Appendix A8:

Land & Soil

Appendix A8-1

N63 Liss to Abbey Realignment Scheme, Geophysical Survey

N63 Liss to Abbey Realignment Scheme

Co. Galway

Geophysical Survey

Report Status: Draft

MGX Project Number: 6494

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7th April 2020

Confidential Report To:

Galway County Council
Prospect Hill
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Issued by:

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Reviewer: Hartmut Krahn (Senior Geophysicist)

Minerex
Geophysics Limited

Subsurface Geophysical Investigations

EXECUTIVE SUMMARY

1. Minerex Geophysics Ltd. (MGX) carried out a geophysical survey consisting of EM31 ground conductivity, 2D-Resistivity and seismic refraction (p-wave) surveying for the proposed road realignment along the N63 between Liss and Abbey, County Galway.

2. The main objectives of the survey were to determine the ground conditions under the site, determine the depth to rock and the overburden thickness, to map the extent of soft ground layers and to detect possible karstified rock.

Corridor

3. The geophysical survey found the general geology along the scheme consisted of deep glacial till overburden over fresh limestone bedrock. There is a thin layer of alluvium identified close to the river and relatively shallow rock near the start of the scheme.

4. The EM31 Ground Conductivity and 2D-Resistivity surveys identify the shallowest rock along the scheme as between Ch0 – 110 in the west of the survey area. The extent of alluvium was also identified using these methods and is displayed on Map 3 and Plans 2a – 2c.

5. The survey does not indicate other karst features along the extent of the corridor. Thick layers of glacial till should provide good protection if the deeper rock should be karstified.

River Banks

6. Seismic refraction profiles carried out along the river indicate a thin layer of very soft to soft or loose topsoil (Layer A) underlain by firm to very stiff or medium dense to very dense overburden (Layers B – C). Fair to good rock (Layer D) is between 6 and 12.5 m deep.

7. Low resistivities (Layer 2) within the high seismic velocity layer (Layer D) along profiles S1/R1 (90 – 150 m) and S2/R2 (100 – 160 m) may indicate a zone of weathered or karstified limestone crossing below the river in a south to north direction. Targeted rotary core holes are recommended here if the bridge will be located here.

8. The depth to highly consolidated overburden and rock is slightly shallower to the east than at the west along the river banks. The eastern end along the banks seems most suitable for bridge foundations.

9. This report will be reviewed and finalised after the complete direct ground investigation data has been received.

CONTENTS

List of Tables, Maps and Figures:

1. INTRODUCTION

1.1 Background

Minerex Geophysics Ltd. (MGX) carried out a geophysical survey for the N63 Liss to Abbey Realignment Scheme. The survey consisted of EM31 ground conductivity, 2D-Resistivity and seismic refraction (p-wave) measurements. The survey was commissioned by AECOM acting on behalf of Galway County Council.

The survey employed various geophysical methods that complement each other and improve the interpretation. The role of geophysics as a non-destructive fast method is to allow later targeted direct investigations. Those results can be used to improve the initial results and interpretation.

The proposed development is a realignment of the existing N63 road including a new bridge crossing the Abbert River.

The survey was aimed at investigating the ground conditions along the entire 2km route of the proposed realignment scheme and along the river banks where the new bridge is proposed.

Detailed descriptions of the site, topography and geology are contained in the tender documents written by Aecom.

1.2 Objectives

The main objectives of the geophysical survey were:

- To determine the ground conditions under the site
- To detect possible karstified zones within the rock
- To determine the depth to rock and the overburden thickness
- To estimate the stiffness of overburden and the rock quality along the river banks
- To determine the type of overburden and rock
- To detect lateral changes within the geological layers
- To map the extent of possible soft ground layers
- To determine the presence of possible faults and fracture zones

1.3 Site Description

The site is located between the village of Abbey in the west and the townland of Derreen to the East and runs primarily through farmland for approx. 2km. The Abbert River dissects the site running roughly E-W. Elevations on site are reasonably flat-lying and level, ranging from 38 mOD near the river to 45 mOD in the east.

1.4 Geology

The overburden geology consists mainly of till derived from limestone while alluvium sediments dominating close to the river.

The online bedrock geological map of Ireland (GSI, 2020) indicates that the survey area is underlain by the Burren Formation, described as pale grey clean skeletal limestone. This formation is liable to karst but there are no karst features recorded on the site. Karst features are common in the wider area with the nearest karst feature, a spring, identified on the map approx. 250 m to the south.

1.5 Report

This report includes the results and interpretation of the geophysical survey. Maps, figures and tables are included to illustrate the results of the survey. More detailed descriptions of geophysical methods and measurements can be found in GSEG (2002), Milsom (1989) and Reynolds (1997).

The client provided maps of the site and the digital version was used as the background map in this report. Elevations were surveyed on site and are used in the vertical sections.

The interpretative nature and the non-invasive survey methods must be taken into account when considering the results of this survey and Minerex Geophysics Limited, while using appropriate practice to execute, interpret and present the data, give no guarantees in relation to the existing subsurface.

2. GEOPHYSICAL SURVEY

2.1 Methodology

The methodology is outlined in the tender documents:

EM31 Ground Conductivity measurements to map a 100m wide corridor along the 2km route and determine targets for 2D-Resistivity Profiling. Additional Seismic Refraction Profiling was carried out close to the river to provide additional geological information for the proposed bridge. The EM31 survey was done first in order to target the more detailed 2D-Resistivity survey afterwards within the corridor.

The survey locations are indicated on Map 1. The profiles, chainage and parameters are tabulated in Table 1 below. For the display a localised chainage was used that has the starting point at the west end of R8.

All geophysical surveys are acquired, processed and reported in accordance with British Standards BS 5930:1999 +A2:2010 'Code of Practice for Site Investigations'.

Table 1: Geophysical Survey Locations and Acquisition Parameters

Profile Name	**Start Chainage/Location**	**Electrode/ Geophone Spacing/m**	**Number of Electrodes/Geophones**	**Profile Length/m**
R1	South of River	3	96	285
R2	North of River	3	96	285
R5	410	3	96	285
R6	823	3	189	564
R7	1395	3	241	720
R8	0	3	192	573
SUM				**2712**
S1	South of River	3	96	285
S2	North of River	3	96	285
SUM				**570**

2.2 EM31 Ground Conductivity

The EM31 ground conductivity survey was carried out over a 21.4 Ha area indicated in Map 1 by the magenta boundary on lines nominally 10 m apart. The survey included the 100m corridor but excluded private gardens, buildings, public roads and strip of forested land. Along each line a reading of ground conductivity was taken every second while walking along, thereby resulting in a survey grid of nominally 10 x 2 m. The locations were measured with a sub-meter accuracy SERES DGPS system attached to the EM31 and all data was jointly stored in a data logger. The conductivity meter was a GEONICS EM31 with Allegro data logger and NAV31 data acquisition software. The instrument was checked at a base station, the readings were stable and no drift occurred.

The conductivity is typical for certain geological material types. Dry and clean sand and gravel and most rock types like clean Limestone have relatively low conductivities while peat, clay and clay-rich rock types (mudstone, shale) have high conductivities.

EM31 ground conductivity determines the bulk conductivity of the subsurface over a typical depth between 0 and 6 m bgl. and over a radius of approx. 5 m around the instrument. When looking for clay, silt and water infill within rock occurring at relatively shallow depth the EM31 can find anomalous rock and overburden zones (always within the 6 m depth). The measurements are disturbed by metal and other conductive objects within the range of the instrument and therefore no geological interpretations can be made in the vicinity of such man-made objects. Either readings were not taken near sources of interference in the first place or notes were taken by the operator in order to remove these during processing or to account for these in the interpretation.

2.3 2D-Resistivity

2D-Resistivity profiles were surveyed with electrode spacing of 3 m, up to 64 electrodes per set-up and a maximum length of 189 m per set-up. The readings were taken with a Tigre Resistivity Meter, Imager Cables, stainless steel electrodes, laptop and ImagerPro acquisition software. For the long lines along the corridor 10 depth levels were continuously measured using the roll-along method. This corresponds to a depth of 15 m below ground level. At the river banks Profiles R1 and R2 were measured to 21 levels which corresponds to a depth of 30m bgl.

During 2D-Resistivity surveying data is acquired in the form of linear profiles using a suite of metal electrodes. A current is injected into the ground via a pair of electrodes while a potential difference is measured across a second pair of electrodes. This allows for the recording of the apparent resistivity in a two-dimensional arrangement below the profile. The data is inverted after the survey to obtain a model of subsurface resistivities. The generated model resistivity values and their spatial distribution can then be related to typical values for different geological materials.

2.4 Seismic Refraction

Seismic refraction profiles were surveyed with geophone spacing of 3 m and 24 geophones per set-up resulting in a 69 m length per set-up. The recording equipment consisted of a 24 Channel GEOMETRICS ES-3000 engineering seismograph with 4.5 Hz vertical geophones. The seismic energy source consisted of a hammer and plate. A zero delay trigger was used to start the recording. Normally 7 shot points per p-wave profile were used.

Set-ups were acquired in longer continuous profiles using common shot points between set-ups and concatenating into longer profiles at the processing stage.

In the seismic refraction survey method a p-wave is generated by a source at the surface resulting in energy travelling through surface layers directly and along boundaries between layers of differing seismic wave velocities. Processing of the seismic data allows geological layer thicknesses and boundaries to be established.

Seismic Refraction generally determines the depth to horizontal or near horizontal layers where the compaction/strength/rock quality changes with an accuracy of 10 – 20% of depth to that layer. Where low velocity layers or shadow zones are present (e.g. below solid ground surface) or where layers dip with more than 20 degrees angle the accuracy becomes much less.

The seismic refraction profiles with 69 m individual length have a reasonable penetration depth of around 12m. An internationally accepted maximum depth estimate for a seismic refraction layout is 1/6 of the layout length. The depth penetration varies according to the velocity structure of the subsurface.

2.5 Site Work

The data acquisition was carried out between the 16th and 27th of March 2020. The weather conditions were variable throughout the acquisition period. Health and safety standards were adhered to at all times.

The locations and elevations were surveyed with a Carlson NR3 RTK-GPS to accuracy < 0.05 m.

3. RESULTS AND INTERPRETATION

The interpretation of geophysical data was carried out utilising the known response of geophysical measurements, typical physical parameters for subsurface features that may underlay the site, and the experience of the authors.

Separate interpretations are given for each method, as each geophysical method measures a different physical property. The EM31 data provides information on the lateral extent of areas with shallow rock (where within or close to 6m depth bgl) and distribution of alluvium and glacial till overburden. The 2D-Resistivity data provides information on overburden and rock types and the depth to rock while the seismic refraction data provides information on the density of the subsurface layers. An overview of all the information obtained is given at the end (Chapter 3.4).

3.1 EM31 Ground Conductivity

The EM31 ground conductivity values were merged into one data file for each survey area and contoured and gridded with the SURFER contouring package. The contours are created by gridding and interpolation and care must be taken when using the data. The contour map is overlaid over the location and base map (Map 2) and the values in milliSiemens/metre (mS/m) are indicated on the colour scale bar.

Low conductivities found at the start of the chainage (<5 mS/m) indicates shallow bedrock. Medium conductivities (5 – 10 mS/m) indicate deep rock and glacial till overburden. This range covers most of the surveyed area. High conductivity (>10 mS/m) are found primarily close to the river and in the flood plain and are interpreted as alluvium overburden (Clay, Silt, Peat or saturated Gravel).

Map 3 and the top panel along Plans 2a – 2c show the areas interpreted as containing shallow rock (Blue) or alluvium (Magenta). Both the EM31 Ground Conductivity data and the 2D-Resistivity data was used for this interpretation. It must be noted that the EM31 measures only one value of ground conductivity so this is affected by a combination of material type and also material thickness, Therefore, these maps should be treated like rough outline maps of these alluvial materials.

3.2 2D-Resistivity

The 2D-Resistivity data was positioned and inverted with the RES2DINV inversion package. Overlapping and roll-along profiles were concatenated for a joint inversion. The programme uses a smoothness constrained least-squares inversion method to produce a 2D model of the subsurface model resistivities from the recorded apparent resistivity values. Three variations of the least squares method are available and for this project the Jacobian Matrix was recalculated for the first three iterations, then a Quasi-Newton approximation was used for subsequent iterations. Each dataset was inverted using seven iterations resulting in a typical RMS error of <3.0%. The resulting models were colour contoured with the same resistivity scale for all profiles and they are displayed as cross sections (Figure 1, Plans 1a – 1c).

Resistivities are characteristic for certain overburden and rock types. If there is a high content of clay minerals (which are electrically conductive) then the overburden resistivity will be lower than as if there is a high content of clastic grains like sand or gravel. The purer the clay and the lower the sand/gravel content the lower the resistivity. The water content in the overburden also influences the resistivities but generally the clay content has a larger effect.

Within bedrock types like clean limestone, high resistivities indicate a fresh strong unweathered rock. As the weathering in the rock increases the resistivity gets lower because of weathering products, remineralisation of rock and infill of cracks, faults and voids with clay and water. Weathering within rock is typically indicated by lower resistivity values in the cross sections.

The resistivities cover a range typical for materials from clay rich overburden or peat (low resistivities) to fresh strong unweathered bedrock (high resistivities). Interpreted figures are displayed in Figure 2 and Plans 2a – 2c. The ranges have been taken into the consideration for the interpretation. Very low resistivity values (<90 Ohmm) typically indicate clay, silt, peat and saturated gravel (Alluvium). Low values (90 to 500 Ohmm) shows sandy gravelly clay and silt overburden (Glacial Till). Medium resistivities (500 - 1000 Ohmm) indicate clayey silty sand and gravel or weathered limestone bedrock. High resistivities indicate fresh limestone bedrock.

Table 2: Summary of Interpretation (Resistivity only)

Layer	General Resistivity Range (Ohmm)	Interpretation
1	<90	Clay, Silt, Peat and saturated Gravel (Alluvium)
2	90 – 500	Sandy gravelly Clay and Silt Overburden (Glacial Till)
3	500 – 1000	Clayey silty Sand and Gravel Overburden or Weathered Rock
4	>1000	Fresh Limestone

3.3 Seismic Refraction

The seismic refraction data was positioned and processed with the SEISIMAGER software package to give a layered model of the subsurface. The numbers of layers has been determined by analysing the seismic traces and 4 layers were used in the models. All seismic profiles were subject to a standardised processing sequence which consisted of a topographic correction which was based on integrated elevation data, first break picking, tomographic inversion, travel-time computation via ray-tracing and velocity modelling. Residual deviations of typically 0.4 to 1.8 msec RMS have been obtained for each profile. Following each processing stage QC procedures were adhered to. The resulting layer boundaries are shown as thick lines

overlaid on the 2D-Resistivity cross sections (Figure 1). The average seismic velocities obtained within the layers are annotated on the sections as bold black numbers.

The p-wave seismic velocity is closely linked to the density of subsurface materials and to parameters like compaction, stiffness, strength and rock quality. The higher the density of the subsurface materials the higher the seismic velocity. Similarly for the other parameters it is generally valid that a more compacted, stiffer and stronger material will have a higher seismic velocity. For rock, the seismic velocity is higher when the rock is stronger, less weathered and has a higher quality. If the rock is more weathered, broken, fractured, fissured or karstified then the seismic velocity will be reduced compared to that of intact fresh rock.

Because of the above relationship, the seismic refraction method and seismic velocities are suitable to investigate ground where the layers get denser, more compacted and stronger with depth. A disadvantage is that some materials may have the same seismic velocity: Very stiff or very dense highly consolidated overburden and a weathered rock can have the same seismic velocity range (as is the case in the layer 3 below).

The modelled seismic data has created the following layered ground model:

Layer A has a thickness of up to 1.75 m and seismic velocities of 100 - 200 m/s. This overburden would be topsoil and soil with a very soft to soft or loose stiffness or compaction.

Layer B was modelled with a velocity range of 700 - 1000 m/s and reaches a depth between 1 and 4 m. The velocity indicates material with firm to stiff or medium dense strength or compaction.

Layer C velocities of 2000 - 2300 m/s indicate predominantly overburden with very stiff or very dense strength or compaction or a weathered rock with poor rock quality. The thickness of this layer varies between 2.5 and 10 m.

Layer D velocities of 4000 - 5000 m/s indicate a fair to good rock. The top of this layer is between 6 and 12.5 m deep. The layer may also contain highly consolidated overburden.

Table 3: Summary of Interpretation (Seismic Refraction Only)

Layer	**General Seismic Velocity Range (m/sec)**	**Stiffness/ Compaction or Rock Strength/ Quality**	**Interpretation**	**Estimated Excavation Method**
A	100 – 200	Very soft to soft or Loose	Topsoil	Diggable
B	700 – 1000	Firm to stiff or medium Dense	Overburden	Diggable
C	2000 – 2300	Very stiff or very dense or poor Rock	Overburden or weathered Rock	Diggable or rippable to marginal rippable
D	4000 - 5000	Fair to good Rock or hard Overburden	Limestone or highly consolidated Overburden	Breaking & Blasting

3.4 Interpretation of Geophysical Survey

Throughout most of the scheme, the geology consists of thick glacial till overburden underlain by fresh limestone bedrock. The shallowest rock indicated along the scheme is at the start of the scheme from Ch 0 – 110 where high resistivities (Layer 4) occur up to 2.5 m below ground level. This area also contains the lowest ground conductivities of the scheme.

Close to the river there is a change in the overburden geology. Very low resistivities (Layer 1) near the surface match high conductivities which are interpreted as clay, silt, peat or saturated gravel, consistent with alluvium overburden. These are indicated on Map 3 and Plans 2a to 2c. The distribution could have been caused by past river meanders.

Throughout the scheme, 2D-Resistivity is the primary method for determining the depth to rock. High bedrock resistivities indicate a clean limestone that would be liable to karstification. This layer (Layer 4) is generally deep which mitigates any effect karstified limestone may have on the proposed development. Along the chainage, there is no indication of karstified limestone bedrock within the depth surveyed.

Along Profiles S1 and S2, seismic refraction is a better method for identifying the depth to rock using changes in density with depth. The depth of seismic layer D is similar to the resistivity layer 4 which indicates a good fresh limestone bedrock. The notable exception is in the middle of both profiles where low resistivities (Layer 2) cut deep into the high seismic velocity layer D (90 to 150 m on R1 and 100 to 160m on R2). This may indicate a zone of weathered or karstified limestone running across the river rather than deeper overburden. This could be a possible fault or fracture zone trending from South to North.

4. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are made:

- The geophysical surveys carried out for the proposed N63 realignment scheme show that the subsurface geology generally consists of thick glacial till overburden underlain by fresh limestone bedrock. Within the river flood plain there are some area of thin alluvium.
- At all locations there was a strong correlation between all three geophysical survey methods, 2D Resistivity, EM31 Ground Conductivity and seismic refraction.
- The EM31 Ground Conductivity and 2D-Resisitvity data indicate an area where shallow rock is present at the start of the scheme (at the western end near Abbey village). These methods further indicate where the overburden changes from glacial till to alluvium near the river (Map 3, Plans 2a – 2c).
- The alluvial deposits are expected to have a lower stiffness and compaction that the glacial till. They could be called 'soft ground' and can be investigated by shallow methods like trial pits, dynamic probes and shear vanes.
- The top of the glacial till is likely weathered while the deeper glacial till is expected to be highly consolidated, suitable for heavy foundations and can provide cover against possible karstification of the deep rock.
- Seismic refraction was carried out along two profiles running parallel to the Abbert River. The data indicates a thin very soft to soft or loose topsoil layer (Layer A) over firm to very stiff or medium dense to very dense overburden (Layers B – C). Fair to good rock (Layer D) is between 6 and 12.5 m deep.
- Thin alluvial material is interpreted in the middle of the profiles along the river banks, while the ends indicate a transition to glacial till at the surface.
- Along profiles R1/S1 and R2/S2 beside the river there is an area defined by low resistivities (Layer 2) within the high seismic velocity layer (Layer D) which can be seen on both profiles (90 to 150 m on R1 and 100 to 160m on R2). This area may indicate a zone of weathered or karstified limestone crossing below the river in a south to north direction.
- The depth to highly consolidated overburden and rock is slightly shallower to the east than at the west along the river banks.
- Considering the above points the eastern end along the banks seems most suitable for bridge foundations. Suitable ground for foundations could be the top of the seismic layer 3 (red line) at a depth of approx. 2.5 m. The expected material here is glacial till with very stiff compaction.

- The survey did not show karst features along the 2D-Resistivity lines along the corridor, and based on the geophysical survey alone the karst risk is interpreted as low.
- The area at 90 to 150 m on R1 and 100 to 160m on R2 with possible thick weathered or karstified limestone is recommended to be avoided for the bridge or direct ground investigation including targeted rotary core holes should be carried out.
- The recommendations above should not preclude any other site investigation that may be carried out based on geological, geotechnical or engineering considerations.
- The interpretation presented here should be reviewed once any additional geotechnical data becomes available.

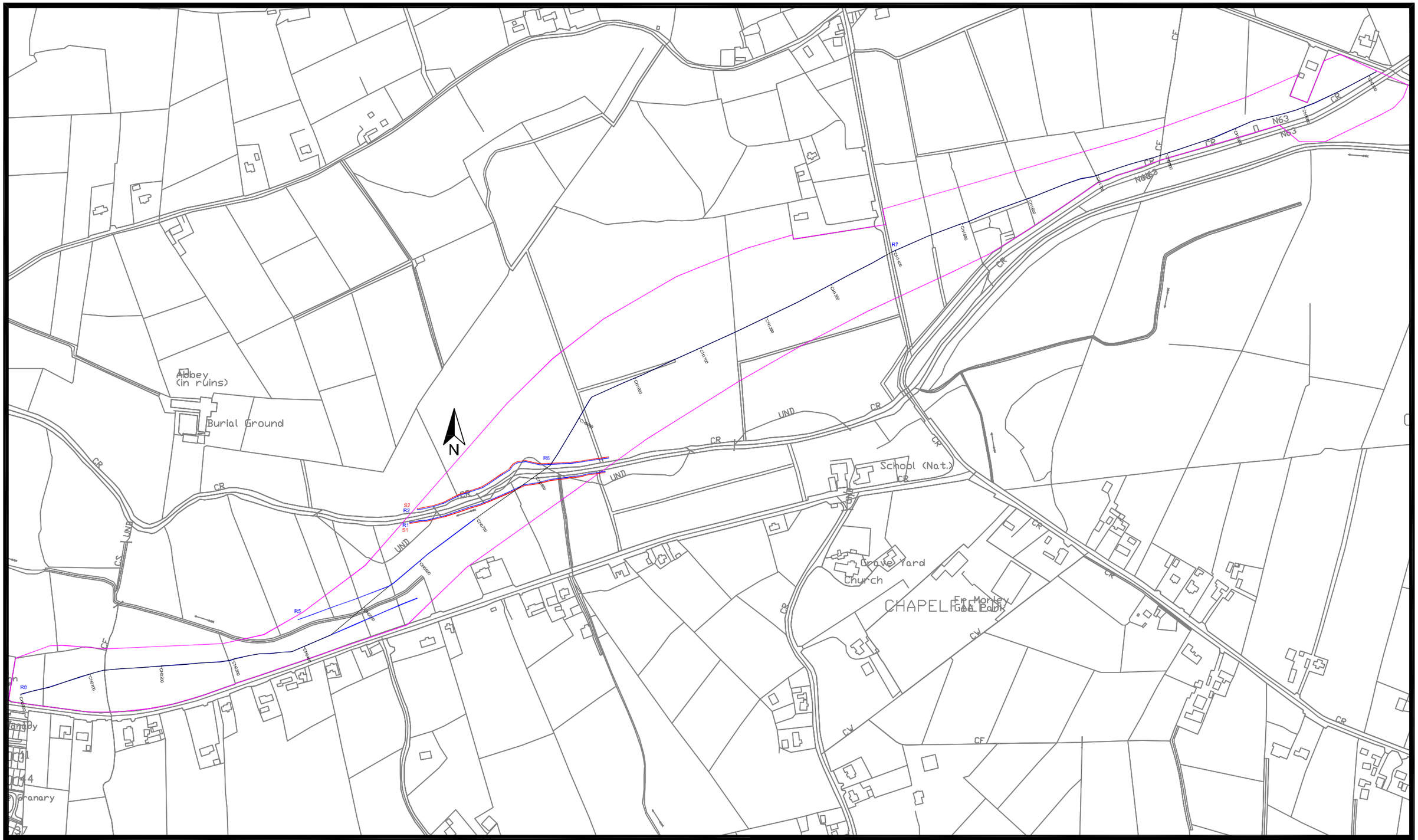
5. REFERENCES

1. **GSEG 2002.** Geophysics in Engineering Investigations. Geological Society Engineering Geology Special Publication 19, London, 2002.

2. **GSI, 2019.** Online Bedrock Geological Map of Ireland. Geological Survey of Ireland 2019.

3. **Milsom, 1989.** Field Geophysics. John Wiley and Sons.

4. **Reynolds, 1997.** An Introduction to Applied and Environmental Geophysics. John Wiley and Son.



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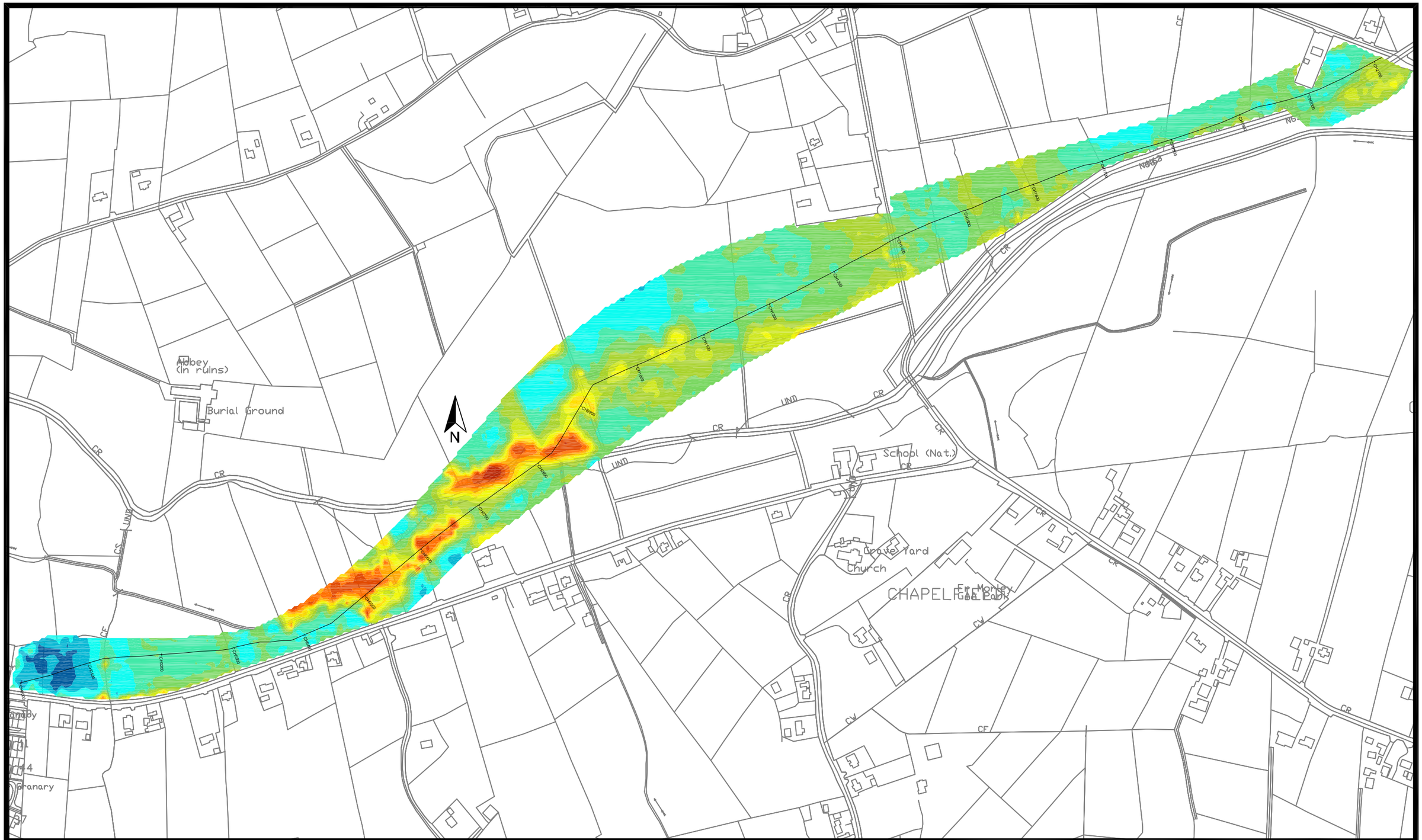
CLIENT	Galway County Council AECOM
PROJECT	N63, County Galway Geophysical Survey
TITLE	Map 1: Geophysical Survey Location Map

SCALE:	1:5000 @ A3
PROJECT:	6494
DRAWN:	JC
DATE:	20/03/2020
MGX FILE:	6494d_MapsFigs.dwg
STATUS:	Draft

LEGEND: Geophysical Survey Locations:

R2	2D-Resistivity Profile
S1	Seismic Refraction Profile
	EM31 Survey Area
CH0100	Centreline with Chainage



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CLIENT	Galway County Council AECOM
PROJECT	N63, County Galway Geophysical Survey
TITLE	Map 2: EM31 Ground Conductivity Contour Map

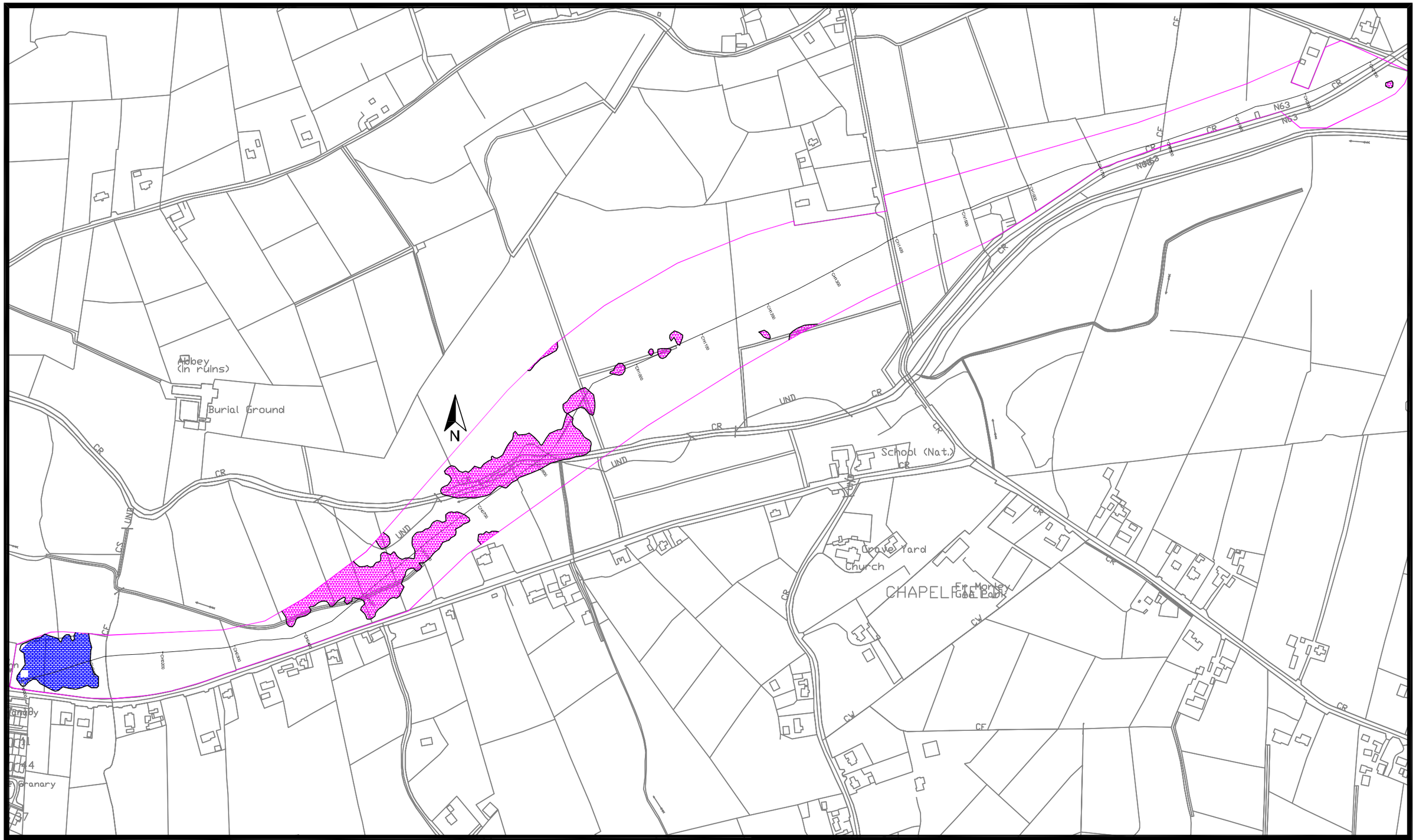
SCALE:	1:5000 @ A3
PROJECT:	6494
DRAWN:	JC
DATE:	20/03/2020
MGX FILE:	6494d_MapsFigs.dwg
STATUS:	Draft

LEGEND:

EM31 Ground Conductivity Scale (mS/m):

2 3 4 5 6 7 8 9 10 11 12 13 14 15

The map shows the EM31 ground conductivity contours mS/m. The low (dark blue) conductivities indicate shallow rock. The middle range (green) values indicate mainly sadny gravelly clay and silt (Glacial Till). The high (yellow - red) values indicate predominantly clay, silt, peat and saturated gravel (alluvium) overburden.



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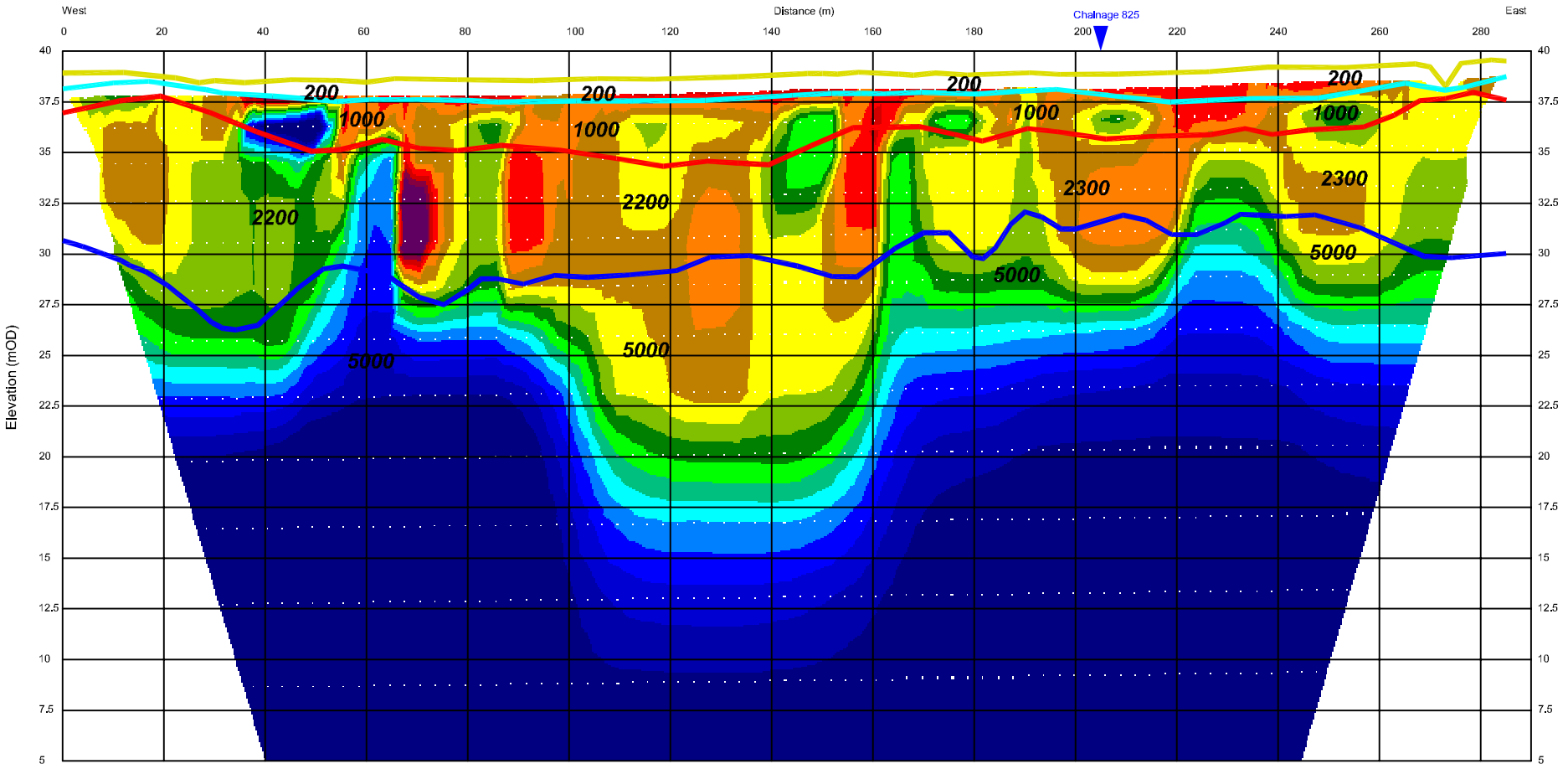
CLIENT	Galway County Council AECOM
PROJECT	N63, County Galway Geophysical Survey
TITLE	Map 3: EM31 Ground Conductivity Interpretation Map

SCALE:	1:5000 @ A3
PROJECT:	6494
DRAWN:	JC
DATE:	20/03/2020
MGX FILE:	6494d_MapsFigs.dwg
STATUS:	Draft

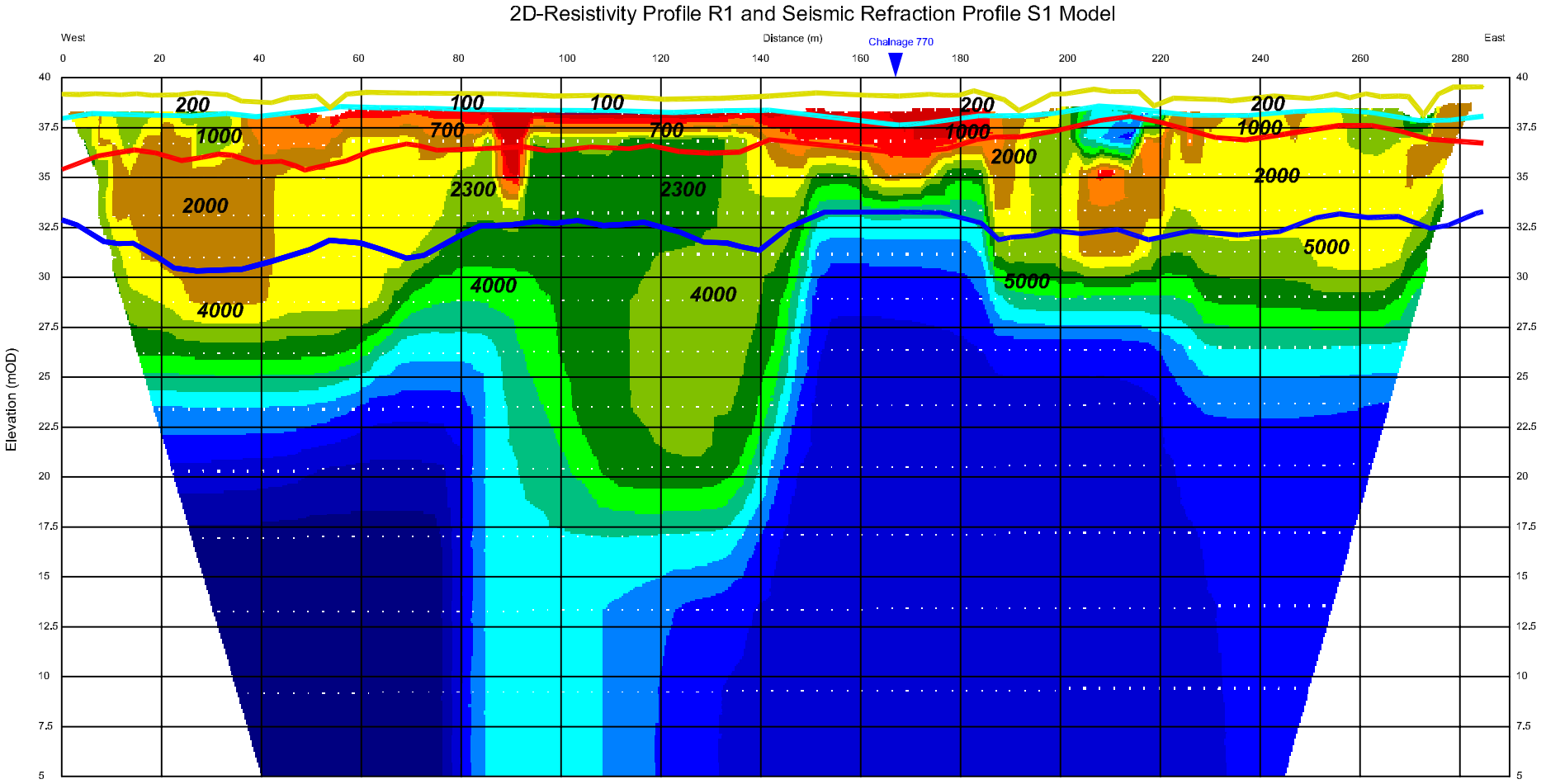
LEGEND: EM31 Interpretation Map:

1 Clay, Silt, Peat and saturated Gravel (Alluvium)
2 Shallow Rock

2D-Resistivity Profile R2 and Seismic Refraction Profile S2 Model



2D-Resistivity Profile R1 and Seismic Refraction Profile S1 Model



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CLIENT	Galway County Council AECOM
PROJECT	N63 Liss to Abbey, Galway Geophysical Survey
TITLE	Figure 1: Models of Geophysical Survey along Abbert River

SCALE:	1:1250 @ A3, VE x 4
PROJECT:	6494
DRAWN:	JC
DATE:	26/03/2020
MGX FILE:	6494d_MapsFigs.dwg
STATUS:	Draft

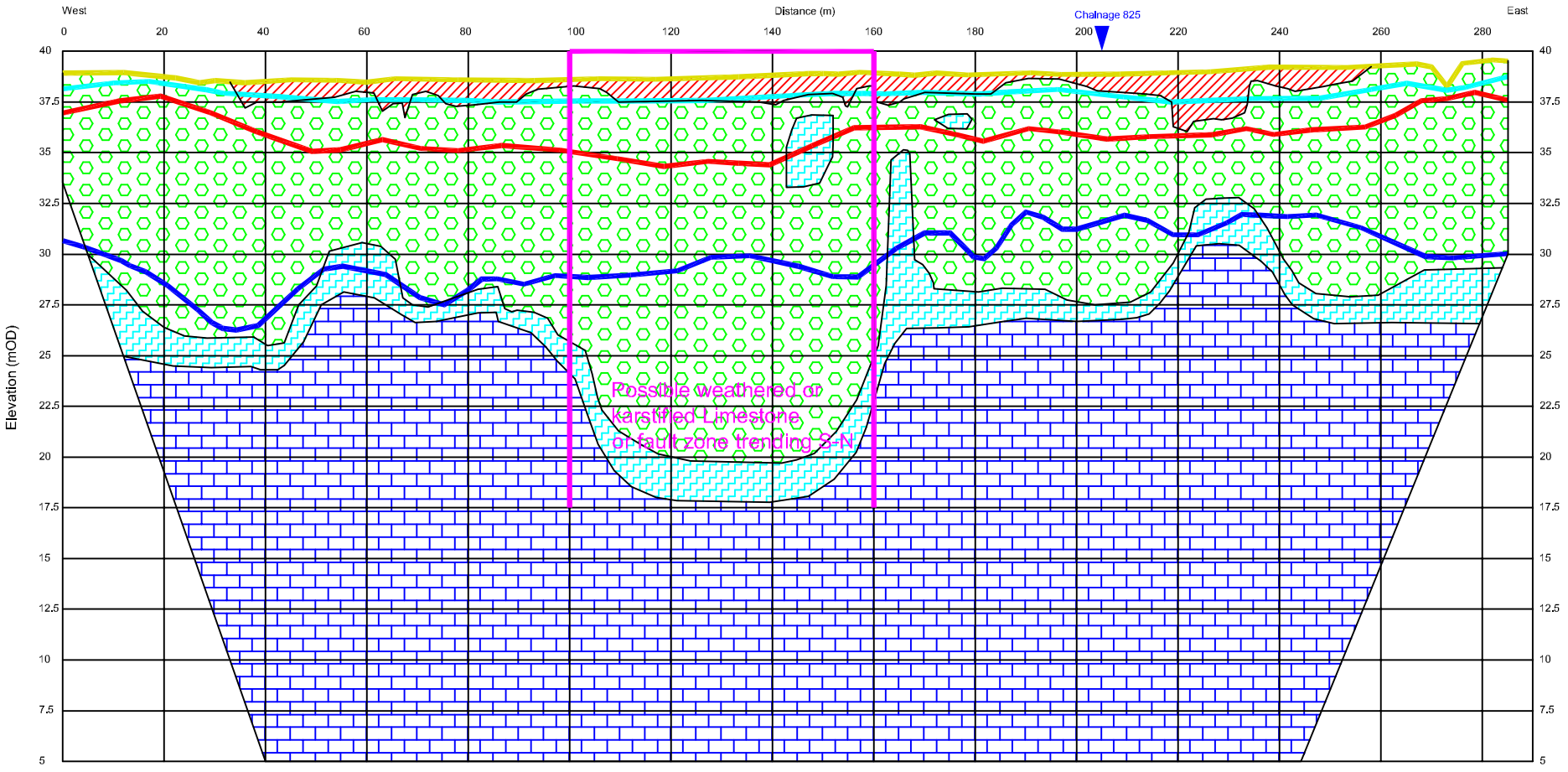
LEGEND: Layers from Seismic Refraction Model:

- Ground Surface/Top of Layer A (100 - 200 m/s)
- Top of Layer B (700 - 1000 m/s)
- Top of Layer C (2000 - 2300 m/s)
- Top of Layer D (4000 - 5000 m/s)

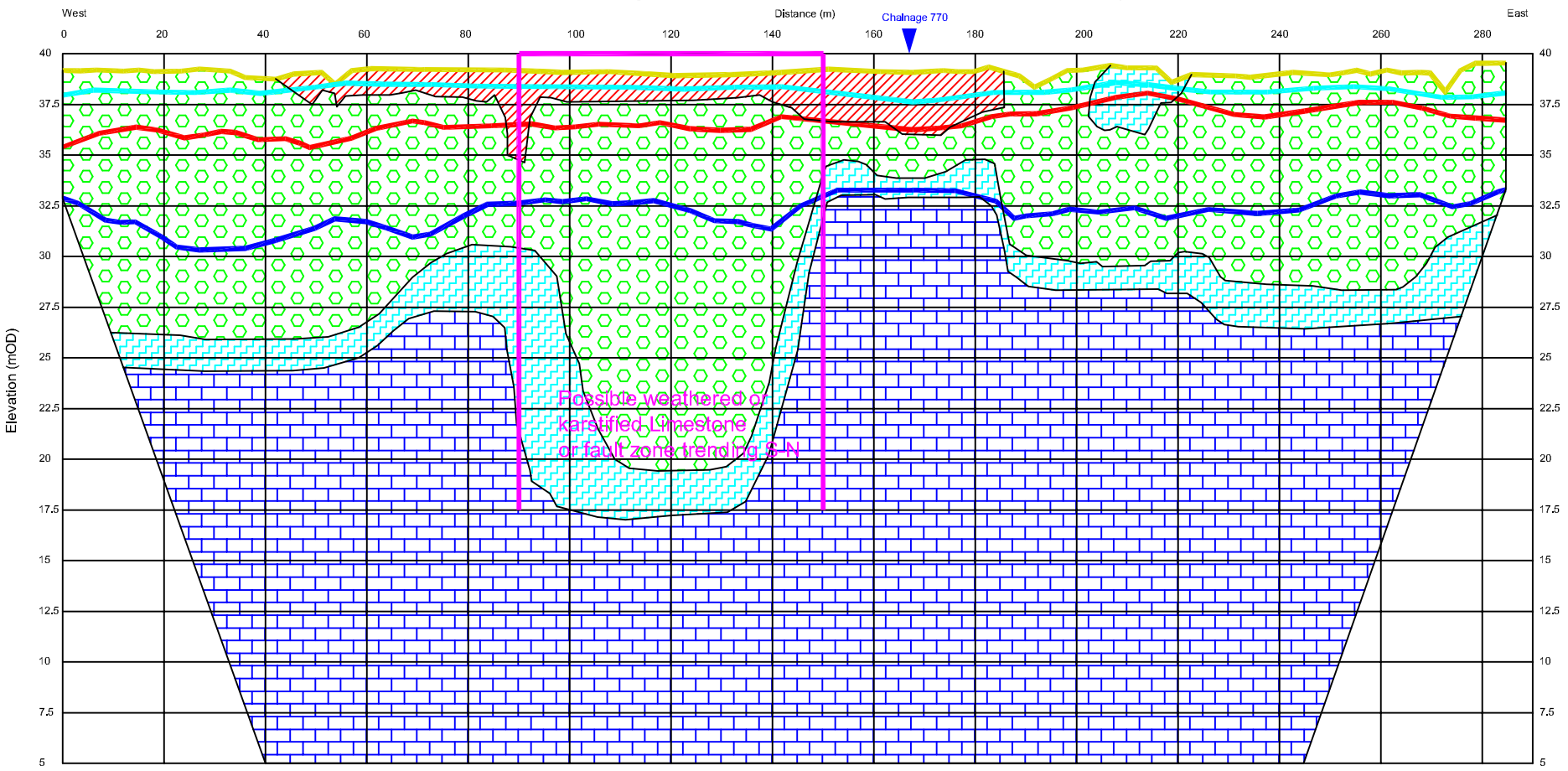
2D-Resistivity Model Values:
Resistivities (Ohmm) for 2D-Resistivity Model

31.3 62.5 125 250 500 1000 2000 4000

2D-Resistivity Profile R2 and Seismic Refraction Profile S2 Interpretation



2D-Resistivity Profile R1 and Seismic Refraction Profile S1 Interpretation



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CLIENT	Galway County Council AECOM
PROJECT	N63 Liss to Abbey, Galway Geophysical Survey
TITLE	Figure 2: Interp. of Geophysical Survey along Abbert River

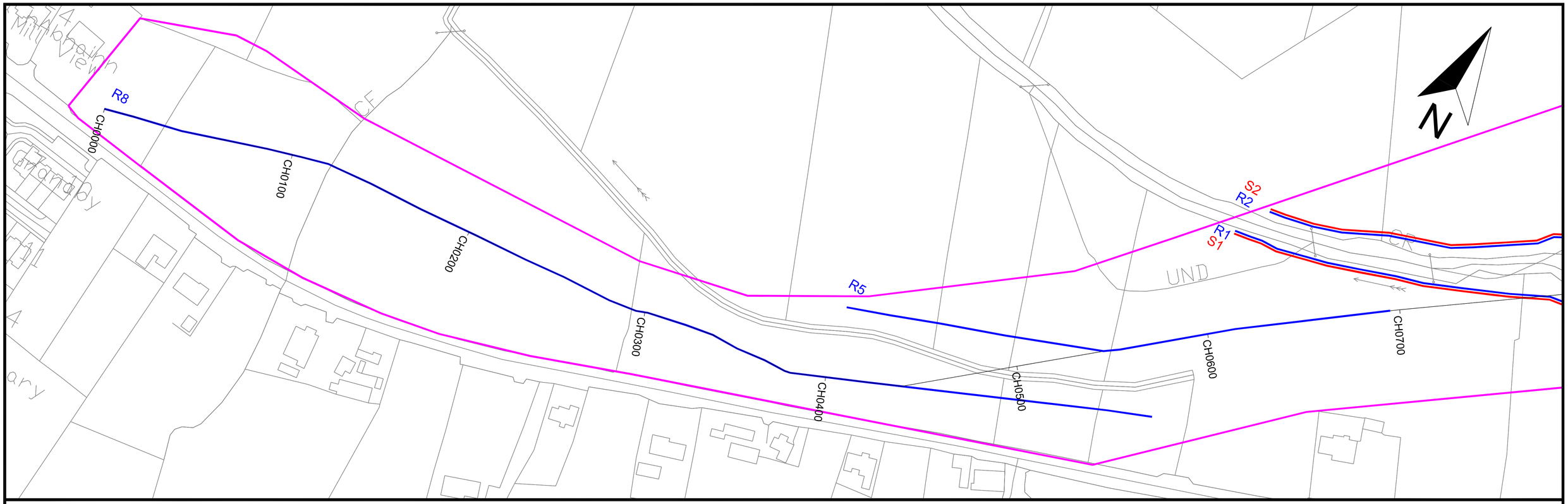
SCALE:	1:1250 @ A3, VE x 4
PROJECT:	6494
DRAWN:	JC
DATE:	26/03/2020
MGX FILE:	6494d_MapsFigs.dwg
STATUS:	Draft

Interpretation of 2D-Resistivity Profiles:

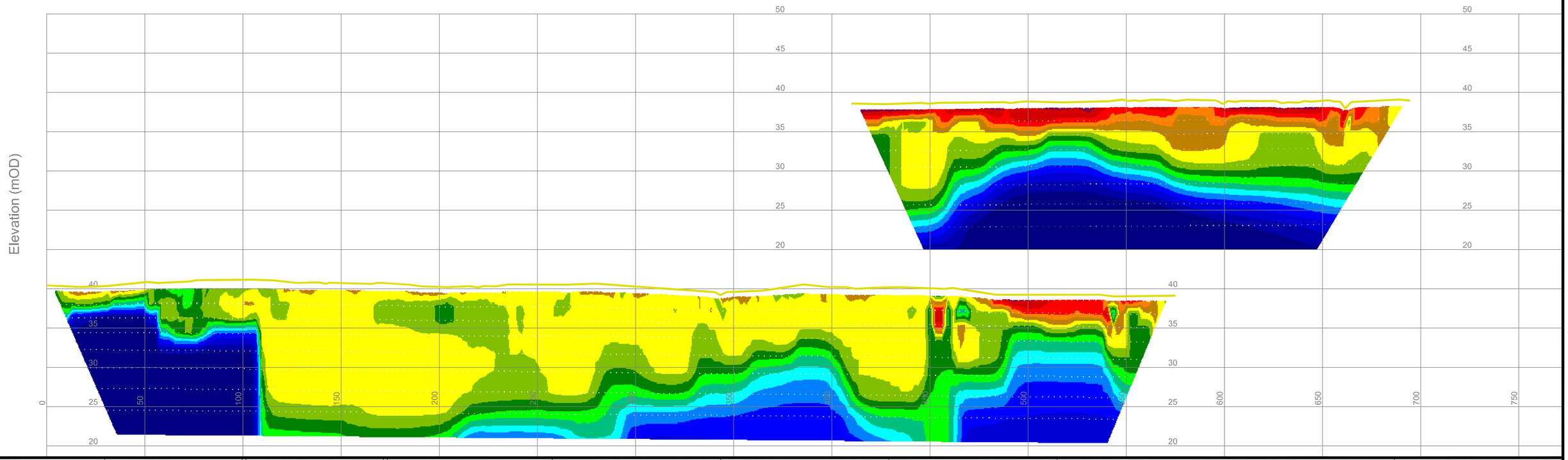
1 Clay, Silt, Peat and saturated Gravel (Alluvium)
2 Sandy Gravelly Clay and Silt (Glacial Till)
3 Clayey silty Sand and Gravel or Weathered Rock
4 Fresh Limestone

Interpretation of Seismic Refraction Layers:

Ground Surface/Top of Layer A: Very soft to soft or loose Material
Top of Layer B: Firm to stiff or medium dense Material
Top of Layer C: Very stiff or very dense Overburden or poor Rock
Top of Layer D: Fair to good Rock or highly consolidated Overburden



2D-Resistivity Profile R5 & R8 Model



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CLIENT	Galway County Council AECOM
PROJECT	N63 Liss to Abbey, Galway Geophysical Survey
TITLE	Plan 1a: Models of 2D-Resistivity Survey along Chainage

SCALE:	1:1000 @ A3, VE x 4
PROJECT:	6494
DRAWN:	JC
DATE:	30/03/2020
MGX FILE:	6494d_MapsFigs.dwg
STATUS:	Draft

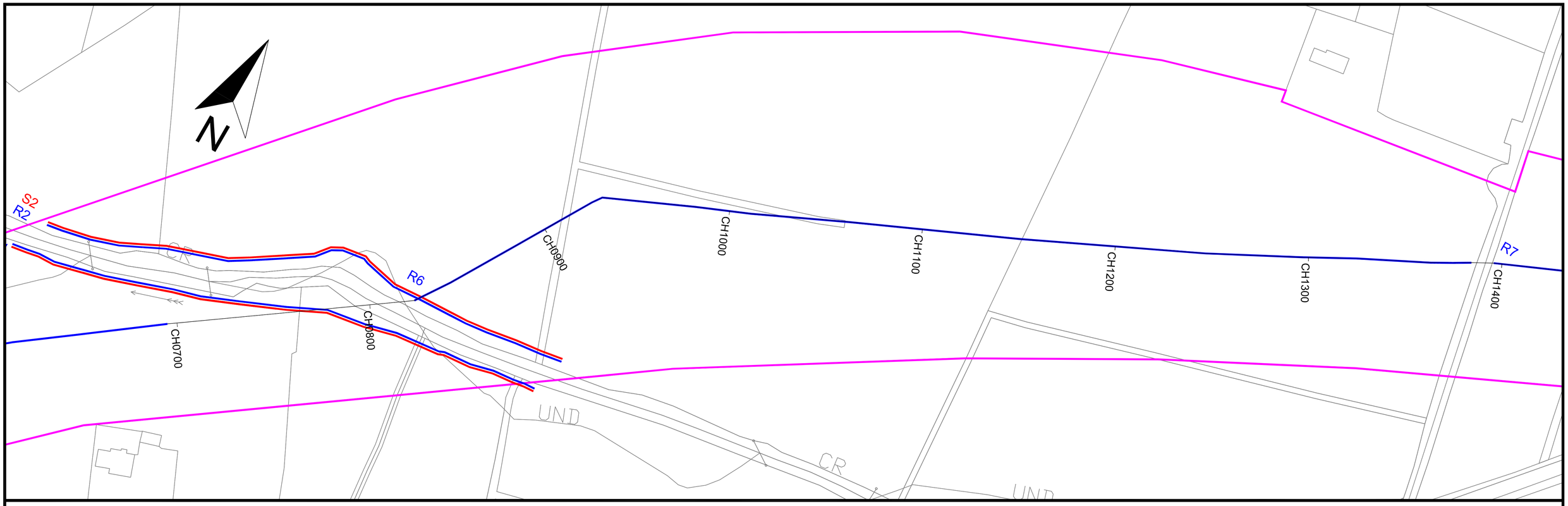
LEGEND: Geophysical Survey Locations:

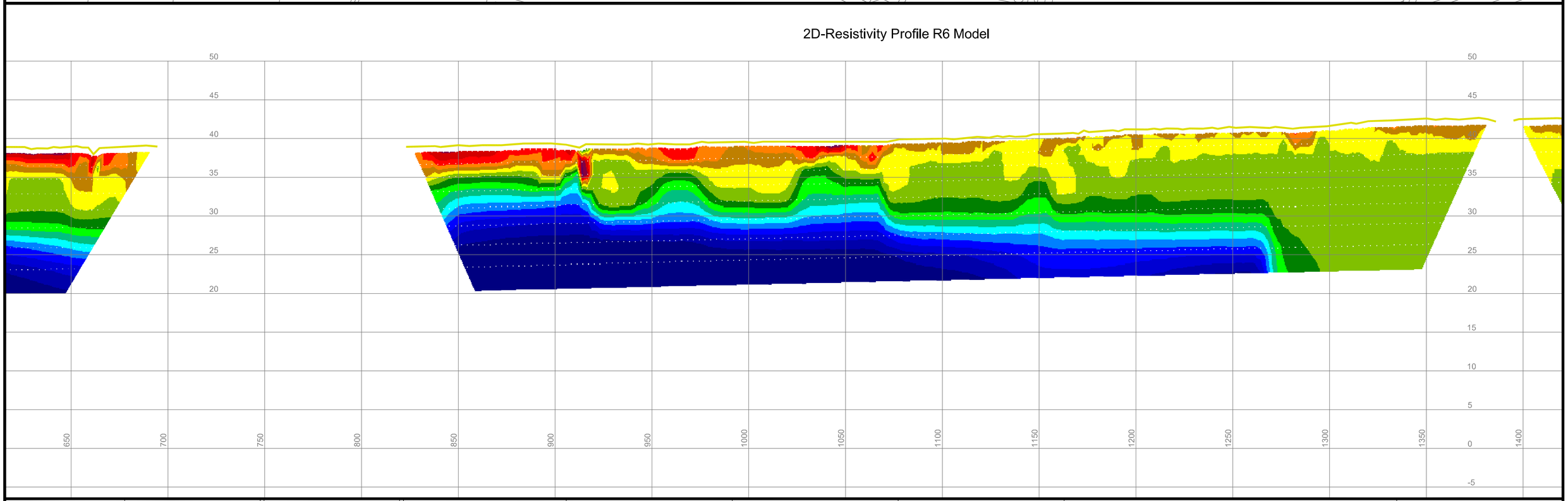
R2	2D-Resistivity Profile
S1	Seismic Refraction Profile
	EM31 Survey Area
CH0100	Centreline with Chainage

2D-Resistivity Model Values:

Resistivities (Ohmm) for 2D-Resistivity Model

31.3 | 62.5 | 125 | 250 | 500 | 1000 | 2000 | 4000





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CLIENT	Galway County Council AECOM
PROJECT	N63 Liss to Abbey, Galway Geophysical Survey
TITLE	Plan 1b: Models of 2D-Resistivity Survey along Chainage

SCALE:	1:1000 @ A3, VE x 4
PROJECT:	6494
DRAWN:	JC
DATE:	30/03/2020
MGX FILE:	6494d_MapsFigs.dwg
STATUS:	Draft

LEGEND:

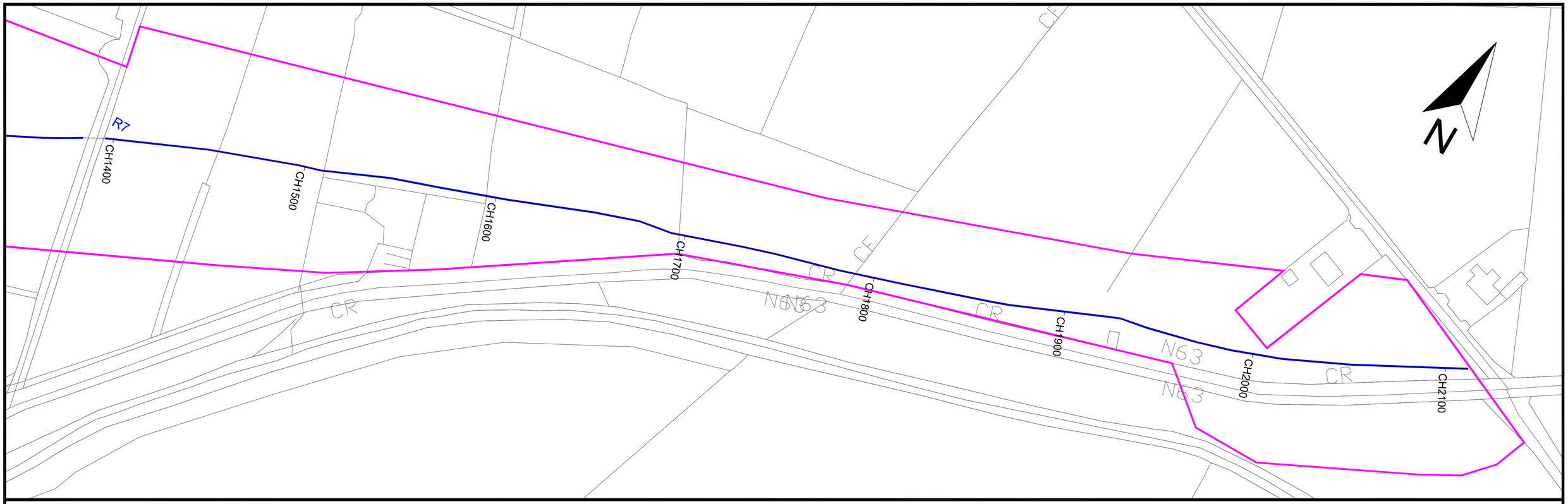
Geophysical Survey Locations:

R2	2D-Resistivity Profile
S1	Seismic Refraction Profile
	EM31 Survey Area
CH0100	Centreline with Chainage

2D-Resistivity Model Values:

Resistivities (Ohmm) for 2D-Resistivity Model

31.3 62.5 125 250 500 1000 2000 4000



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CLIENT	Galway County Council AECOM
PROJECT	N63 Liss to Abbey, Galway Geophysical Survey
TITLE	Plan 1c: Models of 2D-Resistivity Survey along Chainage

SCALE:	1:1000 @ A3, VE x 4
PROJECT:	6494
DRAWN:	JC
DATE:	30/03/2020
MGX FILE:	6494d_MapsFigs.dwg
STATUS:	Draft

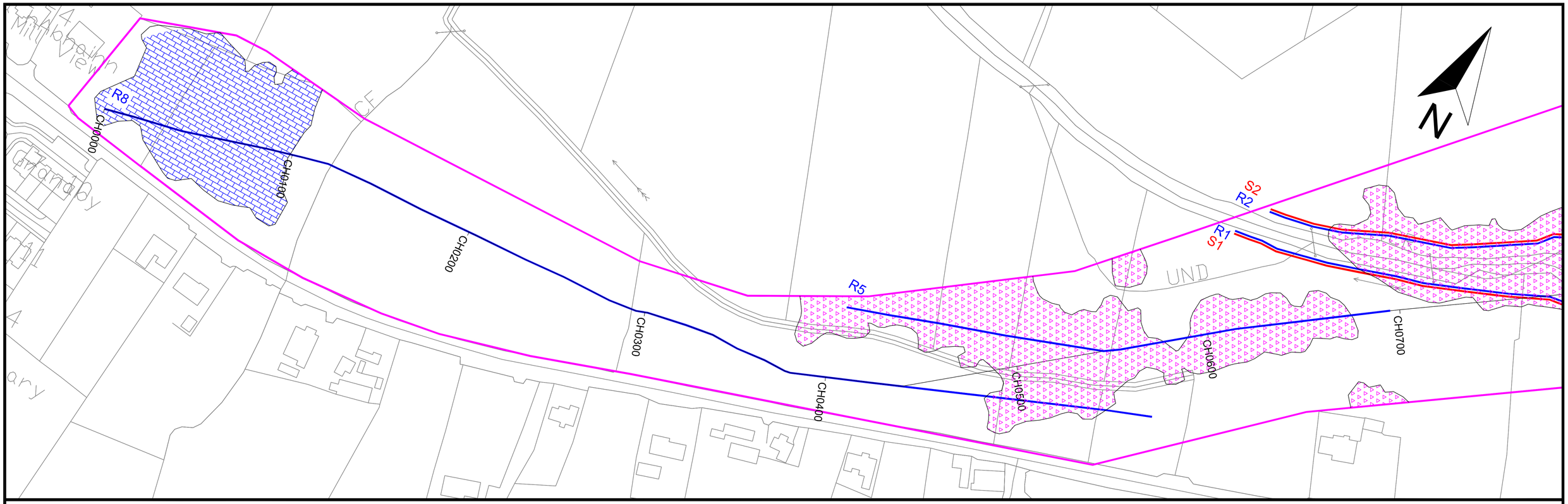
LEGEND: Geophysical Survey Locations:

R2	2D-Resistivity Profile
S1	Seismic Refraction Profile
	EM31 Survey Area
CH0100	Centreline with Chainage

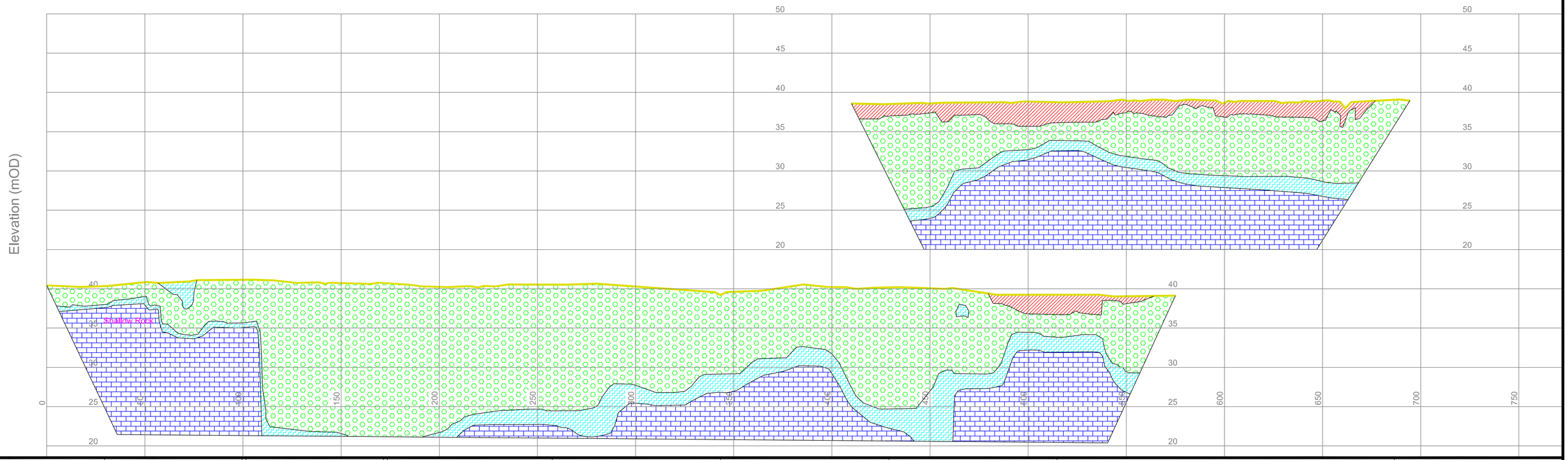
2D-Resistivity Model Values:

Resistivities (Ohmm) for 2D-Resistivity Model

31.3 62.5 125 250 500 1000 2000 4000



2D-Resistivity Profile R5 & R8 Interpretation



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CLIENT	Galway County Council AECOM
PROJECT	N63 Liss to Abbey, Galway Geophysical Survey
TITLE	Plan 2a: Interp. of 2D-Resistivity & EM31 Survey along Chainage

SCALE:	1:1000 @ A3, VE x 4
PROJECT:	6494
DRAWN:	JC
DATE:	30/03/2020
MGX FILE:	6494d_MapsFigs.dwg
STATUS:	Draft

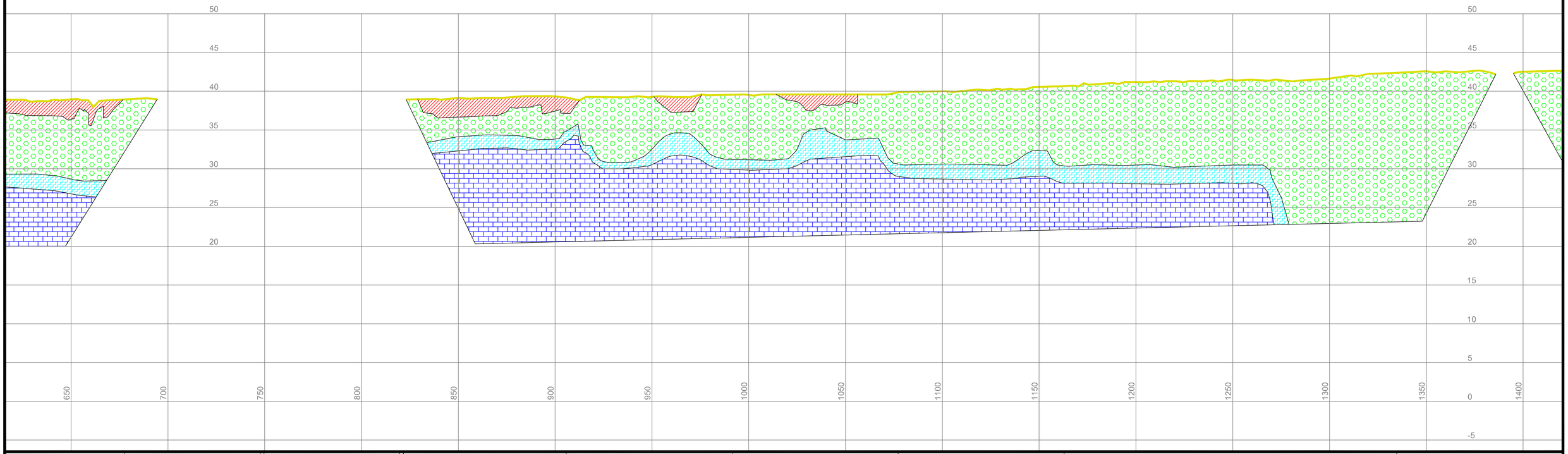
LEGEND: EM31 Interpretation Map:

1 Clay, Silt, Peat and saturated Gravel (Alluvium)
2 Shallow Rock

Interpretation of Resistivity Profiles:

1 Clay, Silt, Peat and saturated Gravel (Alluvium)
2 Sandy Gravelly Clay and Silt (Glacial Till)
3 Clayey silty Sand and Gravel or Weathered Rock
4 Fresh Limestone

2D-Resistivity Profile R6 Interpretation



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CLIENT	Galway County Council AECOM
PROJECT	N63 Liss to Abbey, Galway Geophysical Survey
TITLE	Plan 2b: Interp. of 2D-Resistivity & EM31 Survey along Chainage

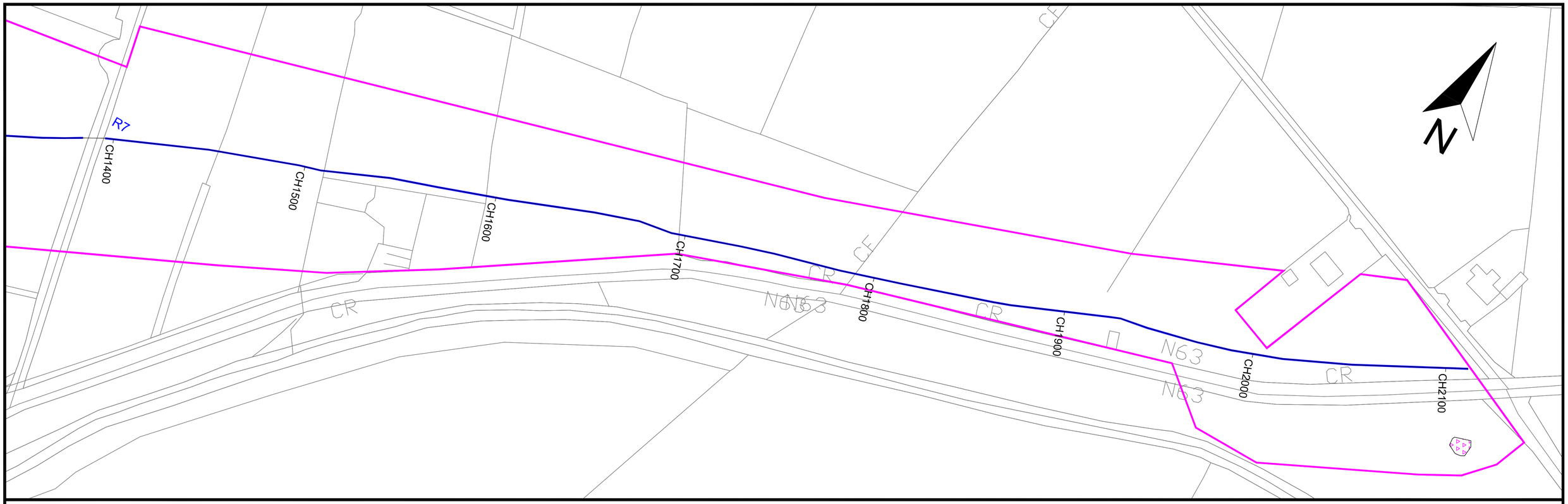
SCALE:	1:1000 @ A3, VE x 4
PROJECT:	6494
DRAWN:	JC
DATE:	30/03/2020
MGX FILE:	6494d_MapsFigs.dwg
STATUS:	Draft

LEGEND: EM31 Interpretation Map:

1 Clay, Silt, Peat and saturated Gravel (Alluvium)
2 Shallow Rock

Interpretation of Resistivity Profiles:

1 Clay, Silt, Peat and saturated Gravel (Alluvium)
2 Sandy Gravelly Clay and Silt (Glacial Till)
3 Clayey silty Sand and Gravel or Weathered Rock
4 Fresh Limestone



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CLIENT	Galway County Council AECOM
PROJECT	N63 Liss to Abbey, Galway Geophysical Survey
TITLE	Plan 2c: Interp. of 2D-Resistivity & EM31 Survey along Chainage

SCALE:	1:1000 @ A3, VE x 4
PROJECT:	6494
DRAWN:	JC
DATE:	30/03/2020
MGX FILE:	6494d_MapsFigs.dwg
STATUS:	Draft

LEGEND: EM31 Interpretation Map:

1 Clay, Silt, Peat and saturated Gravel (Alluvium)
2 Shallow Rock

Interpretation of Resistivity Profiles:

1 Clay, Silt, Peat and saturated Gravel (Alluvium)
2 Sandy Gravelly Clay and Silt (Glacial Till)
3 Clayey silty Sand and Gravel or Weathered Rock
4 Fresh Limestone

Appendix A8-2

Geotechnical Borehole and Trial Pit Records

IGSL Limited

Aecom

N63 Liss to Abbey Realignment

Factual Ground Investigation Report

Report No. 22751

October 2021

Report

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DOCUMENT ISSUE REGISTER

Distribution	Report Status	Revision	Date of Issue	Author
Aecom	Interim Factual Report	0	18/02/2020	D. Green BA BAI CEng MIEI FGS
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Aecom	Factual Report	2	18/10/2021	J. Lawler
Aecom	Factual Report	3	21/10/2021	J. Lawler

TABLE OF CONTENTS

FOREWORD

The following conditions and notes on the geotechnical site investigation procedures should be read in conjunction with this report.

Standards

The ground investigation works for this project have been carried out by IGSL in accordance with Eurocode 7 - Part 2: Ground Investigation & Testing (EN 1997-2:2007). This has been used together with complementary documents such as BS 5930:2015 and BS 1377 (Parts 1 to 9) and the following European Norms:

- EN 1997-2 Eurocode 7: 2007 – Geotechnical Design – Part 2: Ground Investigation & Testing
- EN ISO 22475-1:2006 Geotechnical Investigation and Sampling – Sampling Methods & Groundwater Measurements
- EN ISO 14688-1:2018 Geotechnical Investigation and Testing – Identification and Classification of Soil, Part 1: Identification and Description
- EN ISO 14688-2:2018 Geotechnical Investigation and Testing – Identification and Classification of Soil, Part 2: Classification Principles
- EN ISO 14689-1:2018 Geotechnical Investigation and Testing - Identification & Classification of Rock, Part 1: Identification & Description

Reporting

This report has been prepared for Aecom and the information should not be used without prior written permission of either party. IGSL Ltd accepts no responsibility or liability for this document being used other than for the purposes for which it was intended. No responsibility can be held by IGSL Ltd for ground conditions between exploratory hole locations.

The engineering logs provide ground profiles and configuration of strata relevant to the investigation depths achieved and caution should be taken when extrapolating between exploratory points. No liability is accepted for ground conditions extraneous to the investigation points. Unless specifically stated, no account has been taken of possible subsidence due to mineral extraction, mining works or karstification below or close to the site.

Boring Procedures

Unless otherwise stated, ‘shell and auger' or cable percussive boring technique has been employed as defined by Section 6.3 of IS EN ISO 22475-1:2006. The boring operations, sampling and in-situ testing complies with the recommendations of IS EN 1997-2:2007 and BS 1377:1990 and EN ISO 22476-3:2005+A1:2011. The shell and auger boring technique allows for continuous sampling in clay and silt above the water table and sand and gravel below the water table (Table 2 of IS EN ISO 22475-1:2006).

It is highlighted that some disturbance and variations is unavoidable in particular ground (e.g. blowing sands, gravel / cobble dominant glacial deposits etc). Attention is drawn to this condition, whenever it is suspected. Where cobbles and boulders are recorded, no conclusion should be drawn concerning the size, presence, lithological nature, or numbers per unit volume of ground.

