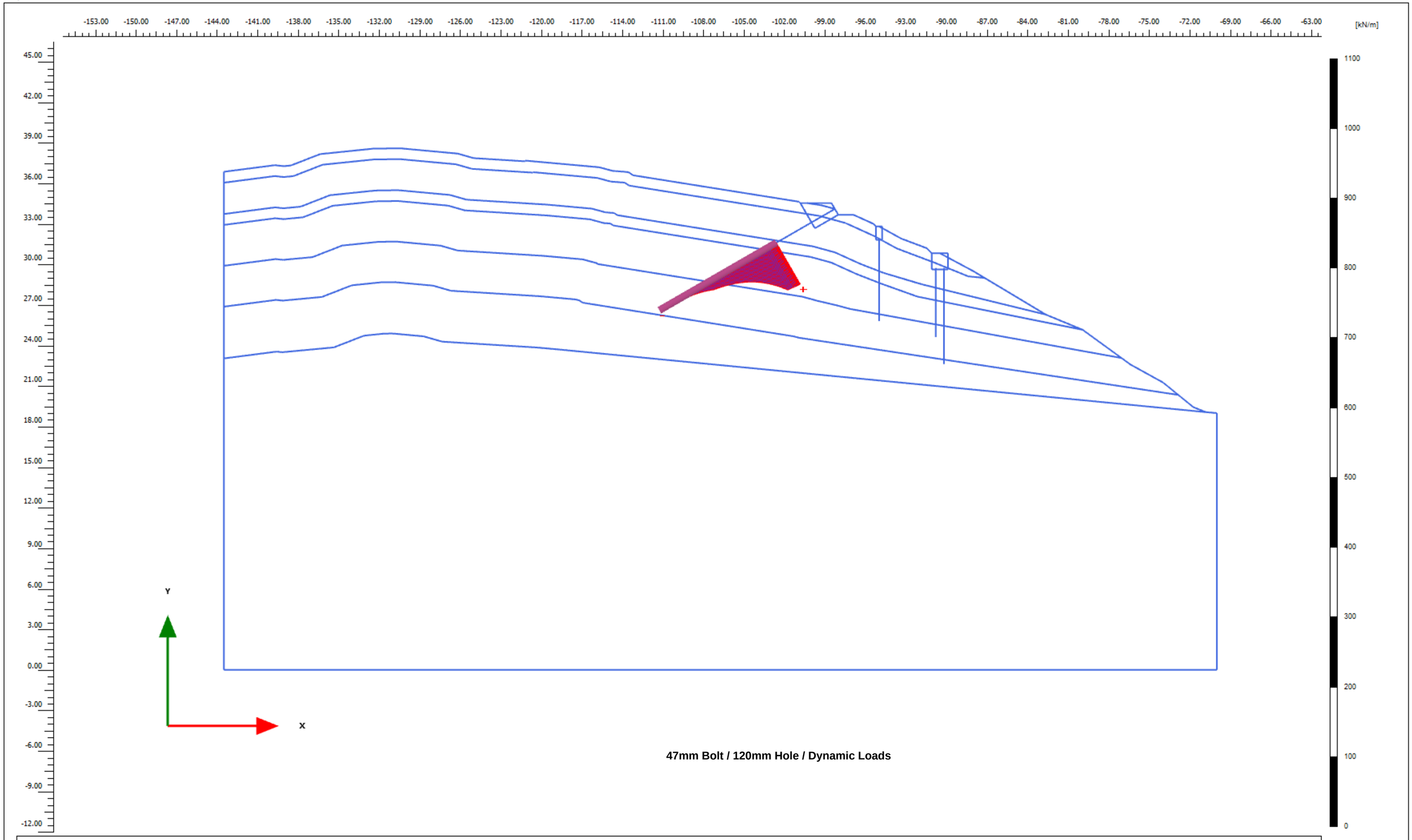


Axial forces N (scaled up 0.0500 times)

Maximum value = -2.310 kN/m (Element 69 at Node 40109)

Minimum value = -75.38 kN/m (Element 57 at Node 40056)

Project description		Date
Marion Costal Walkway Upgrade		18/03/2022
Project filename	Step	Company
Grey Gully S, B01, Lon, Est_RevA	59	CMW Geosciences Pty Ltd

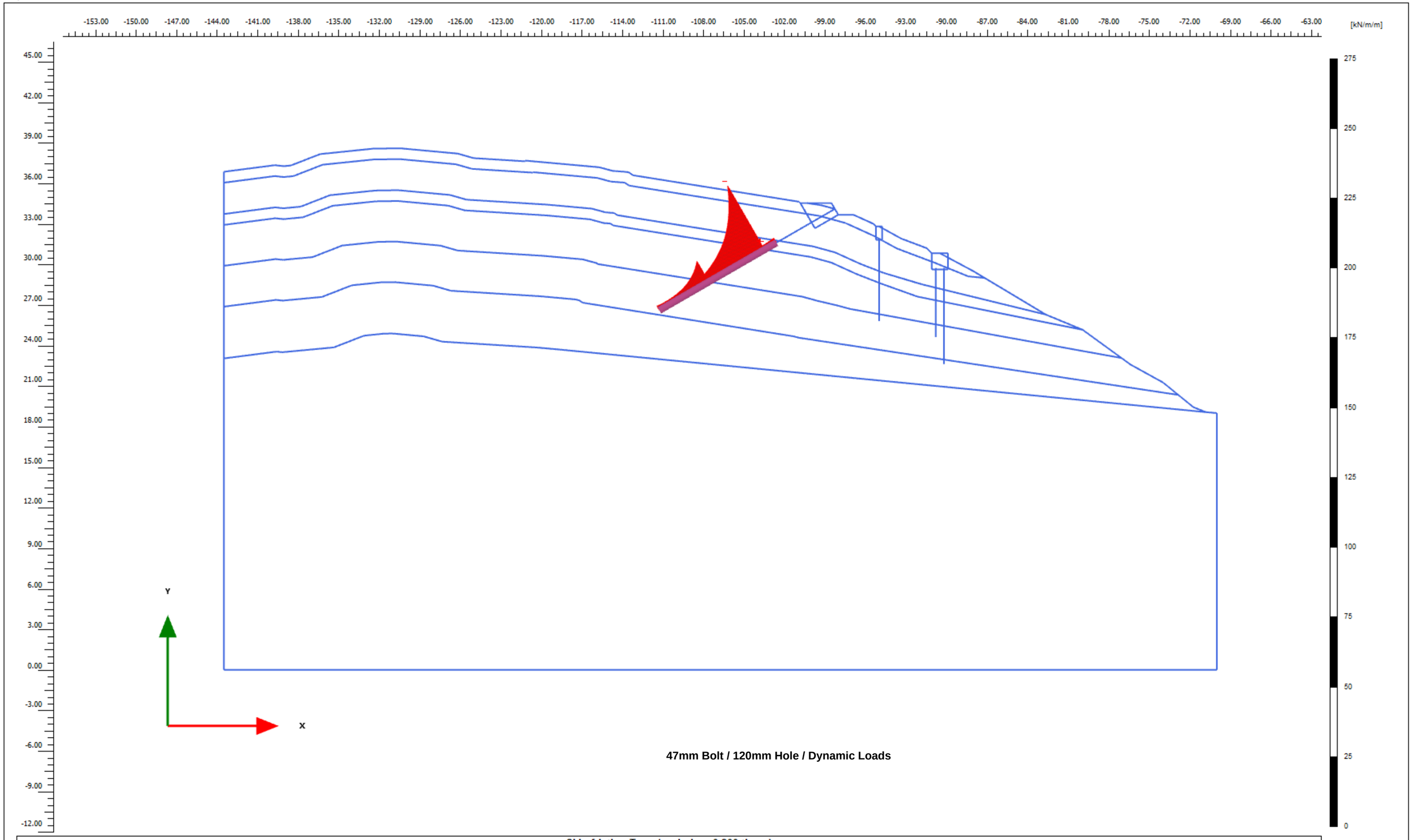


Axial forces N (scaled up 0.0500 times)

Maximum value = 70.95 kN/m (Element 20 at Node 39905)

Minimum value = $0.9246*10^{-3}$ kN/m (Element 43 at Node 40001)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully S, B01, Lon, Est_RevA	Step: 129	Company: CMW Geosciences Pty Ltd	

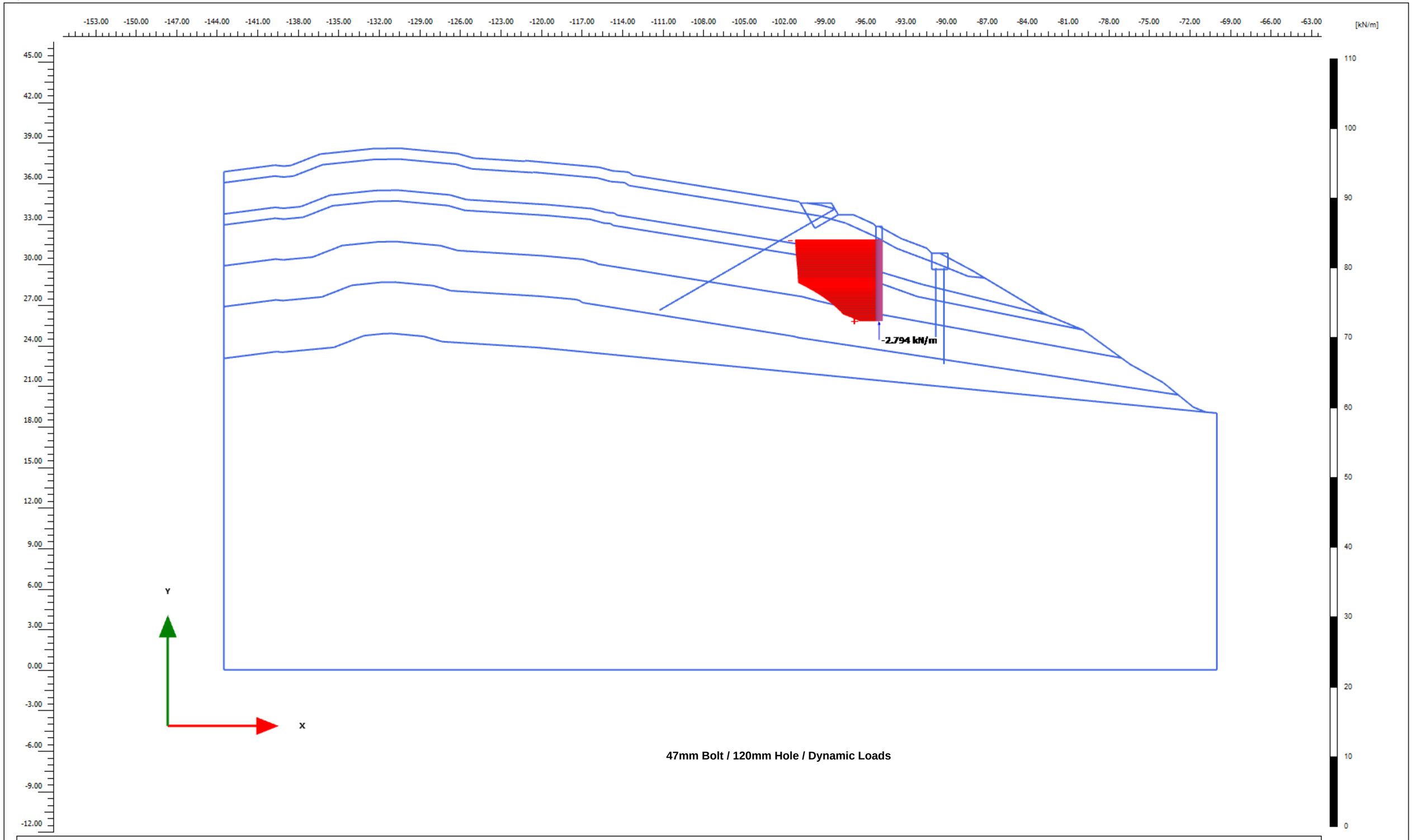


Skin friction T_{skin} (scaled up 0.200 times)

Maximum value = -1.532 kN/m/m (Element 22 at Node 39917)

Minimum value = -27.28 kN/m/m (Element 23 at Node 39917)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully S, B01, Lon, Est_RevA	Step: 129	Company: CMW Geosciences Pty Ltd	

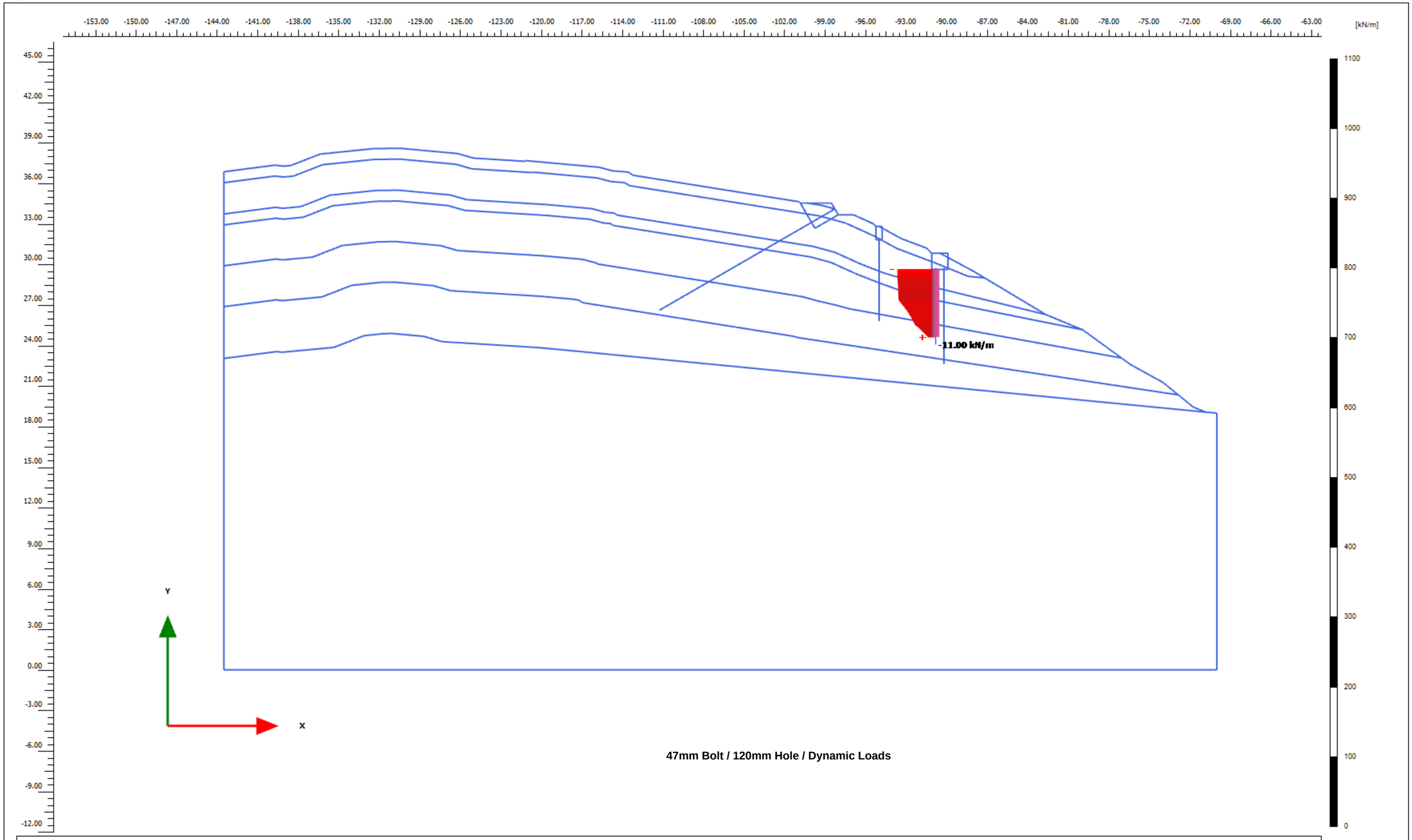


Axial forces N (scaled up 0.500 times)

Maximum value = -2.795 kN/m (Element 19 at Node 39904)

Minimum value = -12.35 kN/m (Element 2 at Node 39833)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully S, B01, Lon, Est_RevA	Step: 129	Company: CMW Geosciences Pty Ltd	

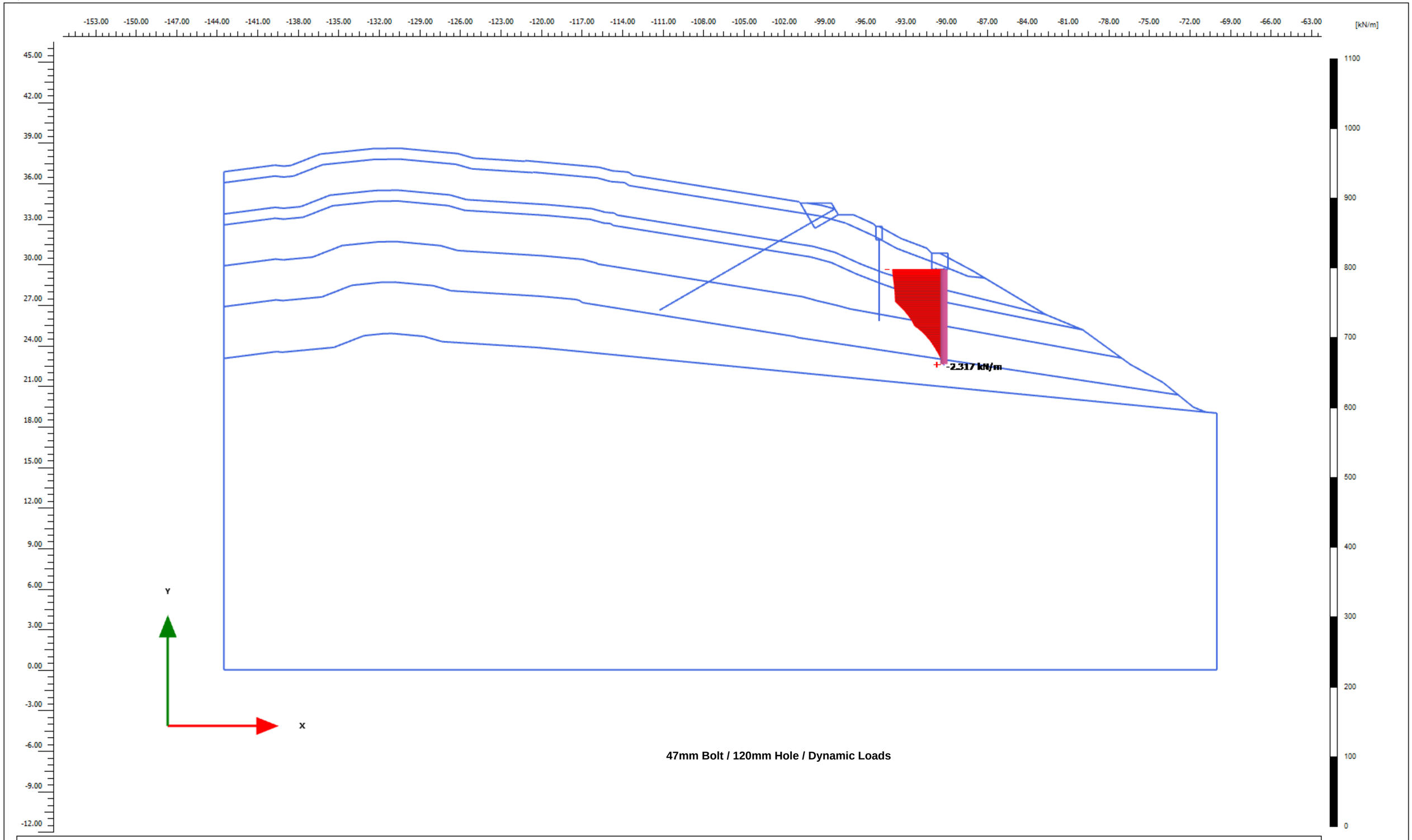


Axial forces N (scaled up 0.0500 times)

Maximum value = -11.04 kN/m (Element 54 at Node 40047)

Minimum value = -56.44 kN/m (Element 46 at Node 40010)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully S, B01, Lon, Est_RevA	Step: 129	Company: CMW Geosciences Pty Ltd	

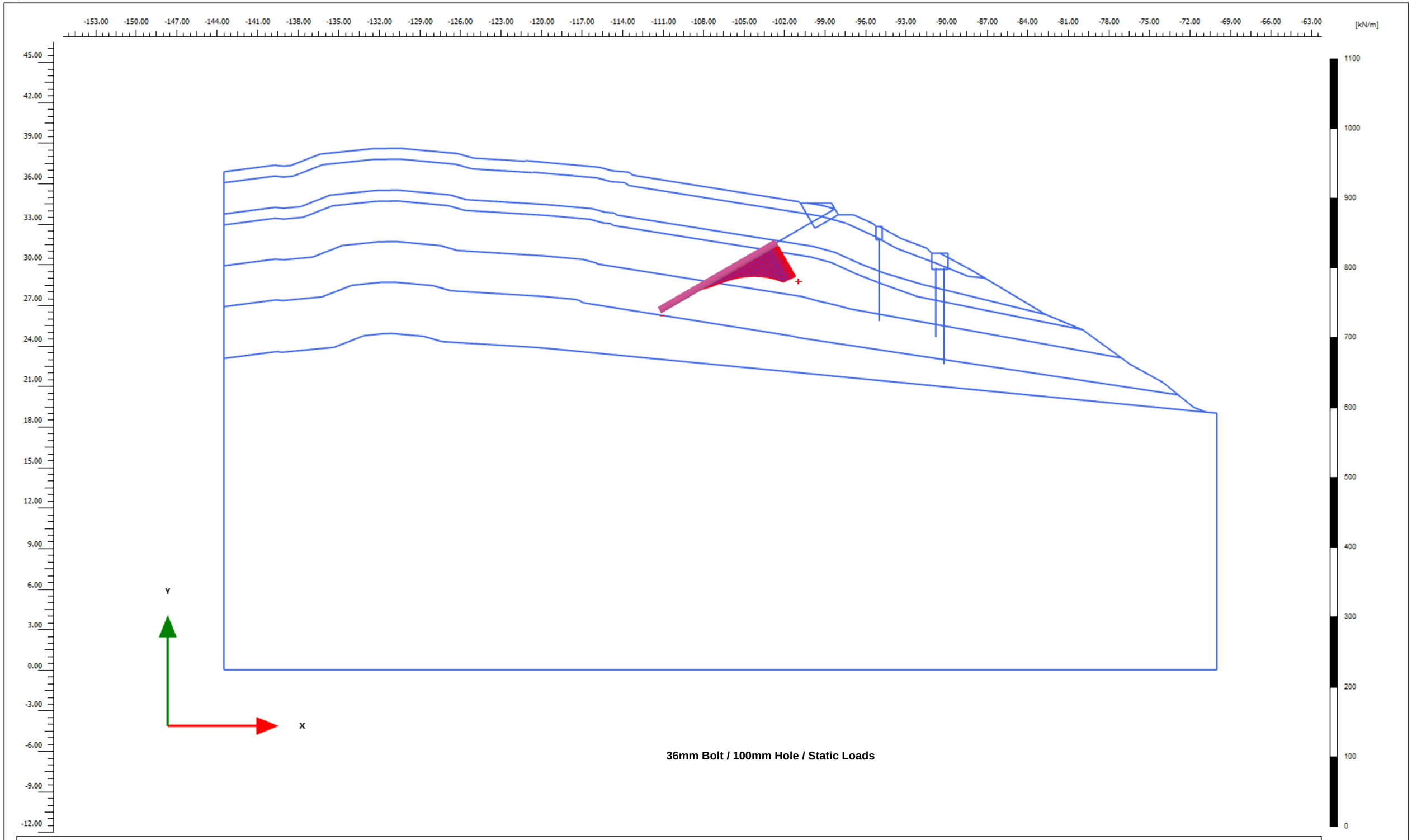


Axial forces N (scaled up 0.0500 times)

Maximum value = -2.317 kN/m (Element 69 at Node 40109)

Minimum value = -76.11 kN/m (Element 57 at Node 40056)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully S, B01, Lon, Est_RevA	Step: 129	Company: CMW Geosciences Pty Ltd	

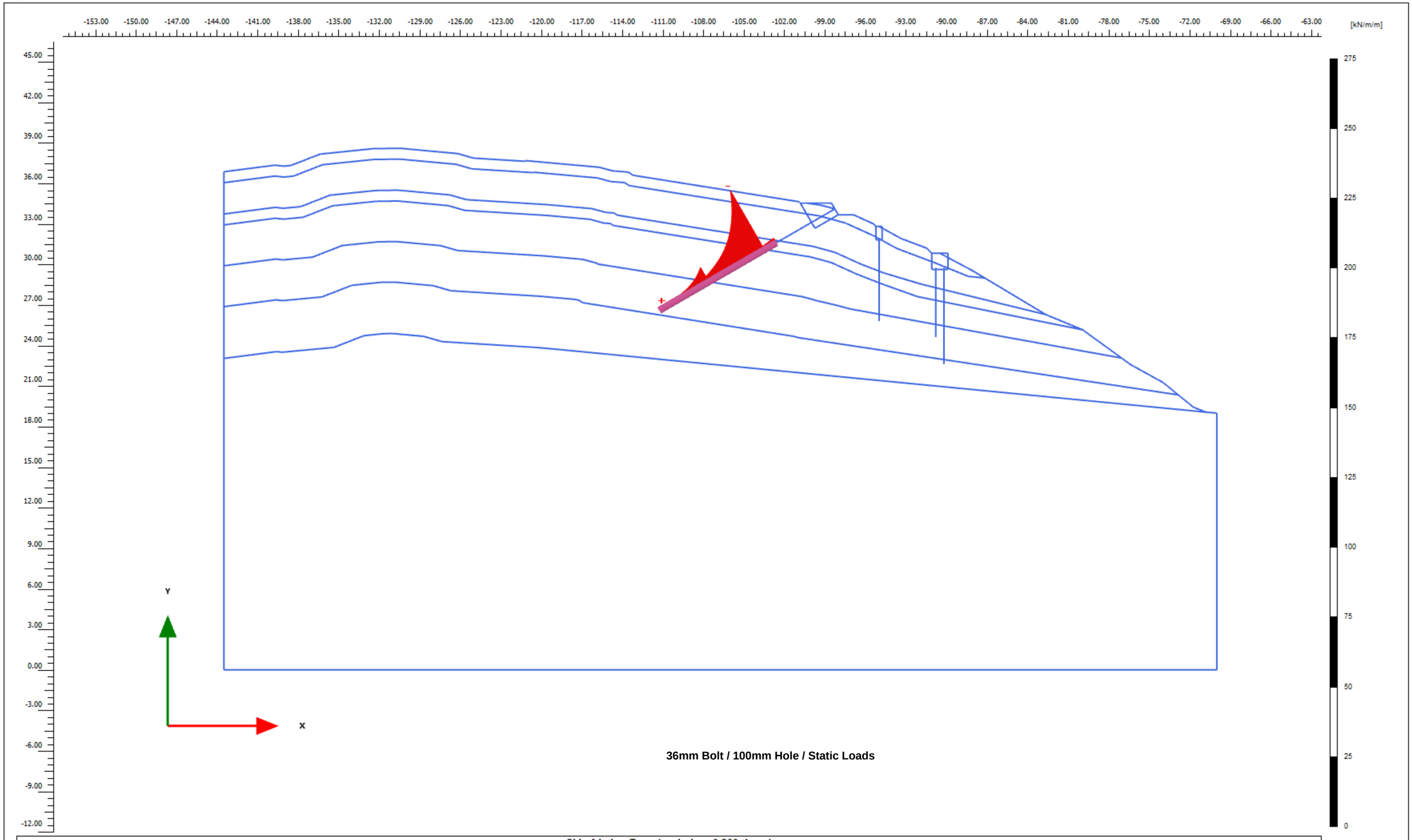


Axial forces N (scaled up 0.0500 times)

Maximum value = 57.62 kN/m (Element 20 at Node 39905)

Minimum value = $0.5033*10^{-3}$ kN/m (Element 43 at Node 40001)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully S, B01, Lon, Est_RevA	Step: 189	Company: CMW Geosciences Pty Ltd	

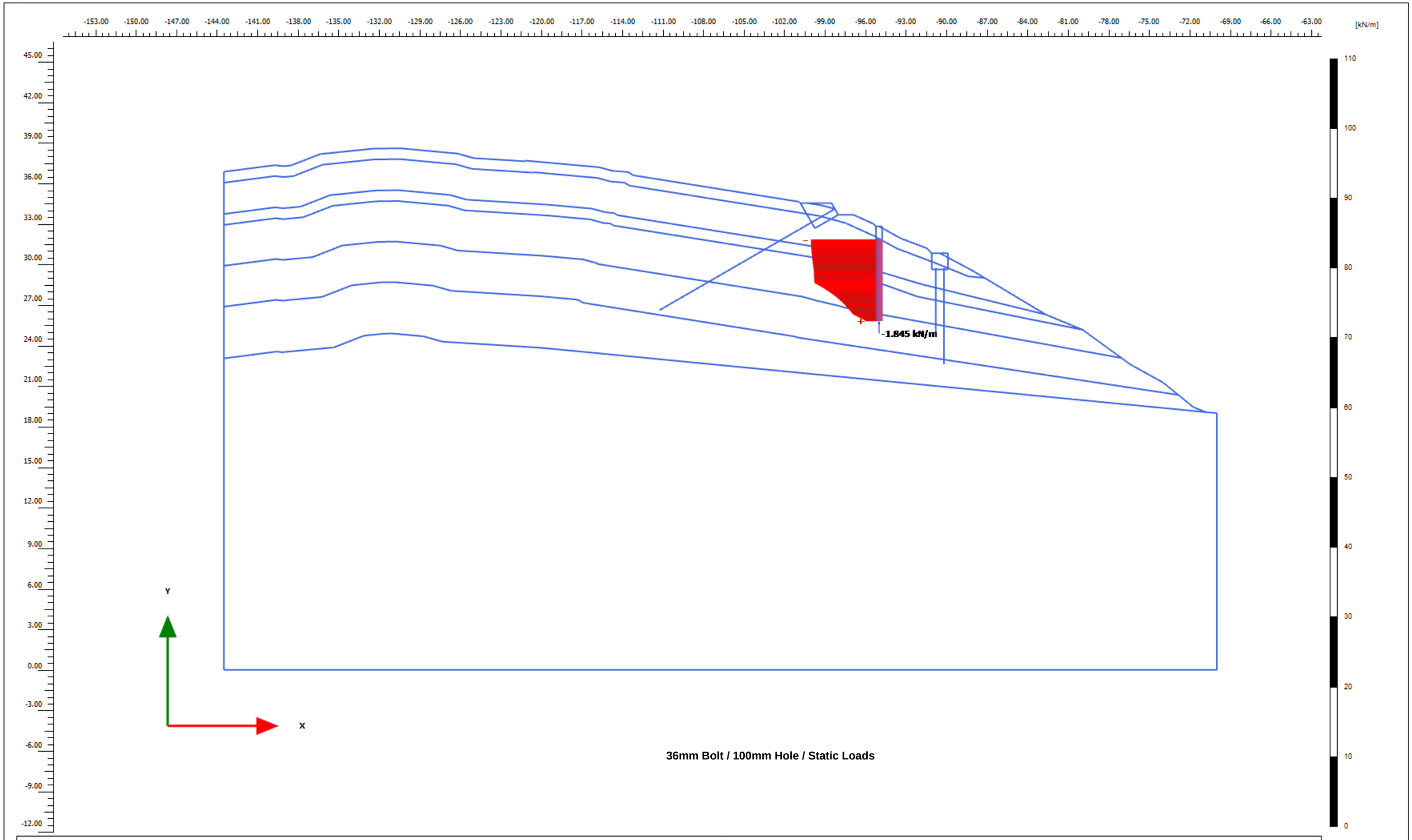


Skin friction T_{skin} (scaled up 0.200 times)

Maximum value = -0.7467 kN/m/m (Element 43 at Node 39997)

Minimum value = -25.22 kN/m/m (Element 23 at Node 39917)

Project description		Date
Marion Costal Walkway Upgrade		18/03/2022
Project filename	Step	Company
Grey Gully S, B01, Lon, Est_RevA	189	CMW Geosciences Pty Ltd

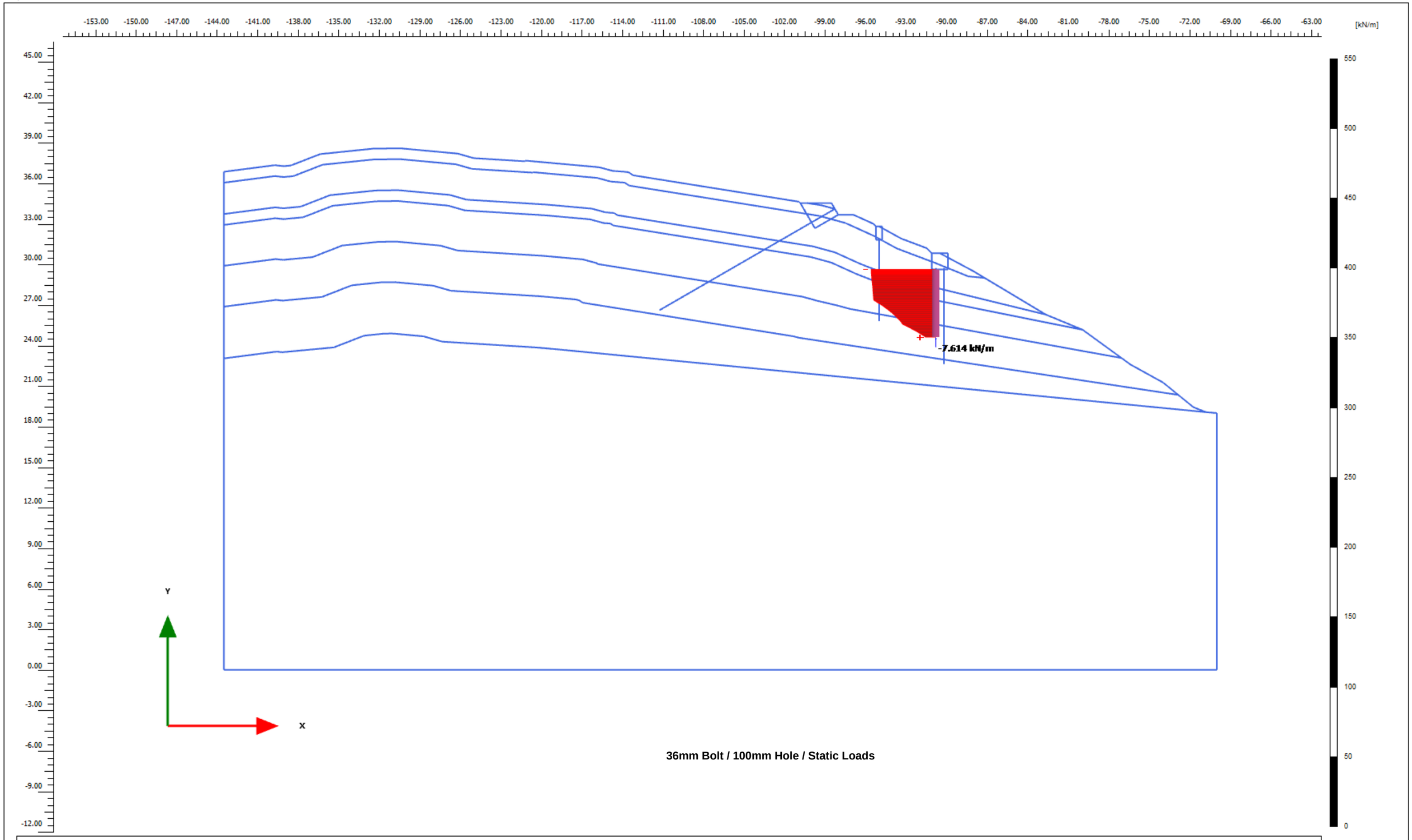


Axial forces N (scaled up 0.500 times)

Maximum value = -1.846 kN/m (Element 19 at Node 39904)

Minimum value = -10.04 kN/m (Element 2 at Node 39831)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully S, B01, Lon, Est_RevA	Step: 189	Company: CMW Geosciences Pty Ltd	

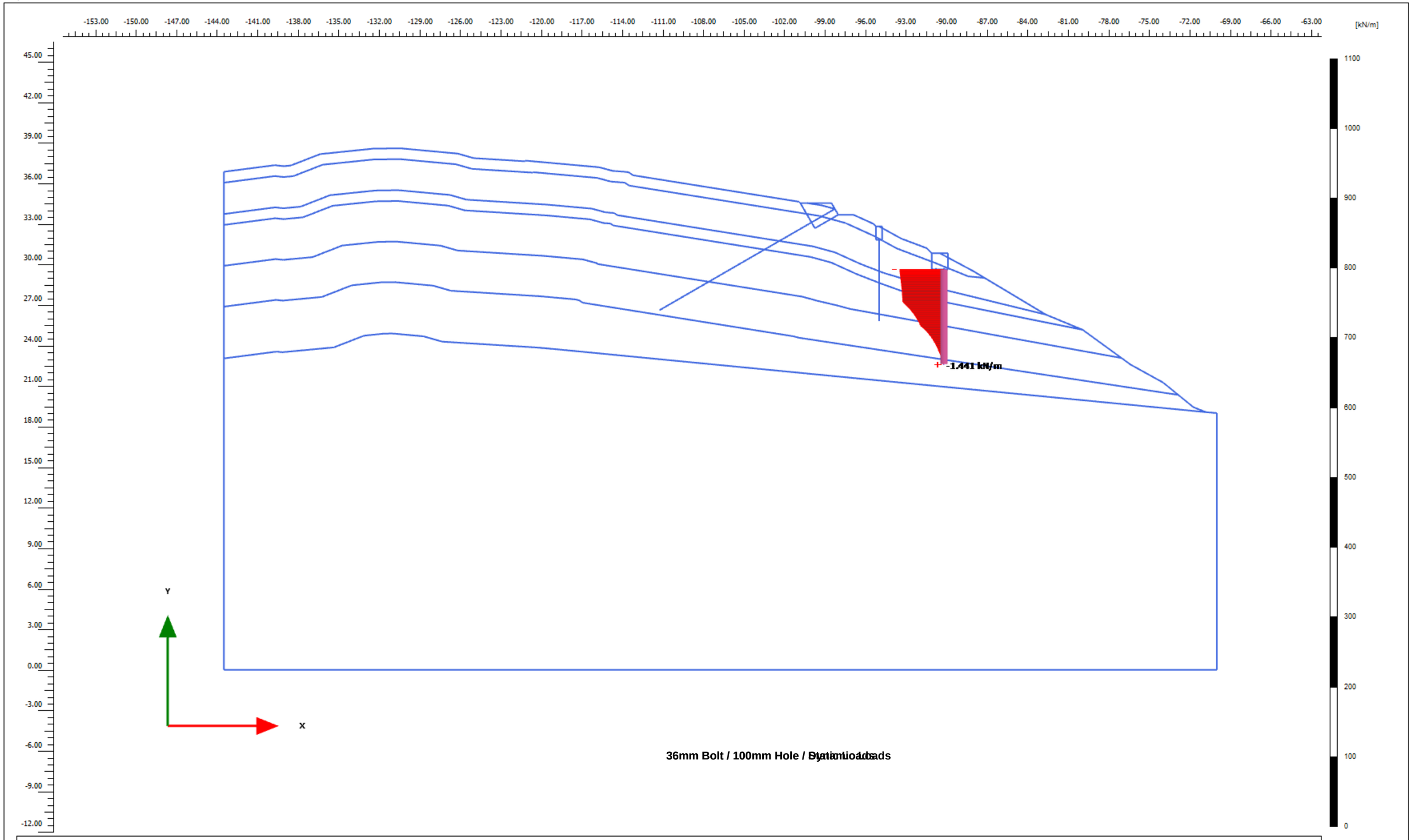


Axial forces N (scaled up 0.100 times)

