

28 June 2018

Raymond O'Brien and Victoria Pichler
C/- Terra Group NZ Limited
PO Box 12858
Penrose
Auckland 1023

Dear Raymond and Victoria

RE: Revised Geotechnical Plan Review of 287 Tuhirangi Road, Makarau, Auckland
(Our Reference: 13704.000.001_06)

1 Introduction

ENGEO Ltd was requested by Terra Group NZ Limited (Terra) on behalf of Raymond O'Brien and Victoria Pichler, to provide a revised geotechnical review of the proposed development plans for the NZ Shooting Sports Centre by Terra Group NZ Ltd, dated 28 June 2018 (project number: 23406, drawing numbers: RC-200, RC-200, RC-201, RC-300, and RC-700 to 704). The plans are included at the rear of this report as Attachment 1. The purpose of this revised plan review is predominantly to address issues identified in the Sentinel Planning Ltd Section 92 request for more information letter dated 8 June 2018.

Based on our discussions with Dale Boddie of Terra (emails dated 26 and 27 April 2017), we understand the proposed clubhouse is to be relocated off-site and it is intended to construct 33 shooting bays, two areas for car parking and an accessway.

This report should be read in conjunction with our Geomorphic Assessment Report of 287 Tuhirangi Road, Makarau (project number: 13846.000.000_02, dated 17 March 2017).

2 Review of Proposed Earthworks Plans

Terra Group NZ Limited has provided us with the proposed development plans (described above). Based on our review of the plans and discussions with Dale Boddie, we have summarised the key geotechnical features below:

- 33 new shooting bays are to be constructed along the northern and southern sides of the proposed access road within the eastern part of the site.

- Anticipated 59,000 m³ of cut and 23,100 m³ of fill, with cut and fill thicknesses varying from up to approximately 9 m and 5.5 m across the site. The greatest thickness of fill is to be placed in bunds between and around the ranges, as well as levelling bays in the southern part of the site. The greatest depth of cut is located at the northern end of Shooting Bays 24 and 23. Approximately 15,500 m³ of topsoil will be stockpiled and re-spread over the site.
- The proposed cut slope angle at the northern ends of Ranges 14 and 24 are approximately 40° and 55°.

3 ENGEO Past Investigations

ENGEO has completed a geomorphic assessment of the site (referenced above) comprising a review of historical aerial photography, preparation of a geomorphic map encompassing the area of development, and seven test pits. Our assessment identified three geologic units on-site; Mahurangi Limestone, Cornwallis Formation and East Coast Bays Formation. We also found evidence of active and historic instability in the form of shallow and deep-seated failures.

We provided recommendations for further subsurface investigations and development of cross-sections for computational slope stability analyses. These recommendations remain valid.

4 Geotechnical Conclusions and Recommendations

Based on our past site investigation and observations, and review of the proposed development plans by Terra Group NZ Ltd (referenced above), we consider the site to be generally suitable for the proposed development.

We recommend further geomorphic and slope stability assessment of the slopes located adjacent to Shooting Bays 23 to 28 and 14 to 16, as the proposed cuts in this location are significant and there is a risk that the cut may destabilise the toe of the slope.

We have been unable to fully investigate the northern slopes to date due to the site topography and dense vegetation. Therefore, we recommend that additional geotechnical assessments be conducted during the earthworks phase to further develop the ground model and complete specific slope stability analyses. This observational approach will enable us to provide recommendations during construction for earthworks modifications and / or slope retaining measures where required.

We understand that, in some cases, final slopes may be required to be formed at steeper grades (> 1 V: 2 H) outside of structural fill and trafficked areas (such as parking, access ways or areas that are regularly accessed on foot). These will require slope specific geotechnical assessment prior to and during formation.

The earthworks programme should include a 2-3 week assessment period in the early stages while we perform supplemental investigations, refine the geological model and provide slope stability analysis.

5 Earthworks Operations

- During excavation, all undocumented fill and loose / soft / organic material should be removed from the base of excavations prior to filling. All topsoil in areas of earthworks should be stripped prior to fill placement. Exposed subgrades should be firm and non-yielding and free and any loose soil or debris prior to placement of fill.
- All excavated soil should be either removed from site or placed in an engineer approved stockpile at an appropriate location to avoid unfavourable loading on construction or preconstruction slope batters, particularly in the vicinity of the stream in the southeast corner of the site.
- Site won cut material should be assessed by a qualified geotechnical engineer for suitability for reuse as engineered fill.
- All vertical / sub-vertical cuts greater than 1.5 m in soil or rock should be supported with a specifically designed retaining wall or approved by a Chartered Professional Engineer practising in Geotechnical Engineering.
- Temporary unsupported cut slopes should not exceed a batter of 1 vertical: 1 horizontal (~45° from horizontal), and should not be left unsupported at this batter angle for longer than two weeks.
- Cuts must not be exposed to adverse weather conditions (i.e. cut during summer earthworks season) and should be covered to minimise environmental effects (i.e.: with polythene plastic).
- Unsupported, finished cut and/or fill slope grades for slopes that are proximate to trafficked areas (such as parking, access ways or areas that are regularly accessed on foot) should be no steeper than 1 vertical: to 2 Horizontal (~26° from horizontal) in soil faces up to 3 m high; cuts higher than 3 m will require specific geotechnical design. Furthermore, all permanent cut faces should be specifically assessed by a Geotechnical Engineer.
- Suitable drainage channels must be put in place to divert surface water from unsupported cut faces. Subsurface drains should also be considered for the toe of permanent slopes.
- In the case of long term-cuts, faces should be vegetated to assist in long-term stability.
- Based on our experience with the types of materials on this site, we anticipate that material strengths may be significantly reduced when exposed to weather. We therefore recommend that trafficked areas and platforms are only trimmed to final levels immediately prior to placing engineered fill and vegetation and that at all times the site is shaped to avoid water ponding during rain, thereby limiting the need for additional undercutting and backfilling. On no account should areas of trimmed subgrade be left exposed to allow the ingress of water, nor should subgrade areas be trafficked prior to drying out after rain.
- All fill placed on existing slopes should be keyed and benched into good soil and drainage provided in accordance with NZS 4431, residential earth fills.
- All engineered or structural hardfills should be placed in ≤ 200 mm lifts and compacted to a minimum of 95% of maximum dry density, at no less than optimum moisture content.

