



# **Earthworks Strategy**

Marubeni Bridgend Green

November 2022



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# Earthworks Strategy

Marubeni Bridgend Green

November 2022

# Issue and Revision Record

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# Contents

1	Project Overview	1
2	Introduction	2
2.1	Scope of work	2
2.2	Existing site Topography/conditions	1
2.3	Expected Ground Conditions	1
3	Earthworks Strategy	2
3.1	Material Bulking and Compaction Factor	2
3.2	Cut and Fill Volumes	2
3.3	Import materials volumes	3
3.4	Drainage volumes	3
3.5	Risks	3
4	Appendices	6
<b>Tables</b>		
	Table 3.1: Cut and Fill volumes	2
	Table 3.2: Imported materials volumes	3
	Table 3.3: Risk Register	3

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# 1 Project Overview

Development of a green hydrogen production facility with electrolysers, hydrogen storage, hydrogen refuelling station, admin building, substation and hydrogen pipeline 'off-take'; with access, circulation, parking, lighting, security fencing, hard and soft landscaping, drainage infrastructure and temporary construction compound, on land at Brynmenyn, Bridgend. Together with the installation of a solar photovoltaic electricity generating station (solar farm), comprising ground-mounted solar panels, inverters, transformer units, switch gear and a substation; with access, circulation, parking, lighting, security fencing, hard and soft landscaping, drainage infrastructure and temporary construction compound, on land at Bryncethin, Bridgend. Sites to be connected via an electrical wire (part under and part overground).

## 2 Introduction

This document outlines the earthworks strategy for Marubeni Bridgend Green Hydrogen Production Facility. The project consists of a planned green hydrogen development to include green hydrogen production from local solar and wind power in Bridgend, Wales, with a design capacity basis of 5 MW of hydrogen (Higher Heating Value - HHV) to be made via electrolysis and shall supply hydrogen for transportation and heating. The project's aim is to facilitate the roll-out of green hydrogen production and supply in the Bridgend County Borough region.

Earthworks are required for Marubeni Bridgend Green Hydrogen project to ensure a level platform for the new operation facility. The earthworks will include cut and fill of the existing undulating topography and a permanent access road entering the southwest of the site, connecting to Squire Drive. Mott MacDonald have been engaged to assist with cut and fill estimates, ground condition assessments and associated required materials for import/export to/from the site.

### 2.1 Scope of work

Mott Macdonald have completed a geotechnical desk study and topographical surveys on site, which have been used to develop a strategy for the site earthworks. The scope of work to be reviewed in this document includes the following areas:

- The site finished platform, suitable for permanent Hydrogen production use, 6,370m<sup>2</sup> in area at +63.800m AOD. This platform must also be suitable for the internal road surrounding the hydrogen production facility. The internal road includes a roundabout connecting it to the access road and a bellmouth that leads to the facility entrance. The platform is to include allowance for a 500mm finished platform makeup, likely to consist of reinforced concrete hardstanding founded on engineered backfill
- A 6m wide access road connecting the site to Squire Drive. A road construction depth of 750mm has been assumed for this preliminary earthworks design. This shall be reviewed at detailed design, whilst considering any site information retrieved by proposed ground investigation surveys
- Earthworks volumes to account for an 80m retaining wall south of the access road and an internal fire wall with a total length of 142m.
- Earthworks for a new surface water attenuation pond.

Any earthworks, drainage or other enabling works required for temporary construction areas are to be optimised by the contractor during the detailed design stage. The Contractor shall identify areas for temporary topsoil storage and ensure all temporary areas are reinstated following the works.

Appendix A shows the proposed layout of the Hydrogen production facility.

## 2.2 Existing site Topography/conditions

The site topography has an increase of approximately 10m across the site, rising from West to East. The change in elevation, is more pronounced to the north where the levels drop down into the Brynmenyn Industrial Estate with the elevation changing from 60m AOD to 55m AOD over a distance of 40m.

## 2.3 Expected Ground Conditions

A Geotechnical and Geoenvironmental desk study has been completed which gives outline of the anticipated ground conditions on site which are anticipated to comprise the following:

- Approximately 0.3m thick made ground which, if present, is likely to comprise reworked natural soils containing anthropogenic materials including brick, concrete, metal, plastic and ceramic in varying proportions
- The superficial deposits underlying the site are understood to comprise Diamicton, described by the British Geological Society (BGS) as comprising 'an unsorted to poorly sorted glacial till with a range in particle sizes from clay to boulders, in an unconsolidated mud and sand matrix'.
- The site may also be underlain by Superficial Deposits comprising glaciofluvial sand and gravel deposits from the same time period (Devensian) which are not clearly described by the BGS but are likely better sorted than the till deposits.
- The northern boundary of site may be underlain by River Terrace Deposits, described by the BGS as 'Sand and gravel, locally with lenses of silt, clay or peat.' and these deposits may extend onto site.
- The bedrock beneath the site is understood to comprise the South Wales Middle Coal Measures Formation described within the BGS Lexicon as comprising grey coal-bearing mudstones and siltstones with seatearths and minor sandstones
- The Coal Authority Consultants Coal Mining Report indicates that there are six coal seams present beneath the site that dip at an angle of between 39.8° and 45° to the north comprising the following:
  - Middle 9ft Top Leaf
  - Upper 9ft
  - Bute
  - Lower 9ft (Top Leaf)
  - 5ft Gellideg
- The Coal Authority does not consider it likely that there are any probably unrecorded shallow workings or spine roadways at shallow depth beneath the site