Maximum value = -7.656 kN/m (Element 54 at Node 40047)

Minimum value = -47.79 kN/m (Element 46 at Node 40010)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully S, B01, Lon, Est_RevA	Step: 189	Company: CMW Geosciences Pty Ltd	

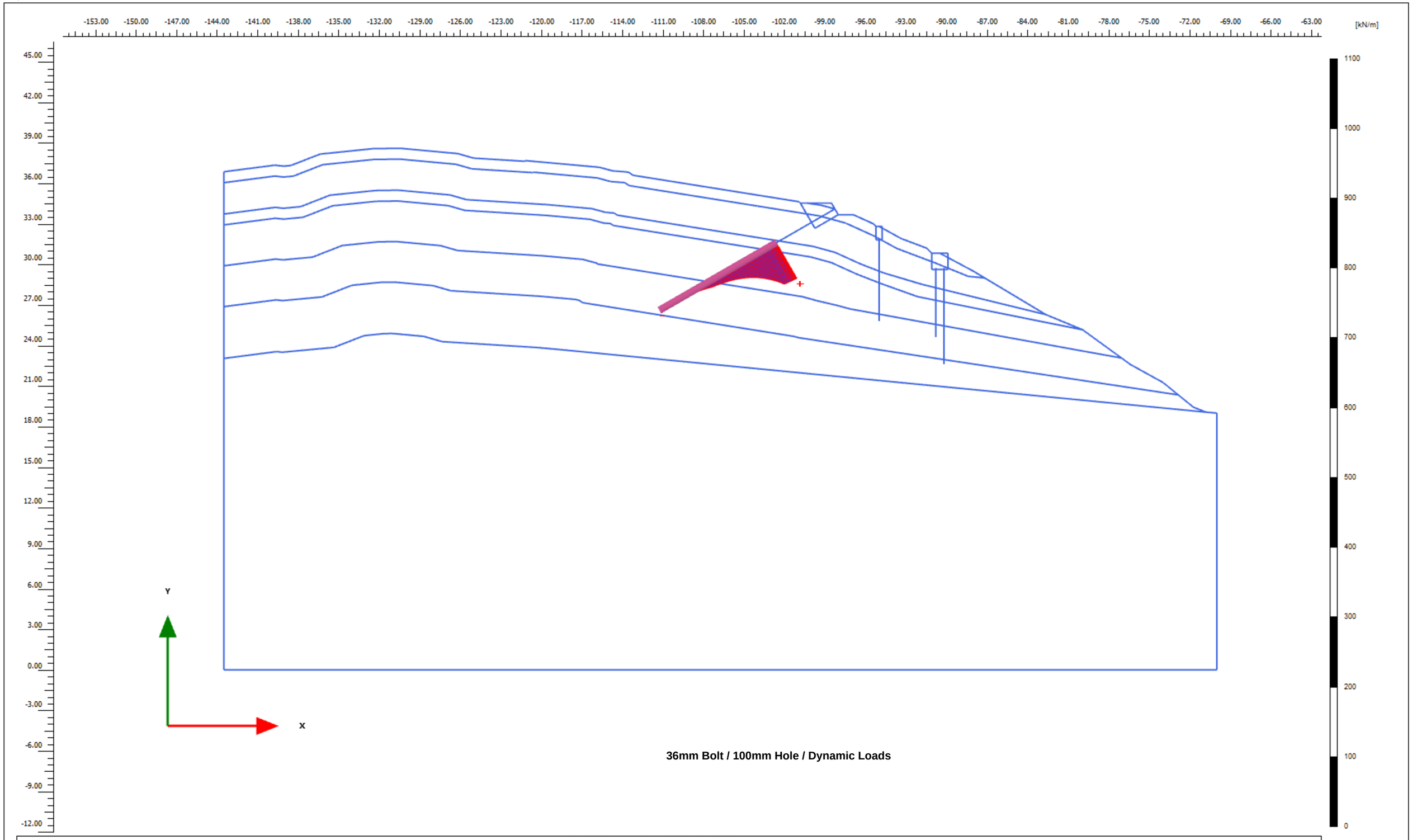


Axial forces N (scaled up 0.0500 times)

Maximum value = -1.441 kN/m (Element 69 at Node 40109)

Minimum value = -65.26 kN/m (Element 57 at Node 40056)

Project description		Date
Marion Costal Walkway Upgrade		18/03/2022
Project filename	**Step**	**Company**
Grey Gully S, B01, Lon, Est_RevA	189	CMW Geosciences Pty Ltd

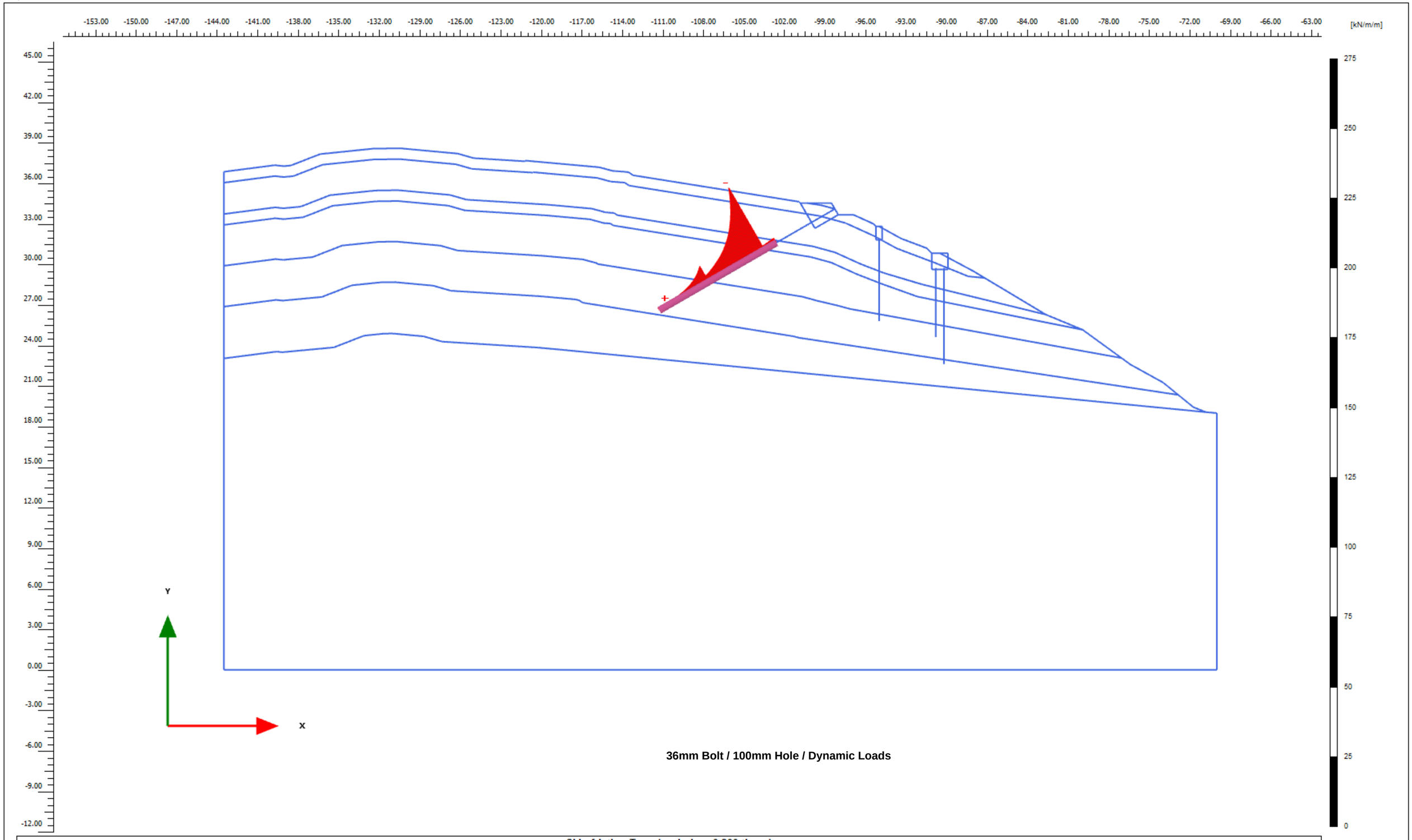


Axial forces N (scaled up 0.0500 times)

Maximum value = 61.01 kN/m (Element 20 at Node 39905)

Minimum value = $0.6971*10^{-3}$ kN/m (Element 43 at Node 40001)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully S, B01, Lon, Est_RevA	Step: 260	Company: CMW Geosciences Pty Ltd	

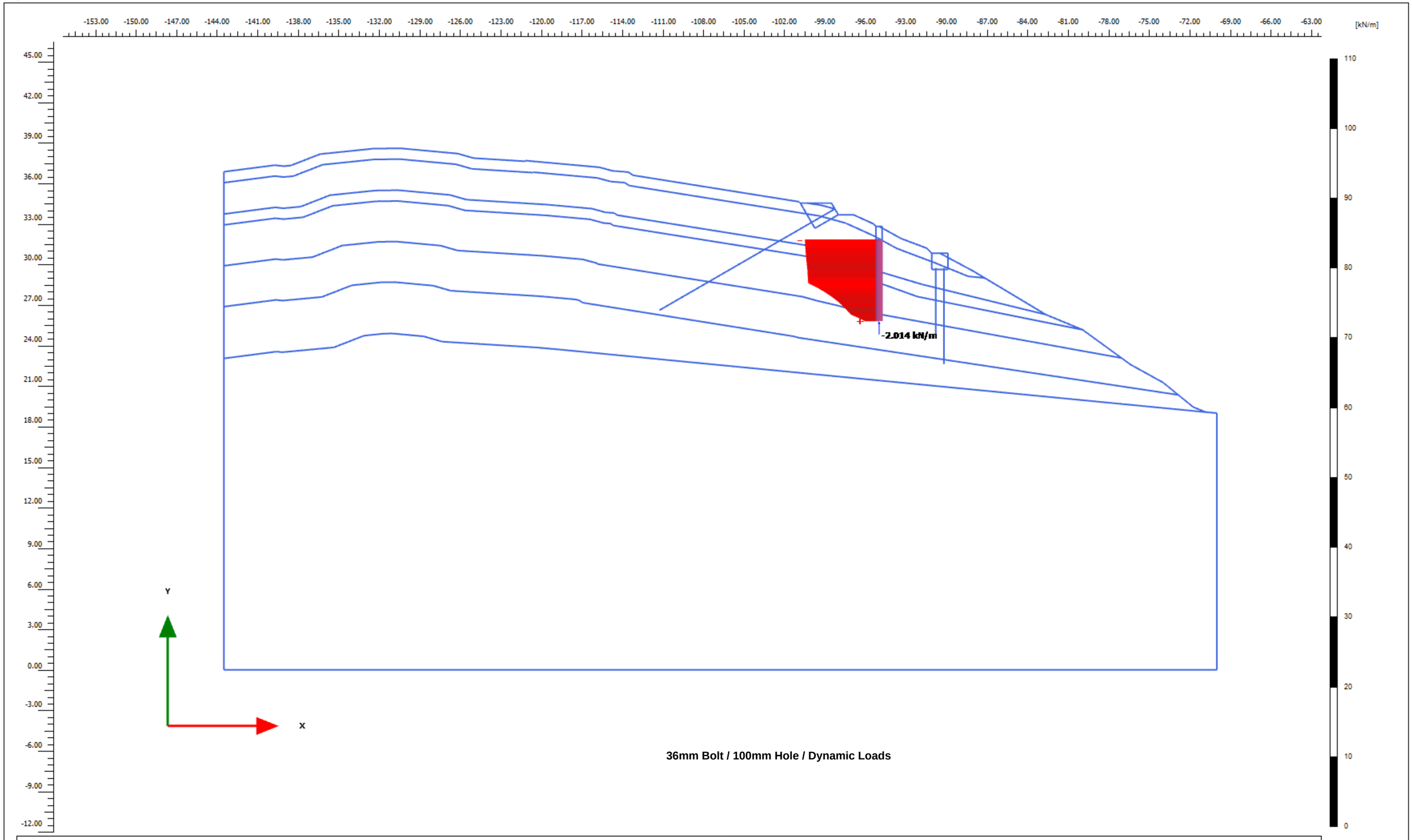


Skin friction T_{skin} (scaled up 0.200 times)

Maximum value = -0.9466 kN/m/m (Element 42 at Node 39995)

Minimum value = -26.52 kN/m/m (Element 23 at Node 39917)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully S, B01, Lon, Est_RevA	Step: 260	Company: CMW Geosciences Pty Ltd	

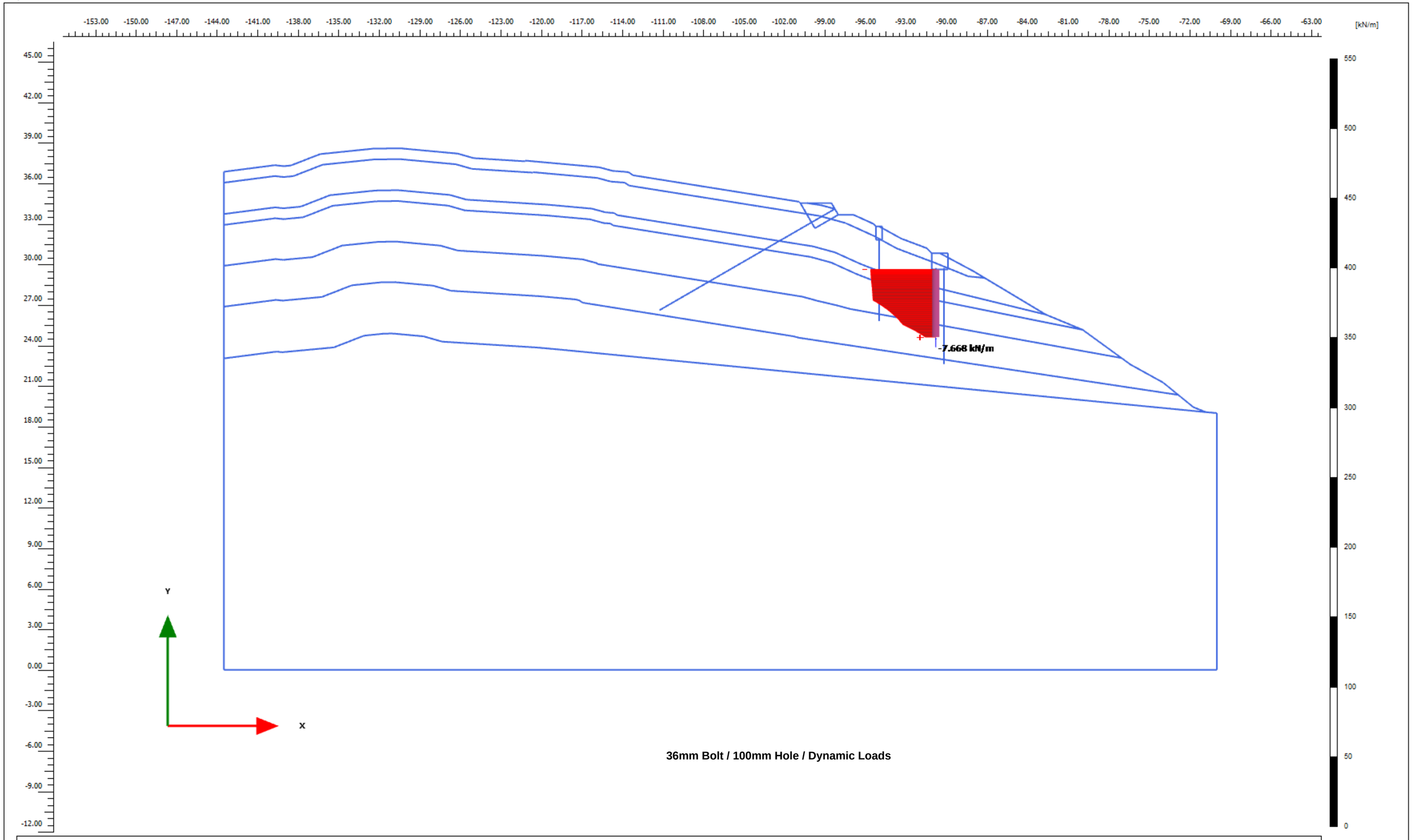


Axial forces N (scaled up 0.500 times)

Maximum value = -2.015 kN/m (Element 19 at Node 39904)

Minimum value = -10.91 kN/m (Element 2 at Node 39831)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully S, B01, Lon, Est_RevA	Step: 260	Company: CMW Geosciences Pty Ltd	

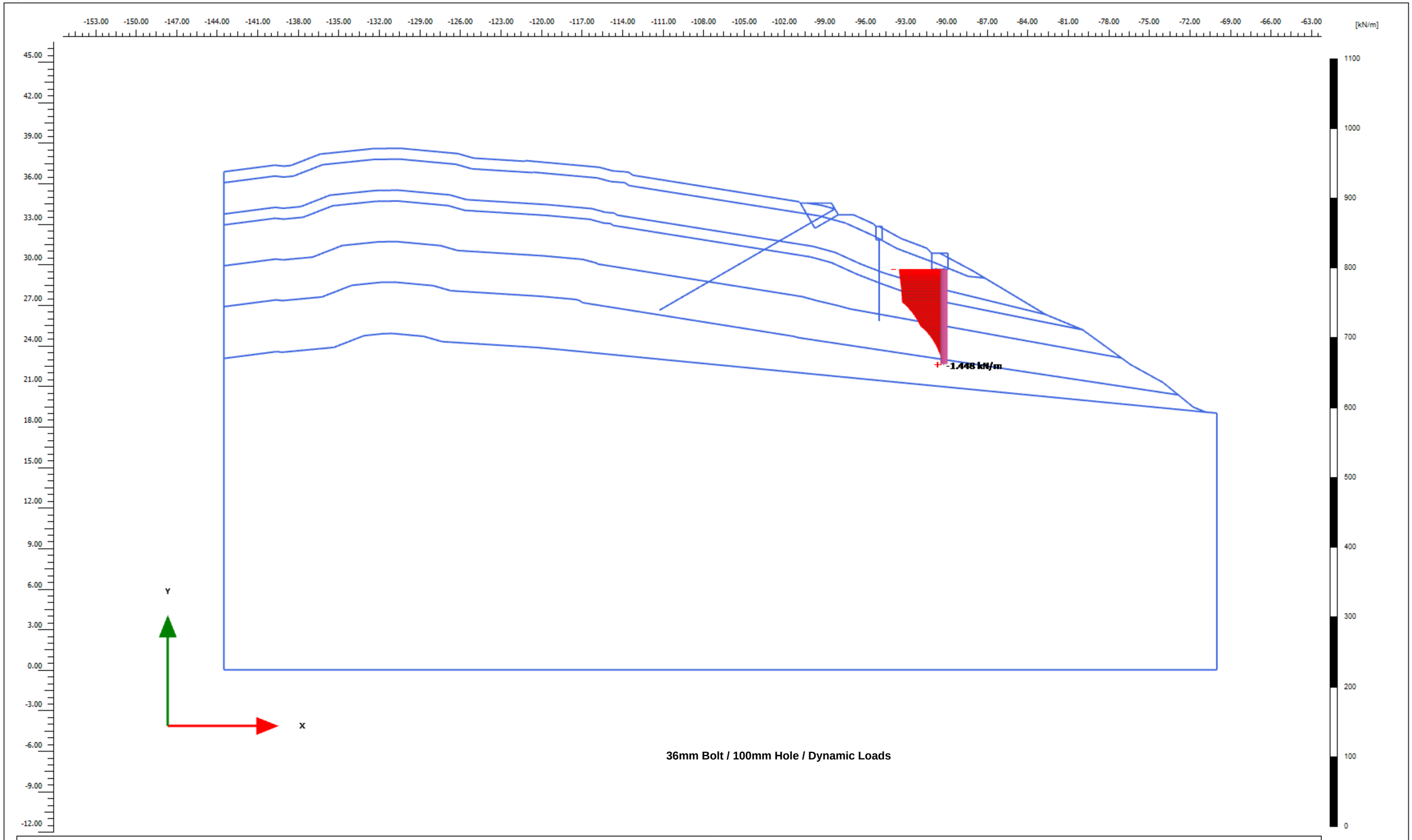


Axial forces N (scaled up 0.100 times)

Maximum value = -7.711 kN/m (Element 54 at Node 40047)

Minimum value = -48.18 kN/m (Element 46 at Node 40010)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully S, B01, Lon, Est_RevA	Step: 260	Company: CMW Geosciences Pty Ltd	



Axial forces N (scaled up 0.0500 times)

Maximum value = -1.448 kN/m (Element 69 at Node 40109)

Minimum value = -65.97 kN/m (Element 57 at Node 40056)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Grey Gully S, B01, Lon, Est_RevA	Step: 260	Company: CMW Geosciences Pty Ltd	

Project Name: Coastal Trail Design
Description: Model Layout
Date: 18/03/2022

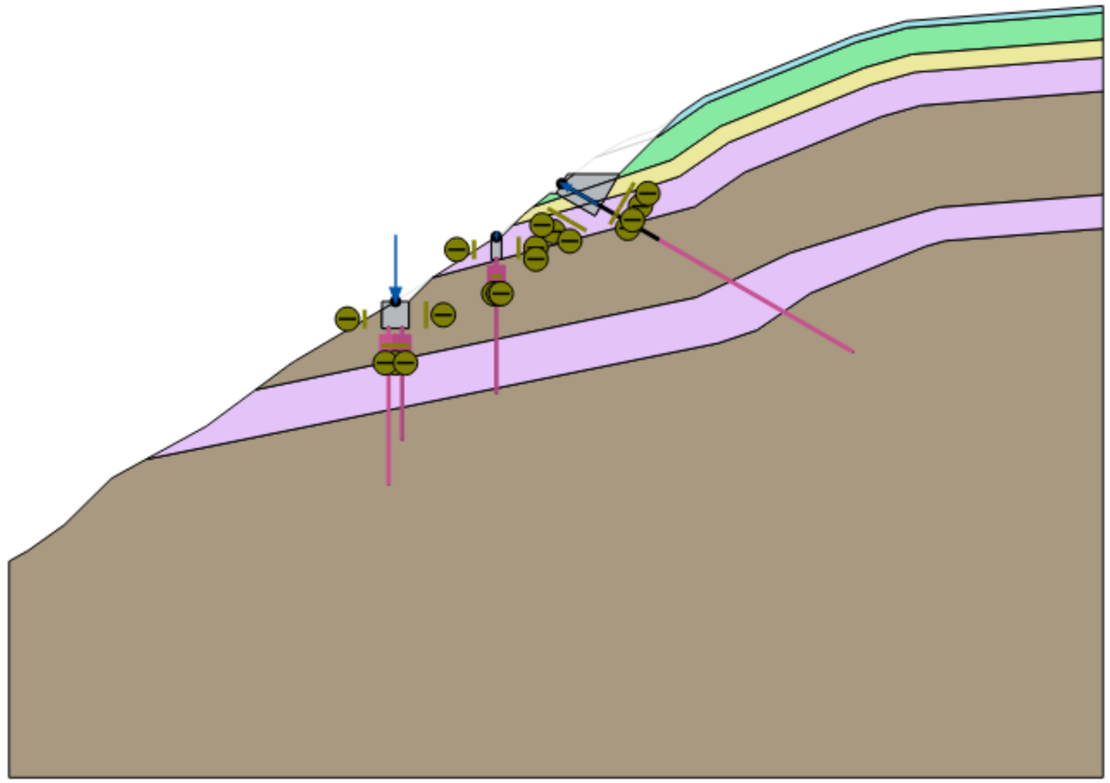
Drawn by: YW
Checked by: JVS

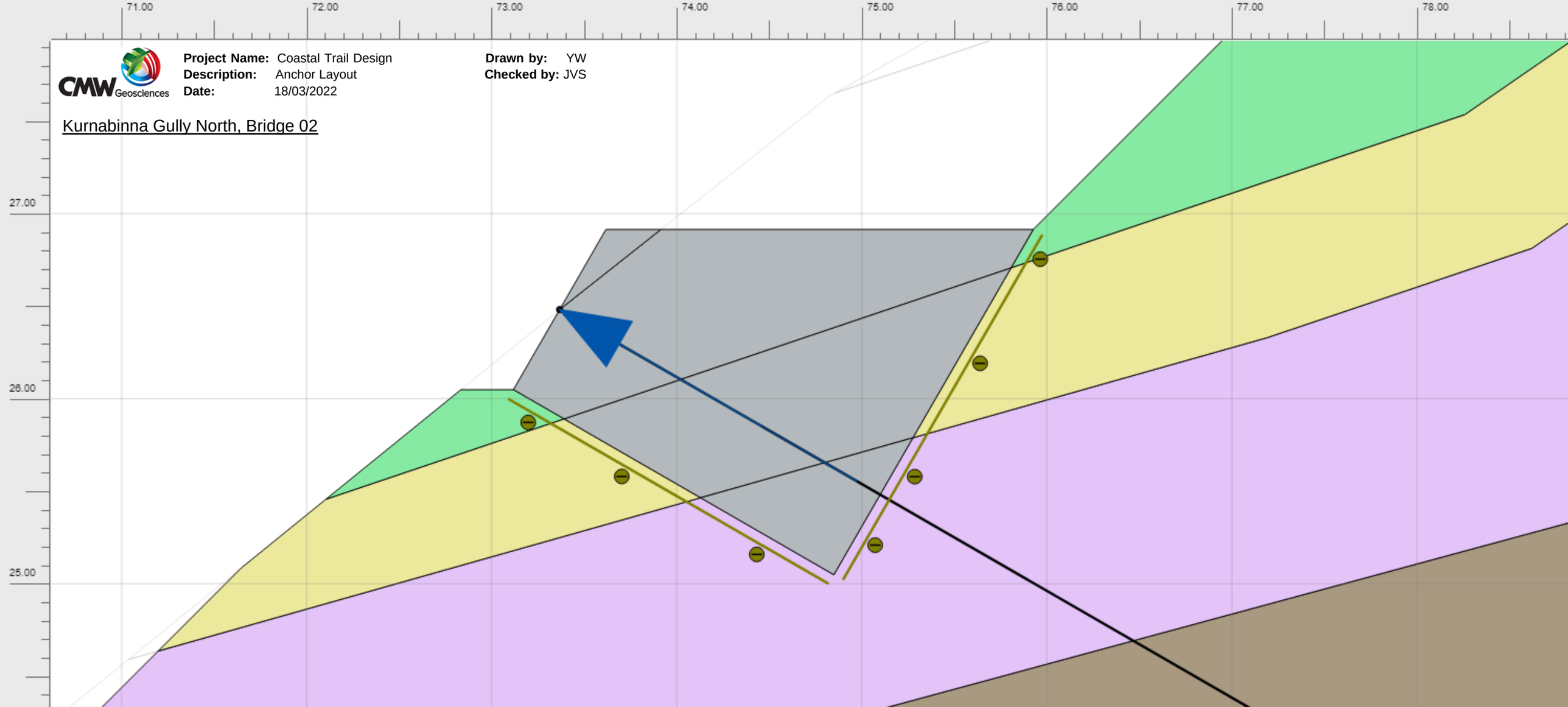
Kurnabinna Gully North, Bridge 02

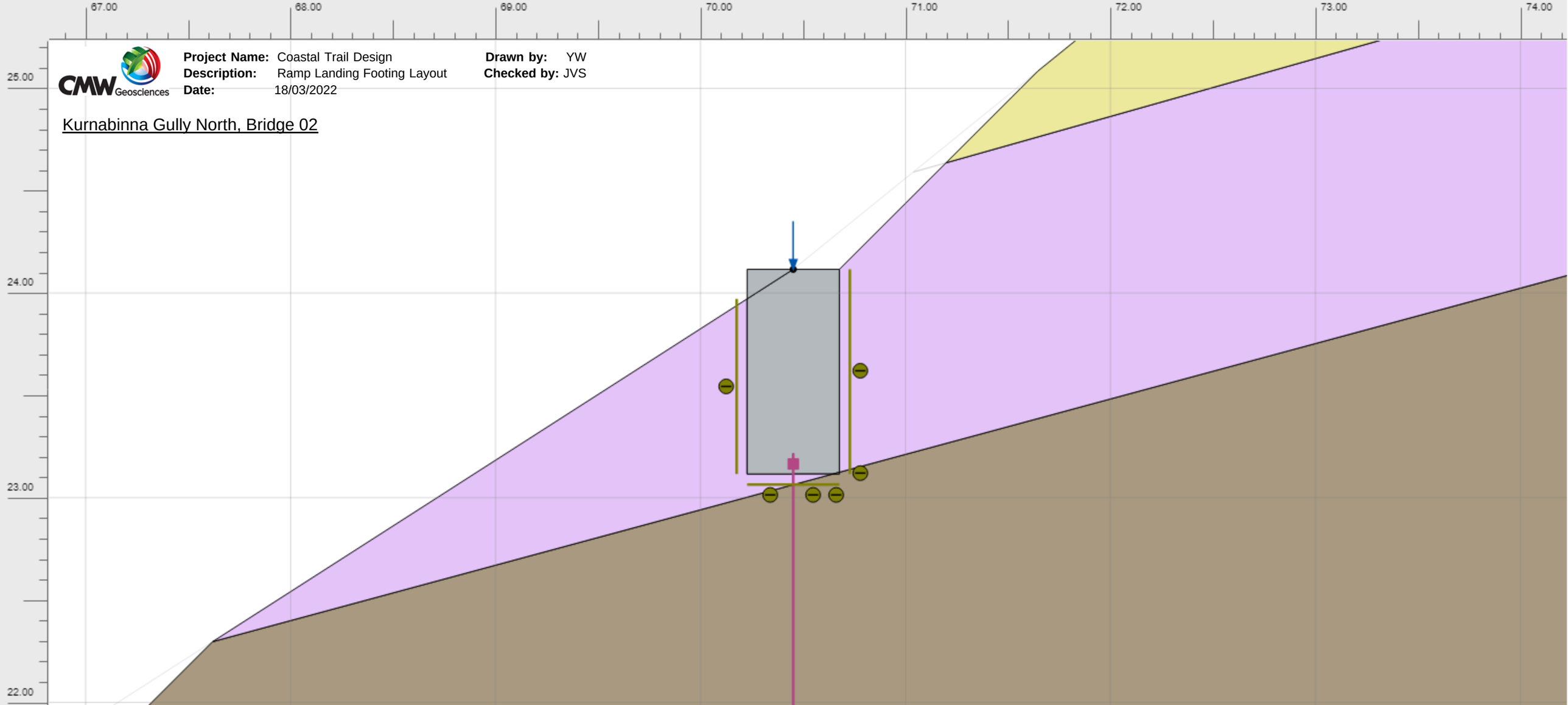
- Anchor Block
- Unit 1: Clay
- Unit 2: Res
- Unit 3: VLS
- Unit 4: LS
- Unit 5: MS

- Grout Anchor (100mm)
- Grout Anchor (120mm)
- Micro Pile (Landing, 100mm)
- Micro Pile (Portal, 100mm, 5m)
- Micro Pile (Portal, 100mm, 7m)
- Micro Pile (Portal, 120mm, 5m)
- Micro Pile (Portal, 120mm, 7m)
- Mircro Pile (Landing, 120mm)

- Node to Node Anchor (36mm)
- Node-to-Node Anchor (26.5mm)
- Node-to-Node Anchor (47mm)



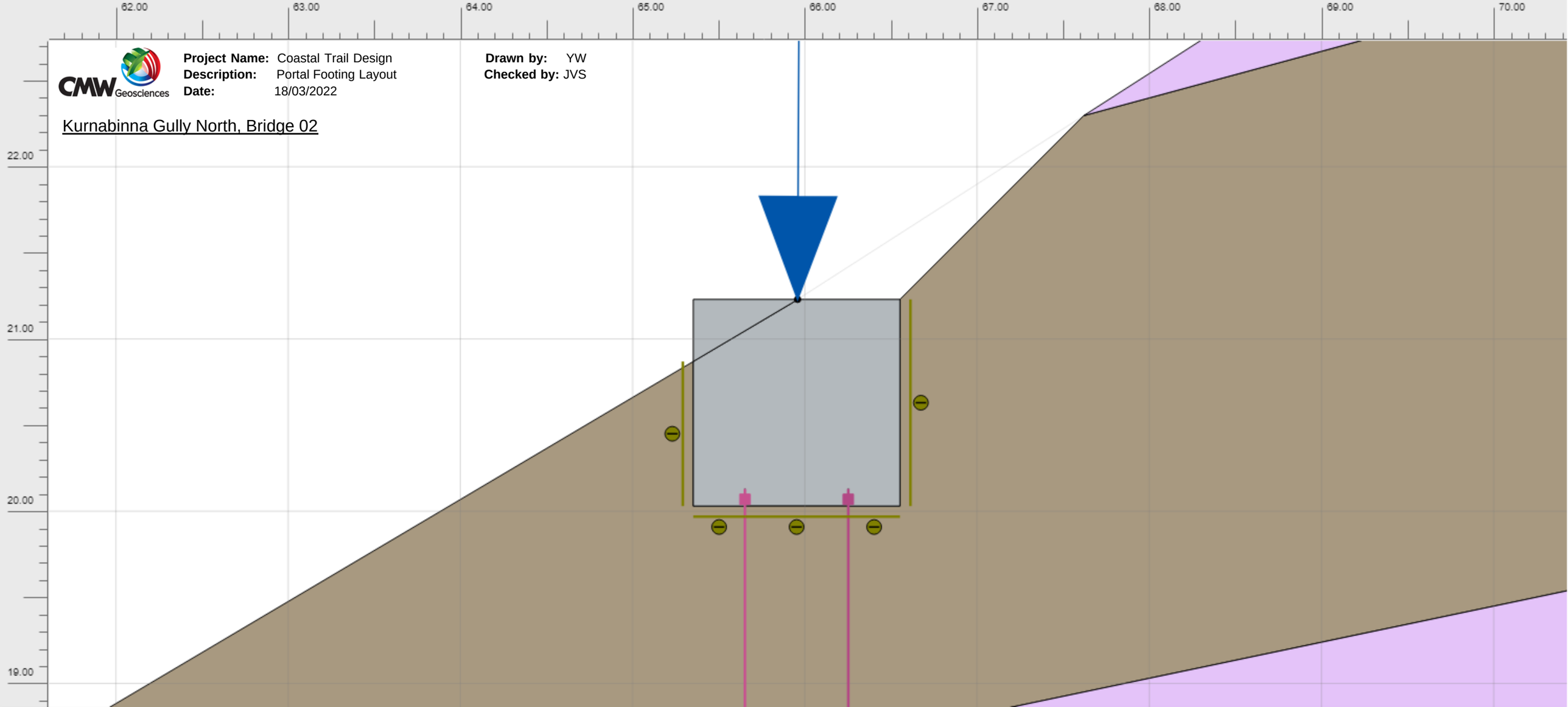

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CMW Geosciences
Project Name: Coastal Trail Design
Description: Anchor Layout
Date: 18/03/2022
Drawn by: YW
Checked by: JVS
Kurnabinna Gully North, Bridge 02