Rotary Drilling Procedures
Rotary drilling methods are used to recover very heavily over-consolidated glacial till and bedrock samples in line with Section 3.5 of IS EN 1997-2:2007 and IS EN ISO 22475-1. Open hole drilling methods (odex or symmetrix) are utilized to advance the drillholes through granular dominant superficial deposits, with coring in hard ('cemented') fine grained or cohesive glacial deposits and bedrock.

In-Situ Testing
Standard penetration tests are conducted by IGSL strictly in accordance with Section 4.6 of IS EN 1997-2:2007. The SPT equipment (hammer energy test) has been calibrated in accordance with EN ISO 22476-3:2005+A1:2011 and the Energy Ratio (E_r) is defined as the ratio of the actual energy E_{meas} (measured energy during calibration) delivered to the drive weight assembly into the drive rod below the anvil, to the theoretical energy (E_{theor}) as calculated from the drive weight assembly. The measured number of blows (N) reported on the engineering logs are uncorrected. In sands, the energy losses due to rod length and the effect of the overburden pressure should be taken into account (see IS EN ISO 22476-3:2005+A1:2011).

Groundwater
The depth of entry of any influx of groundwater is recorded during the course of boring or drilling operations. However, the normal rate of boring does not usually permit the recording of an equilibrium level for any one water strike. Where possible drilling is suspended for a period of twenty minutes to monitor the subsequent rise in water level. Groundwater conditions observed in the borings or pits are those appertaining to the period of investigation. It should be noted however, that groundwater levels are subject to diurnal, seasonal and climatic variations and can also be affected by drainage conditions, tidal variations etc.

Soil Sampling
Three categories of sampling methods are outlined in EN ISO 22475-1:2006. The categories are referenced A, B and C for any given ground conditions and are shown in Tables 1 and 2 of EN ISO 22475-1:2006. Reference should be made to EN 1997-2:2007 for guidelines on sample class and quality for strength and compressibility testing. Samples of quality classes 1 or 2 can only be obtained by using Category A sampling methods.

Where appropriate Class 1 thin wall undisturbed tube samples (UT100) are obtained in fine grained soils and strictly meet the requirements of EN 1997-2:2007 and EN ISO 22475-1:2006. Soil samples for laboratory tests are divided into five classes with respect to the soil properties that are assumed to remain unchanged during sampling, handling transport and storage. The minimum sample quality required for testing purposes to Eurocode 7 compatibility (EN 1997-2:2007) is shown in Table A.

Table A – Details of Sample Quality Requirements

EN 1997 Clause	Test	Minimum Sample Quality Class
5.5.3	Water Content	3
5.5.4	Bulk Density	2
5.5.5	Particle Density	N/S
5.5.6	Particle Size Analysis	N/S
5.5.7	Consistency Limits	4
5.5.8	Density Index	N/S
5.5.9	Soil Dispersivity	N/S
5.5.10	Frost Susceptibility	N/S
5.6.2	Organic Content	4
5.6.3	Carbonate Content	3
5.6.4	Sulphate Content	3
5.6.5	pH	3
5.6.6	Chloride Content	3
5.7	Strength Index	1
5.8	Strength Tests	1
5.9	Compressibility Tests	1
5.10	Compaction Tests	N/S
5.11	Permeability	2

N/S – not stated. Presume a representative sample of appropriate size.

Samples recovered from trial pits or trenches meet the requirements of IS EN ISO 22475-1. It is highlighted that unforeseen circumstances such as variations in geological strata may lead to lower quality sample classes being obtained.

Engineering Logging

Soil and rock identification is based on the examination of the samples recovered and conforms with IS EN ISO 14688-1:2018 and IS EN ISO 14689-1:2018. Rock weathering classification conforms to IS EN ISO 14689-1:2018 while discontinuities (bedding planes, joints, cleavages, faults etc) are classified in accordance with 4.3.3 of IS EN ISO 14689-1:2018. Rock mechanical indices (TCR, SCR, RQD) are defined in accordance with IS EN ISO 22475-1:2006.

Retention of Samples

After satisfactory completion of all the scheduled laboratory tests on any sample, the remaining material will be discarded. Unless a period of retention of samples is agreed, it is company policy to discard soil samples one month after submission of our final report.

1.0 Introduction and Objectives

It is proposed realign a section of the existing N63 National Primary Route that links Galway City with Roscommon Town. The section commences at the townland of Abbeyknockmoy and extends in a north-east direction for a distance of approximately 2 kilometres before rejoining the existing carriageway to south of Derreen.

The proposed route of the realignment is approximately shown on Figure 1.

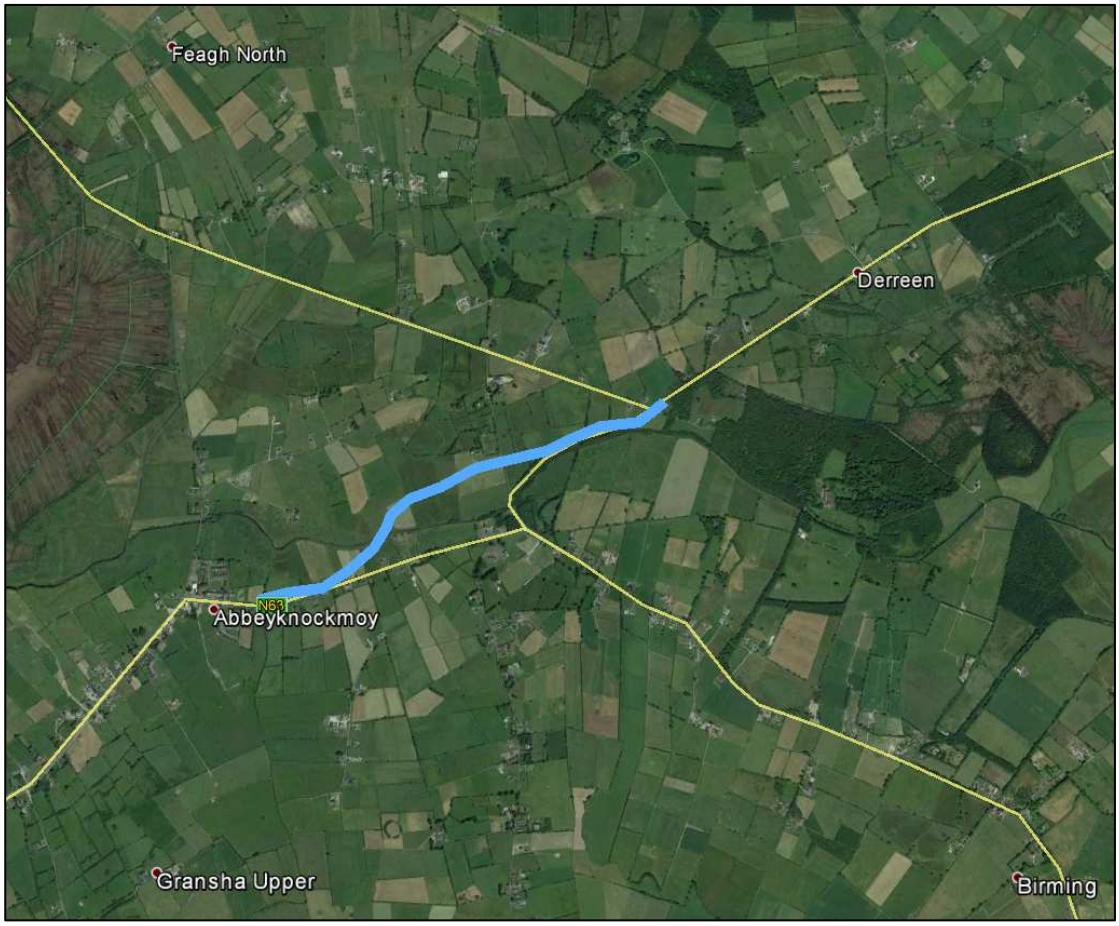

Figure 1 – Site Location (Base Mapping – Google Earth Professional)

IGSL Limited were appointed by Aecom to conduct a ground investigation along the proposed route. The objectives of the investigation were to ascertain the ground and groundwater conditions, and to produce a report which will assist in the geotechnical design of the new development.

Fieldworks to date were undertaken during the period August to November 2020. The resumption of fieldworks post-Christmas was suspended in line with Covid-19 Government restrictions imposed on the Construction Industry. Fieldworks were resumed in April 2021 with the coring of RC04A.

This report presents the exploratory hole records together with laboratory test data.

2.0 Scope of Works

The programme of exploratory works to date included the following:

- 10 no. cable percussive boreholes
- 8 no. rotary coreholes
- 10 no. mechanically excavated trial pits (TP01 to TP10)
- 10 no. Dynamic Cone Penetrometer Tests
- Groundwater Monitoring
- A programme of geotechnical and chemical laboratory testing

The exploratory hole locations are shown on the as-surveyed aerial plan in Appendix 9 of this report.

2.1 Cable Percussive Boreholes

Boreholes were constructed in ten locations (BH01 to BH10) using a Dando 2000 rig equipped with 200mm casing. The bored depths ranged from 2.2 to 7.9 metres below existing ground level (m BGL). In four locations (BH04, 05, 09 and 10), re-drills (suffixed "A") were undertaken when shallow obstructions were encountered during the initial attempt.

A hand dug inspection pit was excavated at each location prior to commencing drilling works and the locations were scanned for services using a CAT detection tool.

During the course of boring, in-situ Standard Penetration Tests (SPT) were undertaken at regular intervals. Samples were also recovered to assist in the visual description of recovered soils and to provide specimens for laboratory testing. In low strength soils, driven tube samples (U100) were obtained.

Instances of groundwater ingress were recorded and monitored for a further 20 minutes to permit the water to rise.

The borehole records are presented in Appendix 1 of this report.

2.2 Rotary Coreholes

Rotary coreholes (RC02 – RC07 and RC10) were drilled adjacent to corresponding cable percussive boreholes to investigate for the presence of bedrock. In April 2021, following lifting of Government of Ireland / Public Health Measures on Covid 19, RC04A was carried out at a revised hole location along the proposed route. It was not pre-bored by cable percussive methods.

At RC02, 03, 04 and 10, Symmetrix "open hole" techniques were used to advance through the upper deposits. It is noted that Symmetrix drilling produces highly pulverised drill returns and therefore, soil descriptions based on these returns are very approximate.

Standard Penetration Tests (SPTs) were undertaken at regular intervals within the overburden soils.

Rotary coring of rock was carried out using an air/mist flush. Cores were placed securely in wooden storage boxes.

At RC04A, 05, 06 and 07, Geobor techniques were used to recover continuous core samples of both the overburden soils and underlying bedrock. A polymer gel flush was utilized in order to maximise recovery.

On completion of drilling, standpipes were installed in coreholes RC03, 05, 06 and 10 in order to permit long term groundwater monitoring.

The recovered core was inspected by a qualified engineering geologist and logged in detail at IGSL's laboratory. Records detailing the Total Core Recovery (TCR), Solid Core Recovery (SCR) and Rock Quality Designation (RQD) were produced. Core records also include a fracture log (spacing between successive core joints measured from the cores).

All cores were labelled and photographed for inclusion in the report. Photographs are presented digitally for ease of browsing and to permit close examination at high resolution. Corehole records and photographs are included in Appendix 2 of this report.

2.3 Trial Pits

Trial pitting was performed at ten locations (TP01 to TP10) using a tracked excavator. The trial pits were logged and sampled by an IGSL geotechnical engineer in accordance with BS 5930 (2015).

Pit sidewalls were assessed in terms of their short term stability and any instances of groundwater ingress were recorded. Bulk soil samples were also recovered to provide specimens for laboratory testing.

The samples were placed in heavy duty polyethene bags and sealed before being transported to Naas for laboratory testing.

The trial pits were backfilled with the as-dug arisings and reinstated to the satisfaction of IGSL's site geotechnical engineer. The trial pit logs in Appendix 3 include descriptions of the soils encountered, groundwater conditions and stability of the pit sidewalls.

2.4 In-situ Dynamic Cone Penetrometer [DCP] Testing

An in-situ dynamic cone penetrometer test was carried out at each of the ten trial pit locations in accordance with TRL recommended procedure* to estimate CBR values* of the indigenous deposits. Testing commenced from ground level. The test results complete with extrapolated CBR value are presented in Appendix 4 of this report.

**CBR values are estimated using the correlation derived by Kleyn and Van Heerden (1983), which is preferred by TRL.*

2.5 Groundwater Monitoring

Groundwater monitoring was undertaken manually during the fieldworks and post-fieldworks period. Levels were measured using an electric dipmeter. The recordings feature in Appendix 5.

2.6 As-Built Survey

On completion of fieldworks, the location (x,y) and elevation (z) of each exploratory location was determined by detailed survey using GPS Realtime Kinetic survey instrument.

The National Grid survey co-ordinates and ground levels related to Malin Head Datum are presented on the exploratory hole records and these were used to plot the as-built locations on the Site Plan in Appendix 9 of this report.

3.0 Laboratory Testing

Laboratory test results are segregated and presented as follows:

- Appendix 6 – Geotechnical Laboratory Testing
- Appendix 7 – Rock Testing
- Appendix 8 – Chemical Testing

Geotechnical testing of soils comprised:

- Moisture Content
- Atterberg Limits (Plasticity Index)
- Particle Size Distribution (PSD)
- Moisture Condition Value (MCV)
- Undrained shear strength in triaxial compression (without pore pressure measurements)

Rock testing comprised:

- Point Load Index
- Unconfined Compressive Strength (UCS) Test

Chemical tests were undertaken by Eurofins Chemtest and included:

- Acid Soluble Sulphate, Water Soluble Sulphate and Total Sulphur
- pH Analysis
- Organic content
- BRE SD1 Suite D

4.0 References

1. BS 5930:2015 Code of Practice for Site Investigations; British Standards Institute
2. Manual of Contract Documents for Highway Works, Volume 5, Section 3, Ground Investigation, Part 4: Specification
3. BRE Special Digest 1: 2005 – Concrete in aggressive ground
4. EN 1997-3; Eurocode 7: Geotechnical Design – Part 3: Design assisted by field testing; 1997
5. BS1377; British Standard Methods of Test for Soils for Civil Engineering Purposes; British Standards Institute;1990.
6. BRE Digest 365, September 1991, British Research Establishment
7. Kleyn, E. & Van Heerden, M.J. (1983, July). Using DCP Soundings to Optimize Pavement Rehabilitation. Paper presented at the Annual Transportation Convention, Milner Park Showgrounds, Johannesburg.
8. Manual of Contract Documents for Road Works, Volume 1: Specification for Road Works (March 2007)
9. Manual of Soil Laboratory Testing, Volume 3; K.H. Head
10. ISRM – Suggested Methods for Determining Point Load Strength
11. ISRM – Suggested Methods for Determining the Uniaxial Compressive Strength and Deformability of Rock Materials
12. TRL Report 447- Sulfate specification for structural backfills
13. CIRIA C580
14. Specification for Roadworks Series 600 – Specification for Roadworks

Appendix 1

Cable Percussive Boreholes

GEOTECHNICAL BORING RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**BOREHOLE NO.**	**BH01**
		SHEET	Sheet 1 of 1
CO-ORDINATES	550,886.94 E 743,373.64 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	38.86	**BOREHOLE DEPTH (m)**	7.30
		DATE COMMENCED	26/08/2020
		DATE COMPLETED	26/08/2020
CLIENT	Galway County Council	**SPT HAMMER REF. NO.**	
		BORED BY	P.Allan
ENGINEER	Aecom	**ENERGY RATIO (%)**	
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		38.66	0.20						
	Soft dark brown / black PEAT				AA134309	B	0.50			
1						U	1.00	80%rec 5 blows	N = 1 (1, 0, 1, 0, 0, 0)	
			37.26	1.60						
	Medium dense grey fine to coarse sandy silty GRAVEL with some cobbles									
2					AA134310	B	2.00		N = 48 (4, 6, 8, 10, 15, 15)	
3					AA134311	B	3.00		N = 18 (2, 3, 4, 4, 5, 5)	
			35.36	3.50						
	Stiff to very stiff grey sandy gravelly SILT with some cobbles									
4					AA134312	B	4.00		N = 19 (2, 3, 4, 5, 5, 5)	
5					AA131709 Fail	B U	5.00 5.00		N = 40 (6, 8, 10, 10, 10, 10)	
6					AA131710	B	6.00		N = 42 (8, 9, 10, 10, 10, 12)	
7					AA131711	B	7.00		N = 50/150 mm (10, 15, 25, 25)	
			31.56	7.30						
	Obstruction End of Borehole at 7.30 m									
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
2.3	2.5	1.5	
6.7	6.9	0.75	
7.2	7.3	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
1.60	1.60	No	1.00	20	Slow

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 1hr Setting up Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out . Tracked dumper needed to move rig into position.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 22751.GPJ IGSL.GDT 21/10/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**BOREHOLE NO.**	**BH02**
		SHEET	Sheet 1 of 1
CO-ORDINATES	550,976.48 E 743,407.29 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	39.17	**BOREHOLE DEPTH (m)**	6.30
		DATE COMMENCED	20/08/2020
		DATE COMPLETED	21/08/2020
CLIENT	Galway County Council	**SPT HAMMER REF. NO.**	
ENGINEER	Aecom	**ENERGY RATIO (%)**	
		BORED BY	P.Allan
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		39.02	0.15						
	Brown sandy peaty SILT/CLAY to silty/clayey PEAT		38.57	0.60	AA141451	B	0.50			
1	Soft to firm brown/grey sandy gravelly SILT/CLAY. Gravel is fine.		37.47	1.70	AA141452	B	1.00		N = 8 (0, 1, 0, 1, 2, 5)	
2	Medium dense grey fine to coarse sandy silty GRAVEL with occasional cobbles				AA141453	B	2.00		N = 22 (2, 4, 5, 6, 5, 6)	
3					AA141454	B	3.00		N = 25 (2, 5, 6, 5, 7, 7)	
4			34.67	4.50	AA141455	B	4.00		N = 29 (4, 5, 6, 7, 8, 8)	
	Very stiff grey/brown very sandy very gravelly SILT/CLAY with occasional cobbles				AA141456	B	4.50			
5					AA141457	B	5.00		N = 33 (3, 6, 8, 8, 9, 8)	
6			33.17	6.00	AA141458	B	6.00		N = 50/150 mm (8, 17, 25, 25)	
	Dense grey fine to coarse sandy GRAVEL with occasional cobbles		32.87	6.30						
	Obstruction End of Borehole at 6.30 m									
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
3.3	3.6	1	
5.5	5.7	0.75	
6.1	6.3	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
0.90	0.90	1.60	0.40	20	Slow
6.00	6.00	No	5.50	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS Standing 6hrs on tracked dumper to move rig.1hr Setting up Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

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GEOTECHNICAL BORING RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**BOREHOLE NO.**	**BH03**
		SHEET	Sheet 1 of 1
CO-ORDINATES	550,998.52 E 743,480.74 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	38.96	**BOREHOLE DEPTH (m)**	7.90
		DATE COMMENCED	24/08/2020
		DATE COMPLETED	25/08/2020
CLIENT	Galway County Council	**SPT HAMMER REF. NO.**	
ENGINEER	Aecom	**ENERGY RATIO (%)**	
		BORED BY	P.Allan
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		38.76	0.20						
	Soft grey/brown sandy SILT/CLAY				AA134301	B	0.50			
			37.96	1.00						
1	Soft dark brown/black silty PEAT		37.66	1.30	AA134302	B	1.00		N = 9 (1, 0, 0, 1, 2, 6)	
	Stiff grey sandy slightly gravelly SILT/CLAY		37.46	1.50						
	Medium dense grey fine to coarse slightly silty sandy GRAVEL with occasional cobbles									
2					AA134303	B	2.00		N = 26 (2, 3, 4, 8, 8, 6)	
3					AA134304	B	3.00		N = 26 (2, 5, 6, 6, 7, 7)	
			35.16	3.80						
4	Stiff to very stiff grey sandy gravelly SILT/CLAY with some cobbles				AA134305	B	4.00		N = 27 (3, 4, 5, 6, 8, 8)	
5					AA134306	B	5.00		N = 28 (3, 4, 6, 8, 6, 8)	
					Fail	U	5.50			
6					AA134307	B	6.00		N = 34 (4, 8, 10, 8, 8, 8)	
7					AA134308	B	7.00		N = 50/225 mm (10, 15, 15, 20, 15)	
			31.06	7.90						
8	Obstruction End of Borehole at 7.90 m								N = 50/150 mm (20, 5, 20, 30)	
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
3.7	3.9	1	
7.3	7.5	0.5	
7.8	7.9	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
1.20	1.20	No	0.90	20	Slow

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS 1hr Setting up Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out . Tracked dumper and flotation tyres required toi move rig.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

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GEOTECHNICAL BORING RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**BOREHOLE NO.**	**BH04**
		SHEET	Sheet 1 of 1
CO-ORDINATES	551,029.80 E 743,487.73 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	39.10	**BOREHOLE DEPTH (m)**	2.20
		DATE COMMENCED	25/08/2020
		DATE COMPLETED	25/08/2020
CLIENT	Galway County Council	**SPT HAMMER REF. NO.**	
ENGINEER	Aecom	**ENERGY RATIO (%)**	
		BORED BY	P.Allan
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		38.90	0.20						
	Soft grey/brown sandy peaty SILT/CLAY		38.10	1.00						
1	Firm to stiff grey/brown sandy gravelly CLAY/SILT with occasional cobbles				AA134271	B	1.00		N = 15 (2, 2, 3, 3, 4, 5)	
			37.10	2.00						
2	Obstruction End of Borehole at 2.20 m				AA134272	B	2.00		N = 50/75 mm (25, 50)	
3										
4										
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
1.7	1.9	0.75	
2	2.2	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 1hr Setting up Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out . Tracked dumper required to move rig . Relocated to BH04A and attempted rebore.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 22751.GPJ IGSL.GDT 21/10/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**BOREHOLE NO.**	**BH04A**
		SHEET	Sheet 1 of 1
CO-ORDINATES	551,029.80 E 743,487.73 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	39.10	**BOREHOLE DEPTH (m)**	4.50
		DATE COMMENCED	25/08/2020
		DATE COMPLETED	25/08/2020
CLIENT	Galway County Council	**SPT HAMMER REF. NO.**	
ENGINEER	Aecom	**ENERGY RATIO (%)**	
		BORED BY	P.Allan
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		38.90	0.20						
	Soft grey/brown sandy peaty SILT/CLAY		38.10	1.00						
1	Medium dense grey very sandy GRAVEL with occasional cobbles (Possibly very gravelly sand)				AA136188	B	1.00		N = 21 (4, 4, 6, 4, 5, 6)	
2					AA136189	B	2.00		N = 17 (2, 2, 3, 4, 4, 6)	
			36.40	2.70						
3	Very stiff grey sandy gravelly SILT with occasional cobbles				AA136190 Fail	B U	3.00 3.00		N = 32 (3, 6, 8, 10, 6, 8)	
			35.00	4.10	AA136191	B	4.00		N = 50/75 mm (25, 50)	
4	Angular COBBLES		34.60	4.50						
	Obstruction End of Borehole at 4.50 m									
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
4.1	4.3	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.00	2.00	No	1.00	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS 1hr Setting up Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .Tracked dumper required to moved rig.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

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GEOTECHNICAL BORING RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**BOREHOLE NO.**	**BH05**
		SHEET	Sheet 1 of 1
CO-ORDINATES	551,042.84 E 743,531.61 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	38.63	**BOREHOLE DEPTH (m)**	2.60
		DATE COMMENCED	27/08/2020
		DATE COMPLETED	27/08/2020
CLIENT	Galway County Council	**SPT HAMMER REF. NO.**	
		BORED BY	P.Allan
ENGINEER	Aecom	**ENERGY RATIO (%)**	
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		38.43	0.20						
	Soft grey/brown sandy peaty SILT/CLAY		37.63	1.00						
1	Stiff to very stiff grey sandy gravelly SILT with cobbles				AA136192	B	1.00		N = 19 (2, 3, 4, 5, 5, 5)	
2					AA136193	B	2.00		N = 50/75 mm (25, 25, 50)	
			36.03	2.60						
	Obstruction End of Borehole at 2.60 m									
3										
4										
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
1.8	2	0.75	
2.1	2.3	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS Standing 1.5hrs on tracked dumper .1hr Setting up Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .Obstruction encountered . Relocated to BH05A and attempted rebore.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 22751.GPJ IGSL.GDT 21/10/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**BOREHOLE NO.**	**BH05A**
		SHEET	Sheet 1 of 1
CO-ORDINATES	551,042.84 E 743,531.61 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	38.63	**BOREHOLE DEPTH (m)**	5.80
		DATE COMMENCED	31/08/2020
		DATE COMPLETED	31/08/2020
CLIENT	Galway County Council	**SPT HAMMER REF. NO.**	
		BORED BY	P.Allan
ENGINEER	Aecom	**ENERGY RATIO (%)**	
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		38.43	0.20						
	Soft grey/brown sandy peaty SILT/CLAY		37.63	1.00						
1	Stiff to very stiff grey sandy gravelly SILT with occasional cobbles				AA134313	B	1.00		N = 18 (3, 3, 5, 4, 4, 5)	
					Fail	U	1.50			
2					AA134314	B	2.00		N = 23 (3, 3, 5, 5, 5, 8)	
3					AA134315	B	3.00		N = 37 (6, 8, 8, 10, 9, 10)	
4					AA134316	B	4.00		N = 45 (6, 9, 10, 15, 10, 10)	
5					AA134317	B	5.00		N = 50/150 mm (10, 15, 30, 20)	
			32.83	5.80					N = 50/75 mm (25, 50)	
6	Obstruction End of Borehole at 5.80 m									
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
1.9	2.1	1	
5.3	5.5	0.5	
5.7	5.8	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 1hr Setting up Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out . Tracked dumper required to move rig . Relocated to BH04A and attempted rebore.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

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GEOTECHNICAL BORING RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**BOREHOLE NO.**	**BH06**
		SHEET	Sheet 1 of 1
CO-ORDINATES	551,072.28 E 743,546.31 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	38.68	**BOREHOLE DEPTH (m)**	5.40
		DATE COMMENCED	01/09/2020
		DATE COMPLETED	01/09/2020
CLIENT	Galway County Council	**SPT HAMMER REF. NO.**	
ENGINEER	Aecom	**ENERGY RATIO (%)**	
		BORED BY	P.Allan
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		38.48	0.20						
	Soft dark brown silty PEAT		37.78	0.90	AA134323	B	0.50			
1	Stiff to very stiff grey sandy gravelly CLAY/SILT with occasional cobbles				AA134324	B	1.00		N = 21 (2, 3, 6, 8, 3, 4)	
2					AA134325	B	2.00		N = 38 (4, 8, 8, 10, 10, 10)	
					AA131712	U	2.50	50%rec		
3					AA134326	B	3.00		N = 41 (10, 7, 7, 10, 12, 12)	
4					AA134327	B	4.00		N = 50/150 mm (10, 15, 30, 20)	
5			33.28	5.40	AA134328	B	5.00		N = 50/75 mm (25, 50)	
	Obstruction End of Borehole at 5.40 m									
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
2.6	2.8	1.25	
5.2	5.4	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 1hr Setting up Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .Tracked dumper required to move rig.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

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GEOTECHNICAL BORING RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**BOREHOLE NO.**	**BH07**
		SHEET	Sheet 1 of 1
CO-ORDINATES	551,088.72 E 743,607.38 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	40.02	**BOREHOLE DEPTH (m)**	4.50
		DATE COMMENCED	31/08/2020
		DATE COMPLETED	31/08/2020
CLIENT	Galway County Council	**SPT HAMMER REF. NO.**	
ENGINEER	Aecom	**ENERGY RATIO (%)**	
		BORED BY	P.Allan
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		39.92	0.10						
	Soft grey/brown sandy gravelly SILT				AA134319	B	0.50			
1					AA134320	B	1.00		N = 10 (2, 2, 3, 3, 2, 2)	
			38.72	1.30						
	Stiff to very stiff grey sandy gravelly SILT with some cobbles									
2					AA134321	B	2.00		N = 18 (2, 3, 4, 5, 4, 5)	
3					AA134322	B	3.00		N = 42 (6, 7, 10, 10, 12, 10)	
4					AA134323	B	4.00		N = 50/150 mm (10, 15, 40, 10)	
			35.52	4.50						
	Obstruction End of Borehole at 4.50 m									
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
2.6	2.8	1	
4.4	4.5	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 1hr Setting up Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out . Tracked dumper required to move rig.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

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GEOTECHNICAL BORING RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**BOREHOLE NO.**	**BH08**
		SHEET	Sheet 1 of 1
CO-ORDINATES	551,183.11 E 743,686.75 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	39.42	**BOREHOLE DEPTH (m)**	2.20
		DATE COMMENCED	02/09/2020
		DATE COMPLETED	02/09/2020
CLIENT	Galway County Council	**SPT HAMMER REF. NO.**	
ENGINEER	Aecom	**ENERGY RATIO (%)**	
		BORED BY	P.Allan
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		39.27	0.15						
	Stiff to very stiff grey sandy gravelly SILT with occasional cobbles. Gravel is fine.				AA134334	B	1.00		N = 26 (3, 4, 8, 5, 7, 6)	
2			37.22	2.20	AA134335	B	2.00		N = 50/75 mm (25, 50)	
	Obstruction End of Borehole at 2.20 m									

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
2	2.2	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS 1hr Setting up Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out .Tracked dumper needed to moved rig.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

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GEOTECHNICAL BORING RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**BOREHOLE NO.**	**BH09**
		SHEET	Sheet 1 of 1
CO-ORDINATES	551,308.45 E 743,744.07 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	40.18	**BOREHOLE DEPTH (m)**	1.70
		DATE COMMENCED	01/09/2020
		DATE COMPLETED	01/09/2020
CLIENT	Galway County Council	**SPT HAMMER REF. NO.**	
ENGINEER	Aecom	**ENERGY RATIO (%)**	
		BORED BY	P.Allan
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		39.98	0.20						
	Stiff grey sandy gravelly SILT with occasional cobbles				Fail	U	0.50			
1					AA134336	B	1.00		N = 50/150 mm (25, 40, 20, 30)	
			38.48	1.70					N = 50/75 mm (25, 50)	
2	Obstruction End of Borehole at 1.70 m									
3										
4										
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
1.5	1.7	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 1hr Setting up Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out . Obstruction encountered . Relocated to BH09A and attempted rebore.Tracked dumper needed to move rig.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 22751.GPJ IGSL.GDT 21/10/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**BOREHOLE NO.**	**BH09A**
		SHEET	Sheet 1 of 1
CO-ORDINATES	551,308.45 E 743,744.07 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	40.18	**BOREHOLE DEPTH (m)**	4.90
		DATE COMMENCED	02/09/2020
		DATE COMPLETED	02/09/2020
CLIENT	Galway County Council	**SPT HAMMER REF. NO.**	
ENGINEER	Aecom	**ENERGY RATIO (%)**	
		BORED BY	P.Allan
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		39.93	0.25						
	Stiff grey sandy gravelly SILT		39.08	1.10	AA134329	B	1.00		N = 50/150 mm (25, 25, 30, 20)	
1	Very stiff grey sandy gravelly SILT with occasional cobbles		38.28	1.90						
2	Very stiff grey slightly sandy gravelly SILT with some cobbles				AA134330	B	2.00		N = 29 (4, 6, 6, 8, 7, 8)	
					AA131713	U	2.50	50%rec		
3					AA134331	B	3.00		N = 50/225 mm (10, 10, 15, 15, 20)	
4					AA134332	B	4.00		N = 36 (7, 9, 8, 10, 7, 11)	
			35.28	4.90						
5	Obstruction End of Borehole at 4.90 m								N = 50/75 mm (25, 50)	
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
3.3	3.5	1	
4.2	4.4	0.75	
4.7	4.9	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 1hr Setting up Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out . Tracked dumper needed to move rig.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 22751.GPJ IGSL.GDT 21/10/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**BOREHOLE NO.**	**BH10**
		SHEET	Sheet 1 of 1
CO-ORDINATES	551,785.74 E 743,909.71 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	43.14	**BOREHOLE DEPTH (m)**	1.20
		DATE COMMENCED	03/09/2020
		DATE COMPLETED	03/09/2020
CLIENT	Galway County Council	**SPT HAMMER REF. NO.**	
ENGINEER	Aecom	**ENERGY RATIO (%)**	
		BORED BY	P.Allan
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		42.94	0.20						
	Soft grey/brown sandy SILT/CLAY		42.74	0.40						
	Soft grey/brown sandy gravelly SILT/CLAY with occasional cobbles		42.34	0.80	AA134333	B	0.50			
1	Obstruction								N = 50/75 mm (21, 30, 50)	
	End of Borehole at 1.20 m									
2										
3										
4										
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
1.1	1.2	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 1hr Setting up Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out . Obstruction encountered . Relocated to BH10A and attempted rebore.Tracked dumper needed to move rig.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 22751.GPJ IGSL.GDT 21/10/21

GEOTECHNICAL BORING RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**BOREHOLE NO.**	**BH10A**
		SHEET	Sheet 1 of 1
CO-ORDINATES	551,785.74 E 743,909.71 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	43.14	**BOREHOLE DEPTH (m)**	2.40
		DATE COMMENCED	03/09/2020
		DATE COMPLETED	03/09/2020
CLIENT	Galway County Council	**SPT HAMMER REF. NO.**	
ENGINEER	Aecom	**ENERGY RATIO (%)**	
		BORED BY	P.Allan
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		42.94	0.20						
	Soft grey SILT with traces of peat		42.54	0.60	AA134334	B	0.50			
1	Very stiff grey/brown sandy gravelly SILT/CLAY with occasional cobbles				AA134335	B	1.00		N = 32 (4, 6, 10, 7, 6, 9)	
					Fail	U	1.50			
2					AA134336	B	2.00		N = 50/75 mm (25, 50)	
	Obstruction End of Borehole at 2.40 m		40.74	2.40						
3										
4										
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
1.6	1.6	1	
2.3	2.4	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 1hr Setting up Covid 19 Safe Working Area . CAT scanned location and hand dug inspection pit carried out . Tracked dumper needed to move rig

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 22751.GPJ IGSL.GDT 21/10/21

Appendix 2

Rotary Corehole Records

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**DRILLHOLE NO**	**RC02**
		SHEET	Sheet 1 of 2
CO-ORDINATES	550,976.48 E 743,407.29 N	**DATE DRILLED**	13/10/2020
GROUND LEVEL (mOD)	39.17	**DATE LOGGED**	14/10/2020
RIG TYPE	Knebel		
FLUSH	Air/Mist		
CLIENT	Galway Co.Co.	**INCLINATION (deg)**	-90
ENGINEER	Aecom	**CORE DIAMETER (mm)**	102
		DRILLED BY	IGSL
		LOGGED BY	D.O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								SYMMETRIX DRILLING: No recovery, observed by driller as returns of peaty TOPSOIL	0.40	38.77		
								SYMMETRIX DRILLING: No recovery, observed by driller as returns of grey silty GRAVEL				
1												
2												
3	3.30								3.30	35.87		
								Returns of grey gravelly SILT/CLAY. Gravel is angular to subrounded fine of limestone.				
4		29	0	0								
	5.00								5.00	34.17		
5								SYMMETRIX DRILLING: No recovery, observed by driller as returns of grey silty GRAVEL with cobbles				
6												N = 50/205 mm (8, 17, 17, 23, 10)
7		0	0	0					7.50	31.67		
								Returns of greyish brown silty gravelly CLAY. Gravel is angular to subrounded fine of limestone.				N = 50/165 mm (7, 12, 13, 26, 11)
8	9.00								9.00	30.17		
9								SYMMETRIX DRILLING: No recovery, observed by driller as returns of grey silty sandy GRAVEL with cobbles				N = 50/95 mm (8, 15, 22, 28)

REMARKS

Hole cased 0.00-13.20m. Erect Covid 19 Safe Zone - 1hr.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
0.20		N/S			Slow
12.80		N/S			Slow

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL RC FI 10M 22751.GPJ IGSL.GDT 21/10/21

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**DRILLHOLE NO**	**RC02**
		SHEET	Sheet 2 of 2
CO-ORDINATES	550,976.48 E 743,407.29 N	**DATE DRILLED**	13/10/2020
GROUND LEVEL (mOD)	39.17	**DATE LOGGED**	14/10/2020
RIG TYPE	Knebel		
FLUSH	Air/Mist		
CLIENT	Galway Co.Co.	**INCLINATION (deg)**	-90
ENGINEER	Aecom	**CORE DIAMETER (mm)**	102
		DRILLED BY	IGSL
		LOGGED BY	D.O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10		3	0	0				SYMMETRIX DRILLING: No recovery, observed by driller as returns of grey silty sandy GRAVEL with cobbles *(continued)*	10.50	28.67		N = 50/180 mm (5, 11, 17, 19, 14)
11								SYMMETRIX DRILLING: No recovery, observed by driller as returns of light brown gravelly CLAY				
12	12.00	0	0	0								N = 70/225 mm (14, 11, 24, 26, 20)
13	13.20	100	100	100		650		Strong, thickly to thinly bedded, dark to light blueish grey, fine-grained, LIMESTONE (dolomitised) slightly weathered.	13.20	25.97		
	13.85	100	90	90				Discontinuities are widely to closely spaced, smooth to locally rough, planar to locally curviplanar. Apertures are tight to locally open, locally clay-filled (at 14.16-14.21m), locally dolomite-veined (1-20mm thick). Dips are 45-60°.	14.45	24.72		
14	14.45	0	0	0				No recovery - Driller notes CLAY band				
15	15.35								15.45	23.72		
16		100	88	77				Strong to very strong, thickly to thinly bedded, dark blueish grey, fine-grained, LIMESTONE (local chert layers, stylolites) fresh to locally slightly weathered.				
	16.85							Discontinuities are widely to closely spaced, smooth to locally rough, planar to locally curviplanar. Apertures are tight to locally open, locally clay/gravel-filled (at 15.80-15.97m), locally calcite-veined (1-40mm thick). Dips are 10-20° & subvertical.				
17		100	95	90		670.0000000000002						
18	18.30											
19		100	90	81		509.9999999999998						
	19.70							End of Borehole at 19.70 m	19.70	19.47		

REMARKS

Hole cased 0.00-13.20m. Erect Covid 19 Safe Zone - 1hr.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
0.20		N/S			Slow
12.80		N/S			Slow

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
14-10-20	19.70	13.20	GL	Water level recorded at end of drilling.

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**DRILLHOLE NO**	**RC03**
		SHEET	Sheet 1 of 3
CO-ORDINATES	550,998.52 E 743,480.74 N	**DATE DRILLED**	07/10/2020
GROUND LEVEL (mOD)	38.96	**DATE LOGGED**	12/10/2020
RIG TYPE	Knebel		
FLUSH	Air/Mist		
CLIENT	Galway Co.Co.	**INCLINATION (deg)**	-90
ENGINEER	Aecom	**CORE DIAMETER (mm)**	102
		DRILLED BY	IGSL
		LOGGED BY	D.O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								SYMMETRIX DRILLING: No recovery, observed by driller as returns of PEAT	1.00	37.96		
1	1.50	33	0	0				Returns of greyish brown clayey sandy cobbly GRAVEL. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse of limestone. Cobbles are of limestone.				
2												
3	3.00	36	0	0								
4	4.40								4.40	34.56		
5	5.40	0	0	0				SYMMETRIX DRILLING: No recovery, observed by driller as returns of grey sandy GRAVEL				
6	6.10	0	0	0								
7	7.60	0	0	0								
8		0	0	0								N = 50/150 mm (7, 15, 18, 22, 10)
9	8.90	0	0	0								N = 50/150 mm (7, 12, 20, 25, 5)

REMARKS

Hole cased 0.00-13.00m. Erect Covid 19 Safe Zone - 1hr.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
12-10-20	21.00	3.00	21.00	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL RC FI 10M 22751.GPJ IGSL.GDT 21/10/21

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**DRILLHOLE NO**	**RC03**
		SHEET	Sheet 2 of 3
CO-ORDINATES	550,998.52 E 743,480.74 N	**DATE DRILLED**	07/10/2020
GROUND LEVEL (mOD)	38.96	**DATE LOGGED**	12/10/2020
RIG TYPE	Knebel		
FLUSH	Air/Mist		
CLIENT	Galway Co.Co.	**INCLINATION (deg)**	-90
ENGINEER	Aecom	**CORE DIAMETER (mm)**	102
		DRILLED BY	IGSL
		LOGGED BY	D.O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10	10.40								10.40	28.56		
	11.00	100	0	0				SYMMETRIX DRILLING: No recovery, observed by driller as returns of cobbly BOULDERS	11.00	27.96		N = 50/105 mm (13, 11, 24, 26)
11	12.00	0	0	0				SYMMETRIX DRILLING: No recovery, observed by driller as returns of grey silty COBBLES	12.00	26.96		
12	13.00	0	0	0				SYMMETRIX DRILLING: No recovery, observed by driller as returns of grey silty GRAVEL	12.80	26.16		N = 60/225 mm (5, 11, 36, 14, 10)
13	13.60	100	100	100		619.999999999999		SYMMETRIX DRILLING: No recovery, observed by driller as returns of ROCK Strong to very strong, thickly to thinly bedded, dark blueish grey, fine-grained, LIMESTONE (local chert layers, stylolites) fresh to locally slightly weathered.	13.00	25.96		
14	14.85	100	100	88				Discontinuities are widely to closely spaced, smooth to locally rough, planar to locally curviplanar. Apertures are tight to locally open, locally clay/gravel-filled (at 16.67-16.77m), locally calcite-veined (1-10mm thick). Dips are 10-20° & locally 45°.				
15	16.50	100	95	95		749.999999999998						
16												
17	18.05	100	92	82		559.999999999999 550.000000000001						
18												
19	19.55	100	93	83		870.000000000001						

REMARKS

Hole cased 0.00-13.00m. Erect Covid 19 Safe Zone - 1hr.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
12-10-20	21.00	3.00	21.00	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL RC FI 10M 22751.GPJ IGSL.GDT 21/10/21

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**DRILLHOLE NO**	**RC03**
		SHEET	Sheet 3 of 3
CO-ORDINATES	550,998.52 E 743,480.74 N	**DATE DRILLED**	07/10/2020
GROUND LEVEL (mOD)	38.96	**DATE LOGGED**	12/10/2020
RIG TYPE	Knebel		
FLUSH	Air/Mist		
CLIENT	Galway Co.Co.	**INCLINATION (deg)**	-90
ENGINEER	Aecom	**CORE DIAMETER (mm)**	102
		DRILLED BY	IGSL
		LOGGED BY	D.O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
20		100	99	99		1290						
21	21.10							End of Borehole at 21.10 m	21.10	17.86		
22												
23												
24												
25												
26												
27												
28												
29												

REMARKS

Hole cased 0.00-13.00m. Erect Covid 19 Safe Zone - 1hr.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
12-10-20	21.00	3.00	21.00	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
12-10-20	21.10	13.00	GL	Water level recorded at end of drilling.

IGSL RC FI 10M 22751.GPJ IGSL.GDT 21/10/21

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**DRILLHOLE NO**	**RC04**
		SHEET	Sheet 1 of 2
CO-ORDINATES	551,029.80 E 743,487.73 N	**DATE DRILLED**	15/10/2020
GROUND LEVEL (mOD)	39.10	**DATE LOGGED**	16/10/2020
CLIENT	Galway Co.Co.	**DRILLED BY**	IGSL
ENGINEER	Aecom	**LOGGED BY**	D.O'Shea
RIG TYPE	Knebel		
FLUSH	Air/Mist		
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	78		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								SYMMETRIX DRILLING: No recovery, observed by driller as returns of gravelly SILT/CLAY	0.50	38.60		
								SYMMETRIX DRILLING: No recovery, observed by driller as returns of PEAT	0.70	38.40		
1								SYMMETRIX DRILLING: No recovery, observed by driller as returns of grey silty GRAVEL	2.00	37.10		
2								SYMMETRIX DRILLING: No recovery, observed by driller as returns of grey GRAVEL	3.40	35.70		
3								SYMMETRIX DRILLING: No recovery, observed by driller as returns of grey silty GRAVEL with cobbles and clay bands				
4												
5												
6												N = 50/15 mm (23, 2, 50)
7												
8												N = 50/150 mm (14, 11, 19, 24, 7)
9												N = 50/150 mm (10, 14, 22, 24, 4)

REMARKS

Hole cased 0.00-11.80m. Erect Covid 19 Safe Zone - 1hr.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL RC FI 10M 22751.GPJ IGSL.GDT 21/10/21

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**DRILLHOLE NO**	**RC04**
		SHEET	Sheet 2 of 2
CO-ORDINATES	551,029.80 E 743,487.73 N	**DATE DRILLED**	15/10/2020
GROUND LEVEL (mOD)	39.10	**DATE LOGGED**	16/10/2020
CLIENT	Galway Co.Co.	**DRILLED BY**	IGSL
ENGINEER	Aecom	**LOGGED BY**	D.O'Shea
RIG TYPE	Knebel		
FLUSH	Air/Mist		
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	78		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10								SYMMETRIX DRILLING: No recovery, observed by driller as returns of grey silty GRAVEL with cobbles and clay bands *(continued)*				N = 50/85 mm (25, 37, 13)
11	11.80								11.80	27.30		
12		100	95	65				Strong to very strong, thickly to thinly bedded, dark blueish grey, fine-grained, LIMESTONE (local chert layers, stylolites) fresh to locally slightly weathered. Discontinuities are widely to closely spaced, smooth to locally rough, planar to locally curviplanar. Apertures are tight to locally moderately open, locally clay-smeared, locally calcite-veined (1-4mm thick). Dips are 10-20° & locally subvertical.				
13	13.35											
14		100	94	89		1070						
15	14.75	100	98	98		640.000000000001						
16	16.10					529.999999999999						
17		100	96	94		850.000000000001						
18	17.70	100	98	83		870.000000000001						
19	19.20							End of Borehole at 19.20 m	19.20	19.90		

REMARKS

Hole cased 0.00-11.80m. Erect Covid 19 Safe Zone - 1hr.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

IGSL RC FI 10M 22751.GPJ IGSL.GDT 21/10/21

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**DRILLHOLE NO**	**RC04A**
		SHEET	Sheet 1 of 2
CO-ORDINATES	551,063.17 E 743,513.29 N	**DATE DRILLED**	12/04/2021
GROUND LEVEL (mOD)	39.24	**DATE LOGGED**	14/04/2021
RIG TYPE	Knebel		
FLUSH	Air/Mist		
CLIENT	Galway Co.Co.	**INCLINATION (deg)**	-90
ENGINEER	Aecom	**CORE DIAMETER (mm)**	102
		DRILLED BY	IGSL
		LOGGED BY	D.O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								SYMMETRIX DRILLING: No recovery, observed by driller as returns of PEAT				
	0.80								0.80	38.44		
1		100	0	0				Soft very dark brown slightly sandy PEAT	1.20	38.04		
	1.50							Soft very dark brown peaty sandy SILT. Sand is fine to coarse.	1.40	37.84		
		80	0	0				Medium dense dark grey/brown gravelly SAND. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse of limestone.				
2	2.25											
		93	0	0					2.80	36.44		
	3.00							Very stiff light brown/grey slightly sandy gravelly SILT with cobbles. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse of limestone. Cobbles are of limestone.				
3		100	0	0								
	3.70											
		88	0	0								
4	4.50											
	4.70	100	0	0								
		100	0	0								
5												
	6.00											
6		100	0	0								N = 38 (7, 8, 9, 7, 10, 12)
	6.70											
		100	0	0								
7	7.50											
		100	0	0								N = 56/225 mm (18, 14, 17, 19, 20)
8												
	9.00											
9		100	0	0					10.00	29.24		N = 63 (10, 12, 12, 18, 17, 16)

REMARKS

Hole cased 0.00-0.80m. Erect Covid 19 Safe Zone - 1hr.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL RC FI 10M 22751.GPJ IGSL.GDT 21/10/21

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**DRILLHOLE NO**	**RC04A**
		SHEET	Sheet 2 of 2
CO-ORDINATES	551,063.17 E 743,513.29 N	**DATE DRILLED**	12/04/2021
GROUND LEVEL (mOD)	39.24	**DATE LOGGED**	14/04/2021
CLIENT	Galway Co.Co.	**DRILLED BY**	IGSL
ENGINEER	Aecom	**LOGGED BY**	D.O'Shea
RIG TYPE	Knebel		
FLUSH	Air/Mist		
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	102		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10	10.50							Very stiff light brown/grey slightly sandy gravelly SILT with cobbles. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse of limestone. Cobbles are of limestone.				N = 50/75 mm (18, 27, 50)
11	11.80	100	0	0					11.80	27.44		
12		100	99	99				Strong to very strong, thickly to thinly bedded, dark blueish grey, fine-grained, LIMESTONE (local chert layers, stylolites) fresh to locally slightly weathered. Discontinuities are widely to closely spaced, smooth to locally rough, planar to locally curviplanar. Apertures are tight to locally open, locally clay-filled (at 12.88-12.92m, 13.76-13.87m & 14.51-14.54m) locally calcite-veined (1-10mm thick). Dips are 10-20°				N = 50/25 mm (50, 50)
13	13.35											
14		100	100	96		510						
15	14.85	100	95	95		1140						
16	16.40											
17	17.15	100	100	100		600.000000000001			17.15	22.09		
18								End of Borehole at 17.15 m				
19												

REMARKS

Hole cased 0.00-0.80m. Erect Covid 19 Safe Zone - 1hr.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
14-04-21	17.15	0.80	1.20	Water level recorded at end of drilling.

IGSL RC FI 10M 22751.GPJ IGSL.GDT 21/10/21

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**DRILLHOLE NO**	**RC05**
		SHEET	Sheet 1 of 2
CO-ORDINATES	551,042.84 E 743,531.61 N	**DATE DRILLED**	19/10/2020
GROUND LEVEL (mOD)	38.63	**DATE LOGGED**	22/10/2020
RIG TYPE	Knebel		
FLUSH	Air/Mist		
CLIENT	Galway Co.Co.	**INCLINATION (deg)**	-90
ENGINEER	Aecom	**CORE DIAMETER (mm)**	102
		DRILLED BY	IGSL
		LOGGED BY	D.O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0	0.50							SYMMETRIX DRILLING: No recovery, observed by driller as returns of PEAT	0.50	38.13		
1		100	0	0				Soft very dark brown slightly sandy PEAT	1.40	37.23		
	2.00							Soft light grey sandy gravelly SILT. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse of limestone.	2.00	36.63		
2		100	0	0				Firm to stiff light brown slightly sandy gravelly SILT with cobbles. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse of limestone. Cobbles are of limestone.				
3	3.00	100	0	0								
4	4.50	100	0	0								
5	5.20	100	0	0								
6	6.00	100	0	0								N = 50/75 mm (15, 10, 31, 19)
7	7.50	100	0	0								N = 50/10 mm (22, 3, 50)
8		100	0	0								
9	9.00	100	0	0								N = 50/0 mm (25, 50)

REMARKS

Hole cased 0.00-12.00m. Erect Covid 19 Safe Zone - 1hr.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
22-10-20	17.35	2.00	17.35	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL RC FI 10M 22751.GPJ IGSL.GDT 21/10/21

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**DRILLHOLE NO**	**RC05**
		SHEET	Sheet 2 of 2
CO-ORDINATES	551,042.84 E 743,531.61 N	**DATE DRILLED**	19/10/2020
GROUND LEVEL (mOD)	38.63	**DATE LOGGED**	22/10/2020
RIG TYPE	Knebel		
FLUSH	Air/Mist		
CLIENT	Galway Co.Co.	**INCLINATION (deg)**	-90
ENGINEER	Aecom	**CORE DIAMETER (mm)**	102
		DRILLED BY	IGSL
		LOGGED BY	D.O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10	10.50							Firm to stiff light brown slightly sandy gravelly SILT with cobbles. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse of limestone. Cobbles are of limestone. *(continued)*	10.85	27.78		N = 50/15 mm (25, 50)
11		100	77	77				Strong to very strong, thickly to thinly bedded, dark blueish grey, fine-grained, LIMESTONE (local chert layers, stylolites) fresh to locally slightly weathered. Discontinuities are widely to closely spaced, smooth to locally rough, planar to locally curviplanar. Apertures are tight to locally moderately open, locally clay-smeared, locally calcite-veined (1-3mm thick). Dips are 10-20°.				
12	12.00 12.40	100	100	100		940						
13		100	100	96		520						
14	13.80 14.50	100	100	100								
15		100	100	100		680.0000000000001						
16	16.10	100	100	100		850.0000000000001						
17	17.35							End of Borehole at 17.35 m	17.35	21.28		
18												
19												

REMARKS

Hole cased 0.00-12.00m. Erect Covid 19 Safe Zone - 1hr.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
22-10-20	17.35	2.00	17.35	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
22-10-20	17.35	12.00	GL	Water level recorded at end of drilling.

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GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**DRILLHOLE NO**	**RC06**
		SHEET	Sheet 1 of 2
CO-ORDINATES	551,072.28 E 743,546.31 N	**DATE DRILLED**	22/10/2020
GROUND LEVEL (mOD)	38.68	**DATE LOGGED**	27/10/2020
RIG TYPE	Knebel		
FLUSH	Air/Mist		
CLIENT	Galway Co.Co.	**INCLINATION (deg)**	-90
ENGINEER	Aecom	**CORE DIAMETER (mm)**	102
		DRILLED BY	IGSL
		LOGGED BY	D.O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0	0.30							SYMMETRIX DRILLING: No recovery, observed by driller as returns of PEAT	0.30	38.38		
		100	0	0				Soft very dark brown slightly sandy PEAT	1.30	37.38		
1	1.50							Firm light brown slightly sandy gravelly CLAY/SILT with cobbles. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse of limestone. Cobbles are of limestone.				
2		100	0	0								
	3.00											
3		100	0	0								
4	4.50								4.60	34.08		
		100	0	0				Stiff light brown slightly sandy gravelly CLAY with cobbles. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse of limestone. Cobbles are of limestone.				
5	6.00											
		100	0	0								N = 50/15 mm (18, 7, 50)
6	7.50											
		100	0	0								N = 50/0 mm (25, 50)
7												
	9.00											
8		100	0	0								N = 50/15 mm (19, 50)
9		100	52	52					9.70	28.98		

REMARKS

Hole cased 0.00-13.50m. Erect Covid 19 Safe Zone - 1hr.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
27-10-20	12.50	2.00	12.50	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL RC FI 10M 22751.GPJ IGSL.GDT 21/10/21

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**DRILLHOLE NO**	**RC06**
		SHEET	Sheet 2 of 2
CO-ORDINATES	551,072.28 E 743,546.31 N	**DATE DRILLED**	22/10/2020
GROUND LEVEL (mOD)	38.68	**DATE LOGGED**	27/10/2020
RIG TYPE	Knebel		
FLUSH	Air/Mist		
CLIENT	Galway Co.Co.	**INCLINATION (deg)**	-90
ENGINEER	Aecom	**CORE DIAMETER (mm)**	102
		DRILLED BY	IGSL
		LOGGED BY	D.O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10	10.50					800.000000000001		Strong to very strong, thickly to thinly bedded, dark blueish grey, fine-grained, LIMESTONE (local chert layers, stylolites) fresh to locally slightly weathered. Discontinuities are widely to closely spaced, smooth to locally rough, planar to locally curviplanar. Apertures are tight to locally open, locally clay/gravel-filled (at 10.82-10.89m), locally calcite-veined (1-5mm thick). Dips are 10-20° & locally 30°. *(continued)*				
11	12.00	100	100	97								
12		100	92	92		570						
13	13.50											
14	14.10	100	100	90								
15	15.60	100	95	91		529.999999999999			15.60	23.08		
16								End of Borehole at 15.60 m				
17												
18												
19												

REMARKS

Hole cased 0.00-13.50m. Erect Covid 19 Safe Zone - 1hr.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
27-10-20	12.50	2.00	12.50	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
27-10-20	15.60	13.50	GL	Water level recorded at end of drilling.

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GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**DRILLHOLE NO**	**RC07**
		SHEET	Sheet 1 of 2
CO-ORDINATES	551,088.72 E 743,607.38 N	**DATE DRILLED**	28/10/2020
GROUND LEVEL (mOD)	40.02	**DATE LOGGED**	30/10/2020
CLIENT	Galway Co.Co.	**DRILLED BY**	IGSL
ENGINEER	Aecom	**LOGGED BY**	D.O'Shea
RIG TYPE	Knebel		
FLUSH	Air/Mist		
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	102		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0	0.70							SYMMETRIX DRILLING: No recovery, observed by driller as returns of PEAT	0.70	39.32		
1	1.40	100	0	0				Loss of recovery - Returns of light brown slightly sandy gravelly CLAY/SILT with occasional cobbles. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse of limestone. Cobbles are of limestone.				
2	2.00	100	0	0					2.30	37.72		
	3.00	100	0	0				Returns of light brown clayey slightly sandy GRAVEL with occasional cobbles. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse of limestone. Cobbles are of limestone.	2.80	37.22		
3								Firm light brown slightly sandy gravelly CLAY/SILT with cobbles. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse of limestone. Cobbles are of limestone.				
4	4.50	100	0	0								
5		100	0	0					5.50	34.52		
6	6.00							Stiff light brown slightly sandy gravelly CLAY/SILT with cobbles. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse of limestone. Cobbles are of limestone.				N = 50/25 mm (19, 6, 50)
7	7.50	100	0	0					7.50	32.52		
8		0	0	0				SYMMETRIX DRILLING: No recovery, observed by driller as returns of sandy gravelly CLAY				N = 50/20 mm (25, 50)
9									9.40	30.62		N = 50/10 mm (25, 50)
	10.00							SYMMETRIX DRILLING: No recovery, observed by driller as returns of probable ROCK	10.00	30.02		

REMARKS

Hole cased 0.00-10.00m. Erect Covid 19 Safe Zone - 1hr.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
8.00		N/S			Slow

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

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GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**DRILLHOLE NO**	**RC07**
		SHEET	Sheet 2 of 2
CO-ORDINATES	551,088.72 E 743,607.38 N	**DATE DRILLED**	28/10/2020
GROUND LEVEL (mOD)	40.02	**DATE LOGGED**	30/10/2020
CLIENT	Galway Co.Co.	**DRILLED BY**	IGSL
ENGINEER	Aecom	**LOGGED BY**	D.O'Shea
RIG TYPE	Knebel		
FLUSH	Air/Mist		
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	102		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10	10.40	100	58	0				Strong to very strong, thickly to thinly bedded, dark blueish grey, fine-grained, LIMESTONE (local chert layers, stylolites) fresh to locally slightly weathered. Discontinuities are widely to closely spaced, smooth to locally rough, planar to locally curviplanar. Apertures are tight to locally open, locally clay-smeared, locally calcite-veined (1-3mm thick). Dips are 10-20° & locally 50°.				
11	11.95	100	94	94								
12		100	99	99		990						
13	13.45					899.9999999999999						
14		100	87	81		859.9999999999999						
15	15.00	100	97	97		1020						
16	16.50								16.50	23.52		
								End of Borehole at 16.50 m				
17												
18												
19												

REMARKS

Hole cased 0.00-10.00m. Erect Covid 19 Safe Zone - 1hr.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
8.00		N/S			Slow

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
30-10-20	16.50	10.00	5.70	Water level recorded at end of drilling.

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

IGSL RC FI 10M 22751.GPJ IGSL.GDT 21/10/21

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**DRILLHOLE NO**	**RC08**
		SHEET	Sheet 1 of 2
CO-ORDINATES	551,785.74 E 743,909.71 N	**DATE DRILLED**	03/11/2020
GROUND LEVEL (mOD)	43.14	**DATE LOGGED**	03/11/2020
CLIENT	Galway Co.Co.	**DRILLED BY**	IGSL
ENGINEER	Aecom	**LOGGED BY**	D.O'Shea
RIG TYPE	Knebel		
FLUSH	Air/Mist		
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	102		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								SYMMETRIX DRILLING: No recovery, observed by driller as returns of peaty TOPSOIL	0.40	42.74		
1	1.50	0	0	0				SYMMETRIX DRILLING: No recovery, observed by driller as returns of CLAY				
2		0	0	0					2.50	40.64		
3	3.00	0	0	0				SYMMETRIX DRILLING: No recovery, observed by driller as returns of grey/brown sandy gravelly CLAY with occasional cobbles.				
4	4.50	0	0	0								N = 65/140 mm (14, 11, 15, 50)
5		0	0	0								
6	6.00	0	0	0								N = 50/45 mm (18, 7, 50)
7	7.50	0	0	0								N = 50/15 mm (16, 9, 50)
8		0	0	0								
9	9.00	0	0	0								N = 50/20 mm (25, 50)

REMARKS

Hole cased 0.00-12.00m. Erect Covid 19 Safe Zone - 1hr.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
1.30		N/S			Slow
8.50		N/S			Slow

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
03-11-20	12.00	1.50	12.00	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL RC FI 10M 22751.GPJ IGSL.GDT 21/10/21

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**DRILLHOLE NO**	**RC08**
		SHEET	Sheet 2 of 2
CO-ORDINATES	551,785.74 E 743,909.71 N	**DATE DRILLED**	03/11/2020
GROUND LEVEL (mOD)	43.14	**DATE LOGGED**	03/11/2020
RIG TYPE	Knebel		
FLUSH	Air/Mist		
CLIENT	Galway Co.Co.	**INCLINATION (deg)**	-90
ENGINEER	Aecom	**CORE DIAMETER (mm)**	102
		DRILLED BY	IGSL
		LOGGED BY	D.O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10	10.50							SYMMETRIX DRILLING: No recovery, observed by driller as returns of grey/brown sandy gravelly CLAY with occasional cobbles. *(continued)*				N = 50/0 mm (25, 50)
11		0	0	0								
12	12.00							End of Borehole at 12.00 m	12.00	31.14		N = 50/45 mm (23, 3, 50)
13												
14												
15												
16												
17												
18												
19												

REMARKS

Hole cased 0.00-12.00m. Erect Covid 19 Safe Zone - 1hr.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
1.30		N/S			Slow
8.50		N/S			Slow

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
03-11-20	12.00	1.50	12.00	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

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GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**DRILLHOLE NO**	**RC10**
		SHEET	Sheet 1 of 2
CO-ORDINATES	551,785.74 E 743,909.71 N	**DATE DRILLED**	03/11/2020
GROUND LEVEL (mOD)	43.14	**DATE LOGGED**	03/11/2020
RIG TYPE	Knebel		
FLUSH	Air/Mist		
CLIENT	Galway Co.Co.	**INCLINATION (deg)**	-90
ENGINEER	Aecom	**CORE DIAMETER (mm)**	102
		DRILLED BY	IGSL
		LOGGED BY	D.O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								SYMMETRIX DRILLING: No recovery, observed by driller as returns of peaty TOPSOIL	0.40	42.74		
		0	0	0				SYMMETRIX DRILLING: No recovery, observed by driller as returns of CLAY/SILT				
1	1.50											
		0	0	0					2.50	40.64		
2								SYMMETRIX DRILLING: No recovery, observed by driller as returns of grey/brown sandy gravelly CLAY/SILT with occasional cobbles.				
	3.00											
3		0	0	0								
	4.50											N = 65/140 mm (14, 11, 15, 50)
4		0	0	0								
	6.00											N = 50/45 mm (18, 7, 50)
5		0	0	0								
	7.50											N = 50/15 mm (16, 9, 50)
6		0	0	0								
	9.00											N = 50/20 mm (25, 50)
7		0	0	0								
8												
9												

REMARKS

Hole cased 0.00-12.00m. Erect Covid 19 Safe Zone - 1hr.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
1.30		N/S			Slow
8.50		N/S			Slow

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
03-11-20	12.00	1.50	12.00	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL RC FI 10M 22751.GPJ IGSL.GDT 21/10/21

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**DRILLHOLE NO**	**RC10**
		SHEET	Sheet 2 of 2
CO-ORDINATES	551,785.74 E 743,909.71 N	**DATE DRILLED**	03/11/2020
GROUND LEVEL (mOD)	43.14	**DATE LOGGED**	03/11/2020
CLIENT	Galway Co.Co.	**DRILLED BY**	IGSL
ENGINEER	Aecom	**LOGGED BY**	D.O'Shea
RIG TYPE	Knebel		
FLUSH	Air/Mist		
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	102		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10	10.50							SYMMETRIX DRILLING: No recovery, observed by driller as returns of grey/brown sandy gravelly CLAY/SILT with occasional cobbles. *(continued)*				N = 50/0 mm (25, 50)
11		0	0	0								
12	12.00							End of Borehole at 12.00 m	12.00	31.14		N = 50/45 mm (23, 3, 50)
13												
14												
15												
16												
17												
18												
19												

REMARKS

Hole cased 0.00-12.00m. Erect Covid 19 Safe Zone - 1hr.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
1.30		N/S			Slow
8.50		N/S			Slow

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
03-11-20	12.00	1.50	12.00	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL RC FI 10M 22751.GPJ IGSL.GDT 21/10/21

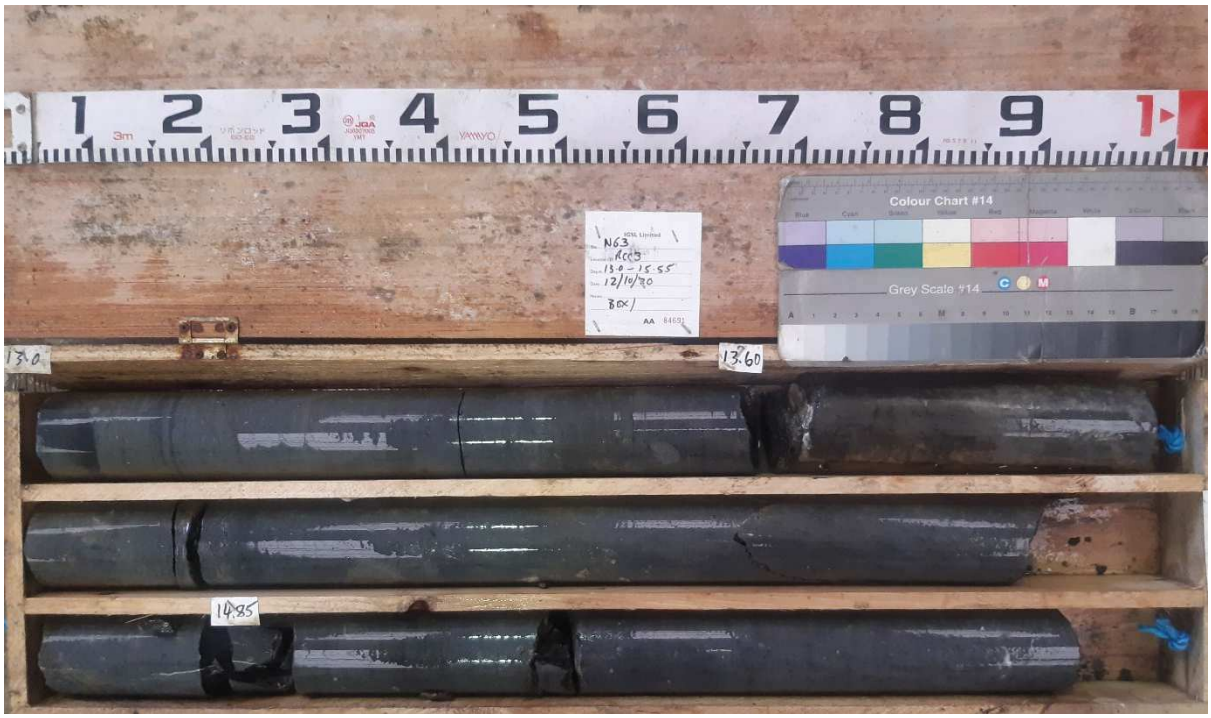
RC02 – Box 1 of 3 – 13.20-14.45m

RC02 – Box 2 of 3 – 15.35-16.85m

RC02 – Box 3 of 3 – 16.85-19.10m

RC03 – Box 1 of 4 – 1.00-11.00m

RC03 – Box 2 of 4 – 13.00-15.55m



RC03 – Box 3 of 4 – 15.55-18.40m

RC03 – Box 4 of 4 – 18.40-21.10m

RC04 – Box 1 of 5 – 11.80-13.50m

RC04 – Box 2 of 5 – 13.50-15.15m

RC04 – Box 3 of 5 – 15.15-17.10m

RC04 – Box 4 of 5 – 17.10-18.85m

RC04 – Box 5 of 5 – 18.85-19.20m

RC04A – Box 1 of 11 – 0.80-2.25m

RC04A – Box 2 of 11 – 2.25-3.70m

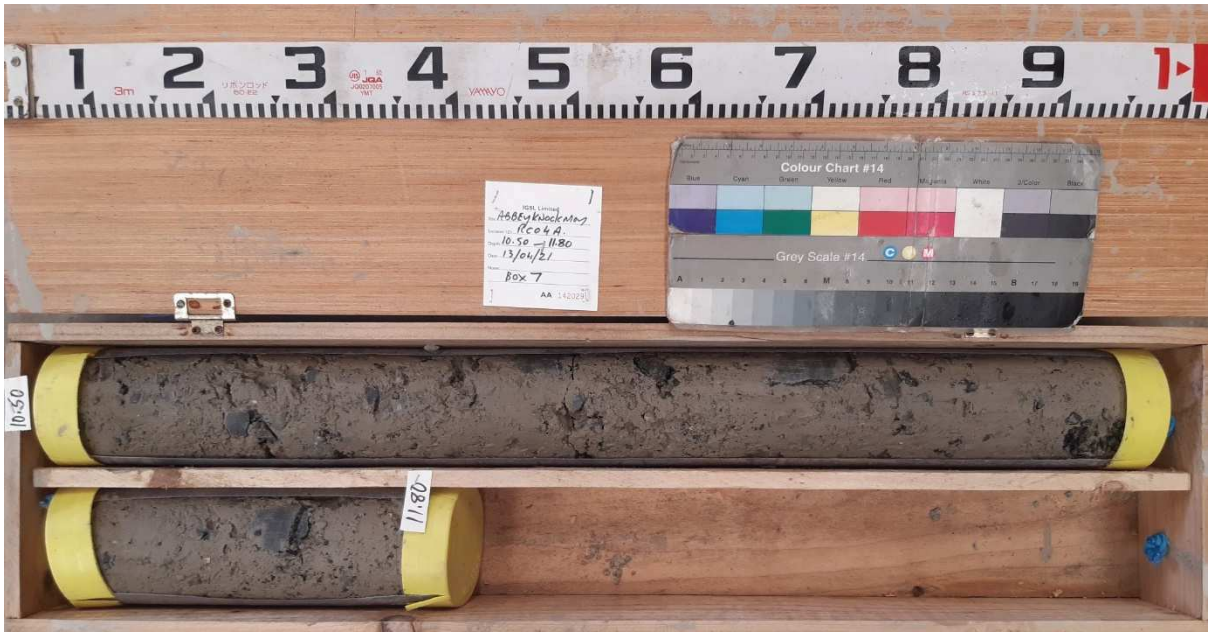
RC04A – Box 3 of 11 – 3.70-5.70m

RC04A – Box 4 of 11 – 5.70-7.30m

RC04A – Box 5 of 11 – 7.30-9.00m

RC04A – Box 6 of 11 – 9.00-10.50m

RC04A – Box 7 of 11 – 10.50-11.80m



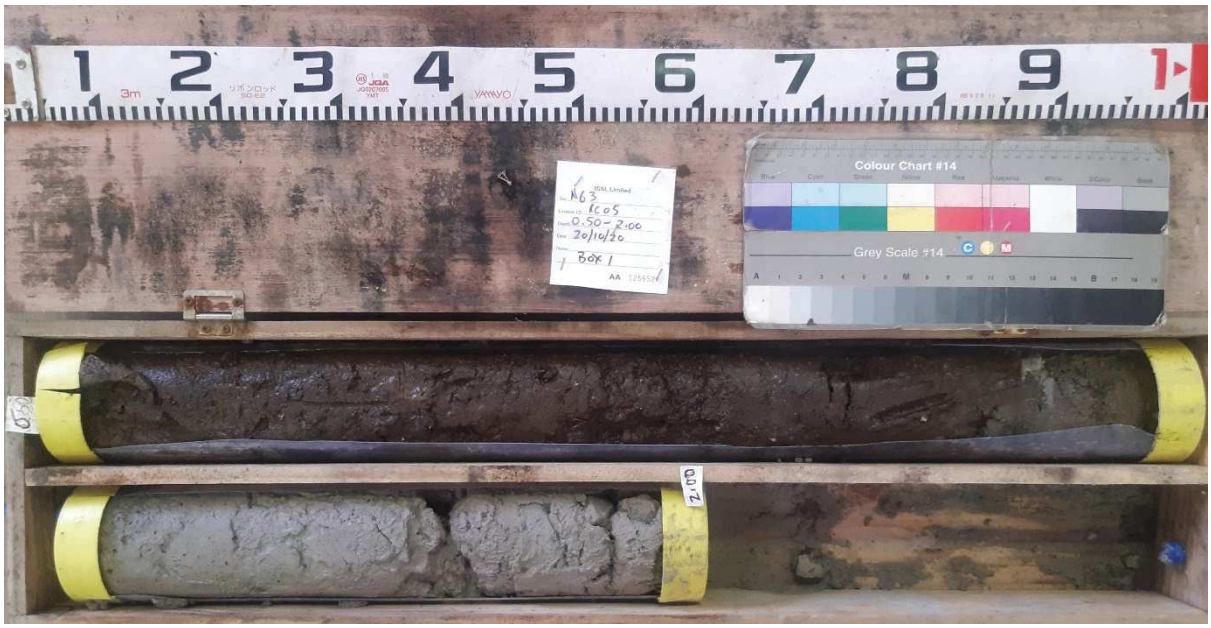
RC04A – Box 8 of 11 – 11.80-13.35m

RC04A – Box 9 of 11 – 13.35-14.85m

RC04A – Box 10 of 11 – 14.85-16.40m

RC04A – Box 11 of 11 – 16.40-17.15m

RC05 – Box 1 of 10 – 0.50-2.00m



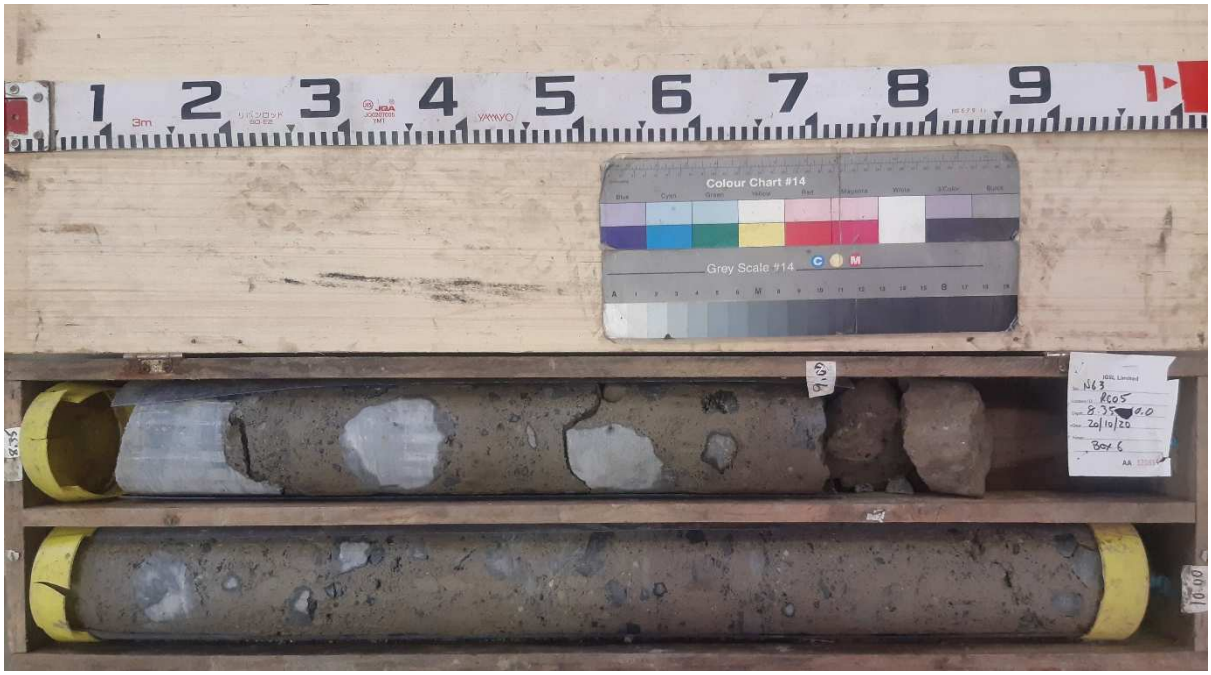
RC05 – Box 2 of 10 – 2.00-4.00m

RC05 – Box 3 of 10 – 4.00-5.20m

RC05 – Box 4 of 10 – 5.20-7.00m

RC05 – Box 5 of 10 – 7.00-8.35m

RC05 – Box 6 of 10 – 8.35-10.00m



RC05 – Box 7 of 10 – 10.00-11.20m

RC05 – Box 8 of 10 – 11.20-12.90m

RC05 – Box 9 of 10 – 12.90-14.50m

RC05 – Box 10 of 10 – 14.50-17.35m

RC06 – Box 1 of 10 – 0.30-1.50m

RC06 – Box 2 of 10 – 1.50-3.00m

RC06 – Box 3 of 10 – 3.00-4.50m

RC06 – Box 4 of 10 – 4.50-6.00m

RC06 – Box 5 of 10 – 6.00-7.50m

RC06 – Box 6 of 10 – 7.50-9.00m

RC06 – Box 7 of 10 – 9.00-10.50m

RC06 – Box 8 of 10 – 10.50-12.00m

RC06 – Box 9 of 10 – 12.00-13.50m

RC06 – Box 10 of 10 – 13.50-15.60m

RC07 – Box 1 of 7 – 0.70-2.00m

RC07 – Box 2 of 7 – 2.00-4.00m

RC07 – Box 3 of 7 – 4.00-5.50m

RC07 – Box 4 of 7 – 5.50-7.00m

RC07 – Box 5 of 7 – 7.00-11.40m

RC07 – Box 6 of 7 – 11.40-14.00m

RC07 – Box 7 of 7 – 14.00-16.50m

Appendix 3

Trial Pit Records

TRIAL PIT RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**TRIAL PIT NO.**	**TP01**
		SHEET	Sheet 1 of 1
LOGGED BY	S.Hannon	**CO-ORDINATES**	550,504.45 E 743,245.86 N
		DATE STARTED	04/09/2020
		DATE COMPLETED	04/09/2020
CLIENT	Galway County Council	**GROUND LEVEL (m)**	42.00
ENGINEER	Aecom	**EXCAVATION METHOD**	Tracked Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL		0.30	41.70						
Light grey silty very gravelly SAND with low cobble content and low boulder content. Gravels cobbles and boulders are rounded to sub rounded.					AA140571	B	0.70		
1.0									
Light grey very silty very gravelly SAND with low cobble content and low boulder content. Gravels cobbles and boulders are rounded to sub rounded.		1.50	40.50						
2.0					AA140572	B	2.00		
3.0 End of Trial Pit at 3.00m		3.00	39.00						

Groundwater Conditions
Dry

Stability
Unstable

General Remarks
Cat Scanned location for services.

TRIAL PIT RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**TRIAL PIT NO.**	**TP02**
		SHEET	Sheet 1 of 1
LOGGED BY	S.Hannon	**CO-ORDINATES**	550,626.91 E 743,285.59 N
		DATE STARTED	04/09/2020
		DATE COMPLETED	04/09/2020
CLIENT	Galway County Council	**GROUND LEVEL (m)**	40.28
ENGINEER	Aecom	**EXCAVATION METHOD**	Tracked Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL		0.30	39.98						
Light grey slightly clayey/silty gravelly SAND with a medium cobble content and low boulder content. Cobbles and boulders are rounded to subrounded. Slow progress with many cobbles and boulders.					AA140569	B	0.50		
1.0									
Light grey clayey/silty gravelly SAND with a medium cobble content and low boulder content. Cobbles and boulders are rounded to subrounded.		1.50	38.78		AA140570	B	1.50		
2.0									
3.0 End of Trial Pit at 3.00m		3.00	37.28						

Groundwater Conditions
Dry

Stability
Unstable

General Remarks
Cat Scanned location for services.

IGSL TP LOG 22751.GPJ IGSL.GDT 21/10/21

TRIAL PIT RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**TRIAL PIT NO.**	**TP03**
		SHEET	Sheet 1 of 1
LOGGED BY	S.Hannon	**CO-ORDINATES**	550,765.57 E 743,293.77 N
		DATE STARTED	04/09/2020
		DATE COMPLETED	04/09/2020
CLIENT	Galway County Council	**GROUND LEVEL (m)**	40.72
ENGINEER	Aecom	**EXCAVATION METHOD**	Tracked Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL									
		0.30	40.42						
Light grey clayey/silty very sandy GRAVEL with a low cobble and boulder content. Gravels, cobbles and boulders are rounded to subrounded.					AA140567	B	0.70		
1.0									
		1.40	39.32						
Light grey very silty gravelly SAND to sandy gravelly SILT with a low cobble content and boulder content. Gravels, cobbles and boulders are rounded to subrounded.									
2.0					AA140568	B	2.20		
		3.00	37.72						
3.0 End of Trial Pit at 3.00m									

Groundwater Conditions
Dry

Stability
Unstable

General Remarks
Cat Scanned location for services.