## 3 Earthworks Strategy

The main objectives and parameters of the earthworks exercise are as follow:

- Provide suitable internal substation road and bellmouth, road to have 2.5% crossfall.
- Provide suitable construction access road, road to have 2.5% crossfall.
- Remove topsoil (assume average 200mm thickness).
- Remove and replace any soft areas with well compacted imported granular material.
- Construct a level platform, suitable to install new hydrogen production facility, aiming to optimise cut and fill volumes based on existing site topography  
Cut and fill slopes generally should be 1:3. In some areas this is not feasible and a suitable reinforced embankment or retaining solution is to be designed during the detailed design stage.
- Site permanent platform shall be formed of reinforced concrete slabs founded on well compacted engineered fill

### 3.1 Material Bulking and Compaction Factor

It is recommended that earthwork volume calculations should assume a conservative bulking factor of 1.4. The true bulking factor may be lower than this but this cannot be ascertained for certain until the ground investigation works have been completed.

A compaction factor of 1.2 will be applied to imported materials.

### 3.2 Cut and Fill Volumes

The cut and fill volumes figure from the below table are calculated based on the raw figures from the drawing 108939-MMD-BRGR-XX-DR-C-0046 and the bulking factors from the section 3.1 of this report. As shown in the earthworks drawing, no fill is required. Therefore, all excess material will be taken off site.

**Table 3.1: Cut and Fill volumes**

Area of Earthworks	Volume (m <sup>3</sup> )	Import/Export	Excess Material Volume (m <sup>3</sup> )
Substation topsoil removal	2846	Export	2846
Access road topsoil removal	403.2	Export	403.2
Platform topsoil removal	2147.6	Export	2147.6
Pond topsoil removal	295.4	Export	295.4
Substation cut/ fill net volume	3556	Export	3556
Access road cut/ fill net volume	2130.8	Export	2130.8
Platform cut/ fill net volume	3690.4	Export	3690.4
Pond cut/ fill net volume	852.6	Export	852.6

### 3.3 Import materials volumes

Table 2.2 shows the volumes of construction materials required to be imported to site to build the site up to finished platform level and to construct the roads. The contractor will develop the design in the detailed design stage.

**Table 3.2: Imported materials volumes**

Imported materials				
	Materials	Depth (m)	Area (m <sup>2</sup> )	Volume (m <sup>3</sup> )
Platform	Reinforced concrete	0.25	6422.5	1605.6
	Compacted Fill	0.25	6422.5	1605.6
Access Road	Road makeup	0.75	541.2	405.9
<b>Total:</b>				3617.1
<b>Total with compaction factor:</b>				4340.5

### 3.4 Drainage volumes

The drainage design consists of a network of filter drains, channel drains and pipes. The total volume of excavated soil required for the installation will be 142.26m<sup>3</sup>, totalling 199.16m<sup>3</sup> with the bulking factor applied.

### 3.5 Risks

The following risk register identifies potential risks, mitigation measures and residual risks associated with this earthwork's strategy.

**Table 3.3: Risk Register**

ITEM	RISK	MITIGATION	RESIDUAL RISK
Ground conditions	Unknown ground conditions	An intrusive ground investigation to be carried out to determine the ground conditions beneath the site based on the results of the Desk Study and non-intrusive geophysical surveys which will feed into the foundation solution design	Risk of contamination or localised areas of unsuitable soil may be identified during the earthworks.
Ground conditions	Presence of low bearing capacity Glacial Till material	Ground investigation proposed to include geotechnical testing to determine strength and consolidation properties of the soils on site	Instability of temporary excavations