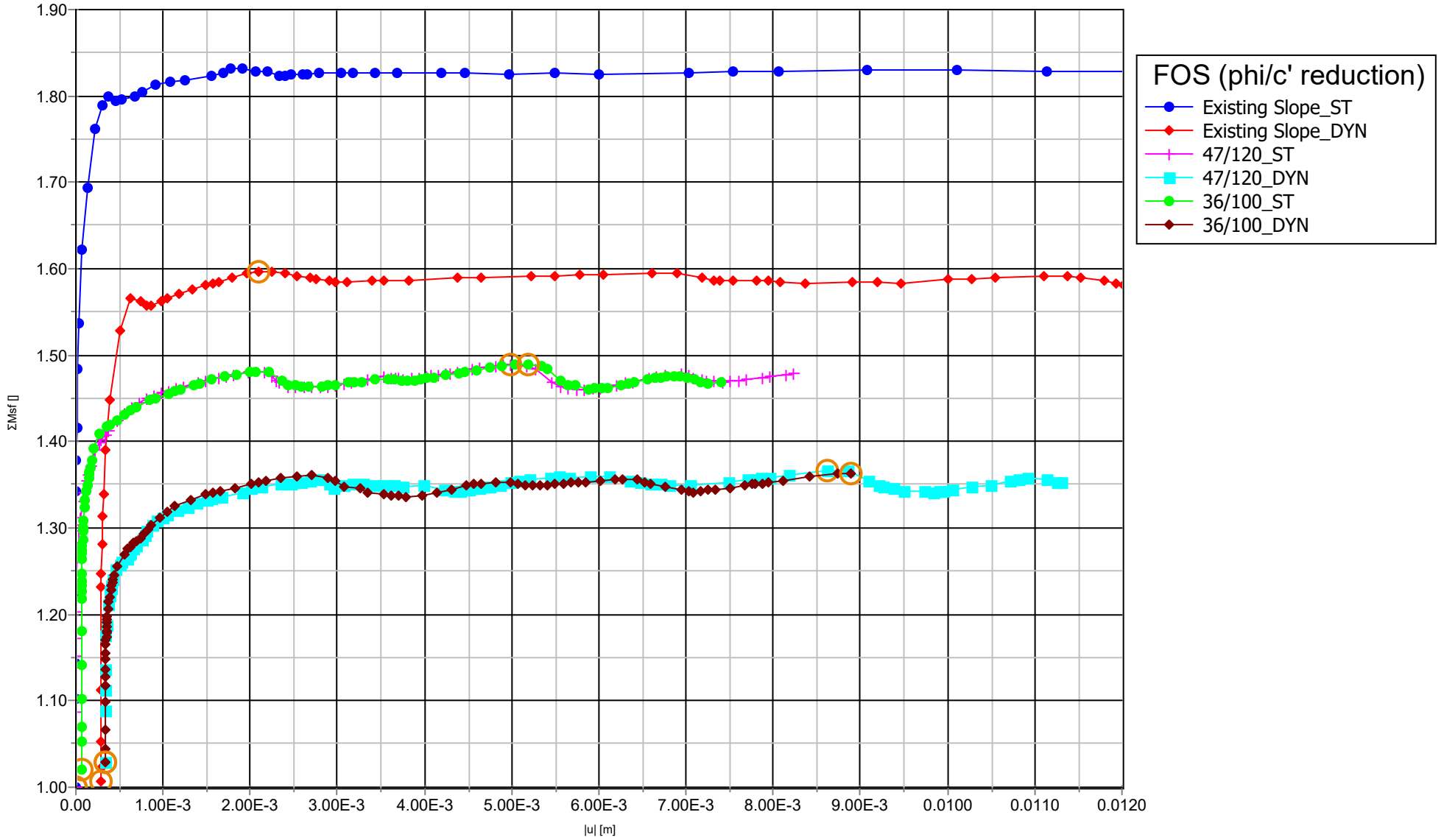

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Project Name: Coastal Trail Design
Description: Ramp Landing Footing Layout
Date: 18/03/2022
Drawn by: YW
Checked by: JVS
Kurnabinna Gully North, Bridge 02

Project Name: Coastal Trail Design
Description: Portal Footing Layout
Date: 18/03/2022

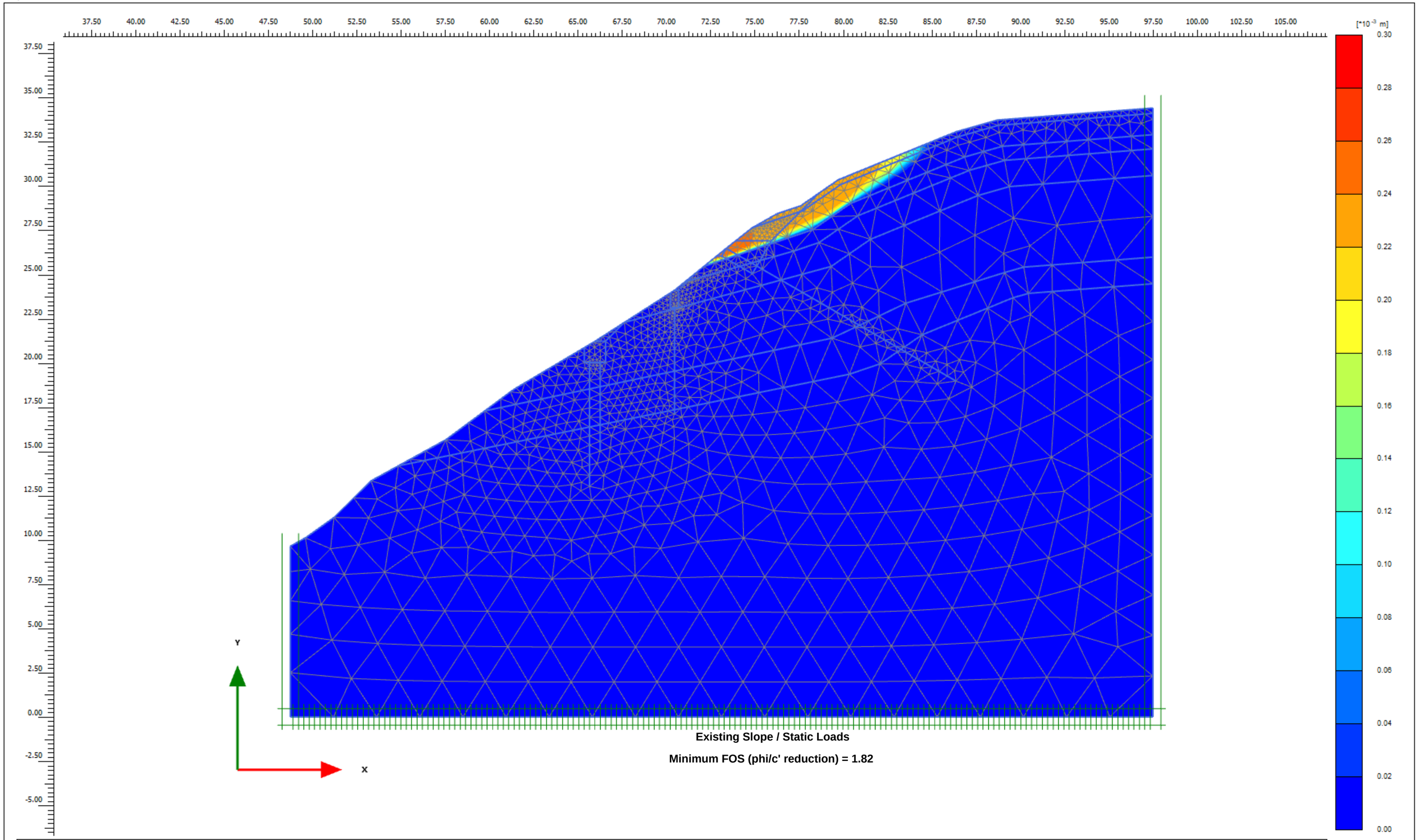
Drawn by: YW
Checked by: JVS

Kurnabinna Gully North, Bridge 02





CMW Geosciences	*Project description* Marion Costal Walkway Upgrade		*Date* 18/03/2022
	Project filename Kurnabinna Gully N, B02, Lon ...	*Step* 684	*Company* CMW Geosciences Pty Ltd



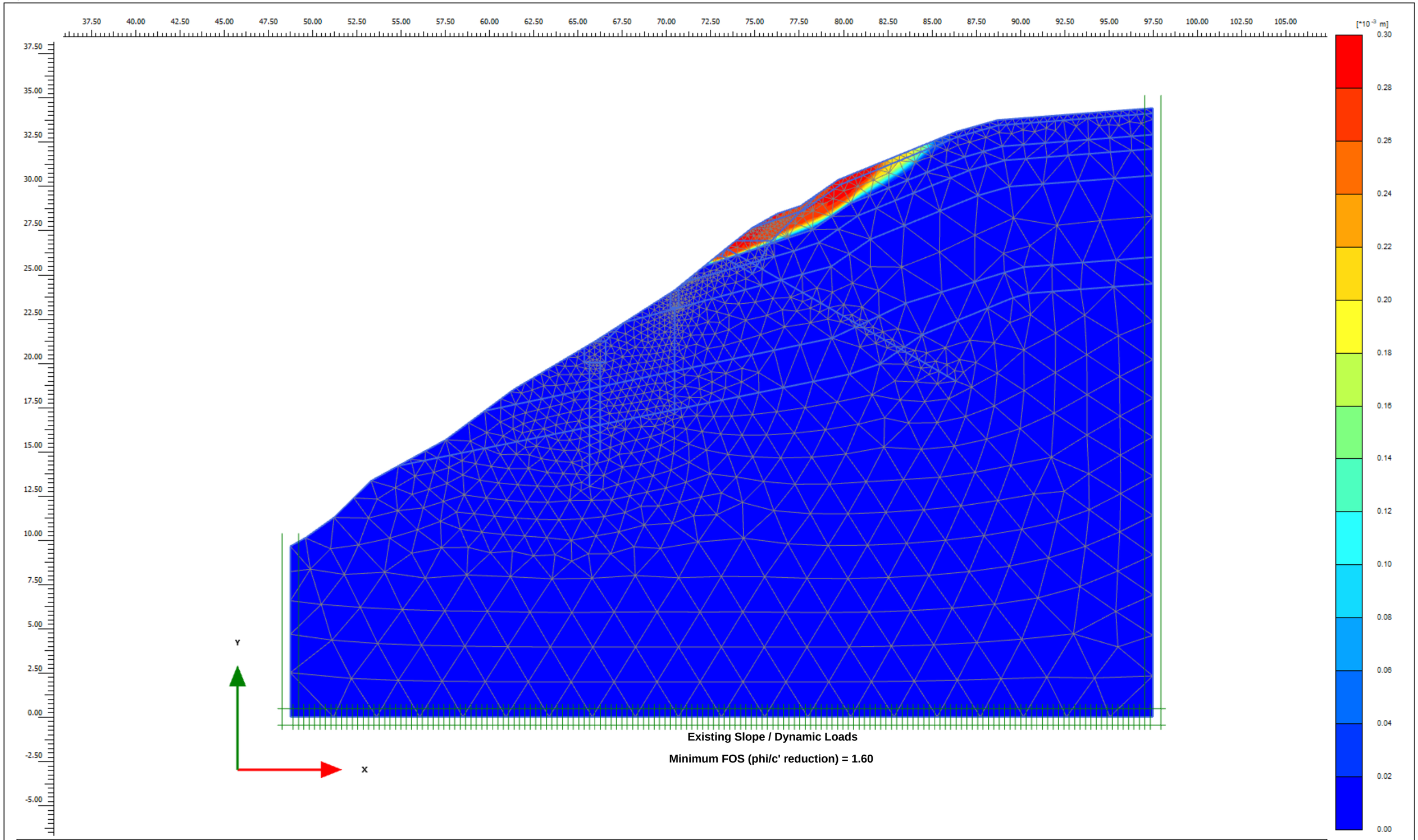
Existing Slope / Static Loads

Minimum FOS (phi/c' reduction) = 1.82

Incremental displacements |Δu| (scaled up 5.00*10 3 times)

Maximum value = 0.2926*10 -3 m (Element 564 at Node 4752)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 184	Company: CMW Geosciences Pty Ltd	



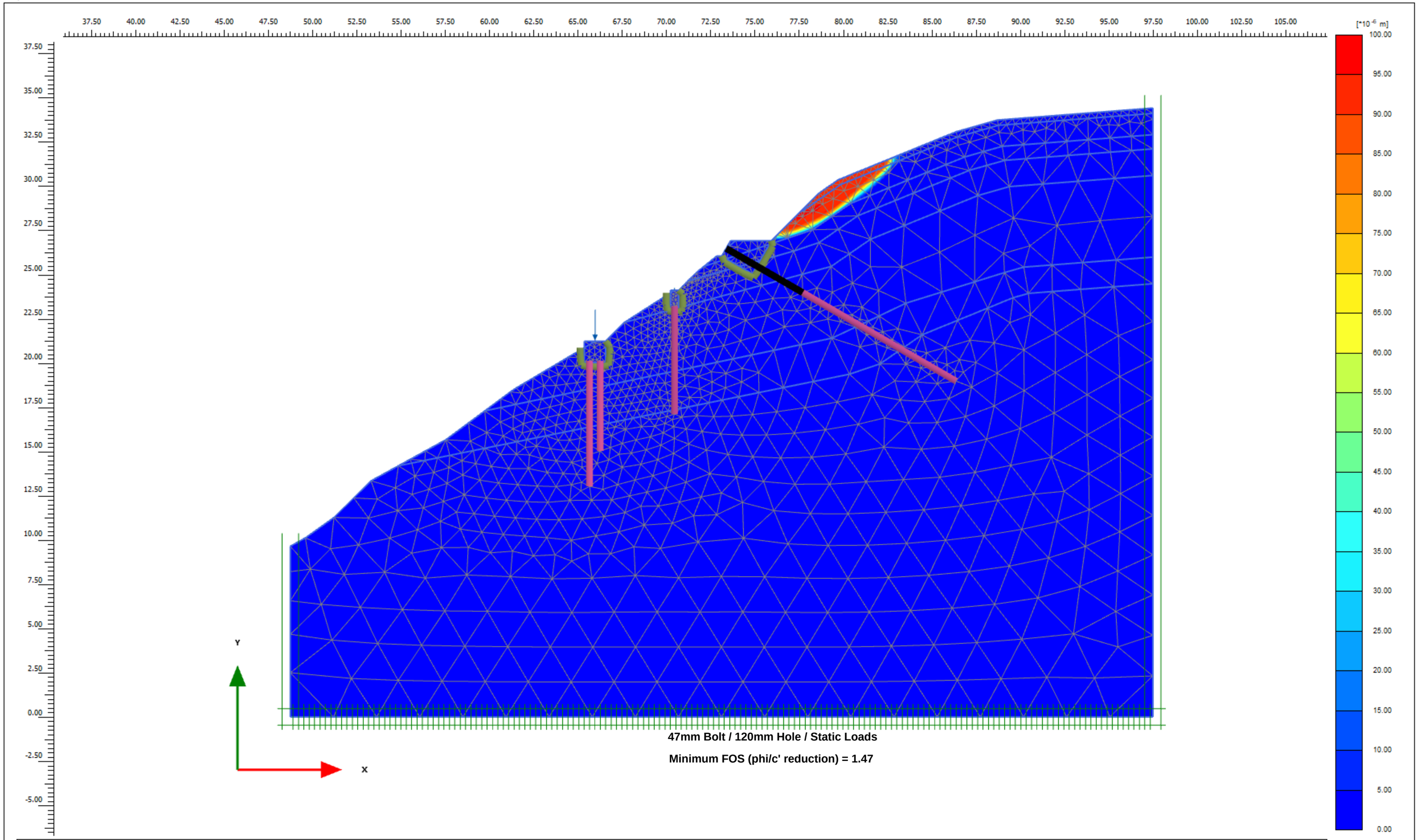
Existing Slope / Dynamic Loads

Minimum FOS (phi/c' reduction) = 1.60

Incremental displacements |Δu| (scaled up 5.00*10 3 times)

Maximum value = 0.2867*10 -3 m (Element 54 at Node 2040)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 284	Company: CMW Geosciences Pty Ltd	



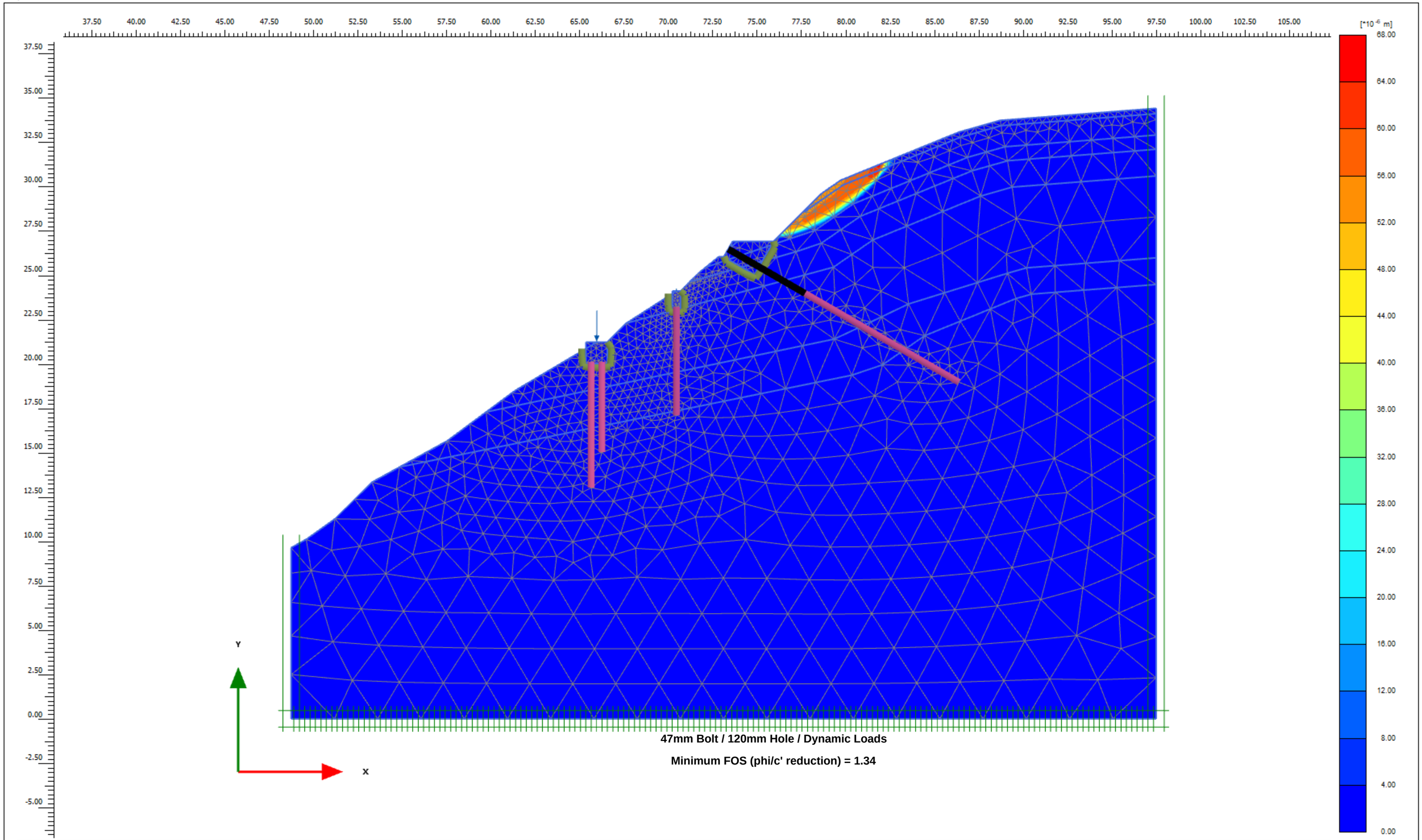
47mm Bolt / 120mm Hole / Static Loads

Minimum FOS (phi/c' reduction) = 1.47

Incremental displacements |Δu| (scaled up 20.0*10 3 times)

Maximum value = 0.09775*10 -3 m (Element 226 at Node 5199)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 384	Company: CMW Geosciences Pty Ltd	



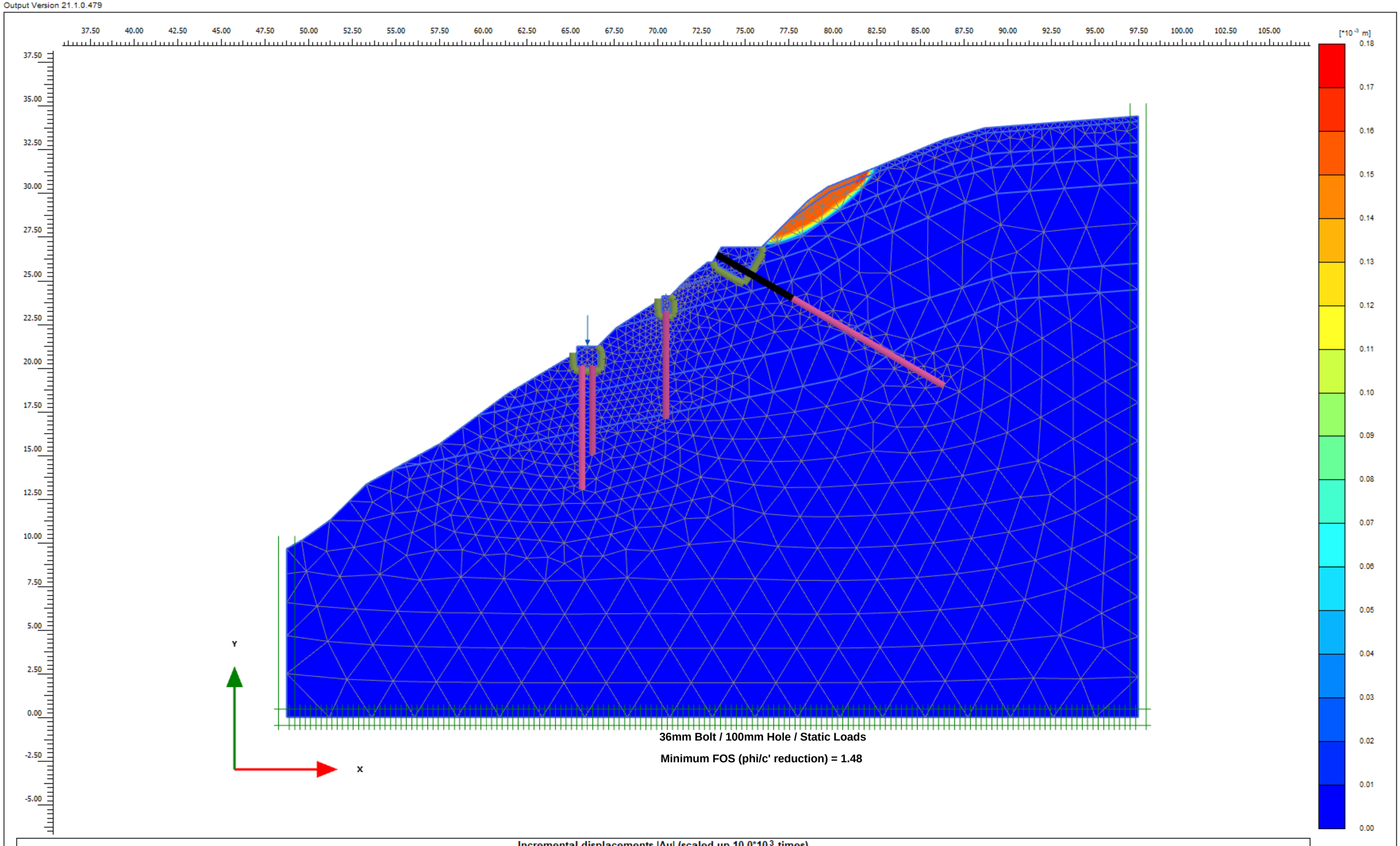
47mm Bolt / 120mm Hole / Dynamic Loads

Minimum FOS (phi/c' reduction) = 1.34

Incremental displacements |Δu| (scaled up $20.0*10^{3}$ times)

Maximum value = $0.06691*10^{-3}$ m (Element 53 at Node 2023)

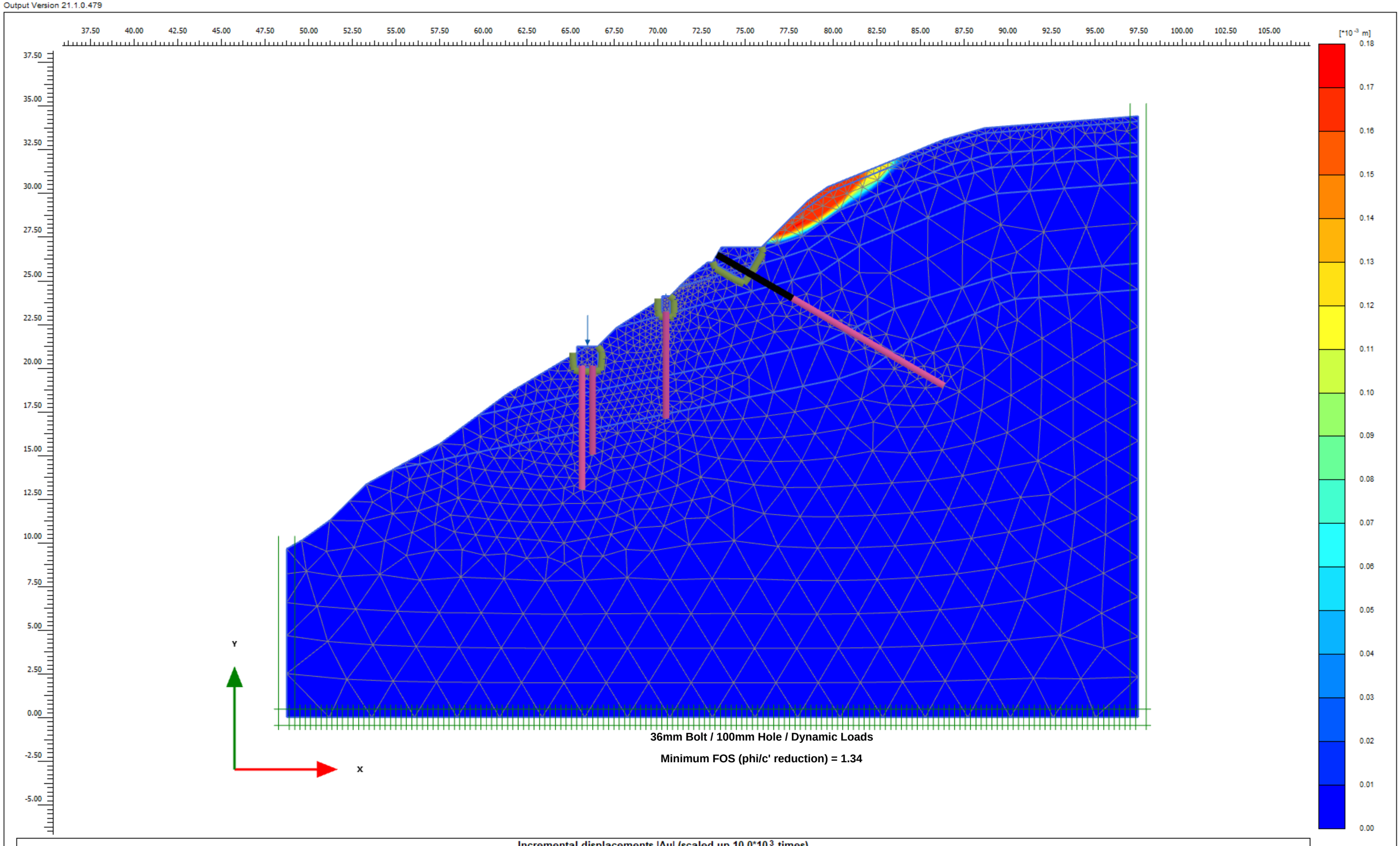
Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 484	Company: CMW Geosciences Pty Ltd	



Incremental displacements |Δu| (scaled up $10.0*10^{3}$ times)

Maximum value = $0.1705*10^{-3}$ m (Element 53 at Node 2023)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 584	Company: CMW Geosciences Pty Ltd	



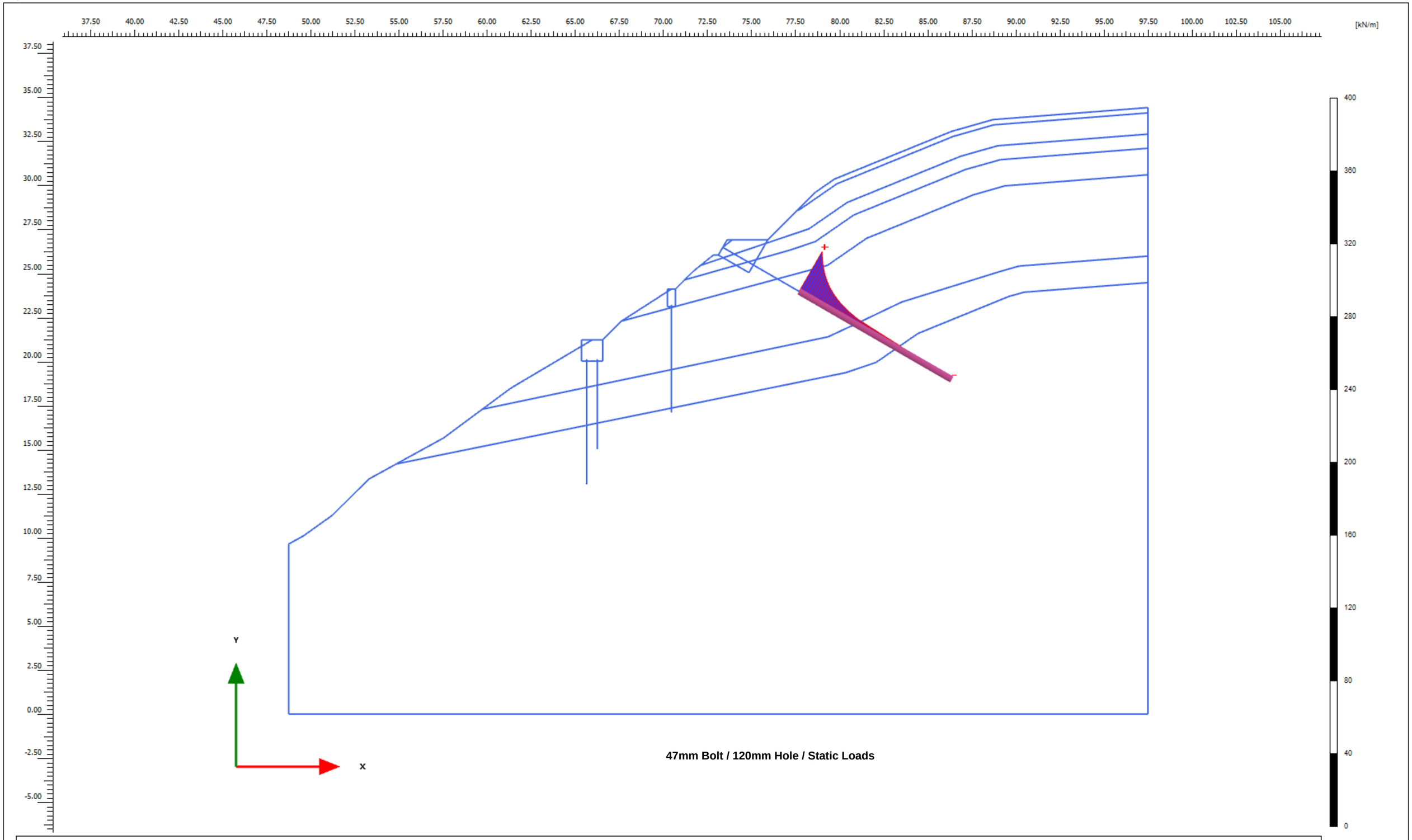
36mm Bolt / 100mm Hole / Dynamic Loads

Minimum FOS (phi/c' reduction) = 1.34

Incremental displacements |Δu| (scaled up $10.0*10^{3}$ times)

Maximum value = $0.1724*10^{-3}$ m (Element 119 at Node 5787)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 684	Company: CMW Geosciences Pty Ltd	

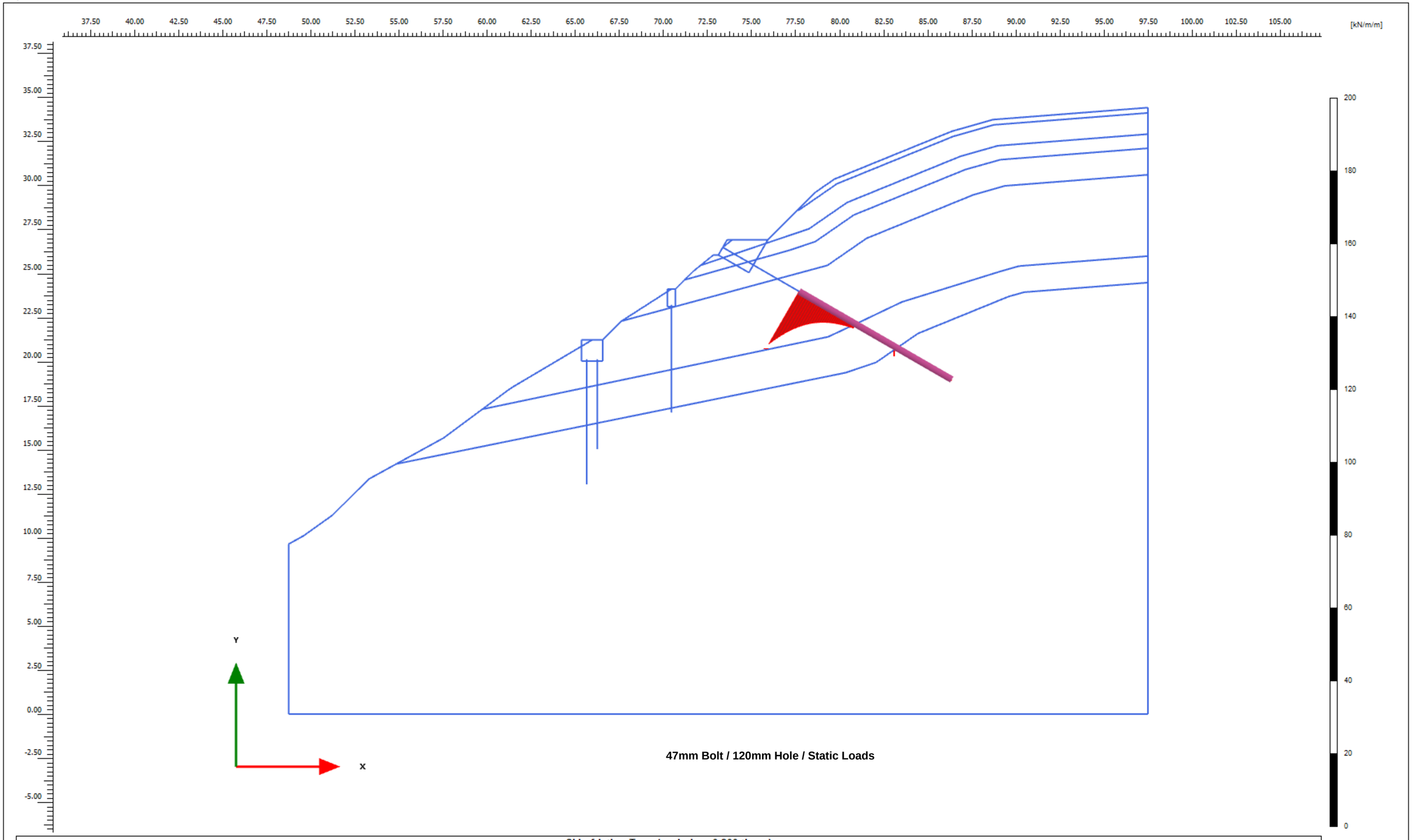


Axial forces N (scaled up 0.100 times)

Maximum value = 26.16 kN/m (Element 23 at Node 19637)

Minimum value = $0.3356*10^{-3}$ kN/m (Element 46 at Node 19733)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 23	Company: CMW Geosciences Pty Ltd	

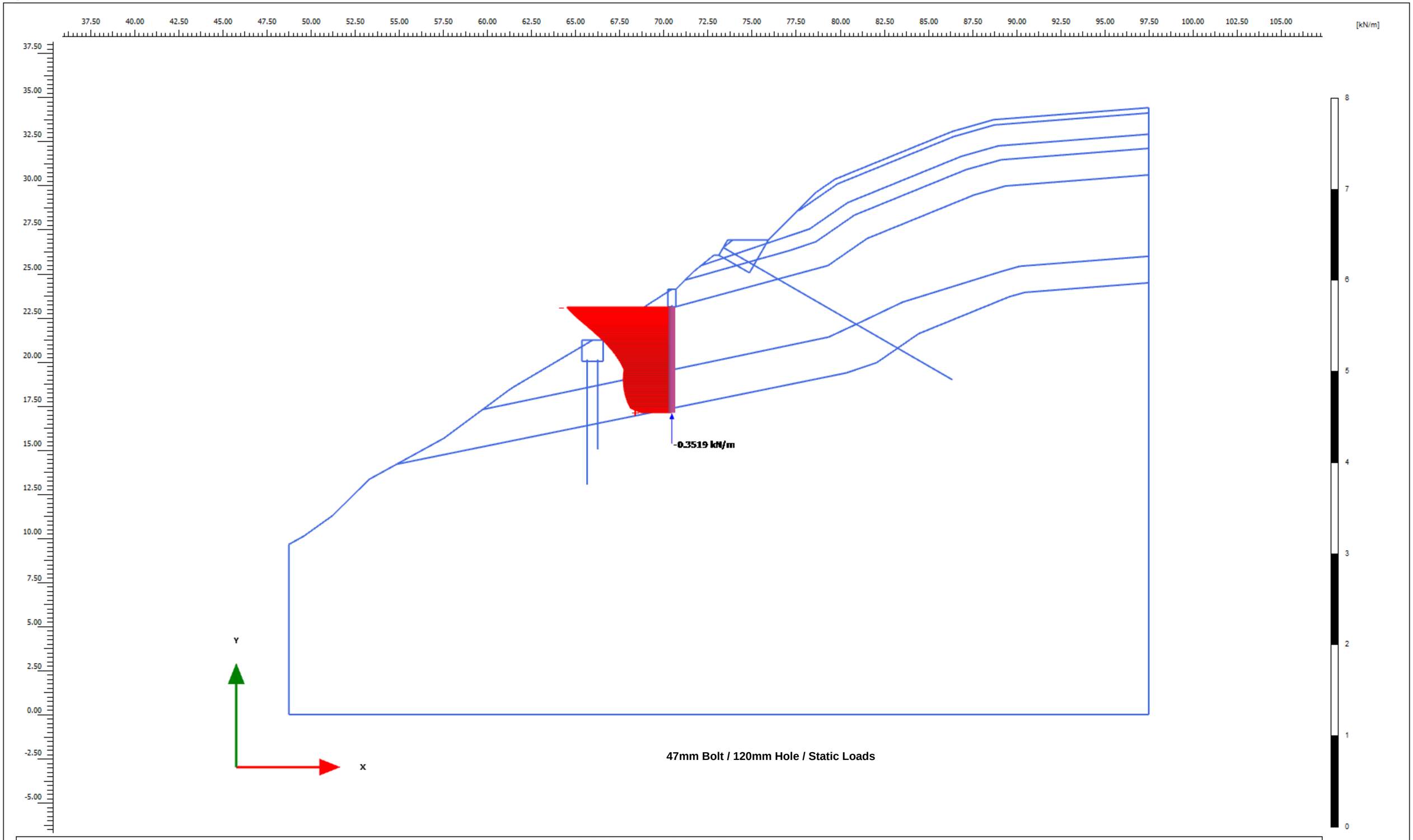


Skin friction T_{skin} (scaled up 0.200 times)