Compaction should be achieved using standard plant and methodology suitable for the imported material. A water source should be maintained on site for moisture control.

- All excavations should be in line with the WorkSafe Good Practice Guidelines for Excavation Safety (July 2016).
- Earthworks operations should be performed under the observation of a suitable Geotechnical Engineer to a minimum construction monitoring level CM-3.

6 Limitations

- i. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our clients, Raymond O'Brien and Victoria Pichler, their professional advisers and the relevant Territorial Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.
- ii. The recommendations in this report are based on the ground conditions indicated from published sources, site assessments and subsurface investigations described in this report based on accepted normal methods of site investigations. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the Client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it should be appreciated that actual conditions could vary from the assumed model.
- iii. Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.
- iv. This Limitation should be read in conjunction with the IPENZ/ACENZ Standard Terms of Engagement.
- v. This report is not to be reproduced either wholly or in part without our prior written permission.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on (09) 972 2205 if you require any further information.

Report prepared by



Jacob Cornall

Engineering Geologist

Report reviewed by



Craig Wright, CEG

Associate Engineering Geologist

Attachments: Terra Group NZ Ltd - Proposed Development Plans - NZ Shooting Sports Centre -
28 June 2018 - 23406

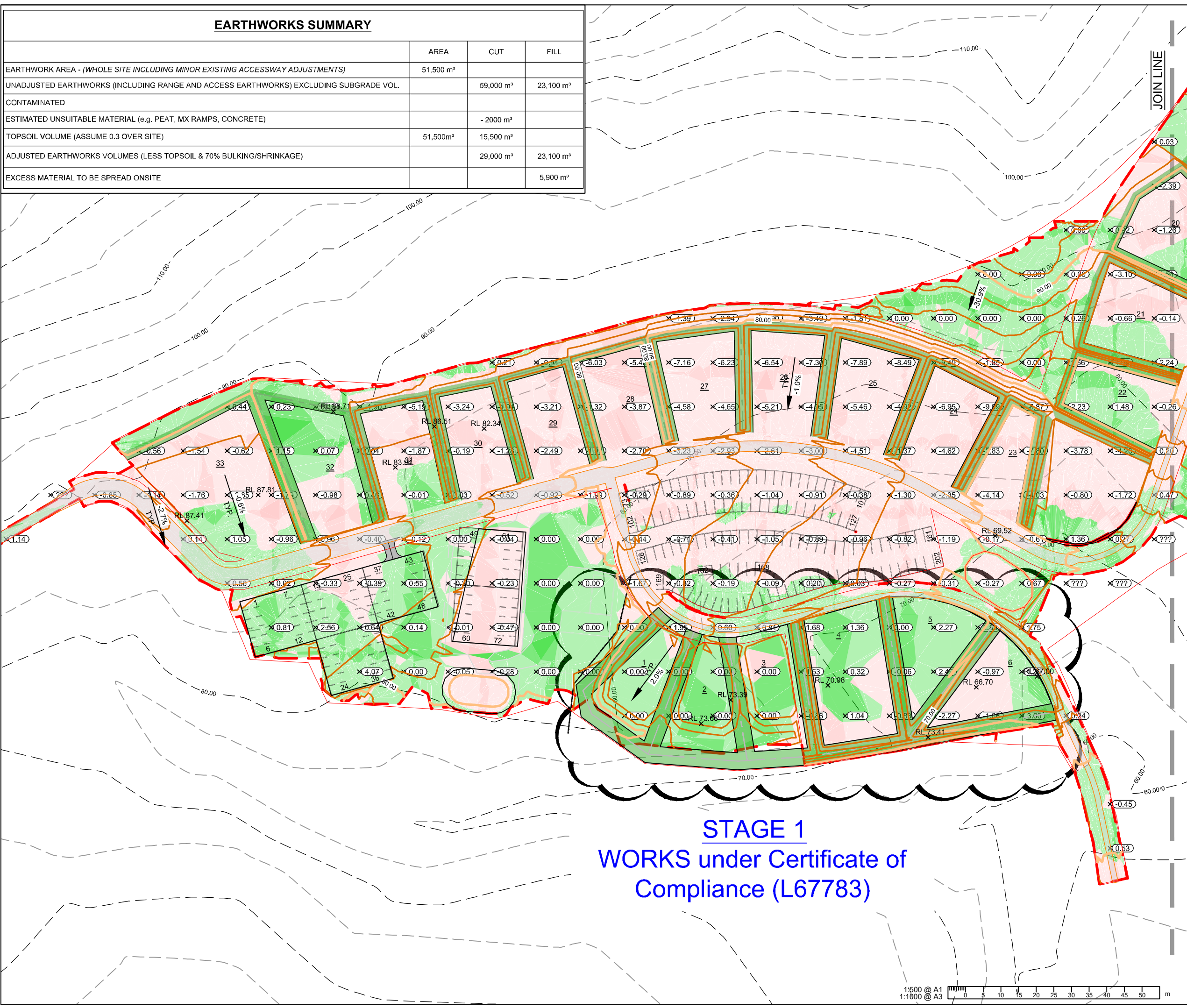
EARTHWORKS SUMMARY

	AREA	CUT	FILL
EARTHWORK AREA - (WHOLE SITE INCLUDING MINOR EXISTING ACCESSWAY ADJUSTMENTS)	51,500 m ²		
UNADJUSTED EARTHWORKS (INCLUDING RANGE AND ACCESS EARTHWORKS) EXCLUDING SUBGRADE VOL.		59,000 m ³	23,100 m ³
CONTAMINATED			
ESTIMATED UNSUITABLE MATERIAL (e.g. PEAT, MX RAMPS, CONCRETE)		- 2000 m ³	
TOPSOIL VOLUME (ASSUME 0.3 OVER SITE)	51,500m ²	15,500 m ³	
ADJUSTED EARTHWORKS VOLUMES (LESS TOPSOIL & 70% BULKING/SHRINKAGE)		29,000 m ³	23,100 m ³
EXCESS MATERIAL TO BE SPREAD ONSITE			5,900 m ³