TRIAL PIT RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**TRIAL PIT NO.**	**TP04**
		SHEET	Sheet 1 of 1
LOGGED BY	S.Hannon	**CO-ORDINATES**	551,474.56 E 743,844.55 N
		DATE STARTED	02/09/2020
		DATE COMPLETED	02/09/2020
CLIENT	Galway County Council	**GROUND LEVEL (m)**	42.12
ENGINEER	Aecom	**EXCAVATION METHOD**	Tracked Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL		0.15	41.97						
Greyish brown slightly clayey/silty gravelly SAND with a medium cobble and low boulder content. Cobbles and boulders are rounded to subrounded.					AA140555	B	0.50		
1.0									
		1.60	40.52		AA140556	B	1.50		
Greyish brown clayey/silty gravelly SAND with a medium cobble and low boulder content. Cobbles and boulders are rounded to subrounded. Recovered wet.									
2.0									
		2.50	39.62						
End of Trial Pit at 2.50m					AA140557	B	2.50		
3.0									

Groundwater Conditions
Fast water at 1.5 m

Stability
Unstable - poor below 1.60m

General Remarks
Cat Scanned location for services.

TRIAL PIT RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**TRIAL PIT NO.**	**TP05**
		SHEET	Sheet 1 of 1
LOGGED BY	S.Hannon	**CO-ORDINATES**	551,633.94 E 743,859.06 N
		DATE STARTED	02/09/2020
		DATE COMPLETED	02/09/2020
CLIENT	Galway County Council	**GROUND LEVEL (m)**	42.43
ENGINEER	Aecom	**EXCAVATION METHOD**	Tracked Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL		0.15	42.28						
Light grey brown clayey/silty very sandy GRAVEL with a medium cobble and low boulder content. Cobbles and boulders are rounded to subrounded.					AA140558	B	0.50		
1.0 Light grey brown clayey/silty gravelly SAND to very sandy SILT/CLAY with a medium cobble and low boulder content. Cobbles and boulders are rounded to subrounded.		1.20	41.23		AA140559	B	1.50		
3.0 End of Trial Pit at 3.00m		3.00	39.43						

Groundwater Conditions
Moderate flow at 1.5 m

Stability
Unstable

General Remarks
Cat Scanned location for services.

TRIAL PIT RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**TRIAL PIT NO.**	**TP06**
		SHEET	Sheet 1 of 1
LOGGED BY	S.Hannon	**CO-ORDINATES**	551,903.34 E 743,968.61 N
		DATE STARTED	04/09/2020
		DATE COMPLETED	04/09/2020
CLIENT	Galway County Council	**GROUND LEVEL (m)**	42.84
ENGINEER	Aecom	**EXCAVATION METHOD**	Tracked Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL		0.20	42.64						
Light grey silty very sandy GRAVEL with a medium cobble and low boulder content. Cobbles and boulders are rounded to subrounded. Slow progress due to numerous cobbles and boulders.					AA140563	B	0.50		
1.0									
Light grey clayey/silty gravelly SAND with a medium cobble and low boulder content. Cobbles and boulders are rounded to sub rounded. Slow progress due to cobbles and boulders.		1.40	41.44		AA140564	B	1.50		
2.0									
End of Trial Pit at 2.50m		2.50	40.34						
3.0									

Groundwater Conditions
Dry

Stability
Unstable

General Remarks
Cat Scanned location for services.

TRIAL PIT RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**TRIAL PIT NO.**	**TP07**
		SHEET	Sheet 1 of 1
LOGGED BY	S.Hannon	**CO-ORDINATES**	552,061.52 E 744,020.27 N
		DATE STARTED	04/09/2020
		DATE COMPLETED	04/09/2020
CLIENT	Galway County Council	**GROUND LEVEL (m)**	44.15
ENGINEER	Aecom	**EXCAVATION METHOD**	Tracked Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL		0.30	43.85						
Light grey clayey/silty gravelly SAND with a medium cobble and low boulder content. Cobbles and boulders are rounded to subrounded.					AA140565	B	0.60		
1.0 Light grey very silty very gravelly SAND with a medium cobble and low boulder content. Cobbles and boulders are rounded to subrounded to rounded. Slow progress due to numerous cobbles and boulders.		1.20	42.95		AA140566	B	1.60		
2.0 2.50m - Large boulder (up to 1.20m)									
3.0 End of Trial Pit at 3.00m		3.00	41.15						

Groundwater Conditions
Dry

Stability
Unstable

General Remarks
Cat Scanned location for services.

IGSL TP LOG 22751.GPJ IGSL.GDT 21/10/21

TRIAL PIT RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**TRIAL PIT NO.**	**TP08**
		SHEET	Sheet 1 of 1
LOGGED BY	S.Hannon	**CO-ORDINATES**	552,235.48 E 744,017.70 N
		DATE STARTED	02/09/2020
		DATE COMPLETED	02/09/2020
CLIENT	Galway County Council	**GROUND LEVEL (m)**	41.97
ENGINEER	Aecom	**EXCAVATION METHOD**	Tracked Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL		0.10	41.87						
Light grey mottled light brown very sandy GRAVEL with a high cobble and low boulder content. Gravel, cobbles and boulders are rounded to subrounded.					AA140551	B	0.50		
1.0		1.20	40.77						
Greyish brown very sandy GRAVEL with a high cobble and low boulder content. Gravel, cobbles and boulders are rounded to subrounded. Recovered wet.					AA140552	B	1.50		
2.0									
End of Trial Pit at 2.40m		2.40	39.57						
3.0									

Groundwater Conditions
Fast water at 1.5 m

Stability
Unstable - Poor stability with continual sidewall collapse

General Remarks
Cat Scanned location for services.

TRIAL PIT RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**TRIAL PIT NO.**	**TP09**
		SHEET	Sheet 1 of 1
LOGGED BY	S.Hannon	**CO-ORDINATES**	552,360.95 E 744,119.23 N
		DATE STARTED	02/09/2020
		DATE COMPLETED	02/09/2020
CLIENT	Galway County Council	**GROUND LEVEL (m)**	43.39
ENGINEER	Aecom	**EXCAVATION METHOD**	Tracked Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL		0.20	43.19						
Soft dark brown sandy slightly gravelly SILT/CLAY. Gravels are subangular to subrounded.		0.40	42.99						
Firm light grey sandy very gravelly CLAY/SILT to clayey/silty sandy GRAVEL with a medium cobble content. Recovered wet.					AA140553	B	0.50		
1.0									
					AA140554	B	1.50		
2.0 End of Trial Pit at 2.00m		2.00	41.39						
3.0									

Groundwater Conditions
Fast water at 1.5 m

Stability
Unstable

General Remarks
Cat Scanned location for services.

TRIAL PIT RECORD

REPORT NUMBER 22751

CONTRACT	N63 - Liss to Abbey Realignment	**TRIAL PIT NO.**	**TP10**
		SHEET	Sheet 1 of 1
LOGGED BY	S.Hannon	**CO-ORDINATES**	551,322.65 E 743,473.86 N
		DATE STARTED	04/09/2020
		DATE COMPLETED	04/09/2020
CLIENT	Galway County Council	**GROUND LEVEL (m)**	43.71
ENGINEER	Aecom	**EXCAVATION METHOD**	Tracked Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL		0.20	43.51						
Light grey brown slightly silty very sandy GRAVEL with a medium cobble and low boulder content. Cobbles and boulders are rounded to subrounded.					AA140560	B	0.50		
1.0									
Light grey brown clayey/silty gravelly SAND with a low cobble and boulder content. Cobbles and boulders are rounded to subrounded.		1.50	42.21		AA140561	B	1.50		
2.0									
					AA140562	B	2.50		
3.0 End of Trial Pit at 3.00m		3.00	40.71						

Groundwater Conditions
Moderate flow at 1.5 m

Stability
Unstable

General Remarks
Cat Scanned location for services.

Appendix 4

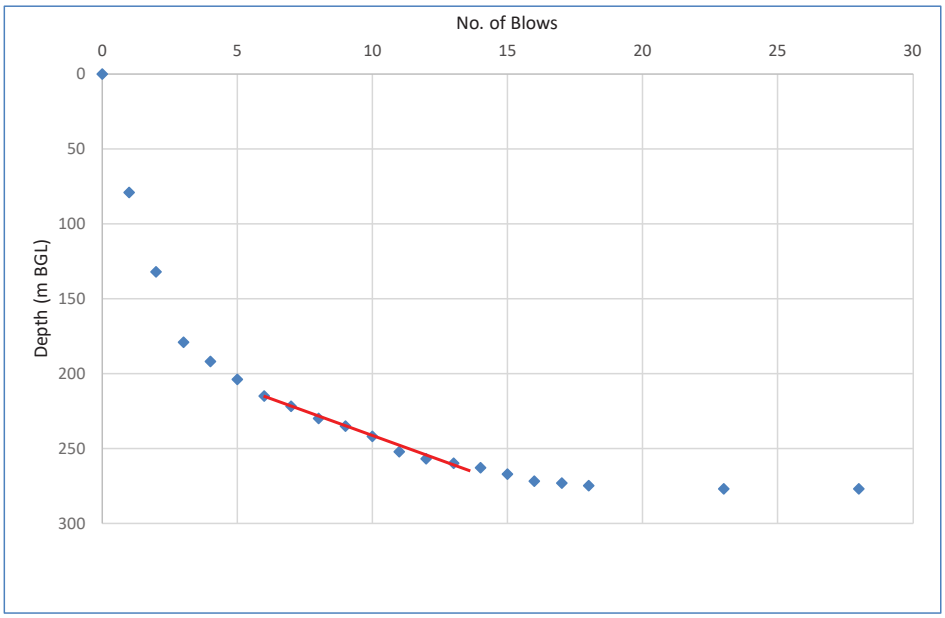
Dynamic Cone Penetrometer Records

Dynamic Cone Penetrometer

Contract	N63 Abbey to Liss	**Date:**	**Test No.** 1
Ref No.	22751		
Client	Galway Co Co		
Engineer	Aecom	**DCP Zero Reading**	58 mm
Location	Adjacent to TP01		
		Start of Test at:	0 m BGL
		Approximate Chainage	

Soil Description
TOPSOIL over gravelly SAND

No of Blows	*Total Blows*	*Reading mm*	*No of Blows*	*Total Blows*	*Reading mm*	*No of Blows*	*Total Blows*	*Reading mm*
0	0	58						
1	1	137						
1	2	190						
1	3	237						
1	4	250						
1	5	262						
1	6	273						
1	7	280						
1	8	288						
1	9	293						
1	10	300						
1	11	310						
1	12	315						
1	13	318						
1	14	321						
1	15	325						
1	16	330						
1	17	331						
1	18	333						
5	23	335						
5	28	335						



	From	to	Penetration	mm / blow
Depth range (mm)	215	263	48	6.00
Blows	6	14	8	

TRRL RN8: Log10 (CBR) = 2.48-1.057*Log10 (mm/blow)

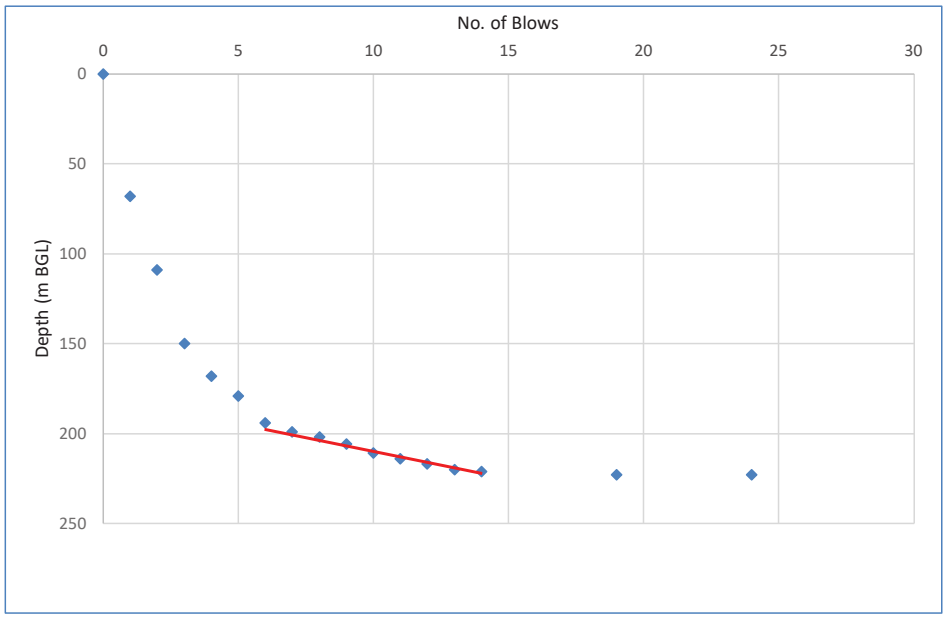
Log10(CBR) = 1.657

CBR = 45.446

Dynamic Cone Penetrometer

Contract	N63 Abbey to Liss	**Date:**	**Test No.** 2
Ref No.	22751		
Client	Galway Co Co	**DCP Zero Reading**	72 mm
Engineer	Aecom		
Location	Adjacent to TP02	**Start of Test at:**	0 m BGL
		Approximate Chainage	
Soil Description	TOPSOIL over gravelly SAND		

No of Blows	*Total Blows*	*Reading mm*	*No of Blows*	*Total Blows*	*Reading mm*	*No of Blows*	*Total Blows*	*Reading mm*
0	0	72						
1	1	140						
1	2	181						
1	3	222						
1	4	240						
1	5	251						
1	6	266						
1	7	271						
1	8	274						
1	9	278						
1	10	283						
1	11	286						
1	12	289						
1	13	292						
1	14	293						
5	19	295						
5	24	295						



	From	to	Penetration	mm / blow
Depth range (mm)	194	221	27	3.38
Blows	6	14	8	

TRRL RN8: Log10 (CBR) = 2.48-1.057*Log10 (mm/blow)

Log10(CBR) = 1.922

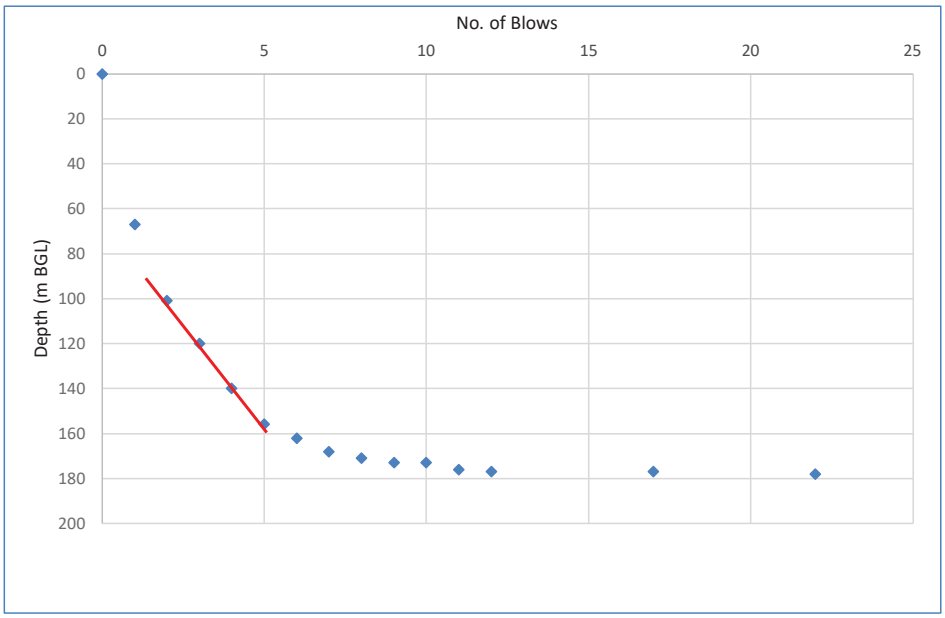
CBR = 83.486

Dynamic Cone Penetrometer

Contract	N63 Abbey to Liss	**Date:**	**Test No.** 3
Ref No.	22751		
Client	Galway Co Co		
Engineer	Aecom	**DCP Zero Reading**	80 mm
Location	Adjacent to TP03		
		Start of Test at:	0 m BGL
		Approximate Chainage	

Soil Description
TOPSOIL over very gravelly SAND

No of Blows	*Total Blows*	*Reading mm*	*No of Blows*	*Total Blows*	*Reading mm*	*No of Blows*	*Total Blows*	*Reading mm*
0	0	80						
1	1	147						
1	2	181						
1	3	200						
1	4	220						
1	5	236						
1	6	242						
1	7	248						
1	8	251						
1	9	253						
1	10	253						
1	11	256						
1	12	257						
5	17	257						
5	22	258						



	From	to	Penetration	mm / blow
Depth range (mm)	101	156	55	18.33
Blows	2	5	3	

TRRL RN8: Log10 (CBR) = 2.48-1.057*Log10 (mm/blow)

Log10(CBR) = 1.145

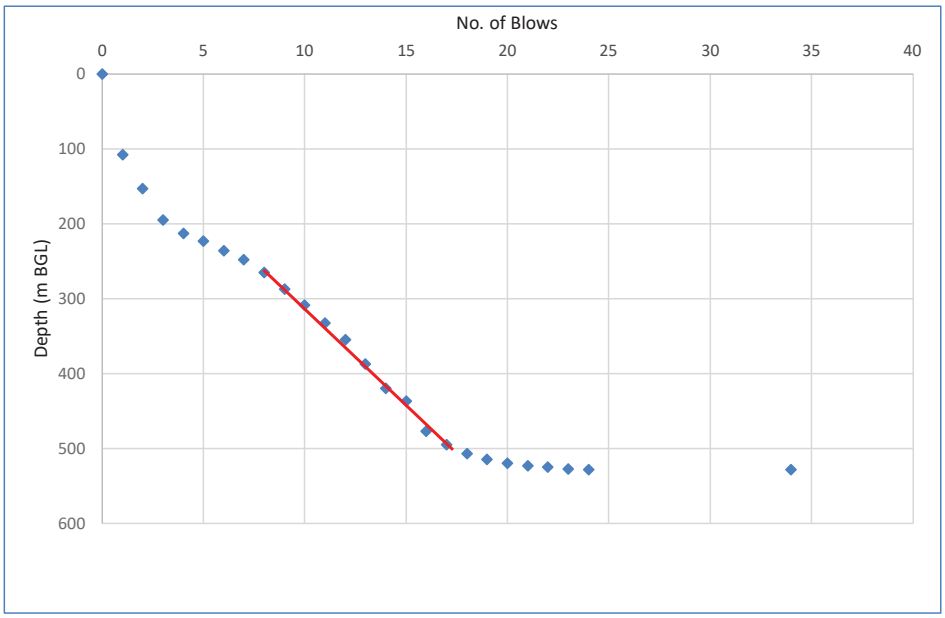
CBR = 13.956

Dynamic Cone Penetrometer

Contract	N63 Abbey to Liss	**Date:**	**Test No.** 4
Ref No.	22751		
Client	Galway Co Co	**DCP Zero Reading**	85 mm
Engineer	Aecom		
Location	Adjacent to TP04	**Start of Test at:**	0 m BGL
		Approximate Chainage	

Soil Description
TOPSOIL over gravelly SAND

No of Blows	*Total Blows*	*Reading mm*	*No of Blows*	*Total Blows*	*Reading mm*	*No of Blows*	*Total Blows*	*Reading mm*
0	0	85	1	21	608			
1	1	193	1	22	610			
1	2	238	1	23	612			
1	3	280	1	24	613			
1	4	298	10	34	613			
1	5	308						
1	6	321						
1	7	333						
1	8	350						
1	9	372						
1	10	394						
1	11	418						
1	12	440						
1	13	472						
1	14	505						
1	15	522						
1	16	562						
1	17	580						
1	18	592						
1	19	600						
1	20	605						



	From	to	Penetration	mm / blow
Depth range (mm)	265	495	230	25.56
Blows	8	17	9	

TRRL RN8: Log10 (CBR) = 2.48-1.057*Log10 (mm/blow)

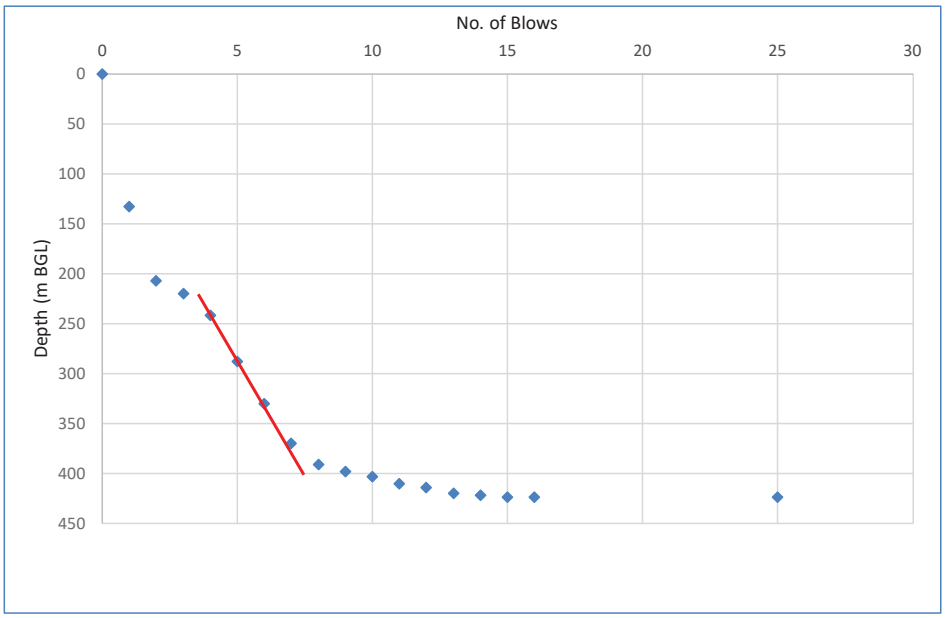
Log10(CBR) = 0.992

CBR = 9.824

Dynamic Cone Penetrometer

Contract	N63 Abbey to Liss	**Date:**	**Test No.** 5
Ref No.	22751		
Client	Galway Co Co	**DCP Zero Reading**	60 mm
Engineer	Aecom		
Location	Adjacent to TP05	**Start of Test at:**	0 m BGL
		Approximate Chainage	
Soil Description	TOPSOIL over gravelly SAND		

No of Blows	*Total Blows*	*Reading mm*	*No of Blows*	*Total Blows*	*Reading mm*	*No of Blows*	*Total Blows*	*Reading mm*
0	0	60						
1	1	193						
1	2	267						
1	3	280						
1	4	302						
1	5	348						
1	6	390						
1	7	430						
1	8	451						
1	9	458						
1	10	463						
1	11	470						
1	12	474						
1	13	480						
1	14	482						
1	15	484						
1	16	484						
9	25	484						



	From	to	Penetration	mm / blow
Depth range (mm)	242	370	128	42.67
Blows	4	7	3	

TRRL RN8: Log10 (CBR) = 2.48-1.057*Log10 (mm/blow)

Log10(CBR) = 0.757

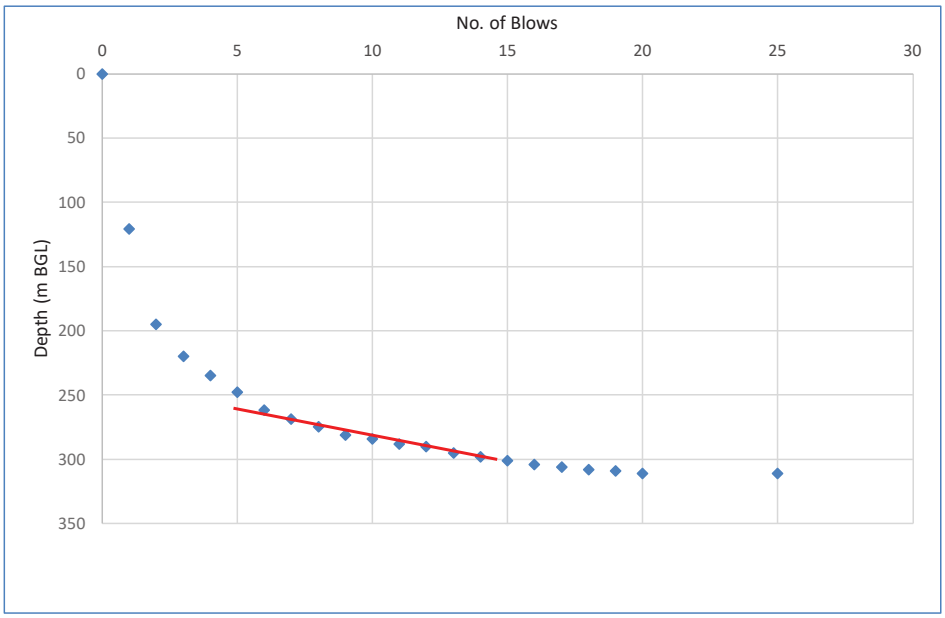
CBR = 5.715

Dynamic Cone Penetrometer

Contract	N63 Abbey to Liss	**Date:**	**Test No.** 6
Ref No.	22751		
Client	Galway Co Co		
Engineer	Aecom	**DCP Zero Reading**	55 mm
Location	Adjacent to TP06		
		Start of Test at:	0 m BGL
		Approximate Chainage	

Soil Description
TOPSOIL over gravelly SAND

No of Blows	*Total Blows*	*Reading mm*	*No of Blows*	*Total Blows*	*Reading mm*	*No of Blows*	*Total Blows*	*Reading mm*
0	0	55	5	25	366			
1	1	176						
1	2	250						
1	3	275						
1	4	290						
1	5	303						
1	6	317						
1	7	324						
1	8	330						
1	9	336						
1	10	339						
1	11	343						
1	12	345						
1	13	350						
1	14	353						
1	15	356						
1	16	359						
1	17	361						
1	18	363						
1	19	364						
1	20	366						



	From	to	Penetration	mm / blow
Depth range (mm)	262	301	39	4.33
Blows	6	15	9	

TRRL RN8: Log10 (CBR) = 2.48-1.057*Log10 (mm/blow)

Log10(CBR) = 1.807

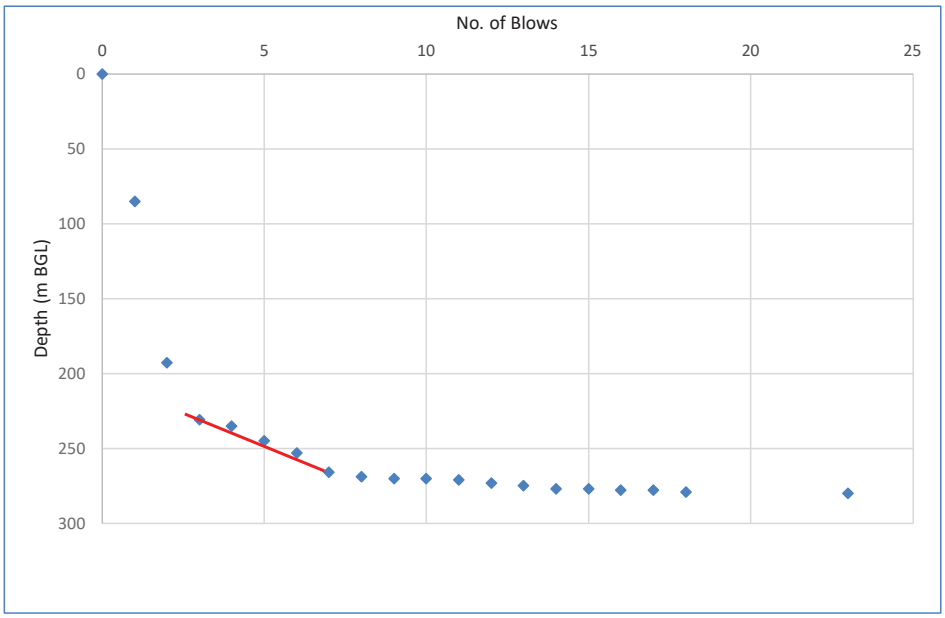
CBR = 64.103

Dynamic Cone Penetrometer

Contract	N63 Abbey to Liss	**Date:**	**Test No.** 7
Ref No.	22751		
Client	Galway Co Co		
Engineer	Aecom	**DCP Zero Reading**	50 mm
Location	Adjacent to TP07		
		Start of Test at:	0 m BGL
		Approximate Chainage	

Soil Description
TOPSOIL over gravelly SAND

No of Blows	*Total Blows*	*Reading mm*	*No of Blows*	*Total Blows*	*Reading mm*	*No of Blows*	*Total Blows*	*Reading mm*
0	0	50						
1	1	135						
1	2	243						
1	3	281						
1	4	285						
1	5	295						
1	6	303						
1	7	316						
1	8	319						
1	9	320						
1	10	320						
1	11	321						
1	12	323						
1	13	325						
1	14	327						
1	15	327						
1	16	328						
1	17	328						
1	18	329						
5	23	330						



	From	to	Penetration	mm / blow
Depth range (mm)	231	266	35	8.75
Blows	3	7	4	

TRRL RN8: Log10 (CBR) = 2.48-1.057*Log10 (mm/blow)

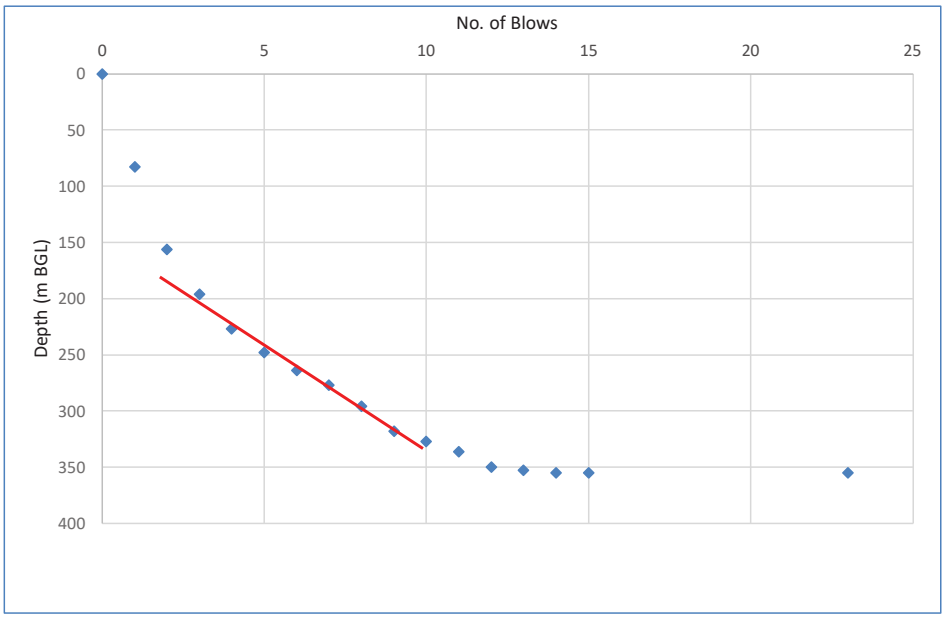
Log10(CBR) = 1.484

CBR = 30.500

Dynamic Cone Penetrometer

Contract	N63 Abbey to Liss	**Date:**	**Test No.** 8
Ref No.	22751		
Client	Galway Co Co		
Engineer	Aecom	**DCP Zero Reading**	54 mm
Location	Adjacent to TP08		
		Start of Test at:	0 m BGL
Soil Description		**Approximate Chainage**	
TOPSOIL over very sandy GRAVEL			

No of Blows	*Total Blows*	*Reading mm*	*No of Blows*	*Total Blows*	*Reading mm*	*No of Blows*	*Total Blows*	*Reading mm*
0	0	54						
1	1	137						
1	2	210						
1	3	250						
1	4	281						
1	5	302						
1	6	318						
1	7	331						
1	8	350						
1	9	372						
1	10	381						
1	11	390						
1	12	404						
1	13	407						
1	14	409						
1	15	409						
8	23	409						



	From	to	Penetration	mm / blow
Depth range (mm)	227	318	91	18.20
Blows	4	9	5	

TRRL RN8: Log10 (CBR) = 2.48-1.057*Log10 (mm/blow)

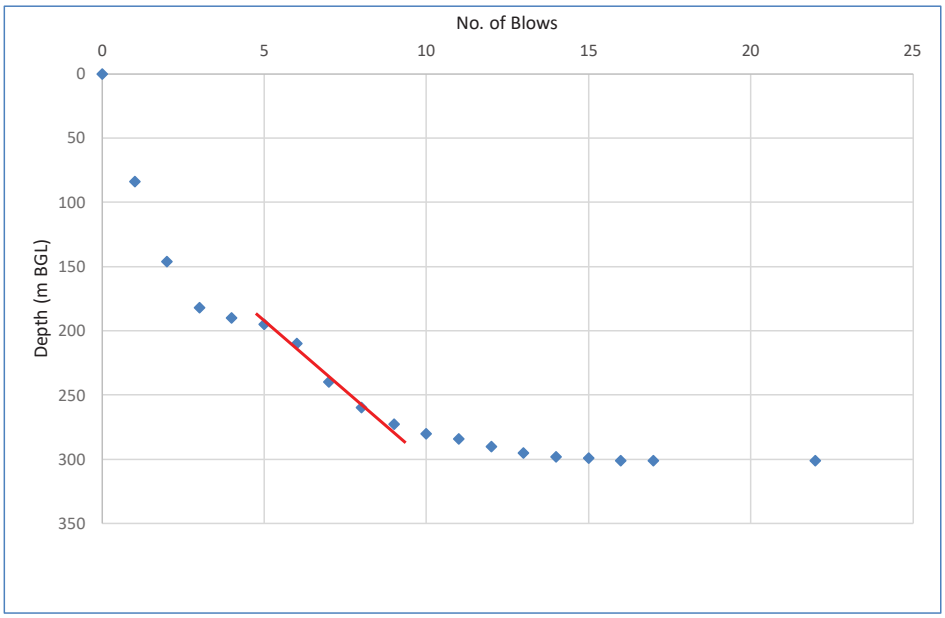
Log10(CBR) = 1.148

CBR = 14.064

Dynamic Cone Penetrometer

Contract	N63 Abbey to Liss	**Date:**	**Test No.** 9
Ref No.	22751		
Client	Galway Co Co		
Engineer	Aecom	**DCP Zero Reading**	60 mm
Location	Adjacent to TP09		
		Start of Test at:	0 m BGL
Soil Description		**Approximate Chainage**	
TOPSOIL over sandy gravelly CLAY			

No of Blows	*Total Blows*	*Reading mm*	*No of Blows*	*Total Blows*	*Reading mm*	*No of Blows*	*Total Blows*	*Reading mm*
0	0	60						
1	1	144						
1	2	206						
1	3	242						
1	4	250						
1	5	255						
1	6	270						
1	7	300						
1	8	320						
1	9	333						
1	10	340						
1	11	344						
1	12	350						
1	13	355						
1	14	358						
1	15	359						
1	16	361						
1	17	361						
5	22	361						



	From	to	Penetration	mm / blow
Depth range (mm)	195	273	78	19.50
Blows	5	9	4	

TRRL RN8: Log10 (CBR) = 2.48-1.057*Log10 (mm/blow)

Log10(CBR) = 1.116

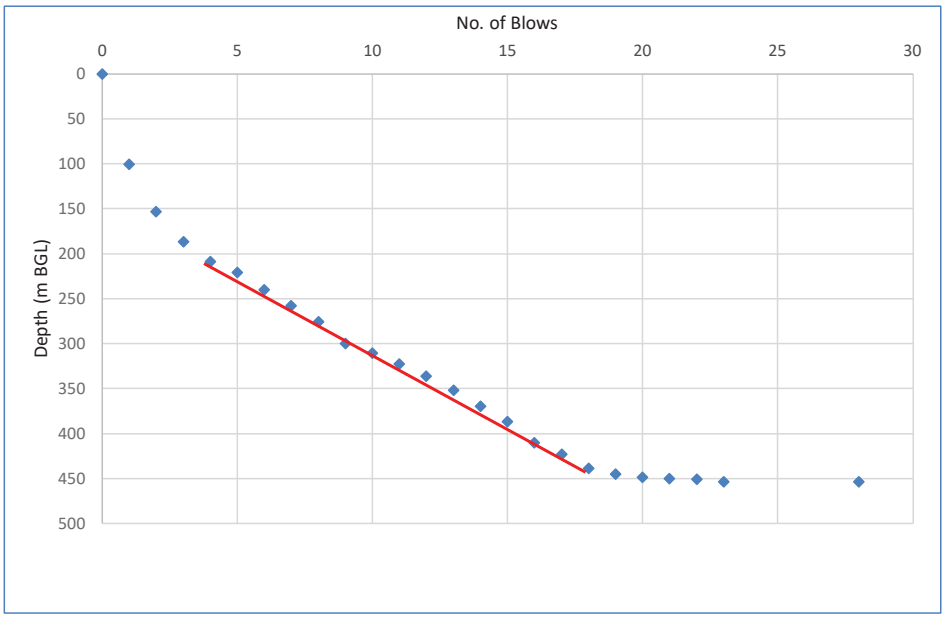
CBR = 13.075

Dynamic Cone Penetrometer

Contract	N63 Abbey to Liss	**Date:**	**Test No.** 10
Ref No.	22751		
Client	Galway Co Co		
Engineer	Aecom	**DCP Zero Reading**	69 mm
Location	Adjacent to TP10		
		Start of Test at:	0 m BGL
		Approximate Chainage	

Soil Description
TOPSOIL over gravelly SAND

No of Blows	*Total Blows*	*Reading mm*	*No of Blows*	*Total Blows*	*Reading mm*	*No of Blows*	*Total Blows*	*Reading mm*
0	0	69	1	21	519			
1	1	170	1	22	520			
1	2	222	1	23	523			
1	3	256	5	28	523			
1	4	278						
1	5	290						
1	6	309						
1	7	327						
1	8	345						
1	9	369						
1	10	380						
1	11	392						
1	12	405						
1	13	421						
1	14	439						
1	15	456						
1	16	479						
1	17	492						
1	18	508						
1	19	514						
1	20	518						



	From	to	Penetration	mm / blow
Depth range (mm)	209	439	230	16.43
Blows	4	18	14	

TRRL RN8: Log10 (CBR) = 2.48-1.057*Log10 (mm/blow)

Log10(CBR) = 1.195

CBR = 15.672

Appendix 5

Groundwater Monitoring

Groundwater Monitoring

Site Location	**N63 - Liss to Abbey Realignment**
Project No.	**22751**
Client	**Galway Co Co**
Engineer	**Aecom**

	Date of Reading					
	12-Apr-21		13-Oct-21			
	m bgl	m OD	m bgl	m OD		
RC03	Artesian	>38.96	Artesian	>38.96		
RC05	Artesian	>38.63	Artesian	>38.63		
RC06	Artesian	>38.68	Artesian	>38.68		
RC10	1.55	41.59	1.76	41.38		

COMMENTS Where the symbol '>' is used, this denotes flowing groundwater or artesian conditions. Level noted is surveyed ground level.

Appendix 6

Geotechnical Laboratory Testing

IGSL Ltd
Materials Laboratory
Unit J5, M7 Business Park
Newhall, Naas
Co. Kildare
045 846176

Test Report

Determination of Moisture Content, Liquid & Plastic Limits

Tested in accordance with BS1377:Part 2:1990, clauses 3.2*, 4.3, 4.4 & 5.3

Report No. **R115525** Contract No. 22751 Contract Name: N63 Liss to Abbey Road

Customer Aecom

Samples Received: 21/09/20 Date Tested: 25/09/20

BH/TP	Sample No.	Depth (m)	Lab. Ref	Sample Type	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425µm	Preparation	Liquid Limit Clause	Classification (BS5930)	Description
BH01	AA134309	0.5	A20/4767	B	300								Brown PEAT
BH01	N/A	1.0	A20/4768	U	308								Brown PEAT
BH01	AA134312	4.0	A20/4770	B	13								Brown sandy gravelly SILT/CLAY
BH01	AA131709	5.0	A20/4771	B	9.9	22	NP	NP	51	WS	4.4		Brown sandy gravelly SILT
BH02	AA141451	0.5	A20/4772	B	133								Brown PEAT
BH02	AA141452	1.0	A20/4773	B	54								Brown sandy SILT/CLAY
BH02	AA141457	5.0	A20/4775	B	10								Brown sandy gravelly SILT/CLAY
BH03	AA134301	0.5	A20/4776	B	52								Mottled brown sandy SILT/CLAY
BH03	AA134302	1.0	A20/4777	B	49								Mottled grey/brown sandy SILT/CLAY
BH03	AA134306	5.0	A20/4779	B	9.1	22	NP	NP	47	WS	4.4		Brown slightly sandy, gravelly, SILT
BH03	AA134308	7.0	A20/4780	B	9.9								Grey sandy gravelly SILT/CLAY
BH04A	AA136191	4.0	A20/4782	B	10	20	NP	NP	49	WS	4.4		Brown sandy gravelly SILT
BH05A	AA134314	2.0	A20/4783	B	11	21	NP	NP	58	WS	4.4		Grey slightly sandy, gravelly, SILT
BH05A	AA134316	4.0	A20/4784	B	9.1								Brown sandy gravelly SILT/CLAY
BH06	AA134323	0.5	A20/4785	B	86								Brown PEAT

Notes:
Preparation: WS - Wet sieved; AR - As received; NP - Non plastic
Liquid Limit Clause: 4.3 Cone Penetrometer definitive method; 4.4 Cone Penetrometer one point method
Sample Type: B - Bulk Disturbed; U - Undisturbed

Remarks:
Results apply to the sample as received.
NOTE: *Clause 3.2 of BS1377 is a "withdrawn" standard due to publication of ISO17892-1:2014
Opinions and interpretations are outside the scope of accreditation.
The results relate to the specimens tested. Any remaining material will be retained for one month.

IGSL Ltd Materials Laboratory

Persons authorized to approve reports
H Byrne (Laboratory Manager)

Approved by: H Byrne
Date: 30/10/20
Page: 1 of 1

IGSL Ltd
Materials Laboratory
Unit J5, M7 Business Park
Newhall, Naas
Co. Kildare
045 846176

Test Report

Determination of Moisture Content, Liquid & Plastic Limits

Tested in accordance with BS1377:Part 2:1990, clauses 3.2*, 4.3, 4.4 & 5.3

Report No. **R115526** Contract No. 22751 Contract Name: N63 Liss to Abbey Road

Customer Aecom

Samples Received: 21/09/20 Date Tested: 25/09/20

BH/TP	Sample No.	Depth (m)	Lab. Ref	Sample Type	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425µm	Preparation	Liquid Limit Clause	Classification (BS5930)	Description
BH06	AA134324	1.0	A20/4786	B	22								Brown slightly clayey/silty, sandy, GRAVEL
BH06	AA131712	2.5	A20/4787	U	12								Brown sandy gravelly SILT/CLAY
BH06	AA134327	4.0	A20/4788	B	10	22	NP	NP	64	WS	4.4		Grey slightly sandy, gravelly, SILT
BH07	AA134319	0.5	A20/4789	B	12	23	NP	NP	57	WS	4.4		Grey/brown sandy gravelly SILT
BH07	AA134320	1.0	A20/4790	B	9.1								Brown sandy gravelly SILT/CLAY
BH07	AA134323	4.0	A20/4791	B	8.7	21	NP	NP	53	WS	4.4		Brown sandy gravelly SILT
BH08	AA134334	1.0	A20/4792	B	22	22	NP	NP	56	WS	4.4		Brown sandy gravelly SILT
BH09A	AA134329	1.0	A20/4793	B	9.0	21	NP	NP	43	WS	4.4		Grey sandy gravelly SILT
BH09A	AA131713	2.5	A20/4794	B	12	20	NP	NP	62	WS	4.4		Grey sandy gravelly SILT
BH09A	AA134332	4.0	A20/4795	B	8.6	22	NP	NP	54	WS	4.4		Brown slightly sandy, gravelly, SILT with some cobbles
BH10	AA134333	0.5	A20/4796	B	20	36	NP	NP	64	WS	4.4		Brown sandy gravelly SILT
BH10A	AA134336	2.0	A20/4797	B	12								Grey sandy gravelly SILT/CLAY

Notes:
Preparation: WS - Wet sieved; AR - As received; NP - Non plastic
Liquid Limit Clause: 4.3 Cone Penetrometer definitive method; 4.4 Cone Penetrometer one point method
Sample Type: B - Bulk Disturbed; U - Undisturbed

Remarks:
Results apply to the sample as received.
NOTE: *Clause 3.2 of BS1377 is a "withdrawn" standard due to publication of ISO17892-1:2014
Opinions and interpretations are outside the scope of accreditation.
The results relate to the specimens tested. Any remaining material will be retained for one month.

IGSL Ltd Materials Laboratory

Persons authorized to approve reports
H Byrne (Laboratory Manager)

Approved by	Date	Page
H Byrne	30/10/20	1 of 1

IGSL Ltd
Materials Laboratory
Unit J5, M7 Business Park
Newhall, Naas
Co. Kildare
045 846176

Test Report

Determination of Moisture Content, Liquid & Plastic Limits

Tested in accordance with BS1377:Part 2:1990, clauses 3.2*, 4.3, 4.4 & 5.3

Report No. **R115527** Contract No. 22751 Contract Name: N63 Liss to Abbey Road

Customer Aecom

Samples Received: 21/09/20 Date Tested: 25/09/20

BH/TP	Sample No.	Depth (m)	Lab. Ref	Sample Type	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425µm	Preparation	Liquid Limit Clause	Classification (BS5930)	Description
TP01	AA140571	0.7	A20/4798	B	13	20	NP	NP	0.7	WS	4.4		Brown sandy, slightly gravelly, SILT
TP02	AA140569	0.5	A20/4799	U	16								Brown sandy gravelly SILT/CLAY
TP03	AA140567	0.7	A20/4800	B	9.1								Grey clayey/silty, very sandy, GRAVEL
TP03	AA140568	2.2	A20/4801	B	9.4	23	NP	NP	47	WS	4.4		Brown slightly sandy, gravelly, SILT
TP05	AA140556	0.5	A20/4803	B	8.5								Brown clayey/silty, very sandy, GRAVEL
TP05	AA140559	1.5	A20/4804	B	8.8								Grey/brown very sandy gravelly SILT/CLAY
TP06	AA140563	0.5	A20/4805	B	9.8	26	NP	NP	31	WS	4.4		Brown silty, very sandy, GRAVEL
TP07	AA140565	0.6	A20/4806	B	8.2								Brown slightly sandy, gravelly, SILT/CLAY
TP09	AA140553	0.5	A20/4808	B	13								Brown clayey/silty, very sandy, GRAVEL
TP10	AA140560	0.5	A20/4809	B	12	29	NP	NP	44	WS	4.4		Brown silty, very sandy, GRAVEL with some cobbles
TP10	AA140562	2.5	A20/4810	B	9.6								Brown slightly sandy, gravelly, SILT/CLAY

Notes:
Preparation: WS - Wet sieved; AR - As received; NP - Non plastic
Liquid Limit Clause: 4.3 Cone Penetrometer definitive method; 4.4 Cone Penetrometer one point method
Sample Type: B - Bulk Disturbed; U - Undisturbed

Remarks:
Results apply to the sample as received.
NOTE: *Clause 3.2 of BS1377 is a "withdrawn" standard due to publication of ISO17892-1:2014
Opinions and interpretations are outside the scope of accreditation.
The results relate to the specimens tested. Any remaining material will be retained for one month.

IGSL Ltd Materials Laboratory

Persons authorized to approve reports
H Byrne (Laboratory Manager)

Approved by: H Byrne

Date: 30/10/20

Page: 1 of 1

TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

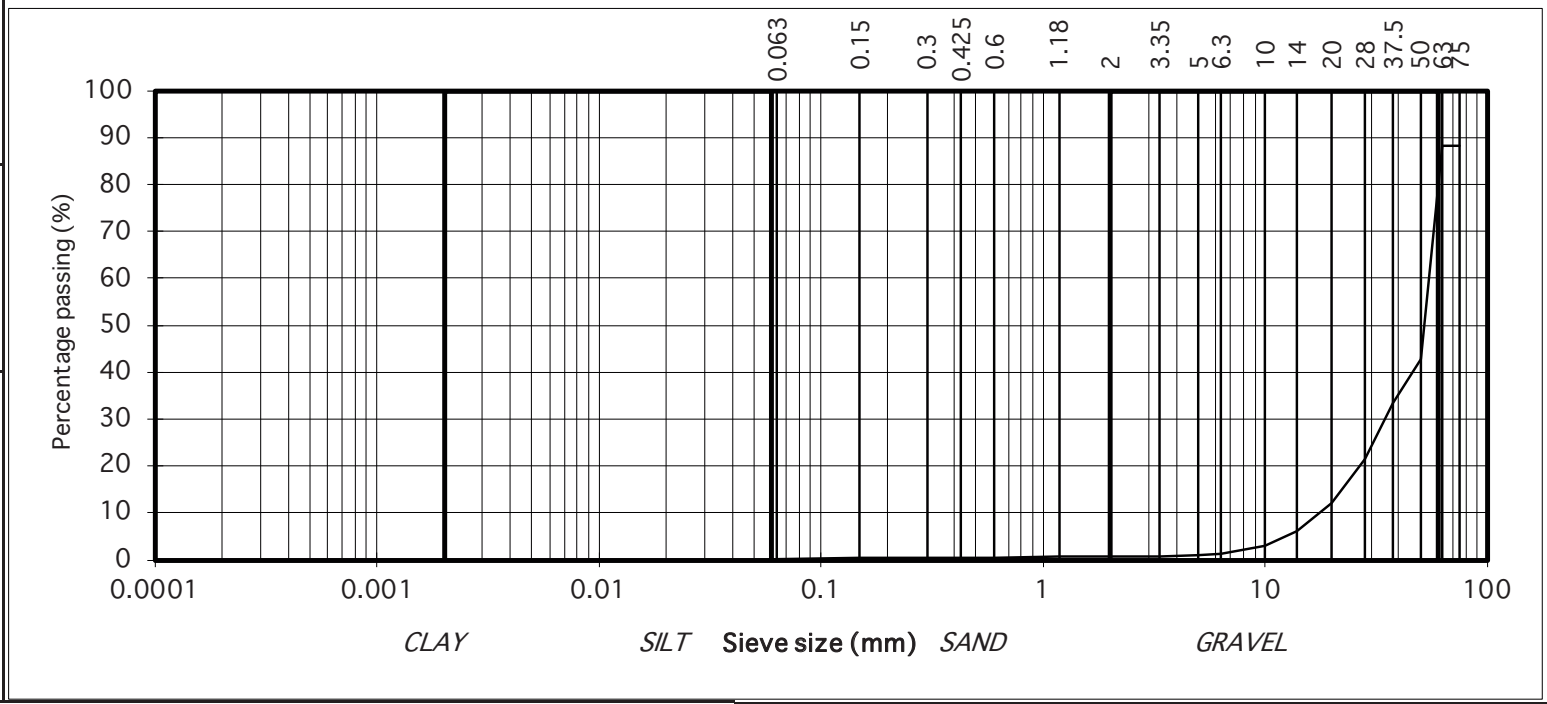
ISO 17025 INAB ACCREDITED TESTING
DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	88	COBBLES
63	88	
50	43	GRAVEL
37.5	33	
28	21	
20	12	
14	6	
10	3	
6.3	1	
5	1	
3.35	1	
2	1	
1.18	1	SAND
0.6	0	
0.425	0	
0.3	0	
0.15	0	
0.063	0	SILT/CLAY

Contract No.	22757	Report No.	R115623
Contract Name:	N63 Liss to Abbey Road		
BH/TP :	BH01		
Sample No.	AA134310	Lab. Sample No.	A20/4769
Sample Type:	B		
Depth (m)	2.00	Customer:	Aecom
Date Received	21/09/2020	Date Testing started	25/09/2020
Description:	Grey GRAVEL with some cobbles		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received. Sample size did not meet the requirements of BS1377



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	30/10/20	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

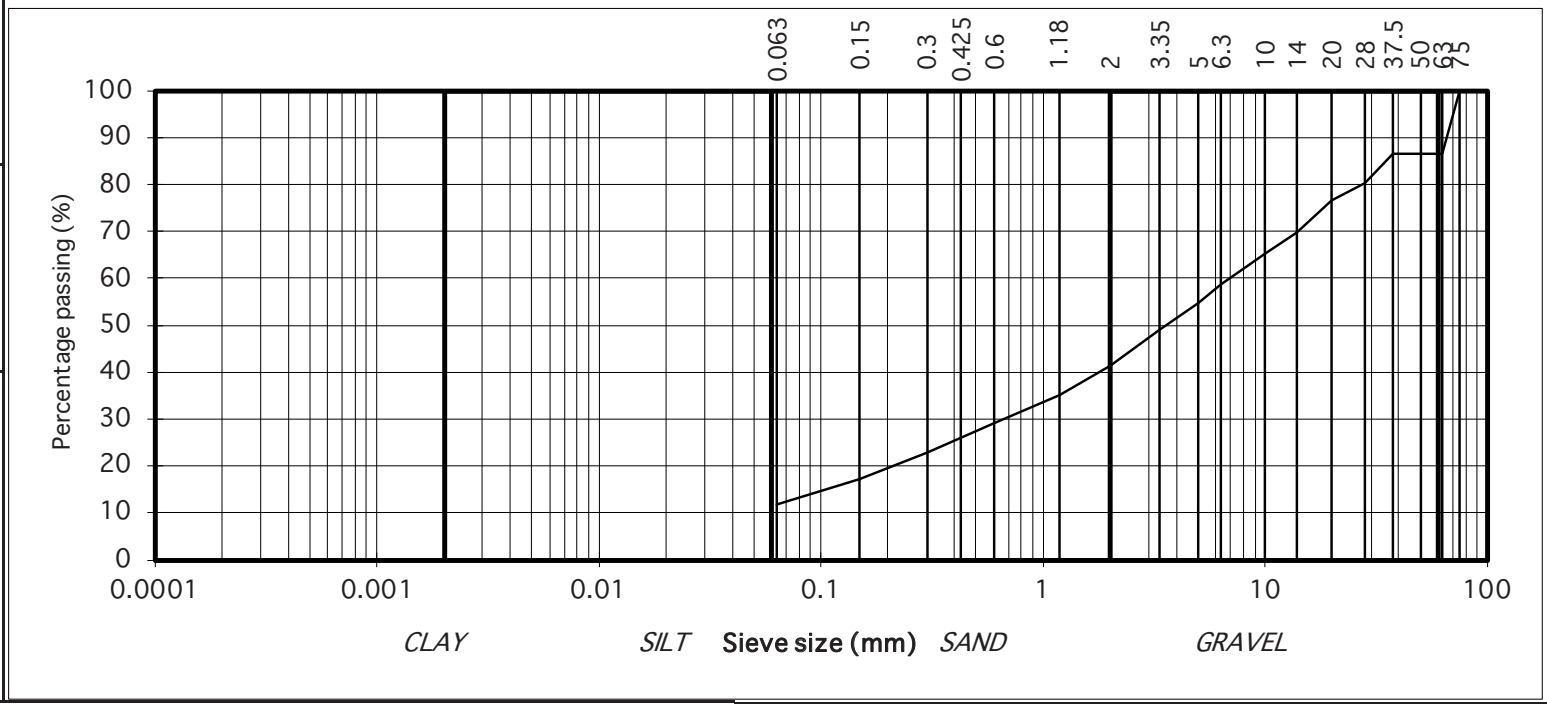
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	87	
50	87	GRAVEL
37.5	87	
28	80	
20	77	
14	70	
10	65	
6.3	59	
5	55	
3.35	49	
2	41	
1.18	35	SAND
0.6	29	
0.425	26	
0.3	23	
0.15	17	
0.063	12	SILT/CLAY

Contract No.	22757	Report No.	R115624
Contract Name:	N63 Liss to Abbey Road		
BH/TP :	BH02		
Sample No.	AA141453	Lab. Sample No.	A20/4774
Sample Type:	B		
Depth (m)	2.00	Customer:	Aecom
Date Received	21/09/2020	Date Testing started	25/09/2020
Description:	Grey clayey/silty, very sandy, GRAVEL with some cobbles		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received. Sample size did not meet the requirements of BS1377



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

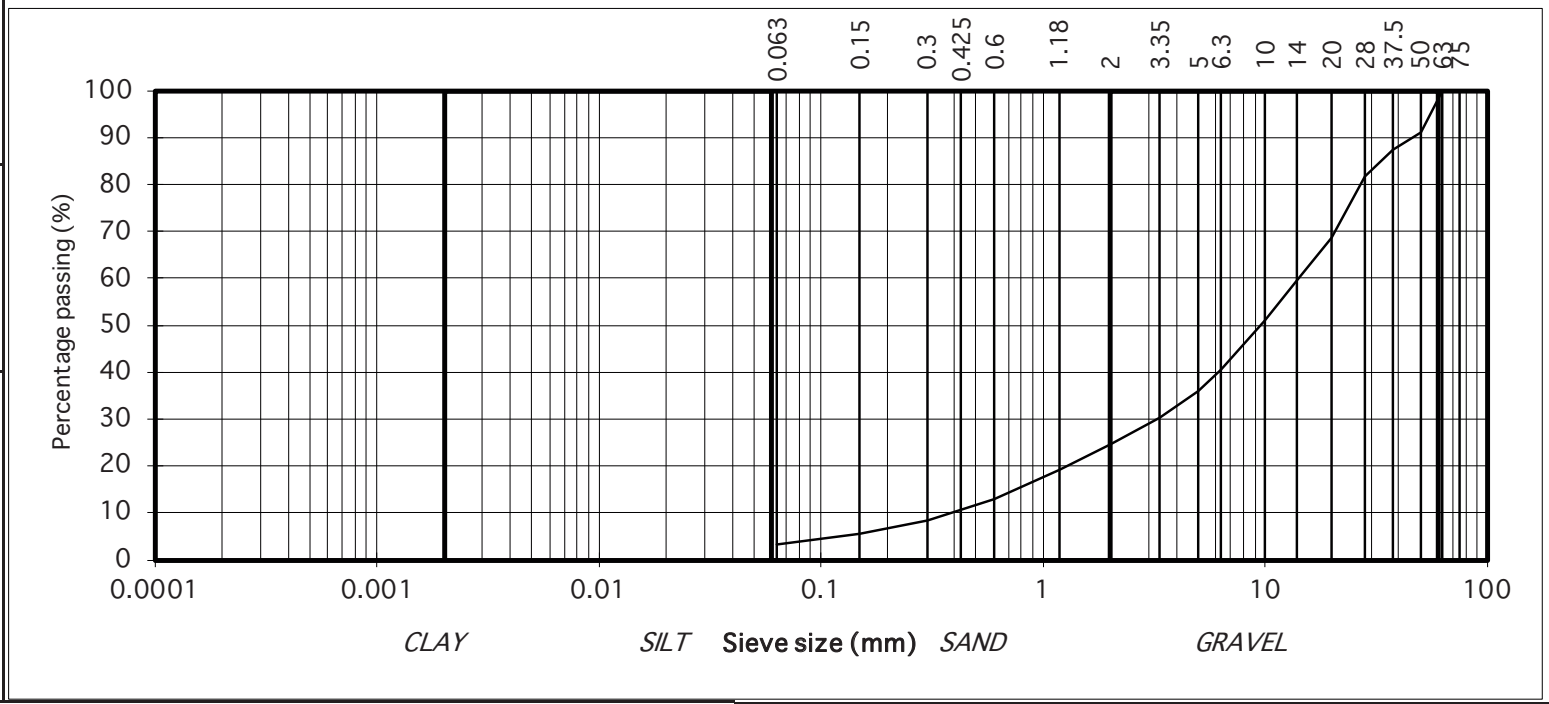
ISO 17025 INAB ACCREDITED TESTING
DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	91	GRAVEL
37.5	87	
28	82	
20	69	
14	60	
10	51	
6.3	40	
5	36	
3.35	30	
2	25	
1.18	19	SAND
0.6	13	
0.425	11	
0.3	8	
0.15	5	
0.063	3	SILT/CLAY

Contract No. 22757 Report No. R115556
Contract Name: N63 Liss to Abbey Road
BH/TP : BH03
Sample No. AA134304 Lab. Sample No. A20/4778
Sample Type: B
Depth (m) 3.00 Customer: Aecom
Date Received 21/09/2020 Date Testing started 25/09/2020
Description: Grey slightly clayey/silty, very sandy, GRAVEL

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

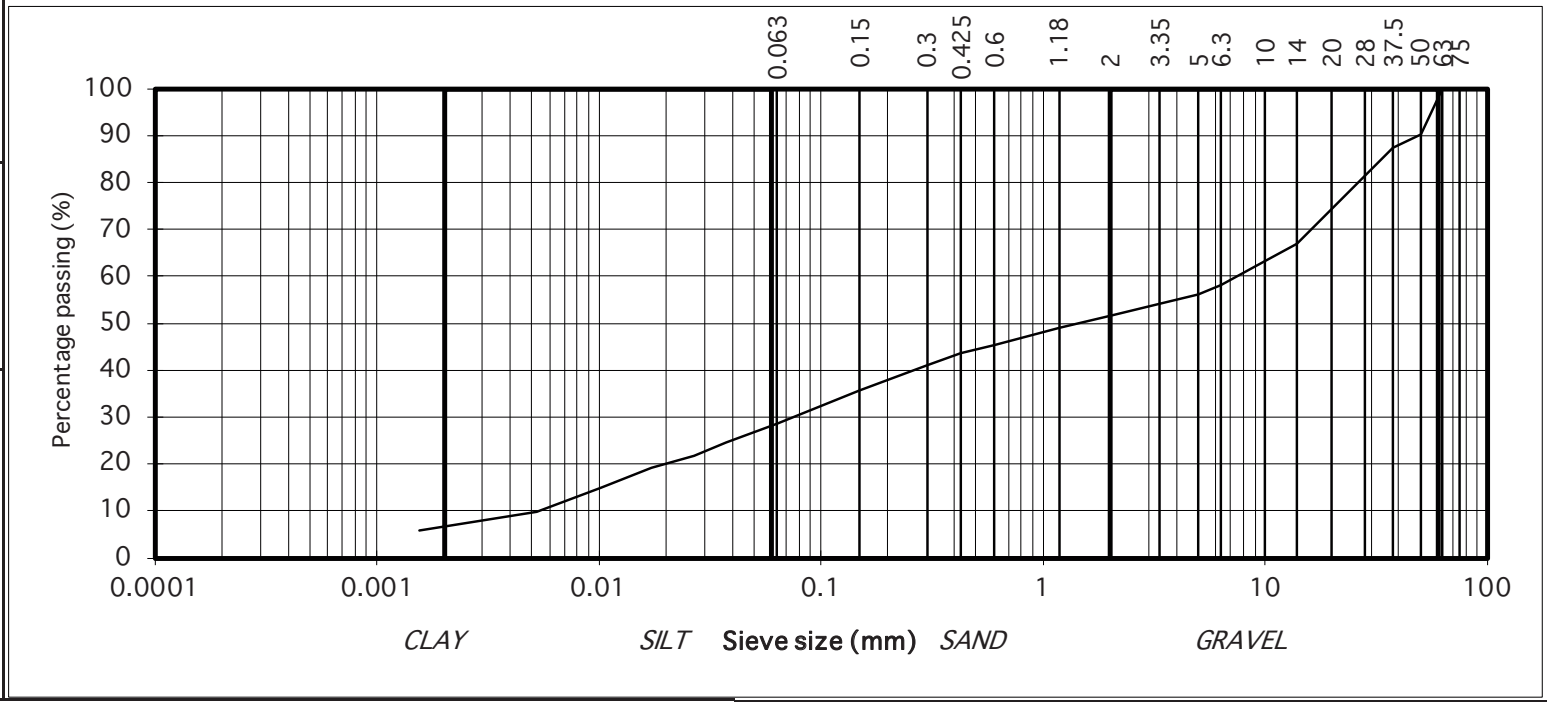
ISO 17025 INAB ACCREDITED TESTING
DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	90	GRAVEL
37.5	88	
28	82	
20	74	
14	67	
10	63	
6.3	58	
5	56	
3.35	54	
2	52	
1.18	49	SAND
0.6	45	
0.425	44	
0.3	41	
0.15	36	
0.063	29	SILT/CLAY
0.037	25	
0.027	22	
0.017	19	
0.010	15	
0.007	12	
0.005	10	
0.002	6	

Contract No.	22757	Report No.	R11557
Contract Name:	N63 Liss to Abbey Road		
BH/TP :	BH03		
Sample No.	A134306	Lab. Sample No.	A20/4779
Sample Type:	B		
Depth (m)	5.00	Customer:	Aecom
Date Received	21/09/2020	Date Testing started	25/09/2020
Description:	Brown slightly sandy, gravelly, SILT		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

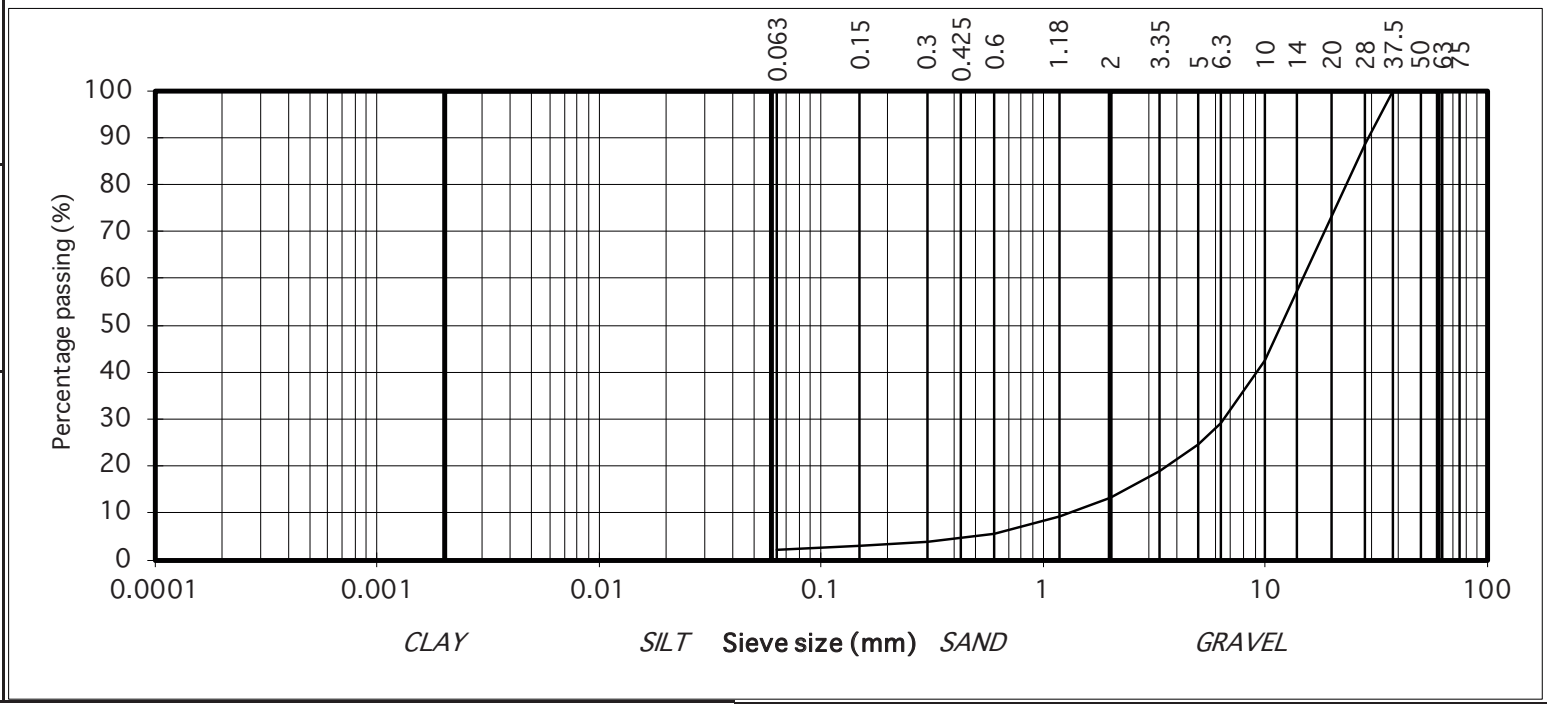
ISO 17025 INAB ACCREDITED TESTING
DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	89	
20	73	
14	57	
10	43	
6.3	29	
5	24	
3.35	19	
2	13	
1.18	9	SAND
0.6	6	
0.425	5	
0.3	4	
0.15	3	
0.063	2	SILT/CLAY

Contract No.	22757	Report No.	R115625	
Contract Name:	N63 Liss to Abbey Road			
BH/TP :	BH04A			
Sample No.	AA138139	Lab. Sample No.		A20/4781
Sample Type:	B			
Depth (m)	2.00	Customer:	Aecom	
Date Received	21/09/2020	Date Testing started		25/09/2020
Description:	Grey slightly clayey/silty, sandy, GRAVEL			

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received. Sample size did not meet the requirements of BS1377



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

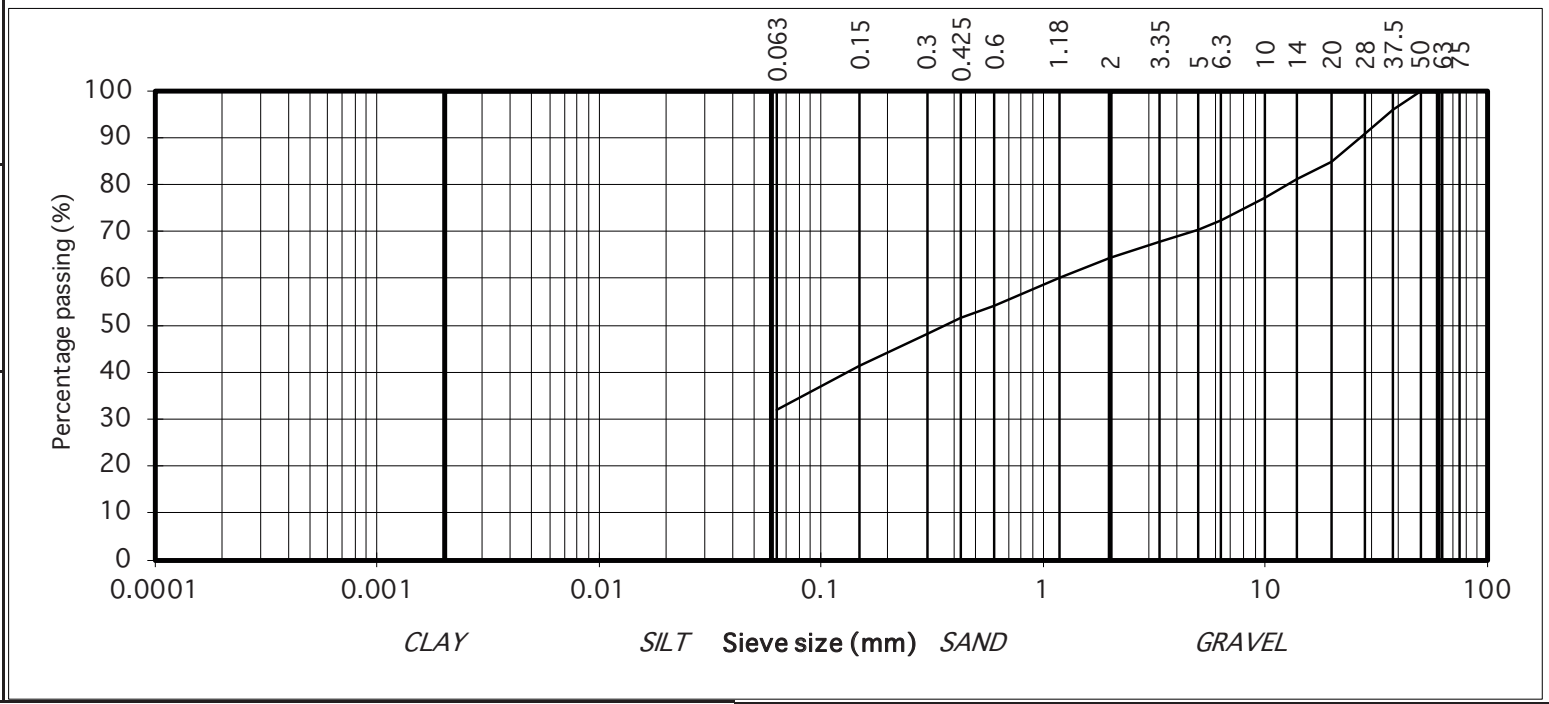
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 1337

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	96	
28	91	
20	85	
14	81	
10	77	
6.3	72	
5	70	
3.35	68	
2	64	
1.18	60	SAND
0.6	54	
0.425	52	
0.3	48	
0.15	41	
0.063	32	SILT/CLAY

Contract No.	22757	Report No.	R115626
Contract Name:	N63 Liss to Abbey Road		
BH/TP :	BH05A		
Sample No.	AA134134	Lab. Sample No.	A20/4783
Sample Type:	B		
Depth (m)	2.00	Customer:	Aecom
Date Received	21/09/2020	Date Testing started	25/09/2020
Description:	Grey slightly sandy, gravelly, SILT		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

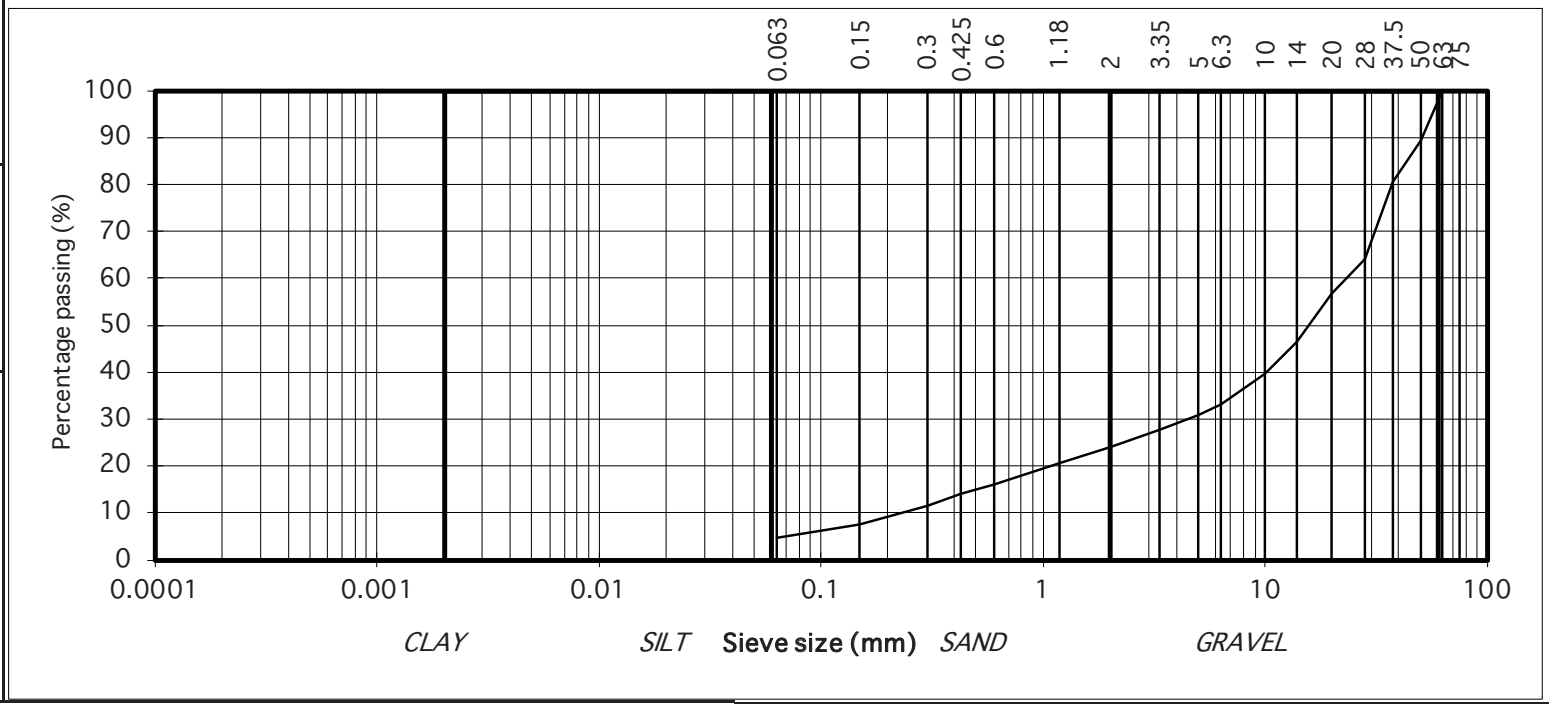
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	89	GRAVEL
37.5	81	
28	64	
20	57	
14	47	
10	40	
6.3	33	
5	31	
3.35	28	
2	24	
1.18	20	SAND
0.6	16	
0.425	14	
0.3	11	
0.15	7	
0.063	5	SILT/CLAY

Contract No.	22757	Report No.	R115558
Contract Name:	N63 Liss to Abbey Road		
BH/TP :	BH06		
Sample No.	AA134324	Lab. Sample No.	A20/4786
Sample Type:	B		
Depth (m)	1.00	Customer:	Aecom
Date Received	21/09/2020	Date Testing started	25/09/2020
Description:	Brown slightly clayey/silty, sandy, GRAVEL		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received. Sample size did not meet the requirements of BS1377



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

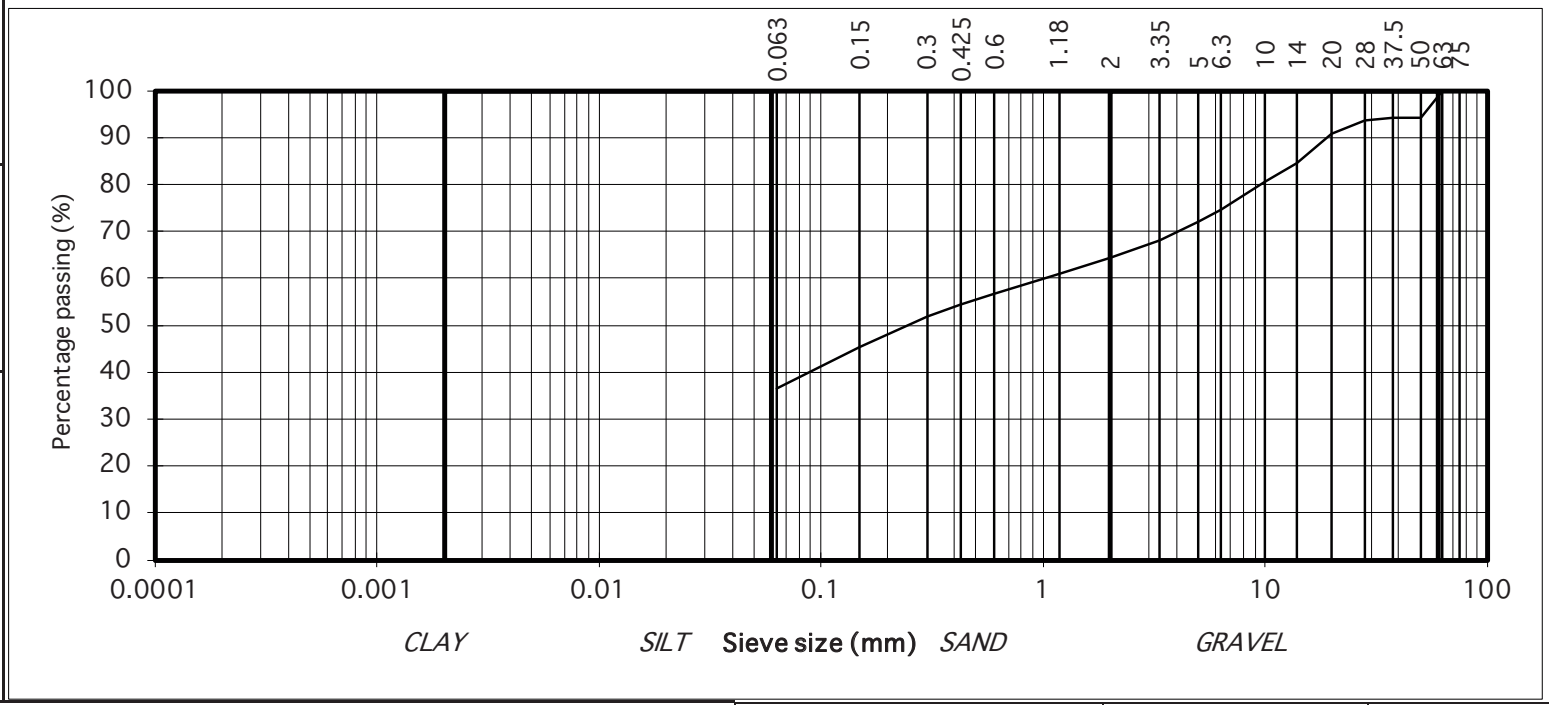
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	94	GRAVEL
37.5	94	
28	94	
20	91	
14	85	
10	81	
6.3	75	
5	72	
3.35	68	
2	64	
1.18	61	SAND
0.6	57	
0.425	54	
0.3	52	
0.15	45	
0.063	37	SILT/CLAY