Maximum value = -0.3236 kN/m/m (Element 38 at Node 19701)

Minimum value = -17.24 kN/m/m (Element 23 at Node 19637)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 23	Company: CMW Geosciences Pty Ltd	

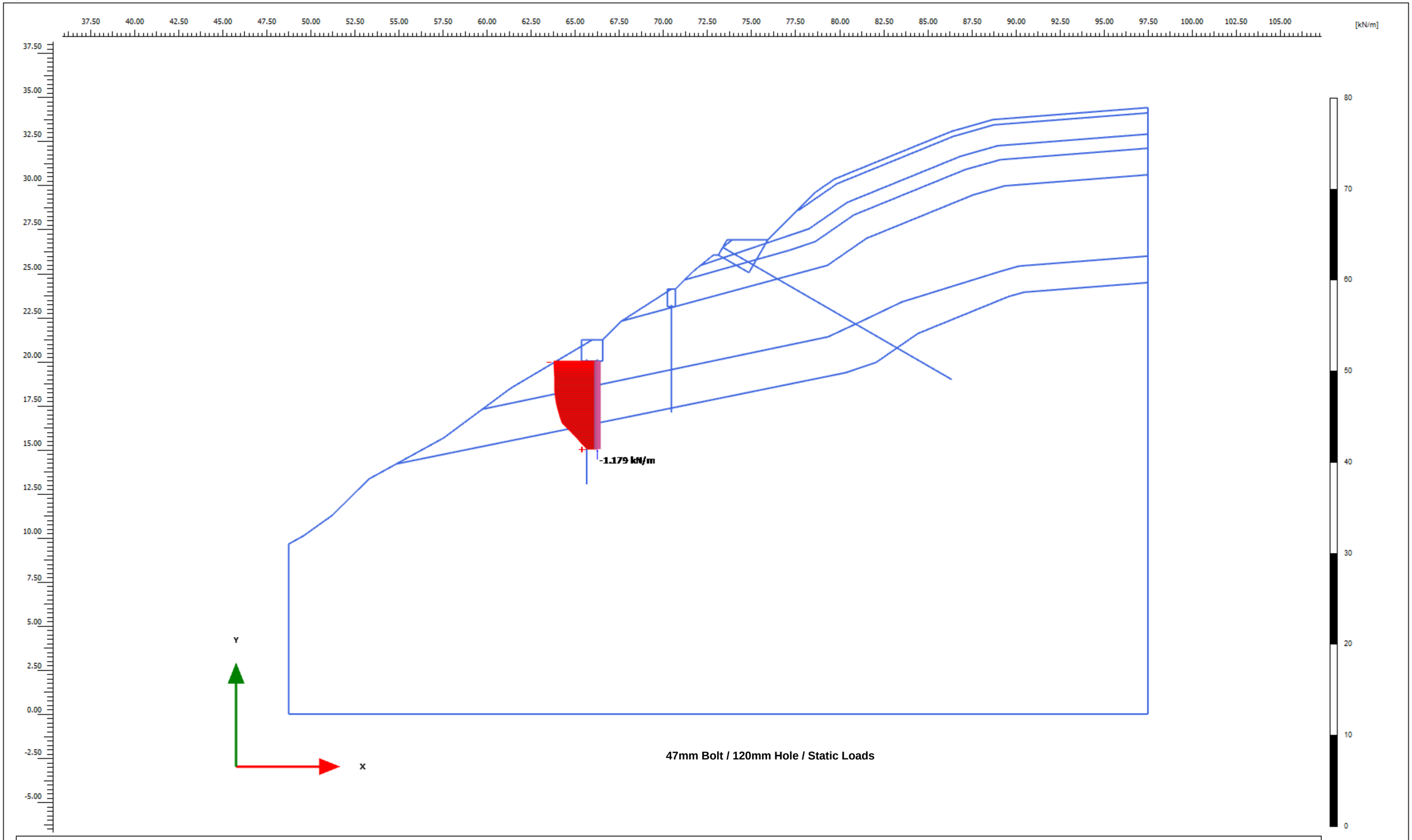


Axial forces N (scaled up 5.00 times)

Maximum value = -0.3519 kN/m (Element 22 at Node 19636)

Minimum value = -1.187 kN/m (Element 2 at Node 19556)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 23	Company: CMW Geosciences Pty Ltd	

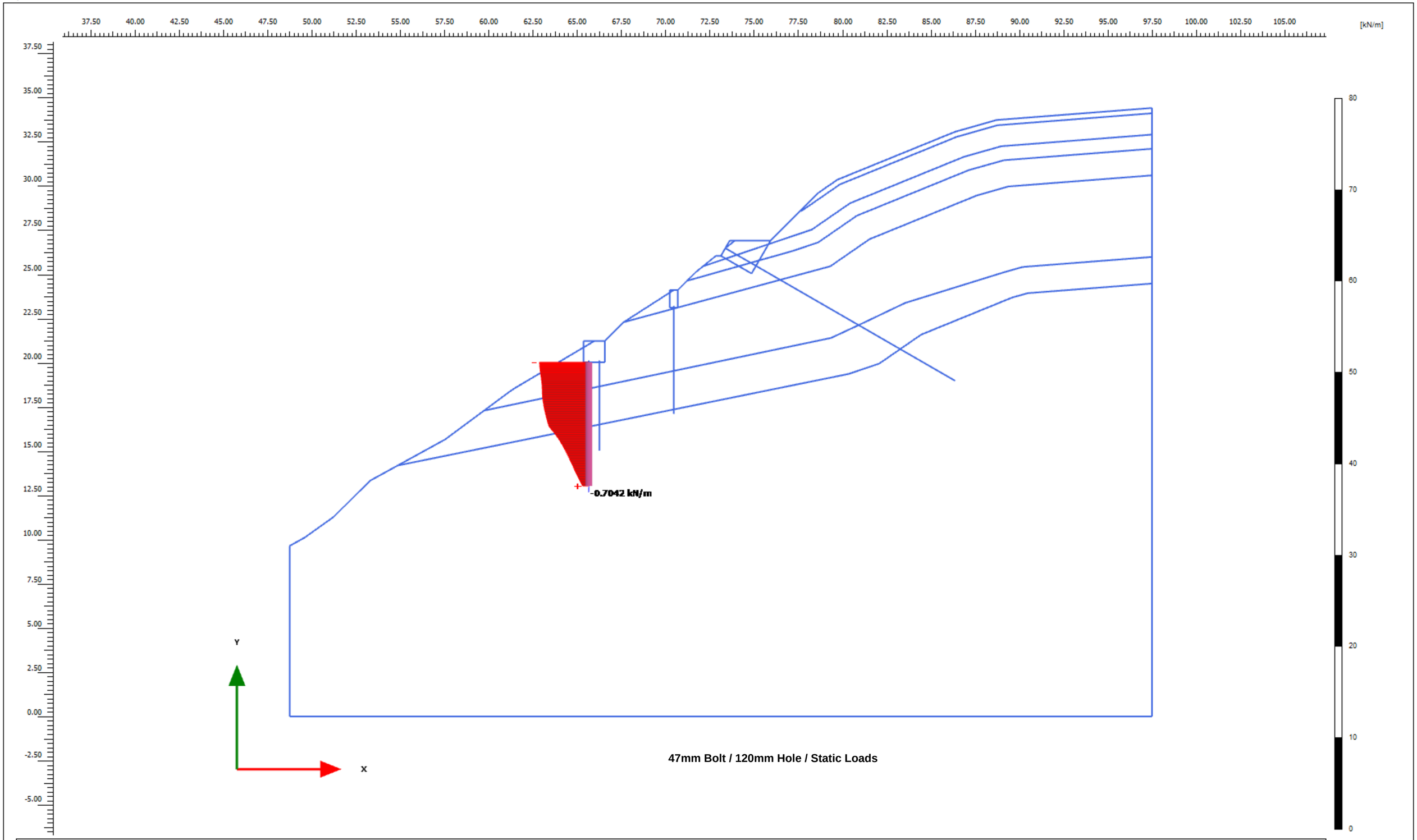


Axial forces N (scaled up 0.500 times)

Maximum value = -1.179 kN/m (Element 76 at Node 19857)

Minimum value = -4.919 kN/m (Element 64 at Node 19806)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 23	Company: CMW Geosciences Pty Ltd	

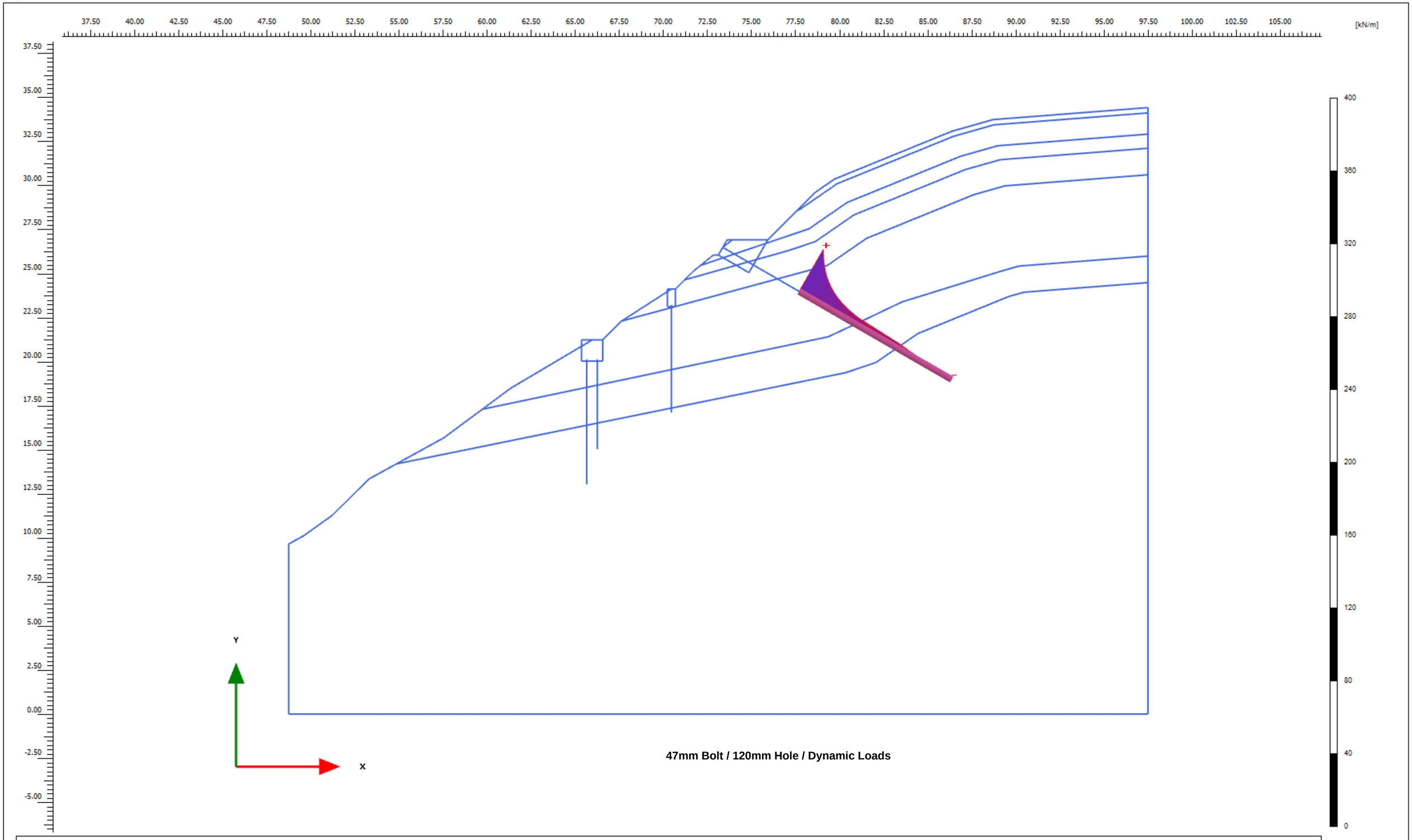


Axial forces N (scaled up 0.500 times)

Maximum value = -0.7046 kN/m (Element 62 at Node 19799)

Minimum value = -5.567 kN/m (Element 48 at Node 19738)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 23	Company: CMW Geosciences Pty Ltd	

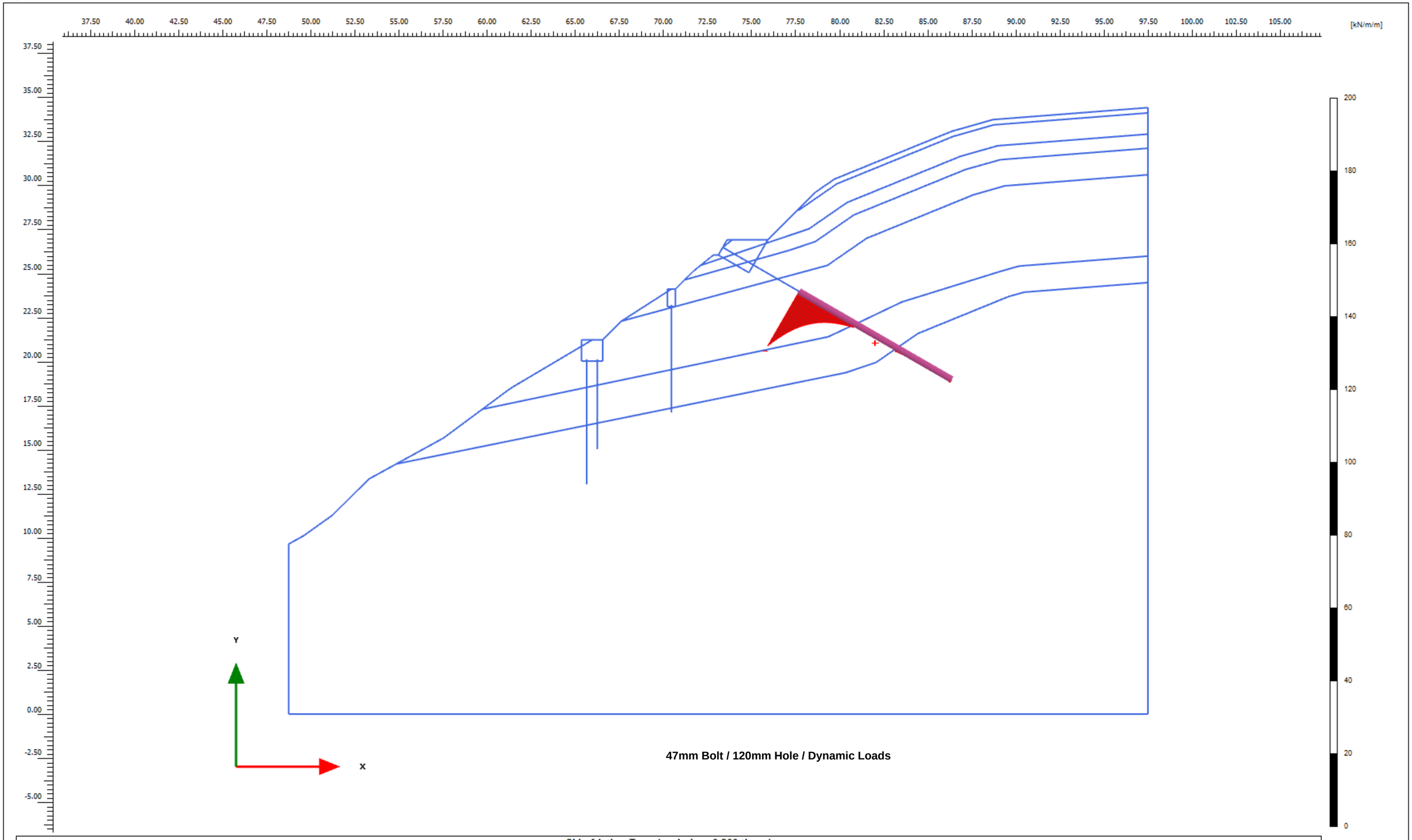


Axial forces N (scaled up 0.100 times)

Maximum value = 27.46 kN/m (Element 23 at Node 19637)

Minimum value = $0.6250*10^{-3}$ kN/m (Element 46 at Node 19733)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 44	Company: CMW Geosciences Pty Ltd	

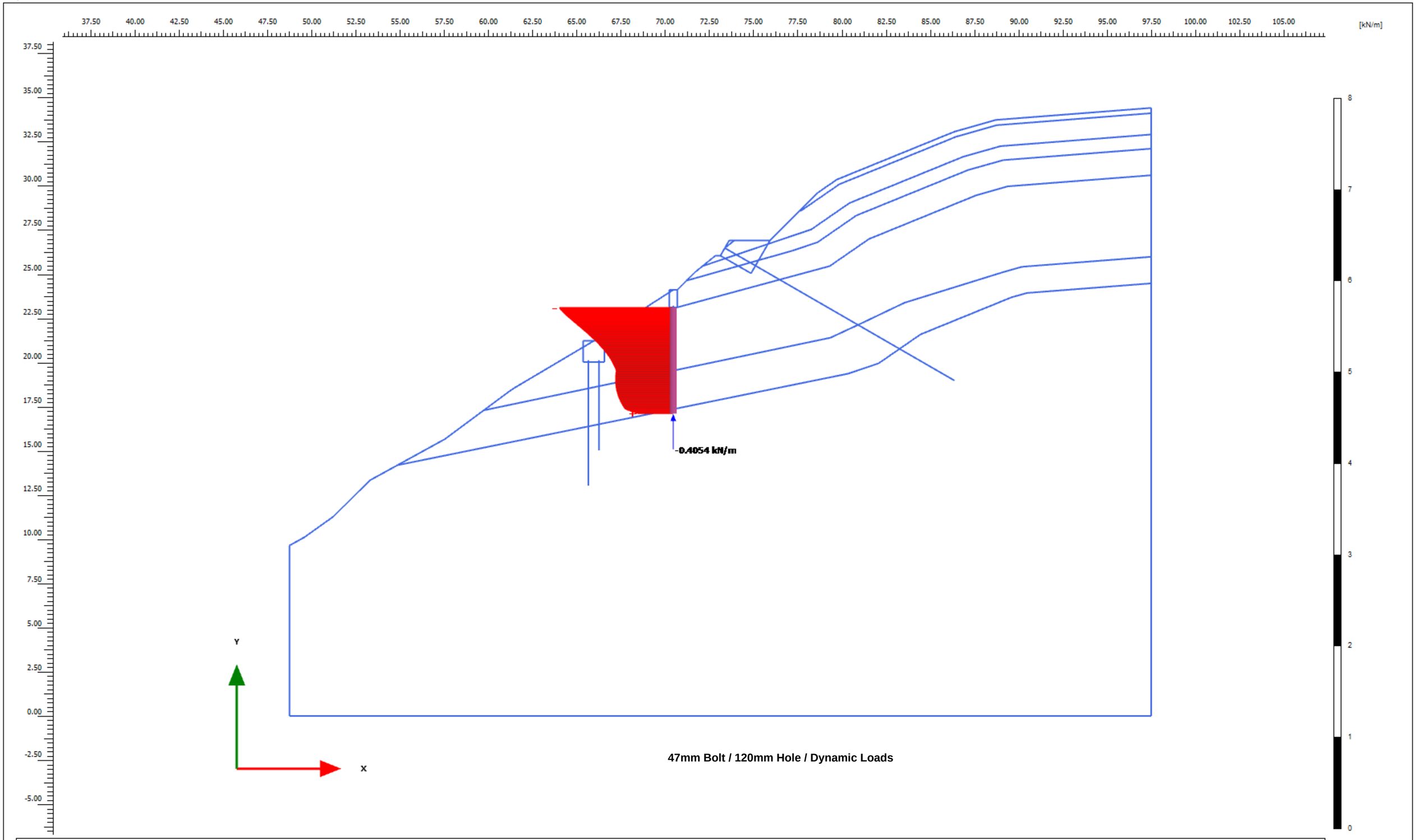


Skin friction T_{skin} (scaled up 0.200 times)

Maximum value = -0.3554 kN/m/m (Element 35 at Node 19687)

Minimum value = -17.89 kN/m/m (Element 23 at Node 19637)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 44	Company: CMW Geosciences Pty Ltd	



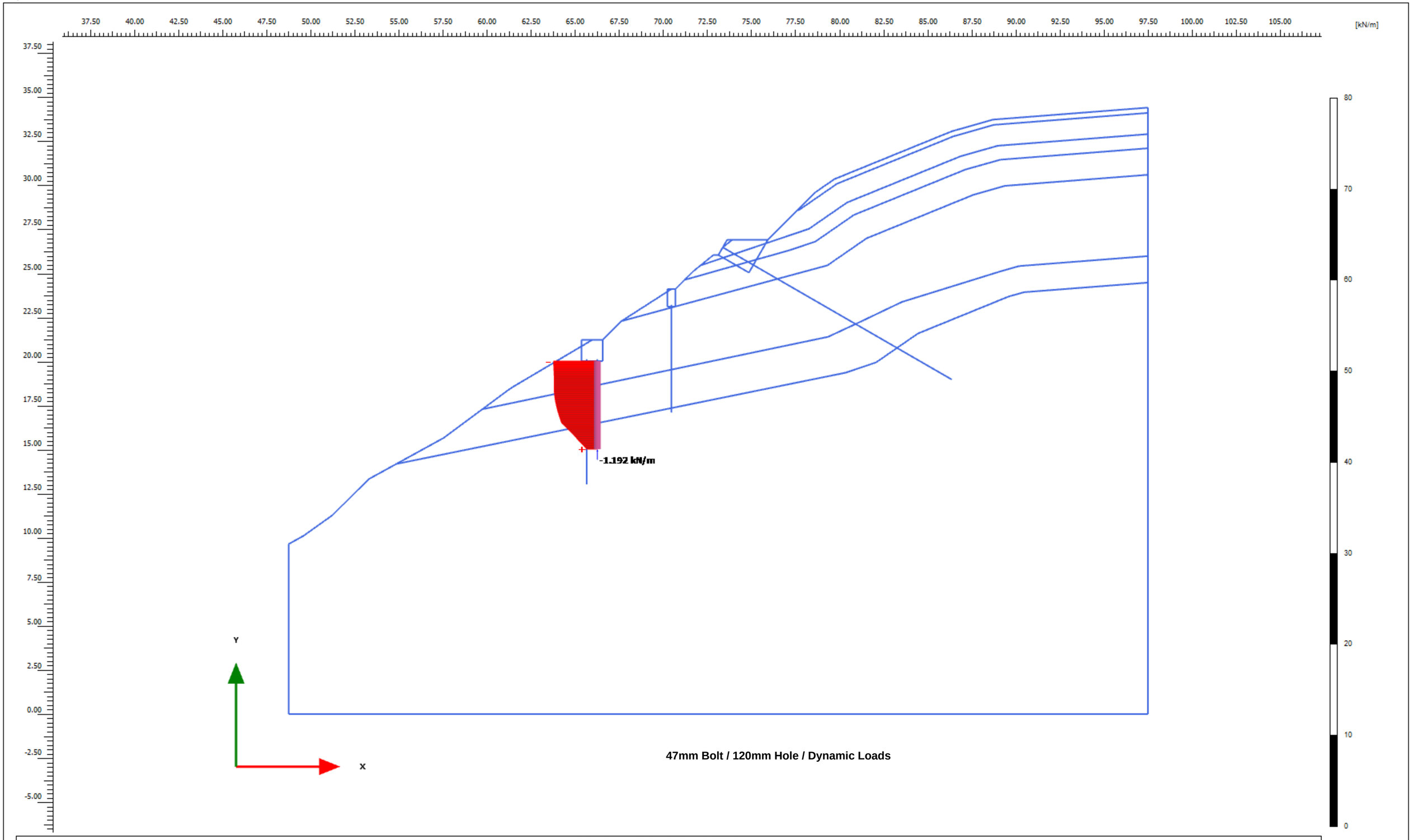
47mm Bolt / 120mm Hole / Dynamic Loads

Axial forces N (scaled up 5.00 times)

Maximum value = -0.4054 kN/m (Element 22 at Node 19636)

Minimum value = -1.285 kN/m (Element 2 at Node 19556)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 44	Company: CMW Geosciences Pty Ltd	

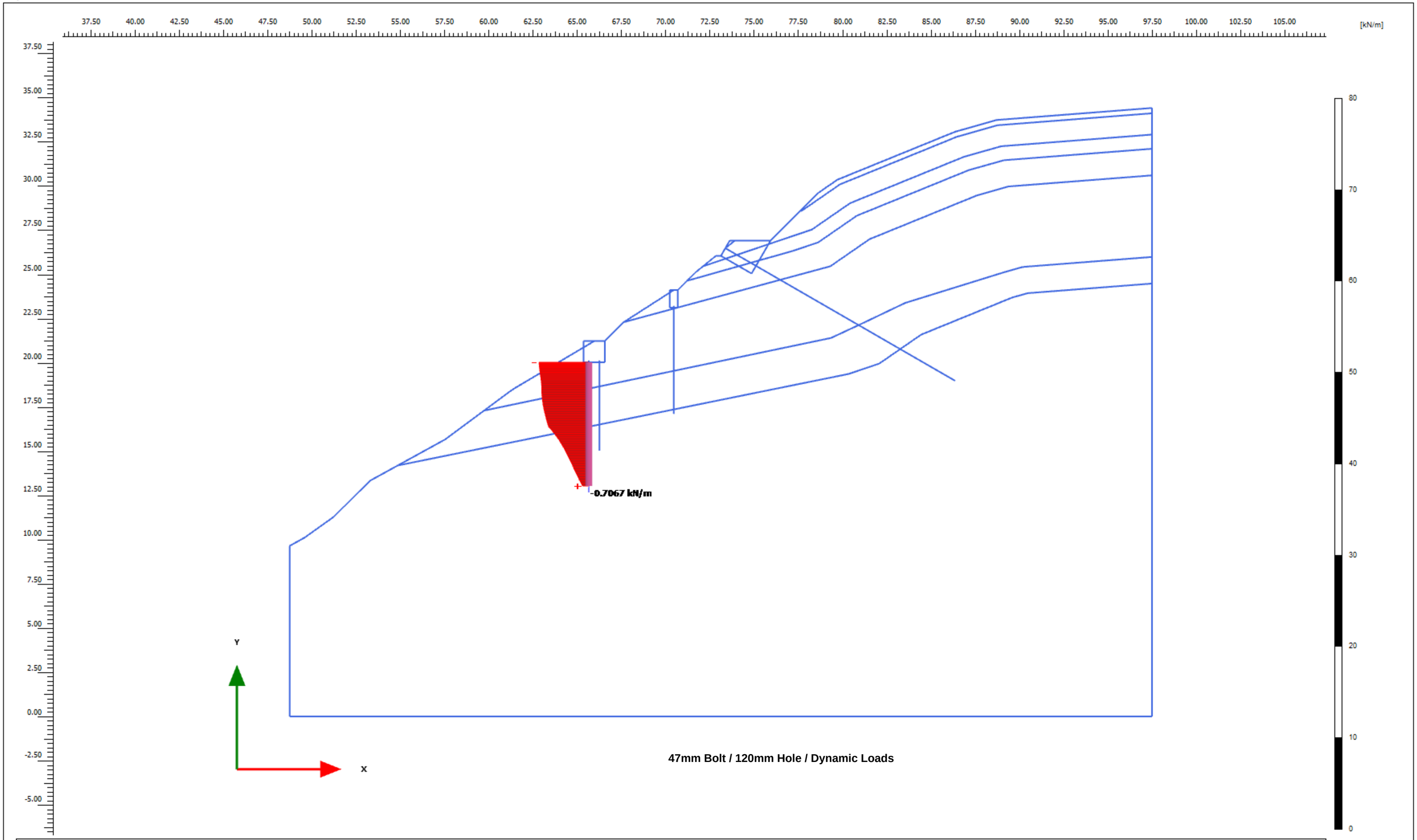


Axial forces N (scaled up 0.500 times)

Maximum value = -1.192 kN/m (Element 76 at Node 19857)

Minimum value = -4.952 kN/m (Element 64 at Node 19806)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 44	Company: CMW Geosciences Pty Ltd	

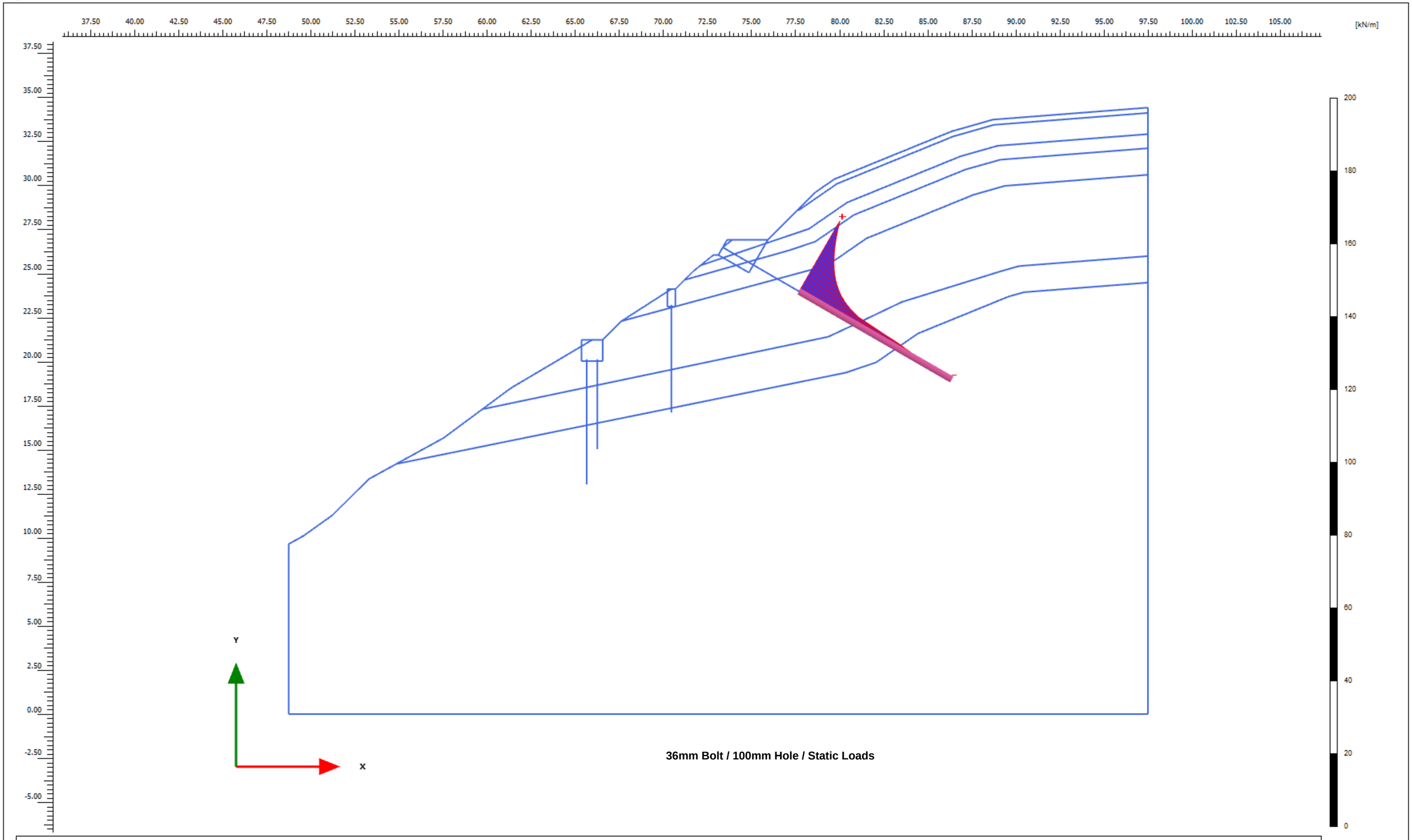


Axial forces N (scaled up 0.500 times)

Maximum value = -0.7070 kN/m (Element 62 at Node 19799)

Minimum value = -5.615 kN/m (Element 48 at Node 19738)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 44	Company: CMW Geosciences Pty Ltd	

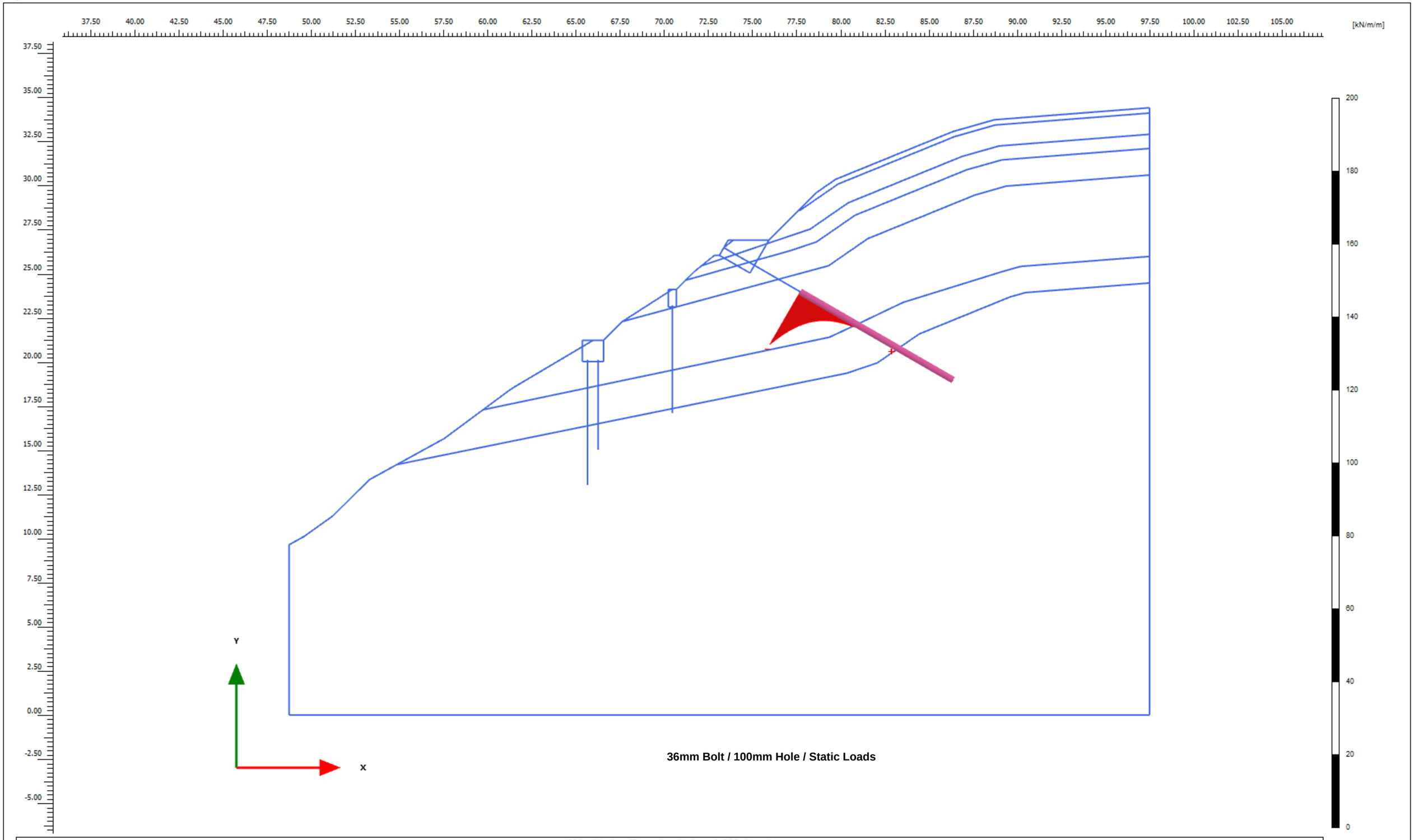


Axial forces N (scaled up 0.200 times)

Maximum value = 23.10 kN/m (Element 23 at Node 19637)

Minimum value = $0.2796*10^{-3}$ kN/m (Element 46 at Node 19733)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 66	Company: CMW Geosciences Pty Ltd	

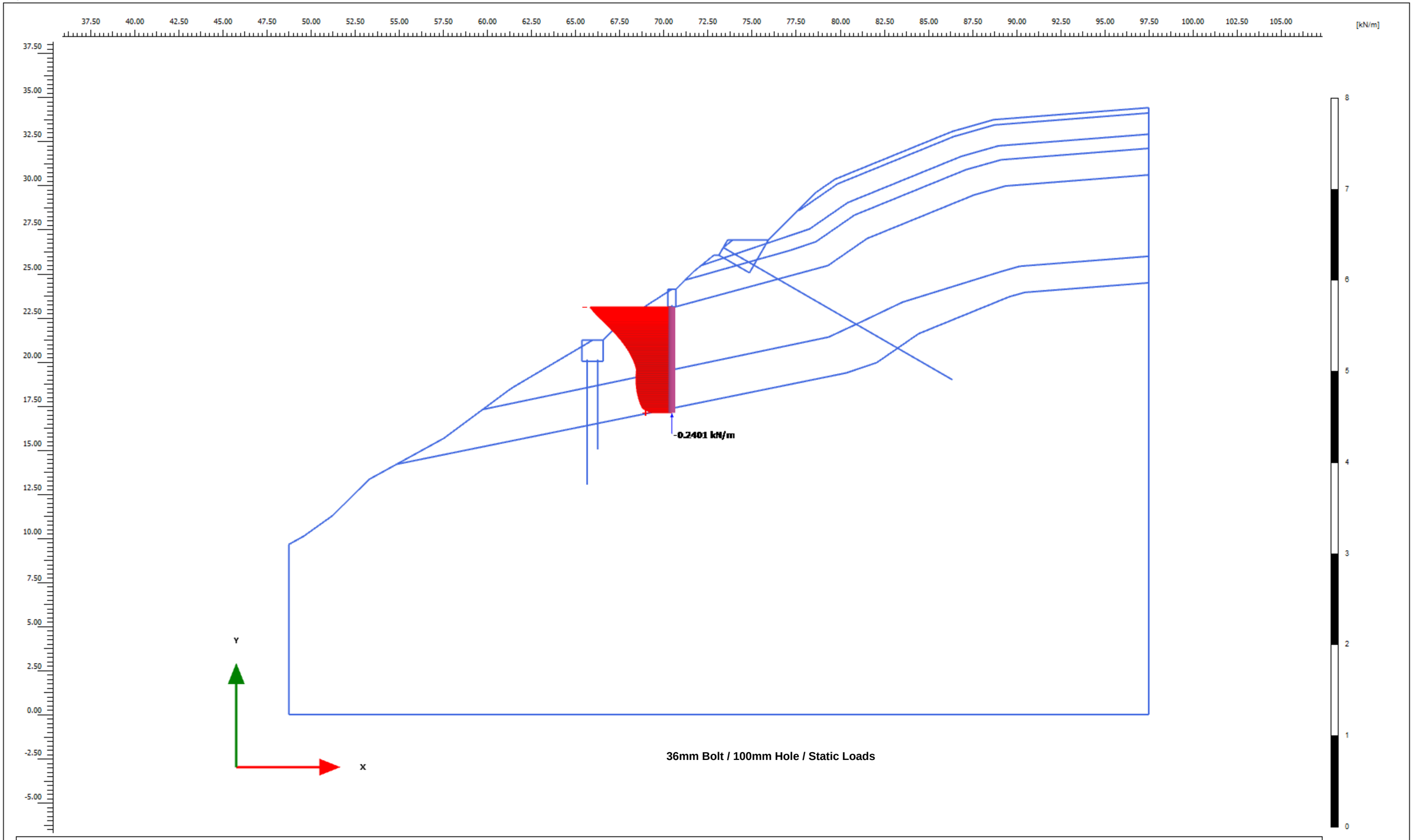


Skin friction T_{skin} (scaled up 0.200 times)