ITEM	RISK	MITIGATION	RESIDUAL RISK
Ground conditions	Unforeseen ground conditions (associated with historic land uses) as a result of the absence of a site specific ground investigation	Ground investigation proposed to characterise ground conditions in areas of historical land use	Unidentified changes in ground conditions may cause localised instability. Site personnel should be aware of changing ground conditions during the earthworks.
Excavation within Glacial Till deposits.	Glacial Till deposits always carries the possibility of discreet pockets of perched water within cut slopes, cut platform or fill foundations.	The earthworks design drawings should allow space for a perimeter filter drain as well as standard details for filter drains and herringbone arrays to control any seepages. Protect the excavation against further wetting during construction which would further reduce the amount of re-usable soil.	Changing levels of water content in soils or areas of perched water could impact the way soils are placed and engineered in-situ. Site personnel should be aware of changing ground conditions.
Aggressive ground conditions	The presence of aggressive ground conditions could cause damage and corrosion of sub-surface structures and utilities, impacting their longevity and functionality	Ground investigation to include assessment of aggressive ground conditions and guidance on the concrete design and utility ducting materials	Ground investigations are inherently finite so pockets of more or less aggressive ground could be present.
Contaminated soils associated with historic industrial land uses	Soils may be chemically unsuitable for use due to a risk posed to human health or controlled waters	Ground Investigation works to include chemical analysis of soil and groundwater samples to allow for the completion of a risk assessment. Remedial works will be necessary should materials that pose a risk be identified on site.	Investigation works may miss areas of ground contamination that may require assessment should they be uncovered during the groundworks.

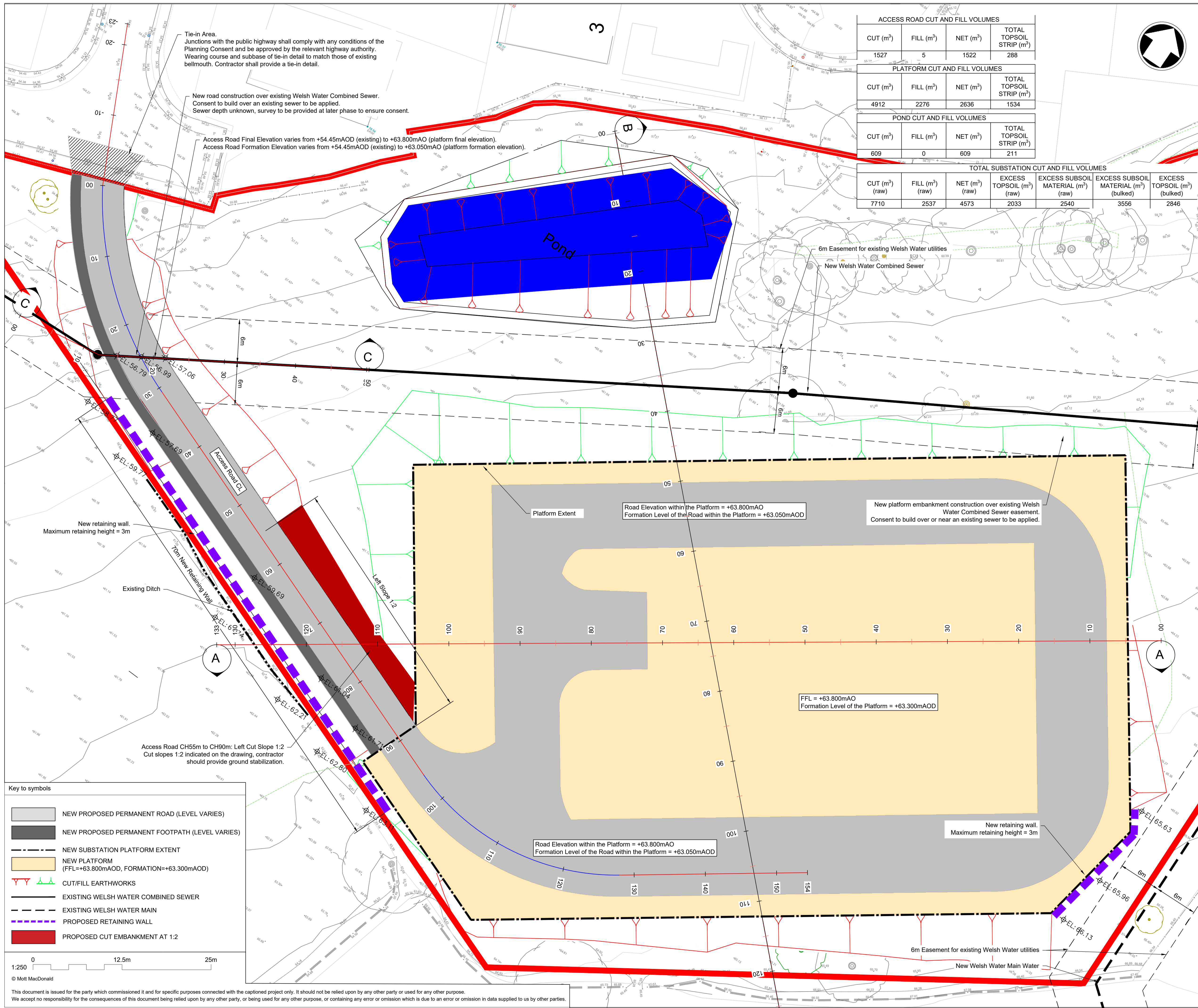
ITEM	RISK	MITIGATION	RESIDUAL RISK
<p>Hazardous ground gases generated from deep coal mine workings</p>	<p>Ground gas could migrate up and into buildings following construction and could build up in confined spaces. Additional risk from coal mine gas mixing with hydrogen production to create an explosive atmosphere.</p>	<p>Ground investigation to include ground gas monitoring to determine the level of risk present and advise on the need for ground gas protection measures</p>	<p>Ground gas risk will need to be managed during the site including the control of confined space entry</p>