Contract No.	22757	Report No.	R115627
Contract Name:	N63 Liss to Abbey Road		
BH/TP :	BH06		
Sample No.	AA134327	Lab. Sample No.	A20/4788
Sample Type:	B		
Depth (m)	4.00	Customer:	Aecom
Date Received	21/09/2020	Date Testing started	25/09/2020
Description:	Grey slightly sandy, gravelly, SILT		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

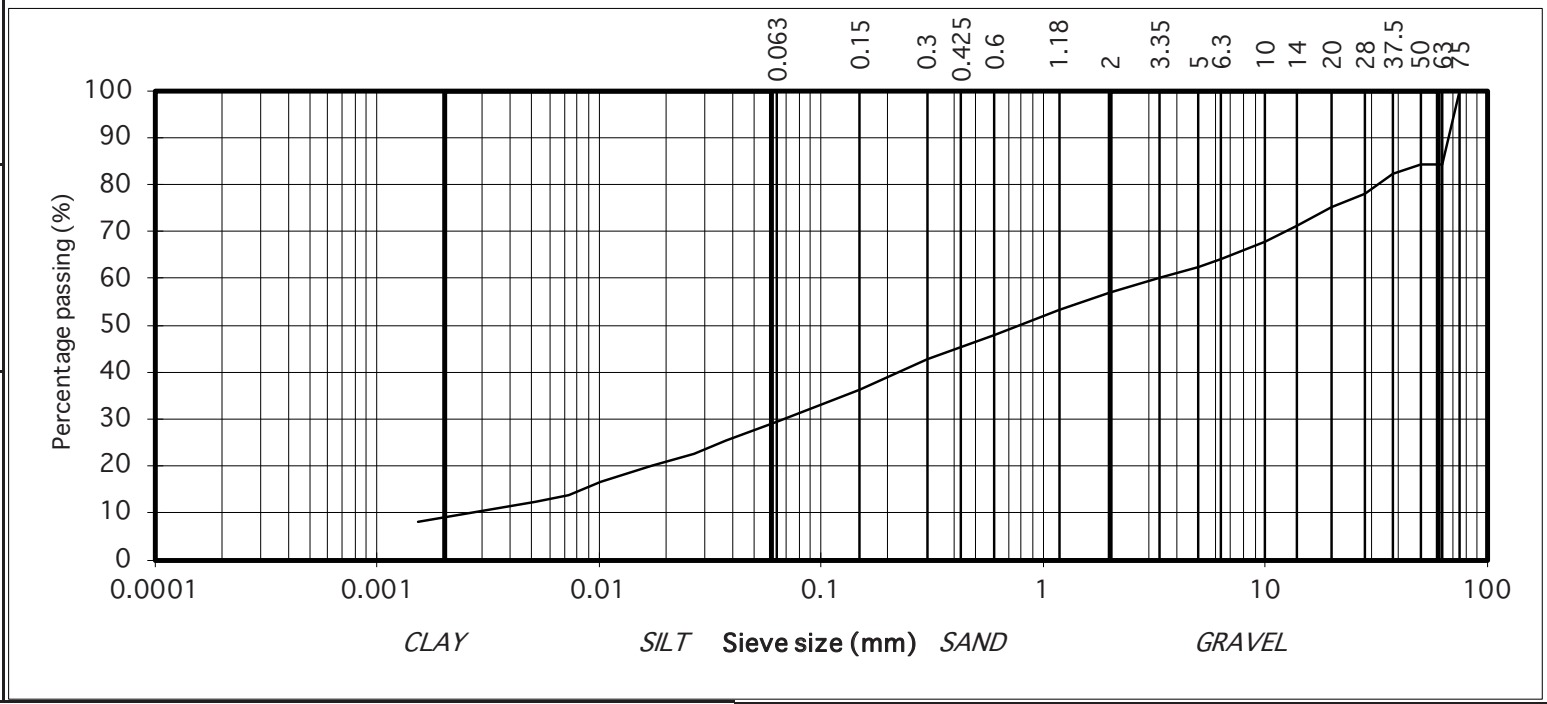
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	84	
50	84	GRAVEL
37.5	82	
28	78	
20	75	
14	71	
10	68	
6.3	64	
5	62	
3.35	60	
2	57	
1.18	53	SAND
0.6	48	
0.425	45	
0.3	43	
0.15	36	
0.063	29	SILT/CLAY
0.037	25	
0.027	23	
0.017	20	
0.010	17	
0.007	14	
0.005	12	
0.002	8	

Contract No.	22757	Report No.	R115628
Contract Name:	N63 Liss to Abbey Road		
BH/TP :	BH09A		
Sample No.	AA134333	Lab. Sample No.	A20/4795
Sample Type:	B		
Depth (m)	4.00	Customer:	Aecom
Date Received	21/09/2020	Date Testing started	25/09/2020
Description:	Brown slightly sandy, gravelly, SILT with some cobbles		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received. Sample size did not meet the requirements of BS1377



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

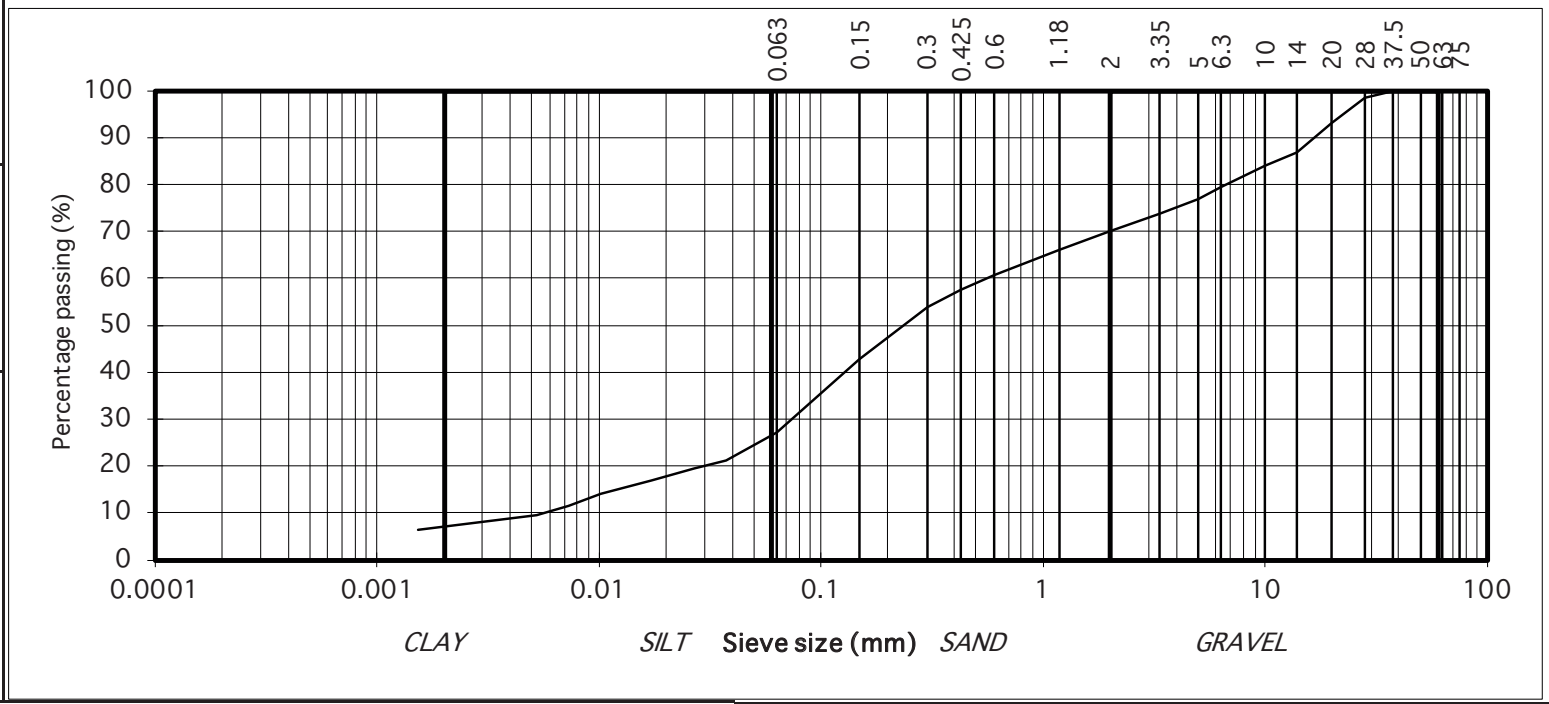
ISO 17025 INAB ACCREDITED TESTING
DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	99	
20	93	
14	87	
10	84	
6.3	79	
5	77	
3.35	74	
2	70	
1.18	66	SAND
0.6	61	
0.425	58	
0.3	54	
0.15	43	
0.063	27	SILT/CLAY
0.037	21	
0.027	19	
0.017	17	
0.010	14	
0.007	11	
0.005	9	
0.002	6	

Contract No.	22757	Report No.	R115559
Contract Name:	N63 Liss to Abbey Road		
BH/TP :	TP01		
Sample No.	AA140571	Lab. Sample No.	A20/4798
Sample Type:	B		
Depth (m)	0.70	Customer:	Aecom
Date Received	21/09/2020	Date Testing started	25/09/2020
Description:	Brown sandy, slightly gravelly, SILT		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

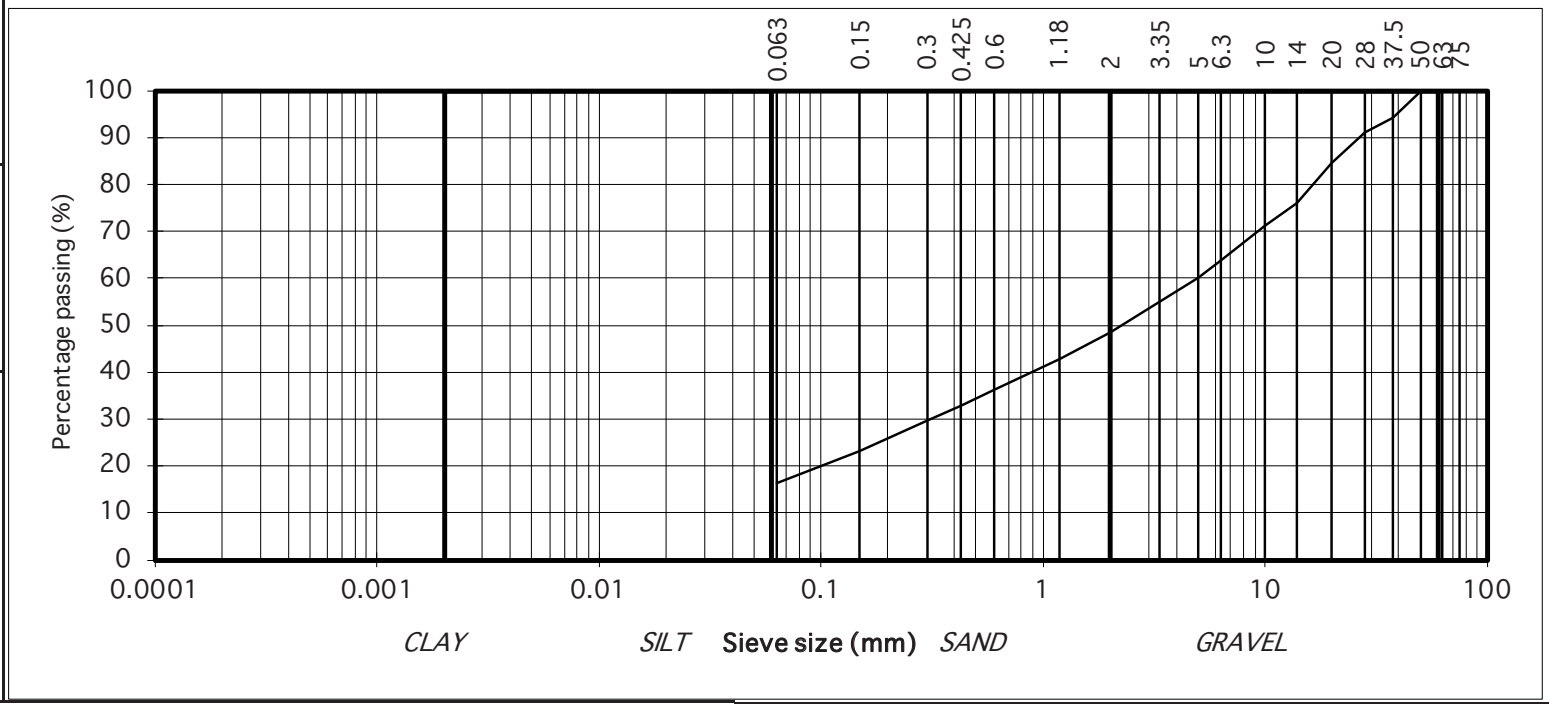
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	94	
28	91	
20	85	
14	76	
10	71	
6.3	64	
5	60	
3.35	55	
2	48	
1.18	43	SAND
0.6	36	
0.425	33	
0.3	30	
0.15	23	
0.063	16	SILT/CLAY

Contract No.	22757	Report No.	R115629
Contract Name:	N63 Liss to Abbey Road		
BH/TP :	TP03		
Sample No.	AA140567	Lab. Sample No.	A20/4800
Sample Type:	B		
Depth (m)	0.70	Customer:	Aecom
Date Received	21/09/2020	Date Testing started	25/09/2020
Description:	Grey clayey/silty, very sandy, GRAVEL		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

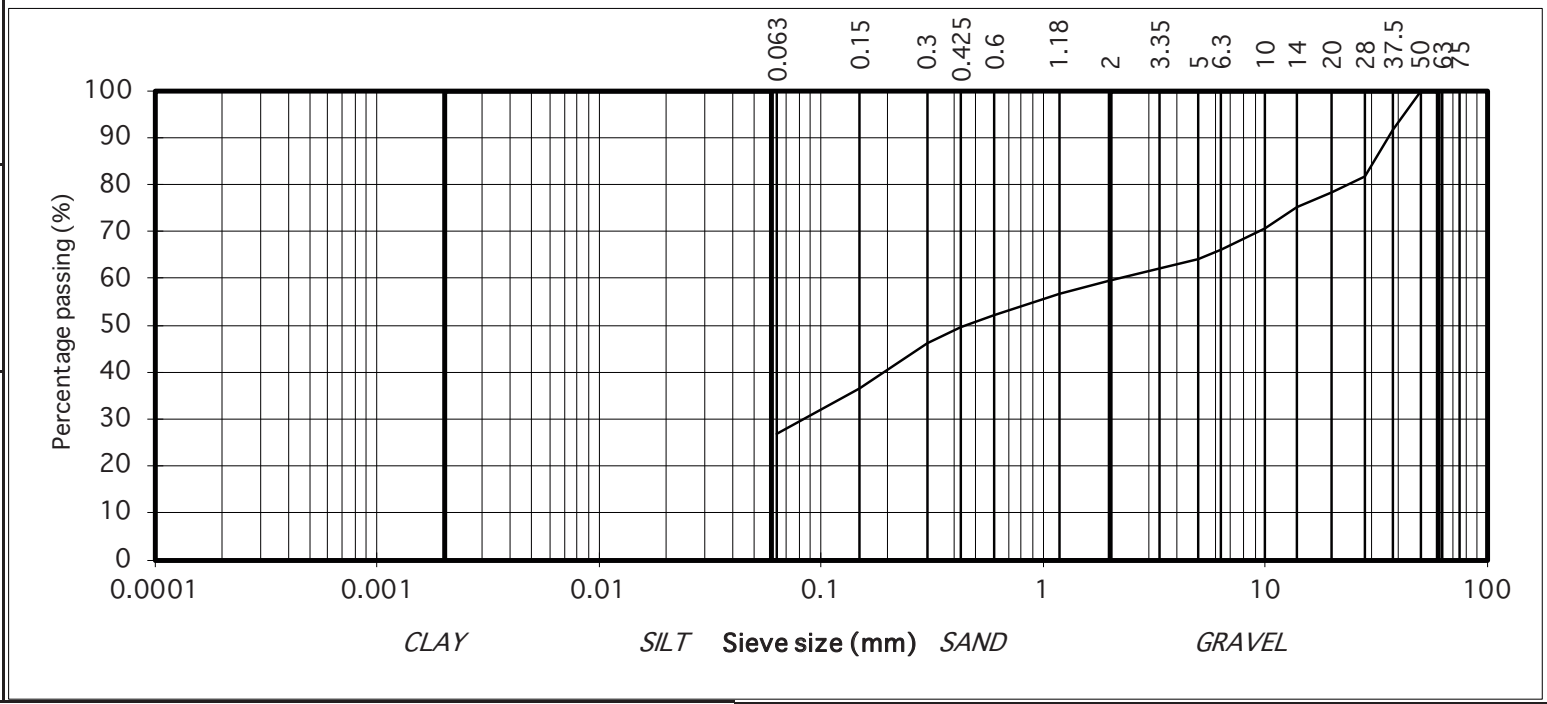
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	92	
28	82	
20	78	
14	75	
10	71	
6.3	66	
5	64	
3.35	62	
2	60	
1.18	57	SAND
0.6	52	
0.425	50	
0.3	46	
0.15	37	
0.063	27	SILT/CLAY

Contract No.	22757	Report No.	R115560
Contract Name:	N63 Liss to Abbey Road		
BH/TP :	TP03		
Sample No.	AA140568	Lab. Sample No.	A20/4801
Sample Type:	B		
Depth (m)	2.20	Customer:	Aecom
Date Received	21/09/2020	Date Testing started	25/09/2020
Description:	Brown slightly sandy, gravelly, SILT		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

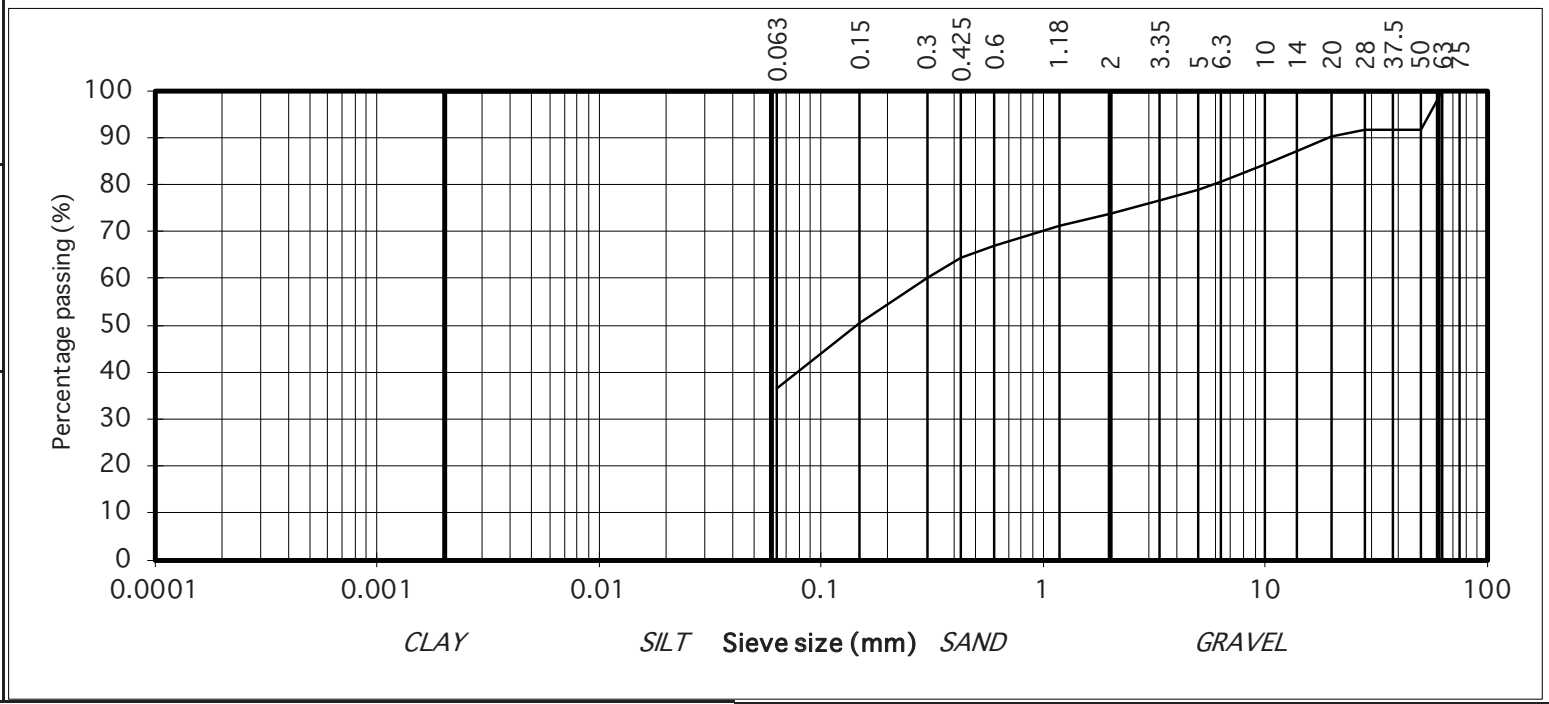
ISO 17025 INAB ACCREDITED TESTING
DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	92	GRAVEL
37.5	92	
28	92	
20	90	
14	87	
10	84	
6.3	81	
5	79	
3.35	77	
2	74	
1.18	71	SAND
0.6	67	
0.425	64	
0.3	60	
0.15	50	
0.063	37	SILT/CLAY

Contract No.	22757	Report No.	R115630
Contract Name:	N63 Liss to Abbey Road		
BH/TP :	TP04		
Sample No.	AA140555	Lab. Sample No.	A20/4802
Sample Type:	B		
Depth (m)	0.50	Customer:	Aecom
Date Received	21/09/2020	Date Testing started	25/09/2020
Description:	Grey sandy, slightly gravelly, SILT/CLAY		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution

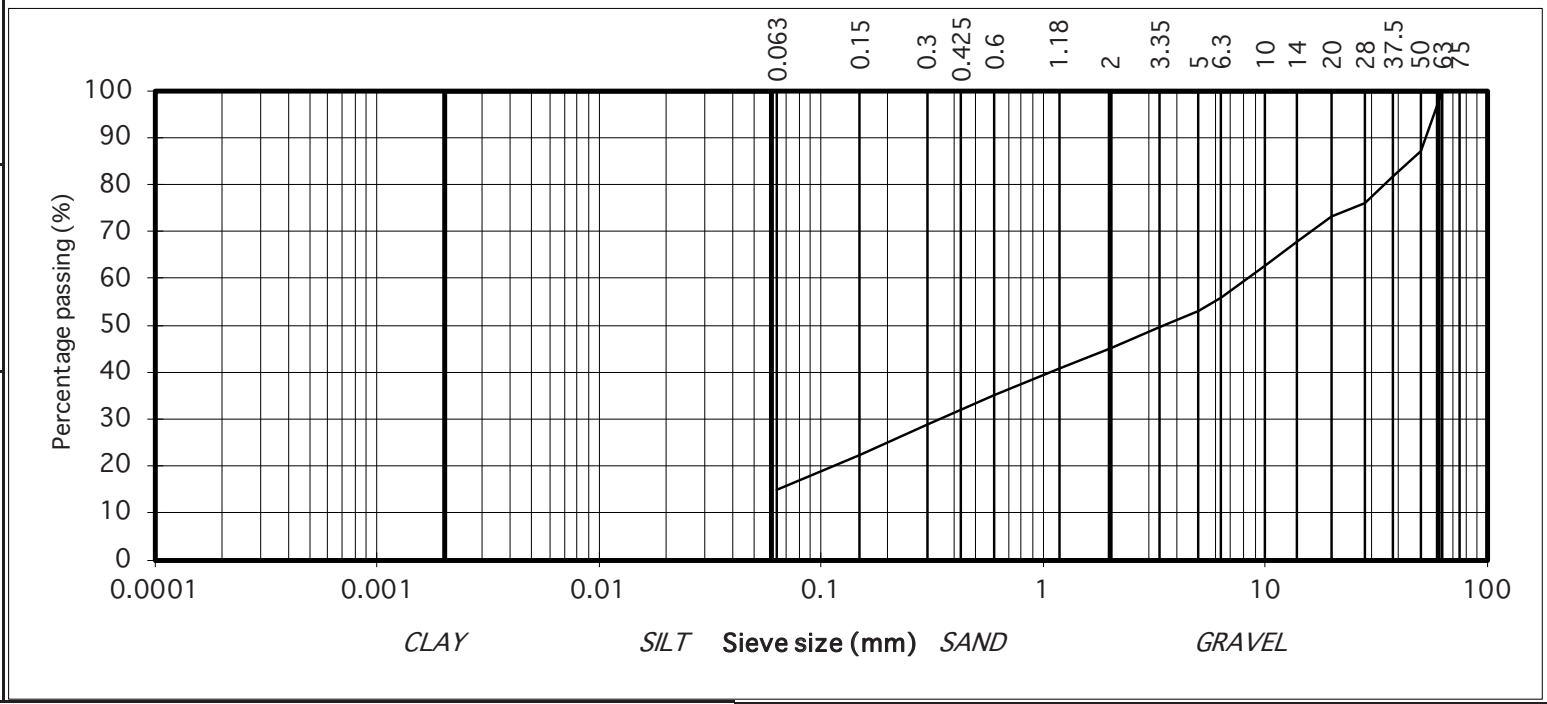
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 1331

particle size	% passing	
75	100	COBBLES
63	100	
50	87	GRAVEL
37.5	82	
28	76	
20	73	
14	68	
10	63	
6.3	56	
5	53	
3.35	50	
2	45	
1.18	41	SAND
0.6	35	
0.425	32	
0.3	29	
0.15	22	
0.063	15	SILT/CLAY

Contract No. 22757 Report No. R115631
Contract Name: N63 Liss to Abbey Road
BH/TP : TP05
Sample No. AA140558 Lab. Sample No. A20/4803
Sample Type: B
Depth (m) 0.50 Customer: Aecom
Date Received 21/09/2020 Date Testing started 25/09/2020
Description: Brown clayey/silty, very sandy, GRAVEL

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received. Sample size did not meet the requirements of BS1377



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution

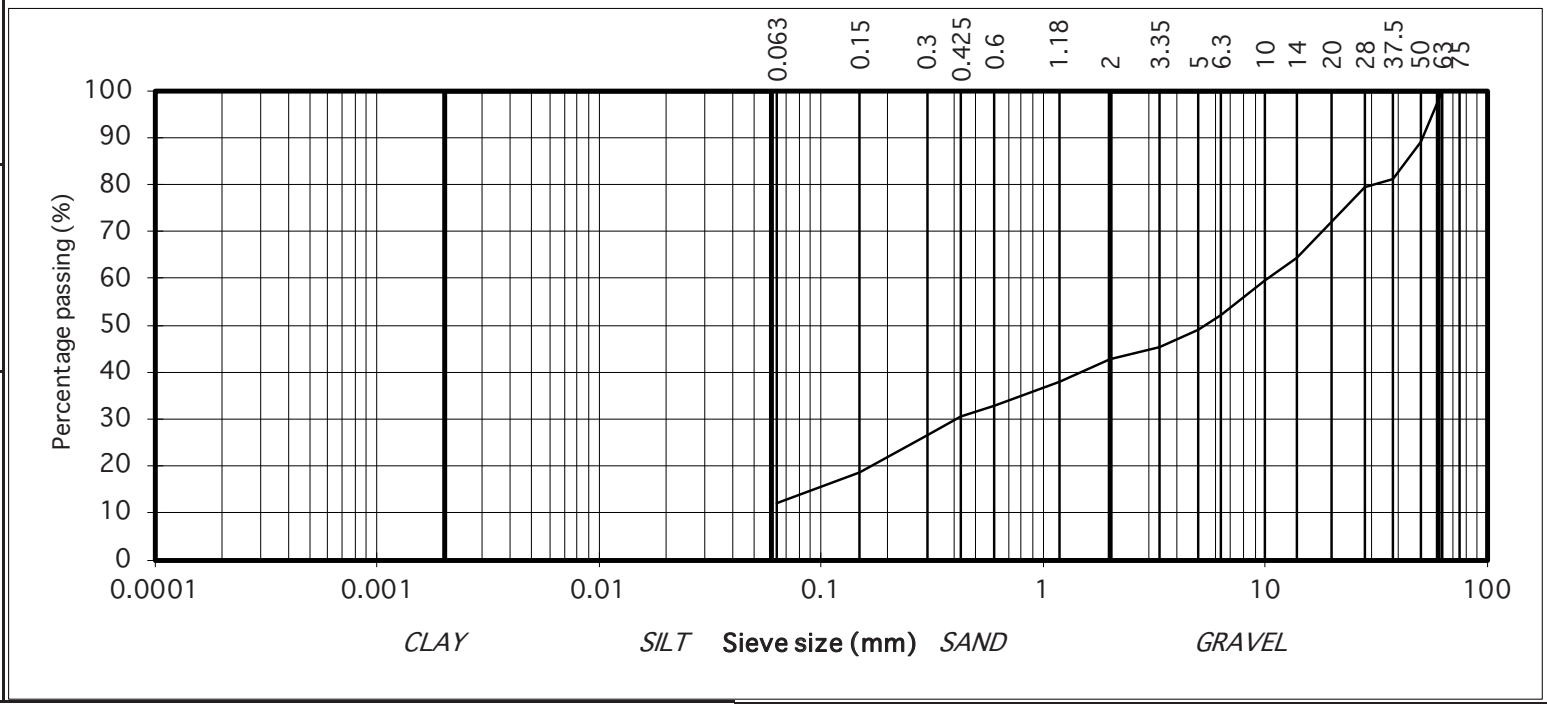
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	89	GRAVEL
37.5	81	
28	79	
20	72	
14	65	
10	60	
6.3	52	
5	49	
3.35	45	
2	43	
1.18	38	SAND
0.6	33	
0.425	30	
0.3	27	
0.15	18	
0.063	12	SILT/CLAY

Contract No. 22757 Report No. R115561
Contract Name: N63 Liss to Abbey Road
BH/TP : TP06
Sample No. AA140563 Lab. Sample No. A20/4805
Sample Type: B
Depth (m) 0.50 Customer: Aecom
Date Received 21/09/2020 Date Testing started 25/09/2020
Description: Brown silty, very sandy, GRAVEL

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received. Sample size did not meet the requirements of BS1377



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	30/10/20	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

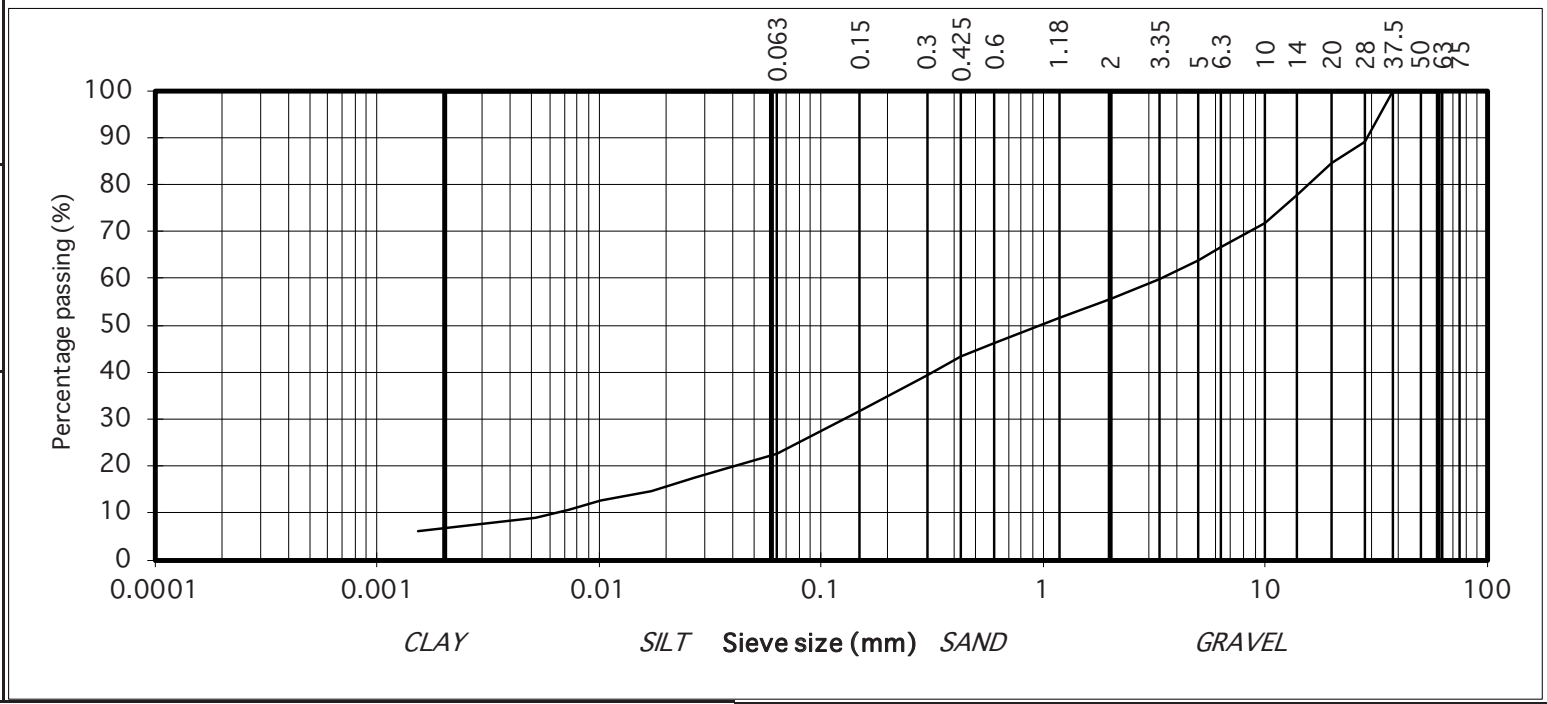
ISO 17025 INAB ACCREDITED TESTING
DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	89	
20	85	
14	78	
10	72	
6.3	67	
5	64	
3.35	60	
2	56	
1.18	52	SAND
0.6	46	
0.425	43	
0.3	39	
0.15	32	
0.063	22	SILT/CLAY
0.037	20	
0.027	17	
0.017	15	
0.010	13	
0.007	11	
0.005	9	
0.002	6	

Contract No.	22757	Report No.	R115632
Contract Name:	N63 Liss to Abbey Road		
BH/TP :	TP07		
Sample No.	AA140565	Lab. Sample No.	A20/4806
Sample Type:	B		
Depth (m)	0.60	Customer:	Aecom
Date Received	21/09/2020	Date Testing started	25/09/2020
Description:	Brown slightly sandy, gravelly, SILT/CLAY		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received. Sample size did not meet the requirements of BS1377



IGSL Ltd Materials Laboratory

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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

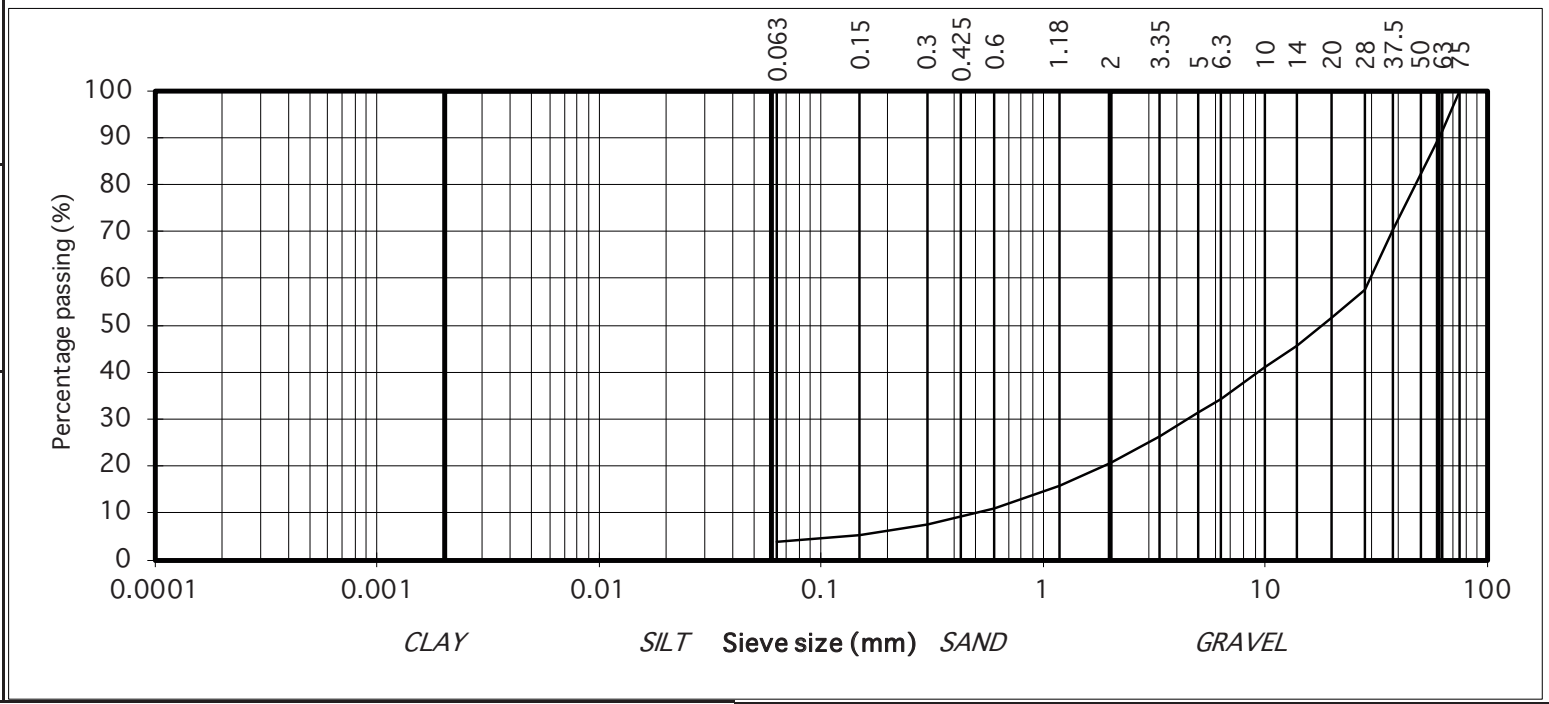
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	92	
50	82	GRAVEL
37.5	70	
28	58	
20	52	
14	46	
10	41	
6.3	34	
5	31	
3.35	26	
2	21	
1.18	16	SAND
0.6	11	
0.425	9	
0.3	8	
0.15	5	
0.063	4	SILT/CLAY

Contract No.	22757	Report No.	R115633
Contract Name:	N63 Liss to Abbey Road		
BH/TP :	TP08		
Sample No.	AA140551	Lab. Sample No.	A20/4807
Sample Type:	B		
Depth (m)	0.50	Customer:	Aecom
Date Received	21/09/2020	Date Testing started	25/09/2020
Description:	Brown slightly clayey/silty, sandy, GRAVEL with some cobbles		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

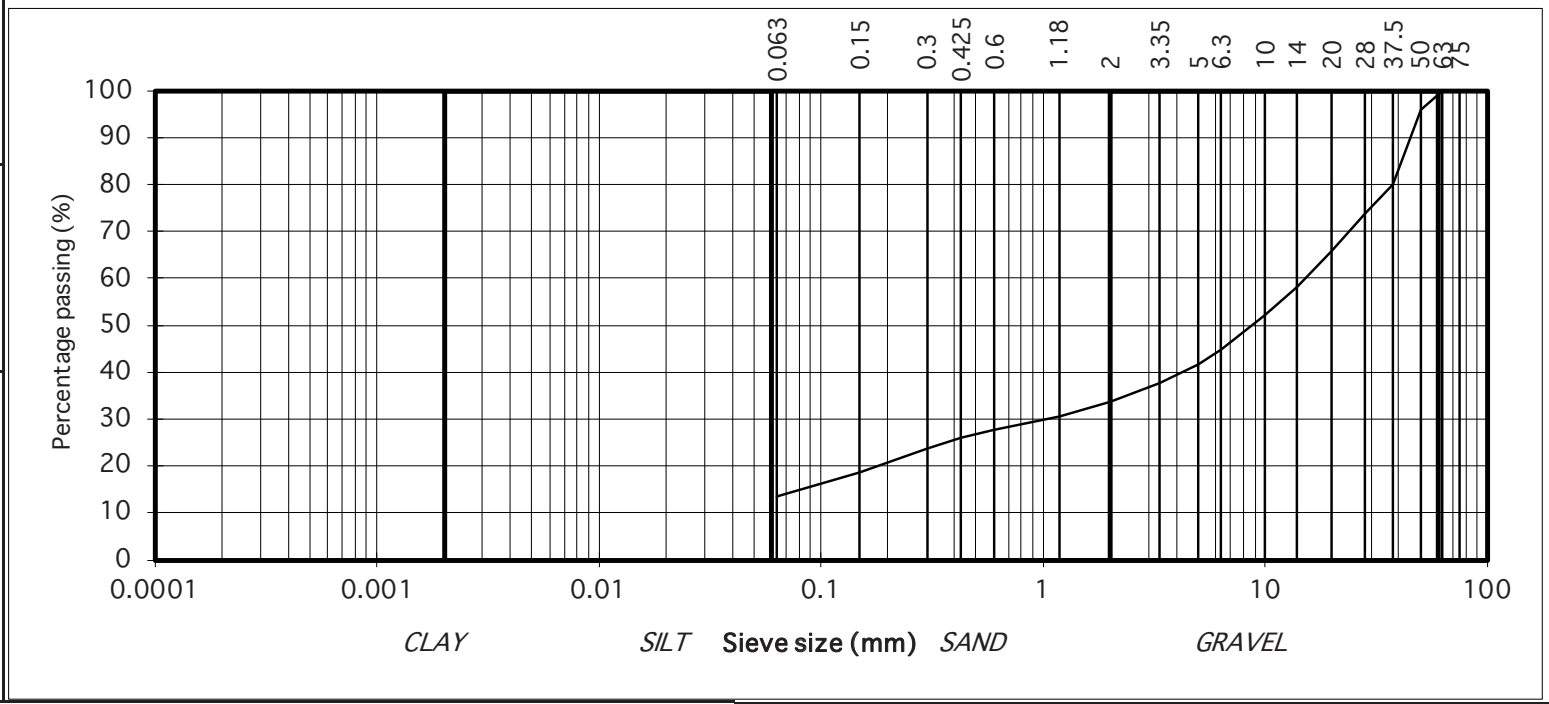
ISO 17025 INAB ACCREDITED TESTING
DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	96	GRAVEL
37.5	80	
28	74	
20	66	
14	58	
10	52	
6.3	45	
5	42	
3.35	38	
2	34	
1.18	31	SAND
0.6	28	
0.425	26	
0.3	24	
0.15	19	
0.063	14	SILT/CLAY

Contract No.	22757	Report No.	R115634
Contract Name:	N63 Liss to Abbey Road		
BH/TP :	TP09		
Sample No.	AA140553	Lab. Sample No.	A20/4808
Sample Type:	B		
Depth (m)	0.50	Customer:	Aecom
Date Received	21/09/2020	Date Testing started	25/09/2020
Description:	Brown clayey/silty, very sandy, GRAVEL		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



IGSL Ltd Materials Laboratory

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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

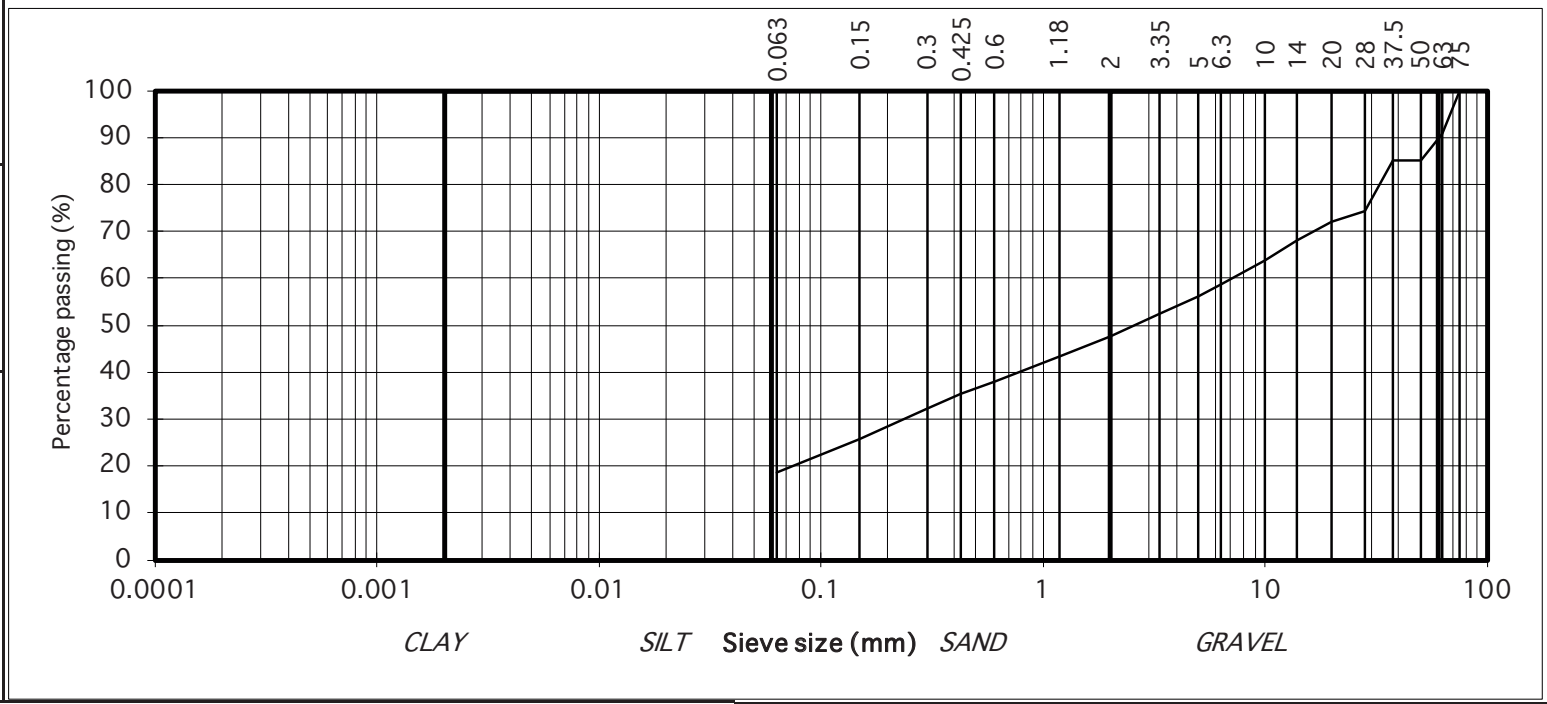
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	91	
50	85	GRAVEL
37.5	85	
28	75	
20	72	
14	68	
10	64	
6.3	59	
5	56	
3.35	52	
2	48	
1.18	43	SAND
0.6	38	
0.425	35	
0.3	32	
0.15	26	
0.063	19	SILT/CLAY

Contract No. 22757 Report No. R115635
Contract Name: N63 Liss to Abbey Road
BH/TP : TP10
Sample No. AA140560 Lab. Sample No. A20/4809
Sample Type: B
Depth (m) 0.50 Customer: Aecom
Date Received 21/09/2020 Date Testing started 25/09/2020
Description: Brown silty, very sandy, GRAVEL with some cobbles

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	30/10/20	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

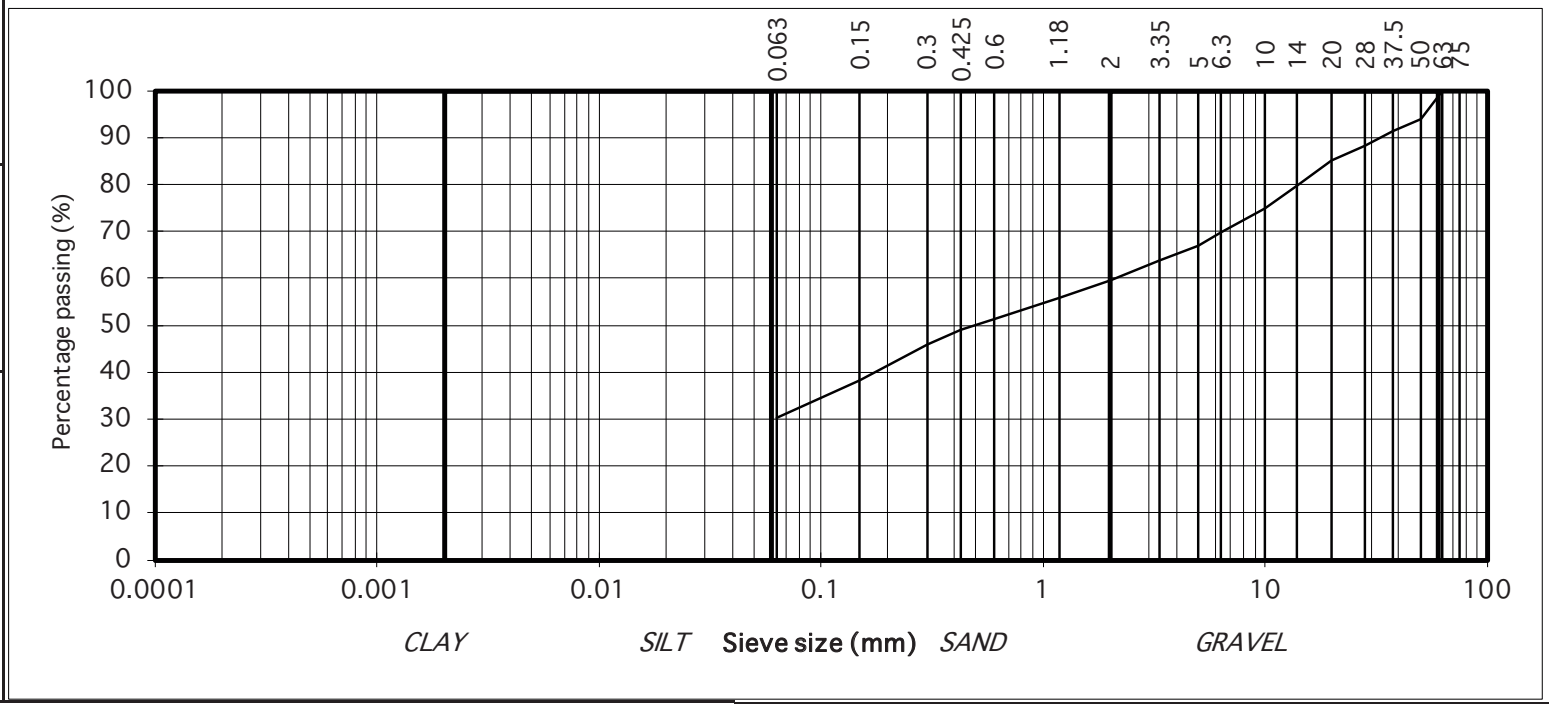
ISO 17025 INAB ACCREDITED TESTING
DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	94	GRAVEL
37.5	91	
28	88	
20	85	
14	80	
10	75	
6.3	70	
5	67	
3.35	64	
2	59	
1.18	56	SAND
0.6	51	
0.425	49	
0.3	46	
0.15	38	
0.063	30	SILT/CLAY

Contract No.	22757	Report No.	R115562
Contract Name:	N63 Liss to Abbey Road		
BH/TP :	TP10		
Sample No.	AA140562	Lab. Sample No.	A20/4810
Sample Type:	B		
Depth (m)	2.50	Customer:	Aecom
Date Received	21/09/2020	Date Testing started	25/09/2020
Description:	Brown slightly sandy, gravelly, SILT/CLAY		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	30/10/20	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

IGSL Ltd
Materials Laboratory
Unit J5,M7 Business Park
Naas
Co. Kildare
045 899324

Test Report

Determination of Moisture Condition Value at Natural Moisture Content

Tested in accordance with BS1377:Part 4:1990, clause 5.4

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Report No.	**R115495**
Contract No.	22751
Contract Name:	N63 - Liss to Abbey Road
Customer:	Aecom
BH/TP	TP01
Sample No.	AA140571
Depth (m)	0.70
Sample Type:	B
Lab Sample No.	A20/4798
Source (if applicable)	unknown
Material Type (if applicable):	B
Sample Received:	21/09/20
Date Tested:	25/09/20
Sample Cert:	N/A
Moisture Content (%):	12
% Particles > 20mm (By dry mass):	29
MCV:	<1
Interpretation of Plot:	Steepest Straight Line
Description of Soil:	Brown sandy, slightly gravelly, SILT

The result applies to the sample as received.
Any remaining material will be retained for one month.
Sampling and opinions and interpretations are outside the scope of accreditation.

Persons authorised to approve reports
J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

IGSL Ltd Materials Laboratory	Approved by	Date	Page
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IGSL Ltd
Materials Laboratory
Unit J5,M7 Business Park
Naas
Co. Kildare
045 899324

Test Report

Determination of Moisture Condition Value at Natural Moisture Content

Tested in accordance with BS1377:Part 4:1990, clause 5.4

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Report No.	**R115498**
Contract No.	22751
Contract Name:	N63 - Liss to Abbey Road
Customer:	Aecom
BH/TP	TP05
Sample No.	AA140558
Depth (m)	0.50
Sample Type:	B
Lab Sample No.	A20/4803
Source (if applicable)	unknown
Material Type (if applicable):	B
Sample Received:	21/09/20
Date Tested:	25/09/20
Sample Cert:	N/A
Moisture Content (%):	12
% Particles > 20mm (By dry mass):	31
MCV:	8.4
Interpretation of Plot:	Steepest Straight Line
Description of Soil:	Brown clayey/silty, very sandy, GRAVEL

The result applies to the sample as received.
Any remaining material will be retained for one month.
Sampling and opinions and interpretations are outside the scope of accreditation.

Persons authorised to approve reports
J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

IGSL Ltd Materials Laboratory	Approved by	Date	Page
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IGSL Ltd
Materials Laboratory
Unit J5,M7 Business Park
Naas
Co. Kildare
045 899324

Test Report

Determination of Moisture Condition Value at Natural Moisture Content

Tested in accordance with BS1377:Part 4:1990, clause 5.4

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Report No.	**R115497**
Contract No.	22751
Contract Name:	N63 - Liss to Abbey Road
Customer:	Aecom
BH/TP	TP06
Sample No.	AA140563
Depth (m)	0.50
Sample Type:	B
Lab Sample No.	A20/4805
Source (if applicable)	unknown
Material Type (if applicable):	B
Sample Received:	21/09/20
Date Tested:	25/09/20
Sample Cert:	N/A
Moisture Content (%):	11
% Particles > 20mm (By dry mass):	32
MCV:	7.6
Interpretation of Plot:	Steepest Straight Line
Description of Soil:	Brown silty, very sandy, GRAVEL

The result applies to the sample as received.
Any remaining material will be retained for one month.
Sampling and opinions and interpretations are outside the scope of accreditation.

Persons authorised to approve reports
J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

IGSL Ltd Materials Laboratory	Approved by	Date	Page
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IGSL Ltd
Materials Laboratory
Unit J5,M7 Business Park
Naas
Co. Kildare
045 899324

Test Report

Determination of Moisture Condition Value at Natural Moisture Content

Tested in accordance with BS1377:Part 4:1990, clause 5.4

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Report No.	**R115496**
Contract No.	22751
Contract Name:	N63 - Liss to Abbey Road
Customer:	Aecom
BH/TP	TP07
Sample No.	AA140565
Depth (m)	0.60
Sample Type:	B
Lab Sample No.	A20/4806
Source (if applicable)	unknown
Material Type (if applicable):	B
Sample Received:	21/09/20
Date Tested:	25/09/20
Sample Cert:	N/A
Moisture Content (%):	9
% Particles > 20mm (By dry mass):	3
MCV:	9
Interpretation of Plot:	Steepest Straight Line
Description of Soil:	Brown slightly sandy, gravelly, SILT/CLAY

The result applies to the sample as received.
Any remaining material will be retained for one month.
Sampling and opinions and interpretations are outside the scope of accreditation.

Persons authorised to approve reports
J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

IGSL Ltd Materials Laboratory	Approved by	Date	Page
	H Byrne	30/10/20	1 of 1

IGSL Ltd
Materials Laboratory
Unit J5, M7 Business Park
Newhall, Naas
Co. Kildare
045 846176

Test Report

Determination of Moisture Content, Liquid & Plastic Limits

Tested in accordance with BS1377:Part 2:1990, clauses 3.2, 4.3, 4.4 & 5.3**

Report No. **R124676** Contract No. 22751 Contract Name: N63 Liss To Abbey Realignment

Customer Aecom/Galway Co.Co.

Samples Received: 15/07/21 Date Tested: 15/07/21

BH/TP*	Sample No.	Depth* (m)	Lab. Ref	Sample Type*	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425µm	Preparation	Liquid Limit Clause	Classification (BS5930)	Description
RC04A	N/A	3.0	A21/3509	B	8.8	19	NP	NP	44	WS	4.4		Brown sandy gravelly SILT
RC04A	N/A	6.0	A21/3510	B	7.9	19	NP	NP	63	WS	4.4		Brown sandy gravelly SILT
RC04A	N/A	10.5	A21/3511	B	7	21	12	9	59	WS	4.4	C L	Brown sandy gravelly CLAY

Notes:
Preparation: WS - Wet sieved; AR - As received; NP - Non plastic
Liquid Limit Clause: 4.3 Cone Penetrometer definitive method; 4.4 Cone Penetrometer one point method
Sample Type: B - Bulk Disturbed; U - Undisturbed

Remarks:
Results relate only to the specimen tested,in as received condition unless otherwise noted.
NOTE: **These clauses have been superceded by EN 17892-1 and EN17892-12.
Opinions and interpretations are outside the scope of accreditation. * denotes Customer supplied information.
This report shall not be reproduced except in fullwithout written approval from the Laboratory.

IGSL Ltd Materials Laboratory

Persons authorized to approve reports
H Byrne (Laboratory Manager)

Approved by	Date	Page
H Byrne	28/07/21	1 of 1

IGSL Ltd
Materials Laboratory
Unit J5, M7 Business Park
Newhall, Naas
Co. Kildare
045 846176

Test Report

Determination of Moisture Content, Liquid & Plastic Limits

Tested in accordance with BS1377:Part 2:1990, clauses 3.2*, 4.3, 4.4 & 5.3

Report No. **R118608** Contract No. 22751 Contract Name: N63 Liss to Abbey Road

Customer Aecom

Samples Received: 20/11/20 Date Tested: 23/11/20

BH/TP	Sample No.	Depth (m)	Lab. Ref	Sample Type	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425µm	Preparation	Liquid Limit Clause	Classification (BS5930)	Description
RC05	N/A	8.2	A20/5903	B	6.5	22	NP	NP	52	WS	4.4		Brown slightly sandy, gravelly, SILT
RC05	N/A	10.2	A20/5904	B	6.7	19	NP	NP	59	WS	4.4		Brown slightly sandy, slightly gravelly, SILT
RC06	N/A	8.5	A20/5905	B	6.4	23	NP	NP	54	WS	4.4		Brown slightly sandy, gravelly, SILT

Notes:
Preparation: WS - Wet sieved; AR - As received; NP - Non plastic
Liquid Limit Clause: 4.3 Cone Penetrometer definitive method; 4.4 Cone Penetrometer one point method
Sample Type: B - Bulk Disturbed; U - Undisturbed

Remarks:
Results apply to the sample as received.
NOTE: *Clause 3.2 of BS1377 is a "withdrawn" standard due to publication of ISO17892-1:2014
Opinions and interpretations are outside the scope of accreditation.
The results relate to the specimens tested. Any remaining material will be retained for one month.

IGSL Ltd Materials Laboratory

Persons authorized to approve reports
H Byrne (Laboratory Manager)

Approved by	Date	Page
H Byrne	16/12/20	1 of 1

TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

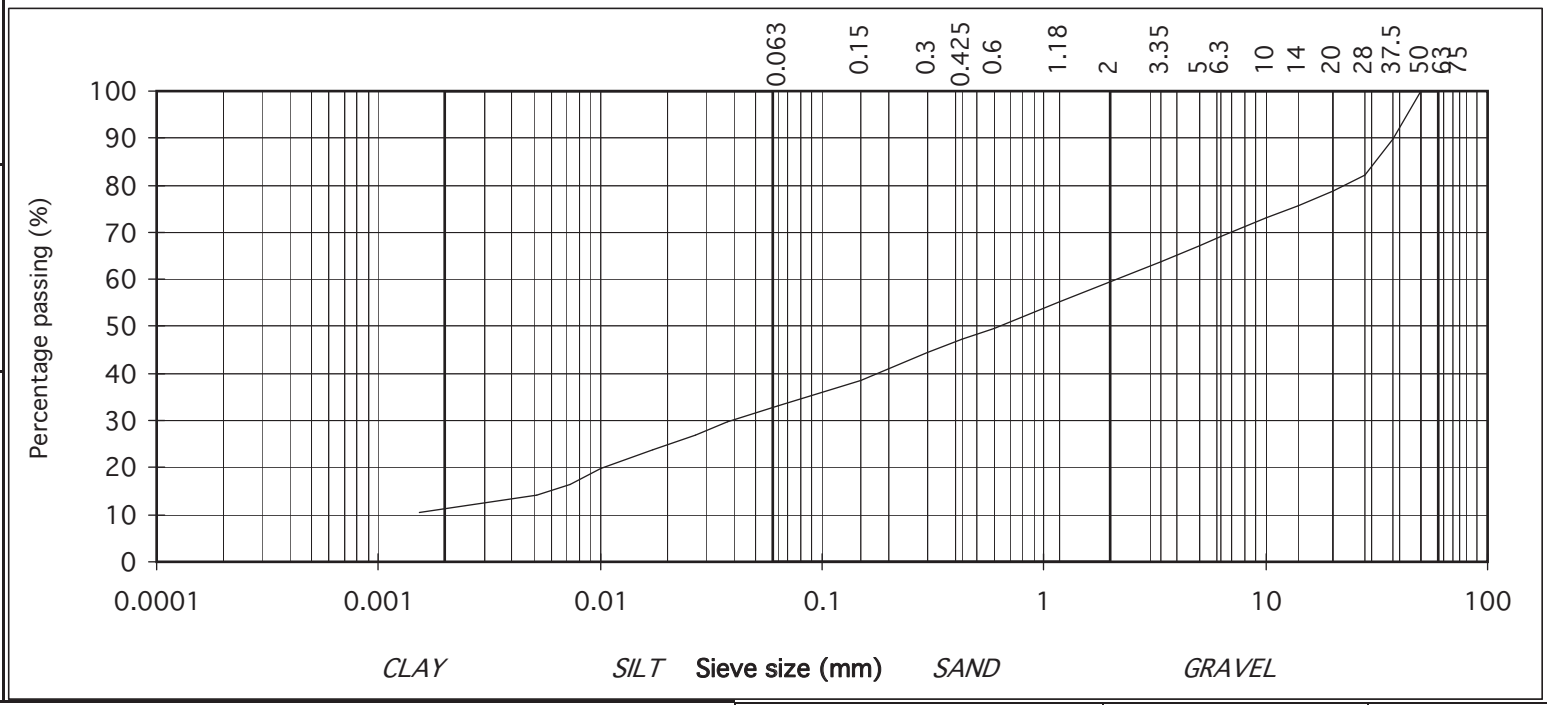
ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 137T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	90	
28	82	
20	79	
14	76	
10	73	
6.3	69	
5	67	
3.35	64	
2	59	
1.18	55	SAND
0.6	50	
0.425	47	
0.3	44	
0.15	39	
0.063	33	SILT/CLAY
0.037	30	
0.027	27	
0.017	24	
0.010	20	
0.007	16	
0.005	14	
0.002	10	

Contract No.	22751	Report No.	R117543
Contract Name:	N63 Liss to Abbey Road		
BH/TP :	RC05		
Sample No.	N/A	Lab. Sample No.	A20/5903
Sample Type:	B		
Depth (m)	8.20	Customer:	Aecom
Date Received	20/11/2020	Date Testing started	23/11/2020
Description:	Brown slightly sandy, gravelly, SILT		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	16/12/20	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

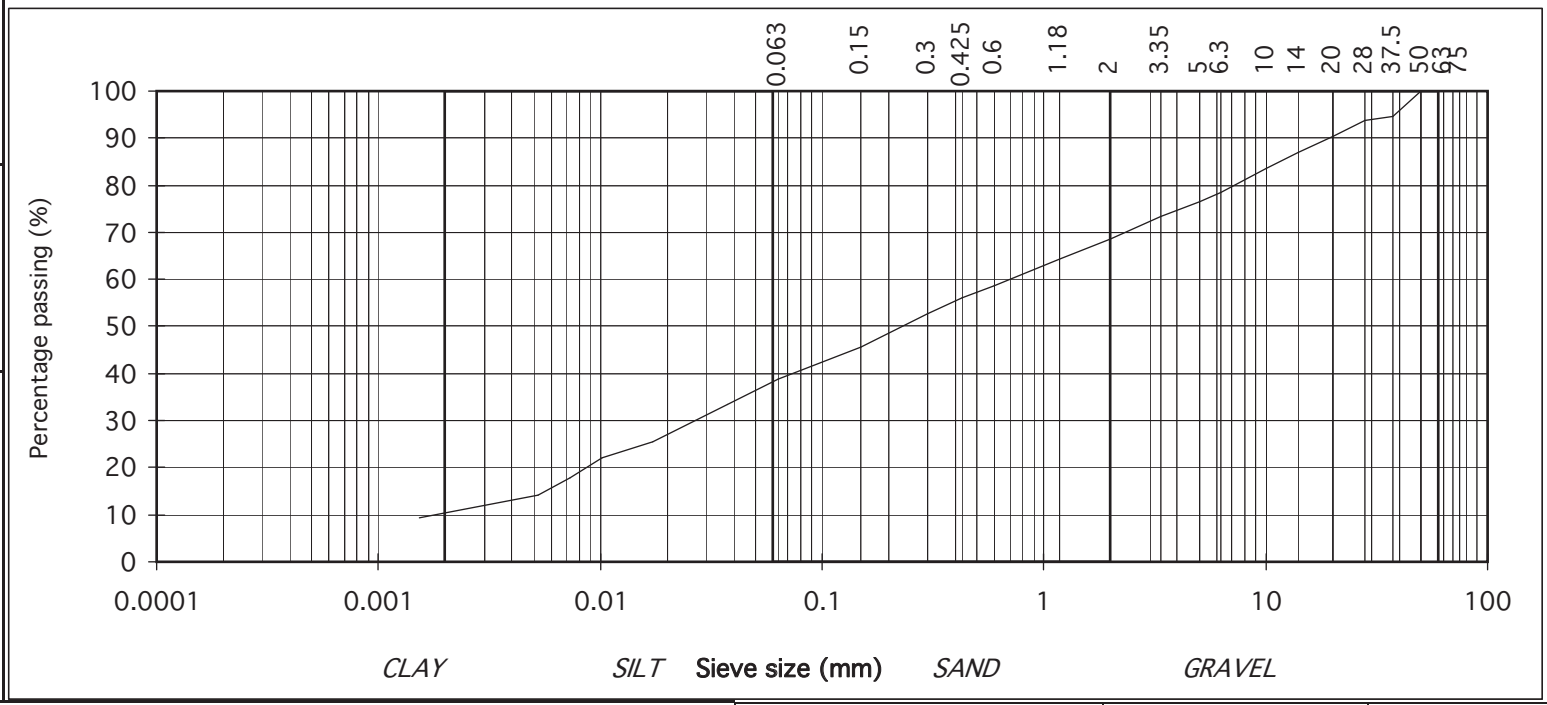
TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	95	
28	94	
20	90	
14	87	
10	84	
6.3	79	
5	76	
3.35	73	
2	69	
1.18	64	SAND
0.6	59	
0.425	56	
0.3	53	
0.15	46	
0.063	39	SILT/CLAY
0.037	34	
0.027	30	
0.017	26	
0.010	22	
0.007	18	
0.005	14	
0.002	9	

Contract No.	22751	Report No.	R117544
Contract Name:	N63 Liss to Abbey Road		
BH/TP :	RC05		
Sample No.	N/A	Lab. Sample No.	A20/5904
Sample Type:	B		
Depth (m)	10.20	Customer:	Aecom
Date Received	20/11/2020	Date Testing started	23/11/2020
Description:	Brown slightly sandy, slightly gravelly, SILT		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received.



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Approved by:	Date:	Page no:
H Byrne	16/12/20	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

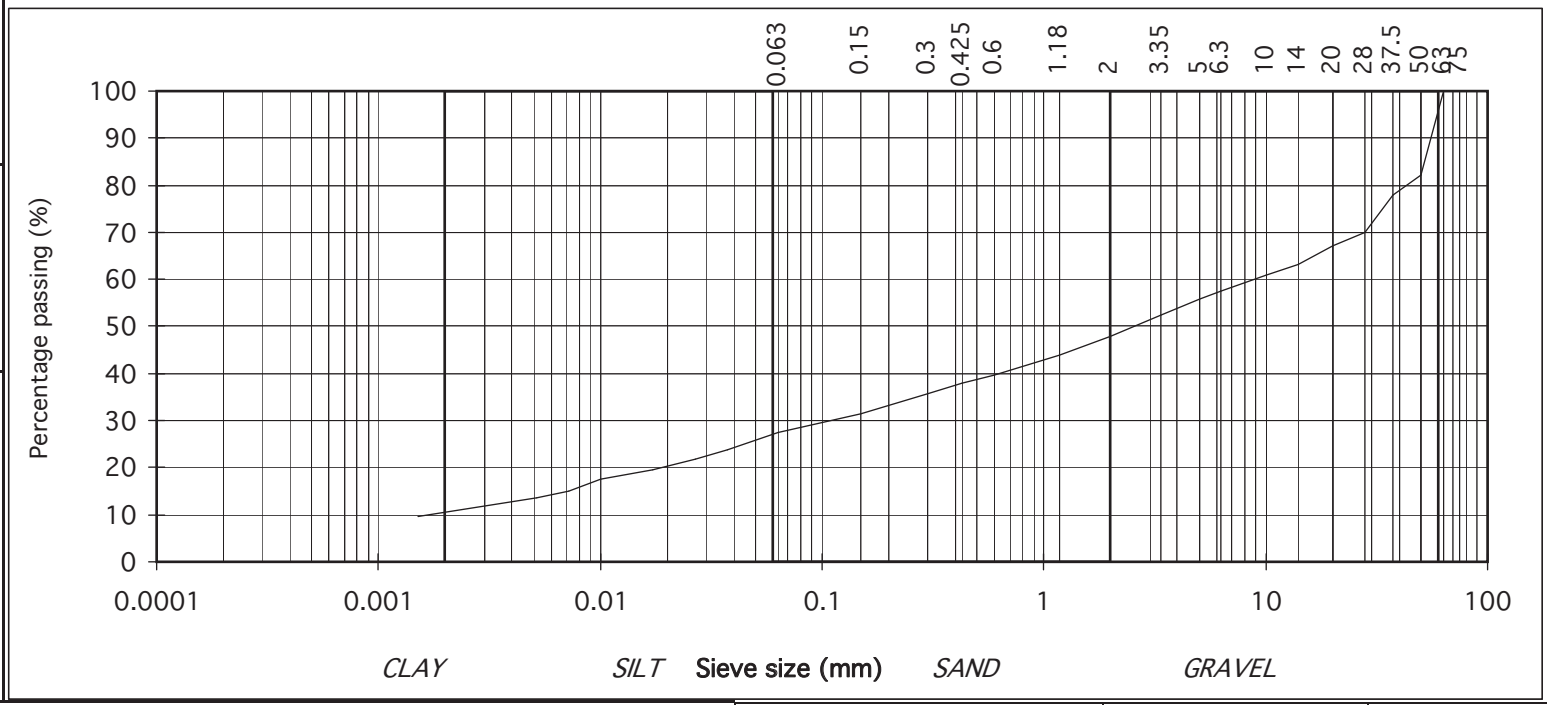
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 134T

particle size	% passing	
75	100	COBBLES
63	100	
50	82	GRAVEL
37.5	78	
28	70	
20	67	
14	63	
10	61	
6.3	58	
5	56	
3.35	52	
2	48	
1.18	44	SAND
0.6	40	
0.425	38	
0.3	36	
0.15	31	
0.063	27	SILT/CLAY
0.037	24	
0.027	22	
0.017	19	
0.010	17	
0.007	15	
0.005	14	
0.002	10	

Contract No.	22751	Report No.	R117545
Contract Name:	N63 Liss to Abbey Road		
BH/TP :	RC06		
Sample No.	N/A	Lab. Sample No.	A20/5905
Sample Type:	B		
Depth (m)	8.50	Customer:	Aecom
Date Received	20/11/2020	Date Testing started	23/11/2020
Description:	Brown slightly sandy, gravelly, SILT		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 . Results apply to sample as received. Sample size did not meet the requirements of BS1377



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	16/12/20	1 of 1

Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

IGSL Ltd
Materials Laboratory
Unit F, M7 Business Park
Naas
Co. Kildare

045-899324

Test Report

Undrained shear strength in triaxial compression
(without pore pressure measurement)

Tested in accordance with BS1377:Part 7:1990 clause 8
(definitive method)*

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 1331

Report no: R117159

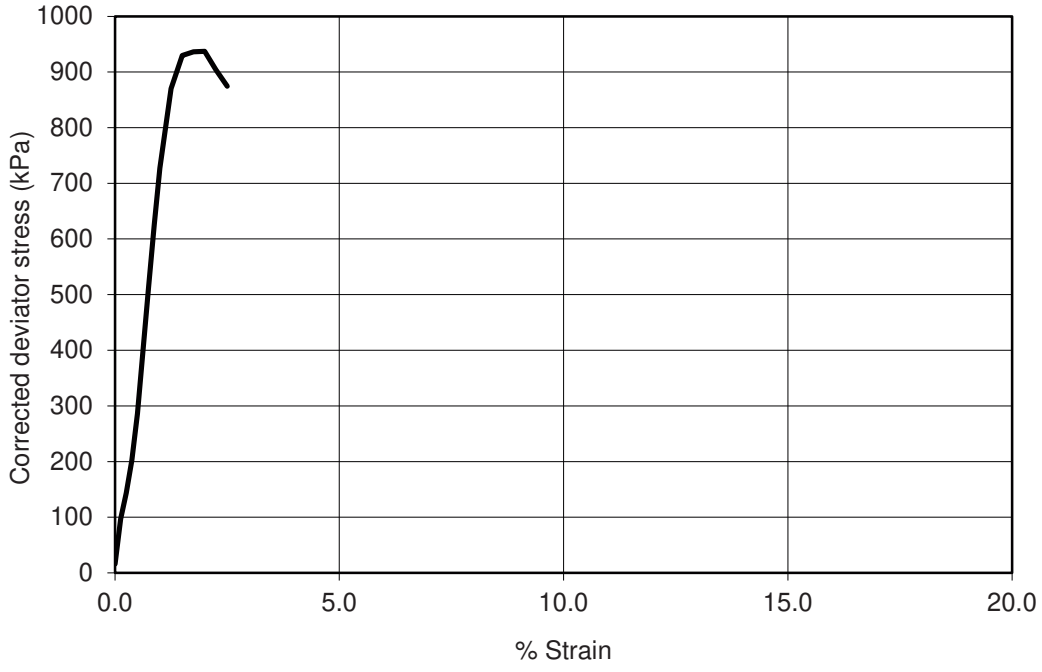
Contract Name: N63 Liss to Abbey Rd Galway Contract No: 22751

Location: RC05 8.2m Sample No. -

Description: Greyish brown slightly sandy slightly gravelly SILT/CLAY

Customer: AECOM

Height (mm)	200	Diameter	102	Cell pressure(kPa)	160
Moisture Content %	6.1	Bulk density (Mg/m^3)	2.34	Dry density (Mg/m^3)	2.21



Strain at failure %	2	Cohesion C_u (kPa) (Undrained shear strength kPa)	469
Rate of strain (%/minute)	0.8		
Thickness of membrane	0.4	Membrane correction (at failure)	0.22
Date received	-	Date tested	27/11/20

The result relates to the specimen in as received condition unless otherwise stated.
Any remaining material will be retained for one month.
*This Standard has been superceded by ISO17892-8:2018

Person authorised to approve report: J Barrett (Quality Manager)

IGSL Ltd.	IGSL Materials Laboratory	Approved by	Date	Page
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IGSL Ltd
Materials Laboratory
Unit F, M7 Business Park
Naas
Co. Kildare

045-899324

Test Report

Undrained shear strength in triaxial compression
(without pore pressure measurement)

Tested in accordance with BS1377:Part 7:1990 clause 8
(definitive method)*

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 1331

Report no: R117160

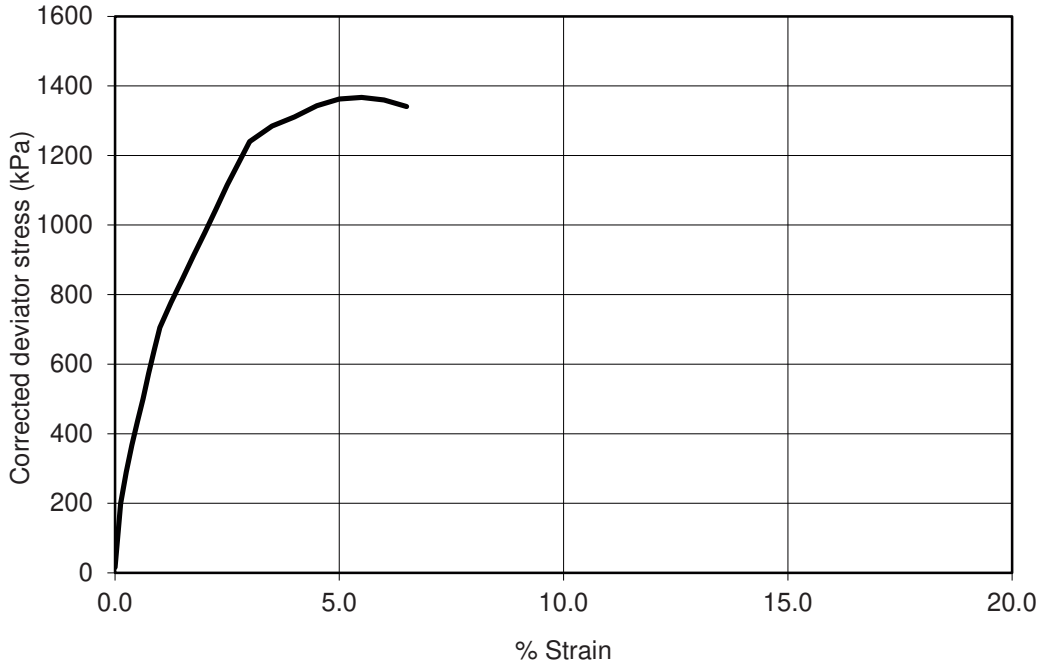
Contract Name: N63 Liss to Abbey Rd Galway Contract No: 22751

Location: RC05 10.2m Sample No. -

Description: Greyish brown slightly sandy slightly gravelly SILT/CLAY

Customer: AECOM

Height (mm)	200	Diameter	102	Cell pressure(kPa)	200
Moisture Content %	6.0	Bulk density (Mg/m^3)	2.39	Dry density (Mg/m^3)	2.25



Strain at failure %	5.5	Cohesion C_u (kPa) (Undrained shear strength kPa)	684
Rate of strain (%/minute)	0.9		
Thickness of membrane	0.4	Membrane correction (at failure)	0.52
Date received	-	Date tested	26/11/20

The result relates to the specimen in as received condition unless otherwise stated.
Any remaining material will be retained for one month.
*This Standard has been superceded by ISO17892-8:2018

Person authorised to approve report: J Barrett (Quality Manager)

		Approved by	Date	Page
IGSL Ltd.	IGSL Materials Laboratory		01/12/20	1 of 1

IGSL Ltd
Materials Laboratory
Unit F, M7 Business Park
Naas
Co. Kildare

045-899324

Test Report

Undrained shear strength in triaxial compression
(without pore pressure measurement)

Tested in accordance with BS1377:Part 7:1990 clause 8
(definitive method)**

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 1331

Report no: R123647

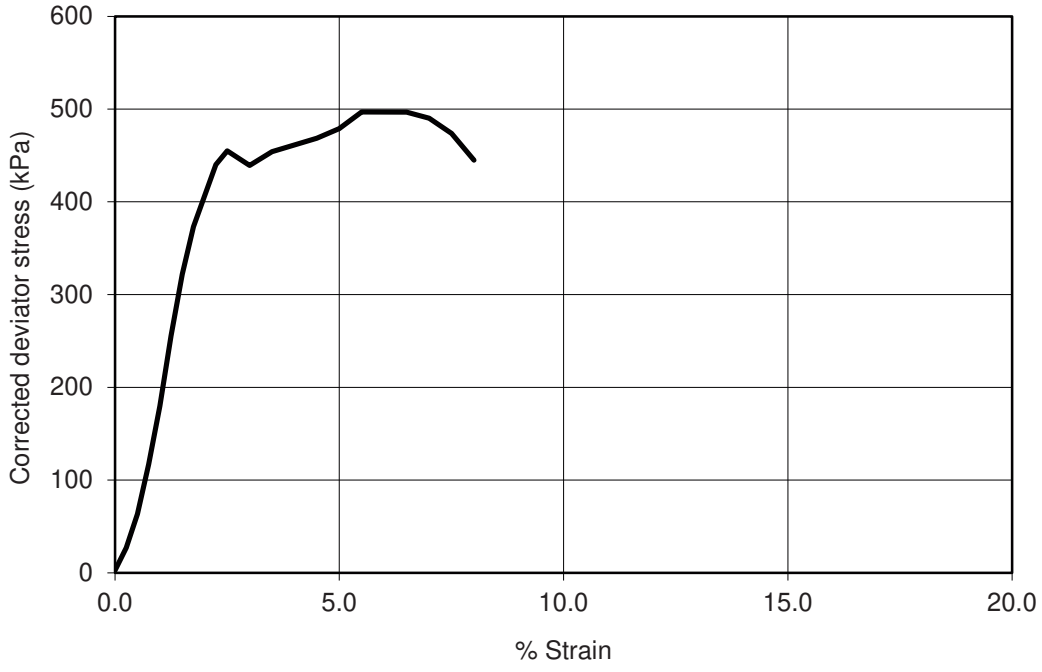
Contract Name: N63 Liss - Abbey Realignment Contract No: 22751

Location*: RC04A 3.0m Sample No*. -

Description: Greyish brown slightly sandy gravelly SILT/CLAY

Customer: Galway County Council

Height (mm)	200	Diameter	102	Cell pressure(kPa)	60
Moisture Content %	6.6	Bulk density (Mg/m^3)	2.38	Dry density (Mg/m^3)	2.23



Strain at failure %	5.5	Cohesion C_u (kPa) (Undrained shear strength kPa)	249
Rate of strain (%/minute)	2.0		
Thickness of membrane	0.4	Membrane correction (at failure)	0.52
Date received	-	Date tested	26/07/21

Results relate only to the specimen tested, in as received condition unless otherwise noted. Opinions and interpretations are outside the scope of accreditation.