Maximum value = -0.2307 kN/m/m (Element 38 at Node 19698)

Minimum value = -17.25 kN/m/m (Element 23 at Node 19637)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 66	Company: CMW Geosciences Pty Ltd	

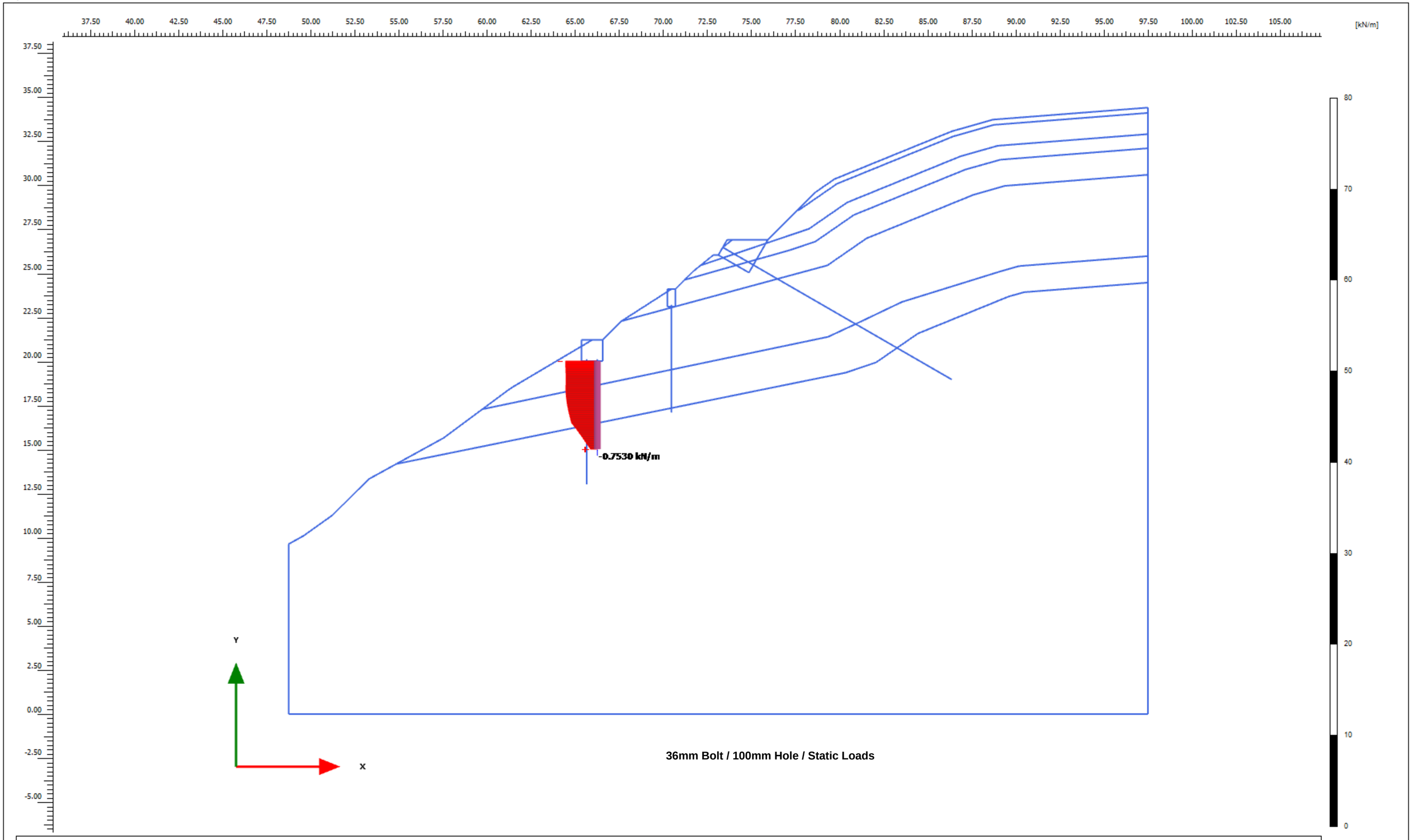


Axial forces N (scaled up 5.00 times)

Maximum value = -0.2401 kN/m (Element 22 at Node 19636)

Minimum value = -0.9242 kN/m (Element 2 at Node 19553)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 66	Company: CMW Geosciences Pty Ltd	

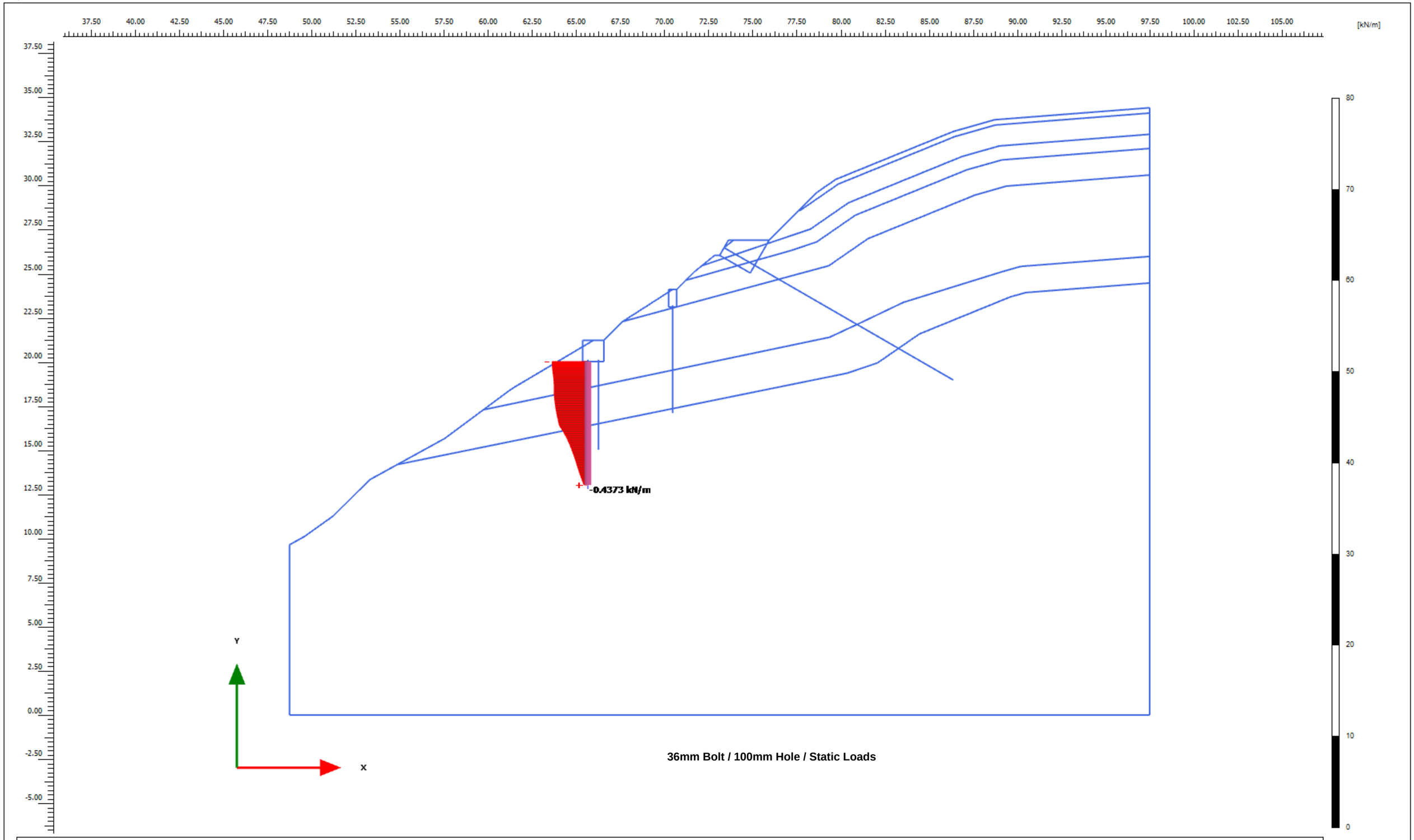


Axial forces N (scaled up 0.500 times)

Maximum value = -0.7536 kN/m (Element 76 at Node 19857)

Minimum value = -3.602 kN/m (Element 64 at Node 19804)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 66	Company: CMW Geosciences Pty Ltd	

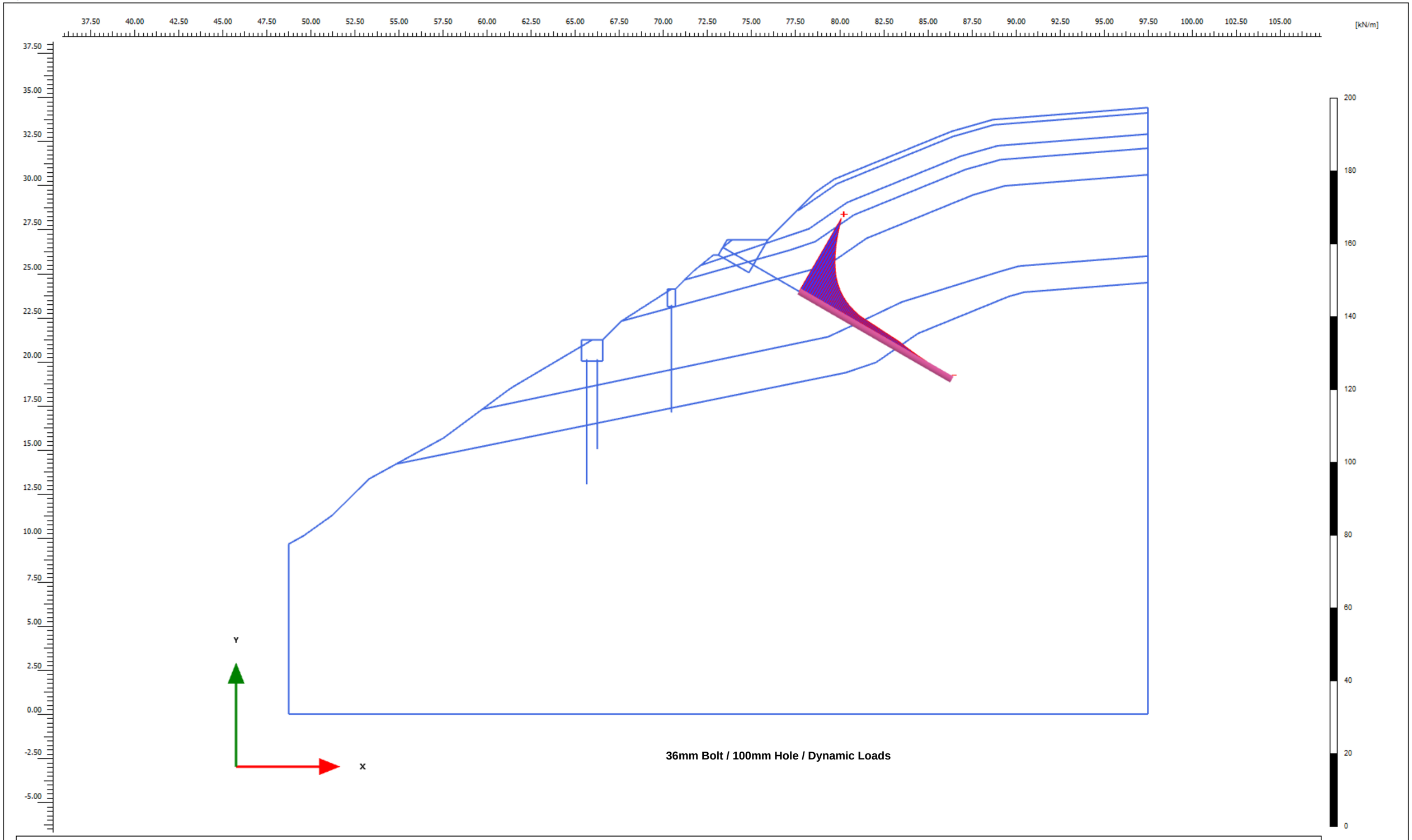


Axial forces N (scaled up 0.500 times)

Maximum value = -0.4378 kN/m (Element 62 at Node 19799)

Minimum value = -4.062 kN/m (Element 48 at Node 19738)

CMW Geosciences	Project description: Marion Costal Walkway Upgrade		Date: 18/03/2022
	Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 66	Company: CMW Geosciences Pty Ltd

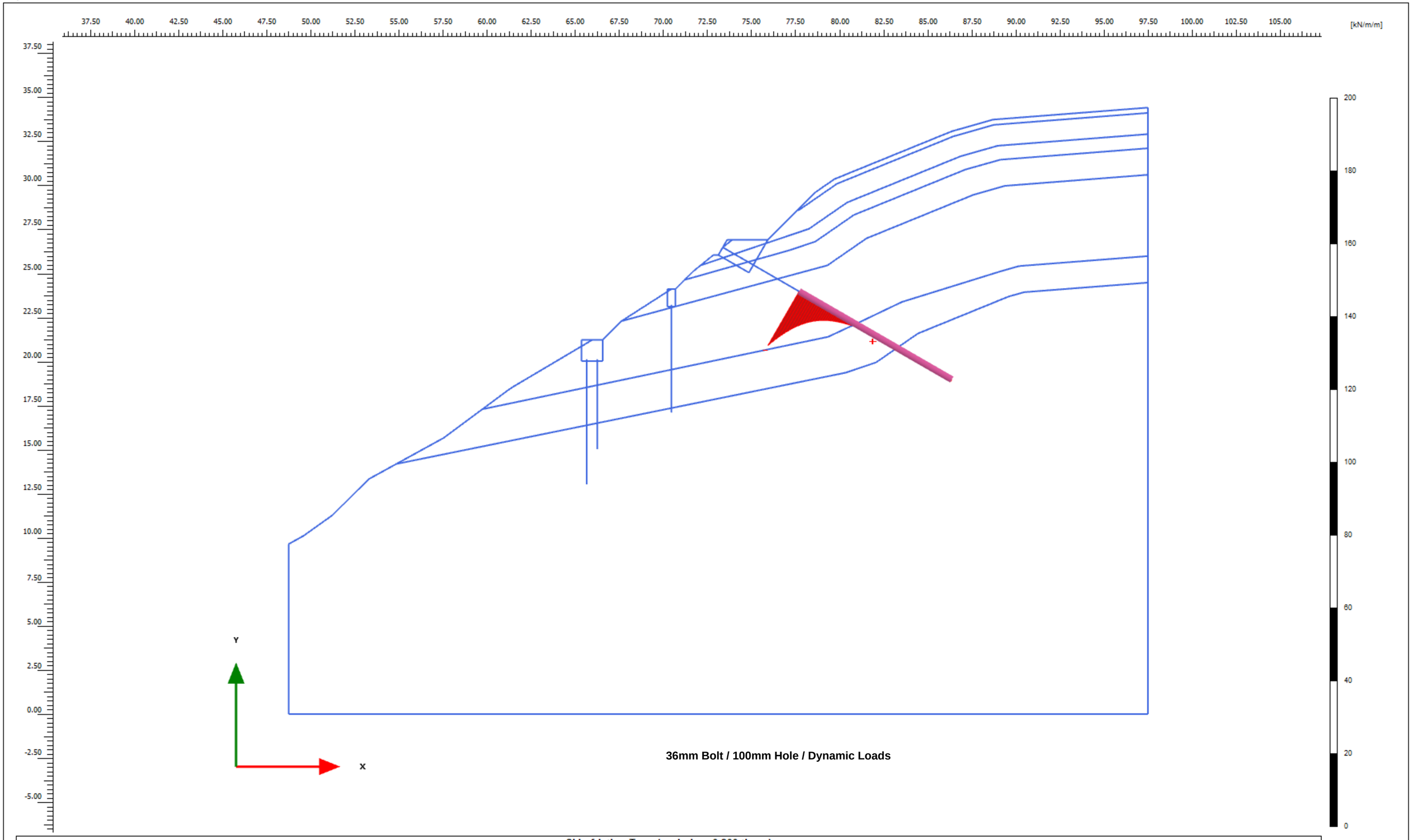


Axial forces N (scaled up 0.200 times)

Maximum value = 23.98 kN/m (Element 23 at Node 19637)

Minimum value = $0.5405*10^{-3}$ kN/m (Element 46 at Node 19733)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 84	Company: CMW Geosciences Pty Ltd	

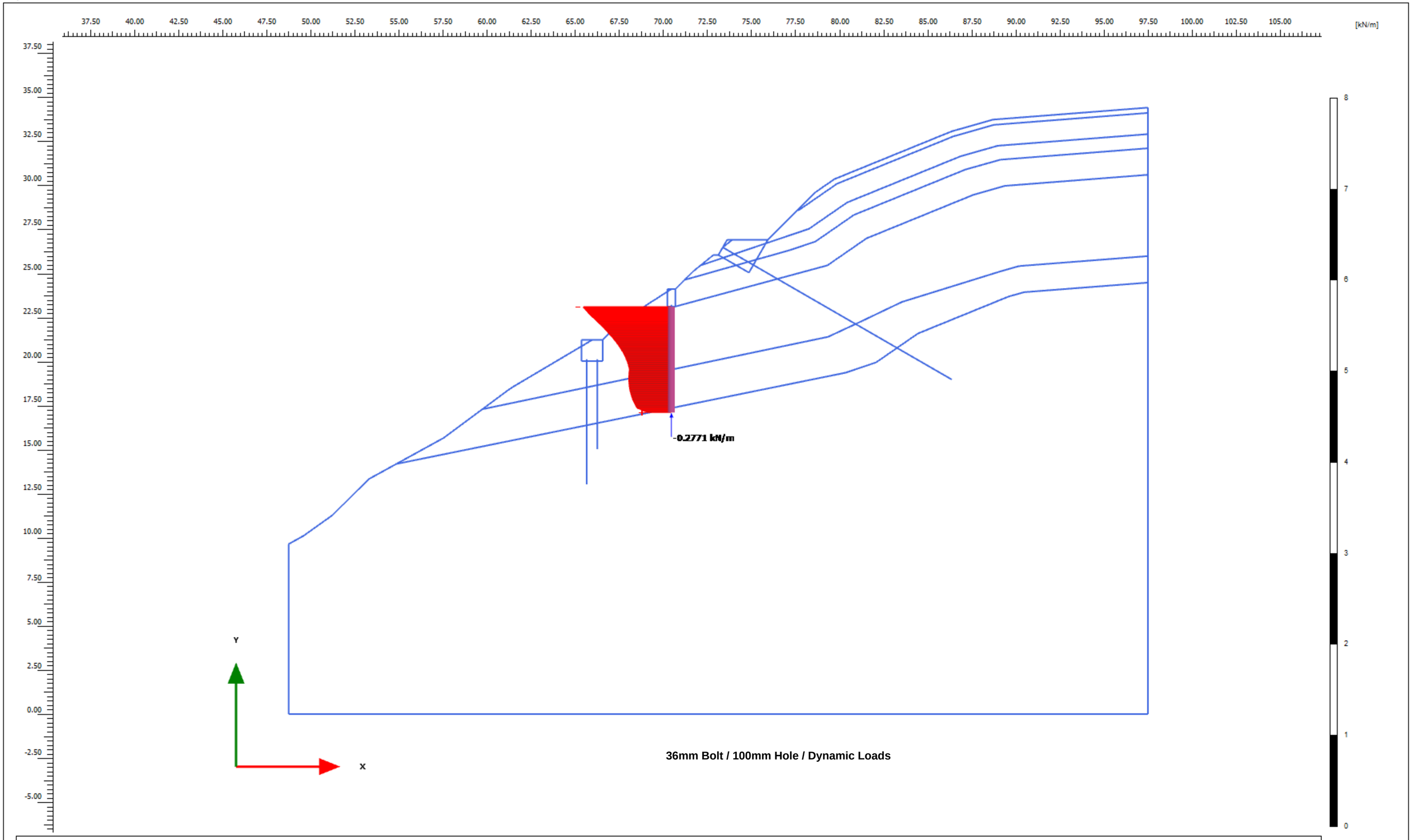


Skin friction T_{skin} (scaled up 0.200 times)

Maximum value = -0.2423 kN/m/m (Element 34 at Node 19685)

Minimum value = -17.75 kN/m/m (Element 23 at Node 19637)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 84	Company: CMW Geosciences Pty Ltd	

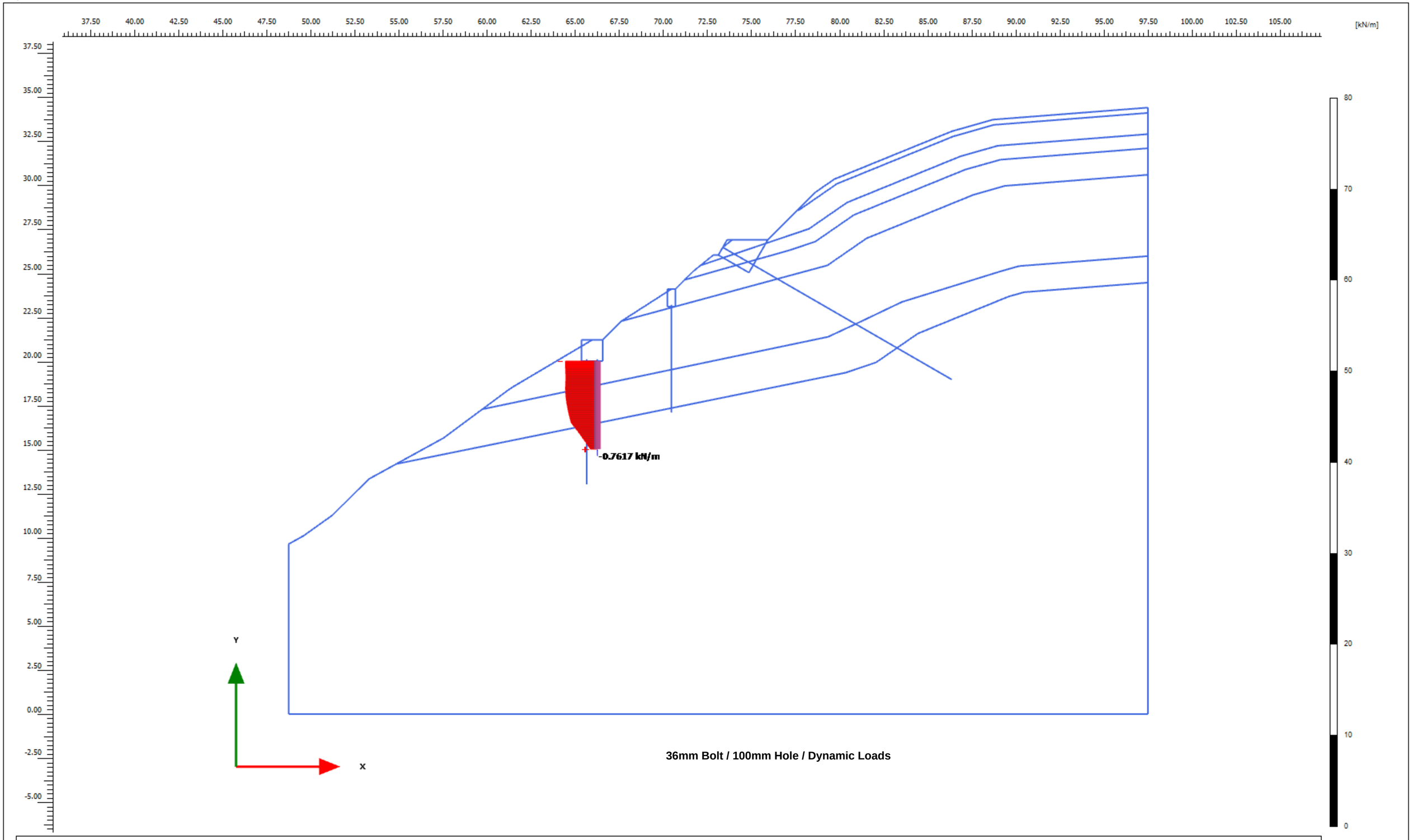


Axial forces N (scaled up 5.00 times)

Maximum value = -0.2771 kN/m (Element 22 at Node 19636)

Minimum value = -0.9975 kN/m (Element 2 at Node 19551)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 84	Company: CMW Geosciences Pty Ltd	

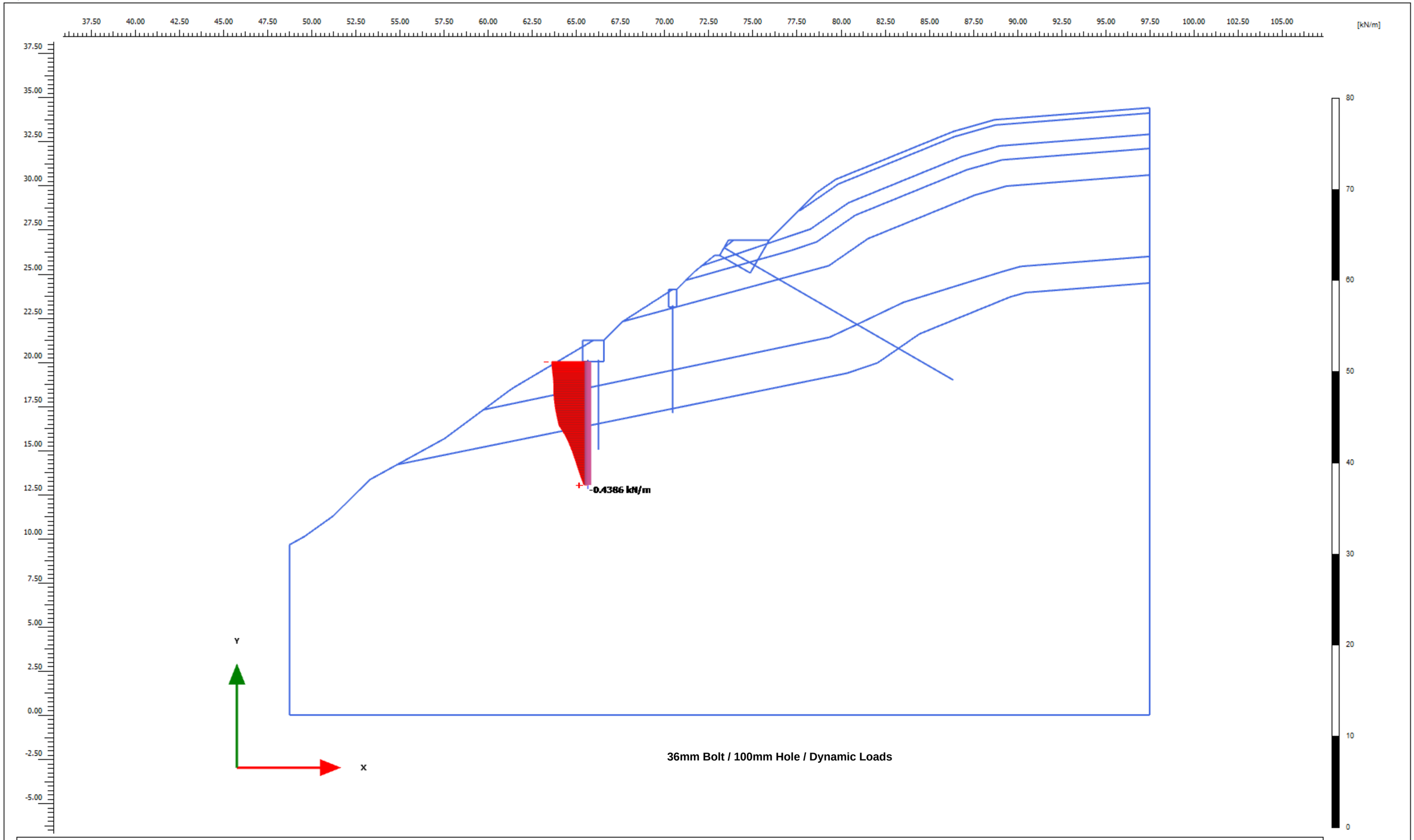


Axial forces N (scaled up 0.500 times)

Maximum value = -0.7622 kN/m (Element 76 at Node 19857)

Minimum value = -3.625 kN/m (Element 64 at Node 19804)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 84	Company: CMW Geosciences Pty Ltd	



Axial forces N (scaled up 0.500 times)

Maximum value = -0.4390 kN/m (Element 62 at Node 19799)

Minimum value = -4.097 kN/m (Element 48 at Node 19738)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully N, B02, Lon, Est_RevA	Step: 84	Company: CMW Geosciences Pty Ltd	

-140.00 -120.00 -100.00 -80.00 -60.00 -40.00

40.00

20.00

0.00

Project Name: Coastal Trail Design
Description: Model Layout
Date: 18/03/2022

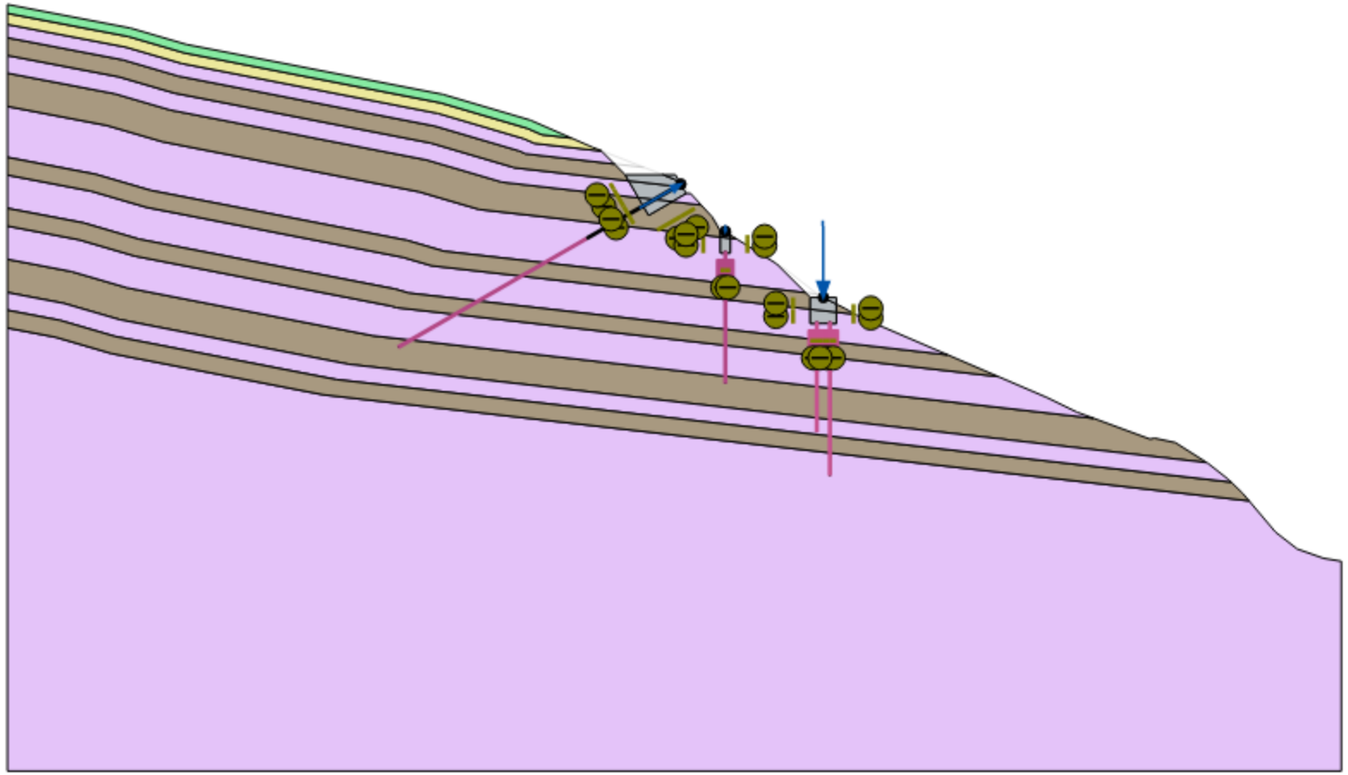
Drawn by: YW
Checked by: JVS

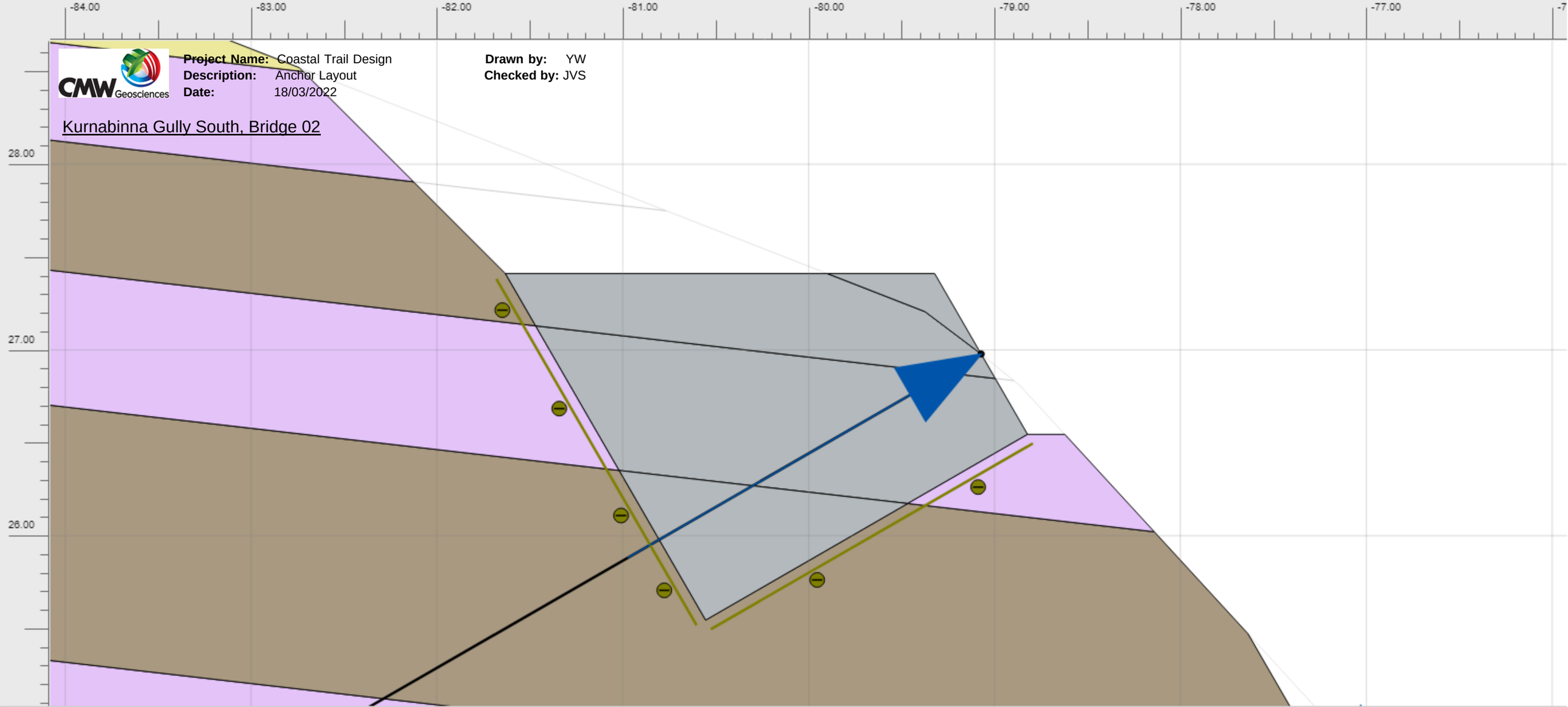
Kurnabinna Gully South, Bridge 02

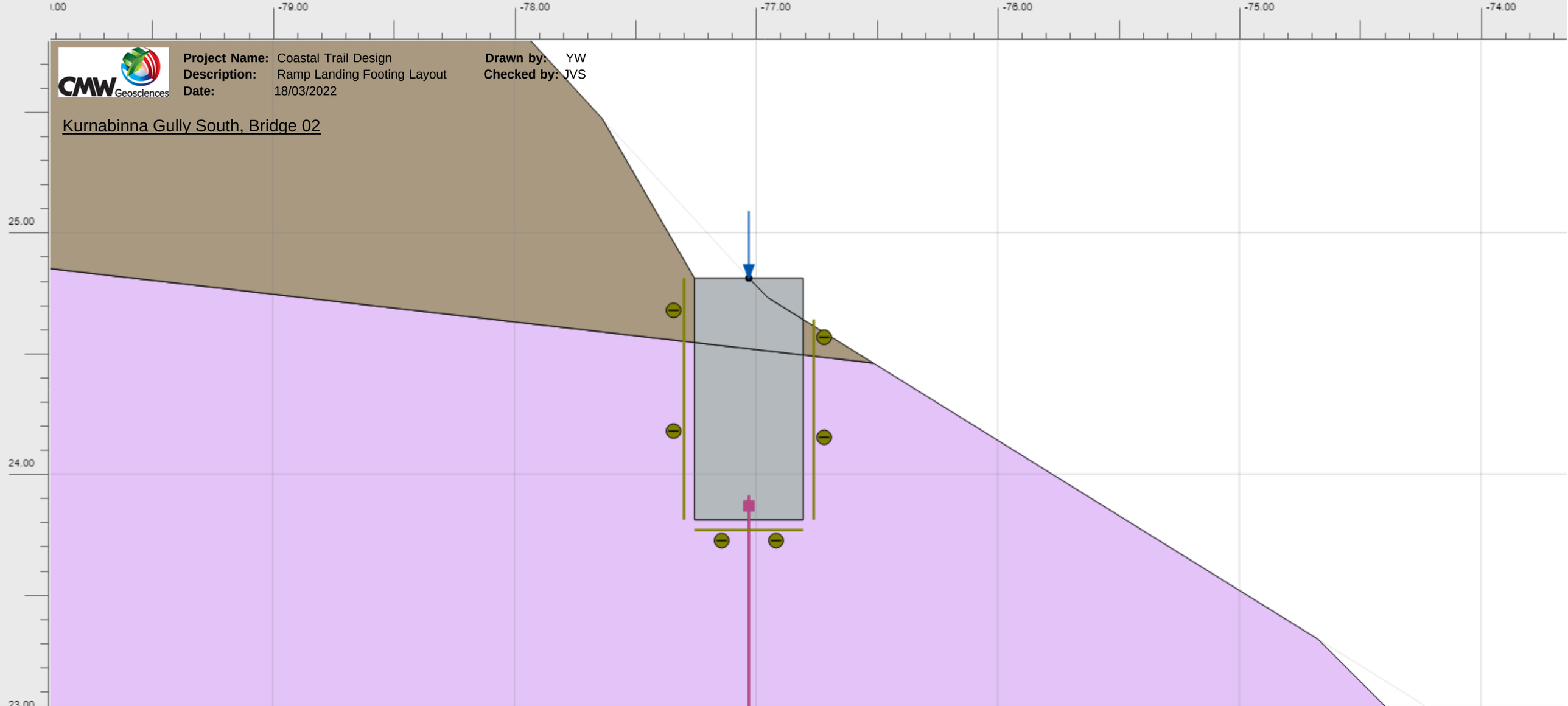
- Anchor Block
- Unit 1: Clay
- Unit 2: Res
- Unit 3: VLS
- Unit 4: LS
- Unit 5: MS