## 4 Appendices

## **Appendix A**

### **Muarubeni Hydrogen production facility Earthworks Drawings**





ACCESS ROAD CUT AND FILL VOLUMES			
CUT (m³)	FILL (m³)	NET (m³)	TOTAL TOPSOIL STRIP (m²)
1527	5	1522	288

PLATFORM CUT AND FILL VOLUMES			
CUT (m³)	FILL (m³)	NET (m³)	TOTAL TOPSOIL STRIP (m²)
4912	2276	2636	1534

POND CUT AND FILL VOLUMES			
CUT (m³)	FILL (m³)	NET (m³)	TOTAL TOPSOIL STRIP (m²)
609	0	609	211

TOTAL SUBSTATION CUT AND FILL VOLUMES						
CUT (m³) (raw)	FILL (m³) (raw)	NET (m³) (raw)	EXCESS TOPSOIL (m³) (raw)	EXCESS SUBSOIL MATERIAL (m³) (raw)	EXCESS SUBSOIL MATERIAL (m³) (bulked)	EXCESS TOPSOIL (m³) (bulked)
7710	2537	4573	2033	2540	3556	2846

- Notes
- Do not scale from this drawing.
  - All dimensions are in metres/millimetres unless otherwise stated.
  - This drawing is to be read in conjunction with all relevant documents and drawings.
  - No unauthorised disclosure, storage or copying.
  - All spatial coordinates relate to the Ordnance Survey, British National Grid (OSGB36).
  - Existing ground profile modeled from topographical survey information by Zenith Land Survey dated April'22.
  - All levels are in meters and relate to AOD (Ordnance Survey, Newlyn).
  - Some areas where no feasible to achieve 1:3 embankment slope, a retaining solution is to be adequately designed during the detailed design stage.
  - Cut slopes 1:3 and Fill slopes 1:3 have been assumed for this preliminary earthworks design. The feasibility of these slopes are to be verified during detailed design. Cut slopes 1:2 indicated on the drawing, contractor should provide stabilization.
  - The following bulk factors have been assumed for this preliminary earthworks design:
    - subsoil bulk factor: 1.40
    - topsoil bulk factor: 1.40
  - A topsoil strip is to occur across the site at the location of the proposed substitution platform, access road and SUDs pond. Thickness applied to topsoil strip: 200mm. It is assumed all excess topsoil and subsoil material is to be removed from site.
  - Material cut from the site to be exported off-site for re-use shall be subject to representative chemical contamination testing in accordance with the requirements of the receiving site.
  - A permanent road construction depth of 750mm has been assumed for this preliminary earthworks design. Permanent road assumed asphalt finish or similar.
  - New platform assumed with concrete slab finish. A 500mm allowance for concrete surface construction for the substitution platform surface.
  - All works shall be completed as per the Manual of Contract Documents for Highway Works (MCHW). Follow Table 6/2 Grading Requirements (Refer Volume 1 Series 600 of MCHW); and Table 6/4 Method of Compaction for Fill (Refer Volume 1 Series 600 of MCHW).
  - Temporary works design associated with the construction of the works shall be responsibility of the contractor.
  - This earthworks assessment assumed that any cut below topsoil level can be reused for fill works. This assumption is to be verified during detailed design and review of recent geotechnical investigation results once received.
  - This earthworks assessment does not account for any temporary works or construction laydown areas. This is to be accounted for the detailed earthworks design once an EPC contractor is appointed.
  - Earthworks quantities provided are for establishing a formation level only. Any additional material required to build up a site platform is to be determined during detailed design.

- Reference drawings
- 108939-MMD-BRGR-XX-DR-C-0044 Hydrogen Production Facility - Drainage Layout
  - 106856-MMD-BRGR-XX-DR-C-0047 Hydrogen Production Facility - Earthworks Longitudinal Sections
  - 106856-MMD-BRGR-XX-DR-C-0048 Hydrogen Production Facility - Earthworks Cross Sections
  - 106856-MMD-BRGR-XX-DR-C-0002 Bridgend Green Hydrogen - Site Layout

P02	15/11/2022	OJ	Seconds Issue	SA	JP
P01	07/11/2022	OJ	First Issue	SA	JP
Rev	Date	Drawn	Description	Ch'k'd	App'd

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Title

**Bridgend Green Hydrogen**

**Hydrogen Production Facility Earthworks**

Designed	A.Ruiz-Diaz	ARD	Eng check	S. Anantharam	SA
Drawn	O. Jeffcock	OJ	Coordination	T. King	TK
Dwg check	T. King	TK	Approved	J. Paul	JP
MMD Project Number	108939	Scale at A1	1:250	Security	STD
Suitability Description	Suitable for Review & Comment				Suit. Code
Drawing Number	108939-MMD-BRGR-XX-DR-C-0046	Revision	P02		