* denotes Customer supplied information

**This Standard has been superceded by ISO17892-8:2018

Person authorised to approve report: J Barrett (Quality Manager)

IGSL Ltd.	IGSL Materials Laboratory	Approved by	Date	Page
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IGSL Ltd
Materials Laboratory
Unit F, M7 Business Park
Naas
Co. Kildare

045-899324

Test Report

Undrained shear strength in triaxial compression
(without pore pressure measurement)

Tested in accordance with BS1377:Part 7:1990 clause 8
(definitive method)**

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 1331

Report no: R123648

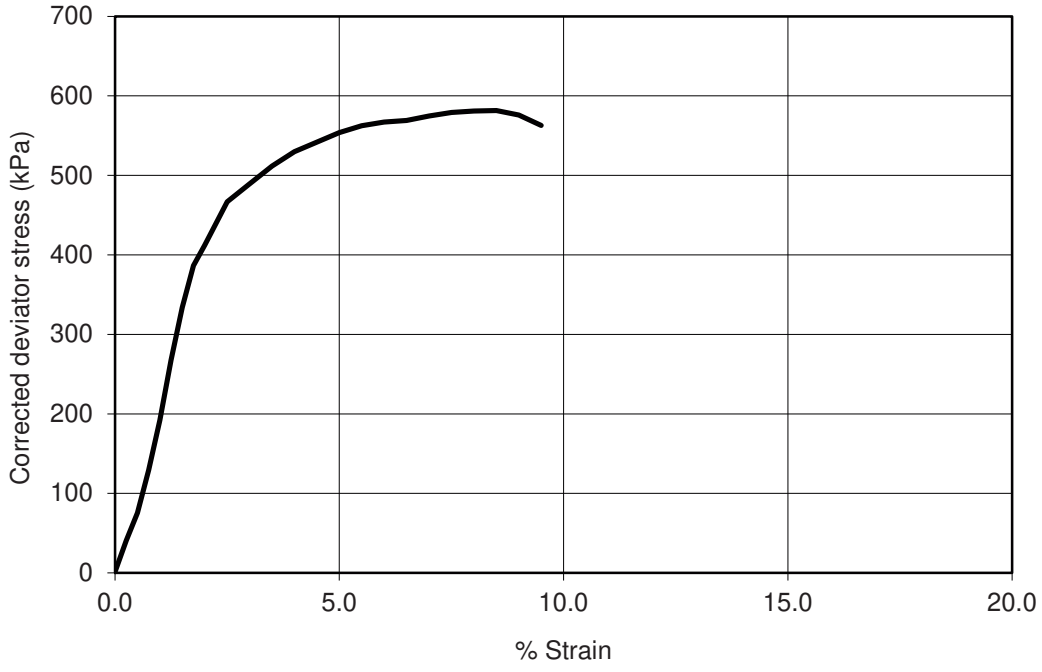
Contract Name: N63 Liss - Abbey Realignment Contract No: 22751

Location*: RC04A 6.0m Sample No*. -

Description: Greyish brown slightly sandy gravelly SILT/CLAY

Customer: Galway County Council

Height (mm)	200	Diameter	102	Cell pressure(kPa)	120
Moisture Content %	6.2	Bulk density (Mg/m^3)	2.39	Dry density (Mg/m^3)	2.25



Strain at failure %	8.5	Cohesion C_u (kPa) (Undrained shear strength kPa)	291
Rate of strain (%/minute)	2.0		
Thickness of membrane	0.4	Membrane correction (at failure)	0.75
Date received	-	Date tested	26/07/21

Results relate only to the specimen tested, in as received condition unless otherwise noted. Opinions and interpretations are outside the scope of accreditation.

* denotes Customer supplied information

**This Standard has been superceded by ISO17892-8:2018

Person authorised to approve report: J Barrett (Quality Manager)

IGSL Ltd.	IGSL Materials Laboratory	Approved by	Date	Page
			27/07/21	1 of 1

Anomalous Sample Notification

From Justin Barrett

To C Kilally /D O shea

Date:27-7-21

Contract Name: N63 Liss To Abbey Realignment Contract Number 22751

After examination of the samples and your test requirements, we have identified the following anomalies. Please could you issue further instructions or tick the Take No Action Box.

							For Engineers Use	
Client Sample Ref.	Lab. Sample No.	Test(s) required	Sample not received	Insufficient material for test(s)	Inadequate instruction	Other	Take no action	Client/Engineer Instruction
RC04 @10.5m	A21/3511					Undrained Shear Strength not possible due to the cobble content of the Geobore at that depth		

Signed (Laboratory Manager) J Barrett

Appendix 7

Rock Strength Testing

(Diametrial) POINT LOAD STRENGTH INDEX TEST DATA

Contract: N63 - Liss to Abbey Realignmer
Contract no. 22751
Date of test: 20/11/20

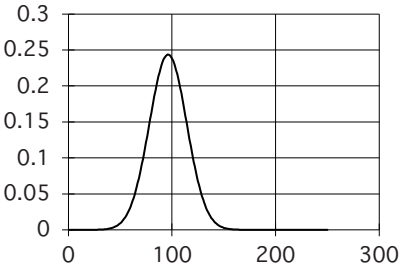
Sample Type: Core

RC No.	Depth m	D (Diameter) mm	P (failure load) kN	F	Is (index strength) Mpa	Is(50) (index strength) Mpa	*UCS MPa	Type	Orienation
RC03	15.6	78	28.0	1.222	4.60	5.62	112	d	//
	16.6	78	22.0	1.222	3.62	4.42	88	d	//
	17.1	78	32.0	1.222	5.26	6.42	128	d	//
RC05	13.1	102	36.0	1.378	3.46	4.77	95	d	//
	13.3	102	32.0	1.378	3.08	4.24	85	d	//
	13.9	78	29.0	1.222	4.77	5.82	116	d	//
	14.4	78	26.0	1.222	4.27	5.22	104	d	//
RC06	10.6	102	28.0	1.378	2.69	3.71	74	d	//
	10.9	102	34.0	1.378	3.27	4.50	90	d	//
	11.5	102	36.0	1.378	3.46	4.77	95	d	//
	11.6	102	26.0	1.378	2.50	3.44	69	d	//

Statistical Summary Data	Is(50)	UCS*
Number of Samples Tested	11	11
Minimum	3.44	69
Average	4.81	96
Maximum	6.42	128
Standard Dev.	0.90	18
Upper 95% Confidence Limit	6.58	131.57
Lower 95% Confidence Limit	3.05	60.95

Comments:
*UCS taken as k x Point Load Is(50): k= 20

*UCS Normal Distribution Curve



Abbreviations	
i	irregular
a	axial
b	block
d	diametral

approx. orientation to planes of weakness/bedding

U	unknown
P	perpendicular
//	parallel

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	N63 - Liss to Abbey Realignment
Job Number:	22751
Hole No:	RC03
Depth (m):	13.40m

Sample Description

Colour:	Blueish grey
Grain size:	Fine to medium-grained
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

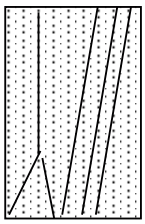
Sample Measurements

Length	199	
Diameter (Ø)	78.1	mm

Testing

Load Rate	4.3	kN/min
Load at Failure (P)	351	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength $= \dfrac{351000}{4788.19385}$

$= \dfrac{1000 \times P}{\prod \times (Ø/2)^2}$

$=$ 73.27 (Mpa)

Bulk Density $=$ 2.65 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	N63 - Liss to Abbey Realignment
Job Number:	22751
Hole No:	RC03
Depth (m):	14.40m

Sample Description

Colour:	Blueish grey
Grain size:	Fine to medium-grained
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

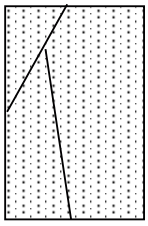
Sample Measurements

Length	211	
Diameter (Ø)	78.1	mm

Testing

Load Rate	4.3	kN/min
Load at Failure (P)	398	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength $= \dfrac{398000}{4788.19385}$

$= \dfrac{1000 \times P}{\prod \times (Ø/2)^2}$

= 83.08 (Mpa)

Bulk Density = 2.66 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	N63 - Liss to Abbey Realignment
Job Number:	22751
Hole No:	RC03
Depth (m):	15.40m

Sample Description

Colour:	Blueish grey
Grain size:	Fine to medium-grained
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

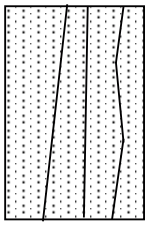
Sample Measurements

Length	198	
Diameter (Ø)	78	mm

Testing

Load Rate	4.3	kN/min
Load at Failure (P)	343	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength $= \dfrac{343000}{4775.94}$

$= \dfrac{1000 \times P}{\prod \times (Ø/2)^2}$

$=$ 71.78 (Mpa)

Bulk Density $=$ 2.69 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	N63 - Liss to Abbey Realignment
Job Number:	22751
Hole No:	RC04
Depth (m):	12.30m

Sample Description

Colour:	Blueish grey
Grain size:	Fine to medium-grained
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

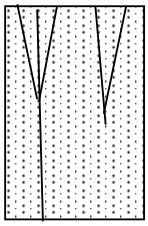
Sample Measurements

Length	180	
Diameter (Ø)	78	mm

Testing

Load Rate	4.3	kN/min
Load at Failure (P)	397	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength $= \dfrac{397000}{4775.94}$

$= \dfrac{1000 \times P}{\prod \times (Ø/2)^2}$

$= 83.08$ (Mpa)

Bulk Density $= 2.63$ (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	N63 - Liss to Abbey Realignment
Job Number:	22751
Hole No:	RC04
Depth (m):	12.80m

Sample Description

Colour:	Blueish grey
Grain size:	Fine to medium-grained
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

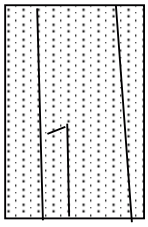
Sample Measurements

Length	198	
Diameter (Ø)	78	mm

Testing

Load Rate	4.3	kN/min
Load at Failure (P)	213	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength $= \dfrac{213000}{4775.94}$

$= \dfrac{1000 \times P}{\prod \times (Ø/2)^2}$

$= 44.58$ (Mpa)

Bulk Density $= 2.63$ (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	N63 - Liss to Abbey Realignment
Job Number:	22751
Hole No:	RC05
Depth (m):	11.30m

Sample Description

Colour:	Blueish grey
Grain size:	Fine to medium-grained
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

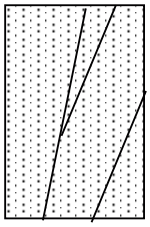
Sample Measurements

Length	218	
Diameter (Ø)	102	mm

Testing

Load Rate	4.3	kN/min
Load at Failure (P)	418	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength $= \dfrac{418000}{8167.14}$

$= \dfrac{1000 \times P}{\prod \times (Ø/2)^2}$

$=$ 51.15 (Mpa)

Bulk Density $=$ 2.66 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	N63 - Liss to Abbey Realignment
Job Number:	22751
Hole No:	RC05
Depth (m):	12.80m

Sample Description

Colour:	Blueish grey
Grain size:	Fine to medium-grained
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

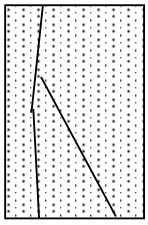
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	232	
Diameter (Ø)	102	mm

Sketch of Failure Surfaces



Testing

Load Rate	4.3	kN/min
Load at Failure (P)	546	kN

Strength Calculations

Uniaxial Compressive Strength $= \dfrac{546000}{8167.14}$

$= \dfrac{1000 \times P}{\prod \times (Ø/2)^2}$

$=$ 66.82 (Mpa)

Bulk Density $=$ 2.67 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	N63 - Liss to Abbey Realignment
Job Number:	22751
Hole No:	RC06
Depth (m):	9.90m

Sample Description

Colour:	Blueish grey
Grain size:	Fine to medium-grained
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

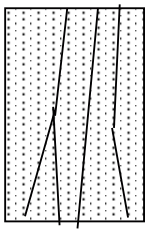
Sample Measurements

Length	228	
Diameter (Ø)	102	mm

Testing

Load Rate	4.3	kN/min
Load at Failure (P)	292	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength $= \dfrac{292000}{8167.14}$

$= \dfrac{1000 \times P}{\prod \times (Ø/2)^2}$

$= 35.73$ (Mpa)

Bulk Density $= 2.63$ (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	N63 - Liss to Abbey Realignment
Job Number:	22751
Hole No:	RC06
Depth (m):	14.70m

Sample Description

Colour:	Blueish grey
Grain size:	Fine to medium-grained
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

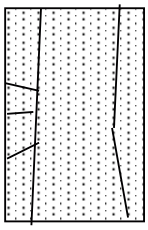
Sample Measurements

Length	204	
Diameter (Ø)	78	mm

Testing

Load Rate	4.3	kN/min
Load at Failure (P)	361	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength $= \dfrac{361000}{4775.94}$

$= \dfrac{1000 \times P}{\prod \times (Ø/2)^2}$

$= 75.55$ (Mpa)

Bulk Density $= 2.66$ (Mg/m^3)

Notes:

Appendix 8

Chemical Laboratory Testing
(Eurofins Chemtest Laboratory)

Report Numbers
20-26415
20-32218
21-25176

eurofins | Chemtest
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

UKAS TESTING
2183

Final Report

Report No.:	20-26415-1		
Initial Date of Issue:	09-Oct-2020		
Client	IGSL		
Client Address:	M7 Business Park Naas County Kildare Ireland		
Contact(s):	Darren Keogh		
Project	22751 N63 LISS TO ABBEY ROAD		
Quotation No.:		**Date Received:**	01-Oct-2020
Order No.:		**Date Instructed:**	01-Oct-2020
No. of Samples:	9		
Turnaround (Wkdays):	7	**Results Due:**	09-Oct-2020
Date Approved:	09-Oct-2020		

Approved By:

Details: Glynn Harvey, Technical Manager

Results - Soil

Project: 22751 N63 LISS TO ABBEY ROAD

Client: IGSL			**Chemtest Job No.:**		20-26415	20-26415	20-26415	20-26415	20-26415	20-26415	20-26415	20-26415	20-26415
Quotation No.:			**Chemtest Sample ID.:**		1073247	1073248	1073249	1073250	1073251	1073253	1073254	1073256	1073257
Order No.:			Client Sample Ref.:			AA134305	AA134307	AA136188	AA134315	AA134328	AA134329	AA140553	AA140560
			Sample Location:		BH01	BH03	BH03	BH04A	BH05A	BH06	BH09A	TP09	TP10
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		1.00	4.00	6.00	1.00	3.00	5.00	1.00	0.50	0.50
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
Moisture	N	2030	%	0.020	12	7.2	8.6	2.6	9.3	10	9.8	9.5	7.8
pH	U	2010		4.0		[A] 9.1	[A] 9.0	[A] 8.4	[A] 8.8	[A] 8.8	[A] 8.9	[A] 8.7	[A] 9.0
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010		[A] < 0.010	[A] < 0.010	[A] 0.017	[A] < 0.010	[A] < 0.010	[A] < 0.010	[A] < 0.010	[A] < 0.010
Sulphate (Total)	U	2430	mg/kg	100		[A] < 100	[A] < 100	[A] 110	[A] < 100	[A] < 100	[A] < 100	[A] 200	[A] < 100
Sulphate (Acid Soluble)	U	2430	%	0.010		[A] 0.041	[A] 0.028	[A] 0.10	[A] 0.025	[A] 0.033	[A] 0.025	[A] 0.041	[A] 0.025
Organic Matter	U	2625	%	0.40	[A] < 0.40								

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request.The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1073247			BH01		A	Amber Glass 250ml
1073247			BH01		A	Plastic Tub 500g
1073248	AA134305		BH03		A	Amber Glass 250ml
1073249	AA134307		BH03		A	Amber Glass 250ml
1073250	AA136188		BH04A		A	Amber Glass 250ml
1073251	AA134315		BH05A		A	Amber Glass 250ml
1073253	AA134328		BH06		A	Amber Glass 250ml
1073254	AA134329		BH09A		A	Amber Glass 250ml
1073256	AA140553		TP09		A	Amber Glass 250ml
1073257	AA140560		TP10		A	Amber Glass 250ml

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.

Report Information

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I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

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A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

eurofins | Chemtest
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

UKAS TESTING
2183

Final Report

Report No.:	20-32218-1
Initial Date of Issue:	30-Nov-2020
Client	IGSL
Client Address:	M7 Business Park Naas County Kildare Ireland
Contact(s):	Darren Keogh
Project	22751 N63 - Liss to Abbey Realignment

Quotation No.:		**Date Received:**	25-Nov-2020
Order No.:		**Date Instructed:**	25-Nov-2020
No. of Samples:	7		
Turnaround (Wkdays):	7	**Results Due:**	03-Dec-2020
Date Approved:	30-Nov-2020		

Approved By:

Details: Glynn Harvey, Technical Manager

Results - Soil

Project: 22751 N63 - Liss to Abbey Realignment

Client: IGSL		**Chemtest Job No.:**			20-32218	20-32218	20-32218	20-32218	20-32218	20-32218	20-32218
Quotation No.:		**Chemtest Sample ID.:**			1103107	1103108	1103109	1103110	1103111	1103112	1103113
		Sample Location:			RC03	RC04	RC05	RC05	RC05	RC06	RC06
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			13.40	13.40	8.20	10.40	11.30	8.50	14.70
		Date Sampled:			20-Nov-2020	20-Nov-2020	20-Nov-2020	20-Nov-2020	20-Nov-2020	20-Nov-2020	20-Nov-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**							
Moisture	N	2030	%	0.020	0.62	0.52	3.5	2.0	0.25	6.0	0.36
pH	U	2010		4.0	8.7	9.0	8.8	9.0	9.2	8.8	8.9
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.11	< 0.010	< 0.010	< 0.010	0.032	< 0.010	< 0.010

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES

Report Information

Key

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SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
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I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
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All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

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C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

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If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

2183

eurofins | Chemtest
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	21-25176-1
Initial Date of Issue:	27-Jul-2021
Client	IGSL
Client Address:	M7 Business Park Naas County Kildare Ireland
Contact(s):	Darren Keogh
Project	N63 22751
Quotation No.:	Q20-21693
Order No.:	
No. of Samples:	5
Turnaround (Wkdays):	7
Date Approved:	27-Jul-2021
Approved By:	
Details:	Glynn Harvey, Technical Manager

Date Received:	22-Jul-2021
Date Instructed:	22-Jul-2021
Results Due:	30-Jul-2021

Results - Soil

Project: N63 22751

Client: IGSL		**Chemtest Job No.:**			21-25176	21-25176	21-25176	21-25176	21-25176
Quotation No.: Q20-21693		**Chemtest Sample ID.:**			1245405	1245406	1245407	1245408	1245409
		Sample Location:			RC04A	RC04A	RC04A	RC04A	RC04A
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			10.5	3.0	6.0	12.0	14.0
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
Moisture	N	2030	%	0.020	5.6	6.0	6.6	9.4	0.15
pH (2.5:1)	N	2010		4.0	[A] 8.4	[A] 8.9	[A] 8.8	[A] 8.5	[A] 8.8
Magnesium (Water Soluble)	N	2120	g/l	0.010	[A] < 0.010	[A] < 0.010	[A] < 0.010	[A] < 0.010	[A] < 0.010
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	[A] < 0.010	[A] < 0.010	[A] < 0.010	[A] 0.044	[A] < 0.010
Total Sulphur	U	2175	%	0.010	[A] 0.027	[A] 0.024	[A] 0.021	[A] 0.11	[A] 0.038
Chloride (Water Soluble)	U	2220	g/l	0.010	[A] < 0.010	[A] < 0.010	[A] < 0.010	[A] 0.015	[A] 0.011
Nitrate (Water Soluble)	N	2220	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Ammonium (Water Soluble)	U	2220	g/l	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Sulphate (Acid Soluble)	U	2430	%	0.010	[A] 0.024	[A] 0.017	[A] < 0.010	[A] 0.028	[A] 0.026

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request.The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1245405			RC04A		A	Plastic Tub 1000g
1245406			RC04A		A	Plastic Tub 1000g
1245407			RC04A		A	Plastic Tub 1000g
1245408			RC04A		A	Plastic Tub 1000g
1245409			RC04A		A	Plastic Tub 1000g

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2220	Water soluble Chloride in Soils	Chloride	Aqueous extraction and measuremernt by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.

Report Information

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I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

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D - Broken Container
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Sample Retention and Disposal

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All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

Appendix 9

As-Surveyed Site Plan

Drawing 1 of 2 - East

Drawing 2 of 2 - West

22751 - N63 Liss to Abbey Realignment

Exploratory Hole Location Plan - East

Legend

- Cable Percussion Borehole
- CP Borehole / Rotary Core Drillhole
- Rotary Core Drillhole
- Trial Pit

22751 - N63 Liss to Abbey Realignment

Exploratory Hole Location Plan - West

Legend

- Cable Percussion Borehole
- CP Borehole / Rotary Core Drillhole
- Rotary Core Drillhole
- Trial Pit

Appendix A9:

Water

Appendix A9-1

Flood Risk Assessment Report

N63 Liss to Abbey Realignment Scheme

Phase 3 - Flood Risk Assessment

Galway County Council

AECOM Project reference: 60571547
GCC Project reference: GC/16/13416

N63-ACM-PH03-ZZ-RP-DR-0001

April 2021

Quality information

Prepared by	Checked by	Verified by	Approved by
Richard Reid Principal Engineer	Joanne Titterington Principal Engineer	Karol McCusker Associate Director	Eoin Greene Technical Director

Revision History

Revision	Revision date	Details	Authorized	Name	Position
0	16-04-2021	First Draft	RSR	Richard Reid	Principal Engineer

Prepared for:

Galway County Council

Prepared by:

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Table of Contents

Figures

Tables

1 Introduction

Galway County Council is proposing to develop a circa 2.3km national secondary road on 13.8ha of predominantly greenfield site to the north-east of the village of Abbeyknockmoy, Co. Galway. The Proposed Road Development comprises a rural all-purpose Type 2 Single Carriageway road, including a new river crossing over the River Abbert. Provision for both pedestrian and cycle facilities has been included as part of the scheme, predominantly along the route of the existing N63.

The scheme is located in the townlands of Culliagh North, Culliagh South, Liss, Abbey, Chapelfield, Clashard, Moyne and Newtown in Co. Galway as illustrated in Figure 1 below.

Figure 1. Regional Location of Proposed Road Development

1.1 Background

In accordance with the 'The Planning System and Flood Risk Management – Guidelines for Planning Authorities' there is a requirement to undertake a Flood Risk Assessment Report, which will accompany the planning application.

1.2 Scope of Services

AECOM is required to undertake a site-specific Flood Risk Assessment (FRA) for the proposed works.

This FRA study has been undertaken in consideration of the following guidance document:

- 'The Planning System and Flood Risk Management – Guidelines for Planning Authorities' DOEHLG 2009.

The assessment will demonstrate that the Proposed Road Development will:

1. Not increase flood risk elsewhere and, if practicable, will reduce overall flood risk.
2. Include measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible.
3. Include measures to ensure that residual risks to the area and/or development can be managed to an acceptable level

2 Site Information

2.1 Site Description

The Proposed Road Development runs in a south-west to north-east direction across the River Abbert between the western tie-in on the eastern edge of Abbeyknockmoy to the eastern tie-in along the existing N63, to the east of the junction with the existing L6234, see Figure 2. The location is characterized by the presence of open greenfield area with some wooded areas along the River Abbert. The River Abbert is part of the Lough Corrib Special Area of Conservation (SAC). The south side of the existing N63 is lined by residential properties, and several community facilities are located in proximity of the junction with the local road L3110. The scheme is also located in close proximity to Abbeyknockmoy Abbey, a National Monument, and runs through the Galway County Scenic View Area.

The Proposed Road Development will facilitate a number of objectives in the Galway County Development Plan (2015-2021), including the provision of higher-quality national roads and the separation of regional and local traffic. The scheme will also meet a number of objectives of the Road Safety Authority's Road Safety Strategy.

Strategically, while the N63 itself does not form part of the TEN-T Network, the proposed road development will support the objectives of the TEN-T in broad terms by improving the connectivity to Junction 19 on the M17 TEN-T network. The Proposed Road Development will provide an improved link for regional traffic to the M17 motorway and reduce traffic congestion at the Liss Bridge and the community facilities.

2.2 Summary of the Proposed Road Development

The Proposed Road Development comprises the following major elements:

- Approximately 2.3 km of new Type 2 Single Carriageway road (predominantly offline);
- One new roundabout at the western end of the scheme to provide connection with the existing N63;
- Two new priority junctions to provide connection to the existing L6159 and L6234, including some minor local road realignments;
- One new clear span bridge crossing of the River Abbert;
- Eight new piped culverts over existing field ditches;
- New pedestrian and cycle facilities, predominantly located along the existing N63;
- Associated earthworks including excavation of unacceptable material, excavation and processing of rock and other material, provision of material deposition areas and deposition and recovery of unacceptable material for reuse in the works;
- Accommodation works, including the provision of access roads and accesses;
- Drainage works, including the construction of attenuation ponds;
- Utilities and services diversion works;
- Safety Barrier, Public Lighting, Fencing;
- Landscaping works; and
- Environmental measures and other ancillary works.

The location and extent of the Proposed Road Development are shown in Drawings N63-AEC-PH03-0000-DR-HW-0010 to N63-AEC-PH03-0000-DR-HW-0015 contained in Volume 3 of the EIAR, with the proposed route corridor shown in Figure 2 below:

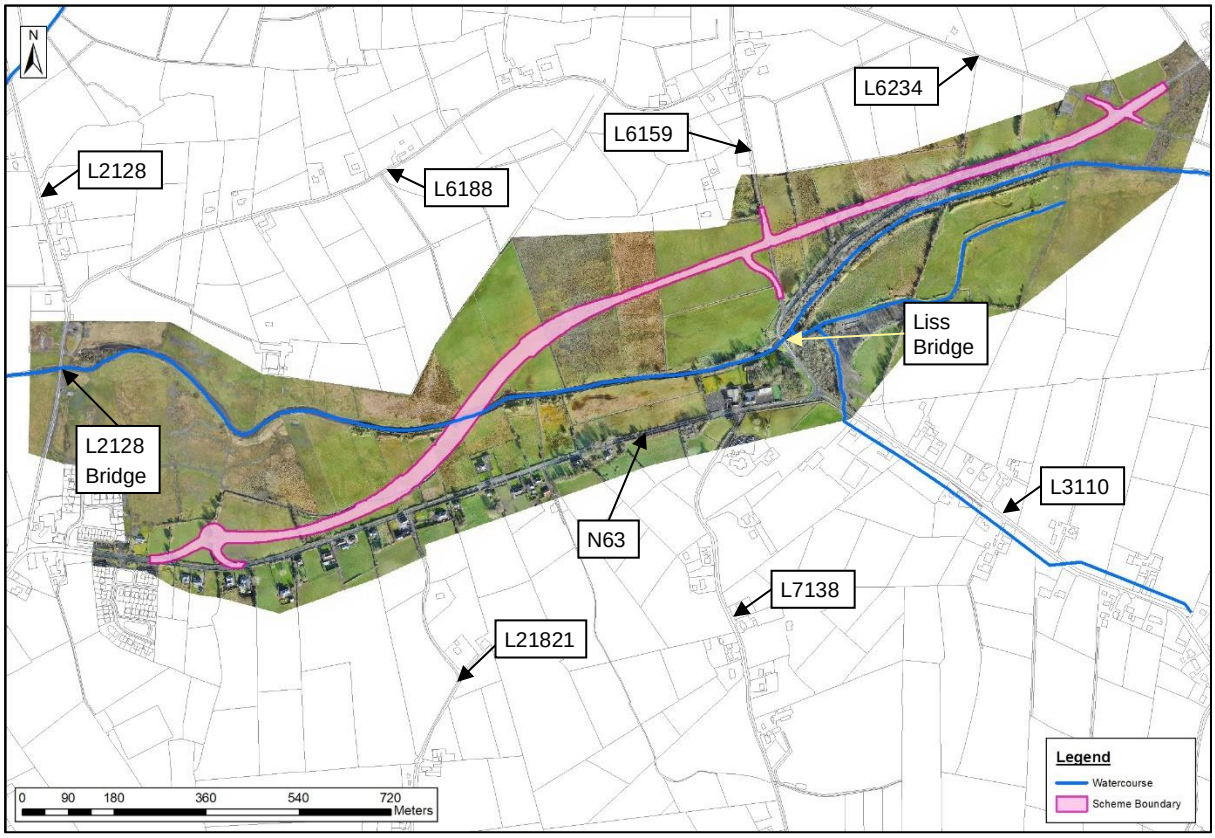


Figure 2. Proposed Road Corridor

2.3 Local Hydrology, Land Use and Existing Drainage

As outlined in 2.2, the Proposed Road Development requires the crossing of the River Abbert. The River Abbert is a significant river with a catchment area of circa 172km^2 at the L2128 bridge, downstream of the proposed crossing. The River Abbert flows in an east to west direction through the study area and confluences with the Clare River circa 10.5km downstream.

The land within the study area is primarily used for agricultural purposes and its current condition suggests it is of poor quality given the presence of areas of rushes. There are also a significant number of land drains and ditches forming along the field boundaries which discharge into the River Abbert.

The River Abbert was also included in the Corrib-Clare Arterial Drainage Scheme which was undertaken in the late 1950's and early 1960's for which the OPW have a statutory maintenance responsibility. These original Arterial Drainage Scheme works involved substantial widening and deepening of the existing channel and tributaries with the purpose of providing outfall for the drainage of agricultural lands.

Also, of note is a substantial weir across the River Abbert just upstream of the L2128 bridge which historically controlled the water level to provide a water supply to an adjacent mill via a mill race. While the mill is no longer in operation, the weir and mill race are still present and could potentially create a significant backwater effect on the river heading upstream.

3 Stage 1 – Flood Risk Identification

The purpose of Stage 1 is to establish whether a flood-risk issue exists or may exist in the future. If there is a potential flood risk issue then, in accordance with 'The Planning System and Flood Risk Management – Guidelines for Planning Authorities (DOEHLG 2009)', the flood risk assessment procedure should move to 'Stage 2 – Initial Flood Risk Assessment'. If no potential flood risk is identified during Stage 1 then the overall flood risk assessment can be concluded.

The following information and data have been collated as part of the screening assessment for the Proposed Road Development.

3.1 Hydrometric Data

Existing sources of hydrometric data from the EPA (https://gis.epa.ie/EPAMaps/Water) were investigated, as shown in Figure 3. This investigation has determined that there are a number of gauging stations in proximity to the Proposed Road Development as outlined in Table 1 below.

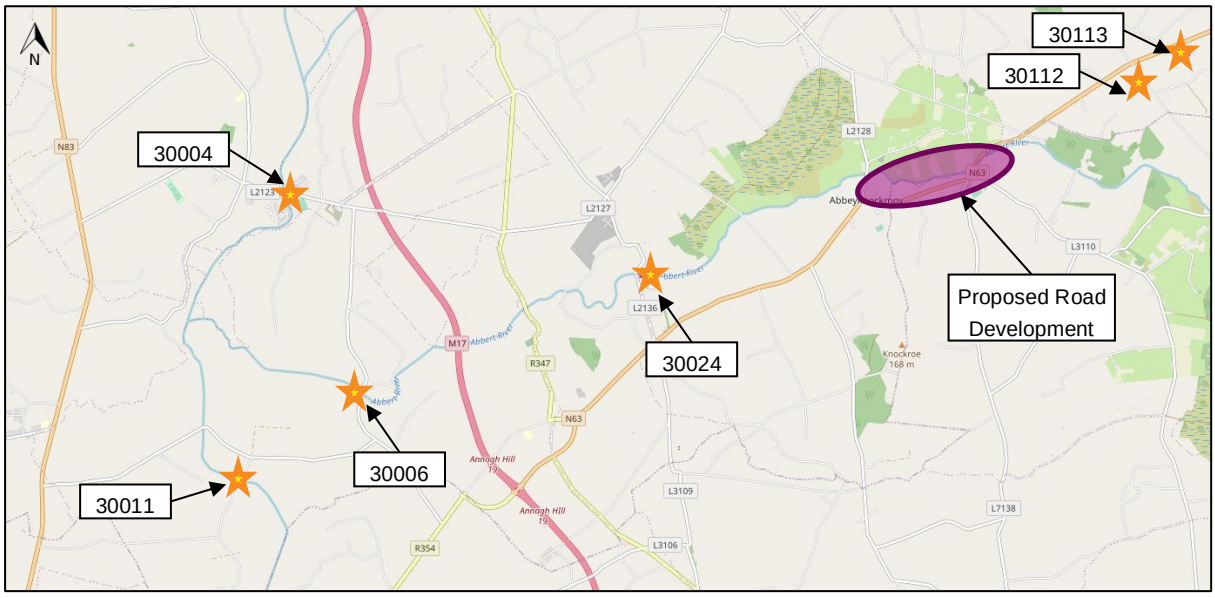


Figure 3. Hydrometric Gauging Stations

Table 1. Hydrometric Gauging Stations

Station No.	Name	Status	Owner	Available Data
30004	Corrofin	Active	Office of Public Works (OPW)	Water Level and Flow
30006	Bullaun	Inactive	Office of Public Works (OPW)	Spot flow measurements only - No continuous water level or flow records available.
30011	Corbally	Inactive	Office of Public Works (OPW)	Spot flow measurements only - No continuous water level or flow records available.
30024	Pallas	Inactive	Galway County Council	Spot flow measurements only - No continuous water level or flow records available.
30112	Mid Galway (Spring)	Active	Galway County Council	Water Level and Flow
30113	Barnaderg Spring	Inactive	Galway County Council	Spot flow measurements only - No continuous water level or flow records available.

The presence of gauging stations are noted at this stage of the FRA however they are of limited benefit. Given the lack of data available for stations 30006, 30011 and 30024 these can be discounted from further consideration. Stations 30112 and 30113 monitor spring flow and not river flows and can also be

discounted. Station 30004 is located upstream of the confluence of the River Abbert with the Clare River and therefore is of limited benefit going forward.

3.2 OPW Flood Hazard Maps

The OPW Flood Hazard Maps Website (www.floodmaps.ie) was consulted in relation to available historical or anecdotal information on any flooding incidences or occurrence in the vicinity of the Proposed Road Development. No flood events have been recorded within the route corridor. Figure 4 below shows mapping from the aforementioned website, which indicates that there are a few historical records of flooding which have occurred in the wider surrounding area. The details of these events are outlined in Table 2 below.

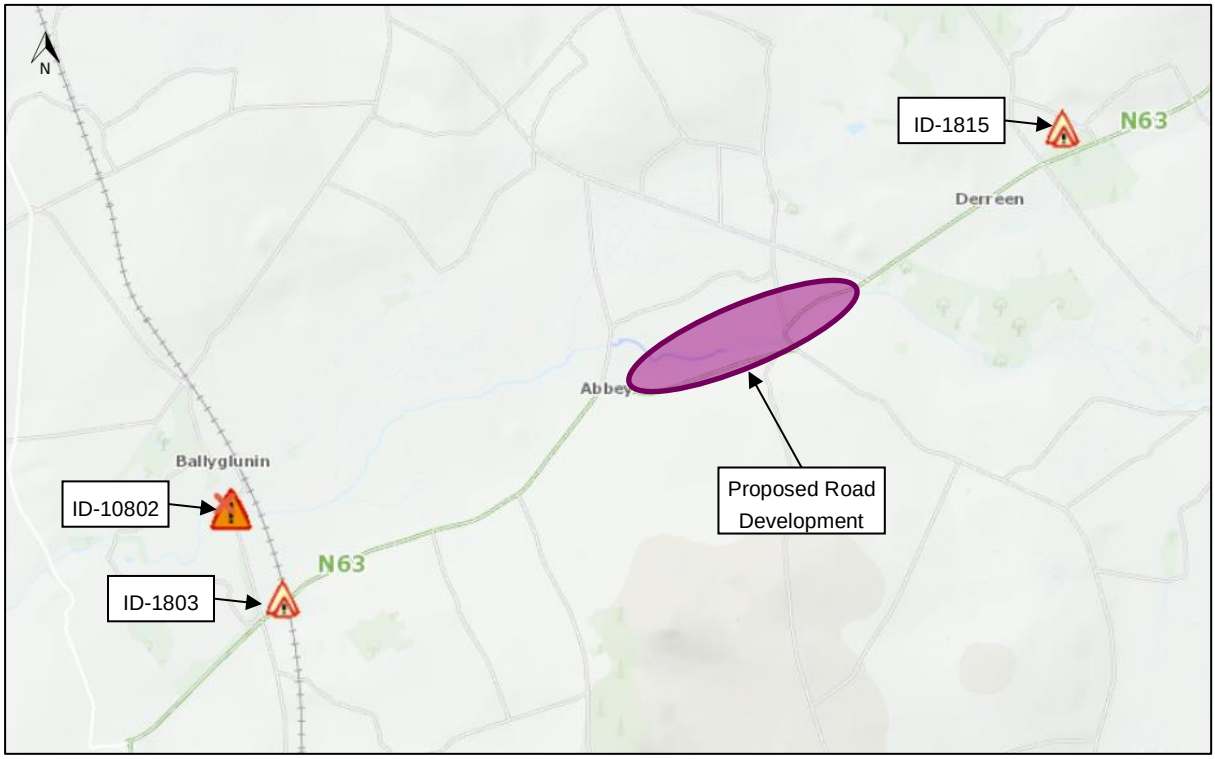


Figure 4. OPW Flood Hazard Maps

Table 2. Historic Flood Events

ID No.	Event Type	Title	Description
ID-1803	Recurring	Ballyglooneen area Recurring	Ballyglooneen Bridge – Turlough rises every year after heavy rain every year. Jan 2005 N63 flooded to an estimated depth of 1 foot to 18 inches.
ID-1815	Recurring	Derreen Cross Recurring	Derreen Cross – Low lying land floods every year after heavy rain
ID-10802	Specific – 19/11/2009	Flooding at Ballyglunin, Corofin, Co. Galway, November 2009	Report gives a series of aerial photographs following the event

3.3 Groundwater Wells and Springs

An investigation into the rise and abstraction of water from underground wells and springs around the site was taken from the Department of Communications, Climate Change and Environment (http://dcenr.maps.arcgis.com). This was to identify if there are any areas of rising groundwater that could contribute to flooding.

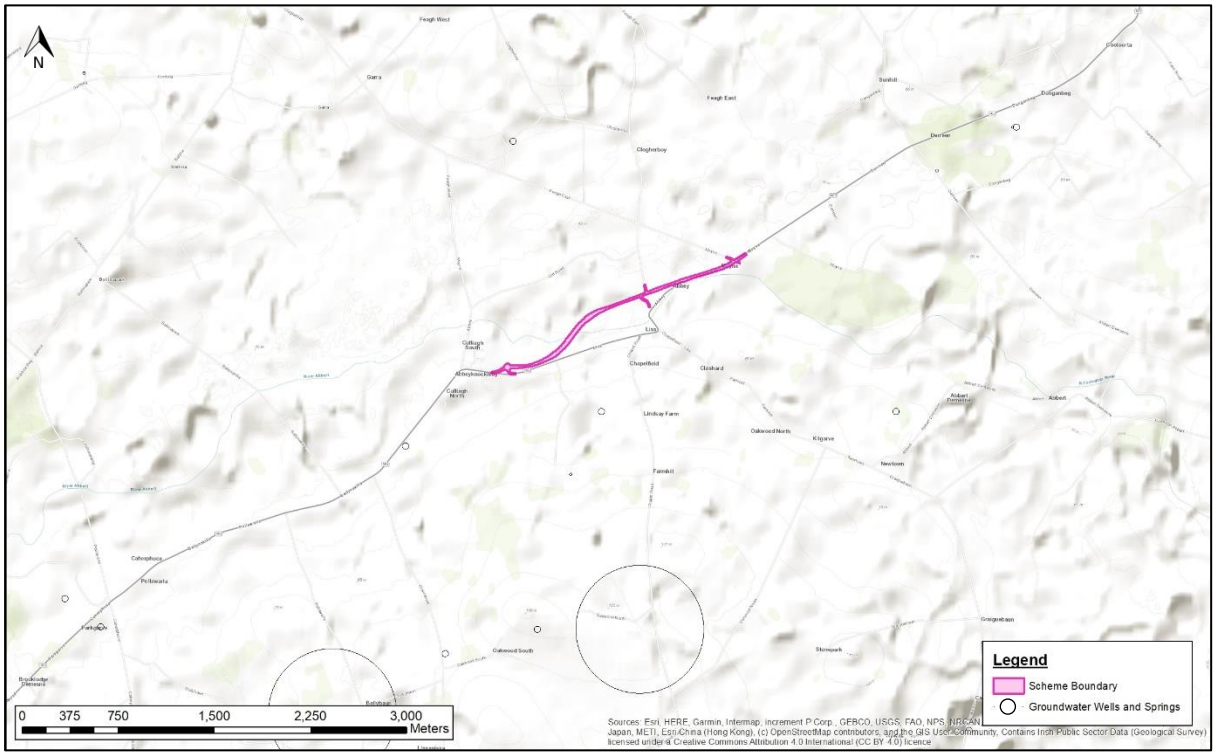


Figure 5. GSI Viewer Groundwater Wells and Springs

Figure 5 shows that there are limited springs or wells in close proximity to the Proposed Road Development. There have been no recorded issues with these groundwater sources contributing to flooding within the area.

3.4 OSi Historic Mapping

Figure 6 below shows the areas identified on historic 6" mapping (from GeoHive viewer; http://map.geohive.ie/) as "Liable to Floods".

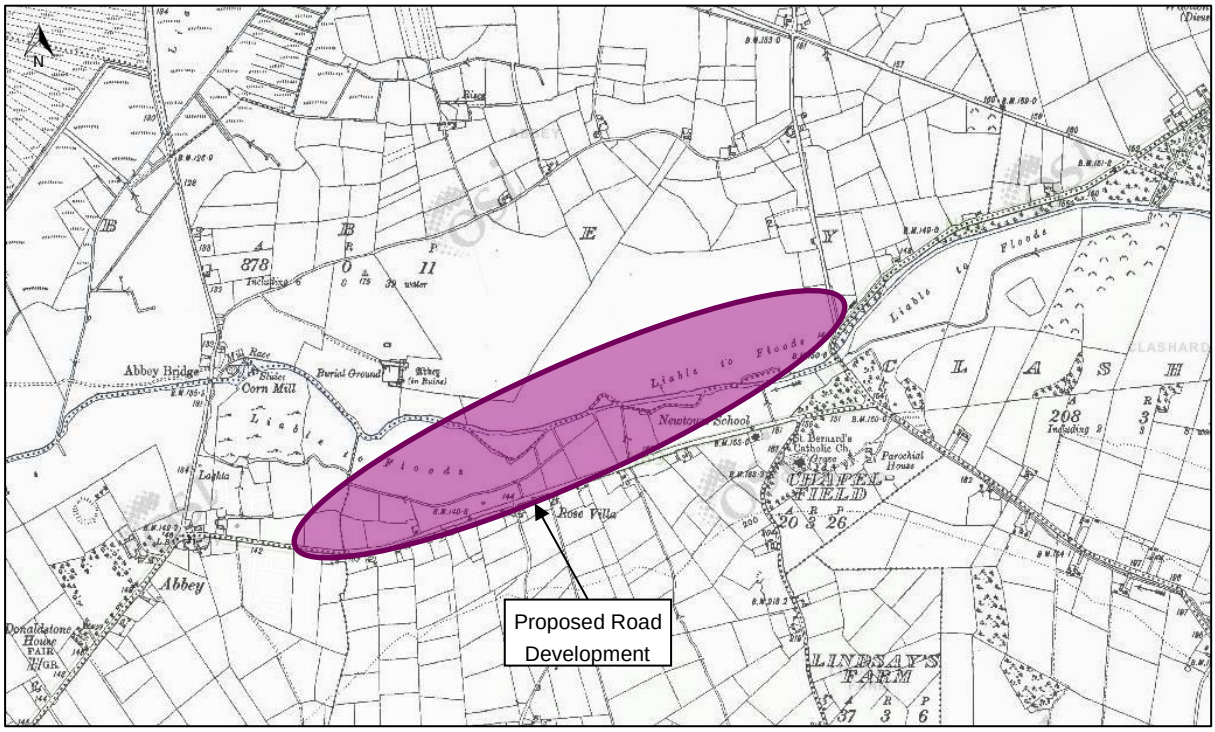


Figure 6. OSi Historic Mapping

These areas are present on both banks of the River Abbert indicating historical flooding may have occurred in these areas.

3.5 OSi Flood Maps

Figure 7 below shows the areas identified on the OSi Flood Maps layer from the GeoHive viewer (http://map.geohive.ie/) as being susceptible to flooding.

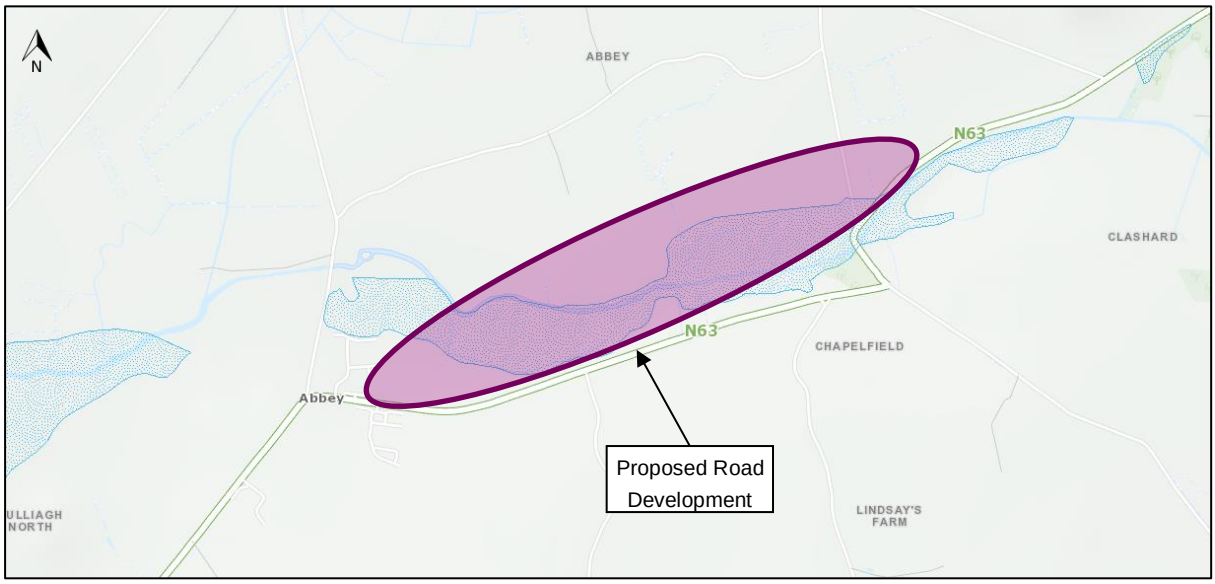


Figure 7. OSi Flood Maps

The mapping suggests that there is area of risk within the Proposed Road Development boundary with the route passing through or close to the floodplain.

3.6 OPW Land Benefitting Maps

As outlined in 2.3, the River Abbert was also included in the Corrib-Clare Arterial Drainage Scheme (ADS) which was undertaken in the late 1950's and early 1960's. Figure 8 below is an extract from the OPW Drainage Map viewer (https://www.floodinfo.ie/map/drainage_map/).

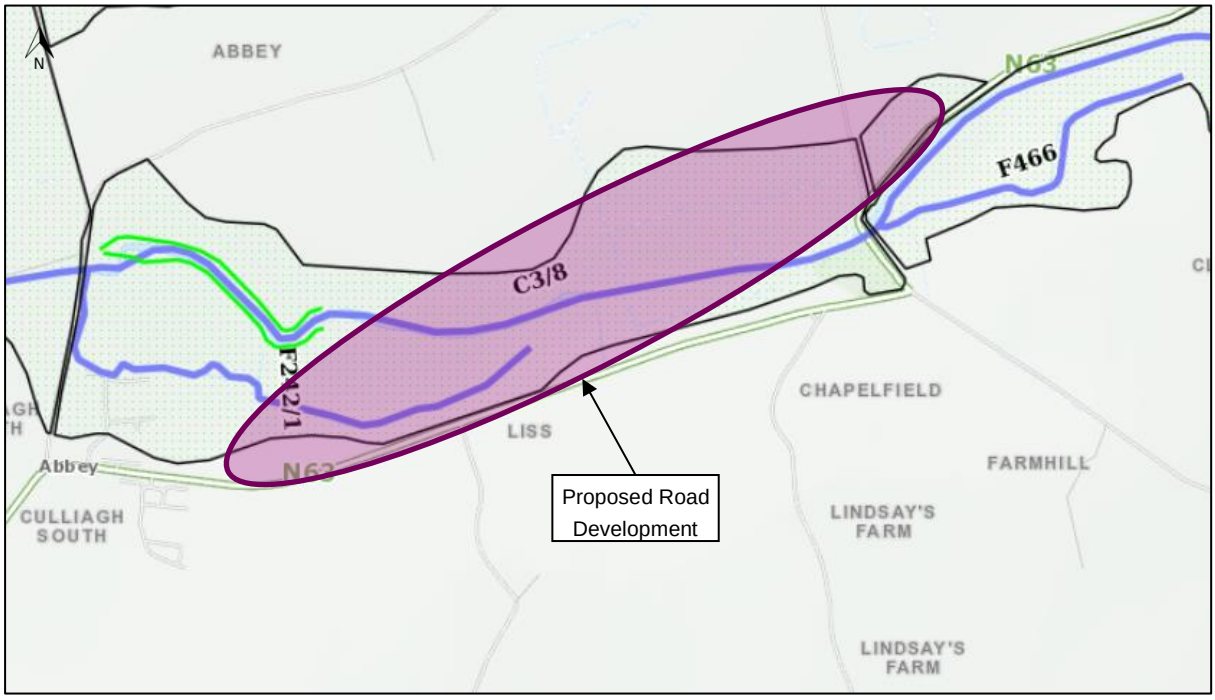


Figure 8. OPW Land Benefitting Maps

Figure 8 indicates the main channel of the River Abbert as an ADS channel (blue), reference number C3/8. It also indicates the presence of a secondary ADS channel to the south of the River Abbert, reference number F242/1 along with an ADS embankment (green) upstream of the L2128 bridge.

3.7 OPW CFRAM Mapping

The OPW CFRAM mapping was consulted in relation to potential flooding at the Proposed Road Development. No mapping information was available for the area.

While no mapping is available from the CFRAM studies, this does not mean that there is no risk of flooding at the site. The CFRAM studies focused on population centres where the impact of flooding is greatest.

3.8 Galway County Development Plan

The Galway County Development Plan 2015 - 2021 outlines flooding objectives to be applied in the preparation of future town development plans and in the assessment of planning applications, referring to the 'Flood Directive' (2007/60/EC) and 'The Planning System and Flood Risk Management – Guidelines for Planning Authorities (DOEHLG 2009)'.

Objective DS 7 is in relation to Flood Risk Management and Assessment as follows:

Objective DS 7 – Flood Risk Management and Assessment
Ensure that proposals for developments located within identified or potential flood risk areas, or which may exacerbate the risk of flooding elsewhere, are assessed in accordance with the provisions of the Flood Risk Management Guidelines 2009 (or any updated/superseding document) the relevant policies, objectives and guidelines within this plan and shall also take account of the National CFRAM Programme Flood Hazard Mapping and Flood Risk Management Plans when they become available.

For more information about the Galway County Development Plan, all documents can be accessed at http://www.galway.ie/en/services/planning/planspolicy/gcdp2021.

The County Development Plan includes a Stage 1 Strategic Flood Risk Assessment as an appendix which also includes high level flood maps. An extract of the relevant map has been produced below as Figure 9.

Figure 9. Galway County Development Plan SFRA

The scale of the mapping leaves it difficult to assess the impact however it is likely that flooding could be expected in along the Proposed Road Development based on the information presented.

3.9 Screening Assessment Conclusion

The possible flooding mechanisms in consideration of the Proposed Road Development are summarised in Table 3 below.

The purpose of this screening assessment was to identify whether a potential risk of flooding exists and to what extent along the Proposed Road Development. This assessment is based on the collation and analysis of existing current information, historical information and data which may indicate the level or extent of any flood risk.

Table 3. Possible Flood Mechanisms

Source of Flooding	Significant?	Comment / Reason
Tidal / Coastal	No	The site is not located in an area subject to tidal/coastal flooding.
Fluvial	Yes	Fluvial flooding is likely in the vicinity of the River Abbert however no definite floodplain extents are available from historic and current information.
Pluvial (Urban Drainage)	No	The existing site is a greenfield site. There are no records and no known instances of failure of the associated drainage systems
Pluvial (Overland Flow)	No	Flooding is not likely to occur from overland flow
Groundwater	No	There are no springs and groundwater discharges recorded in the immediate vicinity of the site

In consideration of the data sources assessment, this flood risk assessment is required to proceed to 'Stage 2 - Initial Flood Risk Assessment'. The screening assessment shows that there is a flooding risk to the Proposed Road Development.

4 Stage 2 – Initial Flood Risk Assessment

In order to undertake the initial flood assessment a determination of the flood zone in which the site is located along with a determination of the vulnerability of the proposed works is required.

4.1 Determination of Vulnerability

The vulnerability of the proposed works is classified into three classes as given below in Table 4.

Table 4. Classification of Vulnerability

Vulnerability class	Land uses and types of development*
Highly vulnerable development (including essential infrastructure)	Garda, ambulance and fire stations and command centres required to be operational during flooding; Hospitals; Emergency access and egress points; Schools; Dwelling houses, student halls of residence and hostels; Residential institutions such as residential care homes, children's homes and social services homes; Caravans and mobile home parks; Dwelling houses designed, constructed or adapted for the elderly or, other people with impaired mobility; and Essential infrastructure, such as primary transport and utilities distribution, including electricity generating power stations and sub-stations, water and sewage treatment, and potential significant sources of pollution (SEVESO sites, IPPC sites, etc.) in the event of flooding.
Less vulnerable development	Buildings used for: retail, leisure, warehousing, commercial, industrial and non-residential institutions; Land and buildings used for holiday or short-let caravans and camping (subject to specific warning and evacuation plans); Land and buildings used for agriculture and forestry; Waste treatment (except landfill and hazardous waste); Mineral working and processing; and Local transport infrastructure.
Water-compatible development	Flood control infrastructure; Docks, marinas and wharves; Navigation facilities; Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location; Water-based recreation and tourism (excluding sleeping accommodation); Lifeguard and coastguard stations; Amenity open space, outdoor sports and recreation and essential facilities such as changing rooms; and Essential ancillary sleeping or residential accommodation for staff required by uses in this category (subject to a specific warning and evacuation plan).

* Uses not listed here should be considered on their own merits

Source: The Planning System and Flood Risk Management - Guidelines for Planning Authorities

The guidelines would indicate that the site, as Primary Transport Infrastructure, should be considered to be a **highly vulnerable development**.

4.2 Determination of Flood Zone

In accordance with 'The Planning System and Flood Risk Management – Guidelines for Planning Authorities (DOEHLG 2009)', there are three flood zones designated in the consideration of flood risk to a particular site. The three flood zones are described in Table 5 below.

Table 5. Flood Zone Description

Flood Zone	Description
Flood Zone A	Where the probability of flooding from watercourses is the highest (greater than 1% or 1 in 100 year for watercourse flooding or 0.5% or 1 in 200 for coastal flooding)
Flood Zone B	Where the probability of flooding from watercourses is moderate (between 0.1% or 1 in 1000 year and 1% or 1 in 100 year for watercourse flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding)
Flood Zone C	Where the probability of flooding from watercourses and the sea is low or negligible (less than 0.1% or 1 in 1000 year for both watercourse and coastal flooding). Flood Zone C covers all areas which are not in Zones A or B.

Source: The Planning System and Flood Risk Management - Guidelines for Planning Authorities

The planning implications for each of the flood zones are:

Zone A - High probability of flooding. Most types of development would be considered inappropriate in this zone. Development in this zone should be avoided and/or only considered in exceptional circumstances, such as in city and town centres, or in the case of essential infrastructure that cannot be located elsewhere, and where the Justification Test has been applied. Only water-compatible development, such as docks and marinas, dockside activities that require a waterside location, amenity open space, outdoor sports and recreation, would be considered appropriate in this zone.

Zone B - Moderate probability of flooding. Highly vulnerable development, such as hospitals, residential care homes, Garda, fire and ambulance stations, dwelling houses and primary strategic transport and utilities infrastructure, would generally be considered inappropriate in this zone, unless the requirements of the Justification Test can be met. Less vulnerable development, such as retail, commercial and industrial uses, sites used for short-let for caravans and camping and secondary strategic transport and utilities infrastructure, and water-compatible development might be considered appropriate in this zone. In general, however, less vulnerable development should only be considered in this zone if adequate lands or sites are not available in Zone C and subject to an FRA to the appropriate level of detail to demonstrate that flood risk to and from the development can or will adequately be managed.

Zone C - Low probability of flooding. Development in this zone is appropriate from a flood risk perspective (subject to assessment of flood hazard from sources other than rivers and the coast) but would need to meet the normal range of other proper planning and sustainable development considerations.

In consideration of the above guidelines, the 1% AEP fluvial event is to be taken into account in order to assess whether any parts of the site are located within Flood Zone ‘A’. Also, consideration should be given to the 0.1% AEP fluvial events to assess if any parts of the site are located within Flood Zone ‘B’ given the classification of the development as highly vulnerable.

4.2.1 Coastal Flooding

The site is not at risk of coastal flooding due to its geographic location.

4.2.2 Fluvial Flooding

The lack of information available is prohibiting the designation of a flood zone at the development site. Based on the information collated, it is likely that fluvial flooding will occur in the vicinity of the River Abbert and therefore both Flood Zone A and Flood Zone B will be present.

4.3 Justification Test Requirement

The requirement for a justification test was reviewed for this study to determine whether the proposed works would be considered acceptable in terms of flood risk. The conclusion of ‘Stage 1 – Flood Risk Identification’ noted that the works may be impacted by fluvial and coastal flooding.

The requirement for a Justification Test is determined based on the type of development and flood zone designation as indicated in Table 6 below.

Table 6. Justification Test Matrix

	Flood Zone A	Flood Zone B	Flood Zone C
Highly Vulnerable Development	Justification Test	Justification Test	Appropriate
Less Vulnerable Development	Justification Test	Appropriate	Appropriate
Water-Compatible Development	Appropriate	Appropriate	Appropriate

Source: The Planning System and Flood Risk Management - Guidelines for Planning Authorities

Given the determination of the development as ‘Highly vulnerable development’ a justification test is required to be passed for the development to proceed should it fall into within either Flood Zone A or Flood Zone B. The present information available however is not sufficient to allow a full determination of the flood zones present across the site.

4.4 Stage 2 Flood Assessment Conclusion

In order to fulfil the Justification Test there is a requirement to quantify the flood risk at the proposed site, and where necessary mitigate the flood risk.

The purpose of the scoping stage is to identify possible flood risks and to implement the necessary level of detail required to assess these possible flood risks, and to ensure these can be adequately addressed in the FRA. The scoping exercise should also identify that sufficient quantitative information is already available to complete an FRA appropriate to the scale and nature of the development.

Given the presence of a major watercourse, there is the potential for fluvial flooding however the extent and depth of this cannot be determined based on the information available. In order to determine the flood extents and level for the Proposed Road Development, a Stage 3 Detailed FRA is required.

It is proposed that a hydraulic model of the watercourse is developed to determine the level and extent of flooding and the impact of the proposed works. The model can then be used, if required, to develop mitigation measures to ensure the flood risk is appropriately managed or remediated.

5 Stage 3 – Detailed Flood Risk Assessment

Section 4 of this report has concluded that a justification test is required to be passed for the development to proceed if any of the Proposed Development falls within Flood Zone A or Flood Zone B. This is due to the determination of the development as 'highly vulnerable development'.

In order to determine the flood extents and level on the proposed site, a hydraulic model will be required. The following section will outline the process undertaken in the development of the hydraulic model.

5.1 Assessment of Flow

AECOM have undertaken a river flood flow assessment for River Abbert employing best practice techniques. Figure 10 below indicates the catchment area of 168.5km^2 for the watercourse downstream of the site, taken from the OPW Flood Studies Update (FSU) database.

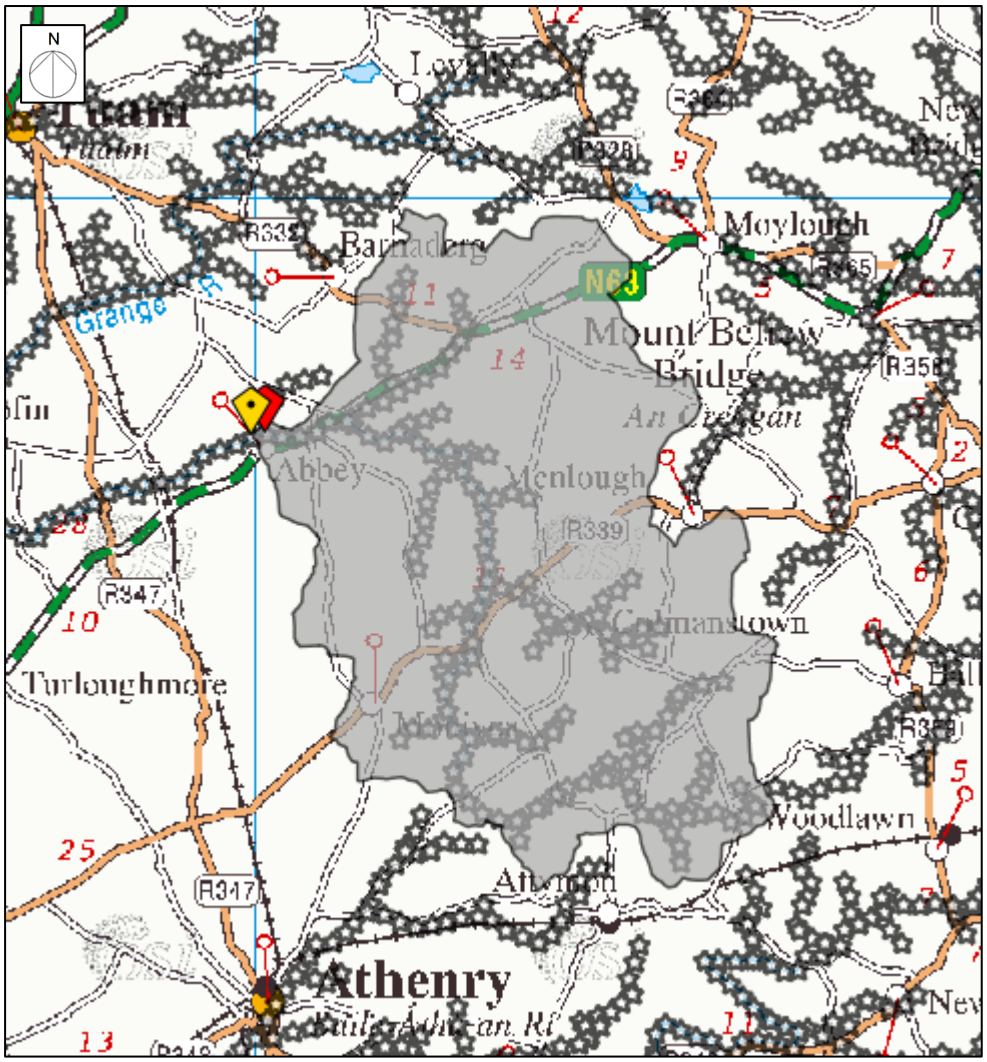


Figure 10. Catchment Area

This has been checked using other mapping and topographic sources with the calculated area slightly greater than the FSU area at 172.2km^2. The increase in area is at the upstream end of the watercourse and represents an increase of circa 2%.

AECOM have undertaken flow estimation using a number of methods with the 1% AEP peak flow from each of these given below in Table 7. A full calculation record can be found in Appendix A.

Table 7. 1% AEP Peak Flow Summary

Calculation Method	1% AEP Peak Flow (m^3/s)
Flood Studies Report 6 variable equation (FSR-6)	48.563
Flood Studies Report 3 variable equation (FSR-3)	71.001
Flood Studies Supplementary Report No.6 (FSSR6)	45.734
Institute of Hydrology Report No.124 (IH124)	56.803
Flood Estimation Paper, Cunnane, Lynn 1976 (FEP)	50.607

The above flows include factorial error allowances for the 95% confidence banding.

5.1.1 Discussion of Flow Choice

The FSR-3 and IH124 methods are more suited to smaller catchments and hence have been deemed to be over-estimating the flow in this instance. The flows produced by FSSR6 and the FEP are within ±6% of the FSR-6 and therefore AECOM have decided to adopt the flow generated by FSR-6 equation as a suitable flow estimate going forward for use in the hydraulic model.

A unit hydrograph has been produced for the catchment to allow unsteady hydraulic analysis to be undertaken. This has been subsequently scaled so the peak matches that calculated by the FSR-6 method. This hydrograph has also been scaled to provide 0.1% AEP event using the Irish Growth Curves giving the following peak flow:

Table 8. Scaled Peak Flows

Return Period	Peak Flow (m^3/s)
1% AEP	48.563
0.1% AEP	63.132

5.1.2 Climate Change Considerations

The Flood Policy Review Report (2004) produced by OPW states that climate change considerations should be taken into consideration when undertaking flood risk assessments. Two possible scenarios are proposed in this report:

- The ‘Mid-Range Future Scenario’ (MRFS) considers the more likely estimates of climate change to the future scenario drivers by 2100. This includes extreme rainfall depths increase by 20%, a resulting 20% increase in flood flow, 0.500 m sea level rise and decrease in time to peak by 1/6 (Tp) due to deforestation. This is supported by the Defra FCDPAG3 (2006) guidance policy, where 20% is used as a sensitivity range to be adopted for peak river flow.
- The ‘High End Future Scenario’ (HEFS) considers the less likely estimates of climate change to the future scenario drivers by 2100. This includes extreme rainfall depths increase by 30%, a resulting 30% increase in flood flow, 1 m sea level rise and decrease in time to peak by 1/3 (Tp) and addition of 10% to the Standard Percentage Runoff (SPR) rate due to deforestation.

Sensitivity testing will be undertaken for the MRFS only by increasing the flood flow estimates by 20% respectively. It should be noted that the 0.1% AEP event will be equivalent to the HEFS and therefore this is already being considered.

5.2 Downstream Conditions

No downstream boundary condition has been used in the model as the model terminates downstream of the L2128 bridge and no known hydraulic constraint is present within the next 1.5km stretch of river reach. The model is therefore assumed to have a free discharge.

5.3 Model Geometry, Build and Parameters

5.3.1 Topographic and Hydrographic Data

In order to construct a hydraulic model representative of the current conditions, a hydrographical survey of designated river channel cross sections was undertaken by Murphy Surveys in May 2020. The survey included details of the watercourse bed levels. It also includes details of hydraulic structures such as culverts and bridges.

The survey included watercourse cross sections and other feature levels at regular intervals within the study area extending for circa 2.3km total; the model commences circa 750m upstream of the current N63 Liss Bridge and extends to just downstream of the L2128 bridge which is circa 900m downstream of the proposed crossing point.

A UAV survey of the site was also undertaken by Murphy Surveys March 2020, supplemented with additional UAV data in March 2021, which was used to create a DTM of the area surrounding the watercourse channels to feed into the 2D elements of the model. Figure 11 below gives a graphic illustration of the topography of the site from the developed DTM.

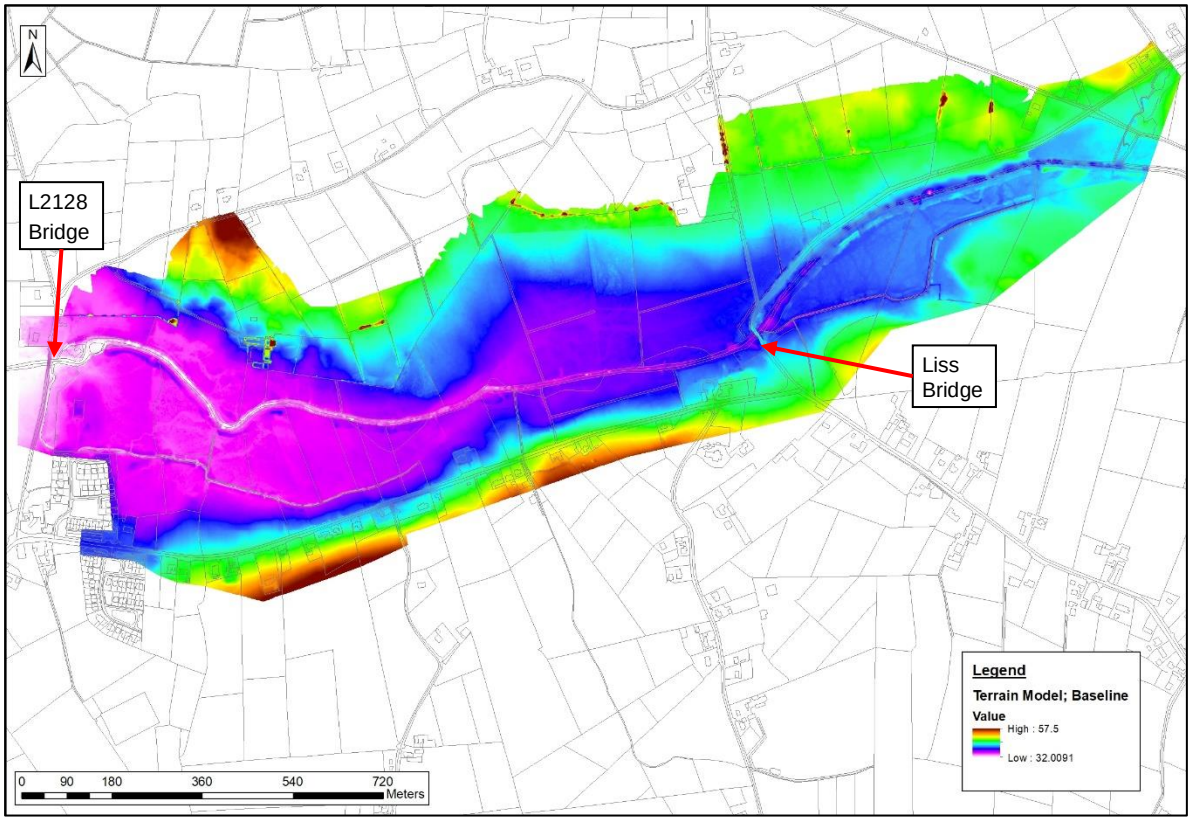


Figure 11. Site Topography

Figure 11 shows the site falling towards the River Abbert in the centre of the DTM and also from east to west. The bed level of the river is circa 39.2mOD at the upstream end and falls to circa 33.5mOD at the downstream end of the model.

5.3.2 Hydraulic Structures

There are a number of crossings and structures on the watercourse; these include 2No. public road crossings and a substantial weir which formerly served a mill. Details of the structures included in the model are given below in Table 9.

Table 9. Hydraulic Structures

Structure ID	Photograph/ Image	Details
R1.01551	Upstream face (see also Figure 12) 	Structure Type: Arch with multiple openings; *3No. in channel,* *1No. on right bank,* *3No. on left bank* Height, Varies; *Main Channel: 3.55 – 3.80m* *Flood Relief: 0.90 – 1.30m* Width, Varies; *Main Channel: 2.20 – 2.60m* *Flood Relief: 1.60 – 2.30m* Upstream Invert: 38.30 mOD Downstream Invert: 38.25 mOD Upstream Soffit: 42.04 mOD Downstream Soffit: 42.03 mOD
R1.00138	Upstream 	Structure Type: Weir/Sluice *(modelled as an inline bank)* Upstream Invert: 35.83 mOD Downstream Invert: 35.56 mOD Crest Level: 36.54 mOD
R1.00007	Upstream face 	Structure Type: Arch Bridge Height: 4.14m Width: 8.68m Upstream Invert: 39.59 mOD Downstream Invert: 39.54 mOD Upstream Soffit: 37.73 mOD Downstream Soffit: 37.68 mOD

Structure ID	Photograph/ Image	Details
R2.00040	Upstream 	Structure Type: Weir Upstream Invert: 36.55 mOD Downstream Invert: 36.09 mOD Crest Level: 37.12 mOD
R2.00015	*As R2.0040 (in distance)*	Structure Type: Twin Box Culvert Height: 0.80m Width: 1.60m (x2) Upstream Invert: 35.46 mOD Downstream Invert: 35.40 mOD Upstream Soffit: 36.26 mOD Downstream Soffit: 36.20 mOD

Figure 12 below is a surveyed elevation of the upstream face of existing N63 Liss Bridge:

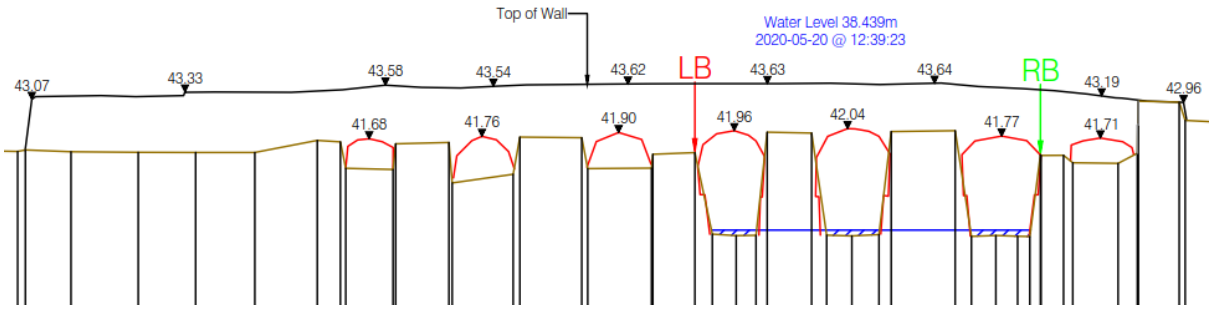


Figure 12. Upstream Elevation, Liss Bridge

A number of small culverts are also present on the secondary OPW drain to the south of the main channel. This drain and the associated culverts are included in the 2D element of the model only.

5.3.3 Model Build

A linked 1D-2D model of the watercourse was constructed using Infoworks ICM. The model geometry consists of river cross sections, bank lines, culverts, and floodplain. The main river channel and tributaries have been constructed as a 1D channel which is then linked to the 2D floodplain. Over-bank flow allows flood waters to escape from the 1D channel into the 2D floodplain. Figure 13 below is a screenshot of the baseline model constructed (route corridor shown for information only).

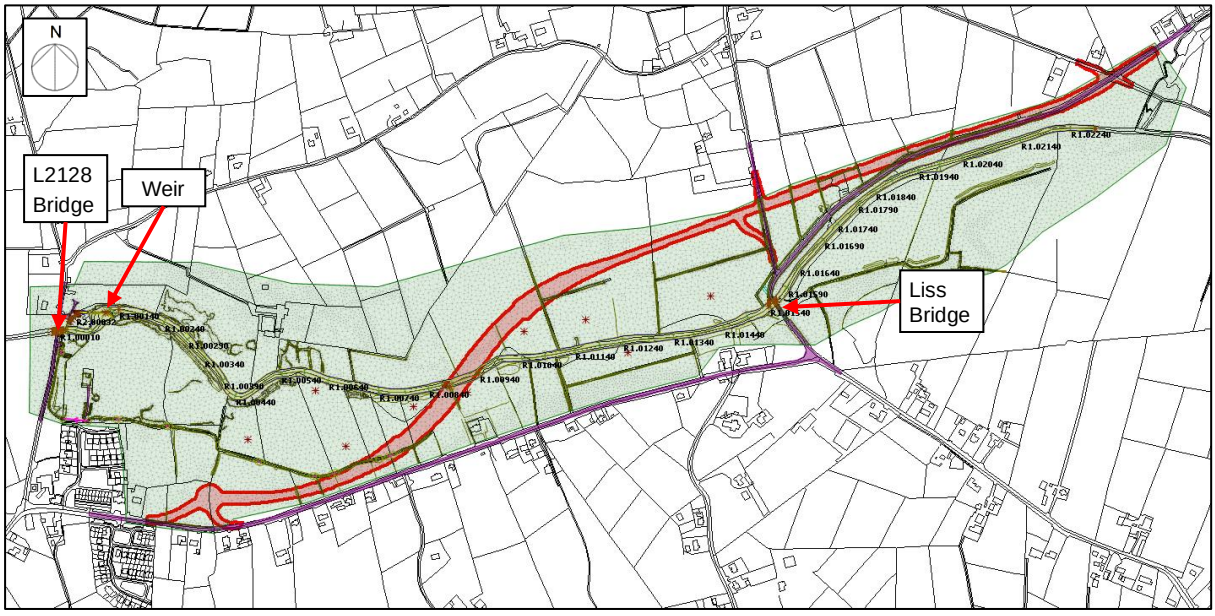


Figure 13. Existing Model Scenario

5.3.4 Model Parameters

The Infoworks ICM engine operates by representing the modelled hydraulic network using a system of nodes and links to represent hydraulically significant features. Nodes utilised by the software may include manholes, pipes, river cross sections, bridges, inflows and outflows etc.; while links represent the river channel, closed conduits, etc.

All of the nodes and links within the model require a series of parameters and coefficients to enable the hydraulic calculations to be completed.

5.3.5 Roughness Coefficients

Evidence from the photographic information provided as part of the survey as well as aerial imagery was used to provide a best estimate of Manning's 'n' values for the terrain for use in the hydraulic model. Manning's 'n' values were used as a measure of the bed roughness. The areas that were out of the assigned bank stations were designated Manning's coefficient which were taken from Chow, 1959. Table 10 summarises the Manning's 'n' values used within the analysis.

Table 10. Manning's 'n' Values

Location	Manning's 'n'
Maintained Grass	0.030
Bushes	0.050
Tree	0.070
Channel poorly maintained – relatively clean channel floor, brush along bank	0.060
Roads, Tracks and Paths	0.025
River Channel	0.035
Earth bank – Stonewall, vegetation	0.070
General Manmade Surface	0.015
Mixed Vegetation	0.070

5.4 Model Scenarios

In order to allow comparison of the potential impacts of the Proposed Road Development it is necessary to construct a number of scenarios as outlined below.