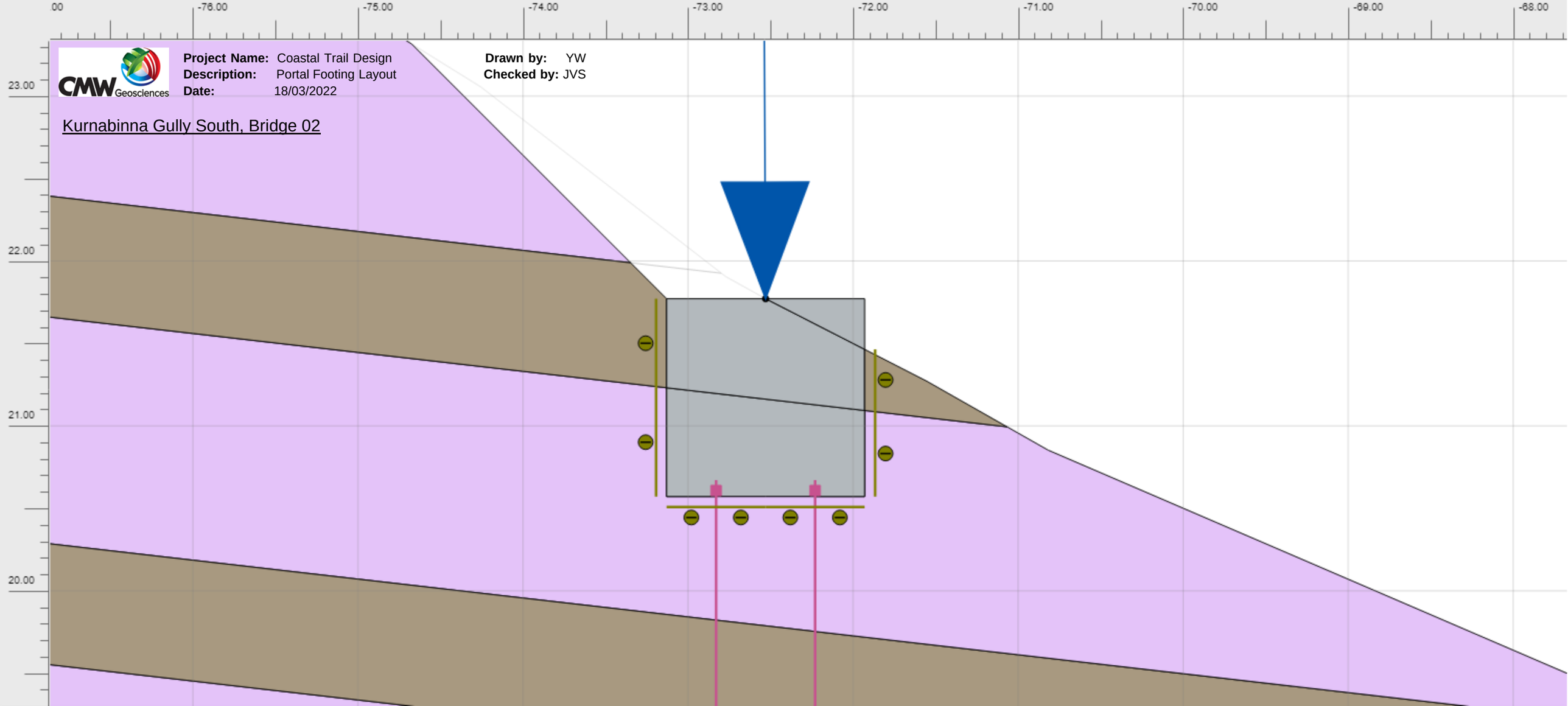
- Grout Anchor (100mm)
- Grout Anchor (120mm)
- Micro Pile (Landing, 100mm)
- Micro Pile (Portal, 100mm, 5m)
- Micro Pile (Portal, 100mm, 7m)
- Micro Pile (Portal, 120mm, 5m)
- Micro Pile (Portal, 120mm, 7m)
- Mircro Pile (Landing, 120mm)

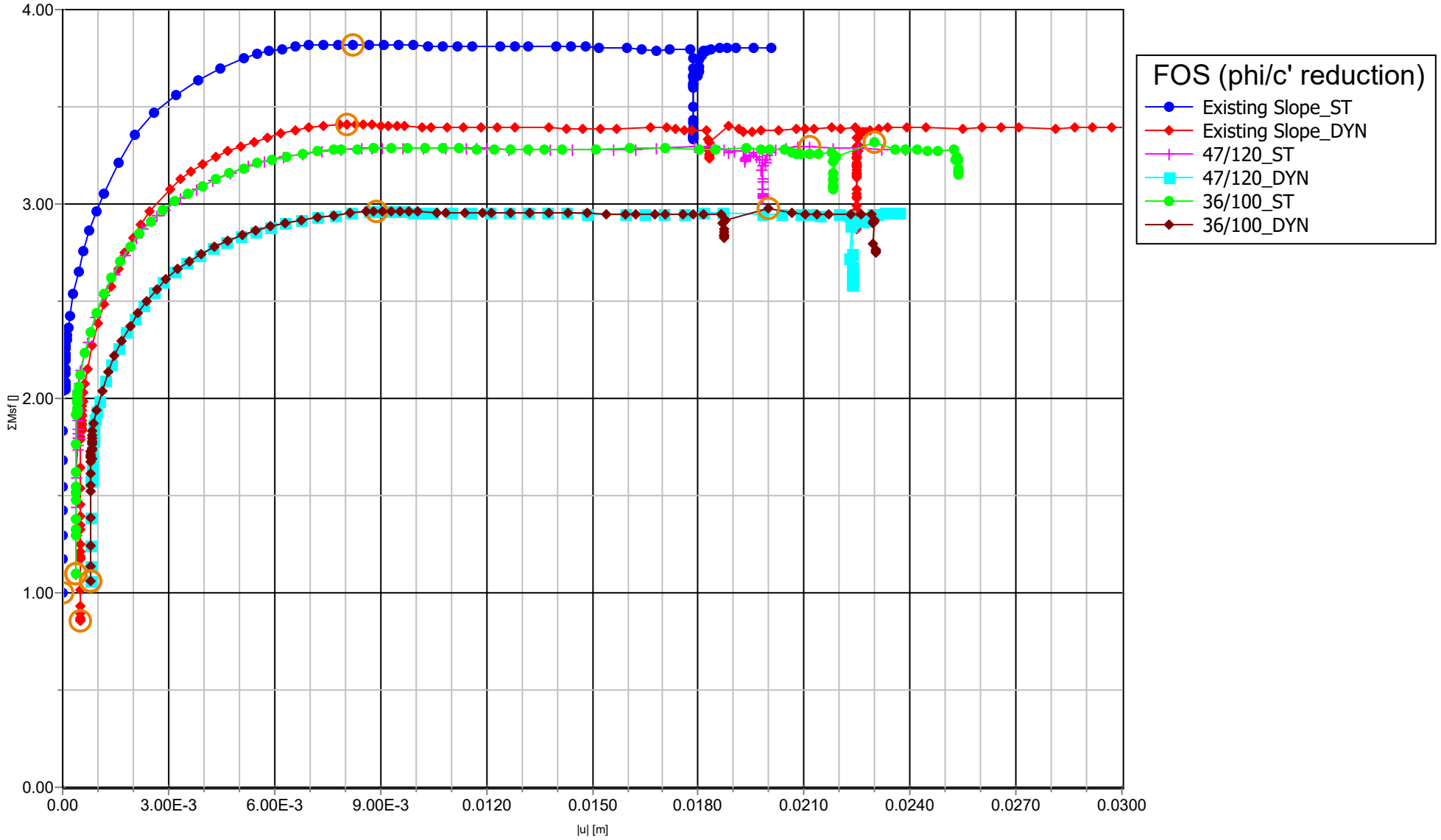
- Node to Node Anchor (36mm)
- Node-to-Node Anchor (26.5mm)
- Node-to-Node Anchor (47mm)




-84.00
-83.00
-82.00
-81.00
-80.00
-79.00
-78.00
-77.00
28.00
27.00
26.00
Project Name: Coastal Trail Design
Description: Anchor Layout
Date: 18/03/2022
Drawn by: YW
Checked by: JVS
Kurnabinna Gully South, Bridge 02


-79.00
-78.00
-77.00
-76.00
-75.00
-74.00
25.00
24.00
23.00
Project Name: Coastal Trail Design
Description: Ramp Landing Footing Layout
Date: 18/03/2022
Drawn by: YW
Checked by: JVS
Kurnabinna Gully South, Bridge 02


-76.00
-75.00
-74.00
-73.00
-72.00
-71.00
-70.00
-69.00
-68.00
23.00
22.00
21.00
20.00
CMW Geosciences
Project Name: Coastal Trail Design
Description: Portal Footing Layout
Date: 18/03/2022
Drawn by: YW
Checked by: JVS
Kurnabinna Gully South, Bridge 02



CMW Geosciences

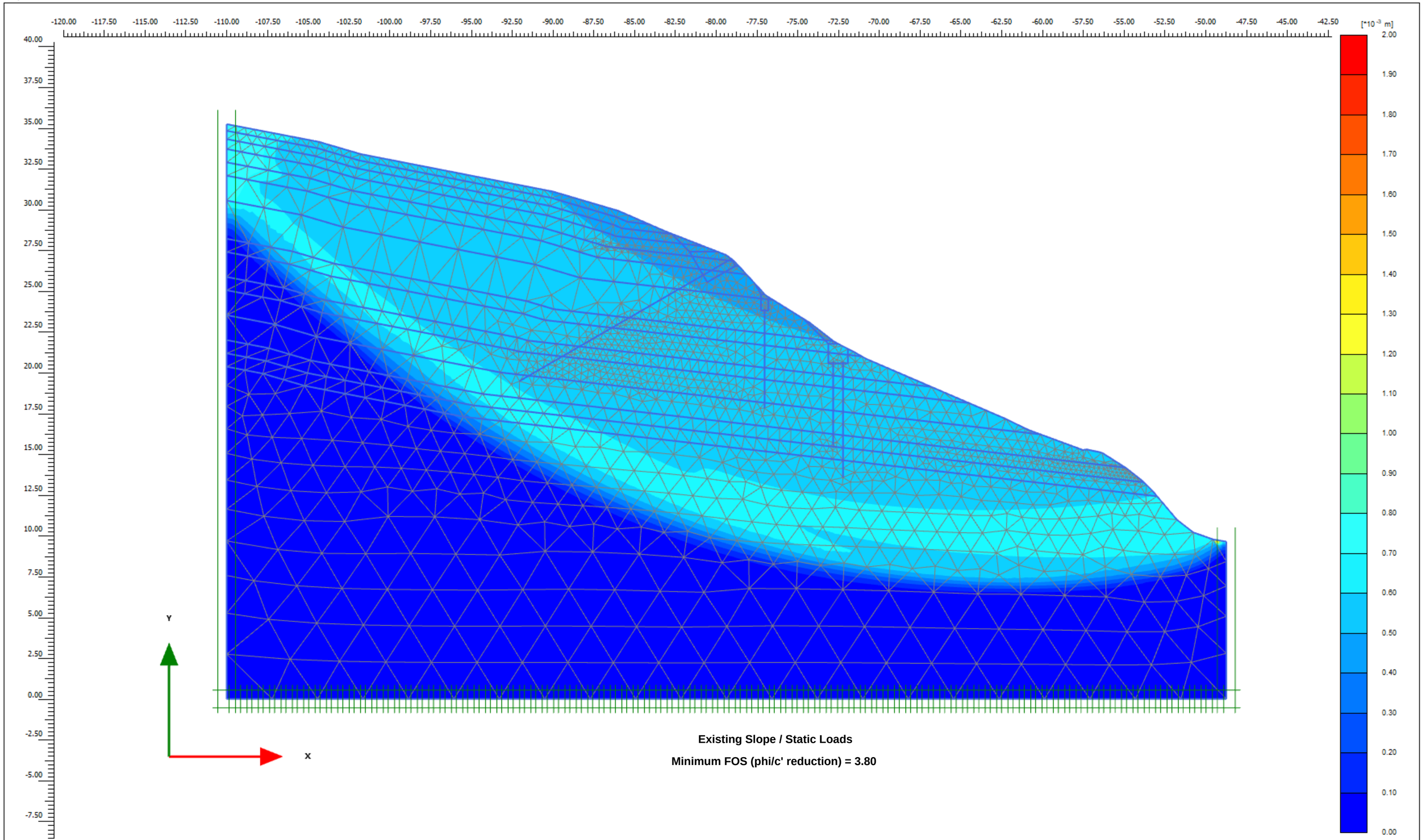
Project description
Marion Costal Walkway Upgrade

Date
18/03/2022

Project filename
Kurnabinna Gully S, B02, Lon ...

Step
715

Company
CMW Geosciences Pty Ltd



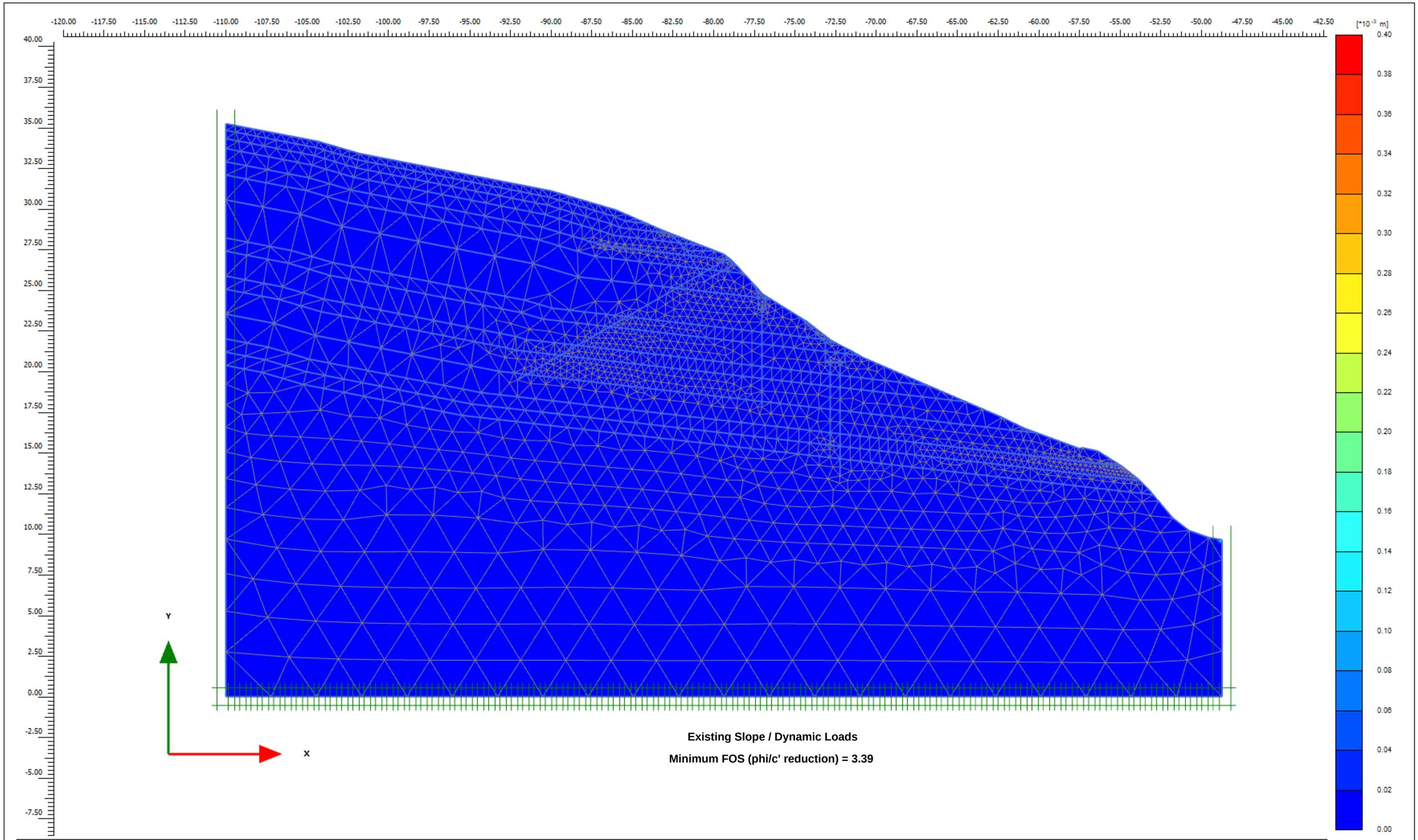
Existing Slope / Static Loads

Minimum FOS (phi/c' reduction) = 3.80

Incremental displacements |Δu| (scaled up 1.00*10 3 times)

Maximum value = 1.927*10 -3 m (Element 3289 at Node 26060)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 115	Company: CMW Geosciences Pty Ltd	



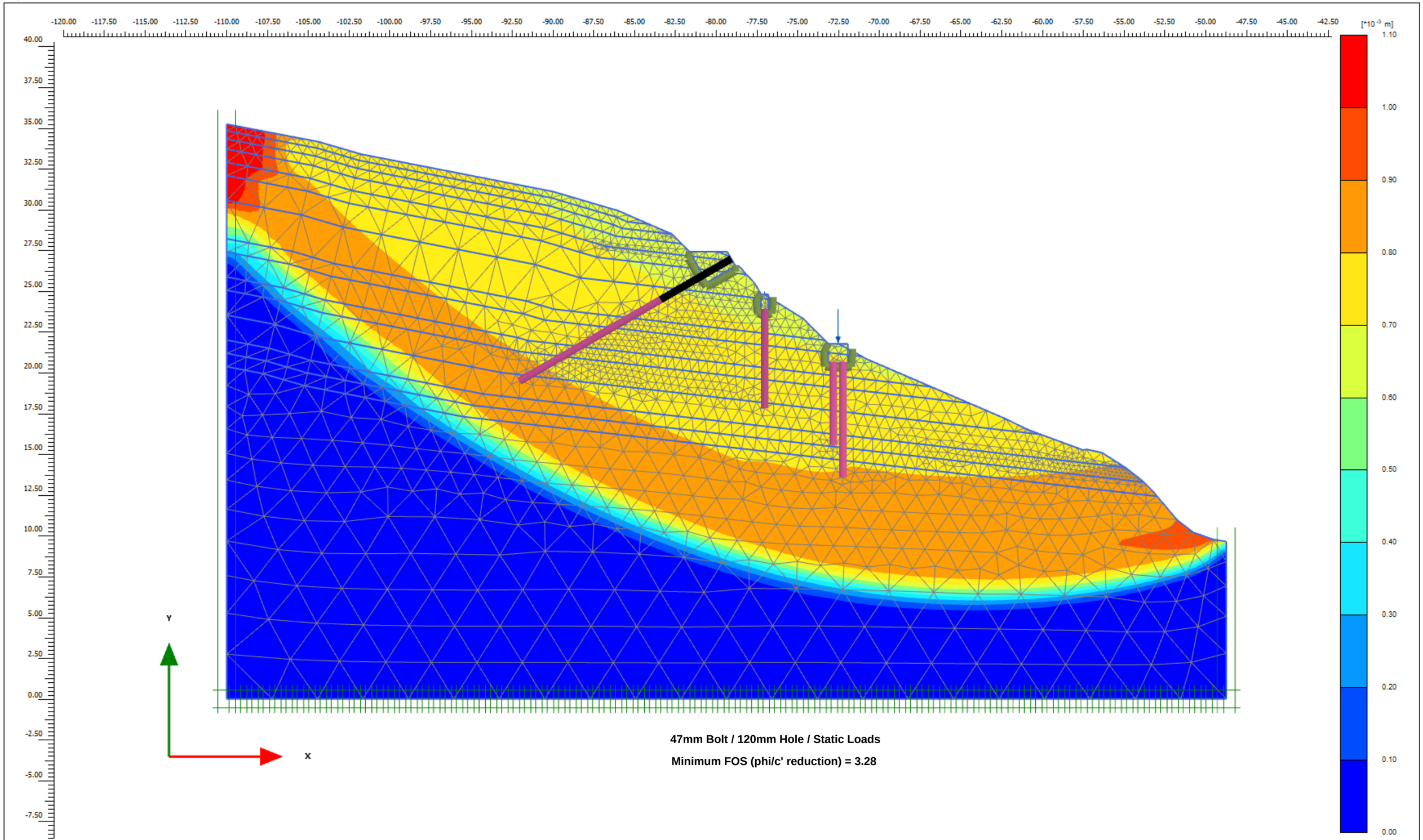
Existing Slope / Dynamic Loads

Minimum FOS (phi/c' reduction) = 3.39

Incremental displacements |Δu| (scaled up 5.00*10 3 times)

Maximum value = 0.3821*10^{-3} m (Element 3289 at Node 26057)

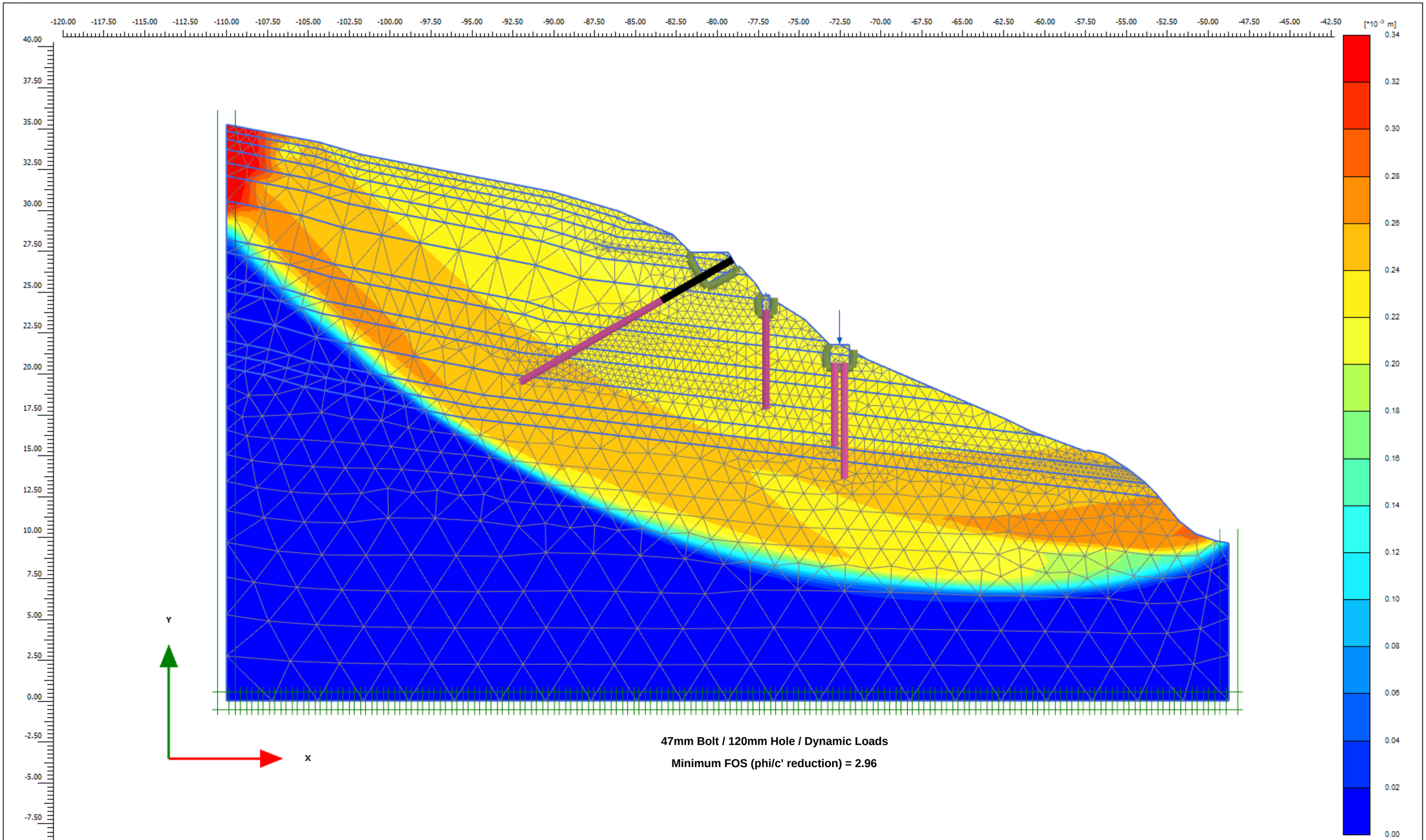
Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 515	Company: CMW Geosciences Pty Ltd	



Incremental displacements |Δu| (scaled up 2.00*10 3 times)

Maximum value = 1.068*10 -3 m (Element 385 at Node 3568)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 215	Company: CMW Geosciences Pty Ltd	



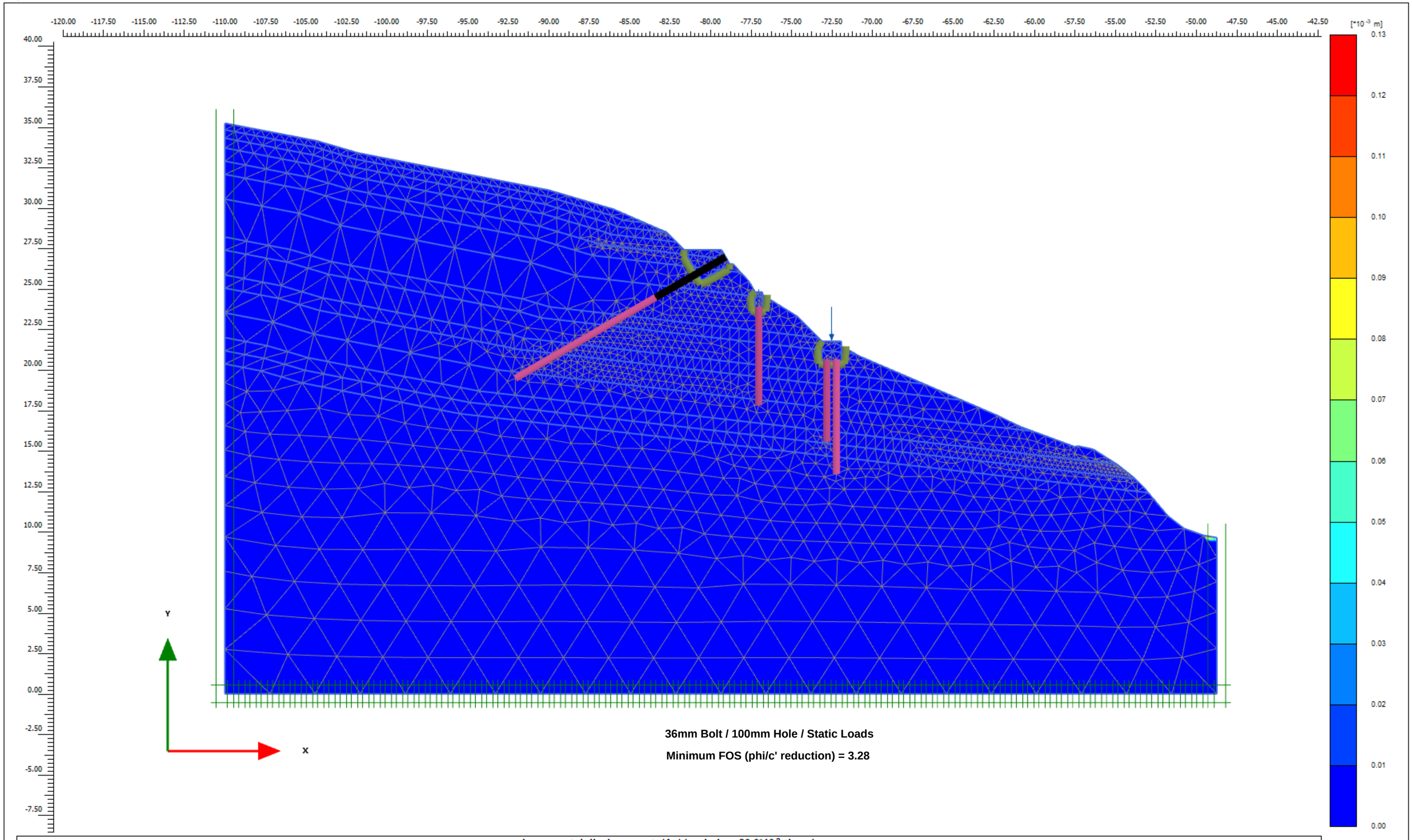
47mm Bolt / 120mm Hole / Dynamic Loads

Minimum FOS (phi/c' reduction) = 2.96

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

Maximum value = $0.3357*10^{-3}$ m (Element 515 at Node 3573)

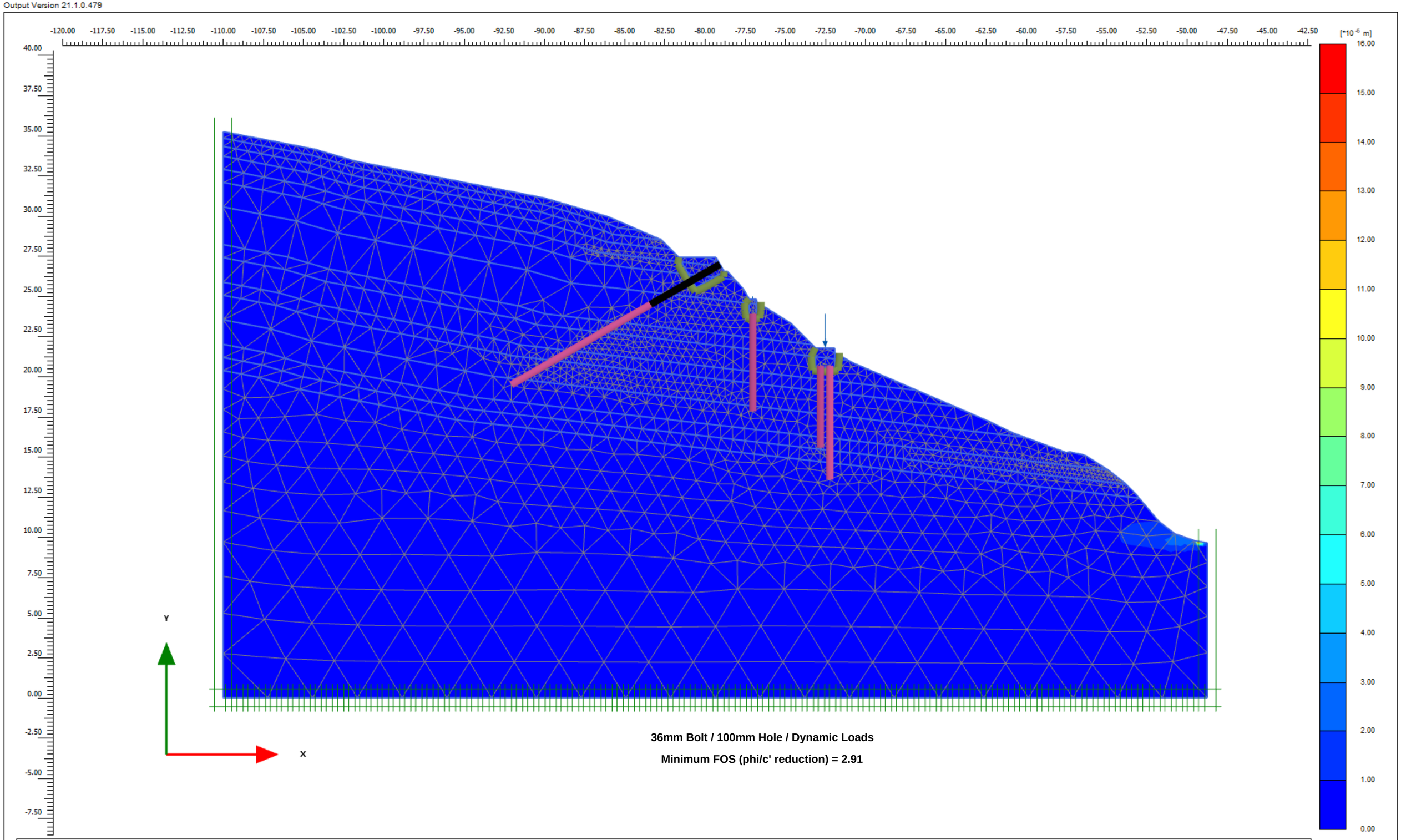
Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 315	Company: CMW Geosciences Pty Ltd	



Incremental displacements |Δu| (scaled up 20.0*10 3 times)

Maximum value = 0.1296*10 -3 m (Element 3289 at Node 26060)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 615	Company: CMW Geosciences Pty Ltd	



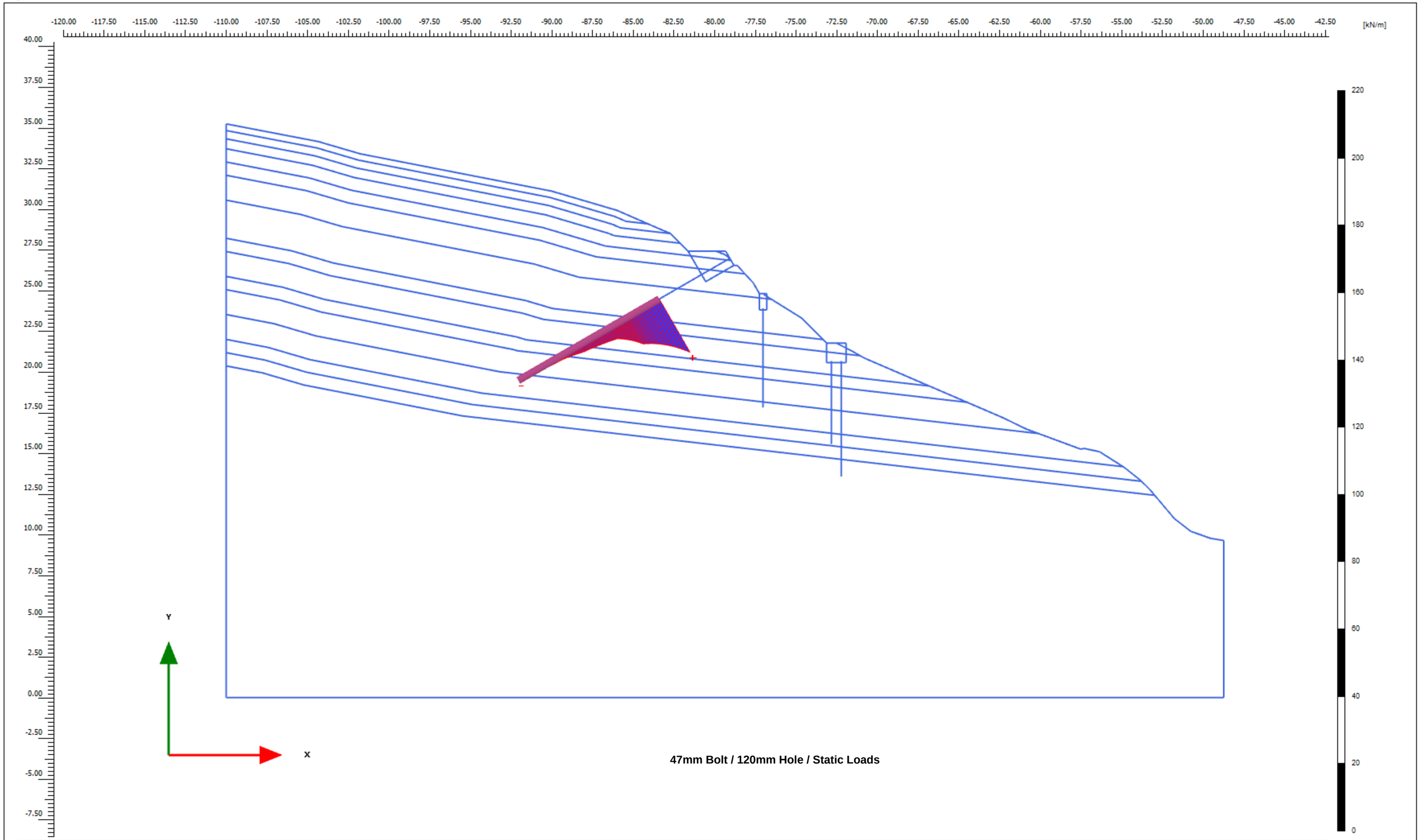
36mm Bolt / 100mm Hole / Dynamic Loads

Minimum FOS (phi/c' reduction) = 2.91

Incremental displacements |Δu| (scaled up $100*10^{3}$ times)