Key to symbols

- NEW PROPOSED PERMANENT ROAD (LEVEL VARIES)
- NEW PROPOSED PERMANENT FOOTPATH (LEVEL VARIES)
- NEW SUBSTATION PLATFORM EXTENT
- NEW PLATFORM (FFL=+63.800mAO, FORMATION=+63.300mAO)
- CUT/FILL EARTHWORKS
- EXISTING WELSH WATER COMBINED SEWER
- EXISTING WELSH WATER MAIN
- PROPOSED RETAINING WALL
- PROPOSED CUT EMBANKMENT AT 1:2

1:250

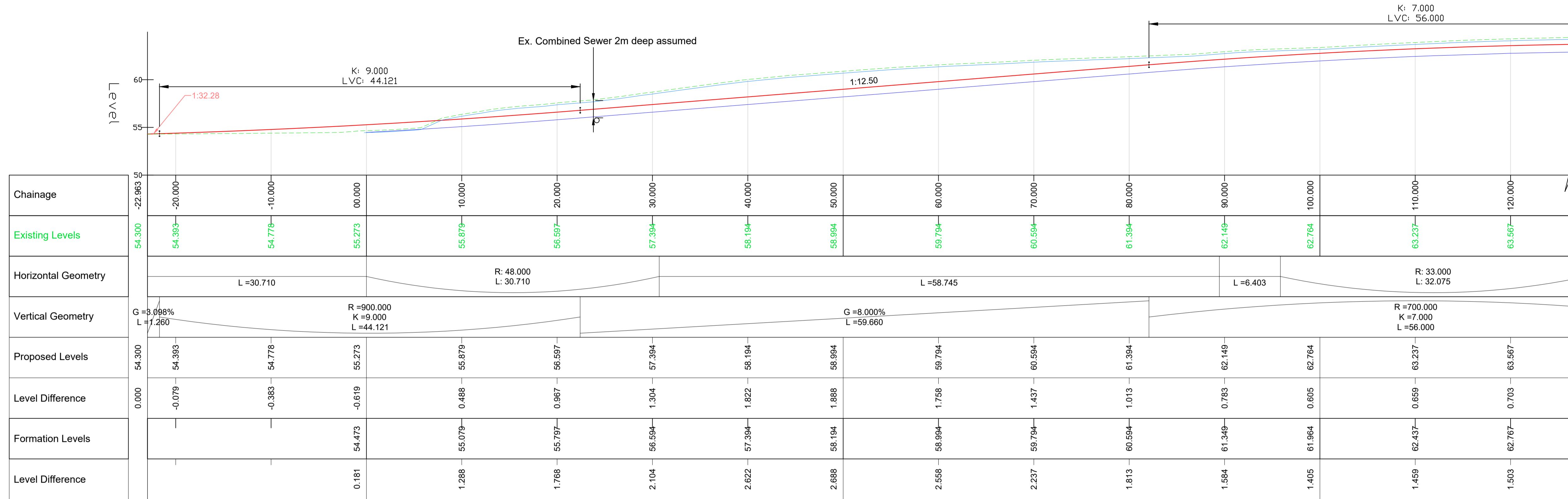
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Access Rd 1- CL - Longsection  
scale: H 1:250, V 1:250.



- Notes
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  - For earthworks notes see drawing 108939-MMD-BRGR-XX-DR-C-0046.

Key to symbols

- EXISTING GROUND PROFILE
- PROPOSED FORMATION PROFILE
- PROPOSED TOPSOIL STRIP PROFILE
- PROPOSED FINISHED LEVEL PROFILE
- ACCESS ROAD
- SUBSTATION PLATFORM
- CUT/FILL EARTHWORKS
- PROPOSED RETAINING WALL

Reference drawings

108939-MMD-BRGR-XX-DR-C-0046 Hydrogen Production Facility - Earthworks  
 106856-MMD-BRGR-XX-DR-C-0047 Sheet 02 Hydrogen Production Facility - Earthworks Longitudinal and Cross Sections  
 106856-MMD-BRGR-XX-DR-C-0002 Bridgend Green Hydrogen - Site Layout