REVISION				
ISSUE	DATE	DETAIL	CHKD	DRWN
A	13/07/17	FOR RESOURCE CONSENT	GC	DB
B	24/04/18	FOR RESOURCE CONSENT	GC	DB
C	28/06/18	MINOR EW REVISIONS	GC	DB

SURFACE LEVEL DATA			
NUMBER	MINIMUM LEVEL	MAXIMUM LEVEL	COLOUR
1	-12.45	0.00	█
2	0.00	10.54	█

 CERTIFICATE OF COMPLIANCE AREA



STAGE 1
WORKS under Certificate of Compliance (L67783)

STAGE

PROJECT CONSULTANTS
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 Northland: (09) 431 4444
 Christchurch: (03) 379 5055
 Email: terra@terragroup.co.nz | Web: www.terragroup.co.nz


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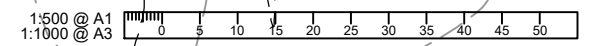
CLIENT
R. O'BRIEN & V.PICHLER

PROJECT
NZ SHOOTING SPORTS CENTER

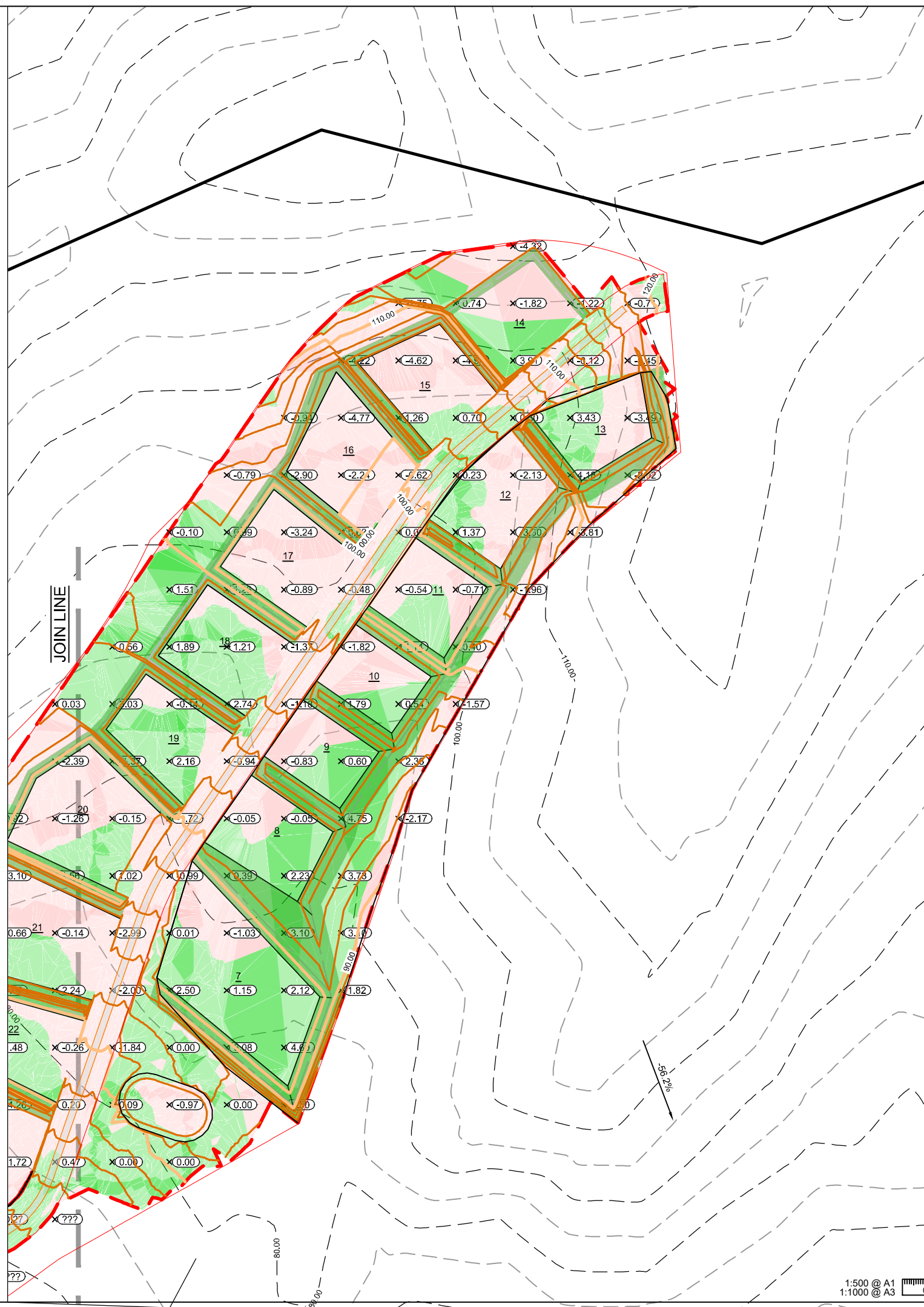
LOCATION
287 TUHIRANGI ROAD, MAKARAU, AUCKLAND

DRAWING TITLE
RANGE ISOPACH PLAN
 SHEET 1 OF 2

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	DATE	13/07/2017
	SURVEYED	
	DESIGNED	G. CLARKE
	DRAWN	D. BODDIE
	CHECKED	G. CLARKE
PROJECT NUMBER	DWG NUMBER	REVISION
23406	RC-200	C




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C	28/06/18	MINOR EW REVISIONS	GC	DB