Maximum value = $0.01588*10^{-3}$ m (Element 3289 at Node 26060)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 715	Company: CMW Geosciences Pty Ltd	

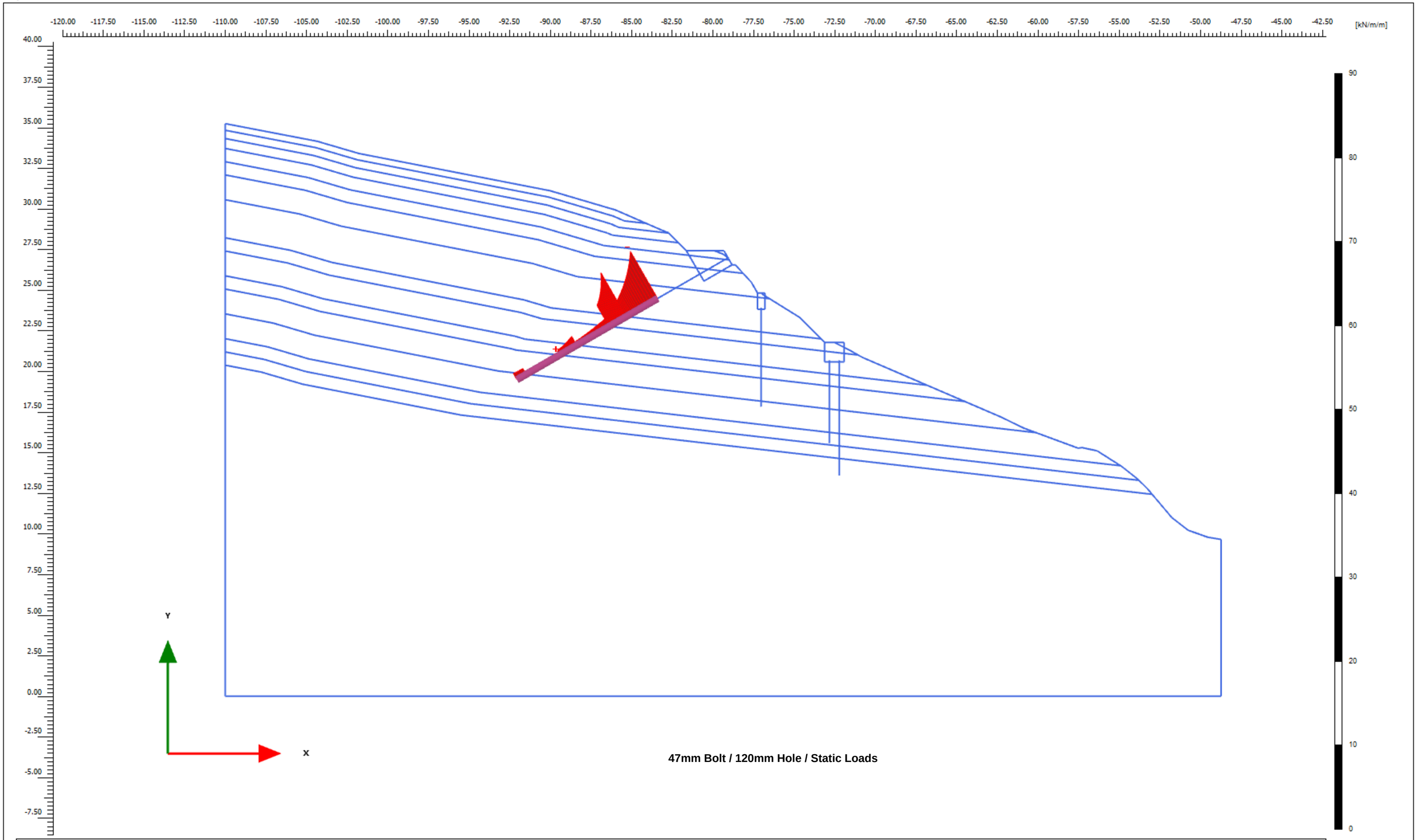


Axial forces N (scaled up 0.200 times)

Maximum value = 18.88 kN/m (Element 1 at Node 29053)

Minimum value = $0.9231*10^{-3}$ kN/m (Element 27 at Node 29161)

CMW Geosciences	Project description: Marion Costal Walkway Upgrade		Date: 18/03/2022
	Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 5	Company: CMW Geosciences Pty Ltd

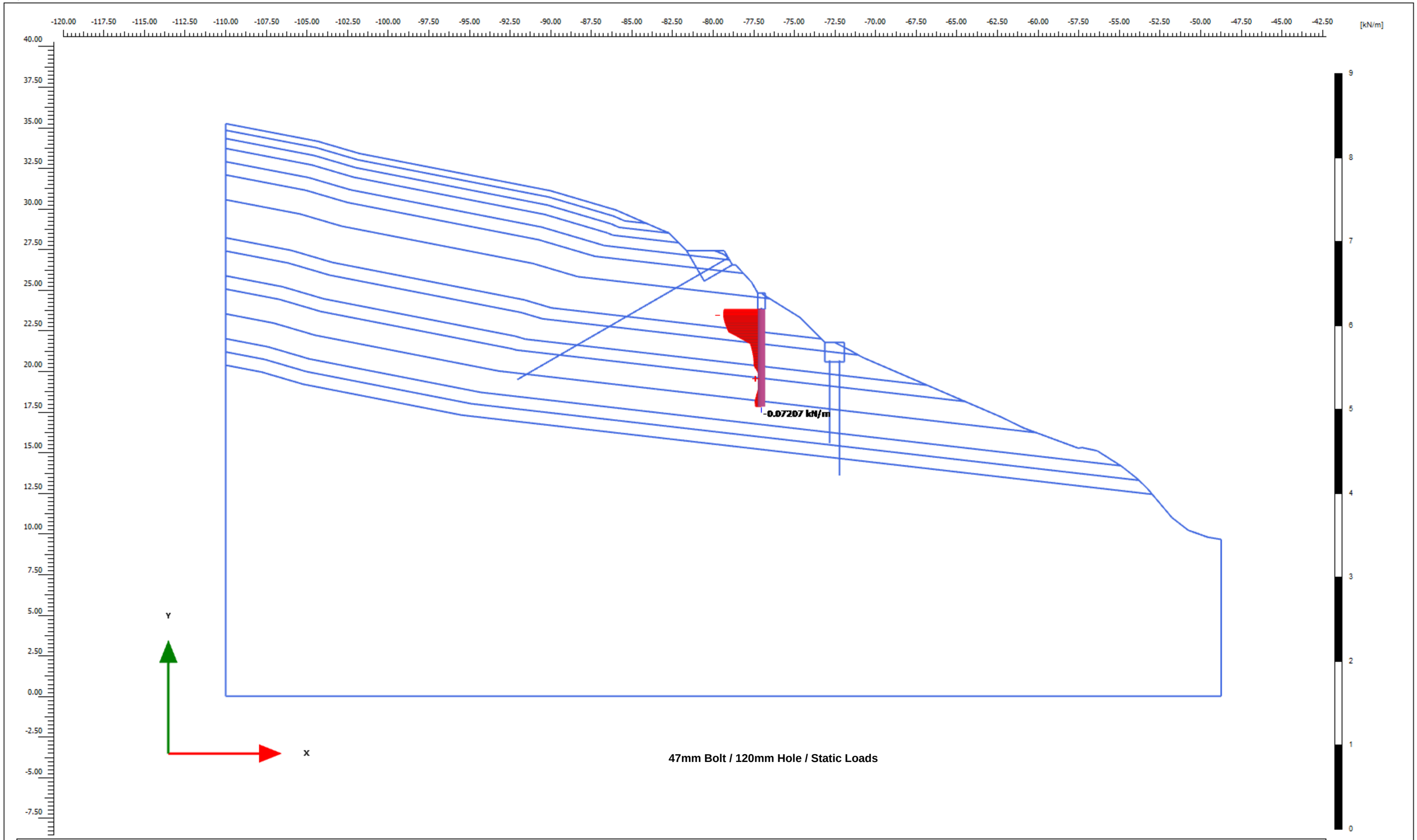


Skin friction T_{skin} (scaled up 0.500 times)

Maximum value = -0.2129 kN/m/m (Element 20 at Node 29129)

Minimum value = -6.699 kN/m/m (Element 1 at Node 29053)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 5	Company: CMW Geosciences Pty Ltd	



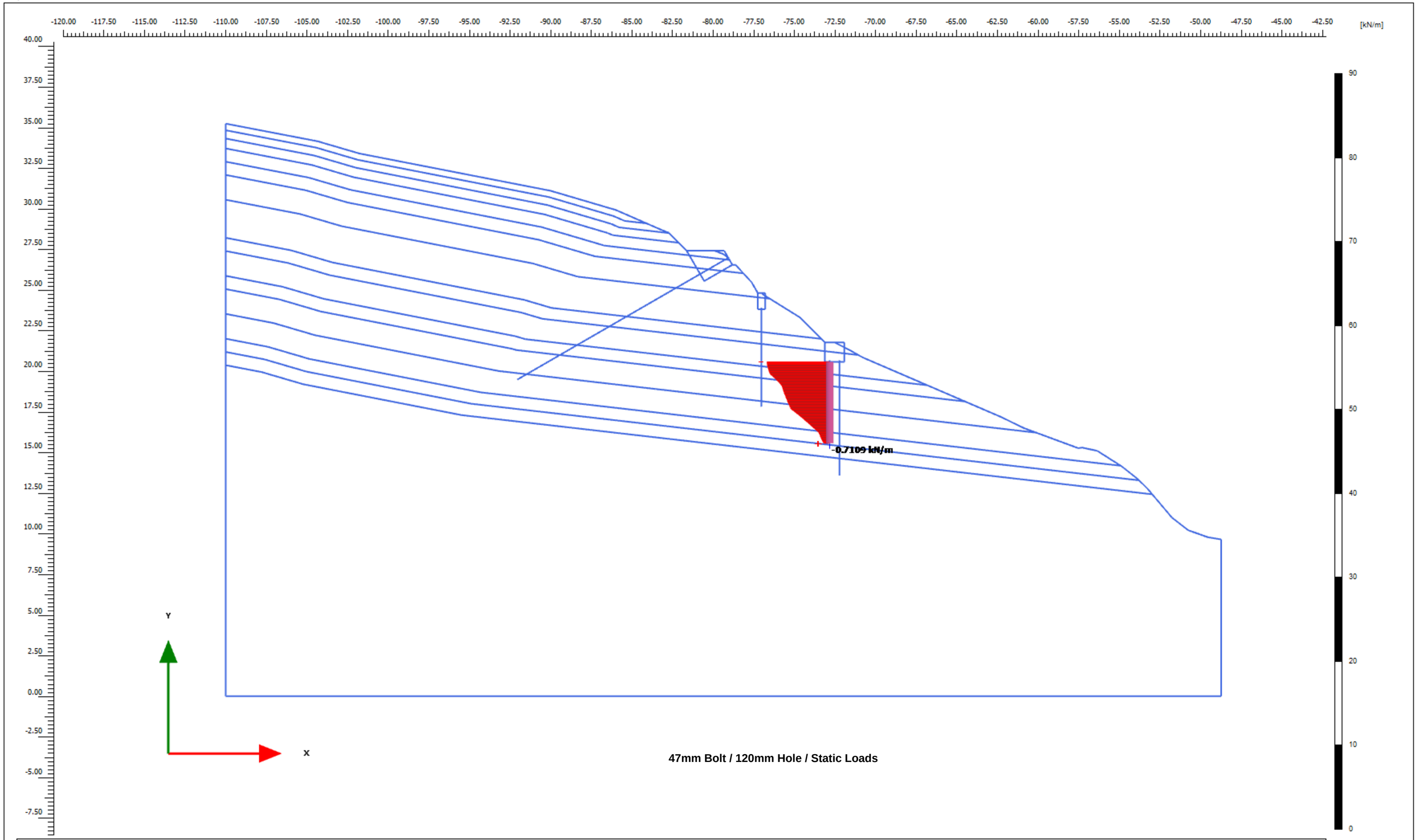
47mm Bolt / 120mm Hole / Static Loads

Axial forces N (scaled up 5.00 times)

Maximum value = $-9.176*10^{-3}$ kN/m (Element 37 at Node 29199)

Minimum value = -0.4664 kN/m (Element 30 at Node 29174)

CMW Geosciences	Project description: Marion Costal Walkway Upgrade		Date: 18/03/2022
	Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 5	Company: CMW Geosciences Pty Ltd

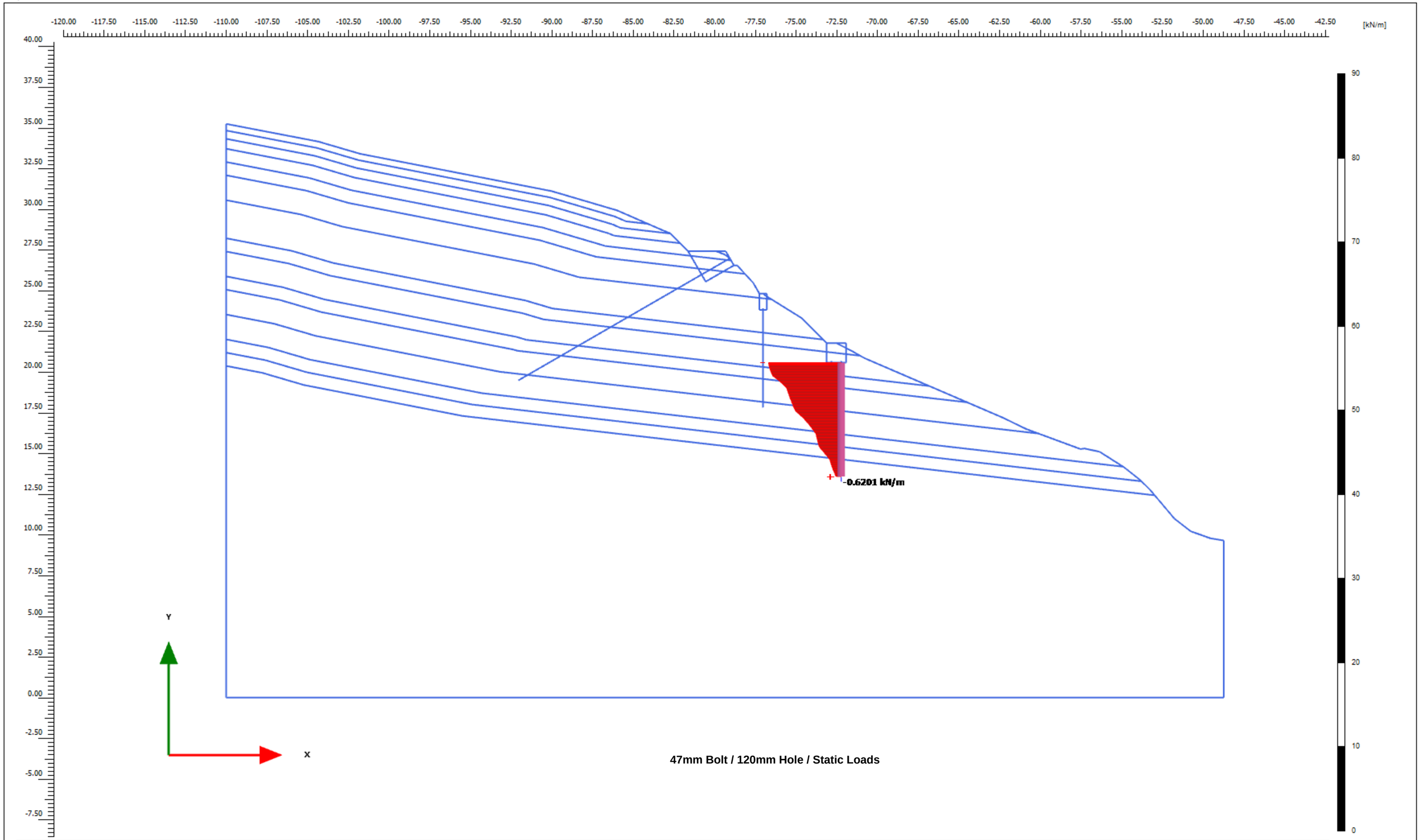


Axial forces N (scaled up 0.500 times)

Maximum value = -0.7109 kN/m (Element 49 at Node 29253)

Minimum value = -7.714 kN/m (Element 41 at Node 29216)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 5	Company: CMW Geosciences Pty Ltd	

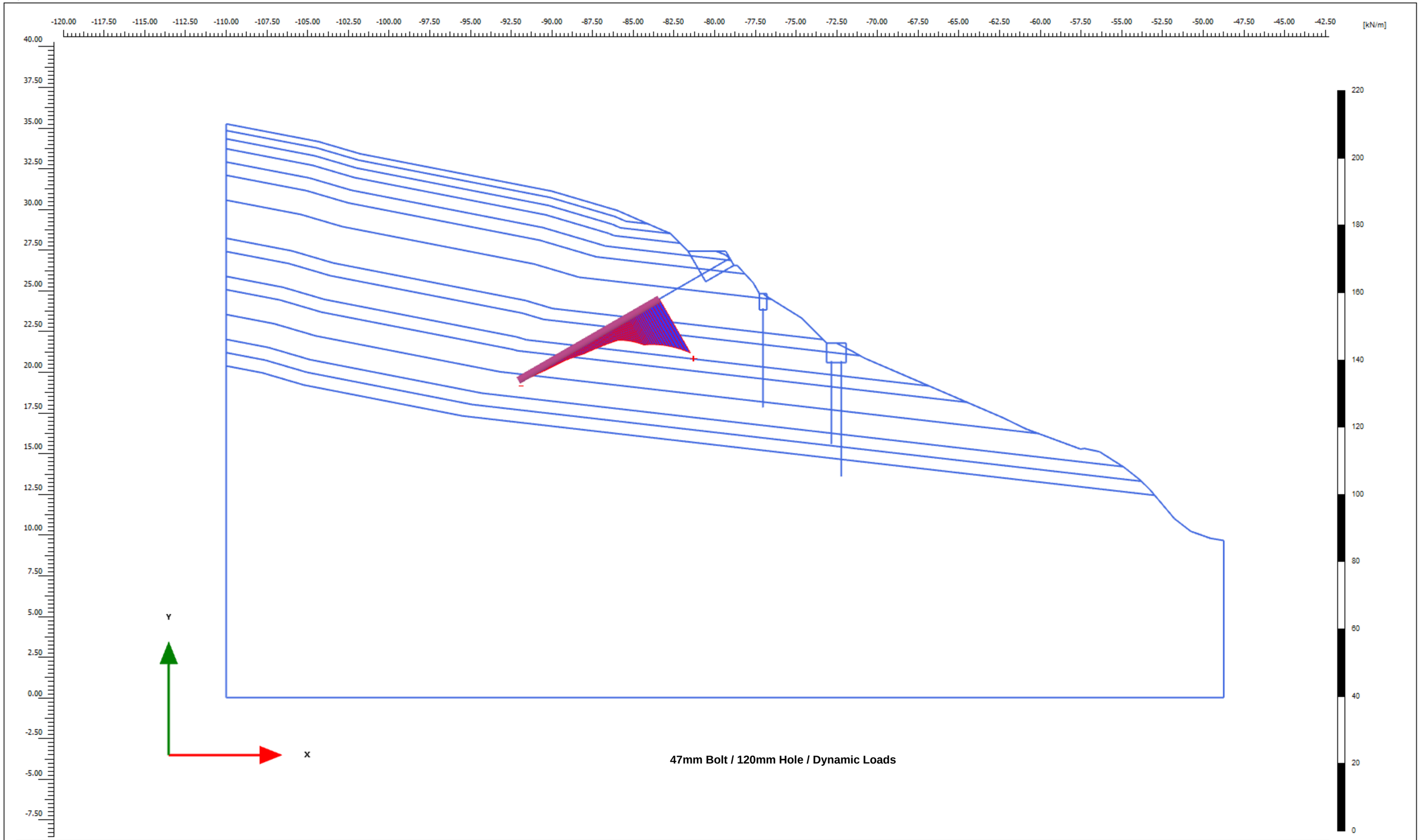


Axial forces N (scaled up 0.500 times)

Maximum value = -0.6201 kN/m (Element 61 at Node 29303)

Minimum value = -8.920 kN/m (Element 51 at Node 29258)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 5	Company: CMW Geosciences Pty Ltd	

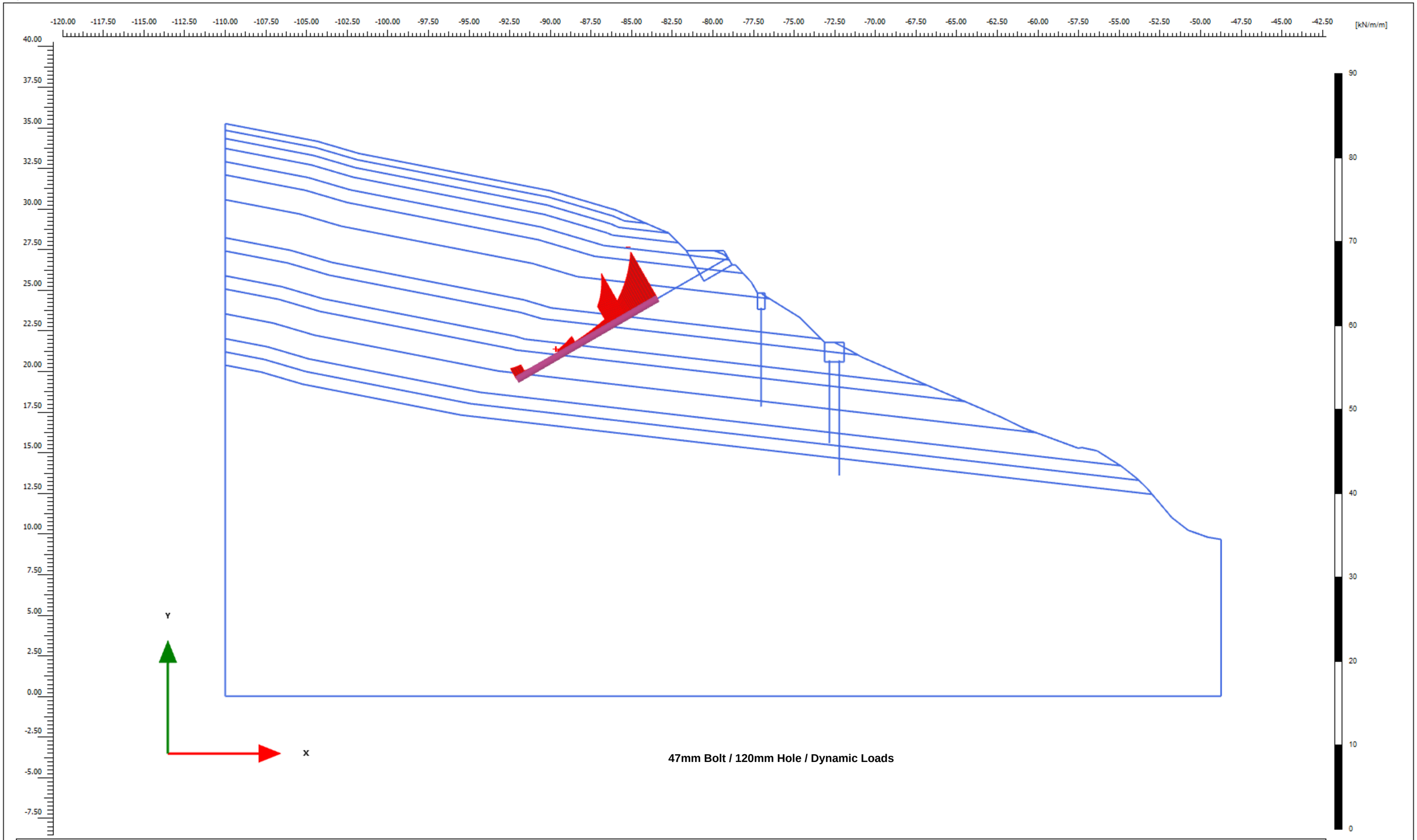


Axial forces N (scaled up 0.200 times)

Maximum value = 19.09 kN/m (Element 1 at Node 29053)

Minimum value = $1.633*10^{-3}$ kN/m (Element 27 at Node 29161)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 9	Company: CMW Geosciences Pty Ltd	

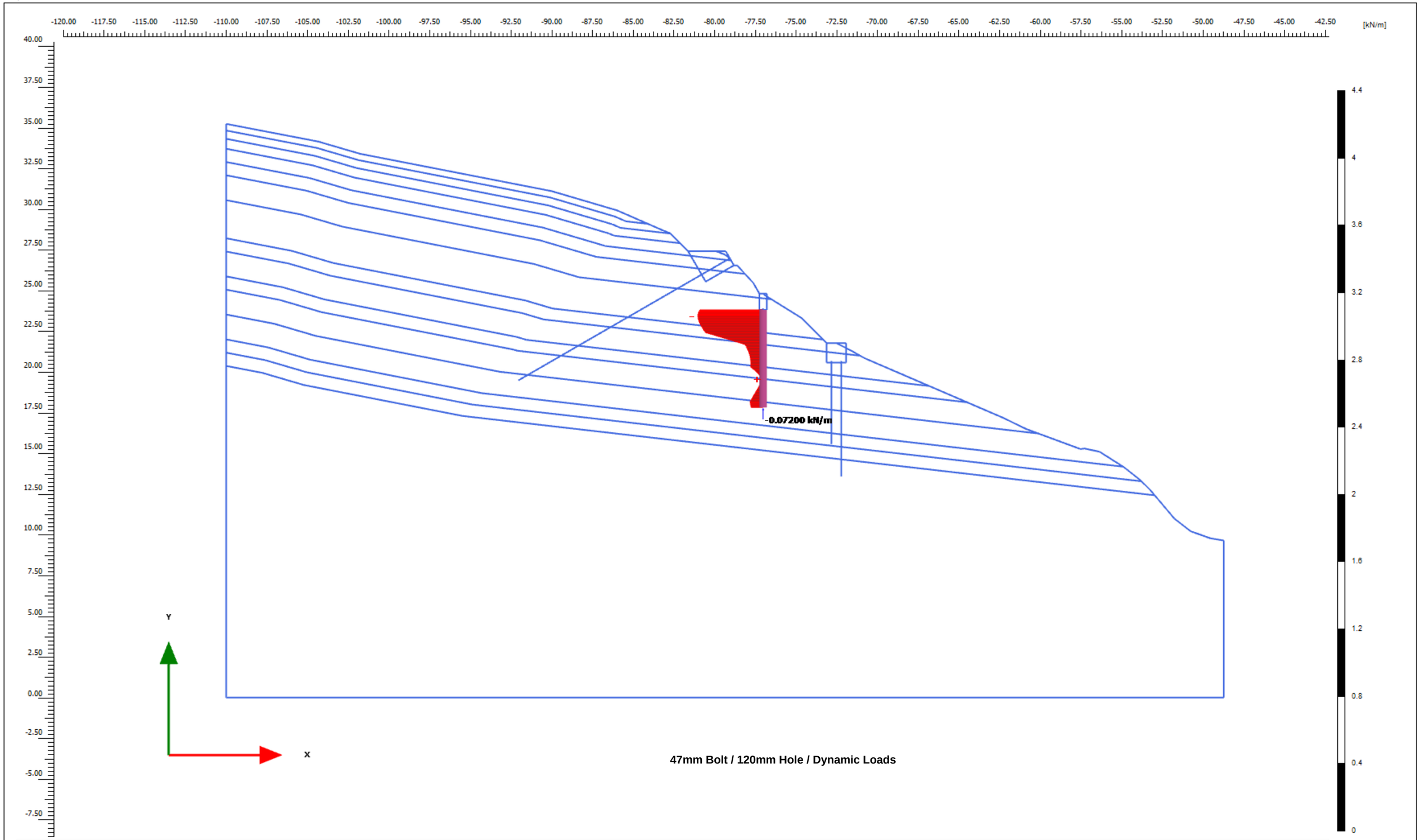


Skin friction T_{skin} (scaled up 0.500 times)

Maximum value = -0.2226 kN/m/m (Element 20 at Node 29129)

Minimum value = -6.623 kN/m/m (Element 1 at Node 29053)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 9	Company: CMW Geosciences Pty Ltd	

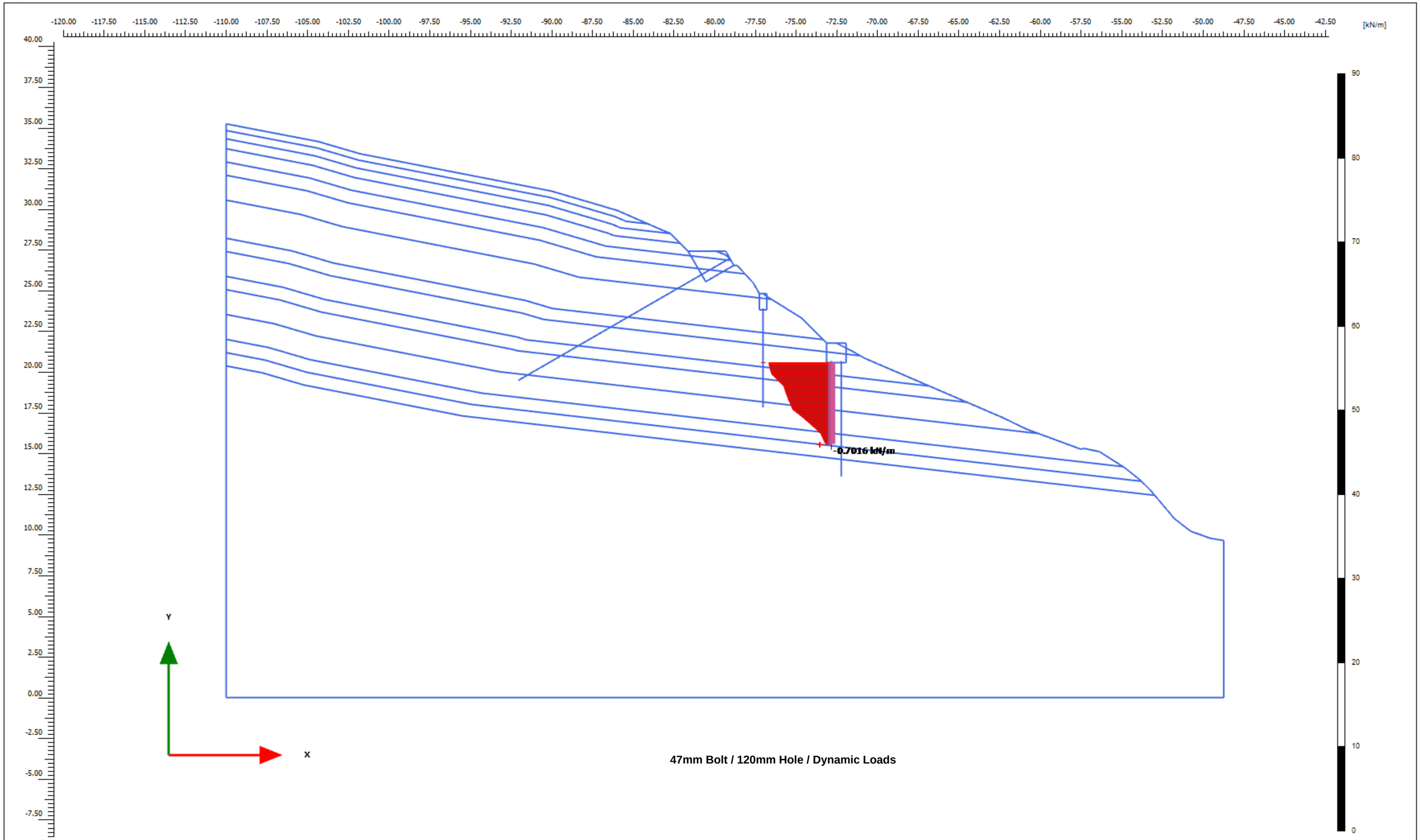


Axial forces N (scaled up 10.0 times)

Maximum value = $-4.673*10^{-3}$ kN/m (Element 37 at Node 29199)

Minimum value = -0.4001 kN/m (Element 31 at Node 29175)

CMW Geosciences	Project description: Marion Costal Walkway Upgrade		Date: 18/03/2022
	Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 9	Company: CMW Geosciences Pty Ltd

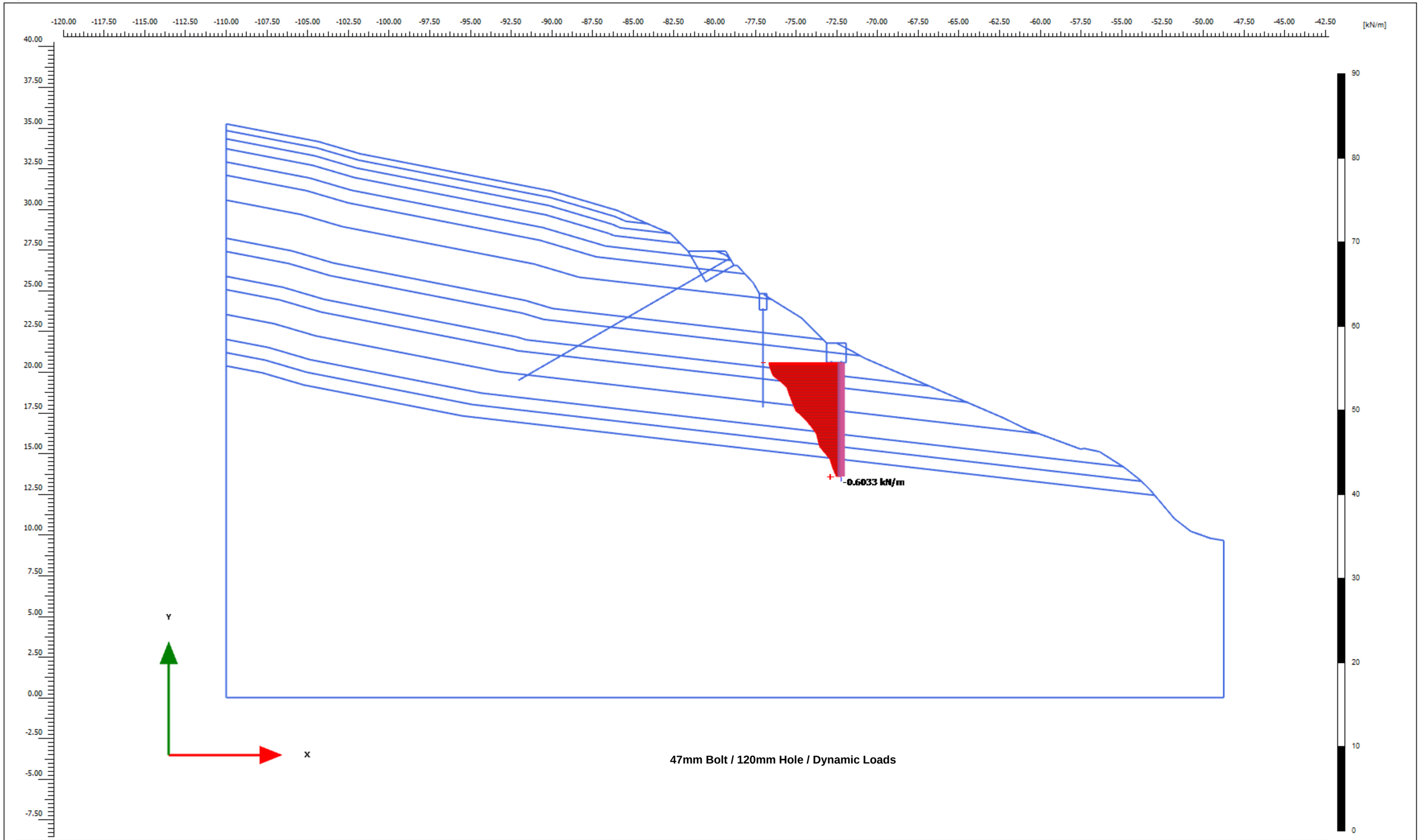


Axial forces N (scaled up 0.500 times)

Maximum value = -0.7016 kN/m (Element 49 at Node 29253)

Minimum value = -7.683 kN/m (Element 41 at Node 29216)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 9	Company: CMW Geosciences Pty Ltd	

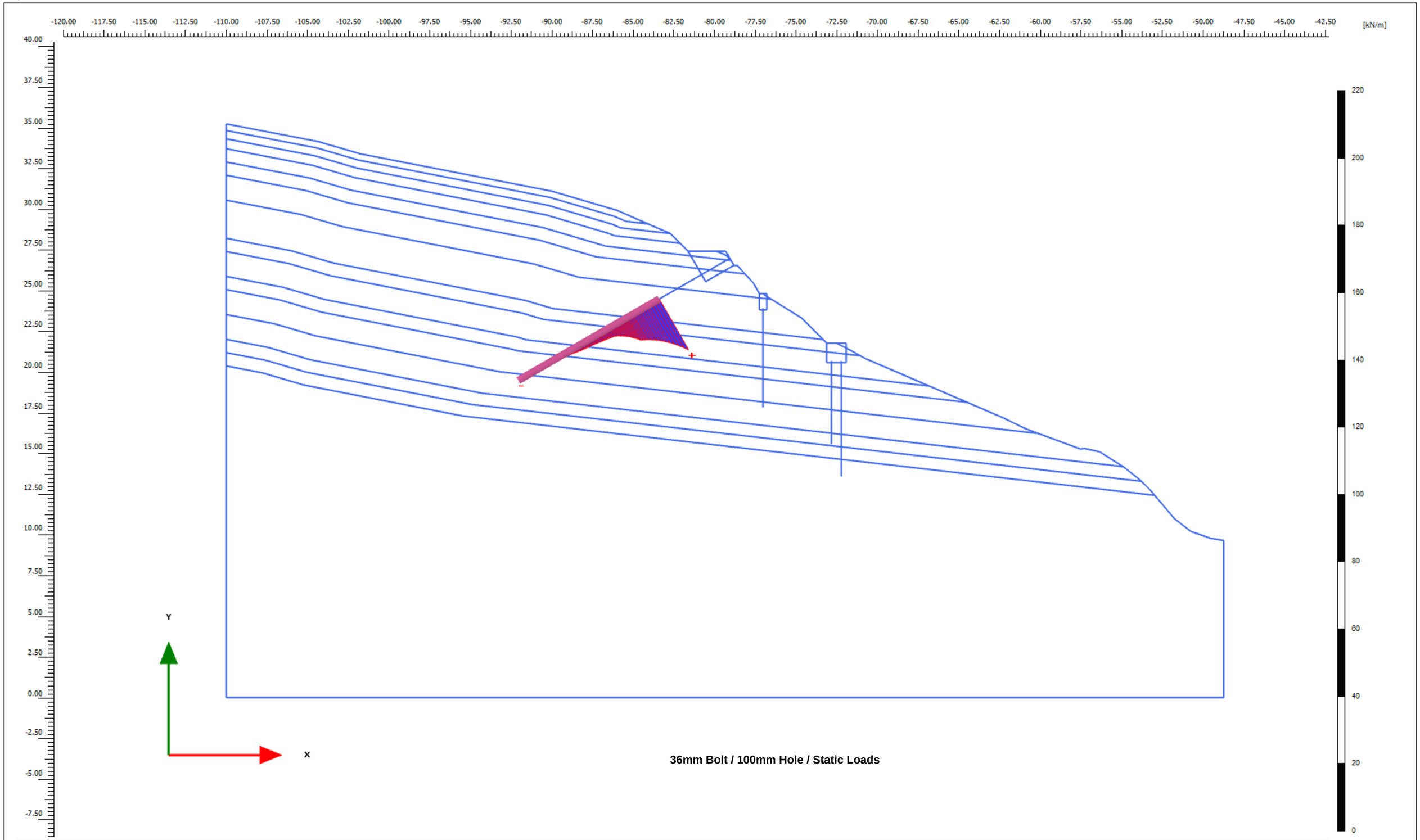


Axial forces N (scaled up 0.500 times)