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P02	15/11/2022	OJ	Second Issue	SA	JP
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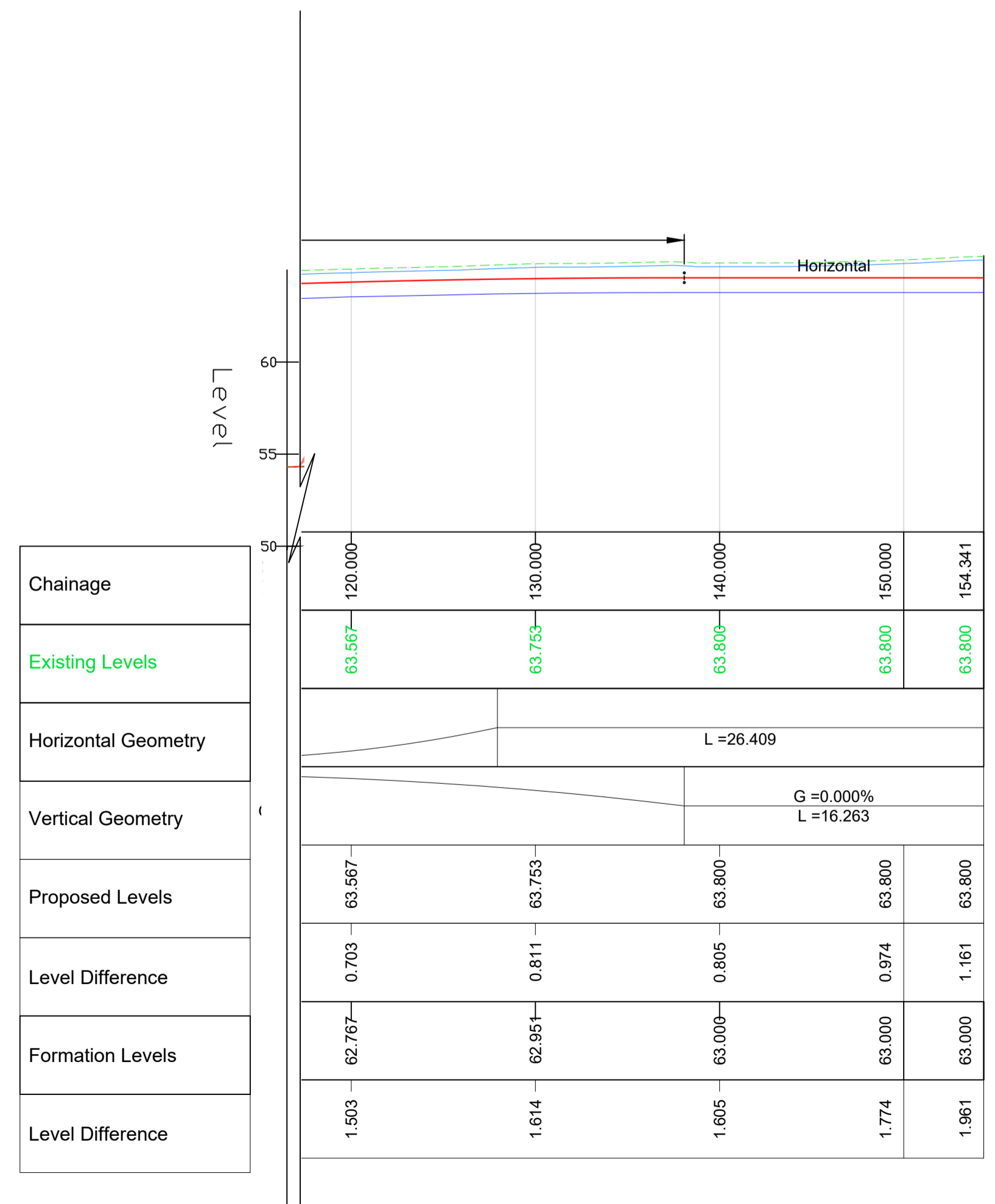