SURFACE LEVEL DATA			
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 CERTIFICATE OF COMPLIANCE AREA

STAGE

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PROJECT


NZ SHOOTING SPORTS CENTER

LOCATION

287 TUHIRANGI ROAD, MAKARAU, AUCKLAND

DRAWING TITLE

RANGE ISOPACH PLAN
SHEET 2 OF 2

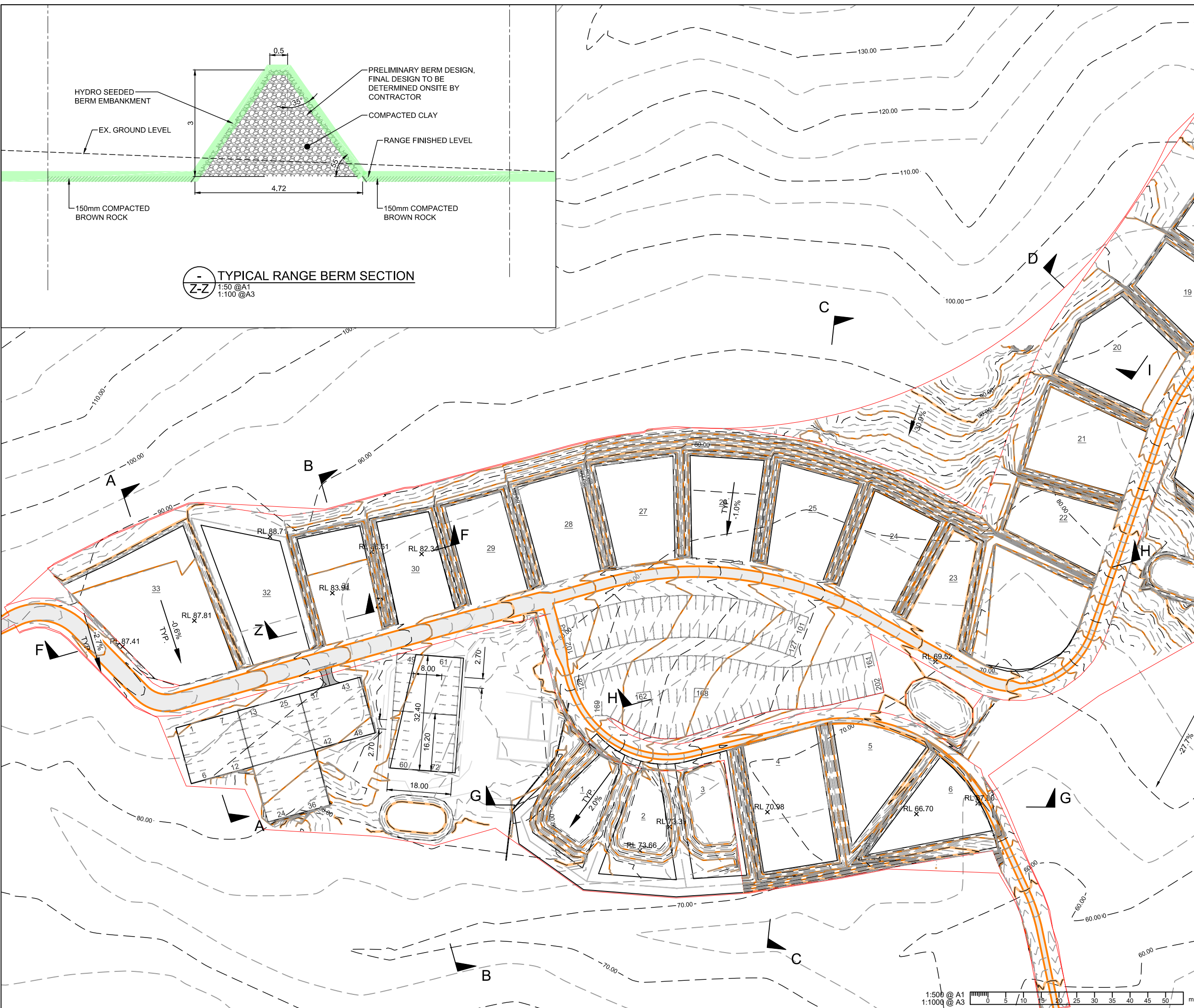
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DRAWN	D. BODDIE	
CHECKED	G. CLARKE	

PROJECT NUMBER: 23406

DWG NUMBER: RC-201

REVISION: C

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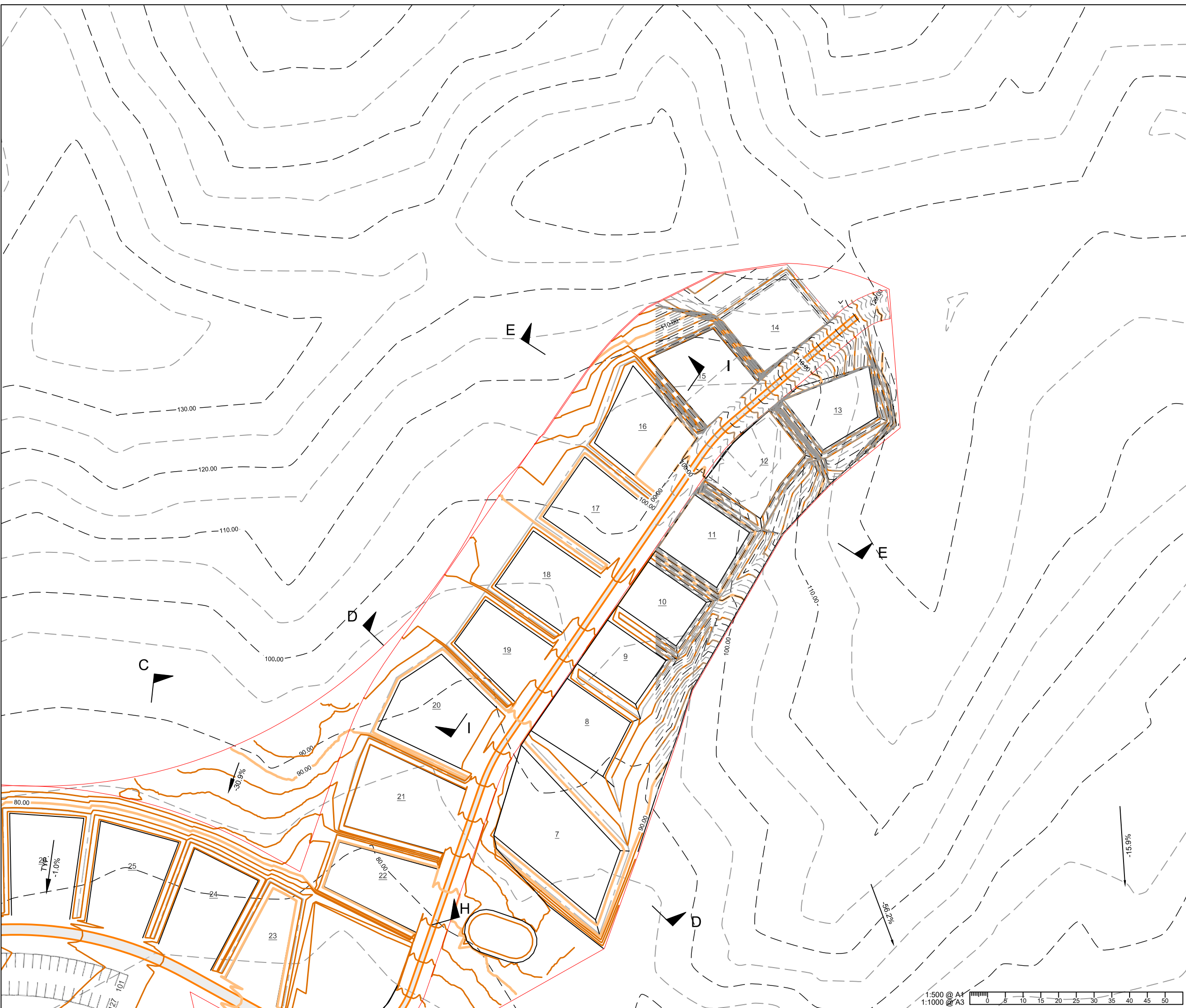
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--- 19.70	--- EXISTING MINOR CONTOUR
— 20.00	— PROPOSED MAJOR CONTOUR
— 19.70	— PROPOSED MINOR CONTOUR
---	--- CONSTRUCTION EXTENT