Maximum value = -0.6033 kN/m (Element 61 at Node 29303)

Minimum value = -8.880 kN/m (Element 51 at Node 29258)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 9	Company: CMW Geosciences Pty Ltd	

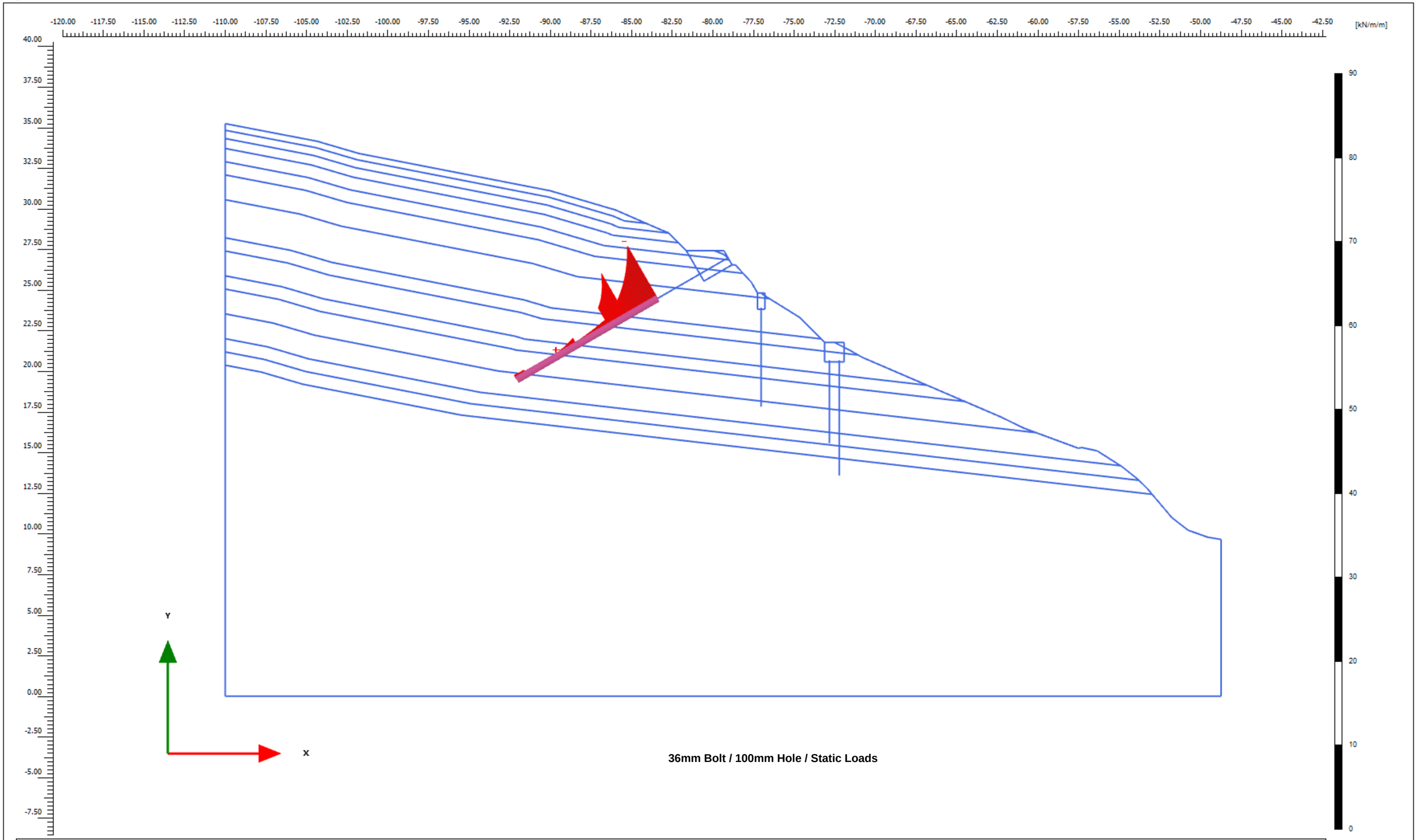


Axial forces N (scaled up 0.200 times)

Maximum value = 18.06 kN/m (Element 1 at Node 29053)

Minimum value = $0.7895*10^{-3}$ kN/m (Element 27 at Node 29161)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 13	Company: CMW Geosciences Pty Ltd	

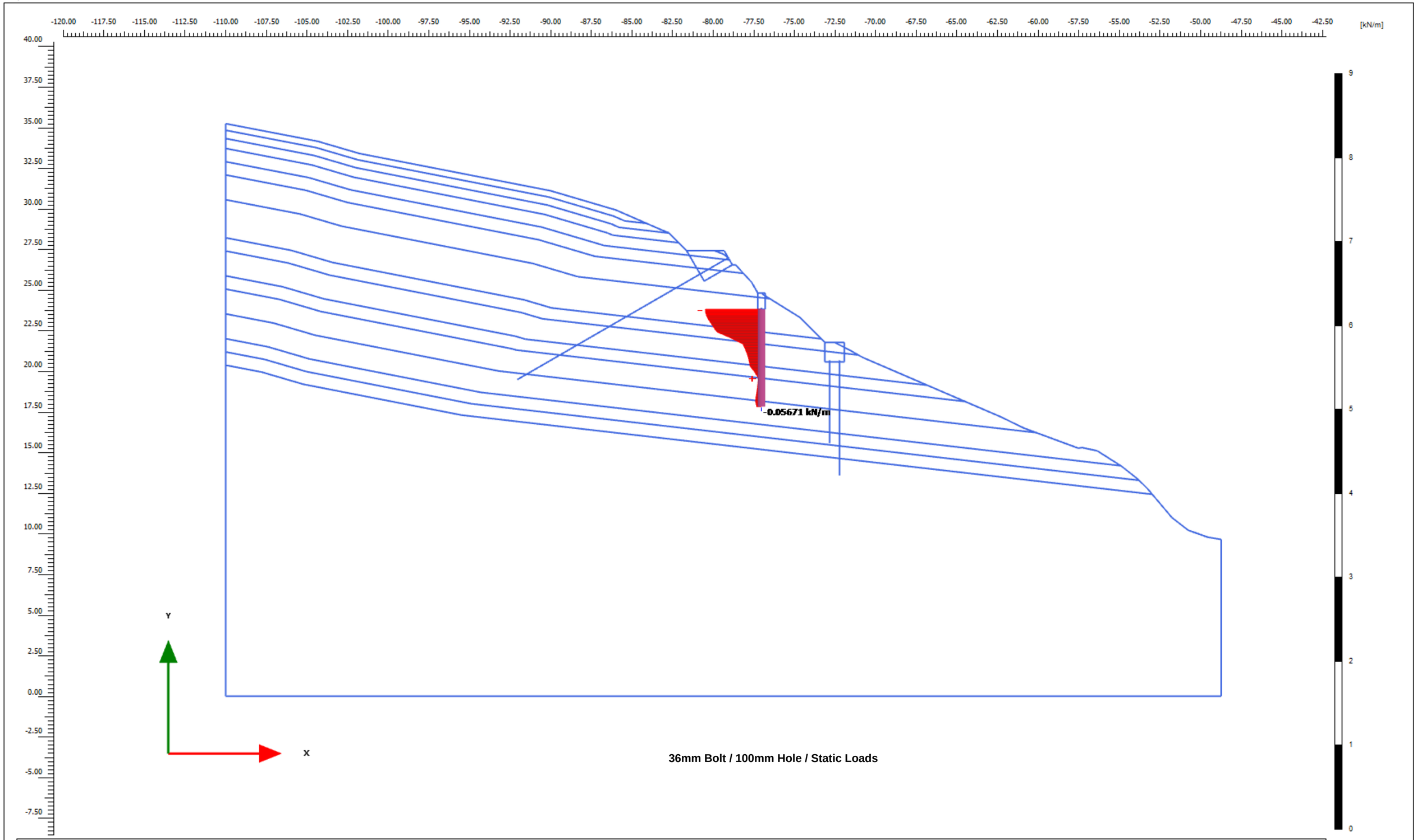


Skin friction T_{skin} (scaled up 0.500 times)

Maximum value = -0.1413 kN/m/m (Element 20 at Node 29129)

Minimum value = -7.456 kN/m/m (Element 1 at Node 29053)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 13	Company: CMW Geosciences Pty Ltd	

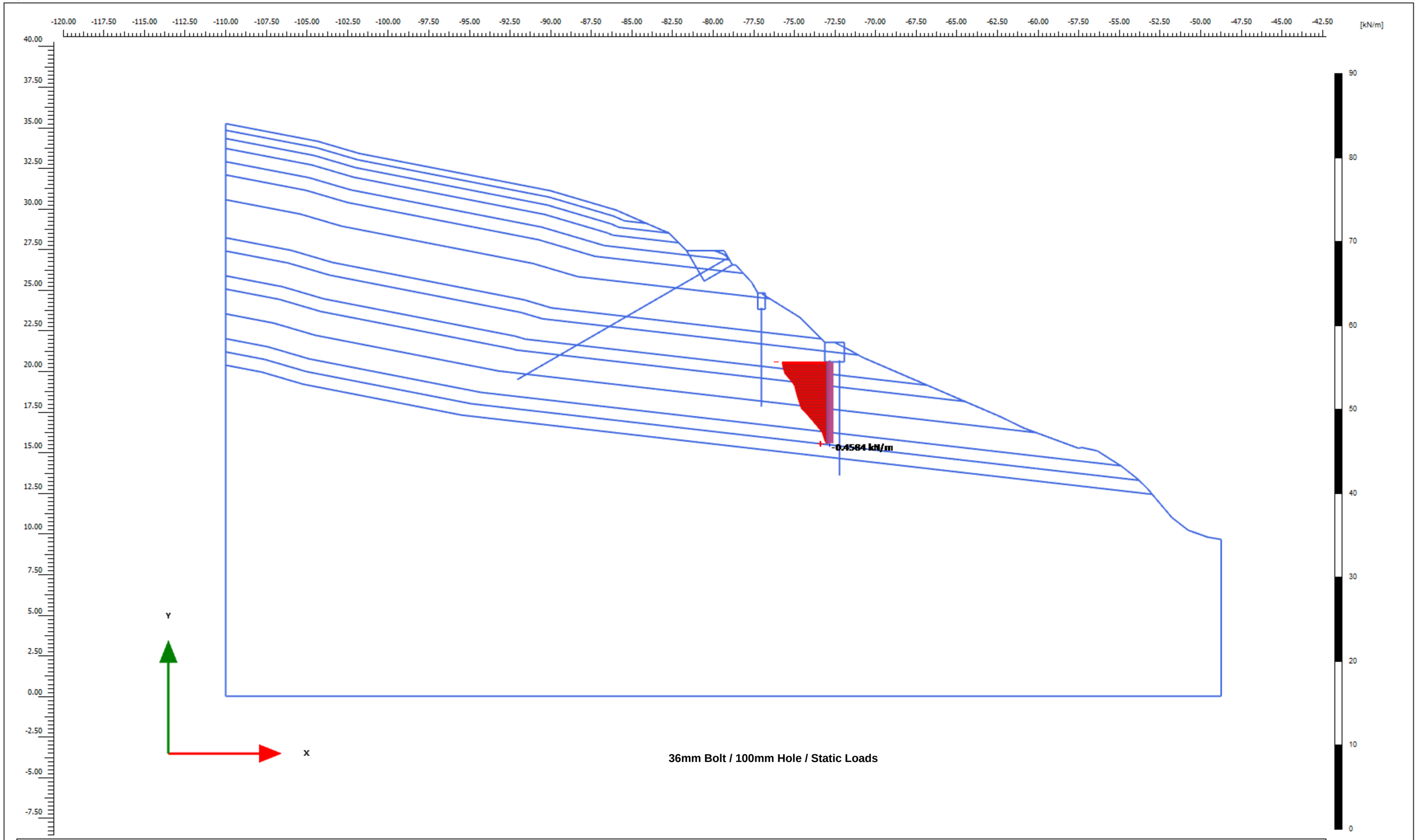


Axial forces N (scaled up 5.00 times)

Maximum value = -0.03946 kN/m (Element 37 at Node 29199)

Minimum value = -0.6894 kN/m (Element 29 at Node 29168)

CMW Geosciences	Project description: Marion Costal Walkway Upgrade		Date: 18/03/2022
	Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 13	Company: CMW Geosciences Pty Ltd

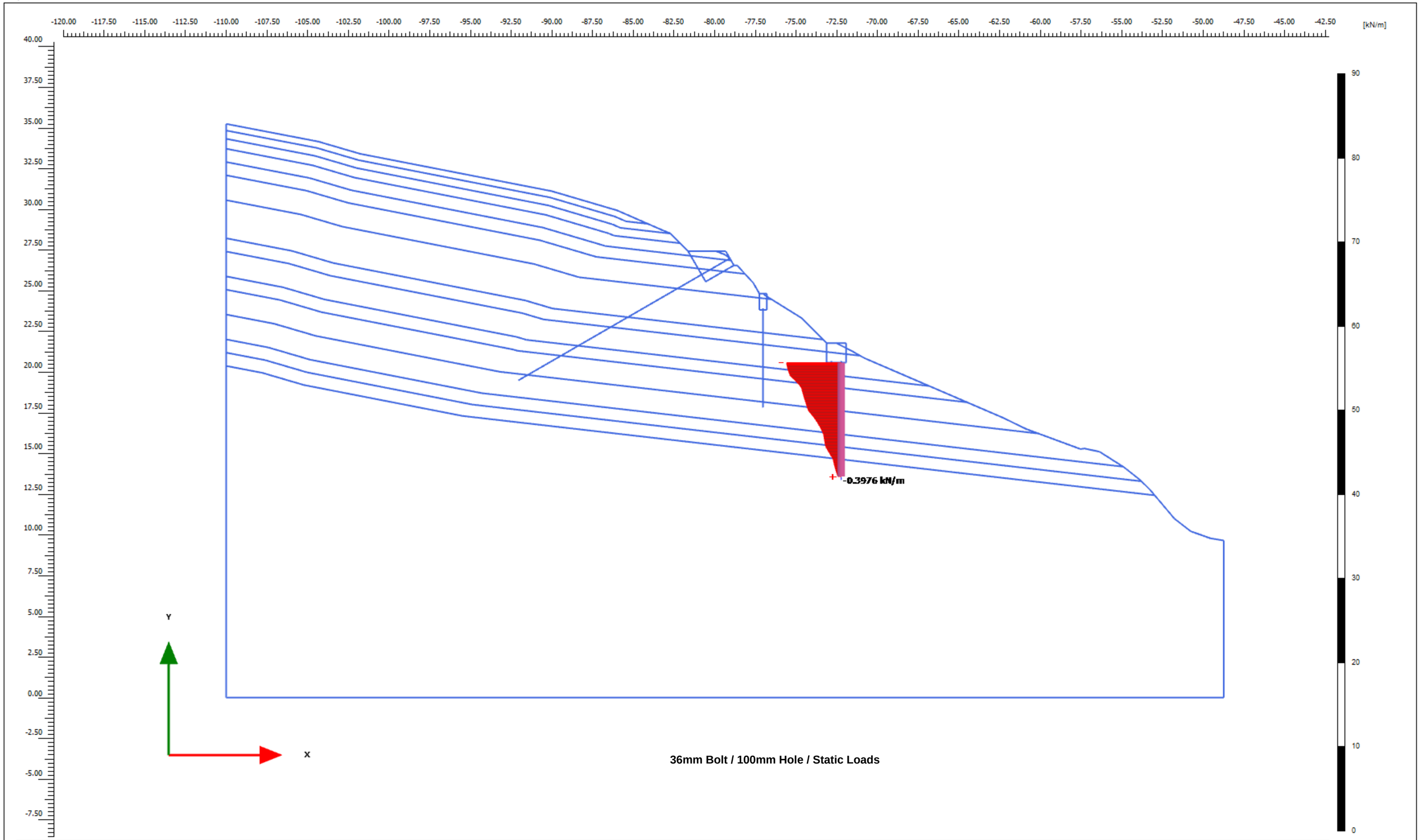


Axial forces N (scaled up 0.500 times)

Maximum value = -0.4584 kN/m (Element 49 at Node 29253)

Minimum value = -5.848 kN/m (Element 41 at Node 29216)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 13	Company: CMW Geosciences Pty Ltd	

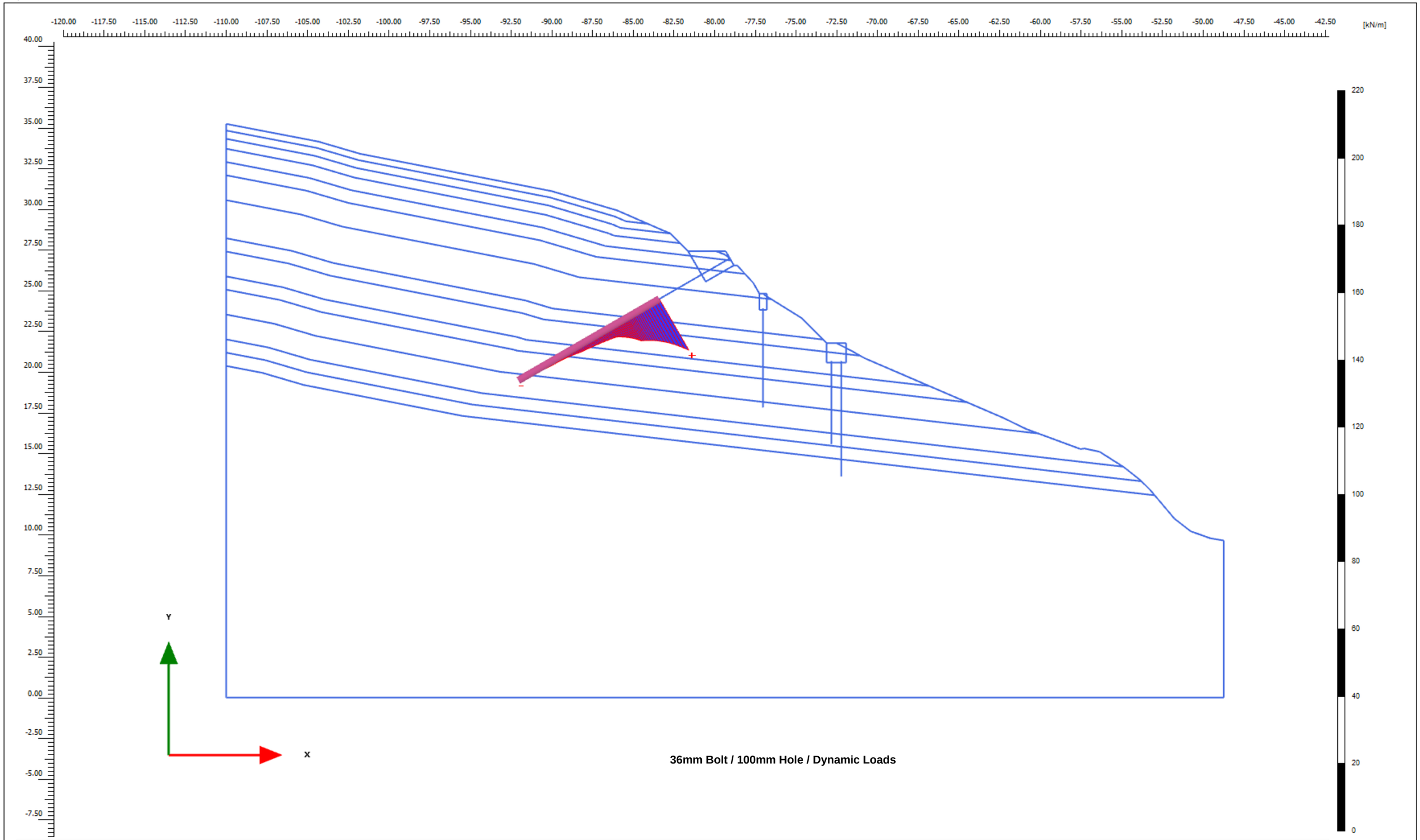


Axial forces N (scaled up 0.500 times)

Maximum value = -0.3977 kN/m (Element 61 at Node 29303)

Minimum value = -6.708 kN/m (Element 51 at Node 29258)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 13	Company: CMW Geosciences Pty Ltd	

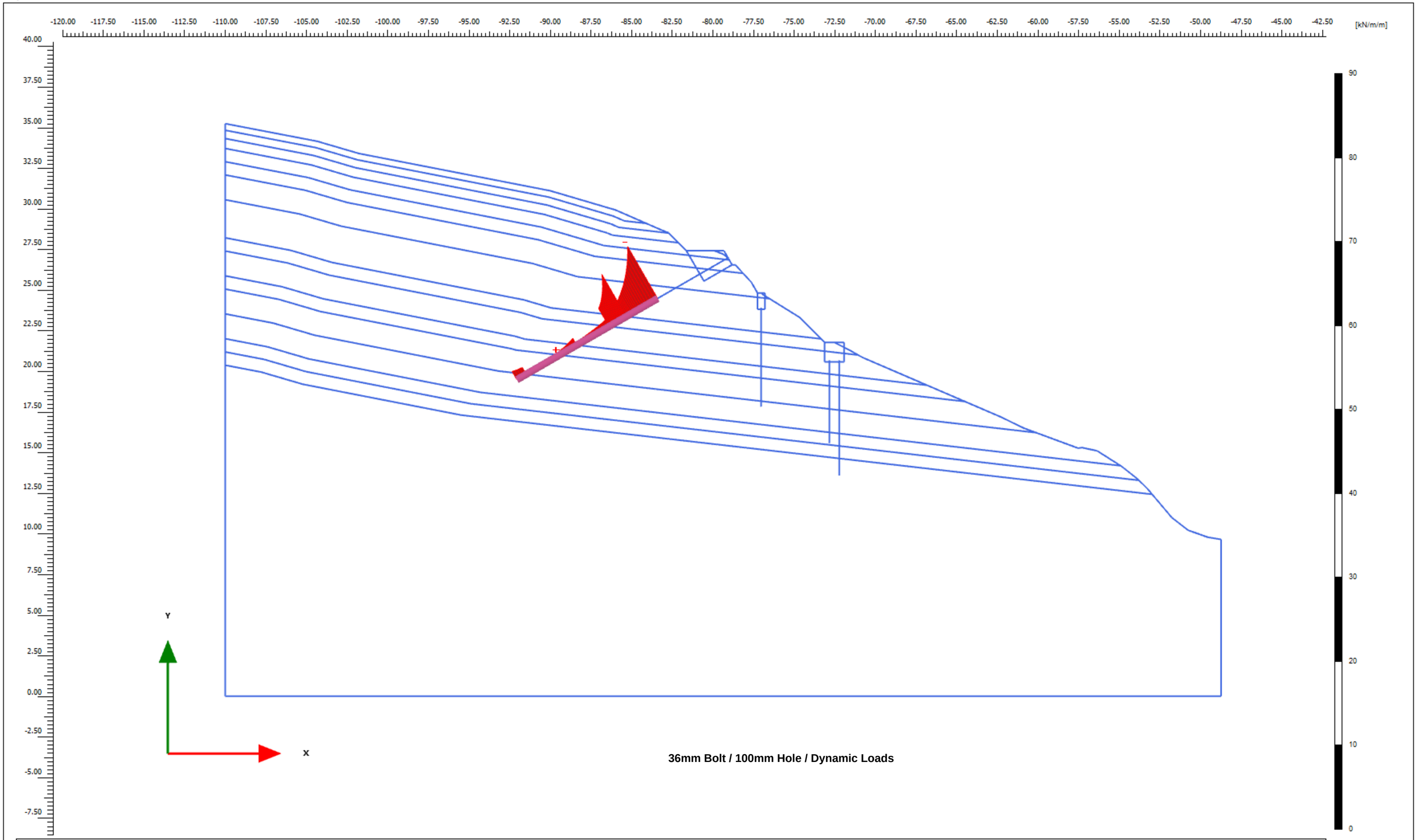


Axial forces N (scaled up 0.200 times)

Maximum value = 18.19 kN/m (Element 1 at Node 29053)

Minimum value = $1.444*10^{-3}$ kN/m (Element 27 at Node 29161)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 15	Company: CMW Geosciences Pty Ltd	

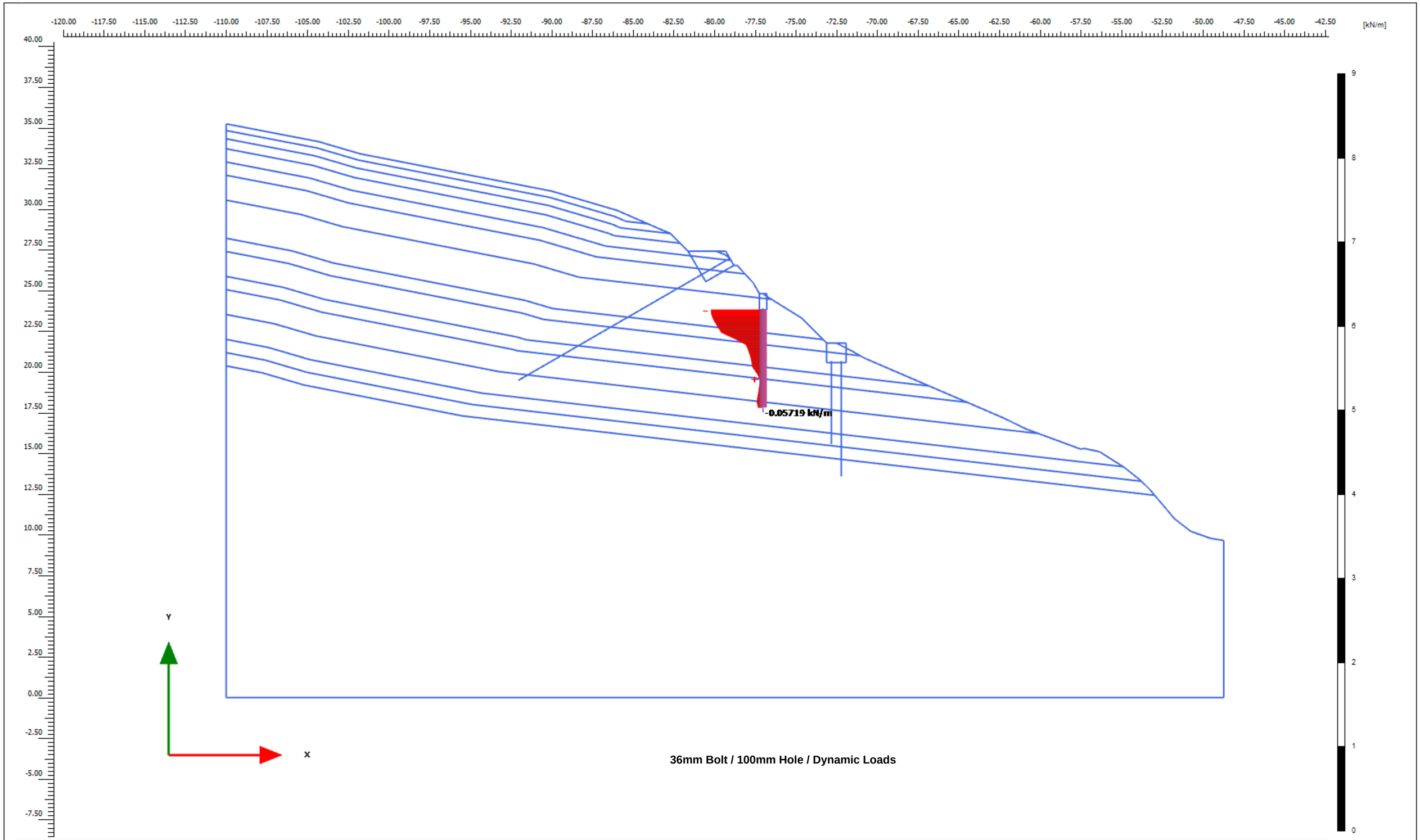


Skin friction T_{skin} (scaled up 0.500 times)

Maximum value = -0.1427 kN/m/m (Element 20 at Node 29129)

Minimum value = -7.389 kN/m/m (Element 1 at Node 29053)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 15	Company: CMW Geosciences Pty Ltd	

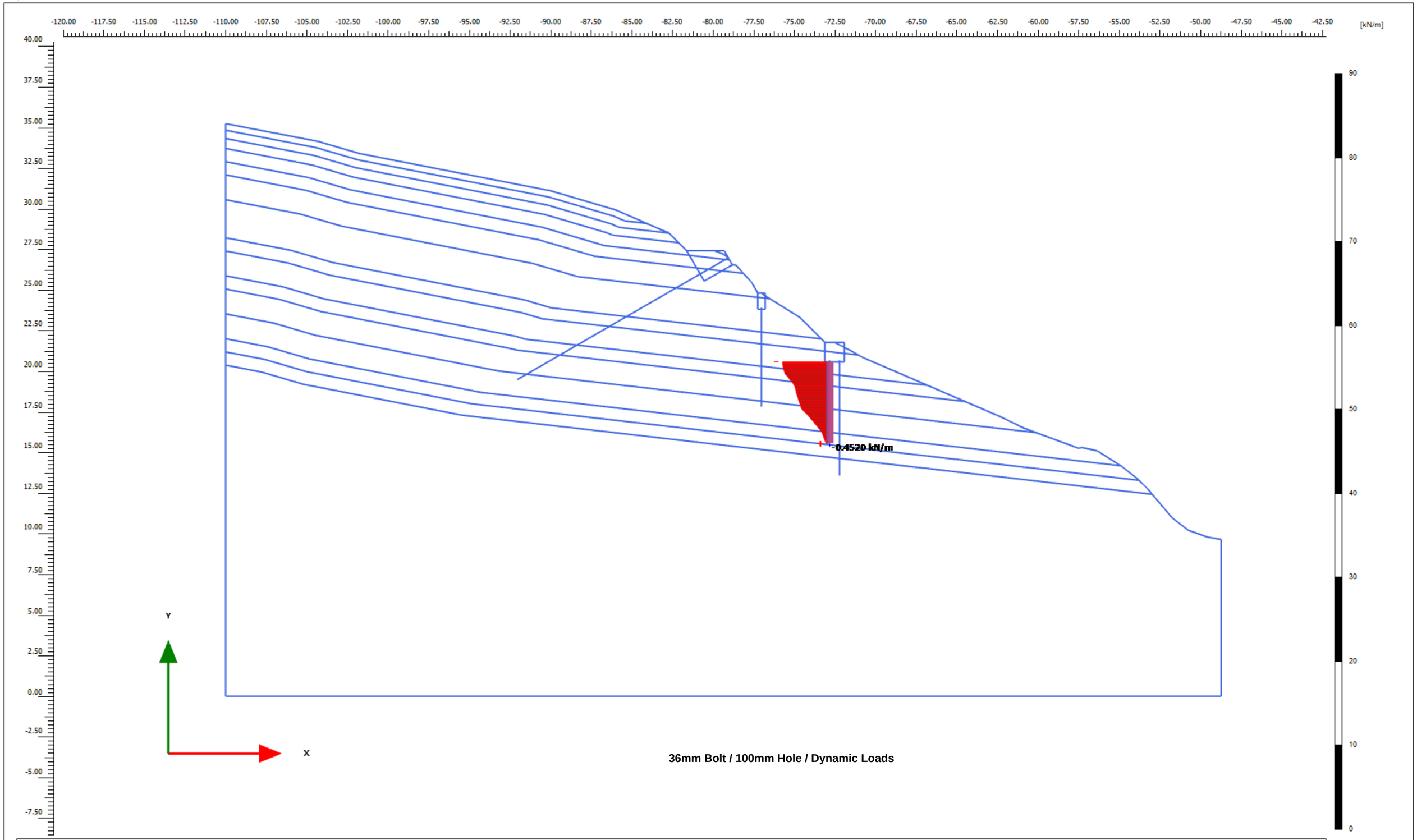


Axial forces N (scaled up 5.00 times)

Maximum value = -0.03725 kN/m (Element 37 at Node 29199)

Minimum value = -0.6361 kN/m (Element 29 at Node 29169)

CMW Geosciences	Project description: Marion Costal Walkway Upgrade		Date: 18/03/2022
	Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 15	Company: CMW Geosciences Pty Ltd

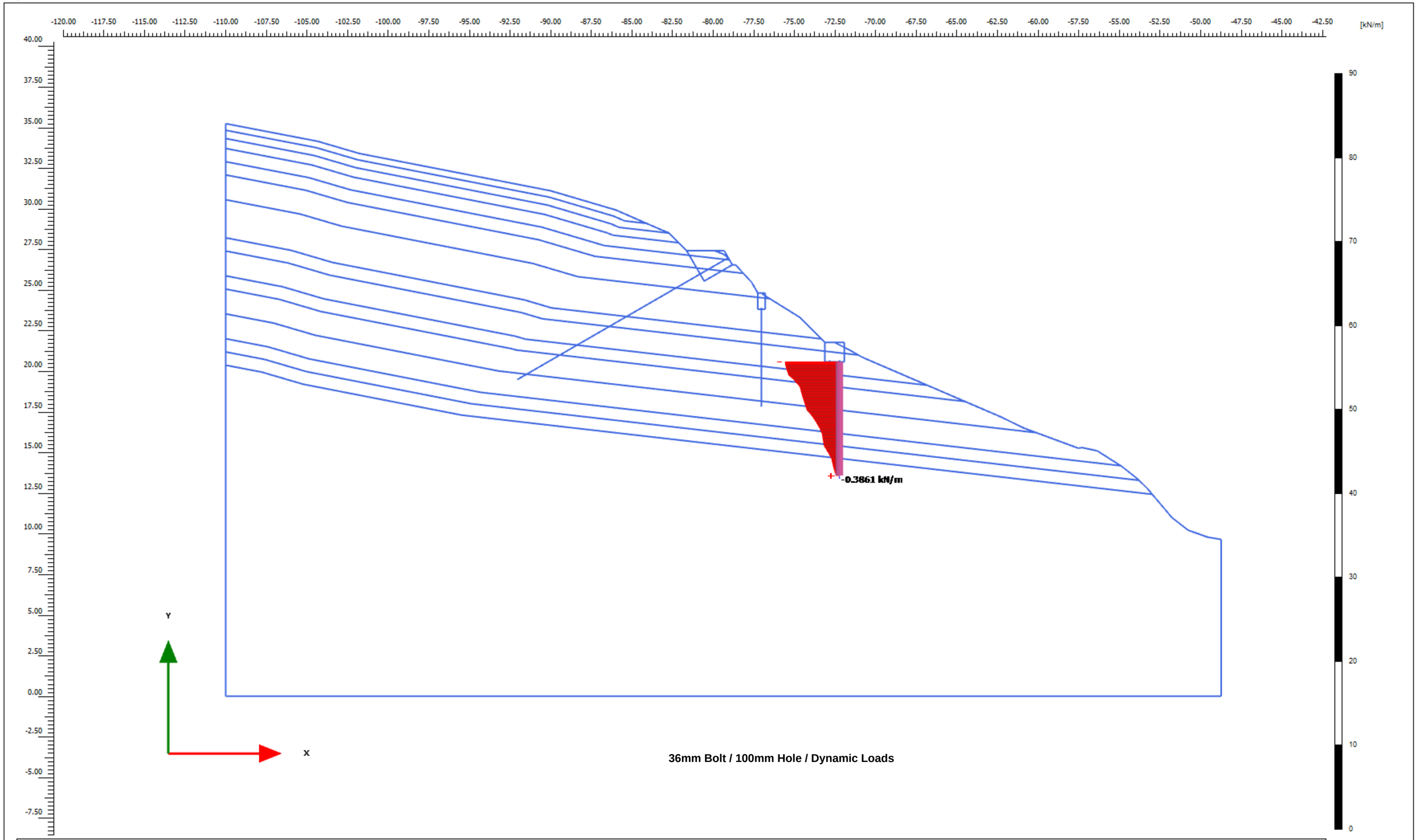


Axial forces N (scaled up 0.500 times)

Maximum value = -0.4520 kN/m (Element 49 at Node 29253)

Minimum value = -5.826 kN/m (Element 41 at Node 29216)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 15	Company: CMW Geosciences Pty Ltd	



Axial forces N (scaled up 0.500 times)

Maximum value = -0.3861 kN/m (Element 61 at Node 29303)

Minimum value = -6.680 kN/m (Element 51 at Node 29258)

Project description: Marion Costal Walkway Upgrade			Date: 18/03/2022
Project filename: Kurnabinna Gully S, B02, Lon, Est_RevA	Step: 15	Company: CMW Geosciences Pty Ltd	