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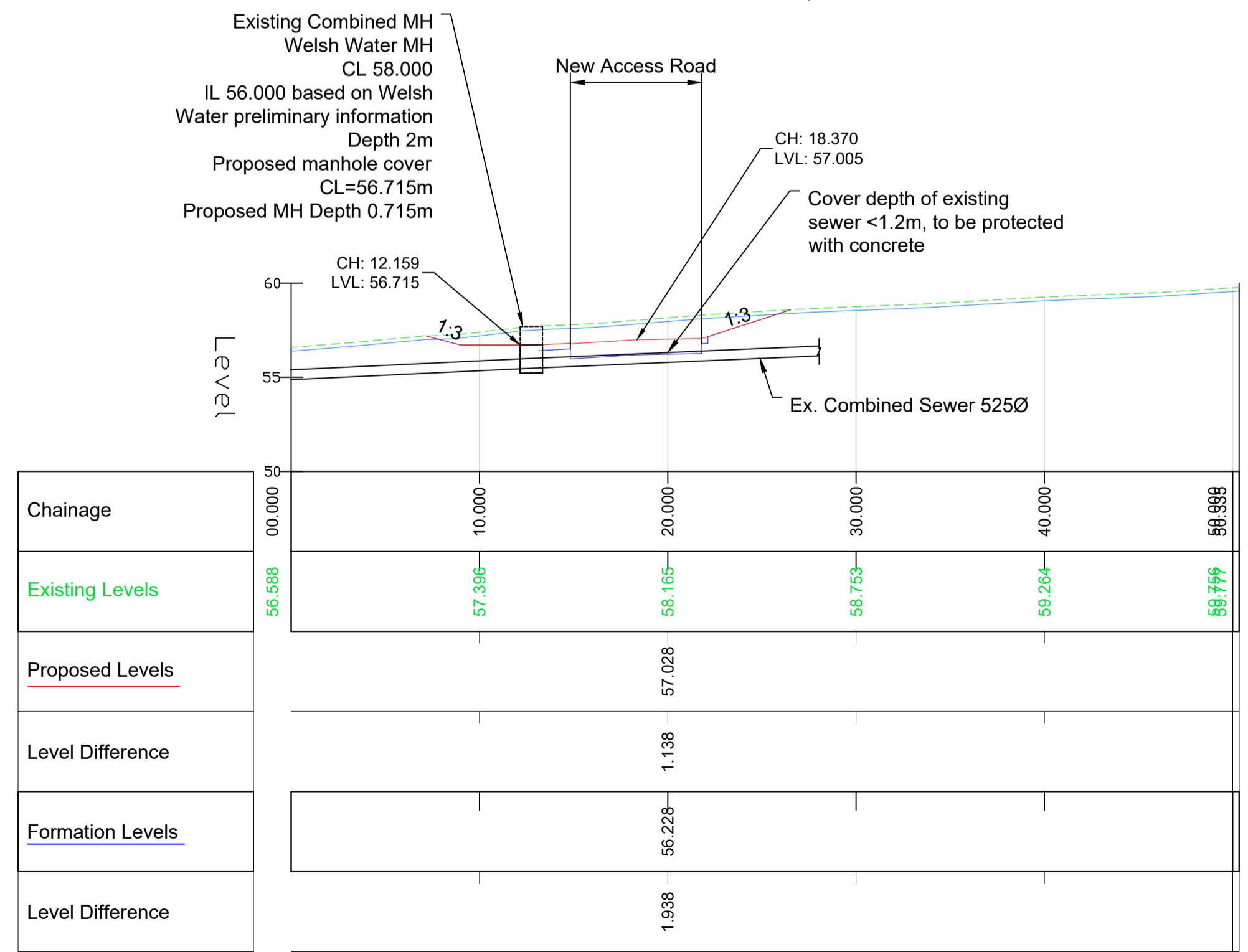
**Bridgend Green Hydrogen  
 Hydrogen Production Facility  
 Earthworks Longitudinal Sections**