5.4.1 Baseline Model

An existing model is constructed which is representative of the current site conditions. This is then used for simulations for multiple flood events to produce a baseline set of results. It is also used for undertaking sensitivity testing on parameters such as roughness coefficients and the impacts of climate change.

5.4.2 "Proposed without Mitigation" Model

The Proposed Road Development is added to the base model to create a "Proposed without Mitigation" model. This model includes the scheme along with proposed watercourse culverts, ditches, watercourse re-alignments and bridges etc. to determine the potential impact the scheme will have on the flood regime. At this stage the culverts and bridges etc. are generally designed on a hydraulic or structural basis only.

5.4.3 "Proposed with Mitigation" Model

The "Proposed with Mitigation" model is a further development of the "Proposed without Mitigation" model. This scenario includes the scheme along with proposed watercourse culverts, ditches, watercourse re-alignments and bridges etc. to determine the potential impact the scheme will have on the flood regime along with additional measures to reduce the impact of the proposals.

5.5 Baseline Model Results

5.5.1 Existing Scenario – Flood Zone "A"

Figure 14 below shows the predicted present day flood extents from the flood model for the 1% AEP fluvial flood event (Flood Zone A).

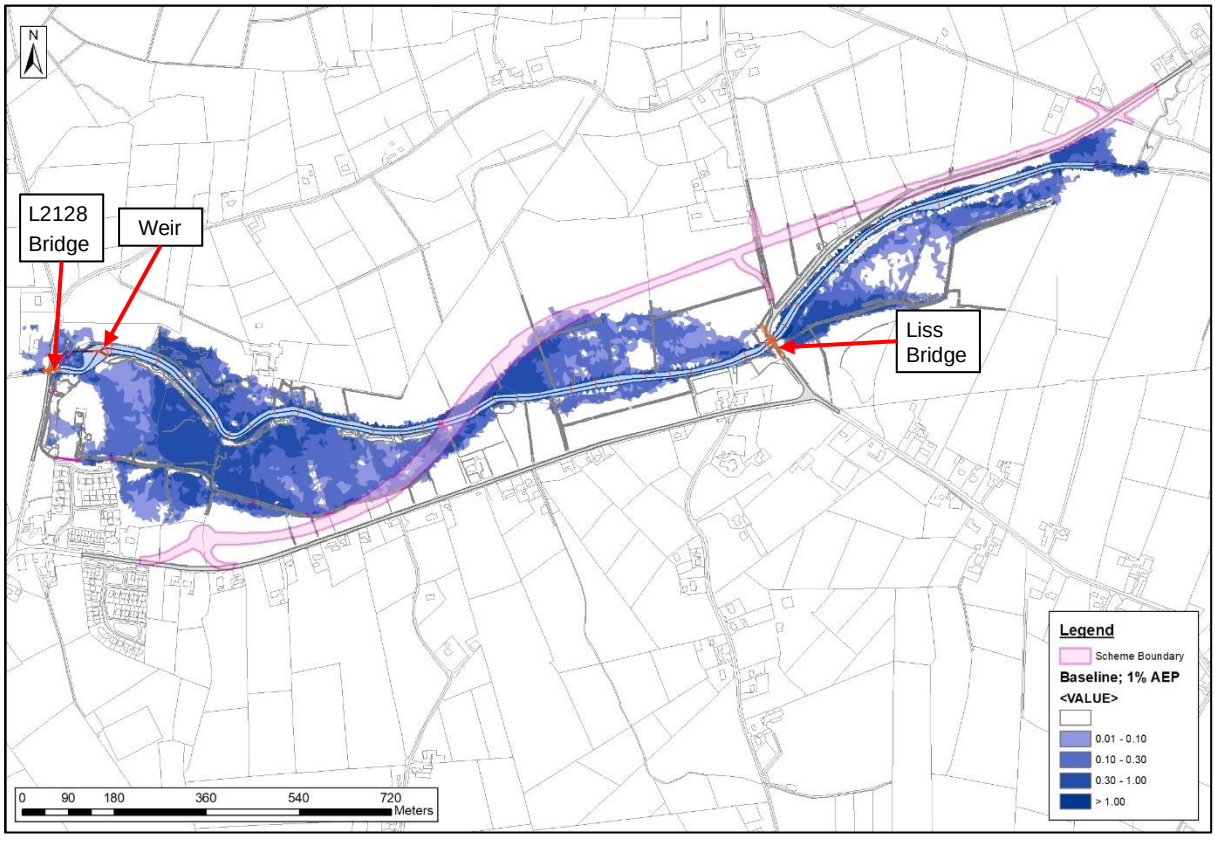


Figure 14. Baseline Model; Present Day 1% AEP Fluvial Flood Extents

The results show how the Proposed Road Development passes through the 1% AEP extents (Flood Zone A) to the south of the River Abbert and infringes again into Flood Zone 'A' to the north of the River Abbert. The flooding in the vicinity of the crossing point is attributed to a lack of capacity in the

watercourse leading to out of bank flooding. This out of bank flooding is subsequently constrained by the surrounding topography.

The existing Liss Bridge also causes a restriction to the flow with a level drop of circa 430mm present across the structure which likely increases flooding upstream of the structure. A further run was undertaken with the weir structure at the old mill removed; this demonstrated that the proposed crossing point is at the edge of the backwater impact zone from the weir.

5.5.2 Existing Scenario – Flood Zone "B"

Given the determination that the development would be considered as "highly vulnerable" it is also important to consider the 0.1% AEP fluvial event to determine the limits of "Flood Zone B". Figure 15 below show the increased extents of the 0.1% AEP fluvial event (Flood Zone B) in comparison to the 1% AEP fluvial extents (Flood Zone A).

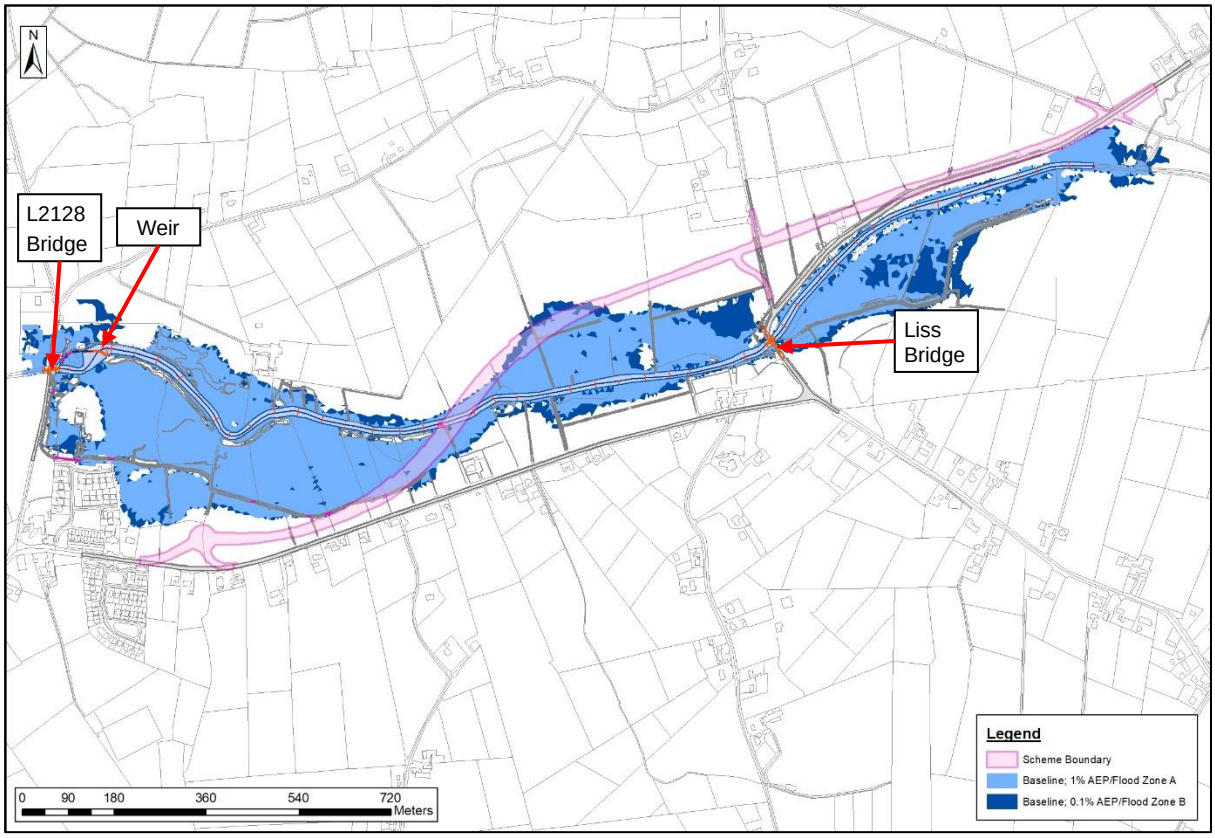


Figure 15. Baseline Model; Present Day 0.1% AEP Fluvial Flood Extents

There is a slight increase flood extent from Flood Zone "A" to Flood Zone "B". The maximum increase in fluvial flood level is 334 mm at cross section R1.01640 which is upstream of Liss Bridge. The increase at the Proposed Road Development crossing point is circa 170mm with an average increase of circa 170mm shown across the model. The flood levels for the cross section locations can be found in Appendix C.

5.5.3 Climate Change Sensitivity

As outlined in Sections 5.1.2, climate change considerations have been allowed for by undertaking an additional run for MRFS fluvial estimations. Figure 16 illustrates the increase in fluvial flood extent for the 1% present day to 1% MRFS fluvial event. Note; the 0.1% AEP event is equivalent to the HEFS fluvial event and so is not repeated below.

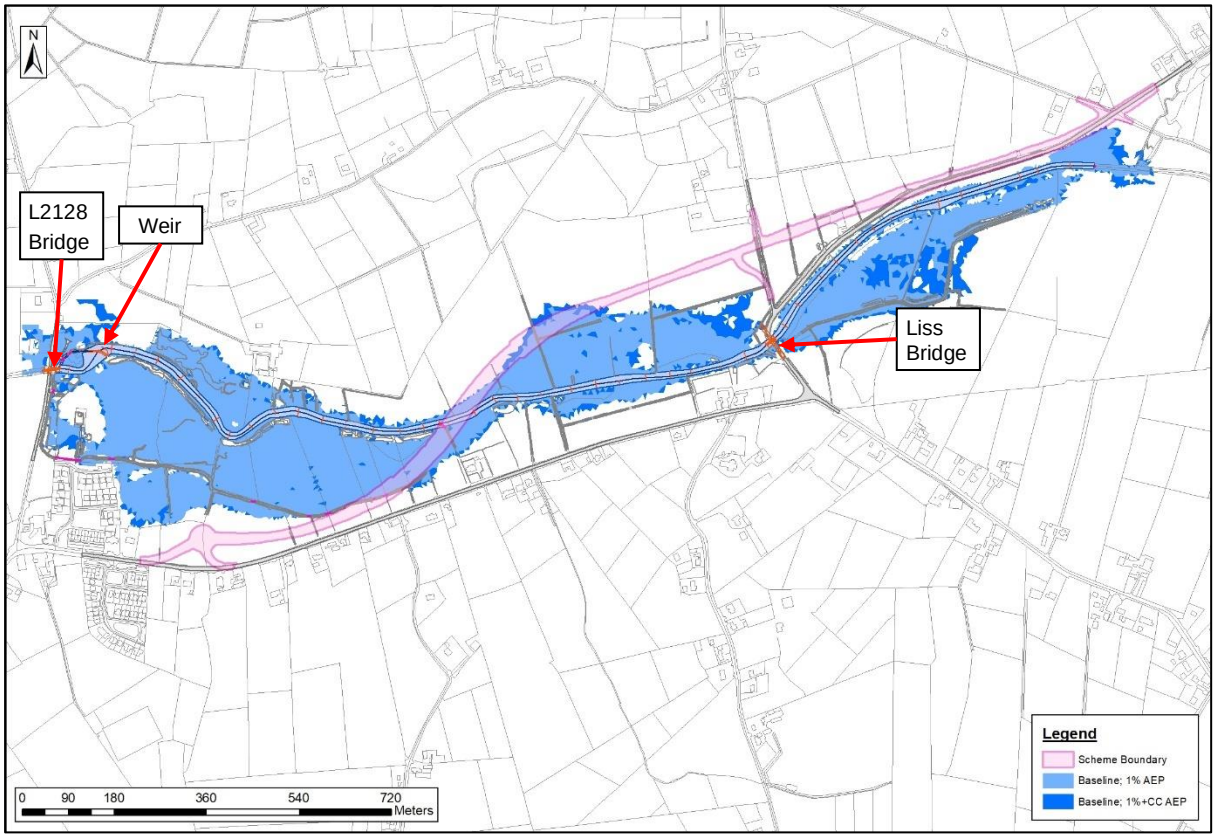


Figure 16. Baseline Model; 1% AEP Climate Change Fluvial Extents

There is a slight increase flood extent from the 1% AEP to the 1%+CC (MRFS) AEP. The maximum increase in fluvial flood level is 219mm at cross section R1.01640 which is upstream of Liss Bridge. The increase at the Proposed Road Development crossing point is circa 115mm with an average increase of circa 115mm shown across the model. The flood levels for the cross section locations can be found in Appendix C.

5.5.4 Manning's 'n' Sensitivity

Sensitivity analysis was undertaken using the baseline model to ascertain the impact of an increase in Manning's 'n' roughness coefficient using the present day 1% AEP fluvial flows. This showed a limited increase in levels ranging from 10mm to 135mm and averaging circa 87mm. The flood levels for the cross section locations can be found in Appendix C.

5.6 "Proposed without Mitigation" Model Results

The "Proposed without Mitigation" model was created as follows:

- Addition of a new watercourse crossing on River Abbert between existing sections R1.00875 and R1.00940
  - Single Span Bridge, 60.5m span width, 6.56m height (at highest)
- New culvert for ditch to north of river
  - 750dia pipe
- New culvert for ditch to south of river
  - 900dia pipe
- Inclusion of Proposed Development DTM into base DTM
  - Includes realignment of ditches

Figure 17 below is a screenshot of the section of the model which has been altered to incorporate the proposals.

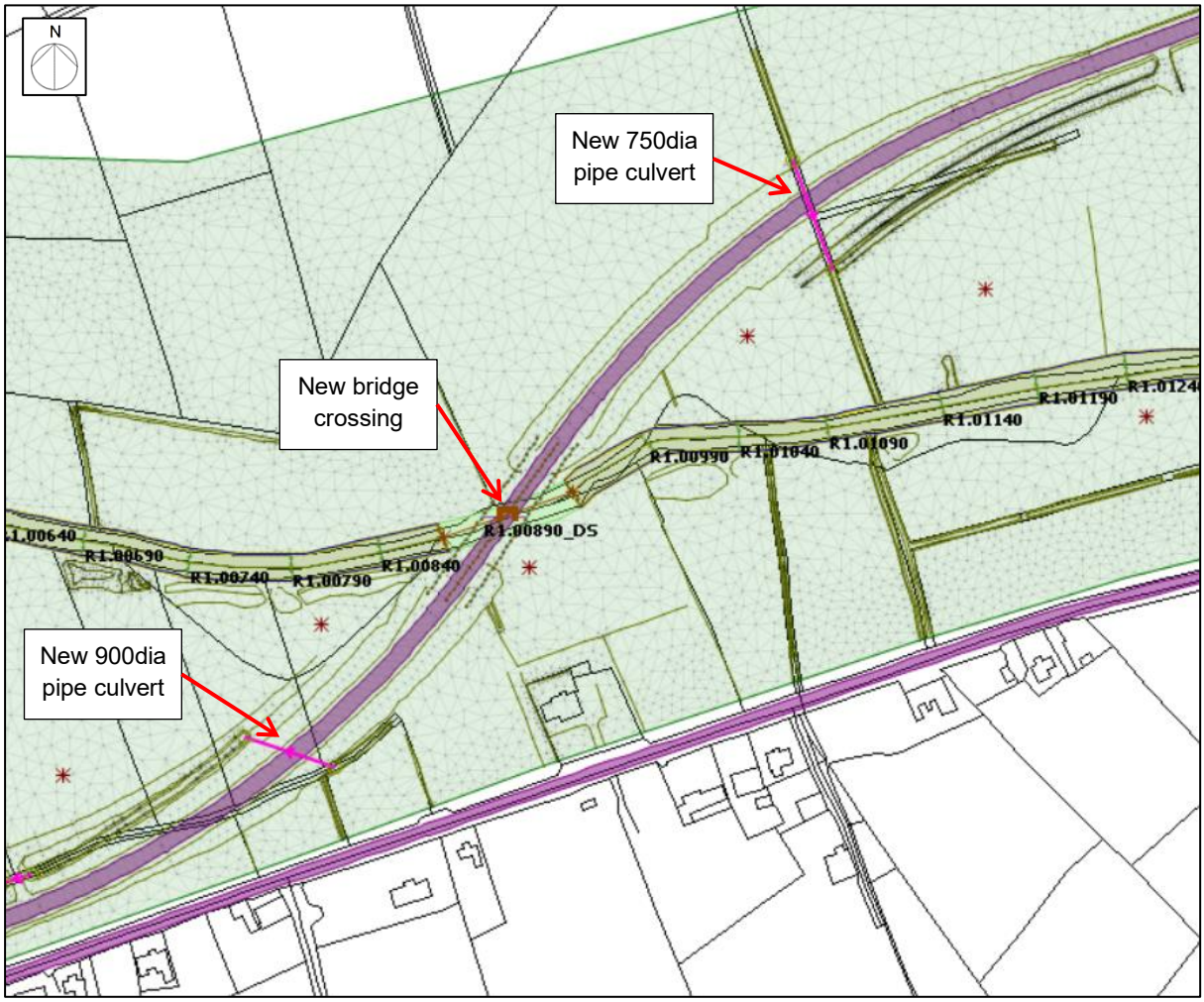


Figure 17. Proposed without Mitigation Model Screenshot

5.6.1 Present Day Fluvial Flooding Comparison

Figure 18 below is a comparison plot for the "Baseline" versus the "Proposed without Mitigation" predicted present day flood extents from the flood model for the 1% AEP fluvial flood event. This figure shows a significant increase in levels upstream of the Proposed Road Development and a subsequent decrease downstream. This has been attributed to the impact of the approach embankments and the span of the bridge restricting the overland flow path.

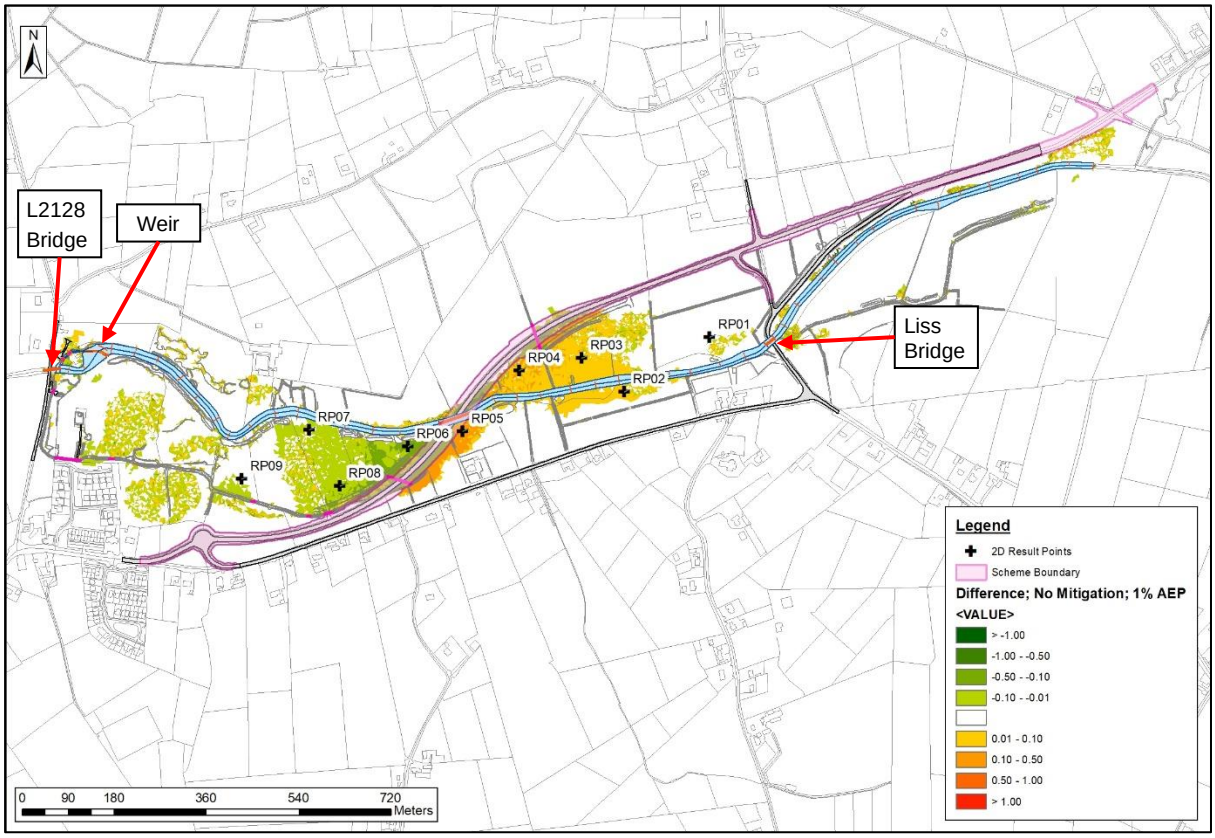


Figure 18. Present Day Fluvial Flooding Comparison – 1% AEP

The cross section results show an increase of 83mm immediately upstream of the new crossing point, at cross section R1.00990, which reduces back to a negligible difference over approx. 400m length. There is also a minor increase in level downstream of the new crossing point for approx. 135m length of 34mm maximum. The flood levels for the cross section locations can be found in Appendix C.

To aid analysis of the impact on the surrounding floodplain, a number of reference points have been created, shown above in Figure 18. RP01 to RP05 are upstream of the Proposed Road Development with RP06 to RP09 downstream. Table 11 below summarises the flood levels at these locations for both the Baseline and “Proposed without Mitigation” model scenarios for the 1% AEP event.

Table 11. 2D Results; Proposed without Mitigation; 1% AEP

Reference Point ID	Baseline; 1% AEP Flood Level (mAOD)	No Mitigation; 1% AEP Flood Level (mAOD)	Difference, No Mitigation - Baseline; 1% AEP (mm)
RP01	40.276	40.274	-2
RP02	39.966	39.981	14
RP03	39.770	39.776	7
RP04	39.618	39.695	77
RP05	39.391	39.560	169
RP06	39.258	No Flood	
RP07	38.908	38.892	-16
RP08	38.928	38.872	-56
RP09	38.817	38.807	-9

A very significant increase in level is experienced at RP05 of 169mm with a significant increase of 77mm experienced at RP04, both upstream of the crossing point. There is subsequently a reduction in level downstream of the crossing point. This has been attributed to the impact of the approach embankments and the span of the bridge restricting the overland flow path.

5.6.2 Climate Change and 0.1% AEP Results

A check has been made against the 1%+CC (MRFS) and 0.1% AEP events. A maximum increase in cross section level of 163mm and 190mm respectively presents at cross section R1.00990 which reduces back to a negligible difference over approx. 450m length. There is also a minor increase in level downstream of the new crossing point for approx. 185m length of a maximum of 67mm and 70mm respectively. The flood levels for the cross section locations can be found in Appendix C.

In relation to the 2D results; these are as summarised in Table 12 & Table 13 below:

Table 12. 2D Results; Proposed without Mitigation; 1%+CC AEP

Reference Point ID	Baseline; 1%+CC AEP Flood Level (mAOD)	No Mitigation; 1%+CC AEP Flood Level (mAOD)	Difference, No Mitigation - Baseline; 1%+CC AEP (mm)
RP01	40.356	40.362	6
RP02	40.056	40.106	49
RP03	39.887	39.982	95
RP04	39.768	39.920	151
RP05	39.501	39.764	264
RP06	39.328	No Flood	
RP07	38.985	38.965	-20
RP08	39.007	38.958	-49
RP09	38.900	38.886	-13

Table 13. 2D Results; Proposed without Mitigation; 0.1% AEP

Reference Point ID	Baseline; 0.1% AEP Flood Level (mAOD)	No Mitigation; 0.1% AEP Flood Level (mAOD)	Difference, No Mitigation - Baseline; 0.1% AEP (mm)
RP01	40.392	40.399	8
RP02	40.098	40.167	69
RP03	39.944	40.068	124
RP04	39.834	40.010	176
RP05	39.546	39.855	309
RP06	39.360	39.125	-234
RP07	39.019	38.996	-24
RP08	39.043	38.992	-51
RP09	38.936	38.919	-17

5.7 "Proposed with Mitigation" Model Results

The "Proposed with Mitigation" model has been developed due to significant increases in flood level evident as a result of the proposals. The following alterations have been made:

- New culvert for ditch to north of river increased in size from 750dia pipe to 2.0x1.6m (WxH) box culvert to increase flood connectivity
- New culvert for ditch to south of river increased in size from 900dia pipe to 2.0x2.3m (WxH) box culvert to increase flood connectivity
- Additional flood connectivity culverts through approach embankments
  - 1No. north of river, 2.0x1.5m (WxH) box culvert
  - 2No. south of river, 2.0x2.3m (WxH) box culverts
- Flood connectivity ditches added to DTM
  - 1No. north of river on downstream side only
  - 2No. south of river, both upstream and downstream of river

Figure 19 below is a screenshot of the section of the model which has been altered.

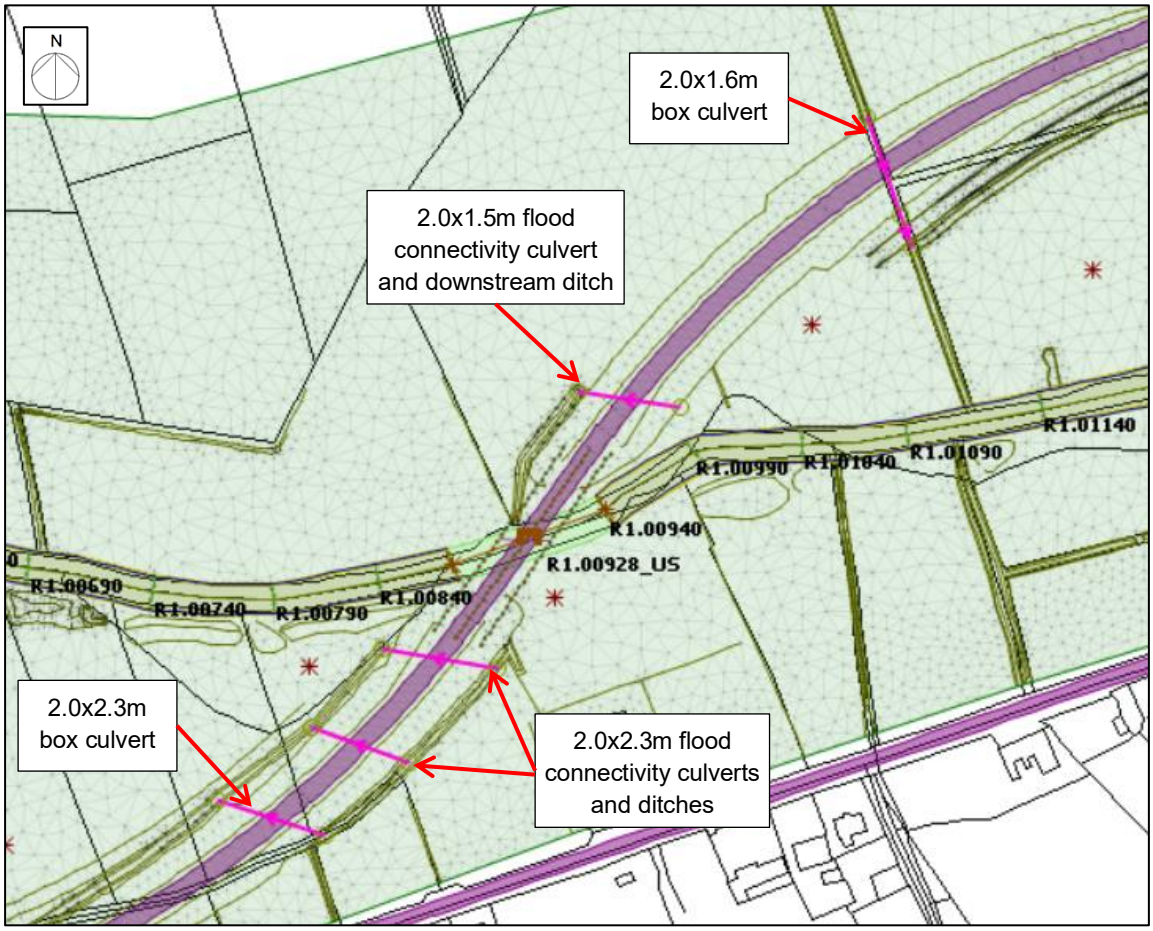


Figure 19. Proposed with Mitigation Model Screenshot

5.7.1 Present Day Fluvial Flooding Comparison

Figure 20 below is a comparison plot for the "Baseline" versus the "Proposed with Mitigation" predicted present day flood extents from the flood model for the 1% AEP fluvial flood event. This figure still shows an increase in level upstream of the Proposed Road Development and a subsequent decrease downstream however it is a significant improvement on the initial proposals. This has been attributed to the impact of the flood connectivity culverts allowing greater volumes of overland flow through the proposed embankments.

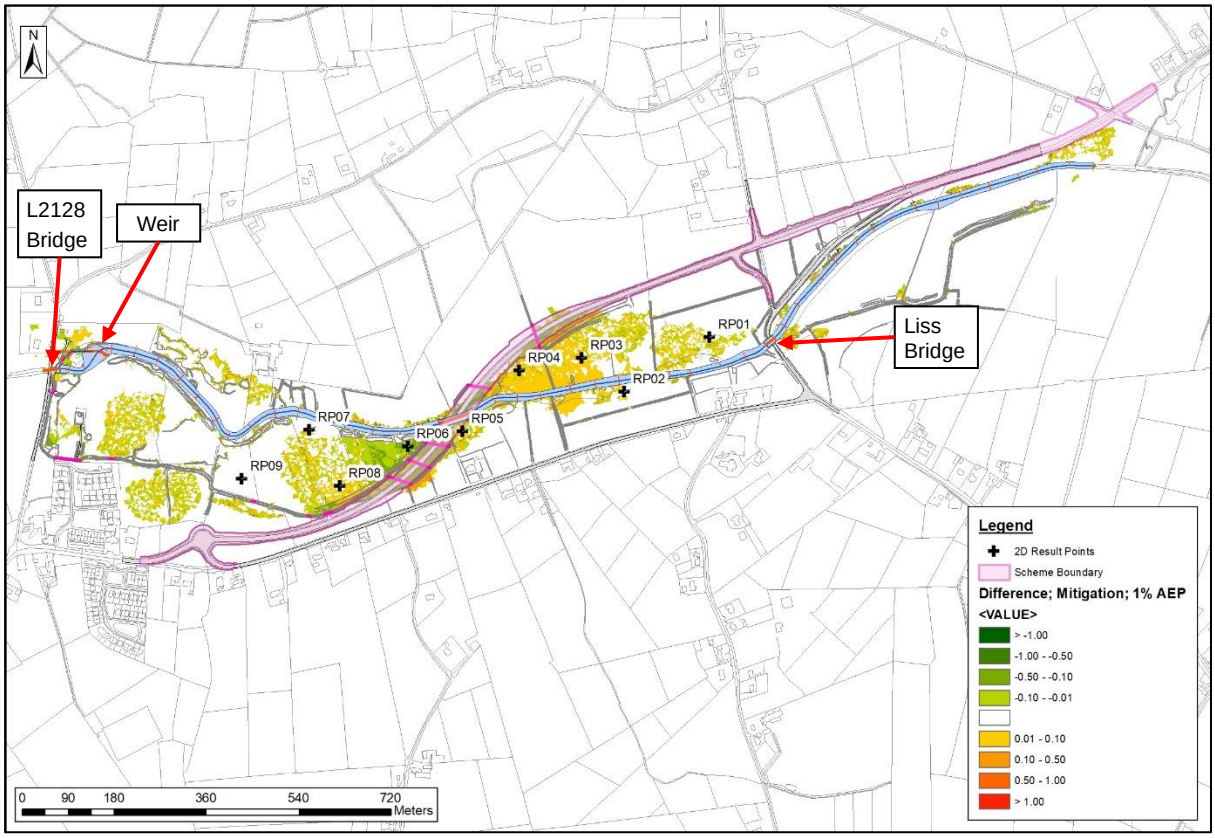


Figure 20. Present Day Fluvial Flooding Comparison – 1% AEP

The cross section results show an increase of 33mm immediately upstream of the new crossing point, at cross section R1.01040, which reduces back to a negligible difference over approx. 300m length. There is a negligible change on the levels downstream of the crossing point. The flood levels for the cross section locations can be found in Appendix C.

Table 14 below summarises the flood levels in the floodplain for both the Baseline and "Proposed with Mitigation" model scenarios for the 1% AEP event.

Table 14. 2D Results; Proposed with Mitigation; 1% AEP

Reference Point ID	Baseline; 1% AEP Flood Level (mAOD)	No Mitigation; 1% AEP Flood Level (mAOD)	Mitigation; 1% AEP Flood Level (mAOD)	Difference, Mitigation - Baseline; 1% AEP (mm)	Difference, Mitigation – No Mitigation; 1% AEP (mm)
RP01	40.276	40.274	40.272	-4	-2
RP02	39.966	39.981	39.976	10	-5
RP03	39.770	39.776	39.753	-17	-23
RP04	39.618	39.695	39.650	33	-45
RP05	39.391	39.560	39.399	8	-161
RP06	39.258	No Flood	39.139	-120	N/A
RP07	38.908	38.892	38.905	-3	13
RP08	38.928	38.872	38.942	14	70
RP09	38.817	38.807	38.812	-4	5

The increase experienced at RP05 of 8mm can now be considered negligible with a slight increase of 33mm experienced at RP04, both upstream of the crossing point. The alteration in level downstream

of the crossing point is also negligible. This has been attributed to the impact of the flood connectivity culverts allowing greater volumes of overland flow through the proposed embankments.

5.7.2 Climate Change and 0.1% AEP Results

A check has been made against the 1%+CC (MRFS) and 0.1% AEP events. A maximum increase in cross section level of 67mm and 86mm respectively presents at cross section R1.01040 which reduces back to a negligible difference over approx. 300m length. There is a negligible change on the levels downstream of the crossing point. The flood levels for the cross section locations can be found in Appendix C.

In relation to the 2D results; these are as summarised in Table 15 & Table 16 below:

Table 15. 2D Results; Proposed with Mitigation; 1%+CC AEP

Reference Point ID	Baseline; 1%+CC AEP Flood Level (mAOD)	No Mitigation; 1%+CC AEP Flood Level (mAOD)	Mitigation; 1%+CC AEP Flood Level (mAOD)	Difference, Mitigation - Baseline; 1%+CC AEP (mm)	Difference, Mitigation – No Mitigation; 1%+CC AEP (mm)
RP01	40.356	40.362	40.349	-7	-13
RP02	40.056	40.106	40.073	17	-32
RP03	39.887	39.982	39.911	24	-70
RP04	39.768	39.920	39.832	63	-88
RP05	39.501	39.764	39.564	63	-201
RP06	39.328	No Flood	39.232	-96	N/A
RP07	38.985	38.965	38.977	-7	13
RP08	39.007	38.958	39.006	-1	48
RP09	38.900	38.886	38.890	-10	3

Table 16. 2D Results; Proposed with Mitigation; 0.1% AEP

Reference Point ID	Baseline; 0.1% AEP Flood Level (mAOD)	No Mitigation; 0.1% AEP Flood Level (mAOD)	Mitigation; 0.1% AEP Flood Level (mAOD)	Difference, Mitigation - Baseline; 0.1% AEP (mm)	Difference, Mitigation – No Mitigation; 0.1% AEP (mm)
RP01	40.392	40.399	40.386	-5	-13
RP02	40.098	40.167	40.126	28	-41
RP03	39.944	40.068	39.993	49	-75
RP04	39.834	40.010	39.918	84	-93
RP05	39.546	39.855	39.642	96	-213
RP06	39.360	39.125	39.266	-93	141
RP07	39.019	38.996	39.012	-7	16
RP08	39.043	38.992	39.038	-4	46
RP09	38.936	38.919	38.927	-9	7

6 Conclusion

Galway County Council is proposing to develop a circa 2.3km national secondary road on 13.8ha of predominantly greenfield site to the north-east of the village of Abbeyknockmoy, Co. Galway. The Proposed Road Development comprises a rural all-purpose Type 2 Single Carriageway road, including a new river crossing over the River Abbert. Provision for both pedestrian and cycle facilities has been included as part of the scheme, predominantly along the route of the existing N63.

The “Stage 1 – Flood Risk Identification” stage of this FRA identified the possibility of the Proposed Road Development corridor being impacted by fluvial flooding from the River Abbert. The “Stage 2 – Initial Flood Risk Assessment” determined the vulnerability of the proposals as “highly vulnerable” given the development can be considered as Primary Transport Infrastructure. However, the extent and depth of fluvial flooding could not be determined based on the information available.

In order to determine the flood extents and levels for the Proposed Road Development, a Stage 3 Detailed FRA was required. A hydraulic model of the watercourse has therefore been developed based on detailed survey information. Three model scenarios have been developed; Baseline, Proposed without Mitigation and Proposed with Mitigation. Hydrological estimation has been undertaken to determine the flows for the 1% AEP, 1%+CC AEP (MRFS) and 0.1% AEP events.

Model output for the Proposed without Mitigation scenario indicated a significant increase (maximum of 83mm in-channel and 169mm in the floodplain for the 1% AEP) in flood level upstream of the proposed crossing. This is attributed to the impact of the approach embankments and the span of the bridge restricting the overland flow path.

The Proposed with Mitigation scenario included upsizing of two proposed ditch culverts and the addition of three flood connectivity culverts to improve the conveyance of flow through the proposed approach embankments. Model output for the Proposed with Mitigation scenario indicated a slight increase (maximum of 33mm in-channel and 33mm in the floodplain for the 1% AEP) in flood level upstream of the proposed crossing. There is no additional risk posed to nearby properties with increases only within agricultural lands.

Appendix A Flood Flow Estimation

Flood Estimation

Calcs By:	RR
Checked By:	RR
Date Checked:	Mar-21

Culvert Catchment	Location / Townland	Chainage (m)	Total Area (km^2)	SOIL	SAAR	R_{smd}	S1085	L	STMFRQ (F_s)	Fn	Estimated Q_{bar} (m^3/s)				
					(mm)		(m/km)				FSR -6	FSR -3	FSSR No.6	IH124/ICP	FEP-6
Abbert	Liss		172.229	0.24	1092.83	41.98	1.70	0.00	0.14	2.7	11.418	22.927	15.251	17.564	11.476

Factorial Error Factors (95%)

FSR -6	FSR -3	FSSR No.6	IH124/ICP	FEP-6
2.17	1.58	1.53	1.65	2.25

Culvert Catchment	Location	Chainage (m)	Total Area (km^2)	Apply Factorial Error Factors to Qbar					Effect of Urbanisation Factor [UF]				OPW FSU Web Portal Calculations
				FSR -6	FSR -3	FSSR No.6	IH124/ICP	FEP-6	Urban	PRr/CIND	CWI	$\frac{Qbar_{(urban)}}{Qbar_{(rural)}}$	
Abbert	Liss	0	172.229	24.777	36.225	23.334	28.981	25.820	0.00	24.58	124	1.00	N/A

Growth Factor [GF]		Climate Change Factor [CC]	Arterial Drainage Factor
Qt (1:x years)	GF	1.00	1.60
5	1.20		
10	1.37		
25	1.60		
50	1.77		
100	1.96		
200	2.14		

Culvert Catchment	Location	Chainage (m)	Total Area (km^2)	Apply Urbanisation Factor, Growth Factor, Climate Change Factor (m^3/s)					Maintained Channel - Arterial Drainage	Apply Arterial Drainage Factor (m3/s)					OPW FSU Web Portal Calculations
				FSR -6	FSR -3	FSSR No.6	IH124/ICP	FEP-6		FSR -6	FSR -3	FSSR No.6	IH124/ICP	FEP-6	
Abbert	Liss	0	172.229	48.563	71.001	45.734	56.803	50.607	No	48.563	71.001	45.734	56.803	50.607	N/A
50				43.856	64.118	41.301	51.297	45.701							
25				39.643	57.960	37.334	46.370	41.312							
10				33.945	49.628	31.967	39.704	35.373							
5				29.733	43.470	28.001	34.777	30.984							

Flood Estimation Methodology - Equations

Flood Studies Report (FSR):-
Six Variable Equation;
Qbar = 0.0172Area0.94STMFRQ0.27SOIL1.23Rsmd1.03S10850.16(1+L)-0.85

FSR 3 variable equation;
Qbar = 0.00066Area0.92SAAR1.22SOIL2

Flood Studies Supplementary Report (FSSR) No. 6:-
Qbar = 0.0288Area0.90Rsmd1.23SOIL1.77STMFRQ0.23

IH 124 Report;
Qbar = 0.00108Area0.89SAAR1.17SOIL2.17
Effect of Urbanisation on Mean Annual Flood c.f. FSSR No. 5.
Qbar Urban/Qbar Rural = (1 + Urban)1.5 (1 + 0.3 Urban(70/PRr -1))
for areas 50ha to 2500ha
Qbar = 0.00108 (Area/50) 500.89SAAR1.17 SOIL2.17

Input Data

S1085	1.70487	m/km	*from FSU*
URBAN	0		*from FSU*
SAAR	1092.83	mm	*from FSU*
MSL	29.584	km	*from FSU*
S1	0.3814		*from FSR Maps*
S2	0.6186		*from FSR Maps*
S3	0		*from FSR Maps*
S4	0		*from FSR Maps*
S5	0		*from FSR Maps*
CWI	123.8	mm	*from chart*
P	70.3	mm	*from FSU*
A	172.2289	km^2	*from measurement*
ARF	0.912		*from FSU*

$Tp(0) = 283.0\ S1085^{-0.33}\ (1+URBAN)^{-2.2}\ SAAR^{-0.54}\ MSL^{0.23}$

$T = Tp(0)/5$

$Tp(T) = Tp(0) + T/2$

$D = (1.0+SAAR/1000)T_p$

$SPR = 10\ S1 + 30\ S2\ \ 37\ S3 + 47\ S4 + 53\ S5$

$DPR_{CWI} = 0.25\ (CWI - 125)$

$DPR_{RAIN} = 0.45\ (P - 40)^{0.7}$ for $P > 40$ mm

$= 0$ for $P \leq 40$ mm

$PR_{RURAL} = SPR + DPR_{CWI} + DPR_{RAIN}$

$PR_{TOTAL} = PR_{RURAL}\ (1.0 - 0.3\ URBAN) + 70\ (0.3\ URBAN)$

$ANSF = [33\ (CWI - 125) + 3.0\ SAAR + 5.5] \times 10^{-5}$

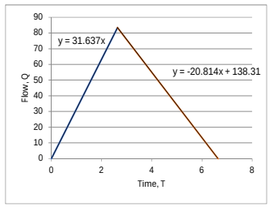
Tp(0)	11.83	hrs
T	1.00	hrs
Tp(T)	12.33	hrs
Dcalc	25.80	hrs
D	27.00	hrs
SPR	22.37	
DPRcwi	-0.30	
DPRrain	4.90	
PRrural	26.97	
PRtotal	26.97	
ANSF	0.03	

Unit Hydrograph

$Qp = 220/Tp(T)$

$Tb = 2.52Tp(T)$

Qp	17.85
Tb	31.06



0	0
12.33	17.85
31.06	0
Rise, x	1.448
Fall, x	-0.953
Fall, intercept	29.590

Rainfall Distribution

% Duration	% Rain	Increment %	Increment (mm)
11.11	26	26	16.67
33.33	64	38	24.36
55.56	83	19	12.18
77.78	93	10	6.41
100.00	100	7	4.49

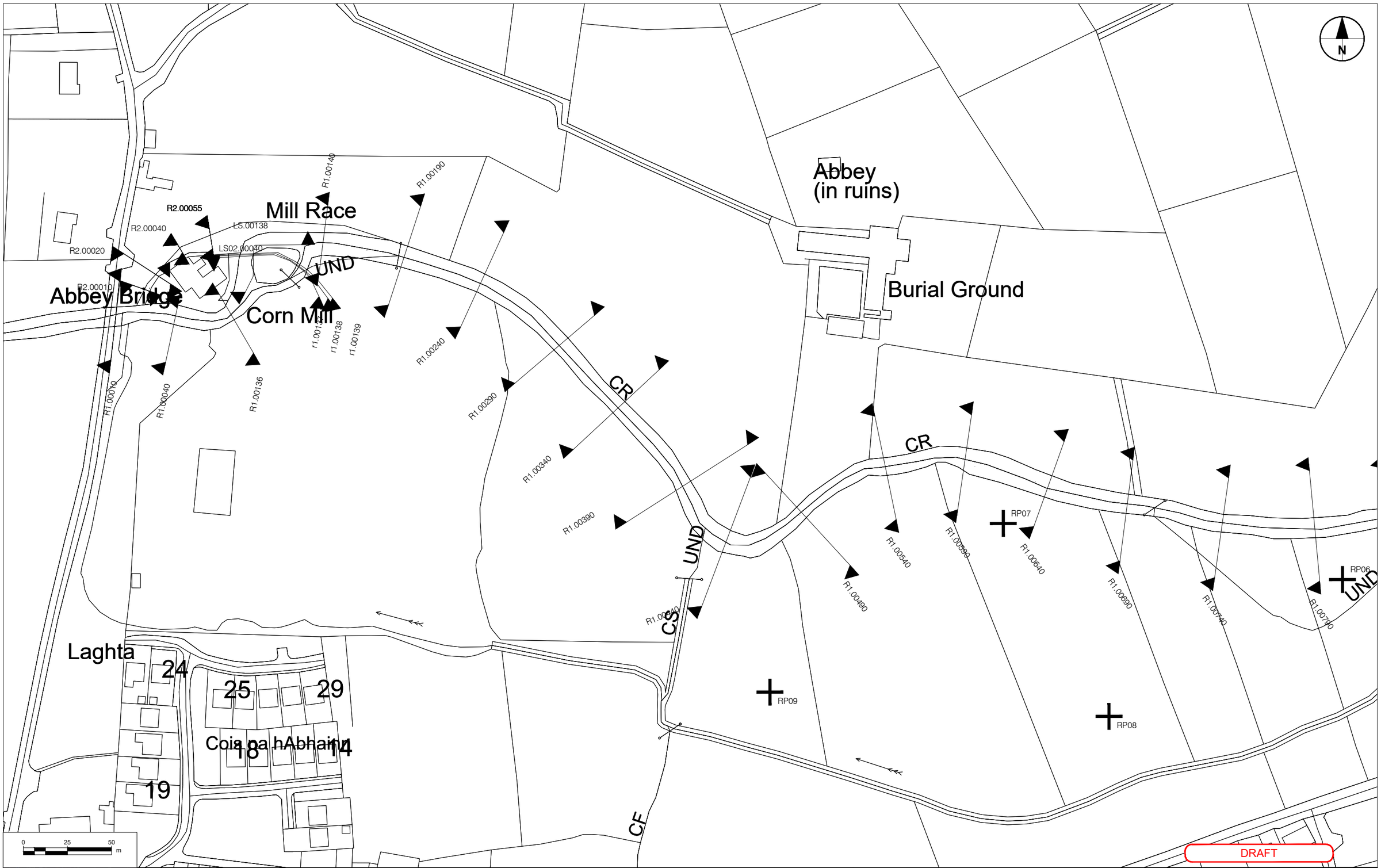
Interval	Total Rain (mm)	Net Rain (mm)
1	2.24	0.61
2	3.21	0.86
3	6.09	1.64
4	12.18	3.29
5	16.67	4.50
6	12.18	3.29
7	6.09	1.64
8	3.21	0.86
9	2.24	0.61

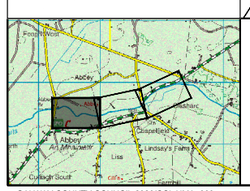
Convolition of Unit Hydrograph and Net Rain Profile

Unit Hydrograph (cumecs)

Net Rain (cm)	0	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00	30.00	31.00	32.00	33.00	34.00	35.00	36.00	37.00	38.00	39.00	40.00
	0.00	2.49	4.99	7.48	9.98	12.47	14.96	17.46	19.95	22.44	24.94	27.43	29.93	29.63	27.99	26.35	24.71	23.07	21.43	19.79	18.15	16.51	14.87	13.23	11.59	9.95	8.31	6.67	5.02	3.38	1.74	0.10									
0.06	0.00	0.15	0.30	0.45	0.60	0.75	0.91	1.06	1.21	1.36	1.51	1.66	1.81	1.79	1.69	1.60	1.50	1.40	1.30	1.20	1.10	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20	0.11	0.01									
0.09		0.00	0.22	0.43	0.65	0.86	1.08	1.29	1.51	1.72	1.94	2.16	2.37	2.59	2.56	2.42	2.28	2.14	1.99	1.85	1.71	1.57	1.43	1.29	1.14	1.00	0.86	0.72	0.58	0.43	0.29	0.15	0.01								
0.16			0.00	0.41	0.82	1.23	1.64	2.05	2.46	2.87	3.28	3.69	4.10	4.51	4.92	4.87	4.60	4.33	4.06	3.79	3.52	3.25	2.98	2.71	2.44	2.17	1.90	1.63	1.36	1.09	0.83	0.56	0.29	0.02							
0.33				0.00	0.82	1.64	2.46	3.28	4.10	4.92	5.74	6.55	7.37	8.19	9.01	9.83	9.74	9.20	8.66	8.12	7.58	7.04	6.50	5.96	5.42	4.89	4.35	3.81	3.27	2.73	2.19	1.65	1.11	0.57	0.03						
0.45					0.00	1.12	2.24	3.36	4.48	5.61	6.73	7.85	8.97	10.09	11.21	12.33	13.45	13.32	12.59	11.85	11.11	10.37	9.64	8.90	8.16	7.42	6.69	5.95	5.21	4.47	3.73	3.00	2.26	1.52	0.78	0.05					
0.33						0.00	0.82	1.64	2.46	3.28	4.10	4.92	5.74	6.55	7.37	8.19	9.01	9.83	9.74	9.20	8.66	8.12	7.58	7.04	6.50	5.96	5.42	4.89	4.35	3.81	3.27	2.73	2.19	1.65	1.11	0.57	0.03			
0.16							0.00	0.41	0.82	1.23	1.64	2.05	2.46	2.87	3.28	3.69	4.10	4.51	4.92	4.87	4.60	4.33	4.06	3.79	3.52	3.25	2.98	2.71	2.44	2.17	1.90	1.63	1.36	1.09	0.83	0.56	0.29	0.02		
0.09								0.00	0.22	0.43	0.65	0.86	1.08	1.29	1.51	1.72	1.94	2.16	2.37	2.59	2.56	2.42	2.28	2.14	1.99	1.85	1.71	1.57	1.43	1.29	1.14	1.00	0.86	0.72	0.58	0.43	0.29	0.15	0.01	
0.06									0.00	0.15	0.30	0.45	0.60	0.75	0.91	1.06	1.21	1.36	1.51	1.66	1.81	1.79	1.69	1.60	1.50	1.40	1.30	1.20	1.10	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20	0.11	0.01
Total	*0.00*	*0.15*	*0.52*	*1.29*	*2.89*	*5.61*	*9.14*	*13.09*	*17.25*	*21.56*	*25.87*	*30.19*	*34.50*	*38.64*	*42.46*	*45.71*	*47.82*	*48.24*	*47.13*	*45.12*	*42.65*	*39.90*	*37.06*	*34.22*	*31.39*	*28.55*	*25.71*	*22.87*	*20.04*	*17.20*	*14.36*	*11.53*	*8.78*	*6.18*	*3.83*	*2.01*	*0.92*	*0.37*	*0.11*	*0.01*	*0.00*
Base Flow	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59
Total Q	**5.59**	**5.74**	**6.11**	**6.88**	**8.48**	**11.19**	**14.73**	**18.68**	**22.84**	**27.15**	**31.46**	**35.77**	**40.09**	**44.23**	**48.05**	**51.30**	**53.41**	**53.83**	**52.72**	**50.71**	**48.24**	**45.49**	**42.65**	**39.81**	**36.97**	**34.14**	**31.30**	**28.46**	**25.63**	**22.79**	**19.95**	**17.11**	**14.37**	**11.76**	**9.42**	**7.60**	**6.50**	**5.96**	**5.70**	**5.59**	**5.59**

Appendix B Drawings





Bonneagar Iompair Éireann
Transport Infrastructure Ireland

GALWAY NATIONAL ROADS PROJECT OFFICE

Comhairle Chontae na Gaillimhe
Galway County Council

Project Ireland 2040
Building Ireland's Future

No.	Revision	Date	By	Chk'd	App'd

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Drawn	Designed	Checked	Approved	Suitability Code - Description
RR	RR	JT	EG	S0 - Work In Progress

Project Title	N63 LISS TO ABBEY REALIGNMENT SCHEME
Drawing Title	FLOOD RISK ASSESSMENT SURVEYED CROSS SECTION PLAN SHEET 1 OF 3

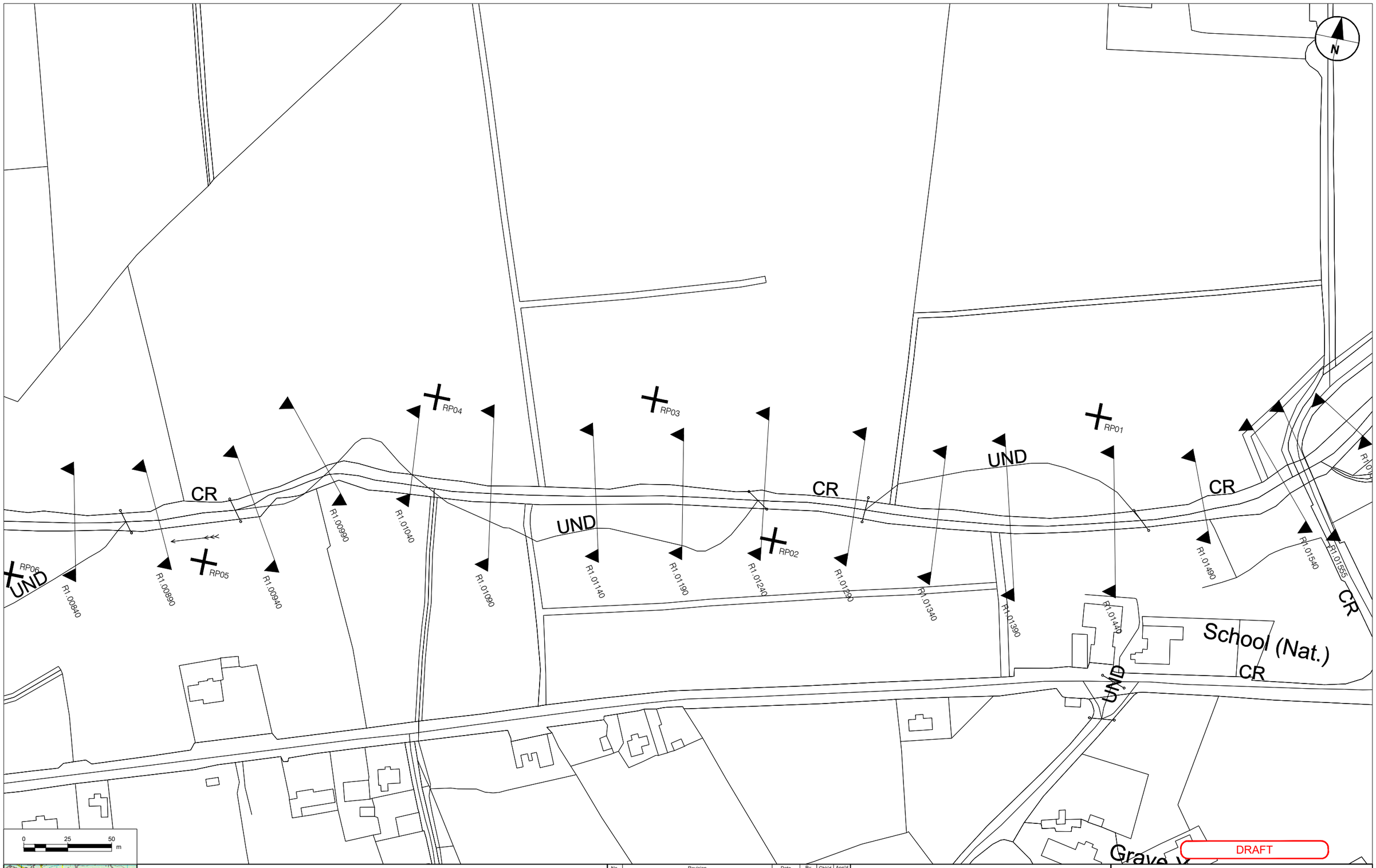
Drawing Number	Project	Originator	Phase	Series	Type	Dept.	Number
	N63	ACM	PH03	0500	DR	DR	0550

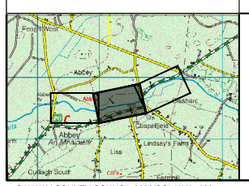
Scale:	Date:	Job No:	Rev:
1:1000 @A1 / 1:2000 @A3	16.04.2021	60597858	0

16 April 2021 09:52:22

\\EU.AECOMNET.COM\UK\IEDBL2\JOBS\PR-395964_N63_PH1-4\900_CAD_GIS\910_CAD\20-SHEETS\01-WIP\N63-ACM-PH03-0500-DR-DR-0550-0552_FRA_CROSS SECTIONS.DWG

DO NOT SCALE USE FIGURED DIMENSIONS ONLY





Bonneagar Iompair Éireann
Transport Infrastructure Ireland

GALWAY NATIONAL ROADS PROJECT OFFICE

Comhairle Chontae na Gaillimhe
Galway County Council

Project Ireland 2040
Building Ireland's Future

No.	Revision	Date	By	Chk'd	App'd

DRAFT

Roughan & O'Donovan-AECOM Alliance

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www.rod.ie

Drawn	Designed	Checked	Approved	Suitability Code - Description
RR	RR	JT	EG	S0 - Work In Progress

Project Title: N63 LISS TO ABBEY REALIGNMENT SCHEME

Drawing Title: FLOOD RISK ASSESSMENT SURVEYED CROSS SECTION PLAN SHEET 2 OF 3

Drawing Number: Project | Originator | Phase | Series | Type | Dept. | Number
N63 - ACM - PH03 - 0500 - DR - DR - 0551

Scale: 1:1000 @A1 / 1:2000 @A3 | Date: 16.04.2021 | Job No: 60597858 | Rev: 0

16 April 2021 09:54:26

\\EU.AECOMNET.COM\UK\IEDBL2\JOBS\PR-395964_N63_PH1-4\900_CAD_GIS\910_CAD\20-SHEETS\01-WIP\N63-ACM-PH03-0500-DR-DR-0550-0552_FRA_CROSS SECTIONS.DWG

DO NOT SCALE USE FIGURED DIMENSIONS ONLY

No.	Revision	Date	By	Chk'd	App'd

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Drawn	Designed	Checked	Approved	Suitability Code - Description
RR	RR	JT	EG	S0 - Work In Progress

Project Title	N63 LISS TO ABBEY REALIGNMENT SCHEME
Drawing Title	FLOOD RISK ASSESSMENT SURVEYED CROSS SECTION PLAN SHEET 3 OF 3

Drawing Number	Project	Originator	Phase	Series	Type	Dept.	Number
	N63	ACM	PH03	0500	DR	DR	0552

Scale:	Date:	Job No:	Rev:
1:1000 @A1 / 1:2000 @A3	16.04.2021	60597858	0

16 April 2021 09:55:32

\\EU.AECOMNET.COM\UK\IEDBL2\JOBS\PR-395964_N63_PH1-4\900_CAD_GIS\910_CAD\20-SHEETS\01-WIP\N63-ACM-PH03-0500-DR-DR-0550-0552_FRA_CROSS SECTIONS.DWG

DO NOT SCALE USE FIGURED DIMENSIONS ONLY

N

0 250 500 Metres

Filename: C:\Users\richard.reid\Documents\Jobs\N63 Abbey-Liss\Model Results_TB.mxd

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Project Title:

N63 LISS TO ABBEY REALIGNMENT SCHEME

Client:

TII Bonneagar Iompair Éireann Transport Infrastructure Ireland

Project Ireland 2040 Building Ireland's Future

Comhairle Chontae na Gaillimhe Galway County Council

LEGEND

Scheme Boundary

Baseline; 1% AEP

<VALUE>

- 0.01 - 0.10
- 0.10 - 0.30
- 0.30 - 1.00
- > 1.00

AECOM Internal Project No:

60597858

Drawing Title:

FLOOD RISK ASSESSMENT
BASELINE FLOOD EXTENTS
1% AEP EVENT

Scale at A3: 1:6,000

Drawing No:

N63-ACM-PH03-0500-DR-DR-0555

Drawn:	Chk'd:	App'd:	Date:
RR	JT	EG	15/04/21

N

0 250 500 Metres

Filename: C:\Users\richard.reid\Documents\Jobs\N63 Abbey-Liss\Model Results_TB.mxd

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Project Title:

N63 LISS TO ABBEY REALIGNMENT SCHEME

Client:

Bonneagar Iompair Éireann Transport Infrastructure Ireland

Project Ireland 2040 Building Ireland's Future

Comhairle Chontae na Gaillimhe Galway County Council

LEGEND

- Scheme Boundary

Baseline;
Mannings+20%;
1% AEP

<VALUE>

- 0.01 - 0.10
- 0.10 - 0.30
- 0.30 - 1.00
- > 1.00

AECOM Internal Project No:

60597858

Drawing Title:

FLOOD RISK ASSESSMENT
BASELINE FLOOD EXTENTS
MANNING'S 'N' +20%
1% AEP EVENT

Scale at A3: 1:6,000

Drawing No:

N63-ACM-PH03-0500-DR-DR-0556

Drawn:	Chk'd:	App'd:	Date:
RR	JT	EG	15/04/21

N

0 250 500 Metres

Filename: C:\Users\richard.reid\Documents\Jobs\N63 Abbey-Liss\Model Results_TB.mxd

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Project Title:

N63 LISS TO ABBEY REALIGNMENT SCHEME

Client:

TII Bonneagar Iompair Eireann Transport Infrastructure Ireland

Project Ireland 2040 Building Ireland's Future

Comhairle Chontae na Gaillimhe Galway County Council

LEGEND

Scheme Boundary

Baseline; 1%+CC AEP

<VALUE>

- 0.01 - 0.10
- 0.10 - 0.30
- 0.30 - 1.00
- > 1.00

AECOM Internal Project No:

60597858

Drawing Title:

FLOOD RISK ASSESSMENT
BASELINE FLOOD EXTENTS
1%+CC AEP EVENT (MRFS)

Scale at A3: 1:6,000

Drawing No:

N63-ACM-PH03-0500-DR-DR-0557

Drawn:	Chk'd:	App'd:	Date:
RR	JT	EG	15/04/21

N

0 250 500 Metres

Filename: C:\Users\richard.reid\Documents\Jobs\N63 Abbey-Liss\Model Results_TB.mxd

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Project Title:

N63 LISS TO ABBEY REALIGNMENT SCHEME

Client:

TII Bonneagar Iompair Eireann Transport Infrastructure Ireland

Project Ireland 2040 Building Ireland's Future

Comhairle Chontae na Gaillimhe Galway County Council

LEGEND

- Scheme Boundary

Baseline; 0.1% AEP

<VALUE>

- 0.01 - 0.10
- 0.10 - 0.30
- 0.30 - 1.00
- > 1.00

AECOM Internal Project No:

60597858

Drawing Title:

FLOOD RISK ASSESSMENT
BASELINE FLOOD EXTENTS
0.1% AEP EVENT

Scale at A3: 1:6,000

Drawing No:

N63-ACM-PH03-0500-DR-DR-0558

Drawn:	Chk'd:	App'd:	Date:
RR	JT	EG	15/04/21

N

0 250 500 Metres

Filename: C:\Users\richard.reid\Documents\Jobs\N63 Abbey-Liss\Model Results_TB.mxd

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Project Title:

N63 LISS TO ABBEY REALIGNMENT SCHEME

Client:

TII Bonneagar Iompair Éireann Transport Infrastructure Ireland

Project Ireland 2040 Building Ireland's Future

Comhairle Chontae na Gaillimhe Galway County Council

LEGEND

Scheme Boundary

Proposed - No Mitigation; 1% AEP

<VALUE>

- 0.01 - 0.10
- 0.10 - 0.30
- 0.30 - 1.00
- > 1.00

AECOM Internal Project No:

60597858

Drawing Title:

FLOOD RISK ASSESSMENT
PROPOSED - NO MITIGATION
FLOOD EXTENTS
1% AEP EVENT

Scale at A3: 1:6,000

Drawing No:

N63-ACM-PH03-0500-DR-DR-0560

Drawn:	Chk'd:	App'd:	Date:
RR	JT	EG	15/04/21

N

0 250 500 Metres

Filename: C:\Users\richard.reid\Documents\Jobs\N63 Abbey-Liss\Model Results_TB.mxd

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Project Title:

N63 LISS TO ABBEY REALIGNMENT SCHEME

Client:

TII Bonneagar Iompair Éireann Transport Infrastructure Ireland

Project Ireland 2040 Building Ireland's Future

Comhairle Chontae na Gaillimhe Galway County Council

LEGEND

Scheme Boundary

Proposed - No Mitigation; 1%+CC AEP

<VALUE>

- 0.01 - 0.10
- 0.10 - 0.30
- 0.30 - 1.00
- > 1.00

AECOM Internal Project No:

60597858

Drawing Title:

FLOOD RISK ASSESSMENT
PROPOSED - NO MITIGATION
FLOOD EXTENTS
1%+CC AEP EVENT (MRFS)

Scale at A3: 1:6,000

Drawing No:

N63-ACM-PH03-0500-DR-DR-0561

Drawn:	Chk'd:	App'd:	Date:
RR	JT	EG	15/04/21

N

0 250 500 Metres

Filename: C:\Users\richard.reid\Documents\Jobs\N63 Abbey-Liss\Model Results_TB.mxd

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Project Title:

N63 LISS TO ABBEY REALIGNMENT SCHEME

Client:

TII Bonneagar Iompair Éireann Transport Infrastructure Ireland

Project Ireland 2040 Building Ireland's Future

Comhairle Chontae na Gaillimhe Galway County Council

LEGEND

Scheme Boundary

Proposed - No Mitigation; 0.1% AEP

<VALUE>

- 0.01 - 0.10
- 0.10 - 0.30
- 0.30 - 1.00
- > 1.00

AECOM Internal Project No:

60597858

Drawing Title:

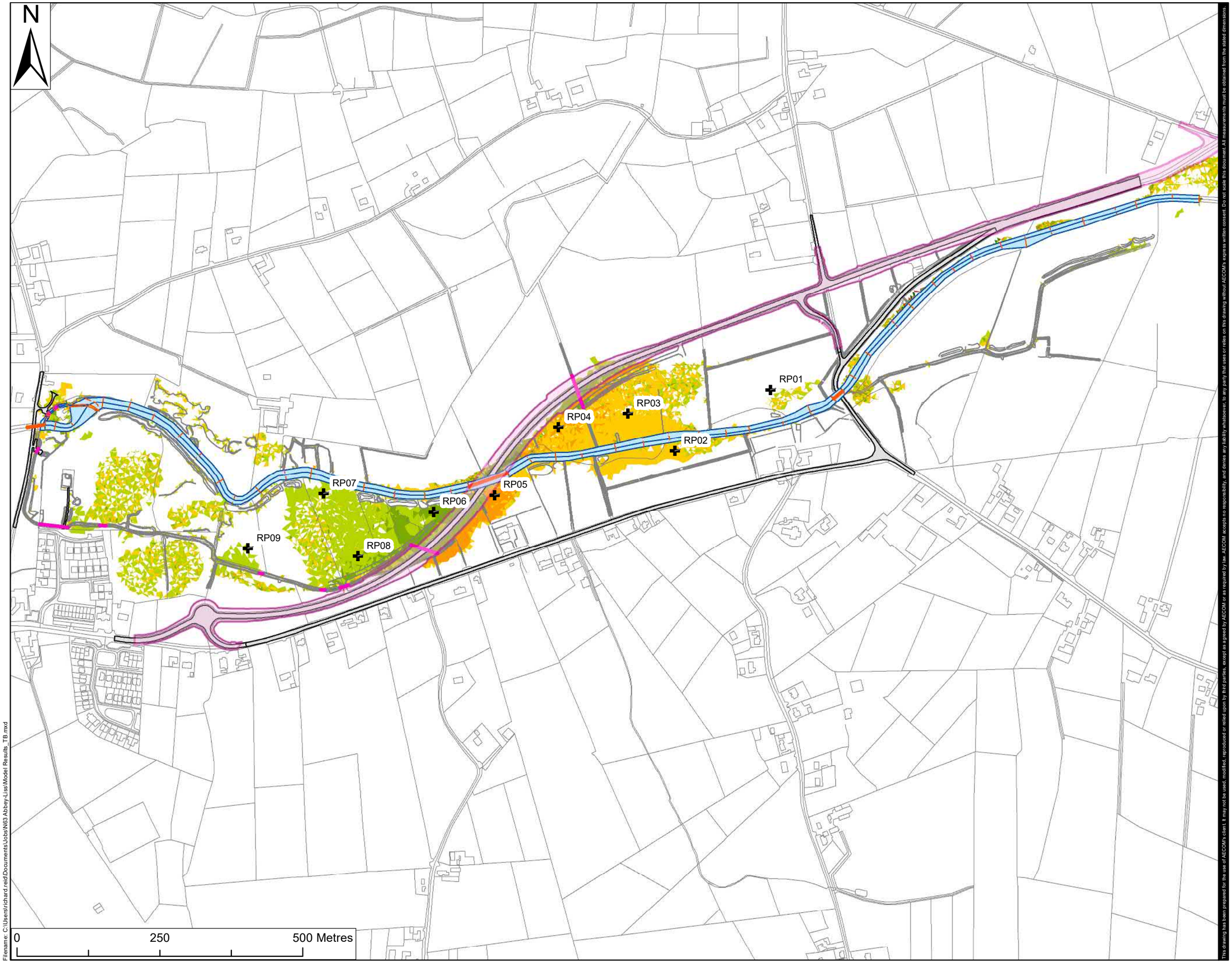
FLOOD RISK ASSESSMENT
PROPOSED - NO MITIGATION
FLOOD EXTENTS
0.1% AEP EVENT

Scale at A3: 1:6,000

Drawing No:

N63-ACM-PH03-0500-DR-DR-0562

Drawn:	Chk'd:	App'd:	Date:
RR	JT	EG	15/04/21



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Project Title:

N63 LISS TO ABBEY REALIGNMENT SCHEME

Client:

Project Ireland 2040
Building Ireland's Future

Comhairle Chontae na Gaillimhe
Galway County Council

LEGEND

- 2D Result Points
- Scheme Boundary

Difference; No Mitigation; 1% AEP

<VALUE>

- > -1.00
- -1.00 - -0.50
- -0.50 - -0.10
- -0.10 - -0.01
- 0.01 - 0.10
- 0.10 - 0.50
- 0.50 - 1.00
- > 1.00

AECOM Internal Project No:

60597858

Drawing Title:

FLOOD RISK ASSESSMENT
DEPTH DIFFERENCE MAP
BASELINE - NO MITIGATION
1% AEP EVENT

Scale at A3: 1:6,000

Drawing No:

N63-ACM-PH03-0500-DR-DR-0563

Drawn:	Chk'd:	App'd:	Date:
RR	JT	EG	15/04/21

Filename: C:\Users\richard.reid\Documents\Jobs\N63 Abbey-Liss\Model Results_TB.mxd

N

0 250 500 Metres

Filename: C:\Users\richard.reid\Documents\Jobs\N63 Abbey-Liss\Model Results_TB.mxd

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Project Title:

N63 LISS TO ABBEY REALIGNMENT SCHEME

Client:

TII Bonneagar Iompair Éireann Transport Infrastructure Ireland

Project Ireland 2040 Building Ireland's Future

Comhairle Chontae na Gaillimhe Galway County Council

LEGEND

Scheme Boundary

Proposed - Mitigation; 1% AEP

<VALUE>

- 0.01 - 0.10
- 0.10 - 0.30
- 0.30 - 1.00
- > 1.00

AECOM Internal Project No:

60597858

Drawing Title:

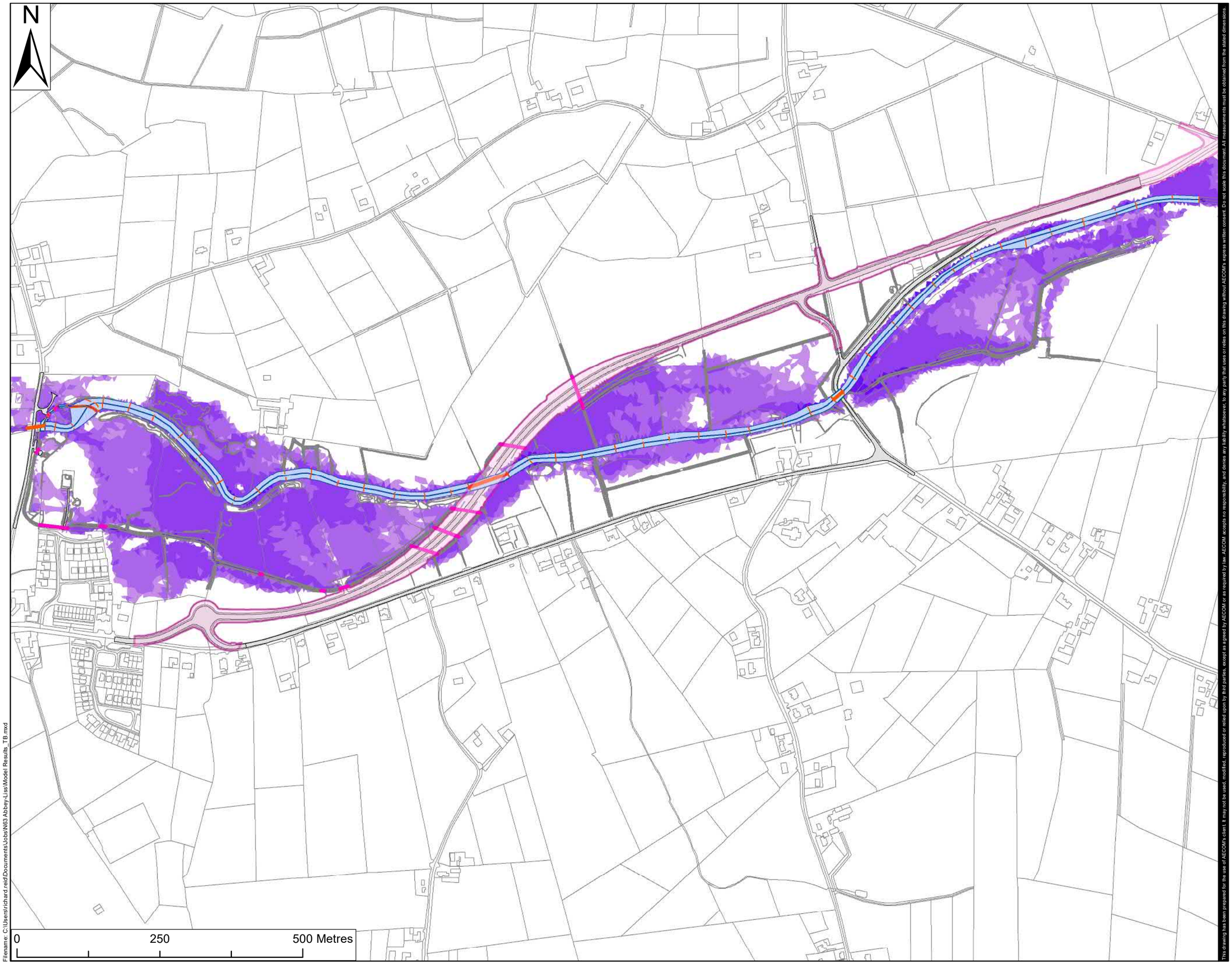
FLOOD RISK ASSESSMENT
PROPOSED - MITIGATION
FLOOD EXTENTS
1% AEP EVENT

Scale at A3: 1:6,000

Drawing No:

N63-ACM-PH03-0500-DR-DR-0565

Drawn:	Chk'd:	App'd:	Date:
RR	JT	EG	15/04/21



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Project Title:

N63 LISS TO ABBEY REALIGNMENT SCHEME

Client:

Project Ireland 2040
Building Ireland's Future

Comhairle Chontae na Gaillimhe
Galway County Council

LEGEND

- Scheme Boundary

Proposed - Mitigation; 1%+CC AEP

<VALUE>

- 0.01 - 0.10
- 0.10 - 0.30
- 0.30 - 1.00
- > 1.00

AECOM Internal Project No:

60597858

Drawing Title:

FLOOD RISK ASSESSMENT
PROPOSED - MITIGATION
FLOOD EXTENTS
1%+CC AEP EVENT (MRFS)

Scale at A3: 1:6,000

Drawing No:

N63-ACM-PH03-0500-DR-DR-0566

Drawn:	Chk'd:	App'd:	Date:
RR	JT	EG	15/04/21

Filename: C:\Users\richard.reid\Documents\Jobs\N63 Abbey-Liss\Model Results_TB.mxd

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Project Title:

N63 LISS TO ABBEY REALIGNMENT SCHEME

Client:

Transport Infrastructure Ireland
Project Ireland 2040 Building Ireland's Future
Comhairle Chontae na Gaillimhe Galway County Council

LEGEND

- Scheme Boundary

Proposed - Mitigation; 0.1% AEP

<VALUE>

- 0.01 - 0.10
- 0.10 - 0.30
- 0.30 - 1.00
- > 1.00

0 250 500 Metres

AECOM Internal Project No:
60597858

Drawing Title:

FLOOD RISK ASSESSMENT
PROPOSED - MITIGATION
FLOOD EXTENTS
0.1% AEP EVENT

Scale at A3: 1:6,000

Drawing No:
N63-ACM-PH03-0500-DR-DR-0567

Drawn:	Chk'd:	App'd:	Date:
RR	JT	EG	15/04/21

Filename: C:\Users\richard.reid\Documents\Jobs\N63 Abbey-Liss\Model Results_TB.mxd

N

RP01
RP02
RP03
RP04
RP05
RP06
RP07
RP08
RP09

0 250 500 Metres

Filename: C:\Users\richard.reid\Documents\Jobs\N63 Abbey-Liss\Model Results_TB.mxd

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Project Title:

N63 LISS TO ABBEY REALIGNMENT SCHEME

Client:

Transport Infrastructure Ireland
Project Ireland 2040 Building Ireland's Future
Comhairle Chontae na Gaillimhe Galway County Council

LEGEND

- 2D Result Points
- Scheme Boundary

Difference; Mitigation; 1% AEP

<VALUE>

- > -1.00
- -1.00 - -0.50
- -0.50 - -0.10
- -0.10 - -0.01
- 0.01 - 0.10
- 0.10 - 0.50
- 0.50 - 1.00
- > 1.00

AECOM Internal Project No:

60597858

Drawing Title:

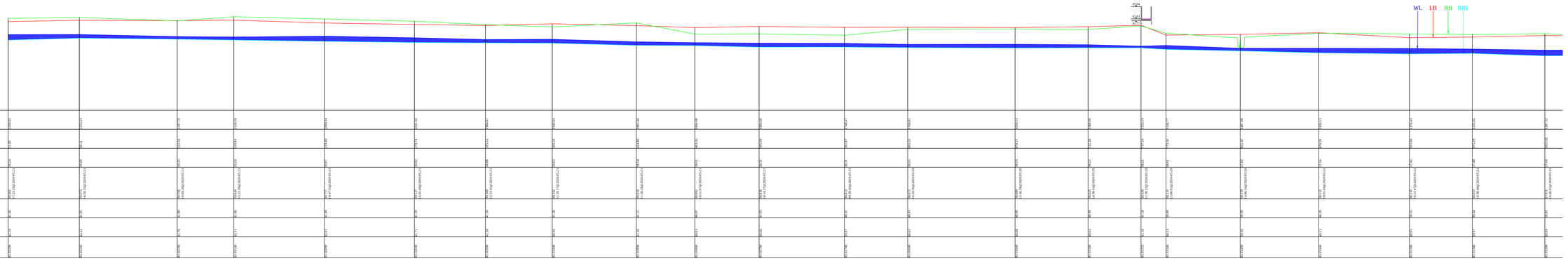
FLOOD RISK ASSESSMENT
DEPTH DIFFERENCE MAP
BASELINE - MITIGATION
1% AEP EVENT

Scale at A3: 1:6,000

Drawing No:

N63-ACM-PH03-0500-DR-DR-0568

Drawn:	Chk'd:	App'd:	Date:
RR	JT	EG	15/04/21



River Profile
Chainage 0.000
Hz. Scale 1:1000
Vt. Scale 1:200
Datum 30.00

ISIS Chainage	2299.05	2252.23	2187.76	2150.50	2090.94	2031.60	1984.81	1940.84	1885.48	1846.98	1804.66	1748.47	1706.81	1636.13	1588.06	1553.19	1536.77	1487.88	1436.13	1376.43	1335.05	1287.32
MIKE Chainage	11.29	58.11	122.58	159.84	219.40	278.74	325.52	369.50	424.86	463.36	505.68	561.87	603.52	674.21	722.28	757.14	773.56	822.45	874.20	933.90	975.29	1023.02
River Bed Level (MIKE 0)	39.24	39.49	39.35	39.24	39.07	38.92	38.88	38.83	38.54	38.51	38.31	38.31	38.25	38.19	38.22	38.21	38.01	37.82	37.56	37.42	37.48	37.16
Elevation Water Level	39.961 17:53:29@2020-05-21	39.973 16:50:35@2020-05-21	39.706 16:04:28@2020-05-21	39.644 15:23:39@2020-05-21	39.757 14:47:55@2020-05-21	39.537 14:05:40@2020-05-21	39.309 12:53:45@2020-05-21	39.342 12:10:17@2020-05-21	39.010 11:28:28@2020-05-21	38.902 10:51:07@2020-05-21	38.836 10:14:37@2020-05-21	38.813 09:39:40@2020-05-21	38.672 16:59:30@2020-05-20	38.684 15:36:58@2020-05-20	38.625 14:38:43@2020-05-20	38.439 12:39:23@2020-05-20	38.531 13:06:02@2020-05-20	38.159 14:06:34@2020-05-20	38.155 10:01:44@2020-05-22	38.135 10:15:47@2020-05-22	38.053 10:30:48@2020-05-22	37.911 10:46:05@2020-05-22
Elevation Left Bank	41.66	41.85	41.80	41.86	41.49	41.29	41.16	41.38	41.15	40.87	41.03	40.91	40.93	40.89	40.99	41.18	39.89	39.99	40.20	39.55	39.64	39.83
Elevation Right Bank	42.10	42.22	41.76	42.31	42.01	41.71	41.28	40.96	41.50	40.03	40.06	39.87	40.65	40.68	40.62	41.10	40.13	39.36	40.13	40.05	39.97	40.09
Section ID	R1.02290	R1.02240	R1.02190	R1.02140	R1.02090	R1.02040	R1.01990	R1.01940	R1.01890	R1.01840	R1.01790	R1.01740	R1.01690	R1.01640	R1.01590	R1.01555	R1.01540	R1.01490	R1.01440	R1.01390	R1.01340	R1.01290

River Profile
Chainage 0.000
Hz. Scale 1:1000
Vt. Scale 1:200
Datum 30.00

ISIS Chainage	1287.32	1235.41	1189.11	1139.57	1079.68	1033.78	986.49	939.84	884.52	836.66	790.23	737.37	682.34	636.28	587.01	540.95	485.84	437.56	395.34	337.71	288.98
MIKE Chainage	1023.02	1074.92	1121.23	1170.77	1230.65	1276.55	1323.85	1370.49	1425.81	1473.67	1520.11	1572.96	1628.00	1674.06	1723.33	1769.38	1824.50	1872.78	1915.00	1972.63	2021.36
River Bed Level (MIKE 0)	37.16	37.25	37.58	37.28	36.91	37.20	37.21	36.87	36.78	36.69	36.84	36.39	36.64	36.70	36.33	35.99	35.78	35.71	36.02	35.56	35.65
Elevation Water Level	37.911 10:46:05@2020-05-22	37.914 11:25:11@2020-05-22	37.884 11:39:21@2020-05-22	37.797 11:56:01@2020-05-22	37.748 12:17:45@2020-05-22	37.713 12:43:44@2020-05-22	37.537 13:05:35@2020-05-22	37.238 16:58:57@2020-05-19	37.231 16:35:01@2020-05-19	37.195 16:19:30@2020-05-19	37.201 15:44:54@2020-05-19	37.138 15:30:18@2020-05-19	37.120 14:54:07@2020-05-19	37.107 14:54:07@2020-05-19	36.732 14:38:06@2020-05-19	36.828 14:19:49@2020-05-19	36.812 13:34:37@2020-05-19	36.823 12:50:44@2020-05-19	36.833 12:50:44@2020-05-19	36.819 12:35:39@2020-05-19	36.804 12:18:08@2020-05-19
Elevation Left Bank	39.83	39.77	39.71	39.61	38.93	39.44	38.86	39.00	39.22	39.15	38.39	38.84	38.97	38.35	38.48	38.42	37.65	39.39	40.20	39.52	39.88
Elevation Right Bank	40.09	39.55	39.50	39.40	39.08	38.78	38.76	38.58	38.54	38.81	38.42	38.80	38.29	38.15	38.64	38.74	38.14	37.90	37.87	38.22	38.18
Section ID	R1.01290	R1.01240	R1.01190	R1.01140	R1.01090	R1.01040	R1.00990	R1.00940	R1.00890	R1.00840	R1.00790	R1.00740	R1.00690	R1.00640	R1.00590	R1.00540	R1.00490	R1.00440	R1.00390	R1.00340	R1.00290

River Profile
Chainage 0.000
Hz. Scale 1:1000
Vt. Scale 1:200
Datum 30.00

ISIS Chainage	682.34	636.28	587.01	540.95	485.84	437.56	395.34	337.71	288.98	231.83	185.99	138.92	124.02	122.97	122.42	75.88	43.52	9.78
MIKE Chainage	1628.00	1674.06	1723.33	1769.38	1824.50	1872.78	1915.00	1972.63	2021.36	2078.50	2124.35	2171.41	2186.32	2187.37	2187.92	2234.45	2266.82	2300.55
River Bed Level (MIKE 0)	36.64	36.70	36.33	35.99	35.78	35.71	36.02	35.56	35.65	35.99	35.93	35.83	36.38	36.53	35.56	35.34	35.12	33.59
Elevation Water Level	37.120 14:54:07@2020-05-19	37.107 14:54:07@2020-05-19	36.732 14:38:06@2020-05-19	36.828 14:19:49@2020-05-19	36.812 13:34:37@2020-05-19	36.823 12:50:44@2020-05-19	36.833 12:50:44@2020-05-19	36.819 12:35:39@2020-05-19	36.804 12:18:08@2020-05-19	36.772 11:44:33@2020-05-19	36.826 11:04:34@2020-05-19	36.726 13:42:24@2020-05-18	36.744 12:31:31@2020-05-18		36.527 11:33:25@2020-05-18	35.772 13:57:16@2020-05-18	35.454 16:28:48@2020-05-18	35.247 17:59:26@2020-05-18
Elevation Left Bank	38.97	38.35	38.48	38.42	37.65	39.39	40.20	39.52	39.88	39.80	39.66	37.66	38.72	38.76	38.34	37.15	36.99	36.33
Elevation Right Bank	38.29	38.15	38.64	38.74	38.14	37.90	37.87	38.22	38.18	38.13	38.40	38.51	38.02	38.10	38.29	36.59	35.91	36.48
Section ID	R1.00690	R1.00640	R1.00590	R1.00540	R1.00490	R1.00440	R1.00390	R1.00340	R1.00290	R1.00240	R1.00190	R1.00140	r1.00139	r1.00138	r1.00137	R1.00136	R1.00040	R1.00010

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long section details

LEGEND

▨ Water Profile
Water Level
Left Bank Level
Right Bank Level
River Bed Level
Road Level
Structure Level

LB Left Bank Level
RB Right Bank Level
WL Water Level
RBL River Bed Level

No. 318

SURVEY ASSOCIATION

Supply-Line

Map Sheet Layout:

Map Sheet 0000

North

- Malin Hd.
- ING

Site Location

Surveyed by : MSL Date: MAY 2020
Drawn by : CE Date: MAY 2020
Checked by : BK Date: 28.05.20

Revisions

No.	Date	Description
0	28.05.20	First Drawing

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SURVEYS
GLOBAL CONSULTING SURVEYORS

Kildare Cork Belfast London

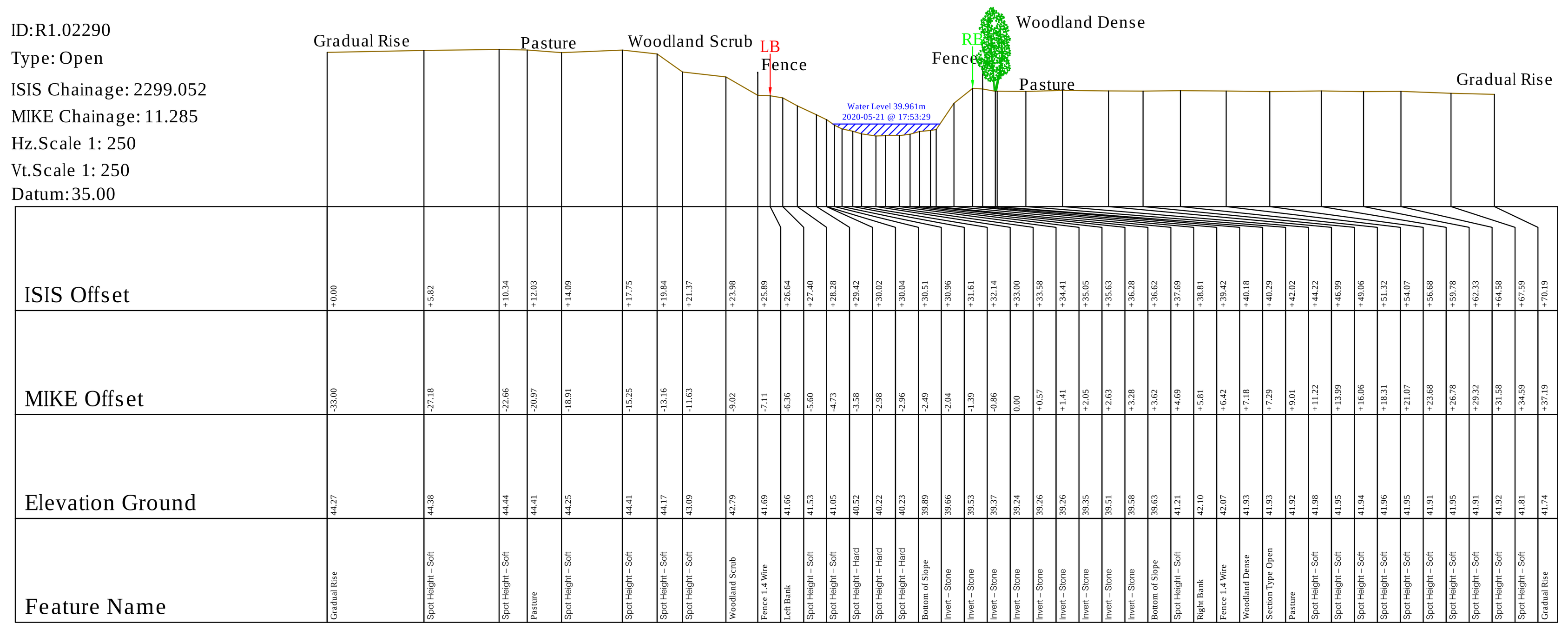
Client :
AECOM

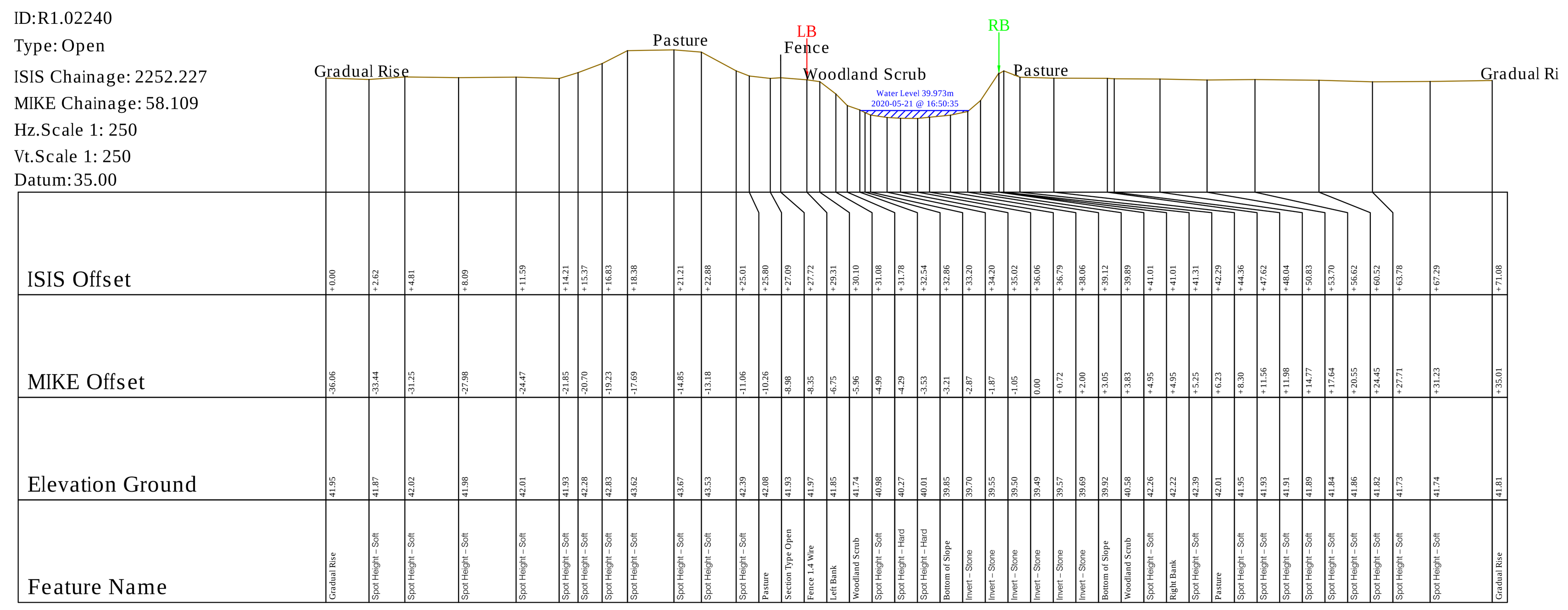
Project :
MSL34881 N63 - Abbeyknockmoy

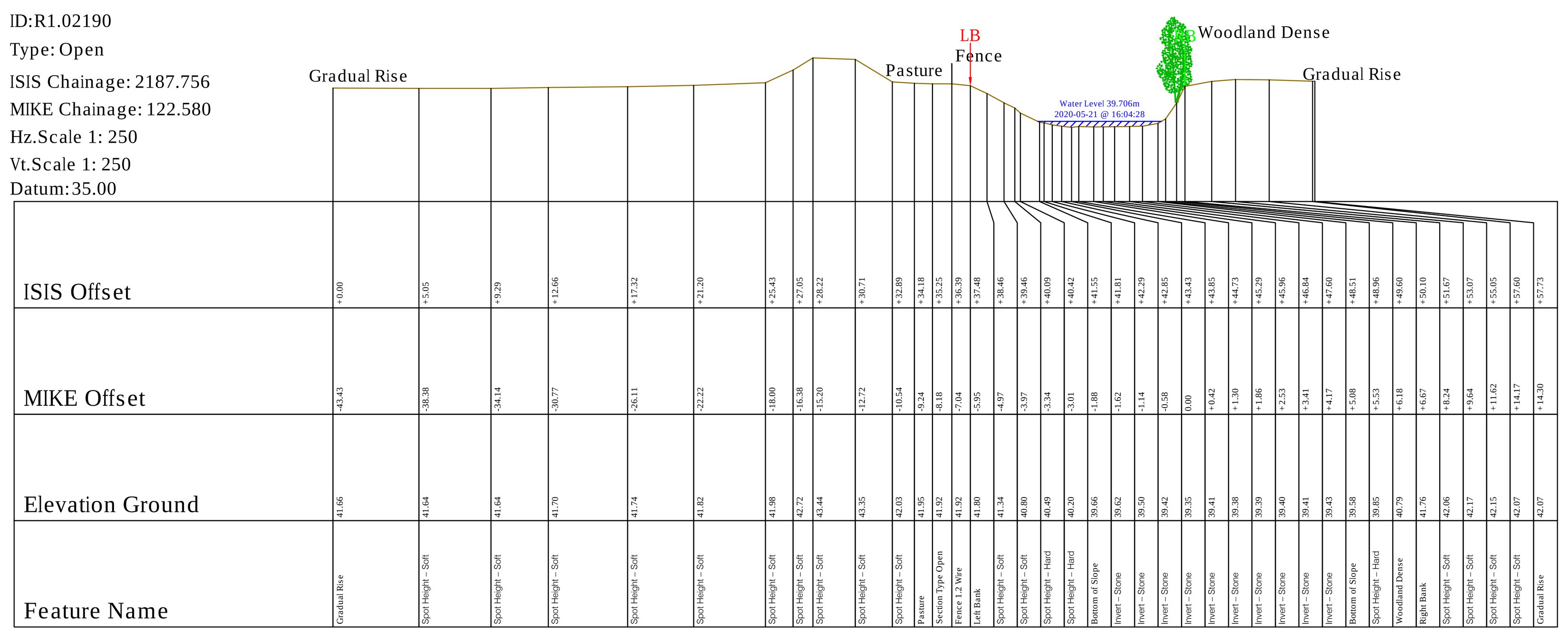
Date : 28.05.20
Scale : AS SHOWN

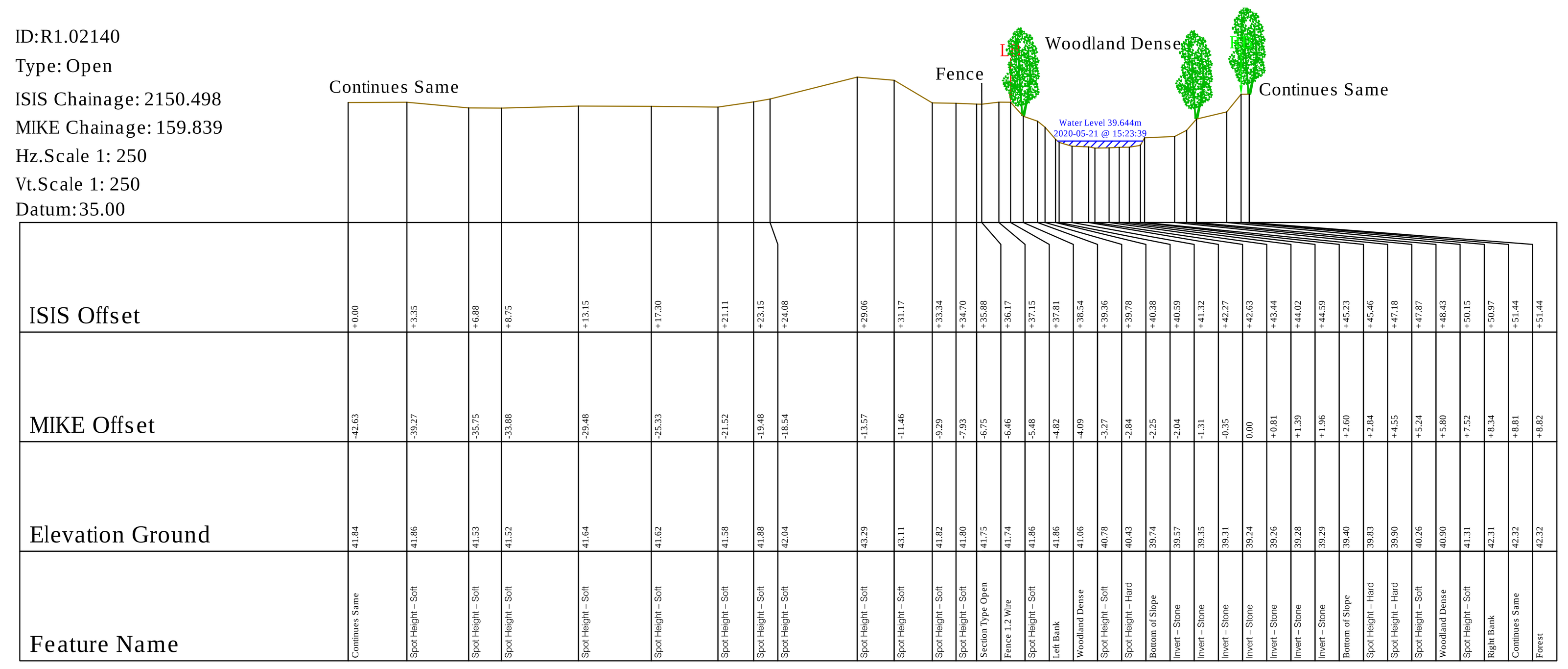
Description :
LONG SECTION

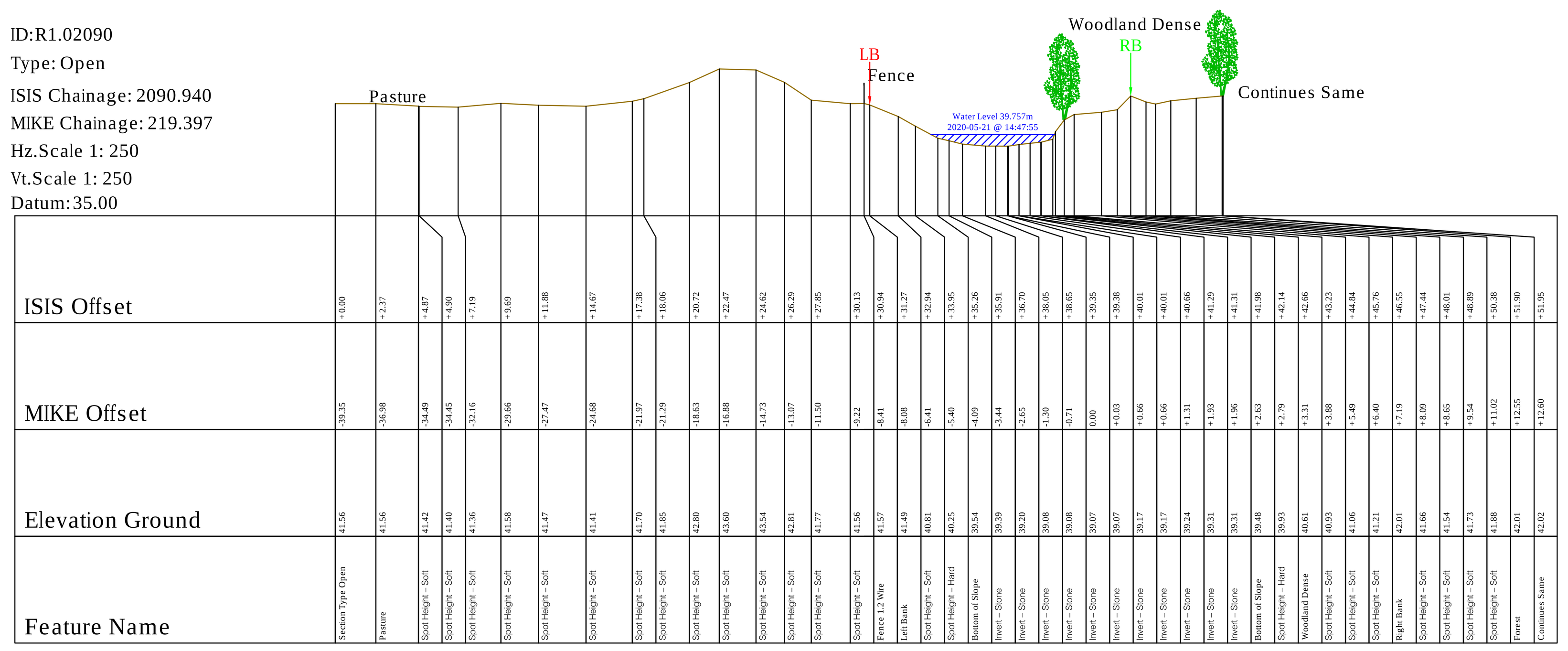
Drawing Number :
MSL34881_R1_LS_1

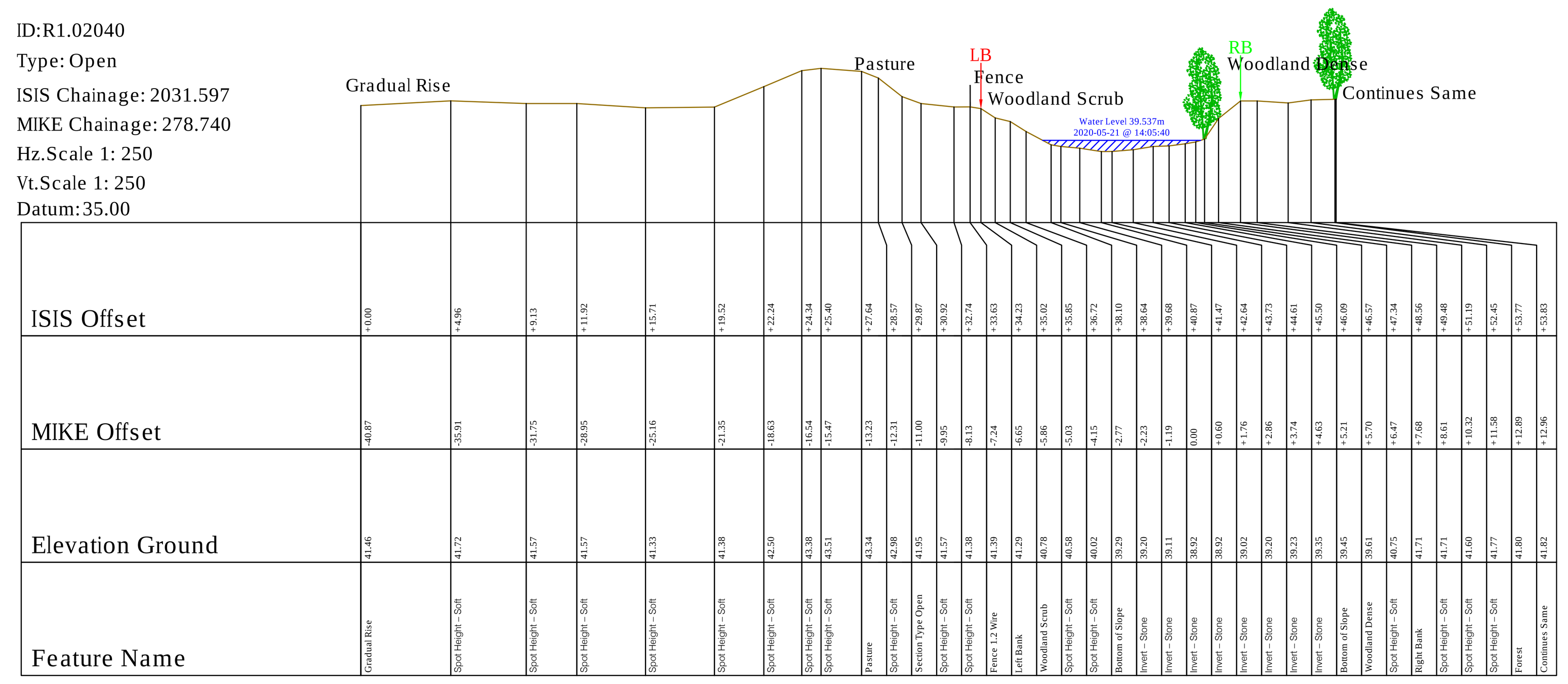


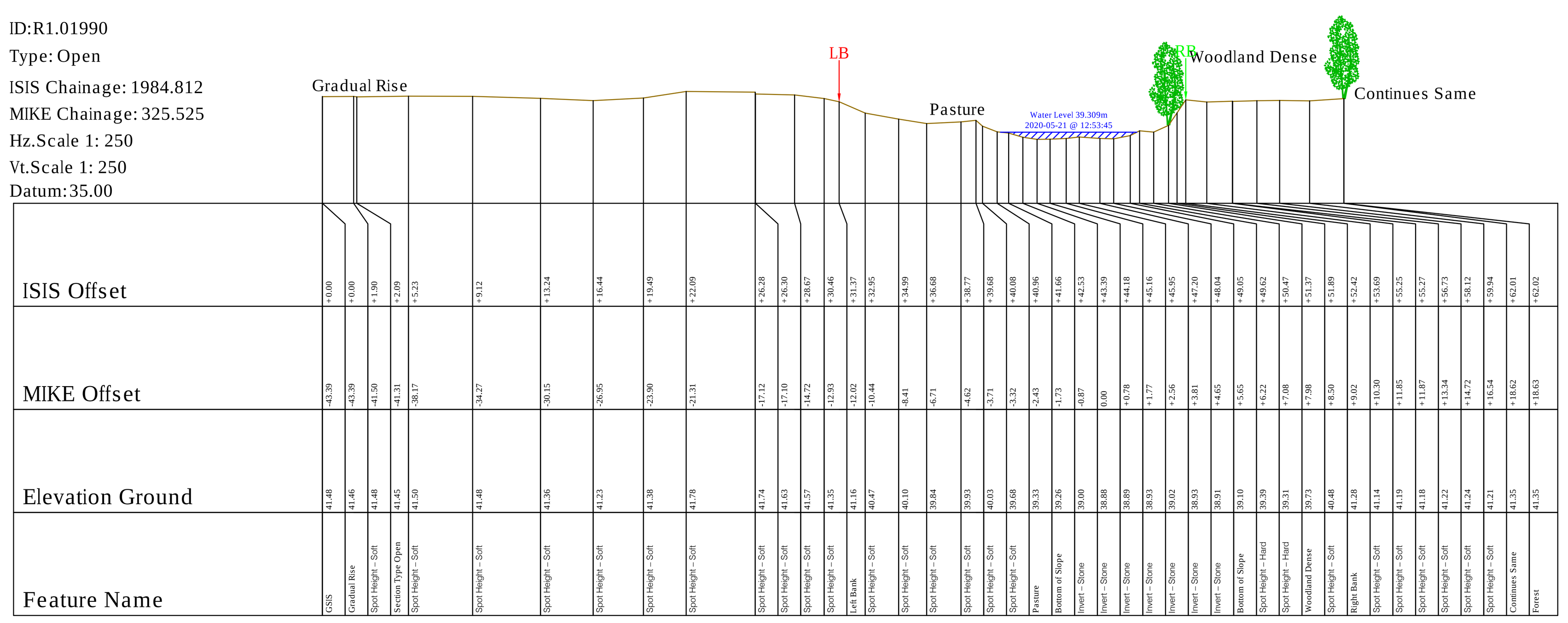


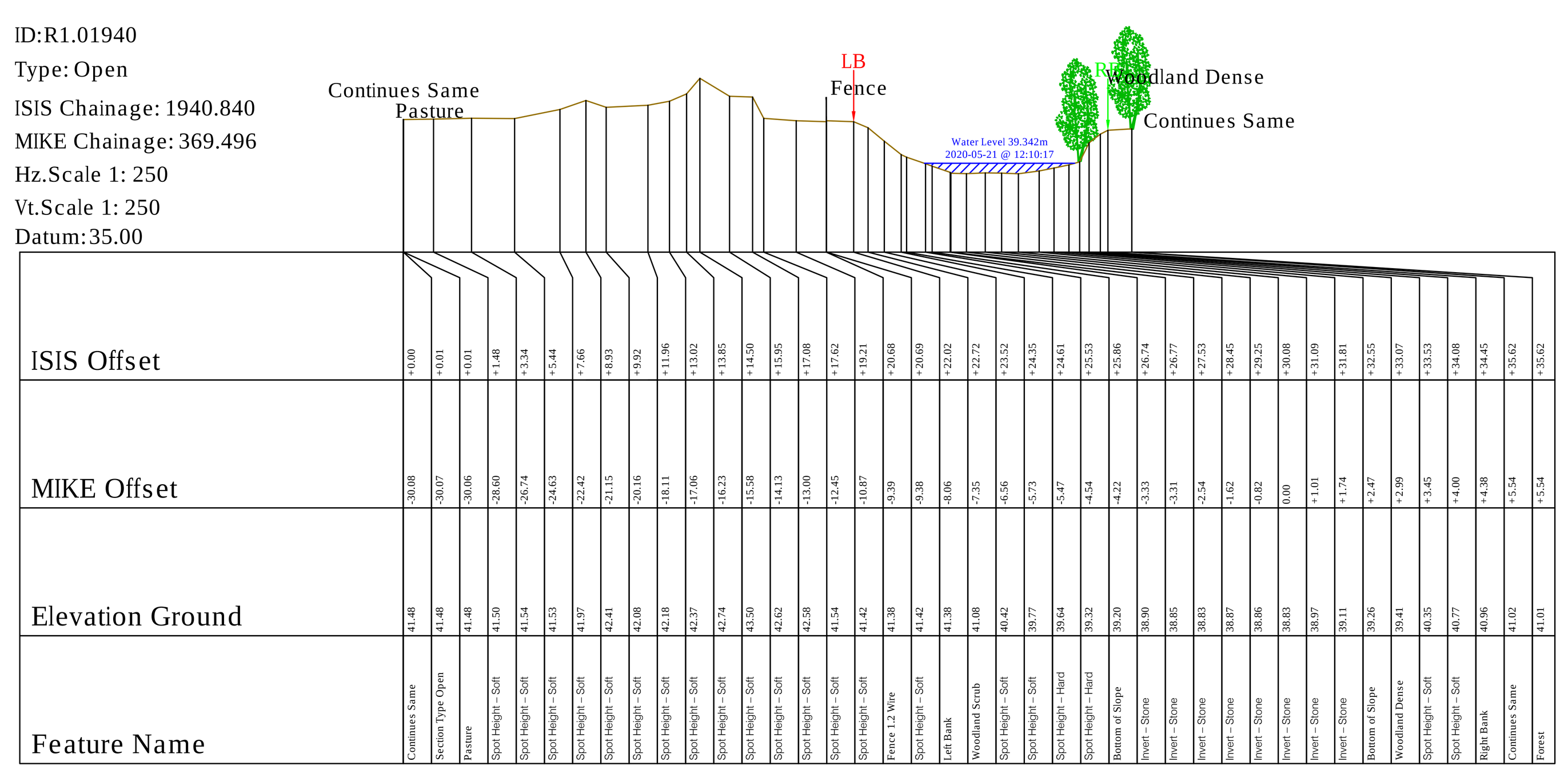


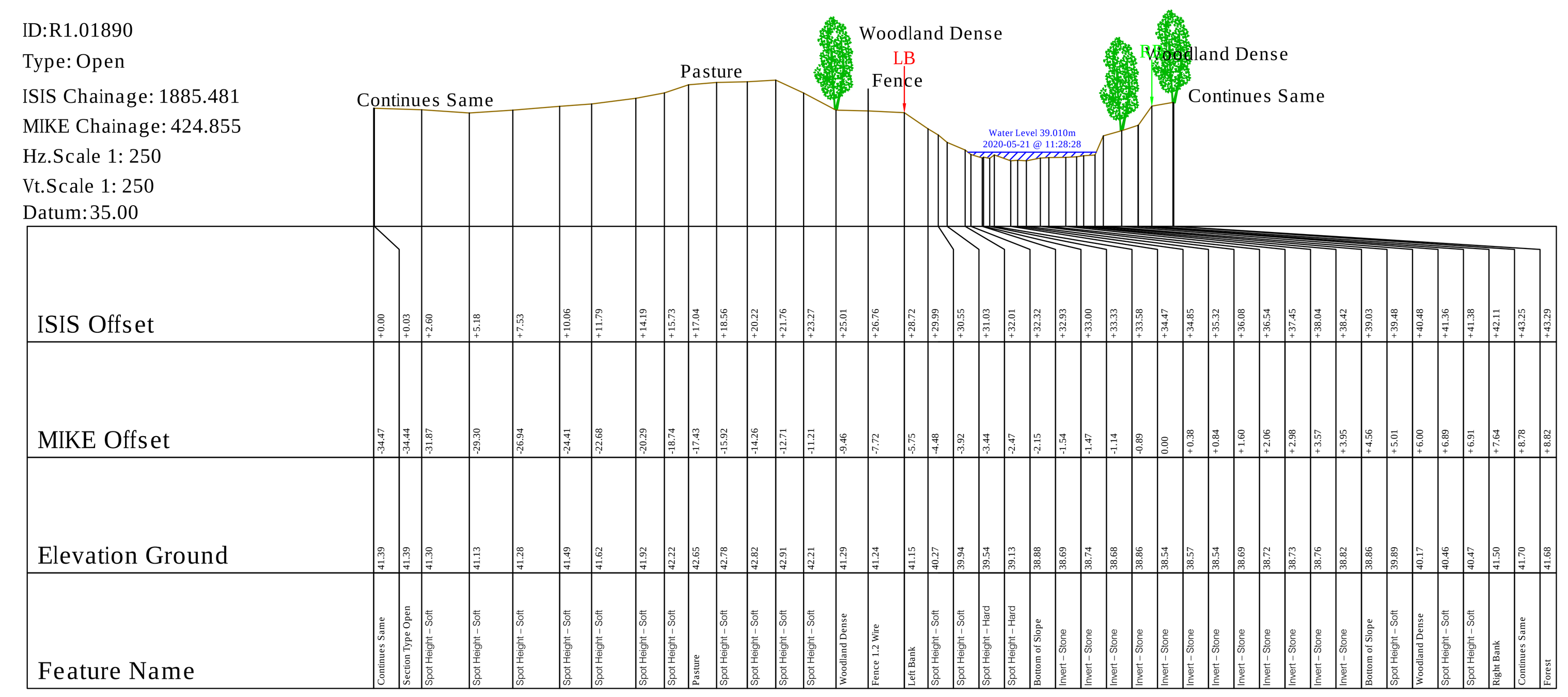












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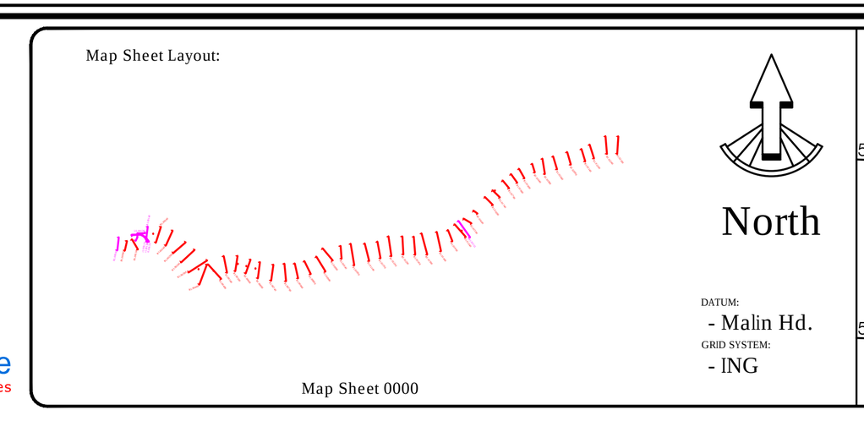
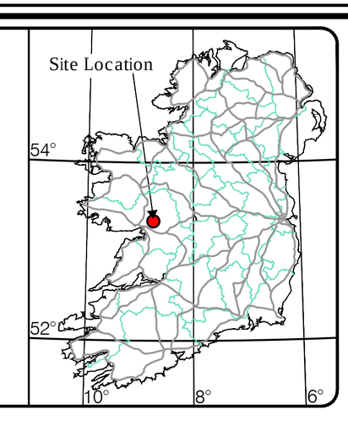
LEGEND — cross section details

Symbol	Meaning	Symbol	Meaning
	River Profile	LB	Left Bank
	Water Level	RB	Right Bank
	Ground Level		Building Line
	Road Line		Wall Line
	Wall Line		Fence Line
	Bridge Line		Pipe Profile





Surveyed by : MSL		Date: MAY 2020	
Drawn by : CE		Date: MAY 2020	
Checked by : BK		Date: 28.05.20	

Revisions

No.	Date	Description
0	28.05.20	First Drawing

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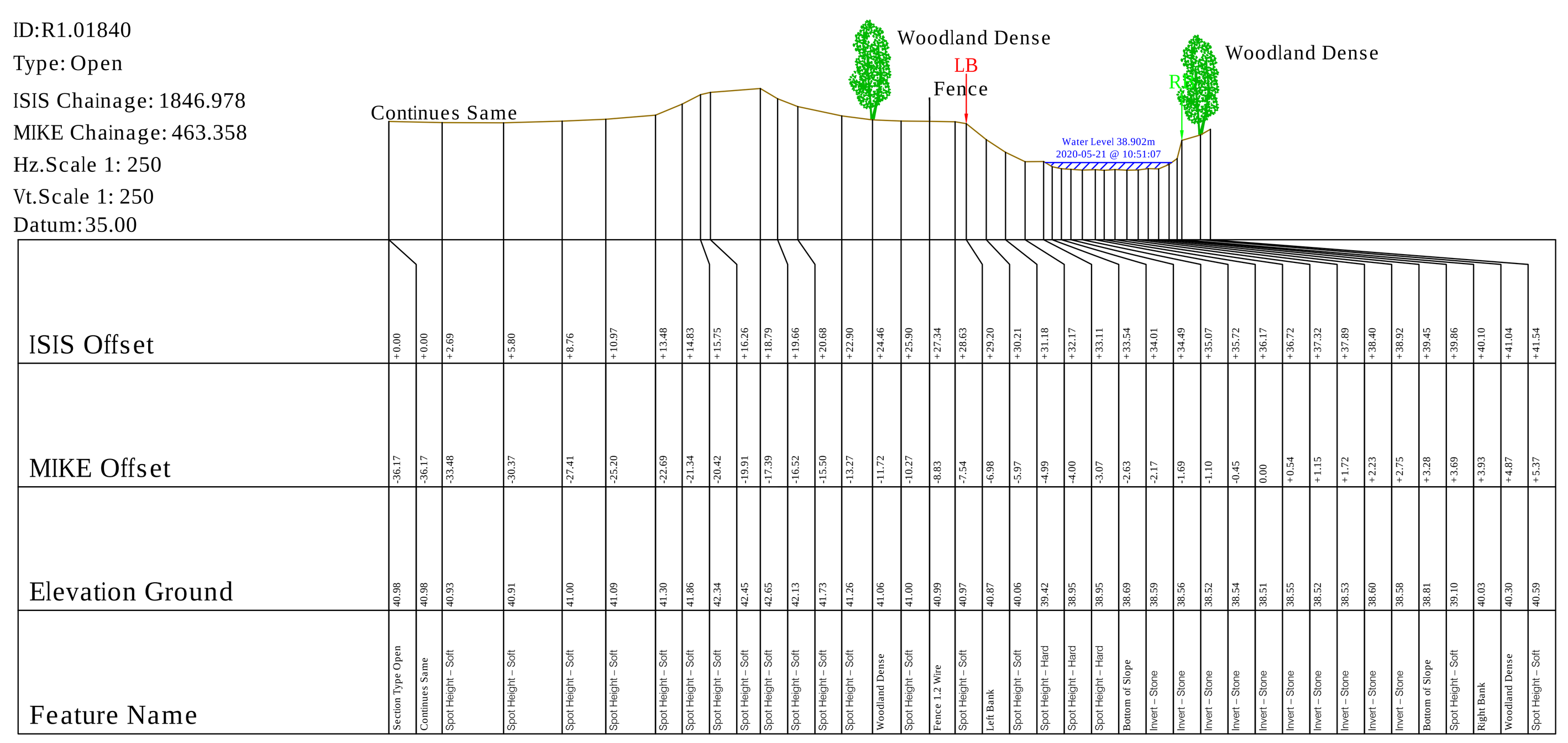
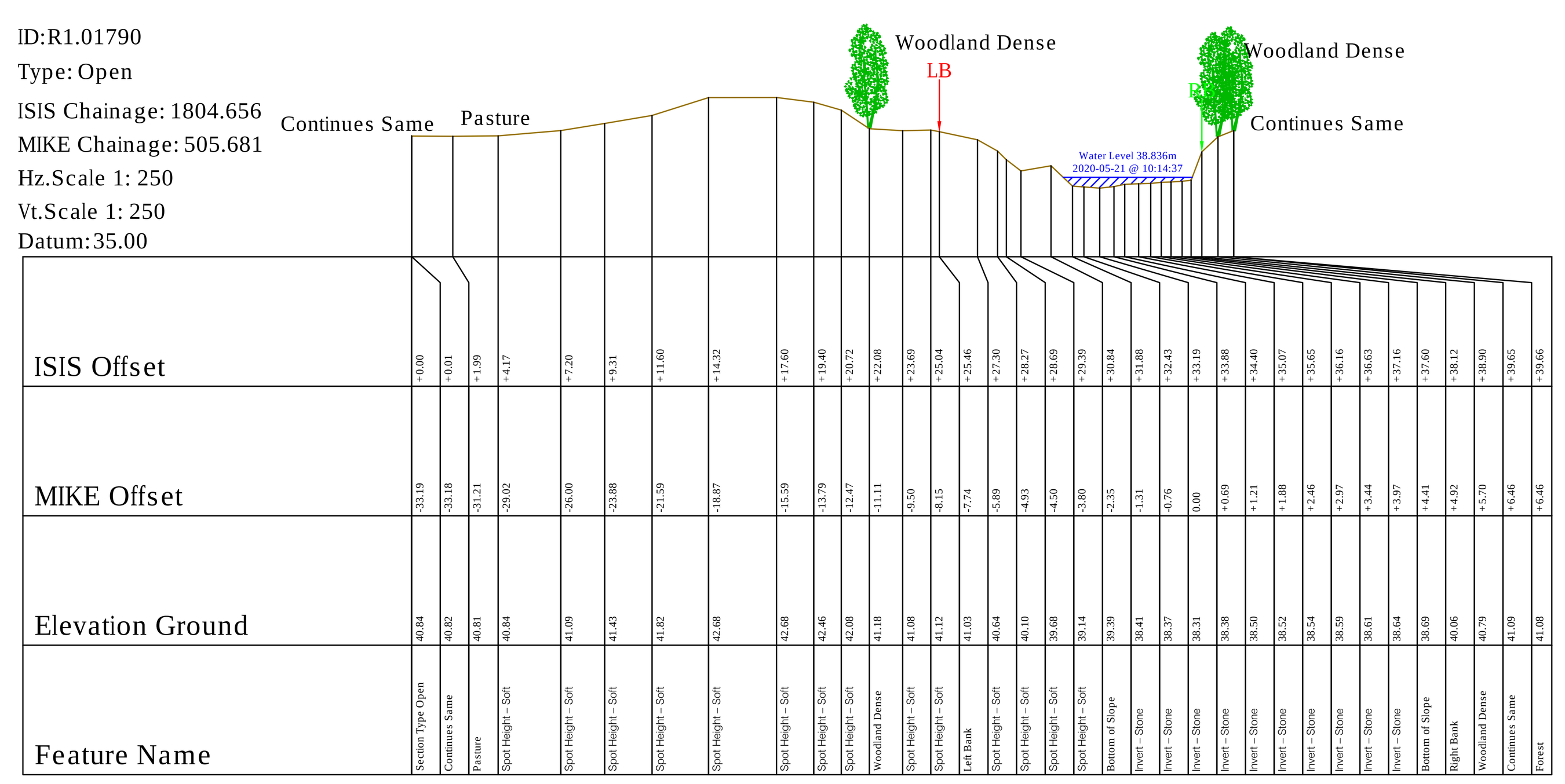
GLOBAL CONSULTING SURVEYORS

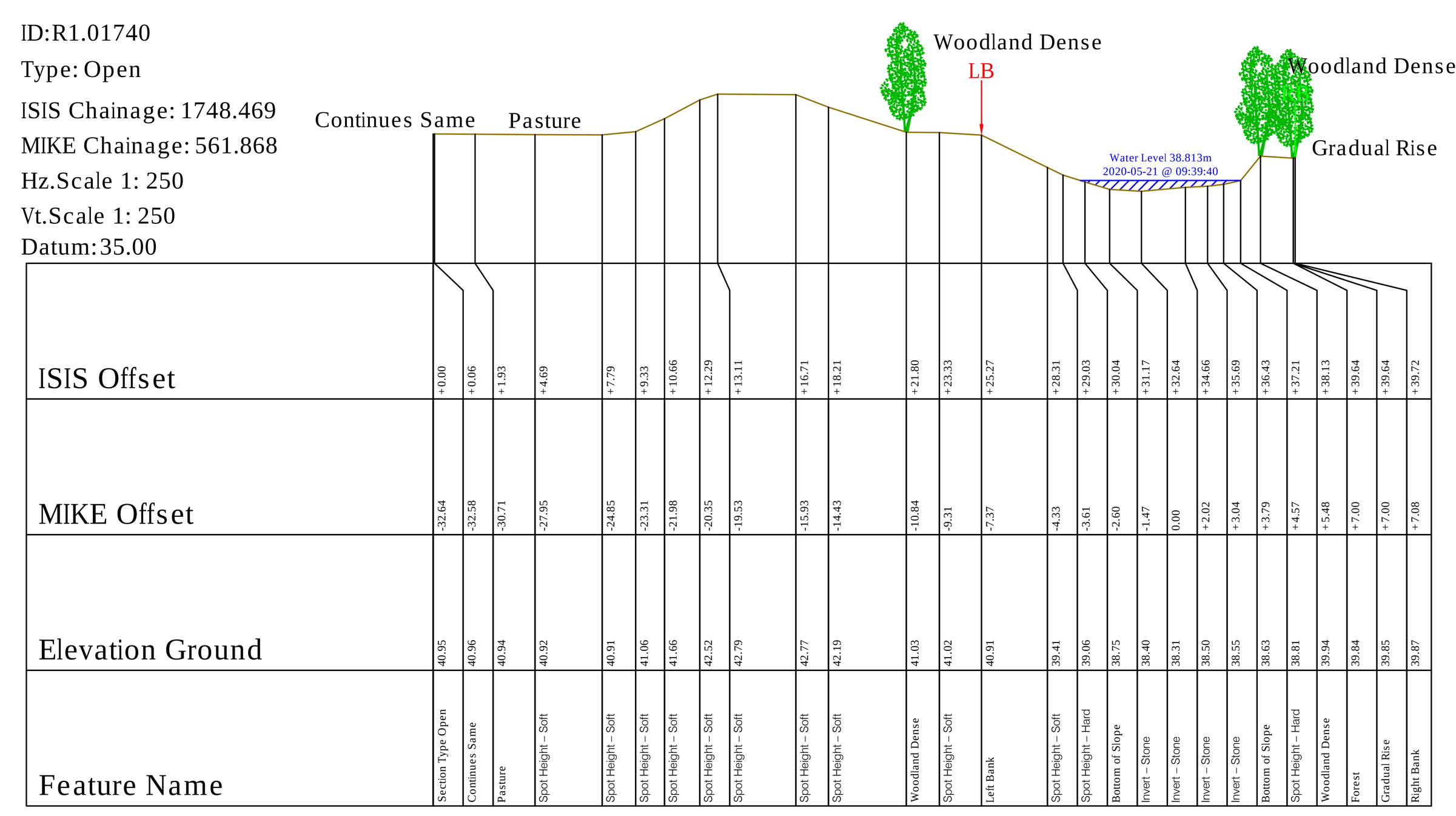
Topographic surveys, Measured Building Surveys, Setting-Out, As-Built Surveys, Hydrographic Surveys, Legal Mapping, Pipeline Surveys, Services Location, Ground Penetrating Radar, Laser Scanning, Rectified Photography

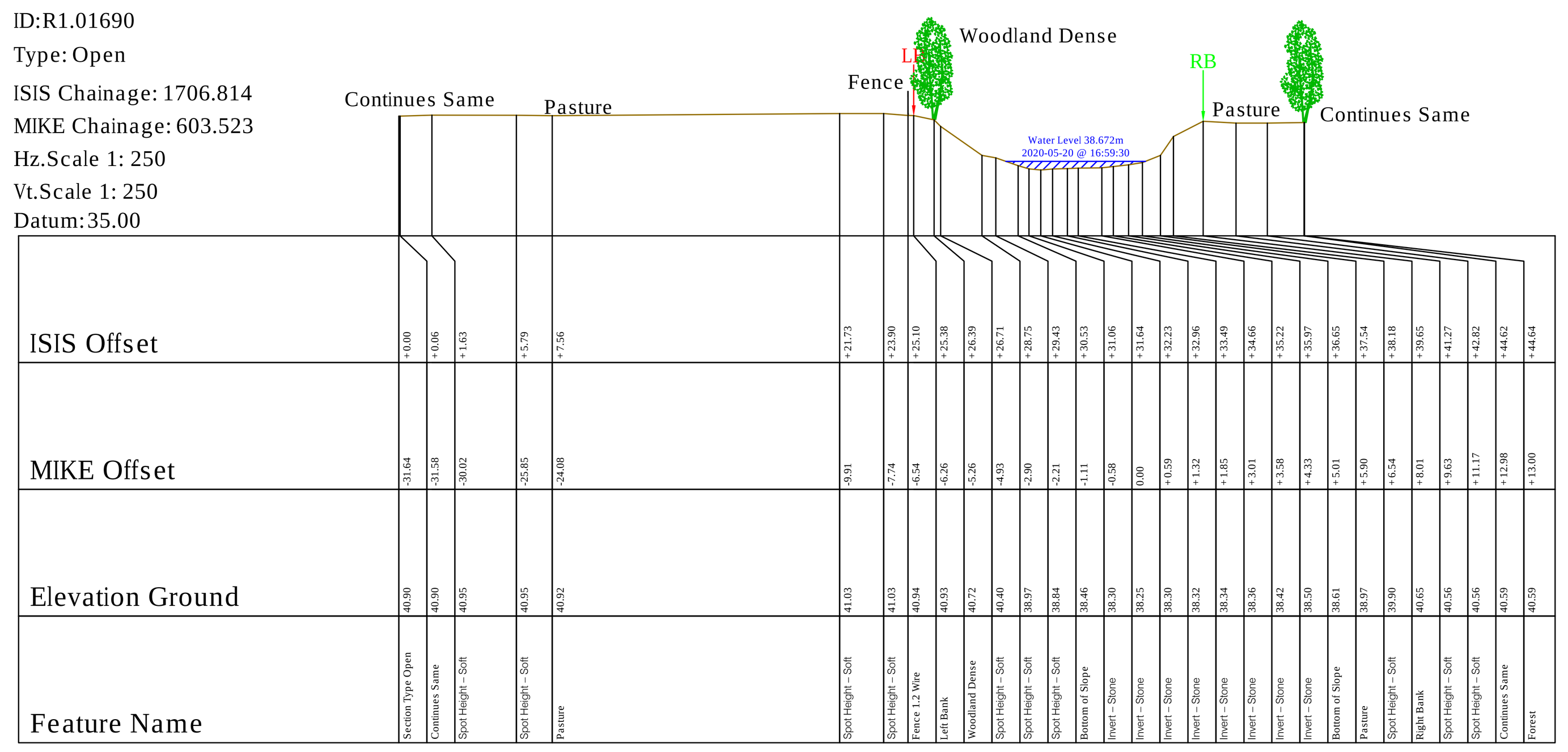
Kildare Cork Belfast London

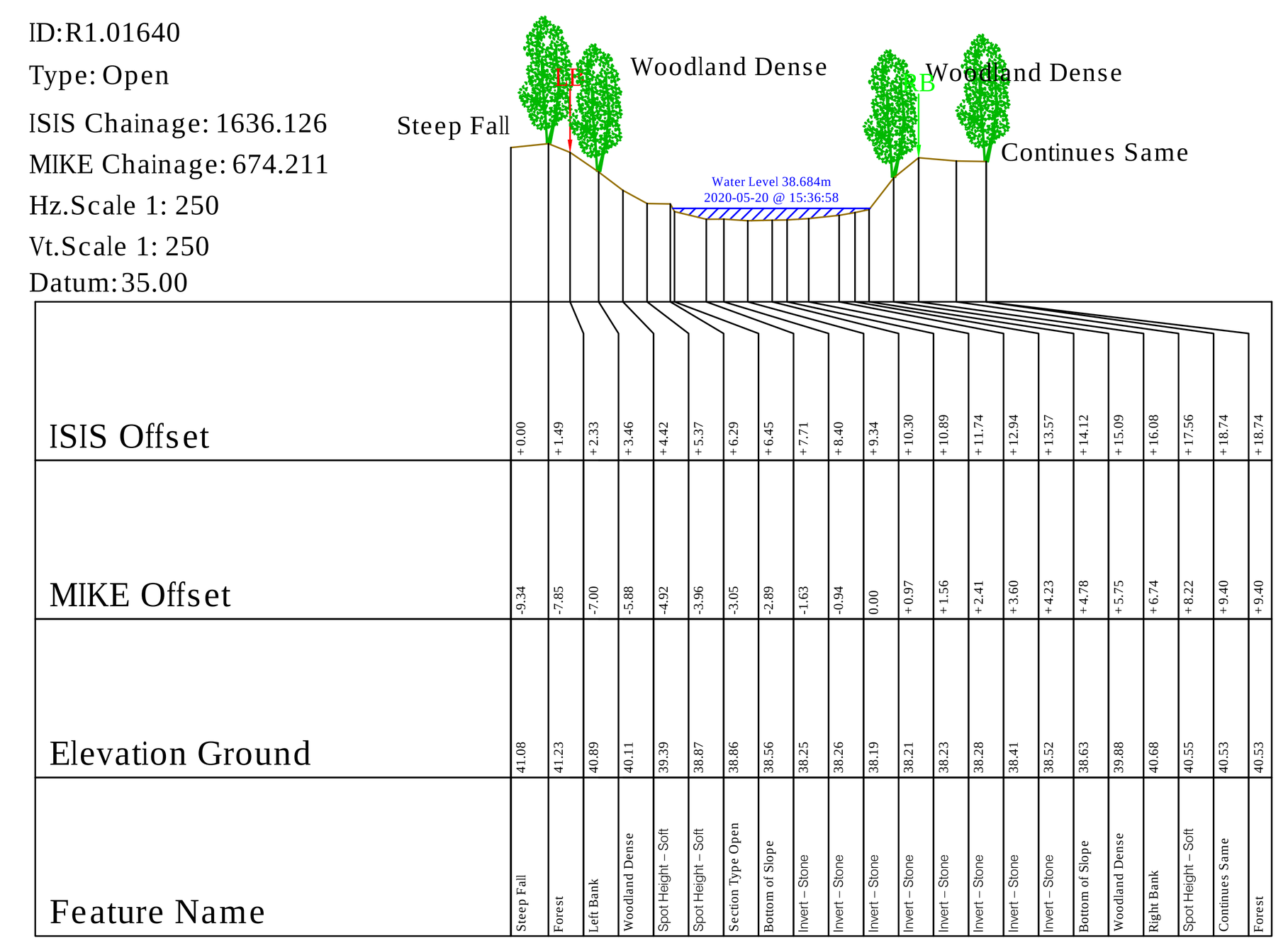
Client :	AECOM
Project :	MSL34881 N63 - Abbeyknockmoy
Date : 28.05.20	Scale : AS SHOWN
Description :	CROSS SECTIONS
Drawing Number :	MSL34881_R1_XS_01

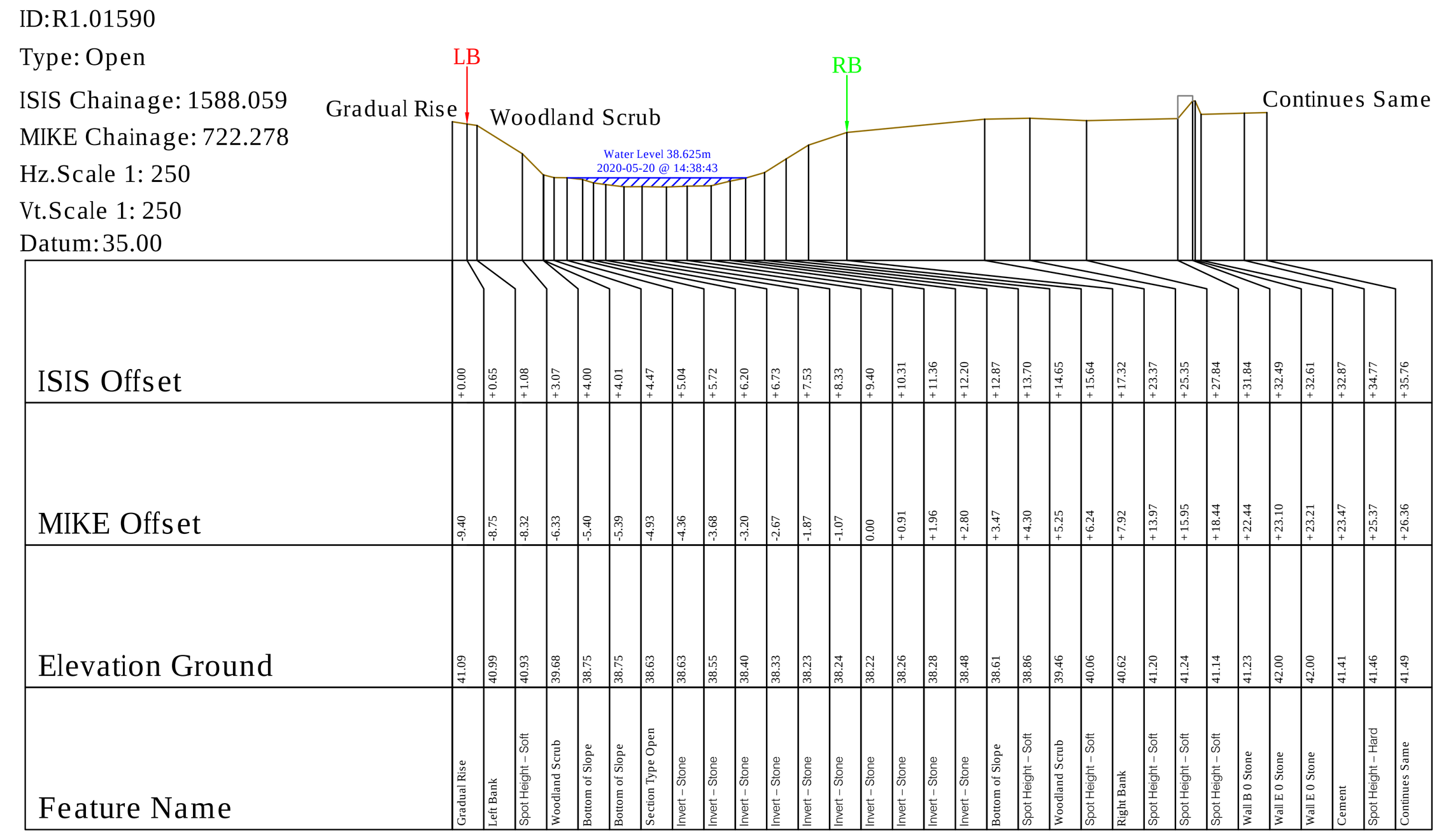


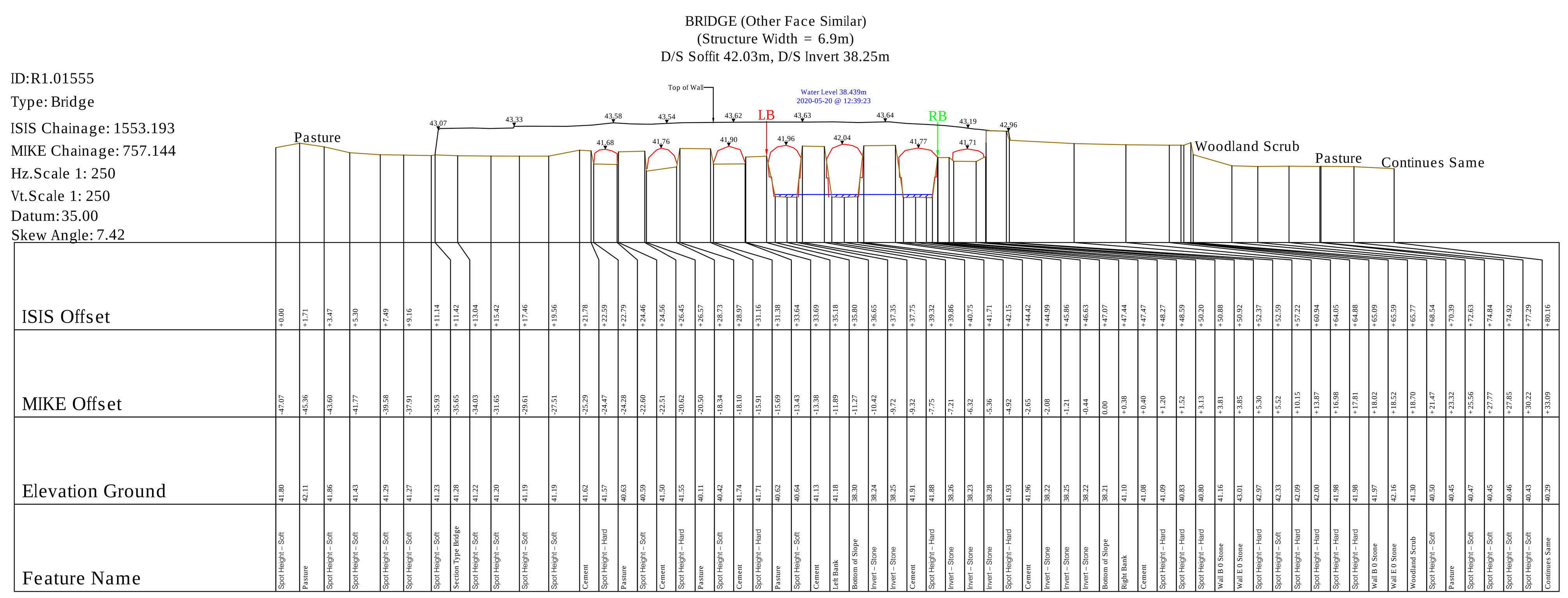


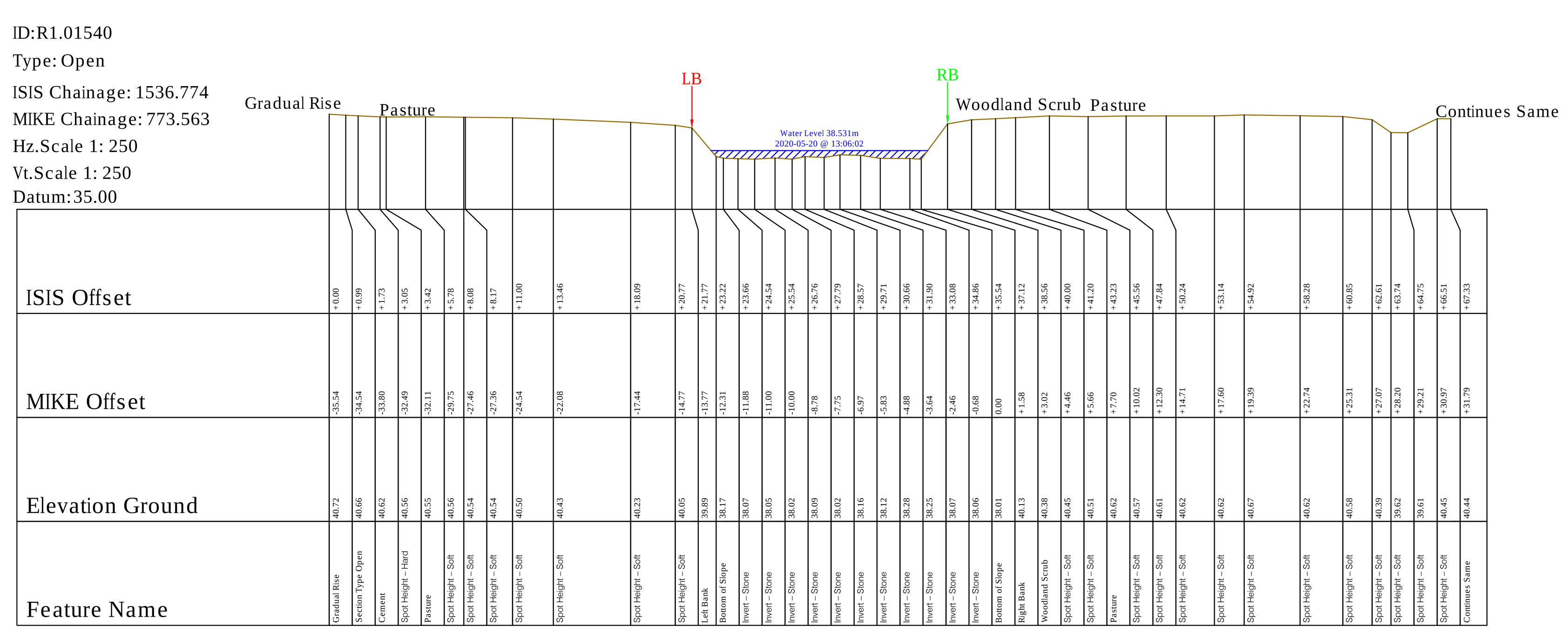


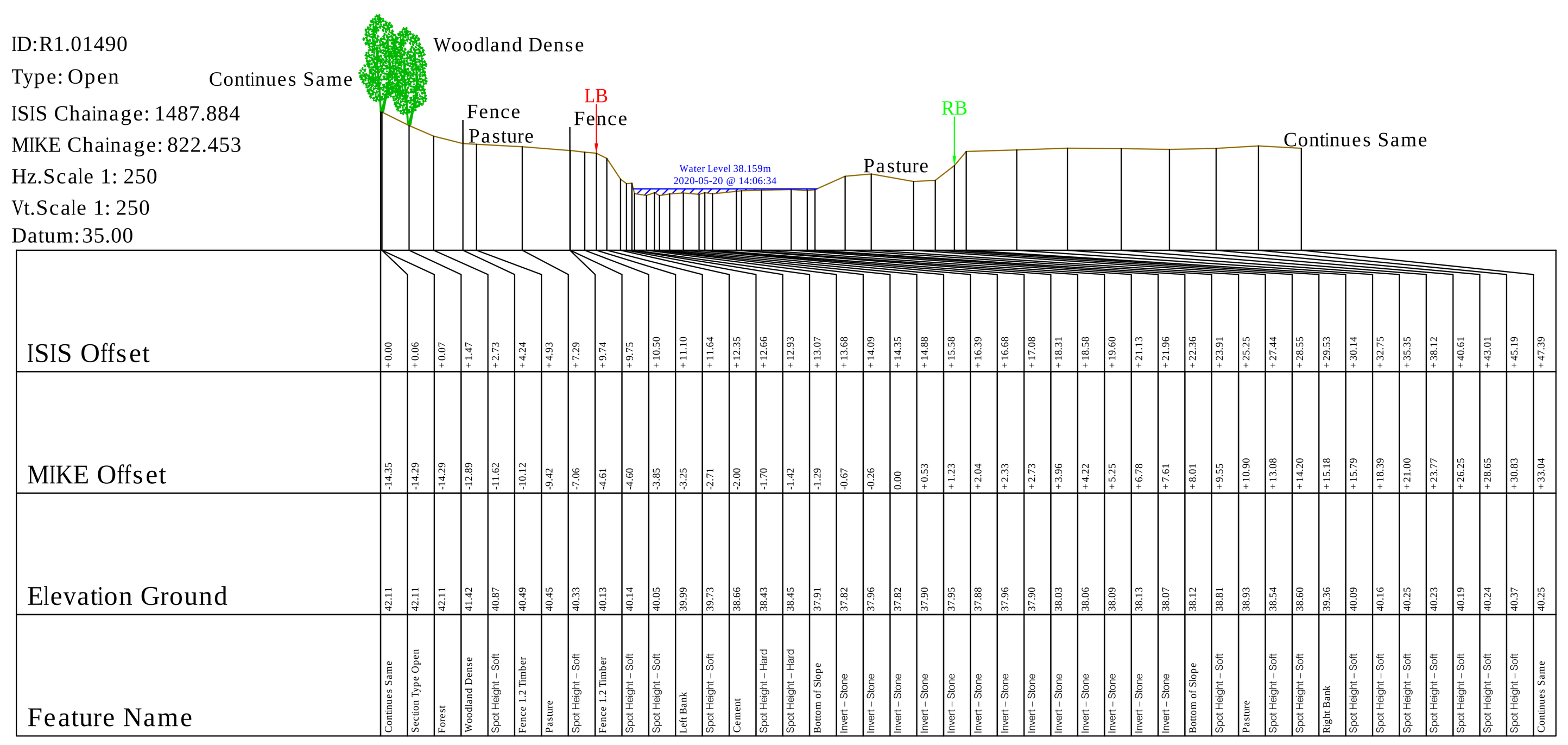


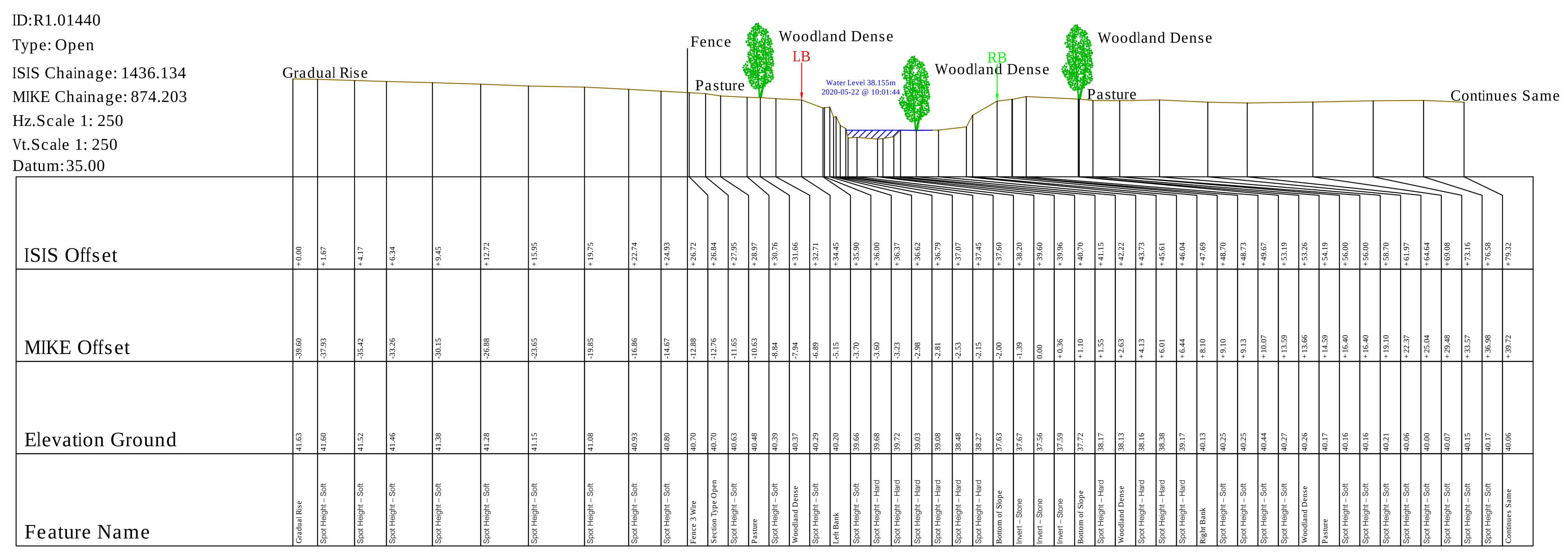












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LEGEND

cross section details

- River Profile
- Water Level
- Ground Level
- Road Line
- Wall Line
- Bridge Line
- LB Left Bank
- RB Right Bank
- Building Line
- Wall Line
- Fence Line
- Pipe Profile

No. 318

Supply-Line

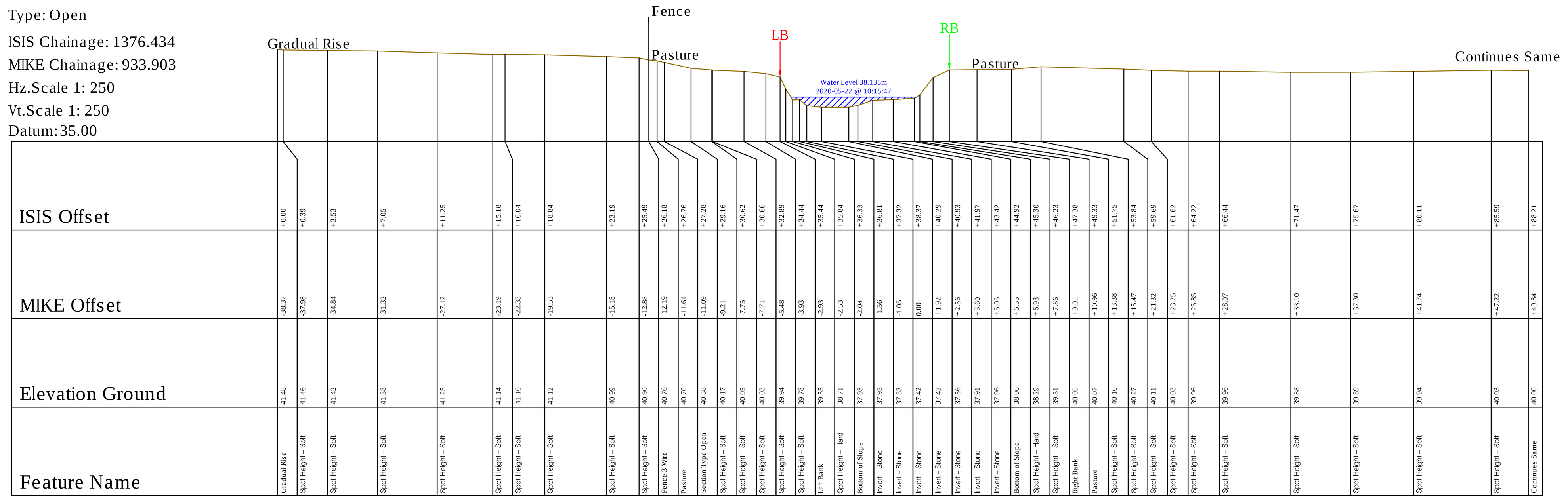
North

murphy SURVEYS GLOBAL CONSULTING SURVEYORS

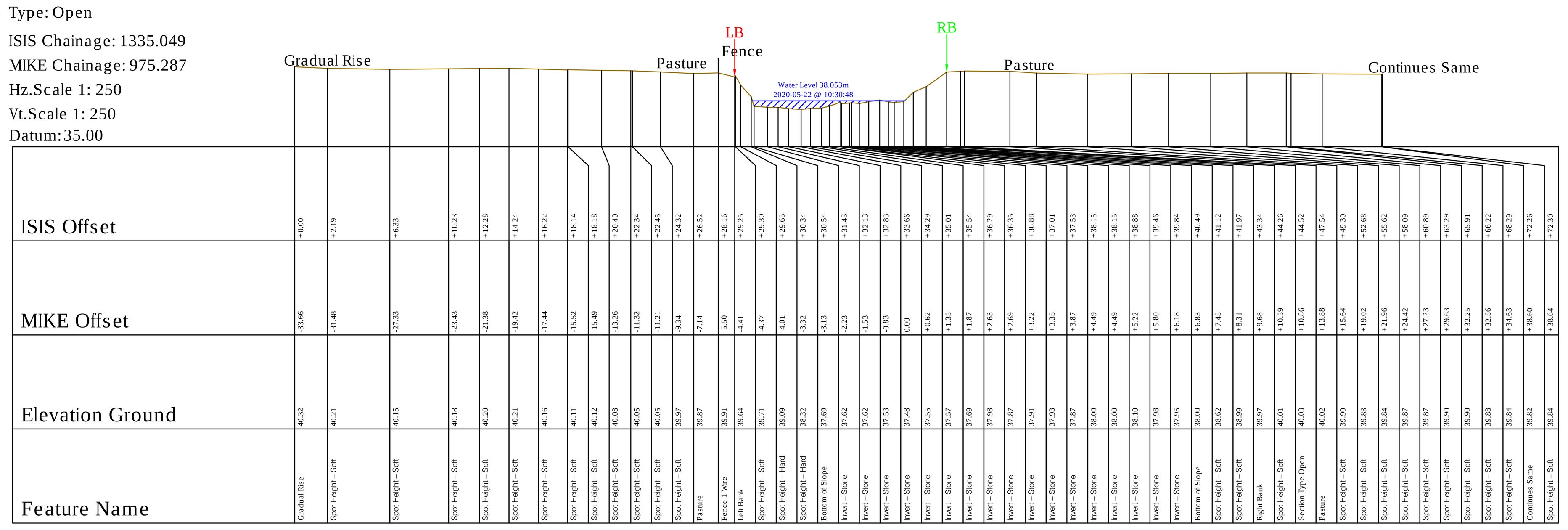
Kildare Cork Belfast London

Client :	AECOM
Project :	MSL34881 N63 - Abbeyknockmoy
Date : 28.05.20	Scale : AS SHOWN
Description :	CROSS SECTIONS
Drawing Number :	MSL34881_R1_XS_02