STAGE	
PROJECT CONSULTANTS	
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PROJECT	
NZ SHOOTING SPORTS CENTRE	
LOCATION	
287 TUHIRANGI ROAD, MAKARAU, AUCKLAND	
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REVISION	DRAWN
C	CHECKED
	G. CLARKE

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- 20.00 EXISTING MAJOR CONTOUR
- 19.70 EXISTING MINOR CONTOUR
- 20.00 PROPOSED MAJOR CONTOUR
- 19.70 PROPOSED MINOR CONTOUR
- CONSTRUCTION EXTENT
- CULVERT



STAGE

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PROJECT
NZ SHOOTING SPORTS CENTRE

LOCATION
287 TUHIRANGI ROAD, MAKARAU, AUCKLAND

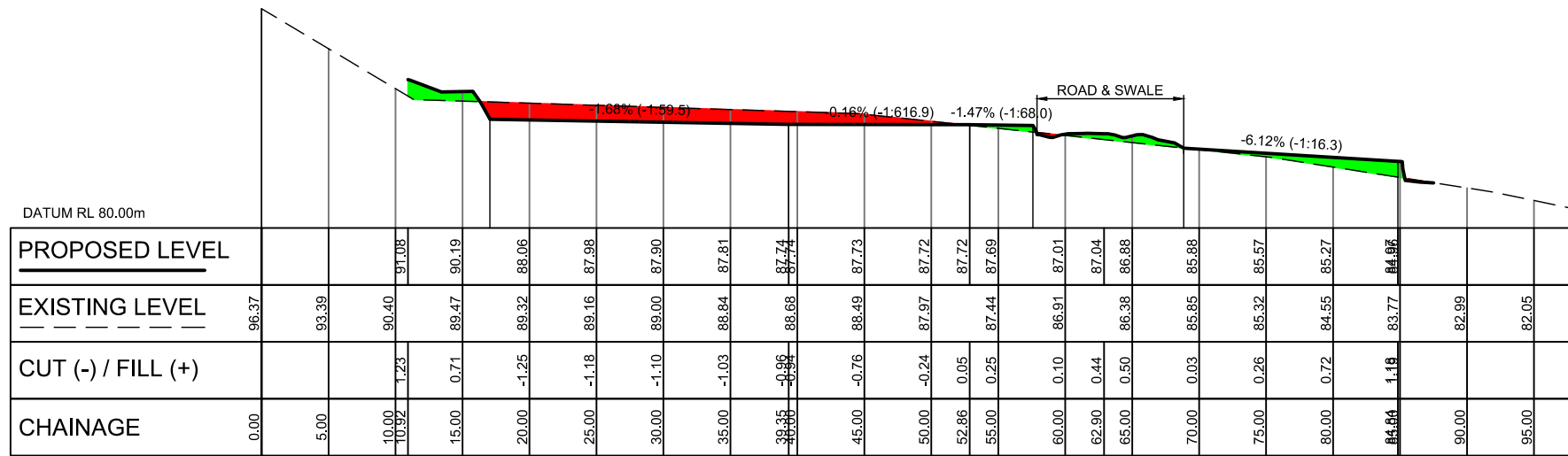
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	DESIGNED	G. CLARKE
DRAWN	D. BODDIE	
CHECKED	G. CLARKE	

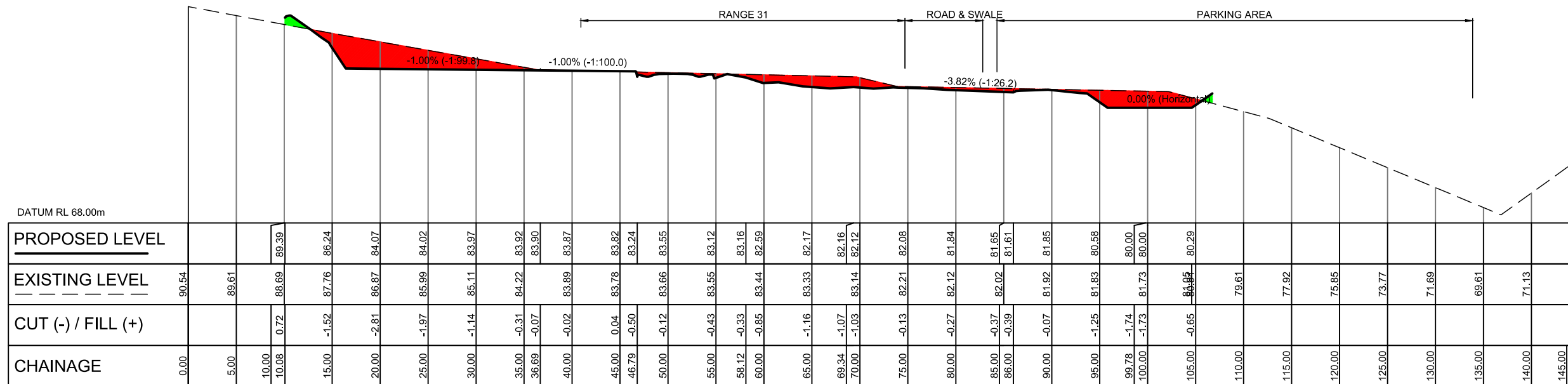
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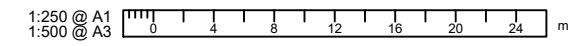
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					CHECKED	13/07/17