Sheet 01 of 02

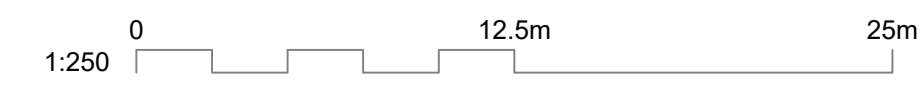
Designed	A.Ruiz-Diaz	ARD	Eng check	S. Anantharam	SA
Drawn	O. Jeffcock	OJ	Coordination	T. King	TK
Dwg check	T. King	TK	Approved	J. Paul	JP
MMD Project Number	108939	Scale at A1	AS SHOWN	Security	STD
Suitability Description	Suitable for Review & Comment			Suit. Code	S3
Drawing Number	108939-MMD-BRGR-XX-DR-C-0047			Revision	P02



C - Longsection  
scale: H 1:250, V 1:250.

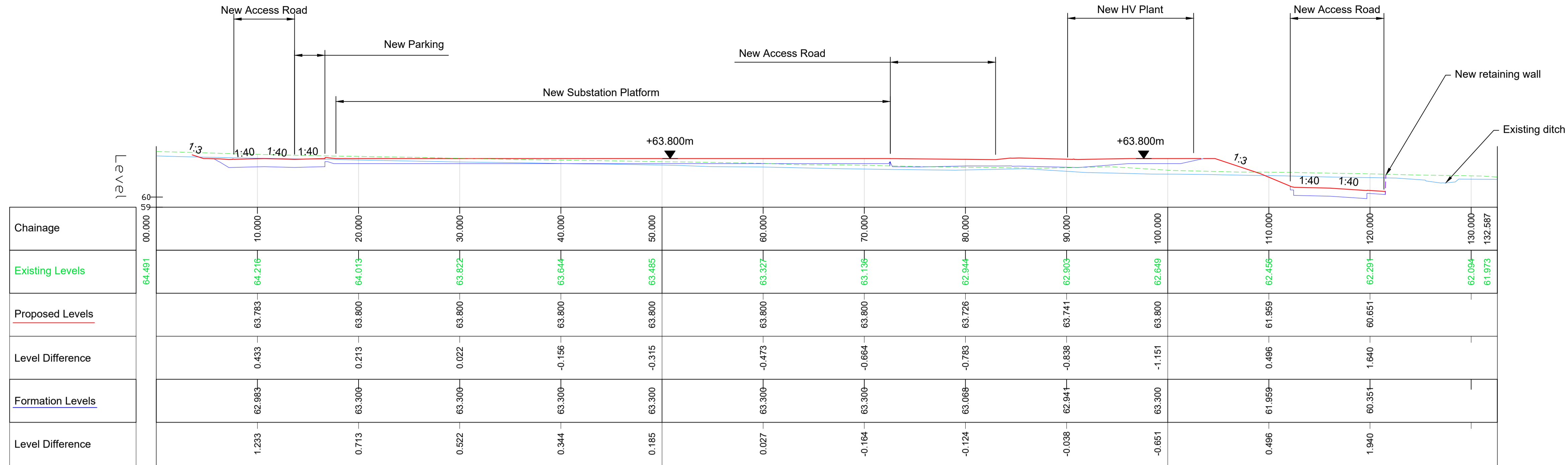


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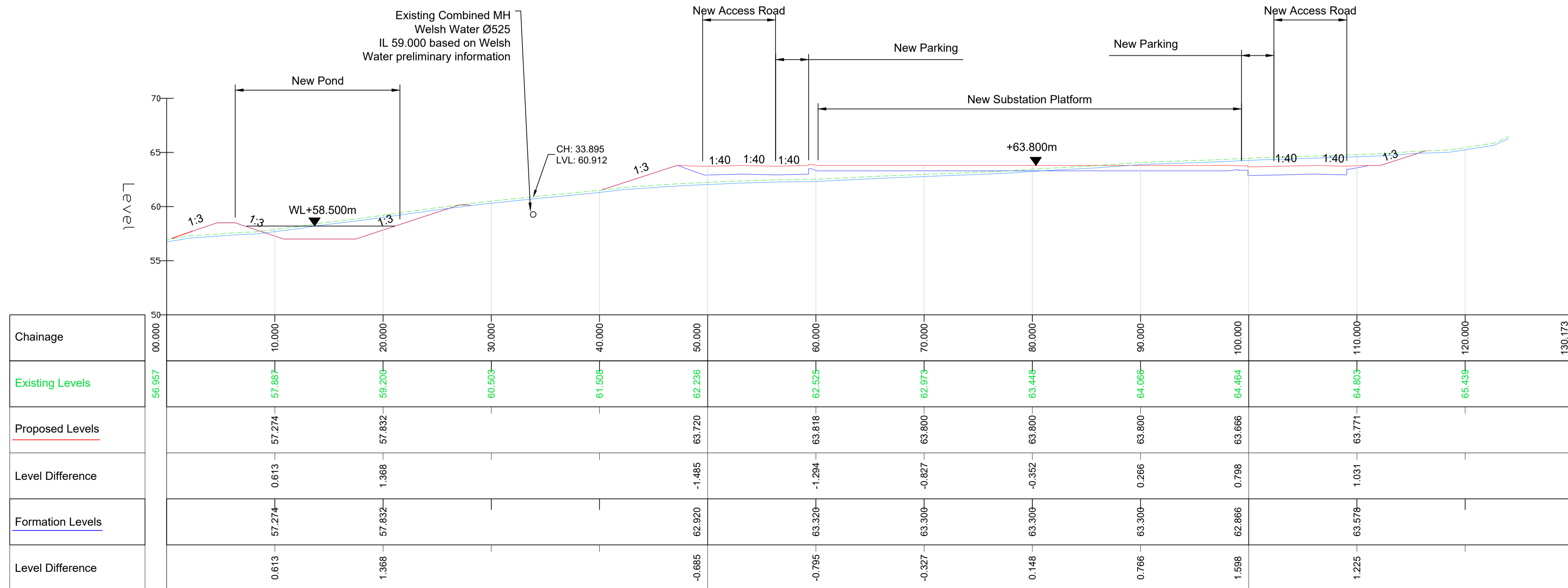




A - Longsection  
scale: H 1:250, V 1:250.



B - Longsection  
scale: H 1:250, V 1:250.



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Key to symbols

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- PROPOSED TOPSOIL STRIP PROFILE
- PROPOSED FINISHED LEVEL PROFILE
- ACCESS ROAD
- SUBSTATION PLATFORM
- CUT/FILL EARTHWORKS
- PROPOSED RETAINING WALL

Reference drawings

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 106856-MMD-BRGR-XX-DR-C-0047 Sheet 01 Hydrogen Production Facility - Earthworks Longitudinal Sections  
 106856-MMD-BRGR-XX-DR-C-0002 Bridgend Green Hydrogen - Site Layout

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Title

**Bridgend Green Hydrogen  
 Hydrogen Production Facility  
 Earthworks Longitudinal and Cross  
 Sections  
 Sheet 02 of 02**

Designed	A.Ruiz-Diaz	ARD	Eng check	S. Anantharam	SA
Drawn	O. Jeffcock	OJ	Coordination	T. King	TK
Dwg check	T. King	TK	Approved	J. Paul	JP

MMD Project Number	Scale at A1	Security
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<b>Suitable for Review &amp; Comment</b>	<b>S3</b>

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<b>108939-MMD-BRGR-XX-DR-C-0047</b>	<b>P02</b>