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PROJECT / LOCATION
**NZ SHOOTING SPORTS CENTRE
 287 TUHIRANGI ROAD, AUCKLAND**

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EARTHWORK CROSS SECTIONS

SHEET 1 OF 5

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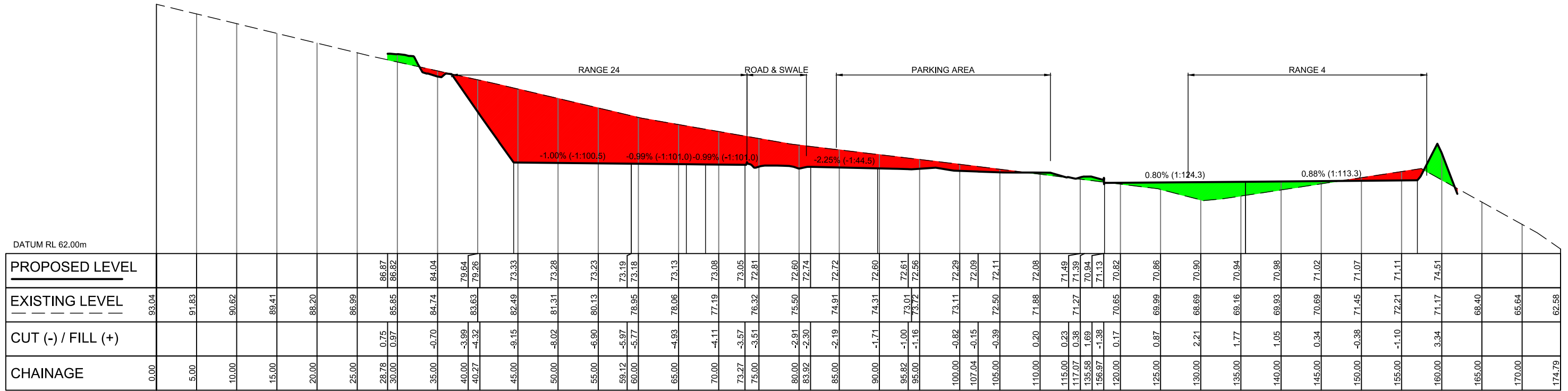
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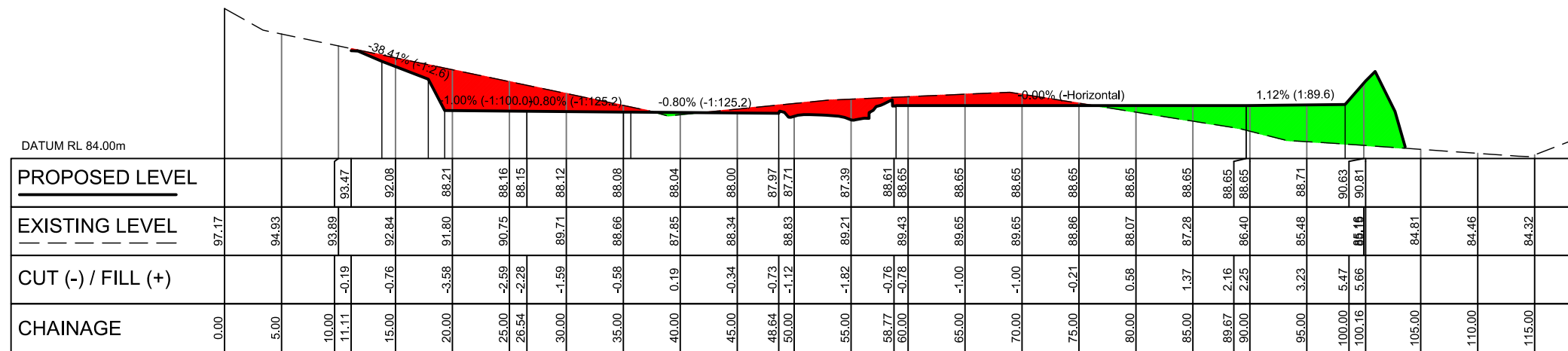
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REVISION
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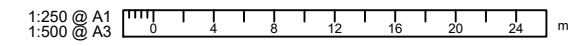
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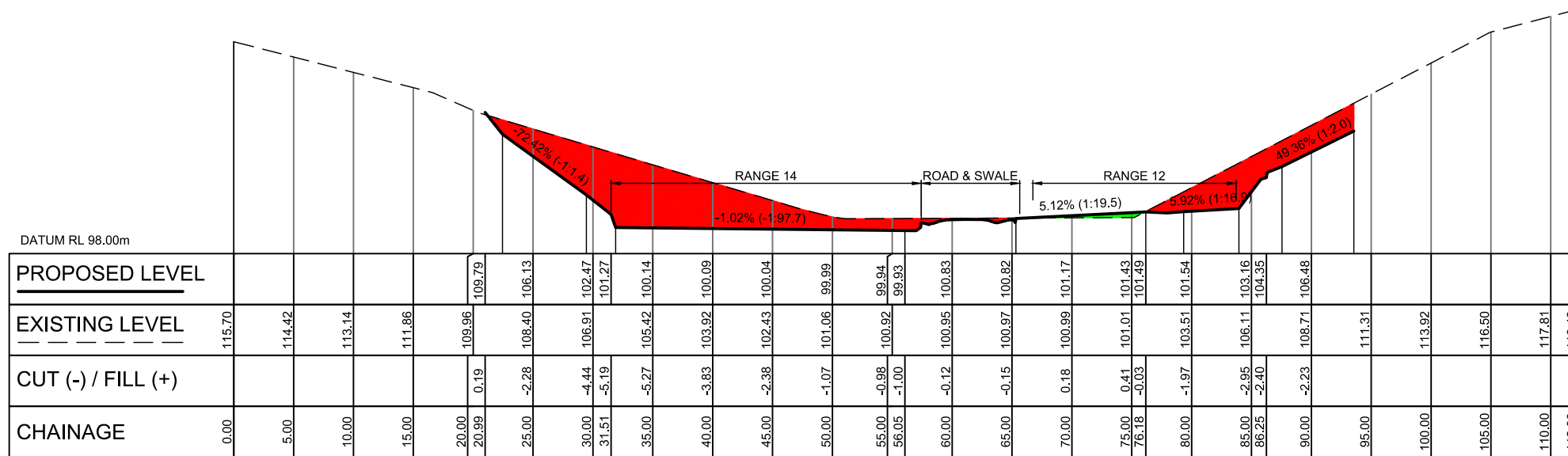
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PROJECT / LOCATION
**NZ SHOOTING SPORTS CENTRE
 287 TUHIRANGI ROAD, AUCKLAND**

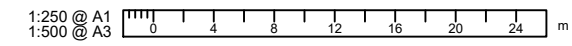
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 SHEET 2 OF 5

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DWG NUMBER RC - 701	REVISION C





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ISSUE	DATE	REVISION	CHKD	DRWN	NAME	DATE	CONSULTANT
A	24/04/18	FOR RESOURCE CONSENT	GC	DB	SURVEYED		terra CONSULTANTS PO BOX 12858, Penrose, New Zealand Auckland: (09) 357 3557 Northland: (09) 431 4444 Christchurch: (03) 379 5055 Email: terra@terragroup.co.nz Web: www.terragroup.co.nz DRAWINGS ARE COPYRIGHT AND PROPERTY OF TERRA CONSULTANTS
B	21/06/18	FOR RESOURCE CONSENT	GC	DB	DESIGNED	13/07/17	
C	28/06/18	MINOR EW AMENDMENTS AS PER GEOTECH DISCUSSION	GC	DB	DRAWN	13/07/17	
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					CHECKED	13/07/17	

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PROJECT / LOCATION
**NZ SHOOTING SPORTS CENTRE
 287 TUHIRANGI ROAD, AUCKLAND**

DRAWING TITLE
EARTHWORK CROSS SECTIONS
 SHEET 3 OF 5

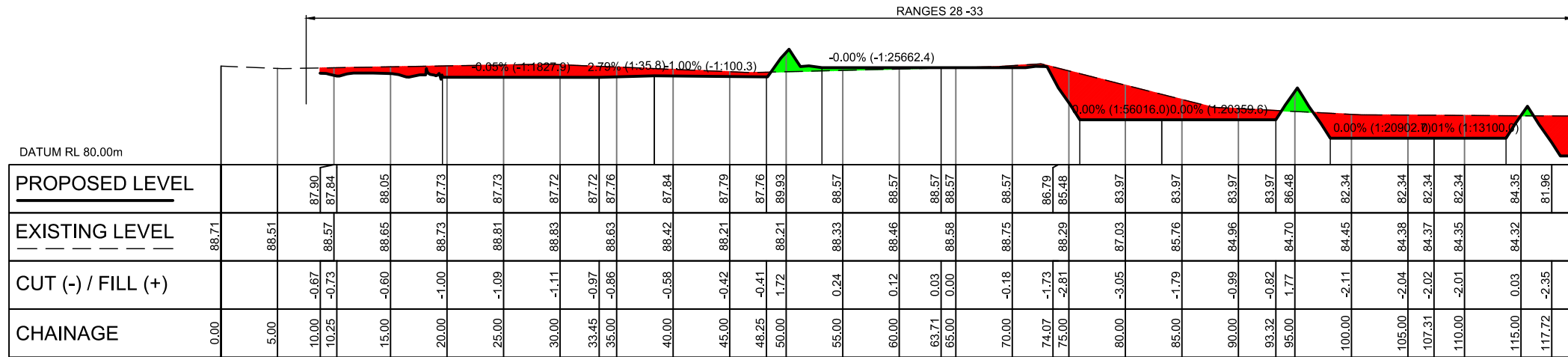
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PROJECT NUMBER
23406

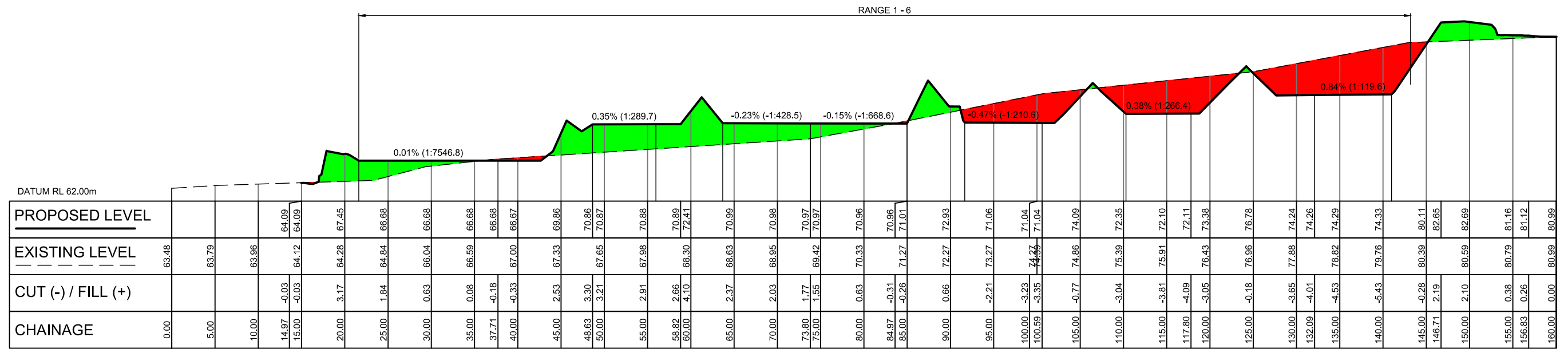
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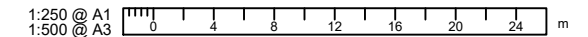
REVISION
C



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G LONGSECTION
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C	28/06/18	MINOR EW AMENDMENTS AS PER GEOTECH DISCUSSION	GC	DB	DRAWN	13/07/17
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					CHECKED	13/07/17

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PROJECT / LOCATION
**NZ SHOOTING SPORTS CENTRE
 287 TUHIRANGI ROAD, AUCKLAND**

DRAWING TITLE
EARTHWORK CROSS SECTIONS

SHEET 4 OF 5

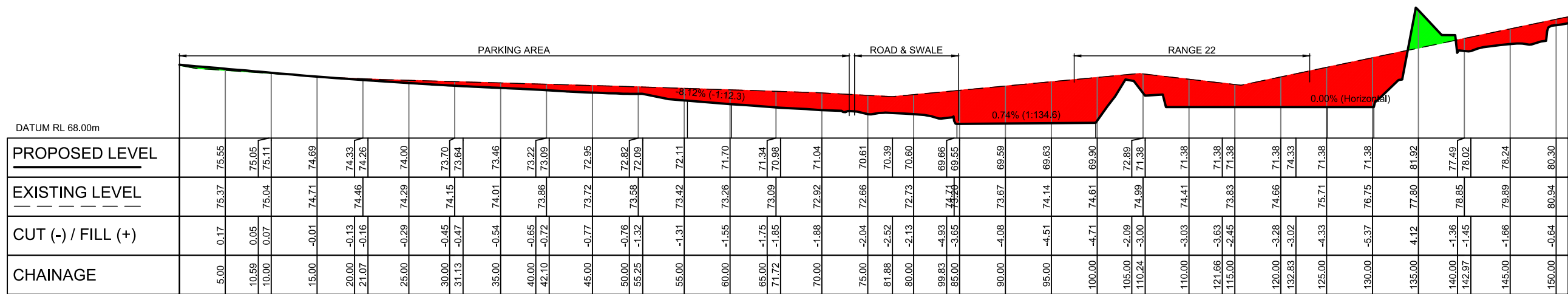
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FOR RESOURCE CONSENT
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PROJECT NUMBER
23406

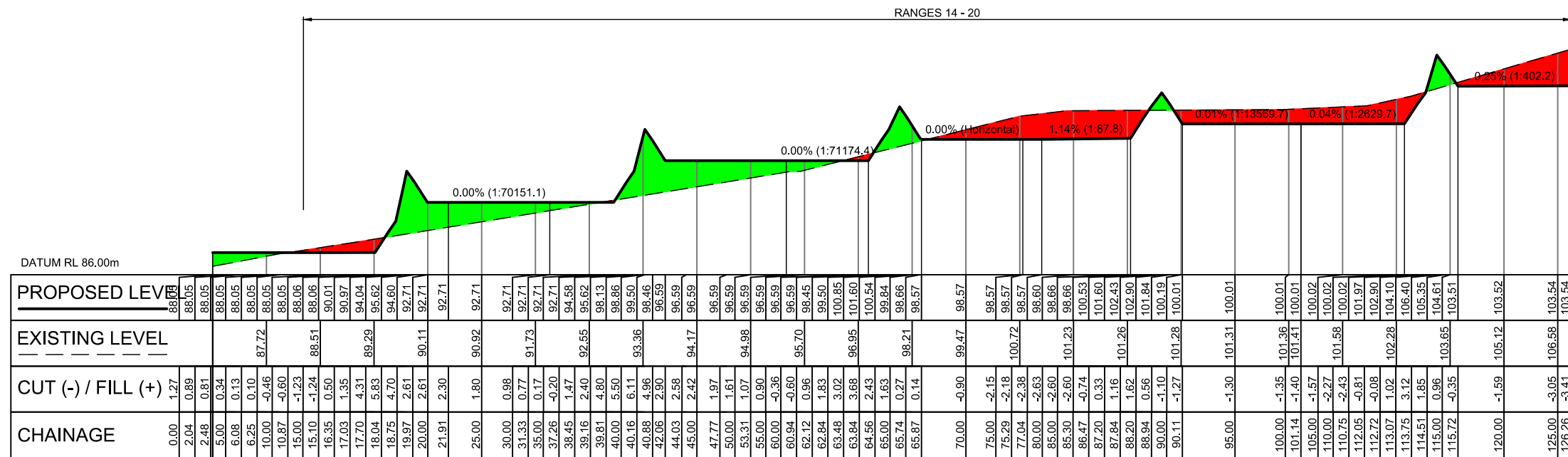
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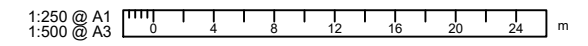
REVISION
C



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I LONGSECTION
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ISSUE	DATE	REVISION	CHKD	DRWN	NAME	DATE
A	24/04/18	FOR RESOURCE CONSENT	GC	DB	SURVEYED	
B	21/06/18	FOR RESOURCE CONSENT	GC	DB	DESIGNED	13/07/17
C	28/06/18	MINOR EW AMENDMENTS AS PER GEOTECH DISCUSSION	GC	DB	DRAWN	13/07/17
					TRACED	
					CHECKED	13/07/17

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PROJECT / LOCATION
**NZ SHOOTING SPORTS CENTRE
 287 TUHIRANGI ROAD, AUCKLAND**

DRAWING TITLE
EARTHWORK CROSS SECTIONS

SHEET 5 OF 5

STAGE
FOR RESOURCE CONSENT
 THIS DRAWING IS NOT SUITABLE FOR SETOUT PURPOSES

PROJECT NUMBER
23406

DWG NUMBER
RC - 704

SCALE
 A1 AS SHOWN
 A3 AS SHOWN

REVISION
C

Z:\Tuhirangi Road, Kaukapakapa (273)\Engineering\CAD Drawing\02_WORKING DWG\04_RESOURCE CONSENT\1700-RC-700_SECTIONS.dwg, 704_6/28/2018 12:20 PM