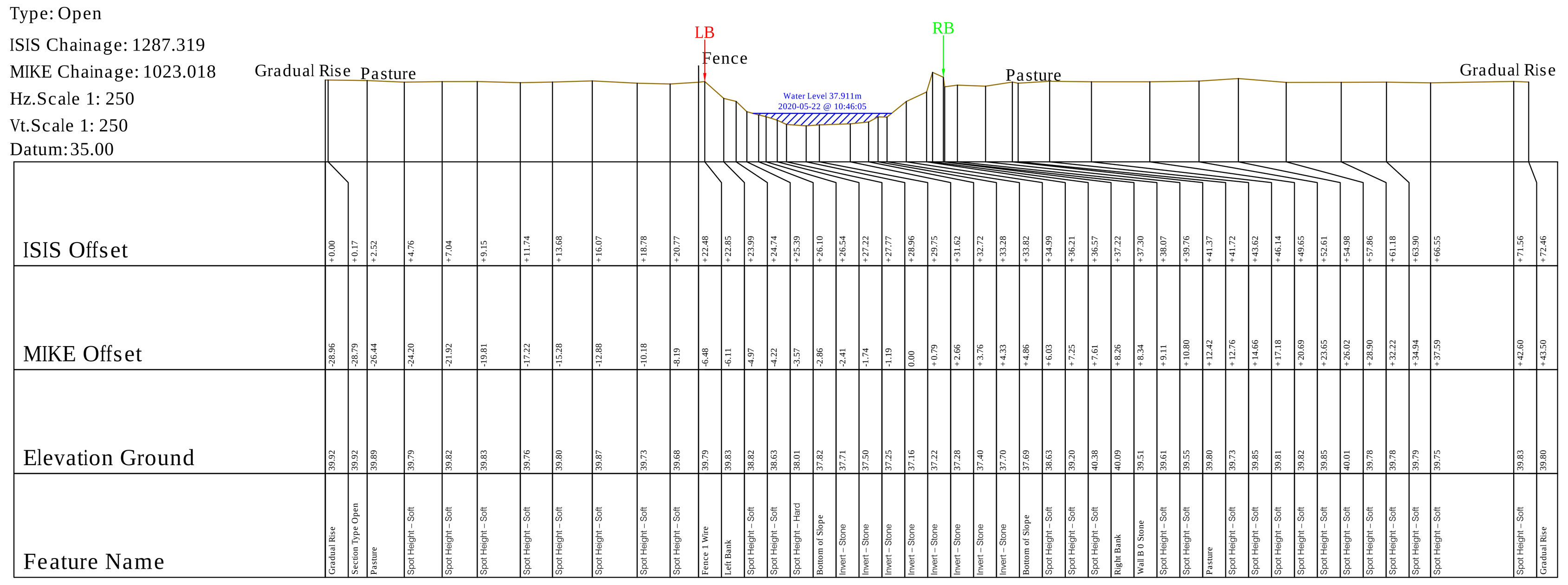
ID:R1.01390
Type: Open
ISIS Chainage: 1376.434
MIKE Chainage: 933.903
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum: 35.00



ID:R1.01340
Type: Open
ISIS Chainage: 1335.049
MIKE Chainage: 975.287
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum: 35.00



ID:R1.01290
Type: Open
ISIS Chainage: 1287.319
MIKE Chainage: 1023.018
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum: 35.00



ID:R1.01240
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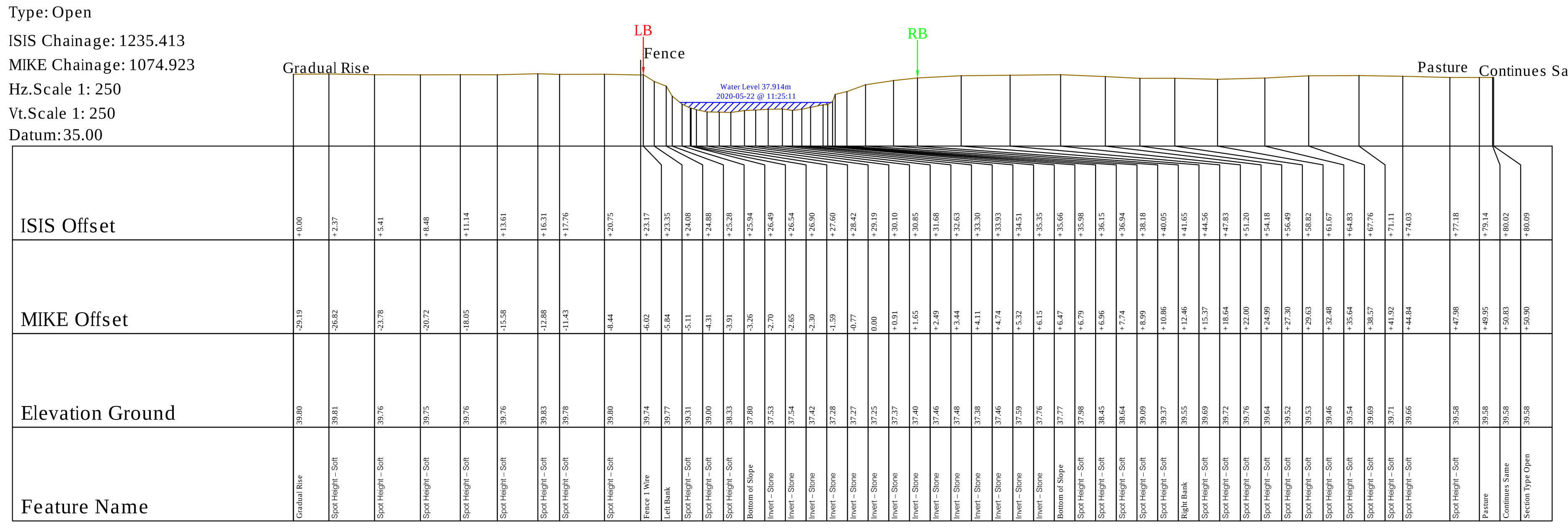
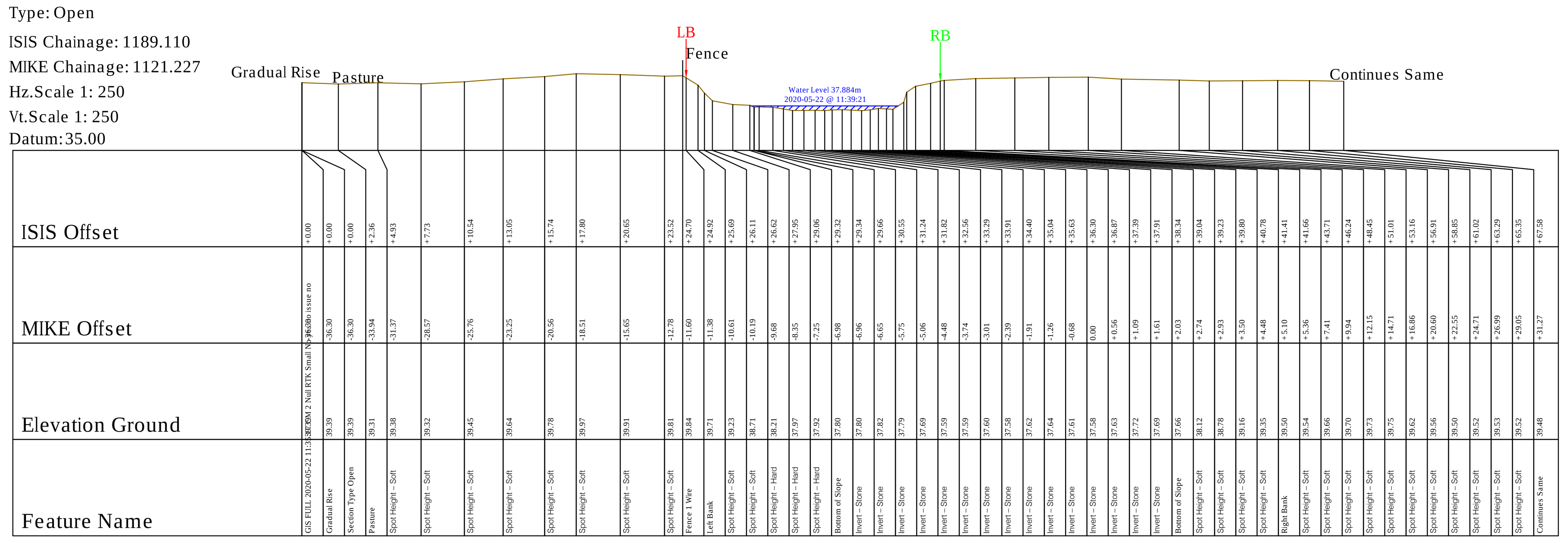
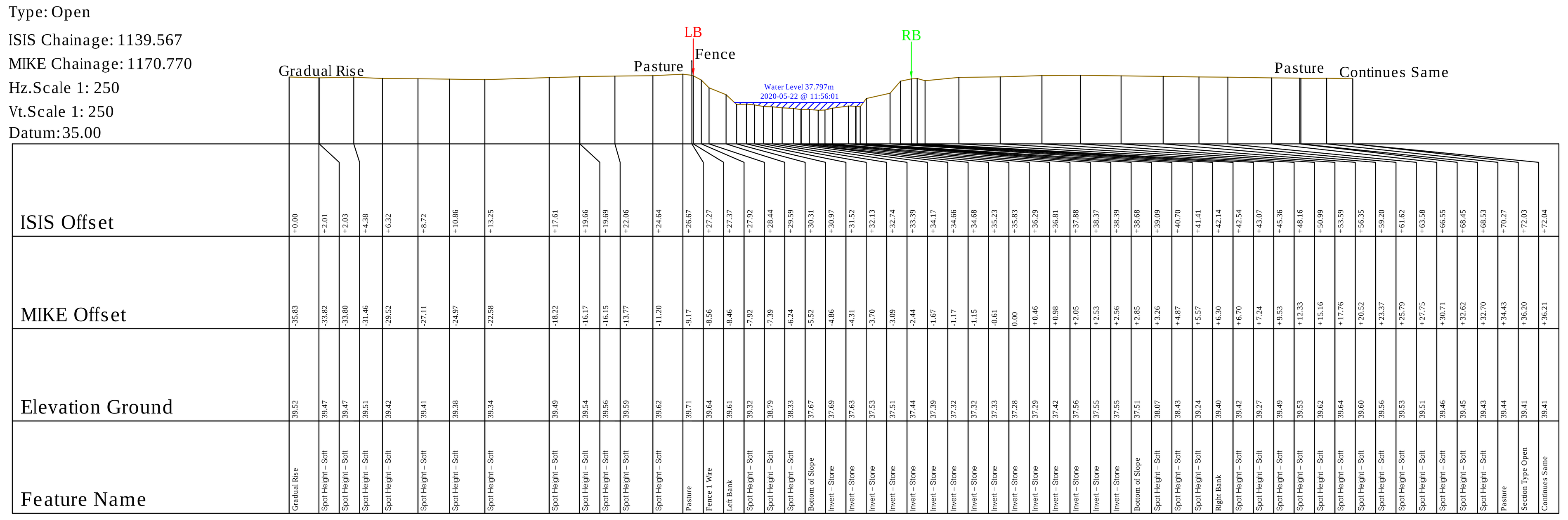
MIKE Chainage: 1074.923
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum: 35.00



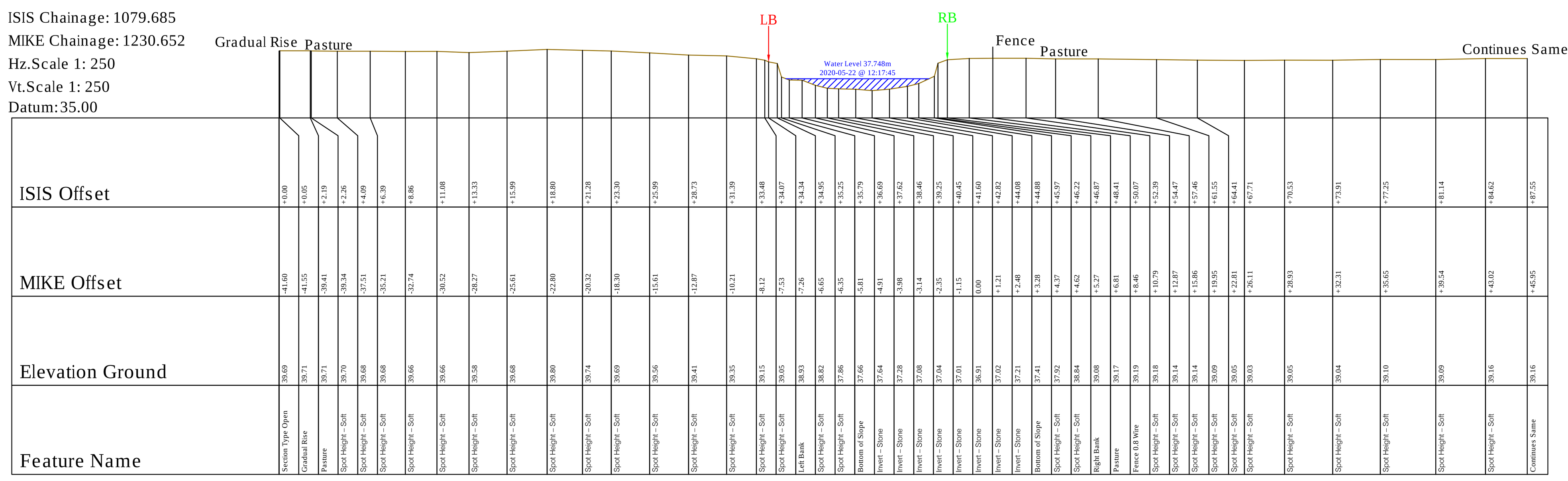
ID:R2.01190
Type: Open
ISIS Chainage: 1189.110
MIKE Chainage: 1121.227
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum: 35.00



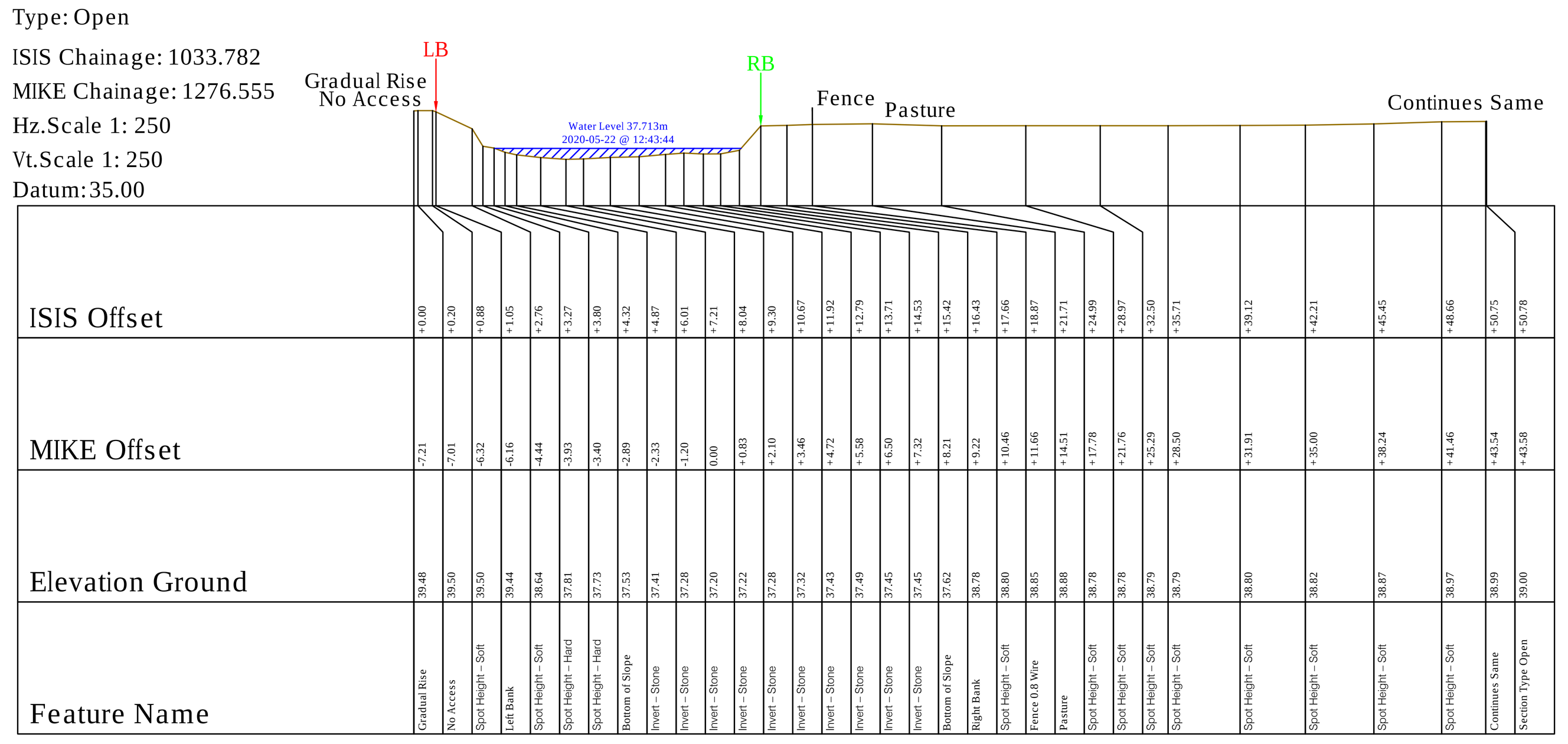
ID:R1.01140
Type: Open
ISIS Chainage: 1139.567
MIKE Chainage: 1170.770
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum: 35.00



ID:R1.01090
Type: Open
ISIS Chainage: 1079.685
MIKE Chainage: 1230.652
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum: 35.00



ID:R1.01040
Type: Open
ISIS Chainage: 1033.782
MIKE Chainage: 1276.555
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum: 35.00



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LEGEND

cross section details

- River Profile
- Water Level
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- Road Line
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- LB Left Bank
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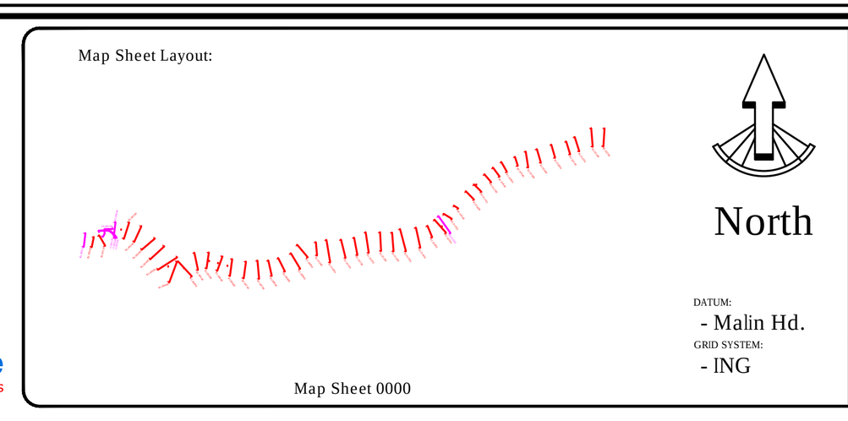
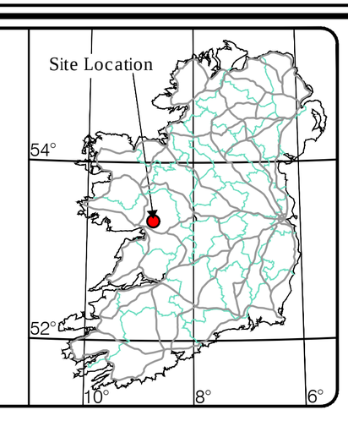
- Building Line
- Wall Line
- Fence Line
- Pipe Profile





Surveyed by : MSL		Date:	MAY 2020
Drawn by : CE		Date:	MAY 2020
Checked by : BK		Date:	28.05.20

Revisions

No.	Date	Description
0	28.05.20	First Drawing

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GLOBAL CONSULTING SURVEYORS
Topographic surveys, Measured Building Surveys, Setting-Out, As-Built Surveys, Hydrographic Surveys, Legal Mapping, Pipeline Surveys, Services Location, Ground Penetrating Radar, Laser Scanning, Rectified Photography
Kildare Cork Belfast London

Client :	AECOM
Project :	MSL34881 N63 - Abbeyknockmoy
Date : 28.05.20	Scale : AS SHOWN
Description :	CROSS SECTIONS
Drawing Number :	MSL34881_R1_XS_03

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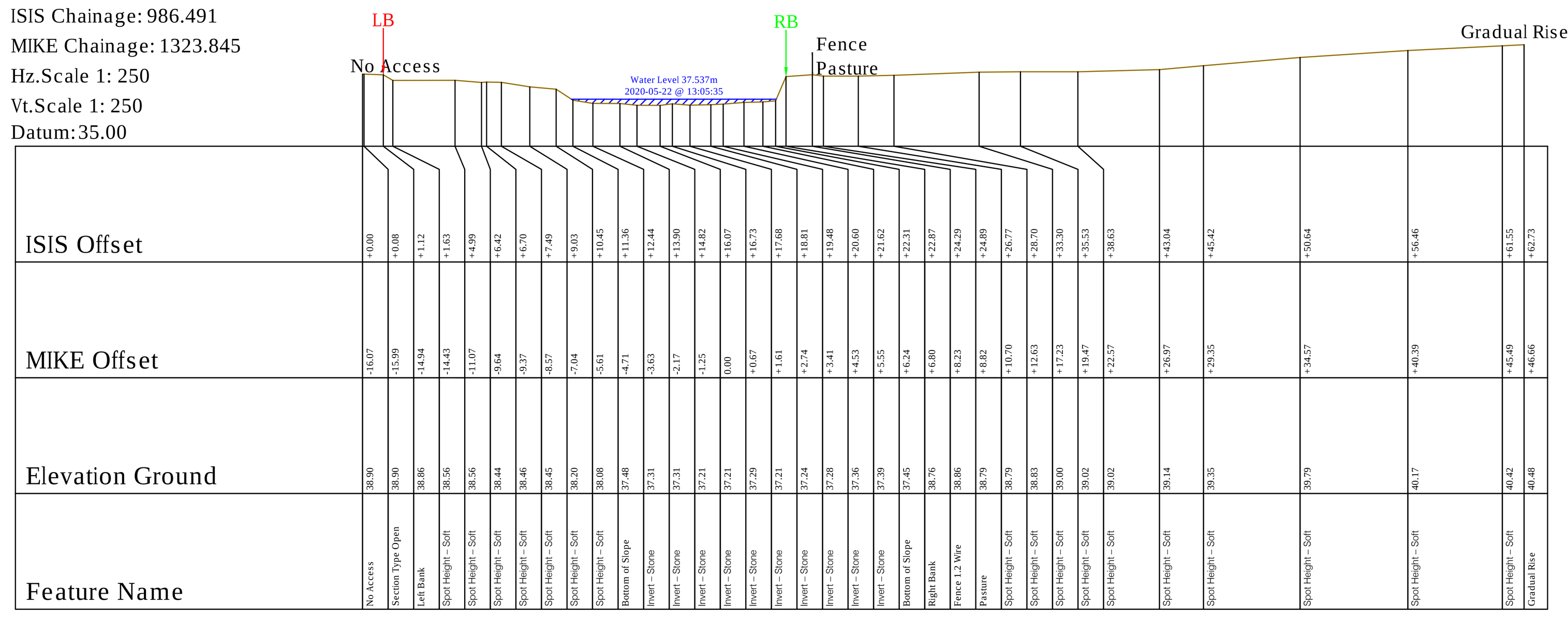
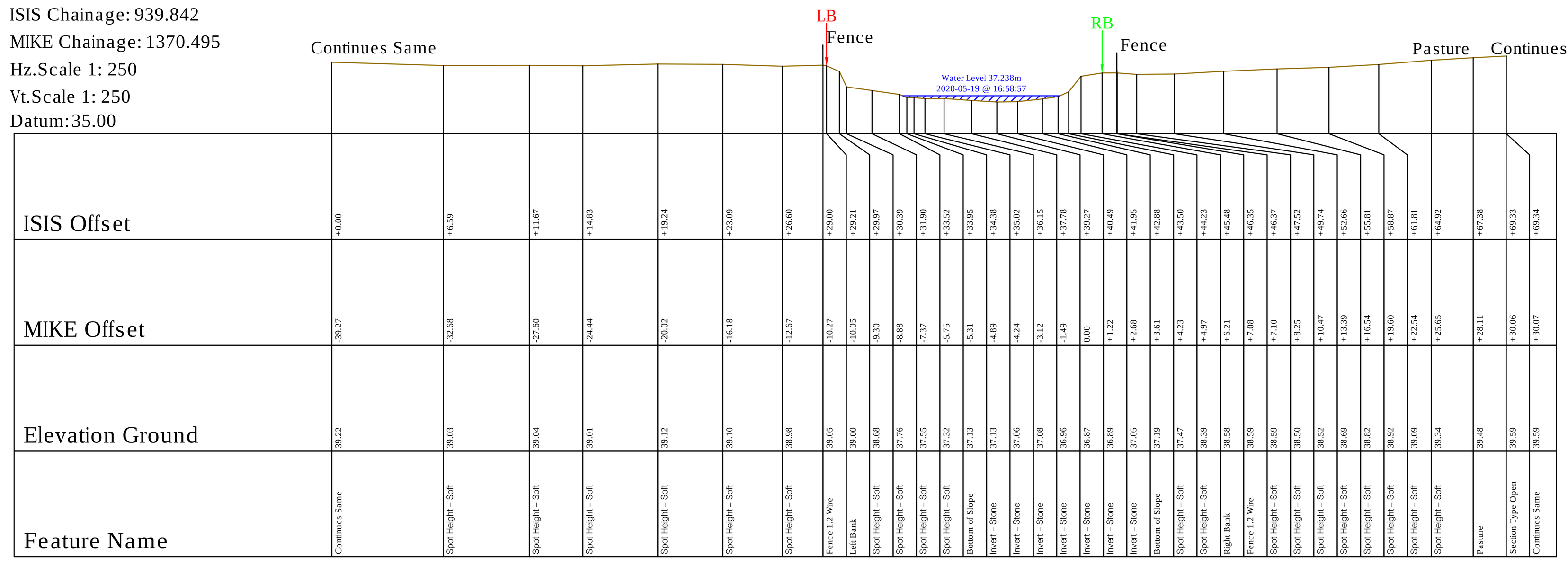
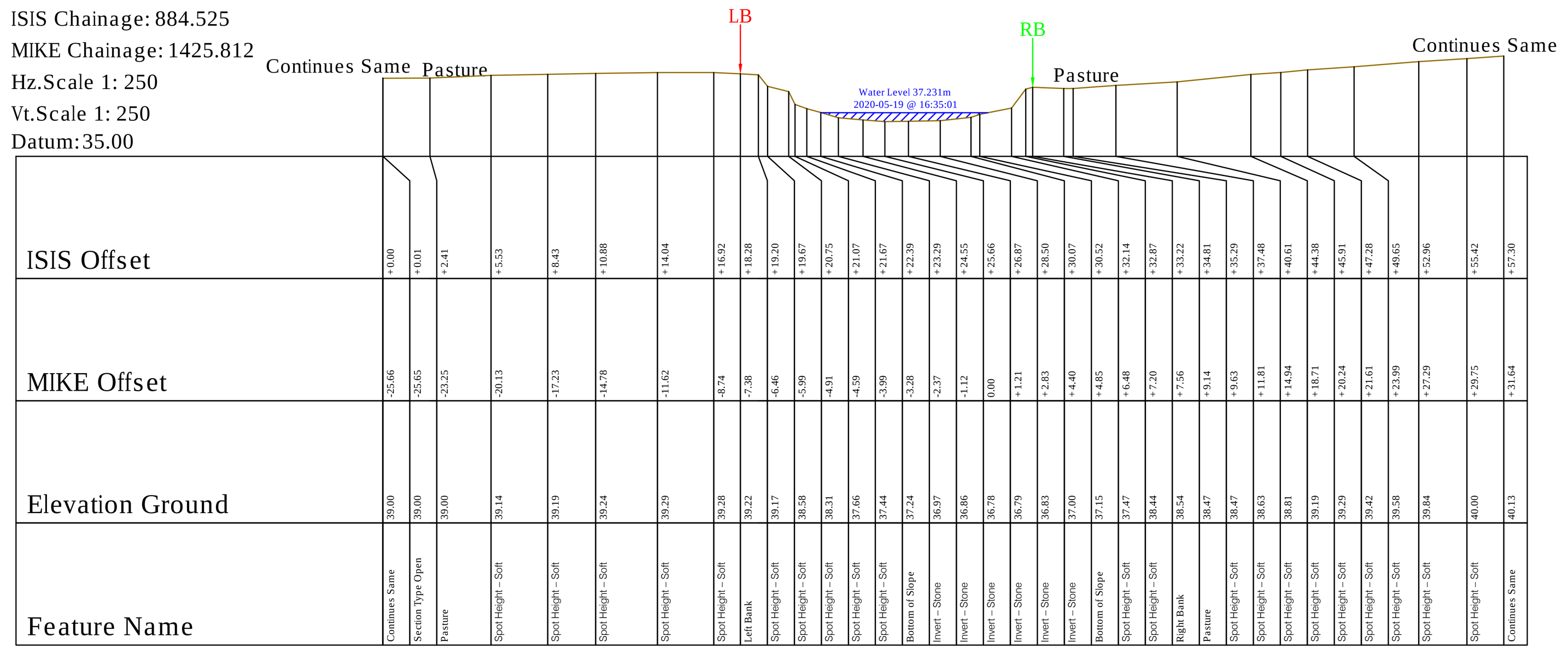
MIKE Chainage: 1323.845
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00



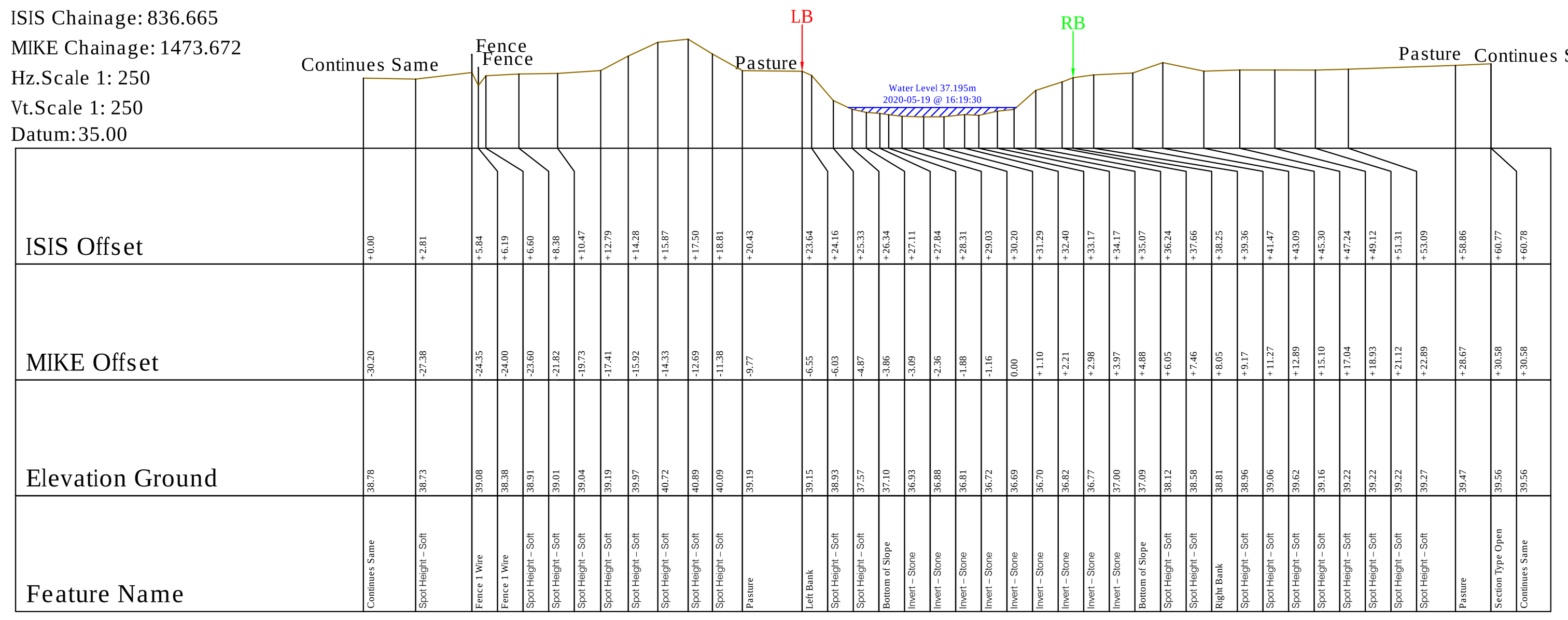
ID:R1.00940
Type: Open
ISIS Chainage: 939.842
MIKE Chainage: 1370.495
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00



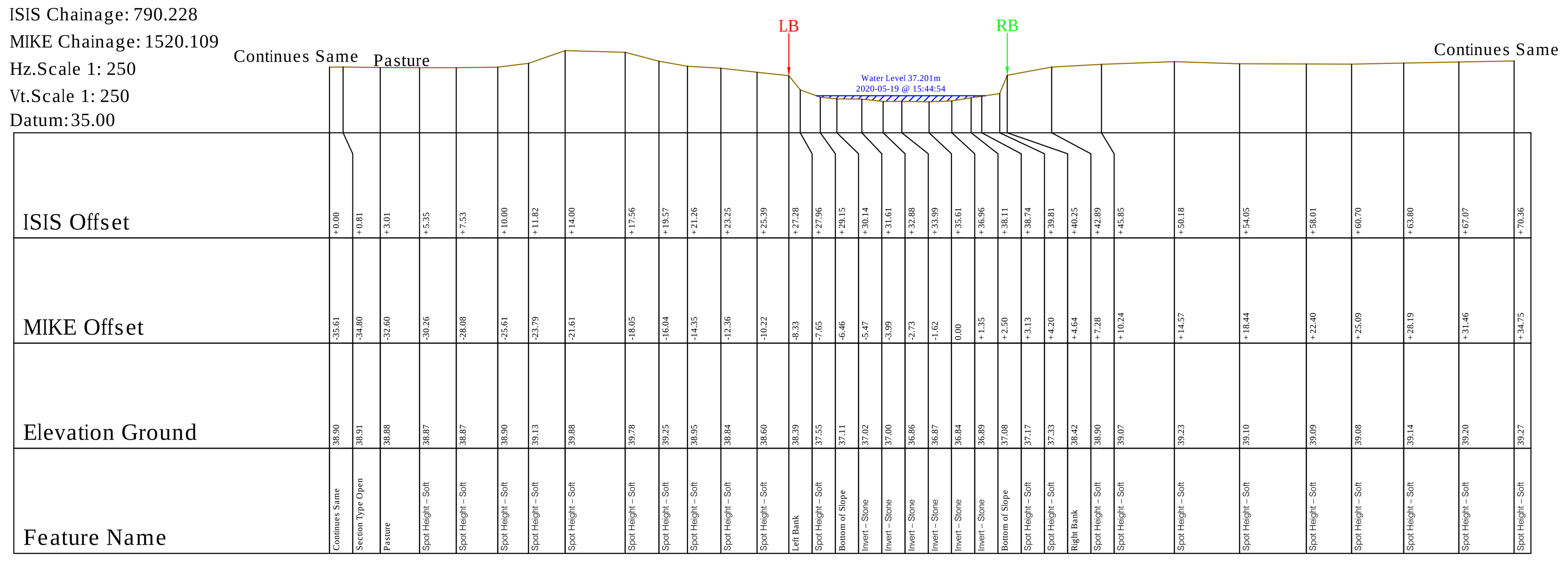
ID:R1.00890
Type: Open
ISIS Chainage: 884.525
MIKE Chainage: 1425.812
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00



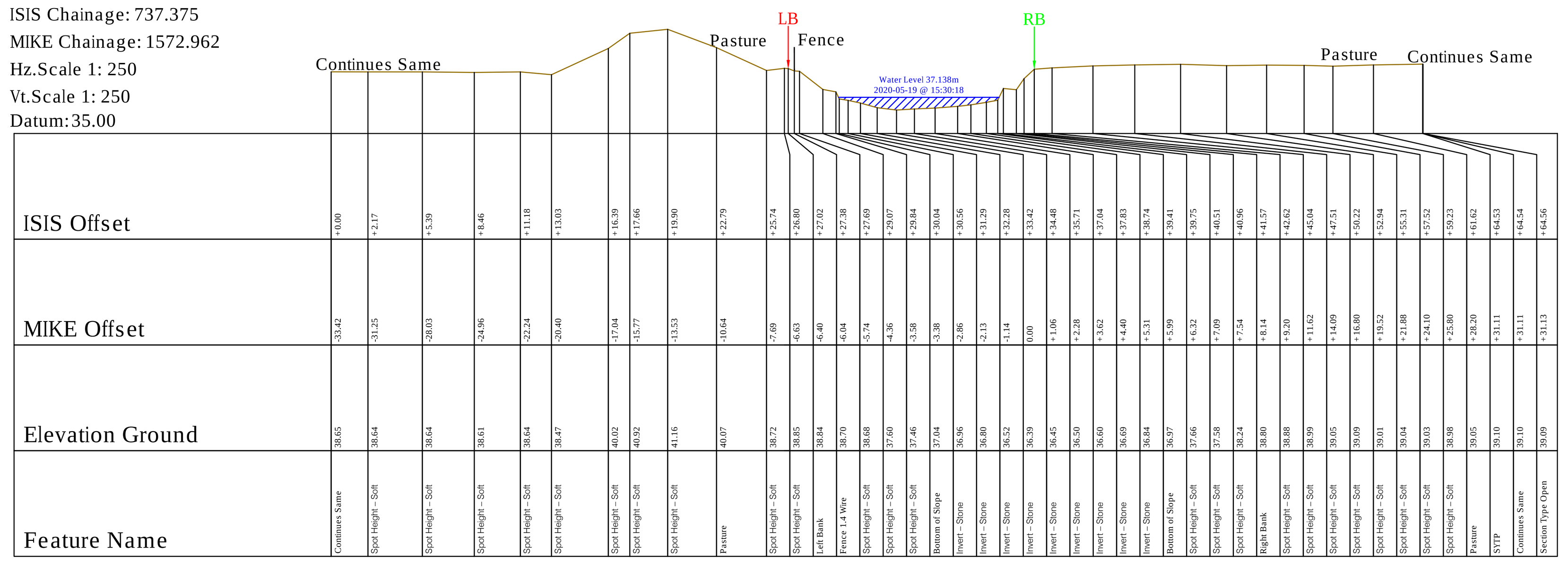
ID:R1.00840
Type: Open
ISIS Chainage: 836.665
MIKE Chainage: 1473.672
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00



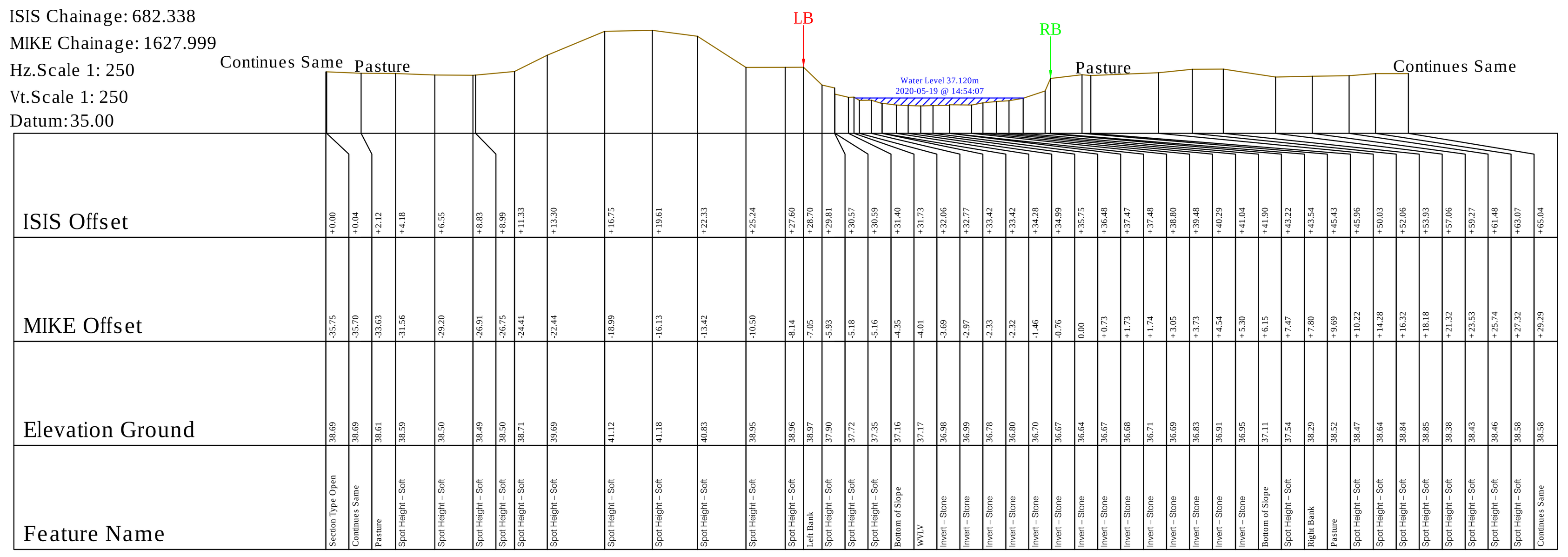
ID:R1.00790
Type: Open
ISIS Chainage: 790.228
MIKE Chainage: 1520.109
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00



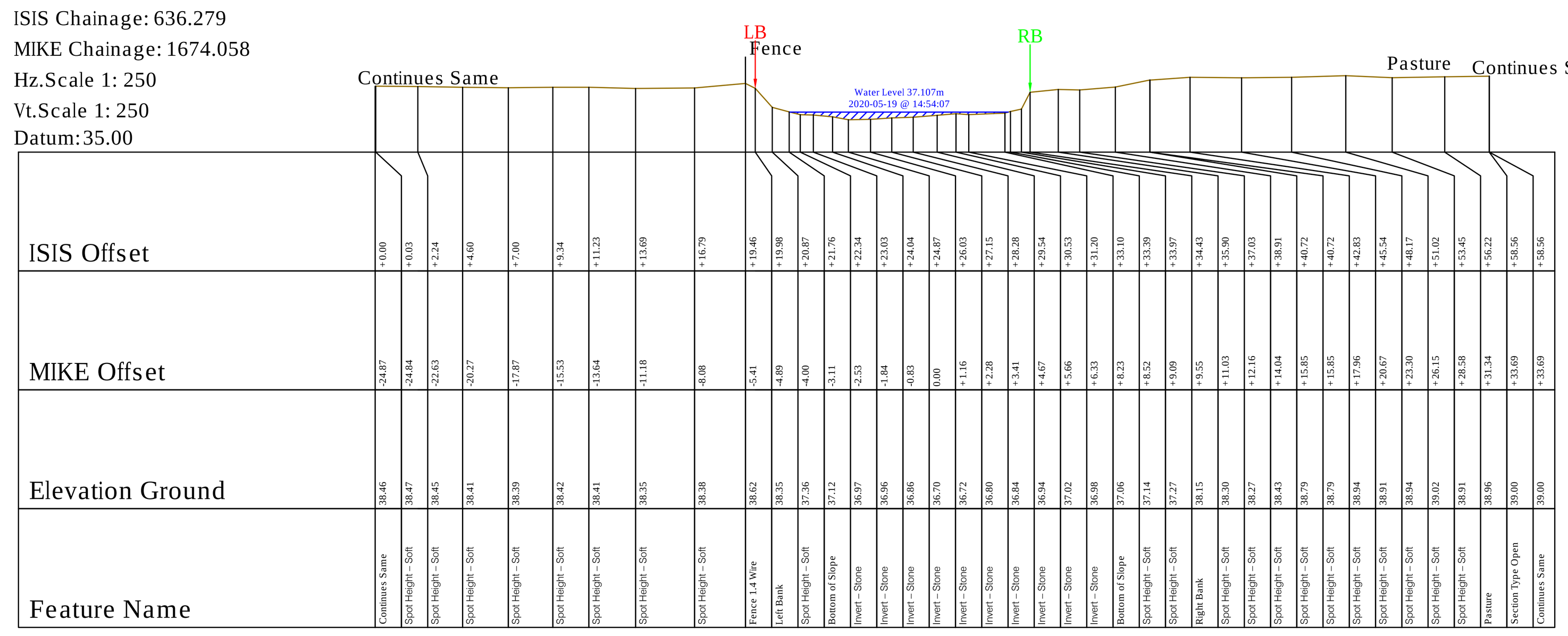
ID:R1.00740
Type: Open
ISIS Chainage: 737.375
MIKE Chainage: 1572.962
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00



ID:R1.00690
Type: Open
ISIS Chainage: 682.338
MIKE Chainage: 1627.999
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00



ID:R1.00640
Type: Open
ISIS Chainage: 636.279
MIKE Chainage: 1674.058
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00



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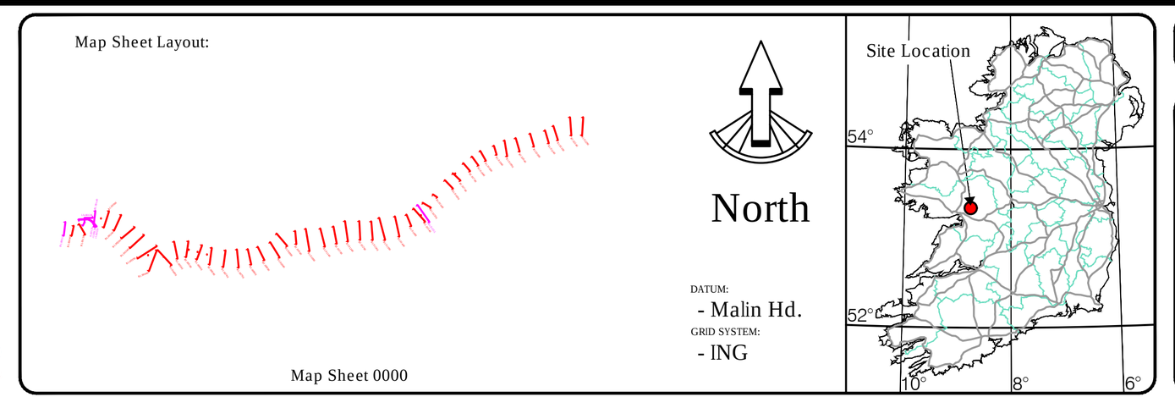
LEGEND
cross section details
River Profile
Water Level
Ground Level
Road Line
Wall Line
Bridge Line
LB Left Bank
RB Right Bank
Building Line
Wall Line
Fence Line
Pipe Profile

No. 318
SURVEY ASSOCIATION
Supply-Line



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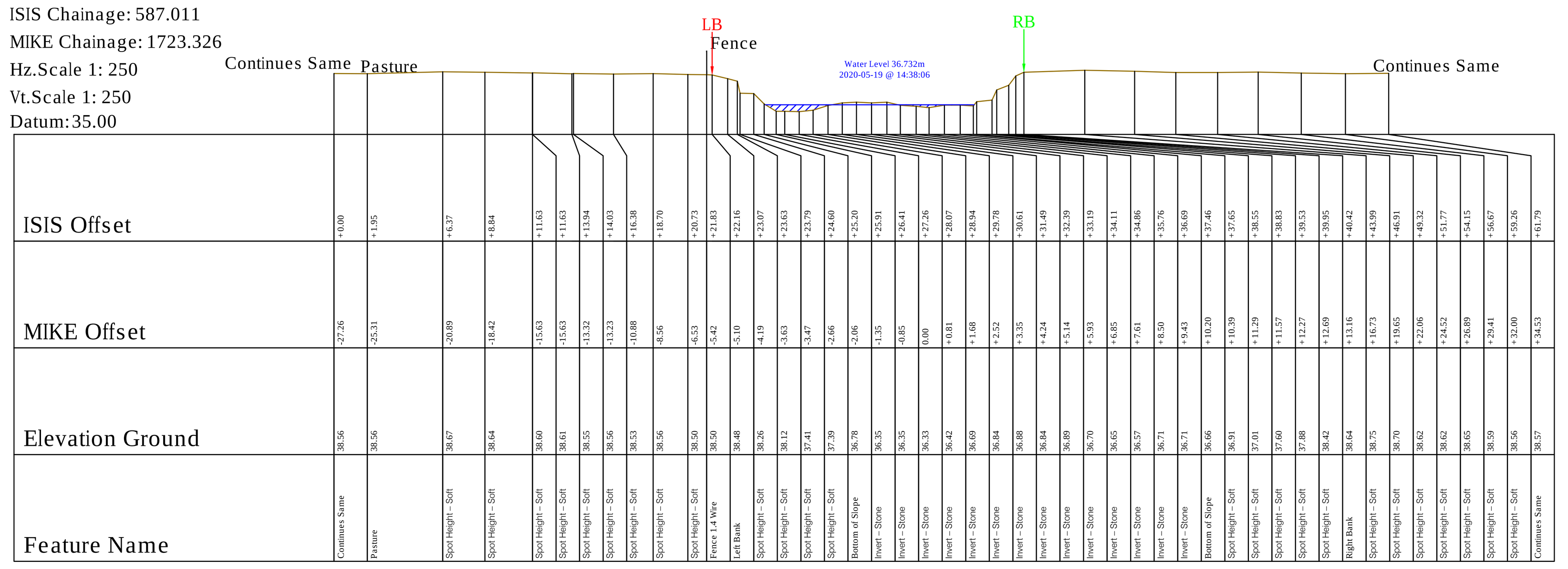
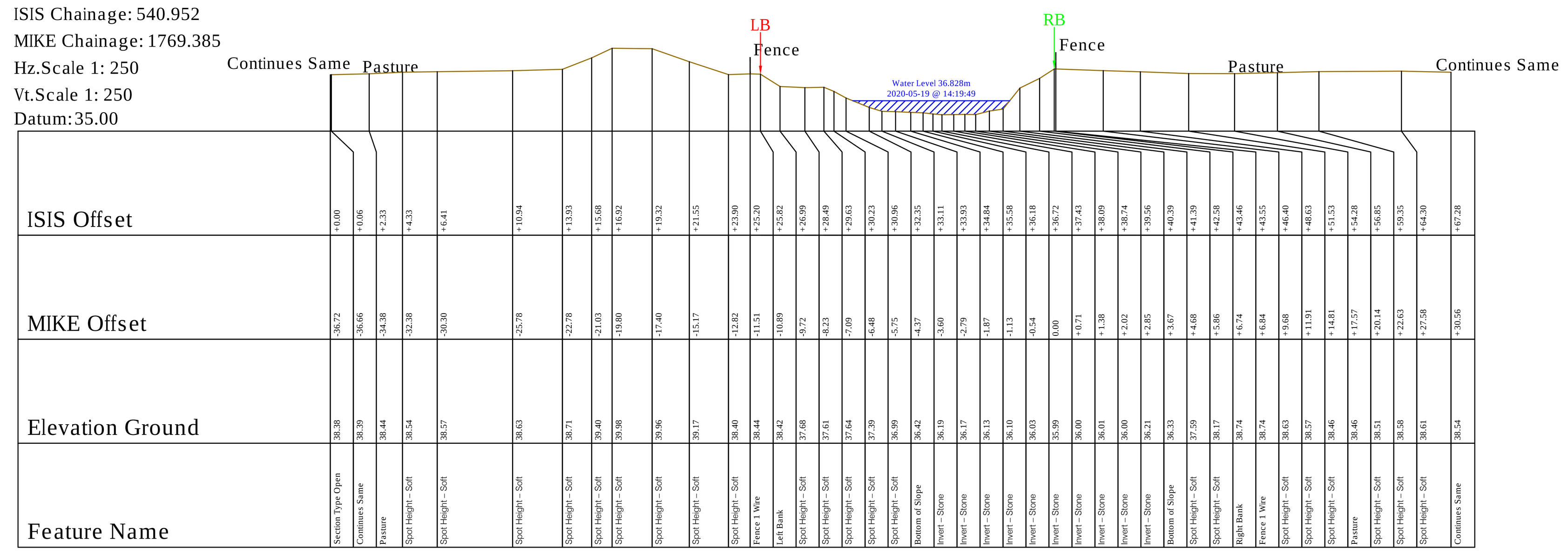
Client :	AECOM
Project :	MSL34881 N63 - Abbeyknockmoy
Date :	28.05.20
Scale :	AS SHOWN
Description :	CROSS SECTIONS
Drawing Number :	MSL34881_R1_XS_04

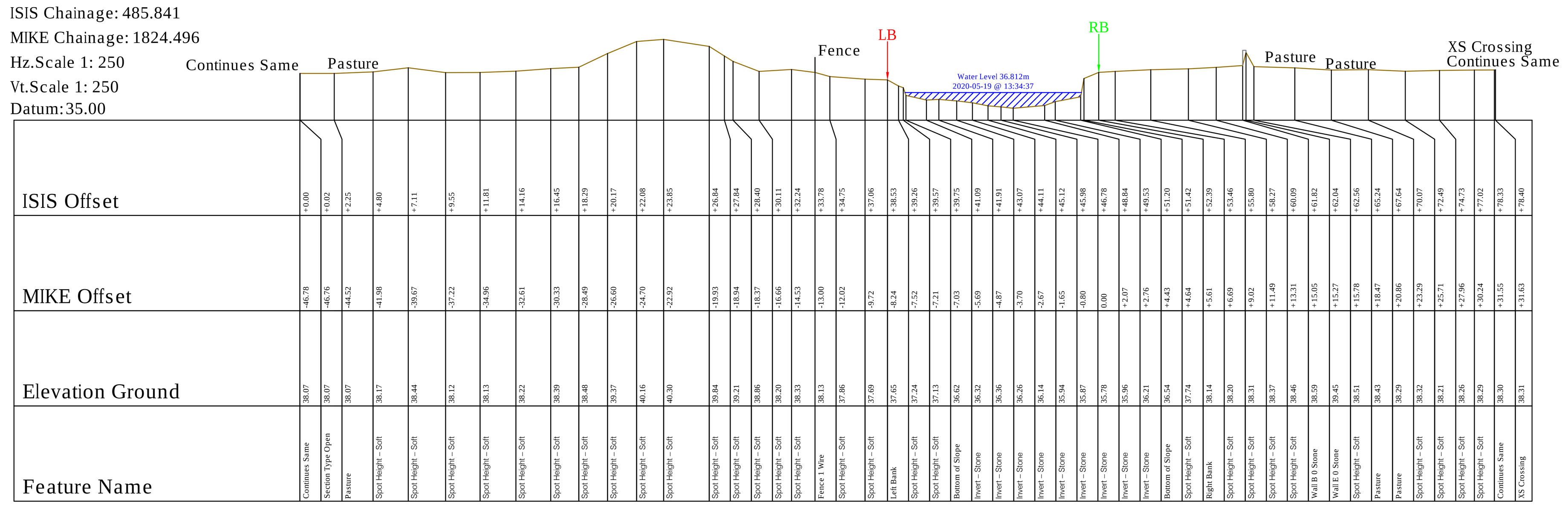
ID:R1.00590
Type: Open
ISIS Chainage: 587.011
MIKE Chainage: 1723.326
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00



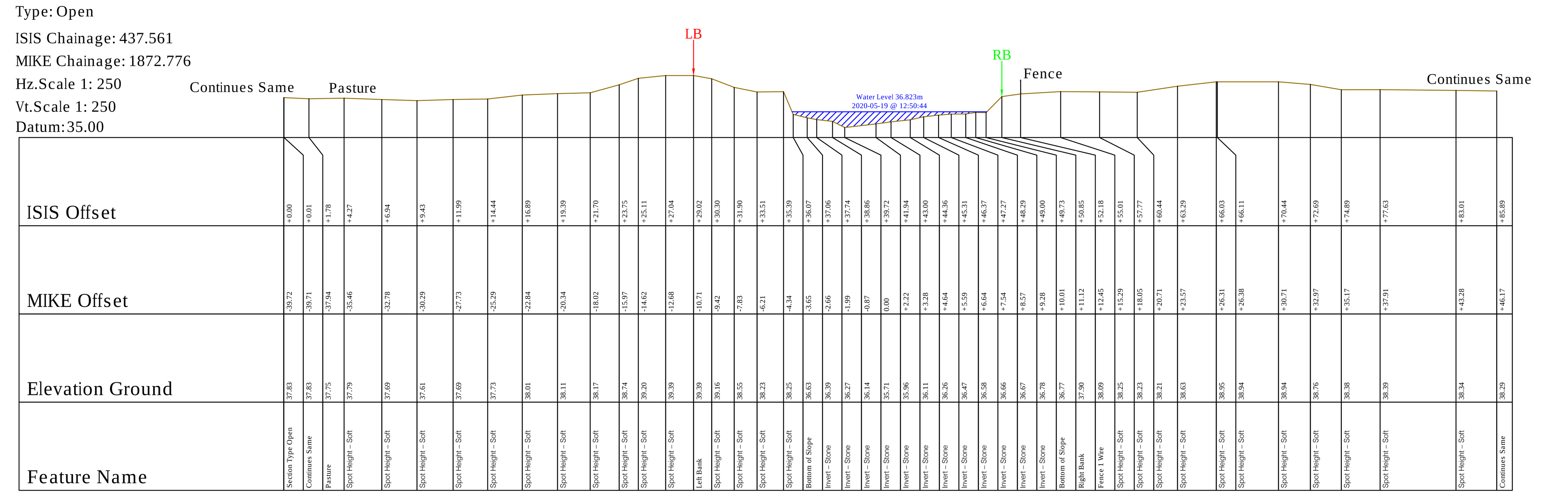
ID:R1.00540
Type: Open
ISIS Chainage: 540.952
MIKE Chainage: 1769.385
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00



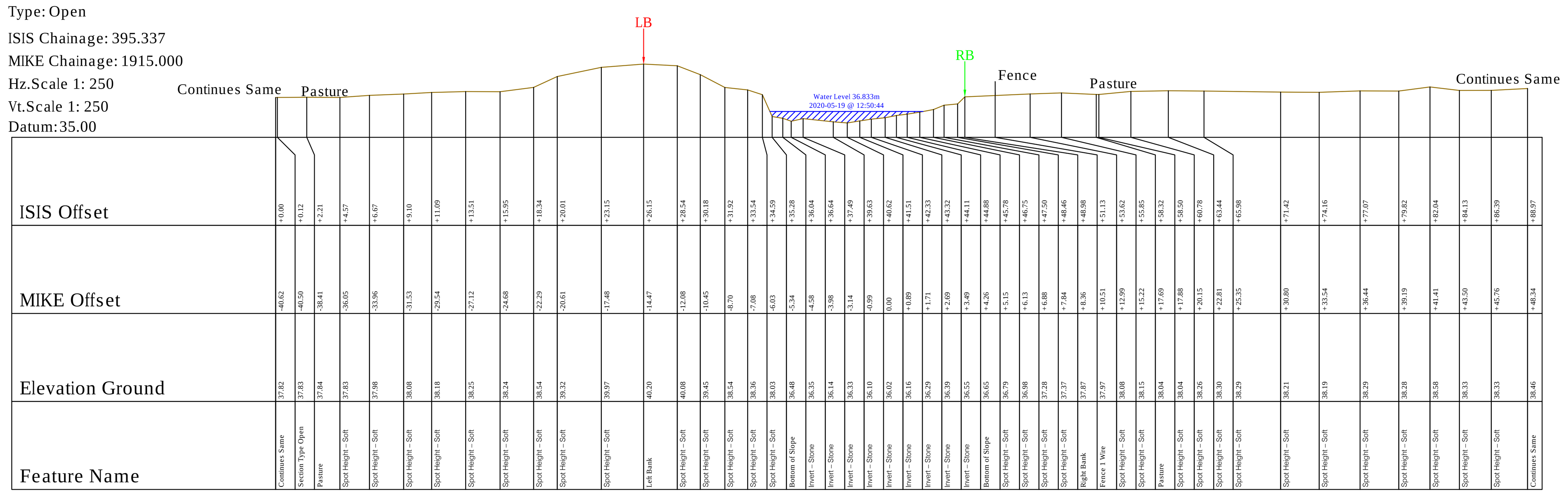
ID:R1.00490
Type: Open
ISIS Chainage: 485.841
MIKE Chainage: 1824.496
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00



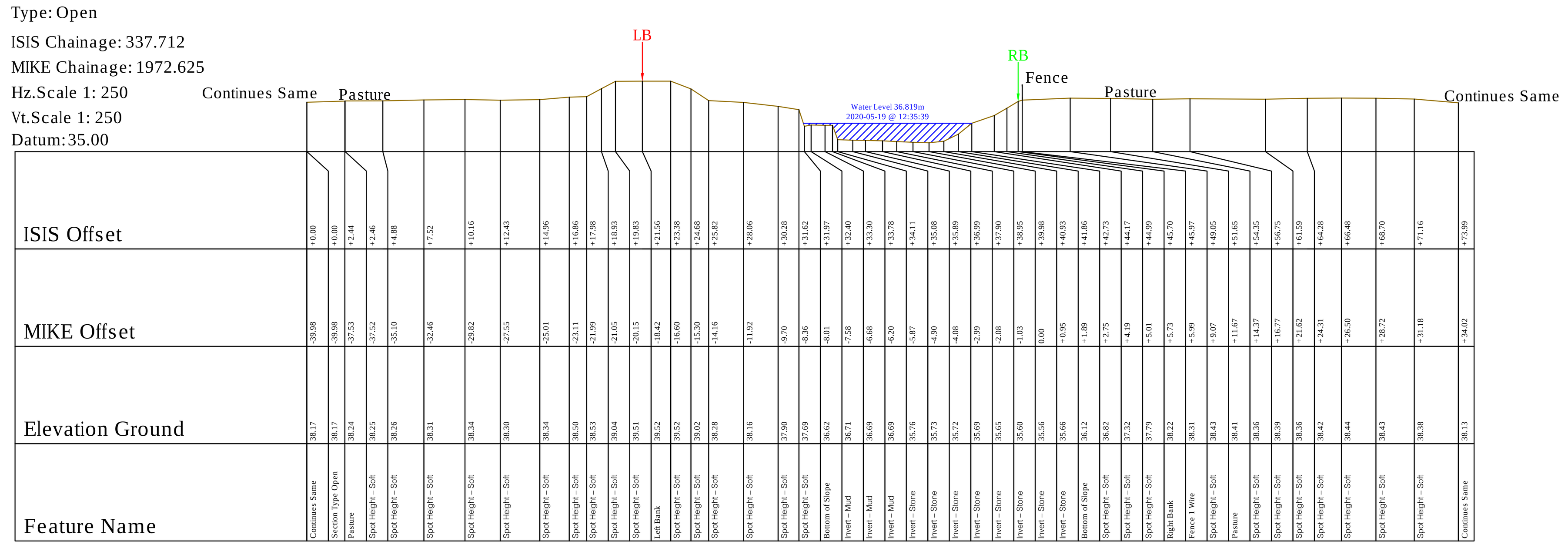
ID:R1.00440
Type: Open
ISIS Chainage: 437.561
MIKE Chainage: 1872.776
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00



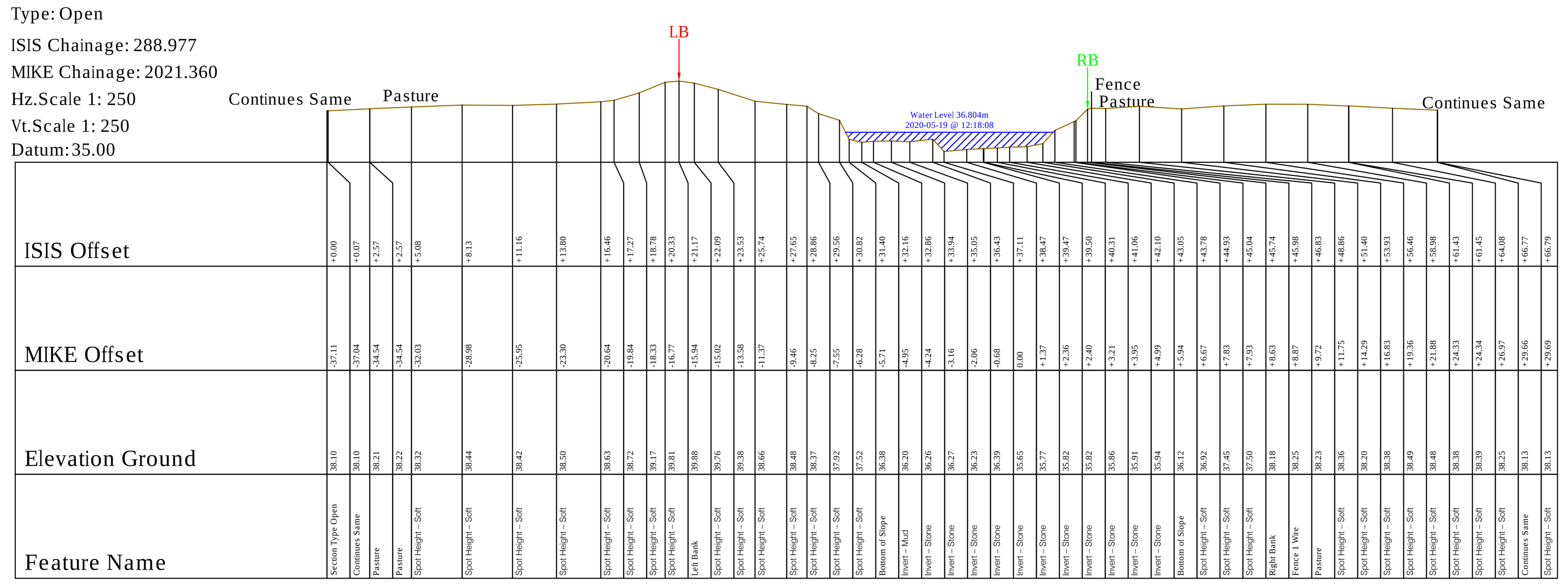
ID:R1.00390
Type: Open
ISIS Chainage: 395.337
MIKE Chainage: 1915.000
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00



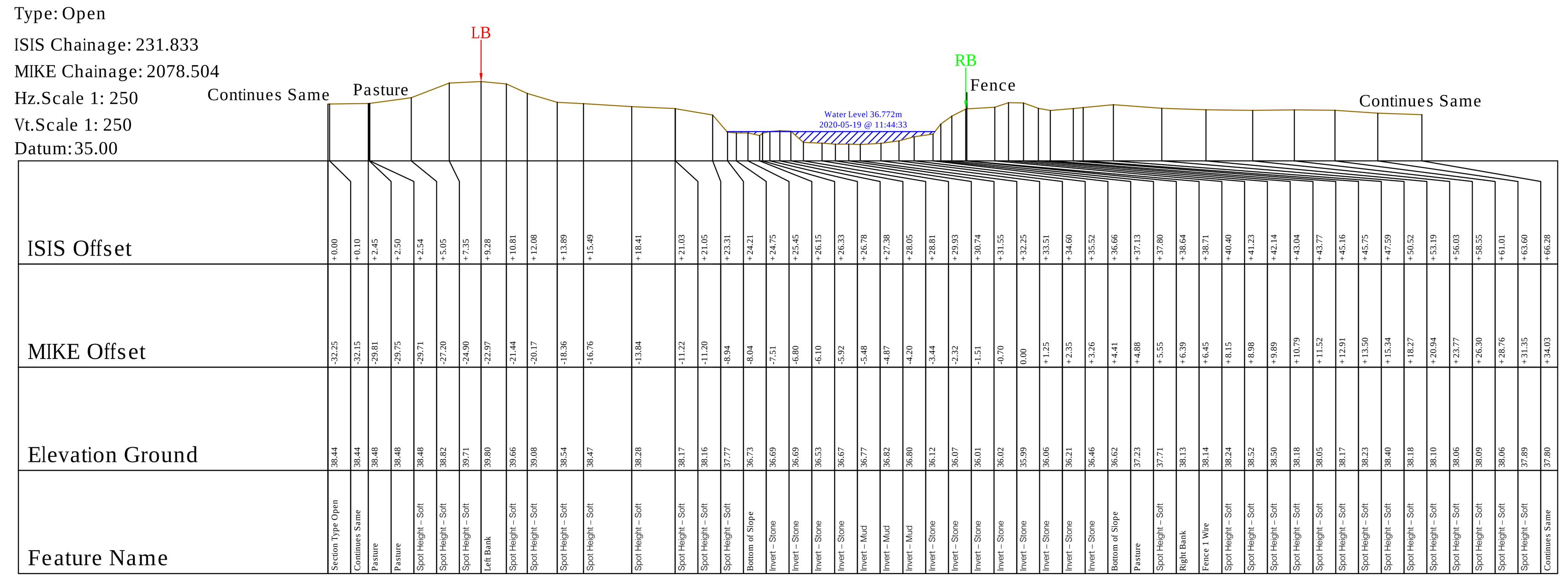
ID:R1.00340
Type: Open
ISIS Chainage: 337.712
MIKE Chainage: 1972.625
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00



ID:R1.00290
Type: Open
ISIS Chainage: 288.977
MIKE Chainage: 2021.360
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00



ID:R1.00240
Type: Open
ISIS Chainage: 231.833
MIKE Chainage: 2078.504
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00



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LEGEND

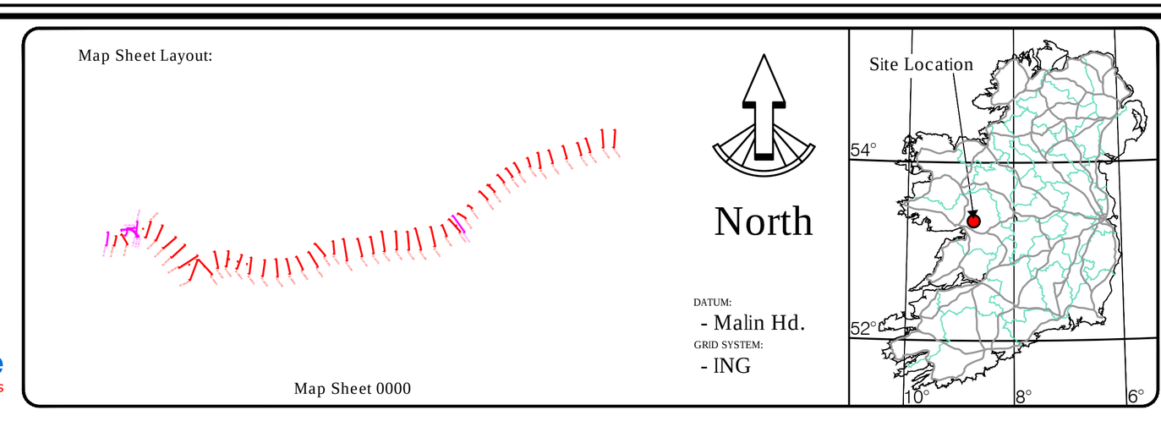
cross section details

River Profile
Water Level
Ground Level
Road Line
Wall Line
Bridge Line
LB Left Bank
RB Right Bank
Building Line
Wall Line
Fence Line
Pipe Profile

No. 318

THE SURVEY ASSOCIATION

Supply-Line empowered by Achilles



Surveyed by : MSL		Date: MAY 2020	
Drawn by : CE		Date: MAY 2020	
Checked by : BK		Date: 28.05.20	

Revisions

No.	Date	Description
0	28.05.20	First Drawing

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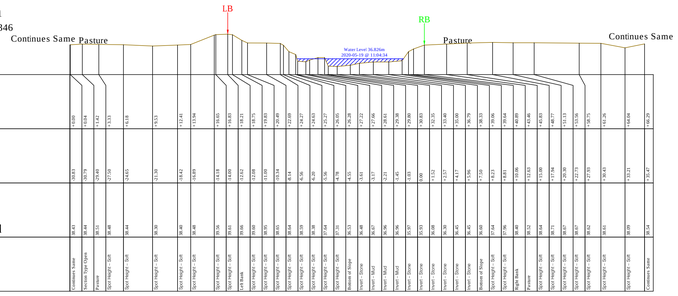
Kildare Cork Belfast London

Client :	AECOM
Project :	MSL34881 N63 - Abbeyknockmoy
Date : 28.05.20	Scale : AS SHOWN
Description :	CROSS SECTIONS
Drawing Number :	MSL34881_R1_XS_05



ID:R1.00190
Type: Open
ISIS Chainage: 185.991
MIKE Chainage: 2124.346
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00

ID:R1.00140
Type: Open
ISIS Chainage: 138.924
MIKE Chainage: 2171.413
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00

ID:R1.00139
Type: Weir
ISIS Chainage: 123.500
MIKE Chainage: 2186.837
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00
Skew Angle: 337.12

ID:R1.00138
Type: Weir
ISIS Chainage: 122.970
MIKE Chainage: 2187.366
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00
Skew Angle: 340.50

ID:R1.00137
Type: Weir
ISIS Chainage: 122.417
MIKE Chainage: 2187.920
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00
Skew Angle: 341.48

Weir Long Section
Crest: LS.00138
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00

ID:R1.00136
Type: Open
ISIS Chainage: 75.884
MIKE Chainage: 2234.452
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00

ID:R1.00040
Type: Open
ISIS Chainage: 43.518
MIKE Chainage: 2266.818
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00

BRIDGE (Other Face Similar)
(Structure Width = 6.7m)
D/S Soffit 37.68m, D/S Invert 33.63m

ID:R1.00010
Type: Bridge
ISIS Chainage: 9.784
MIKE Chainage: 2300.553
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:30.00
Skew Angle: 9.27

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LEGEND
cross section details

▨	River Profile	LB	Left Bank
—	Water Level	RB	Right Bank
—	Ground Level	▨	Building Line
—	Road Line	|	Wall Line
—	Wall Line	|	Fence Line
—	Bridge Line	▬	Pipe Profile

No. 318

THE SURVEY ASSOCIATION

Supply-Line
empowered by Achilles

Map Sheet Layout:

Map Sheet 0000

North

DATUM:
- Malin Hd.
GRID SYSTEM:
- ING

Surveyed by : MSL Date: MAY 2020
Drawn by : CE Date: MAY 2020
Checked by : BK Date: 28.05.20

Revisions

No.	Date	Description
0	28.05.20	First Drawing

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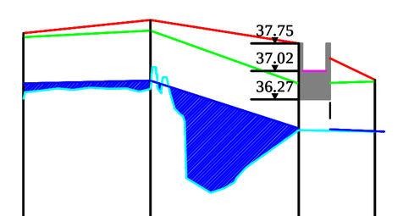
Kildare Cork Belfast London

Client : AECOM
Project : MSL34881 N63 - Abbeyknockmoy
Date : 28.05.20
Scale : AS SHOWN
Description : CROSS SECTIONS
Drawing Number : MSL34881_R1_XS_06

River Profile
Chainage 0.000
Hz. Scale 1:1000
Vt. Scale 1:200
Datum 30.00



ISIS Chainage	58.92	42.15	22.55	12.49
MIKE Chainage	3.33	20.10	39.69	49.75
River Bed Level (MIKE 0)	36.29	36.55	35.46	35.42
Elevation Water Level	36.692 17:42:26@2020-05-18	36.769 09:34:31@2020-05-19	35.14 09:34:31@2020-05-19	35.42 09:34:31@2020-05-19
Elevation Left Bank	38.02	38.37	37.75	36.79
Elevation Right Bank	37.92	38.09	36.68	36.74
Section ID	R2.00055	R2.00040	R2.00020	R2.00010

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LEGEND

long section details

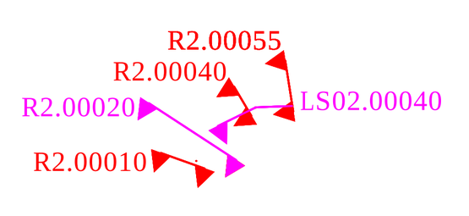
Water Profile			
Water Level			
Left Bank Level		LB	Left Bank Level
Right Bank Level		RB	Right Bank Level
River Bed Level		WL	Water Level
Road Level		RBL	River Bed Level
Structure Level			

No. 318

THE SURVEY ASSOCIATION

Supply-Line empowered by Achilles

Map Sheet Layout:

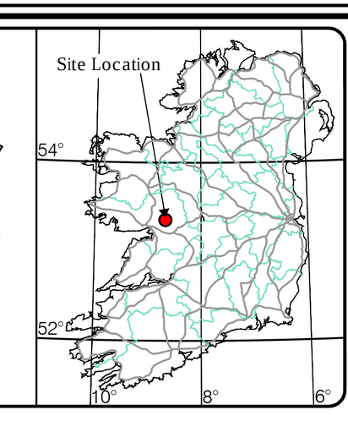


Map Sheet 0000

North

DATUM:
- Malin Hd.
GRID SYSTEM:
- ING

Site Location



Surveyed by : MSL Date: MAY 2020
Drawn by : CE Date: MAY 2020
Checked by : BK Date: 26.05.20

Revisions

No.	Date	Description
0	26.05.20	First Drawing

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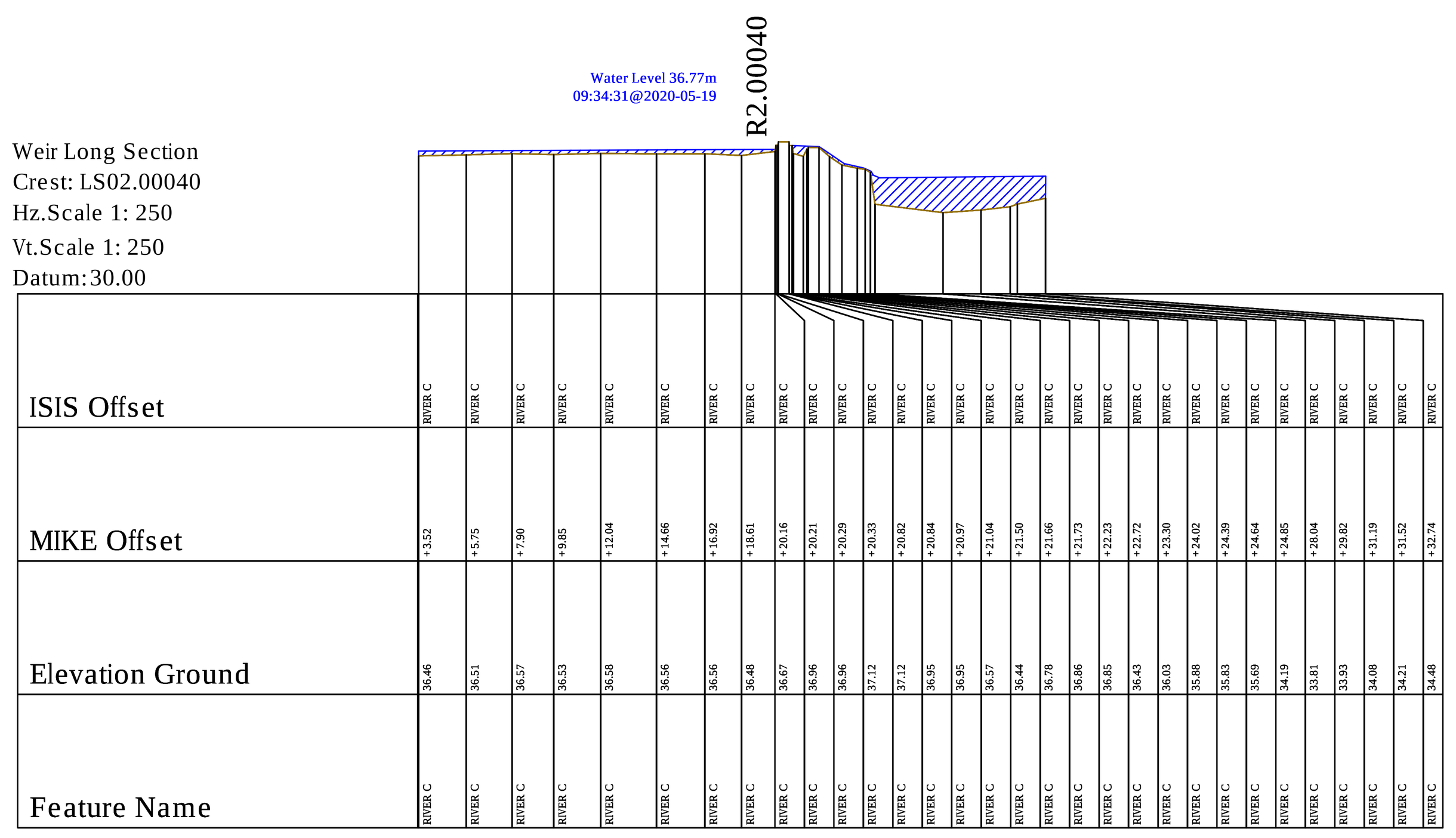
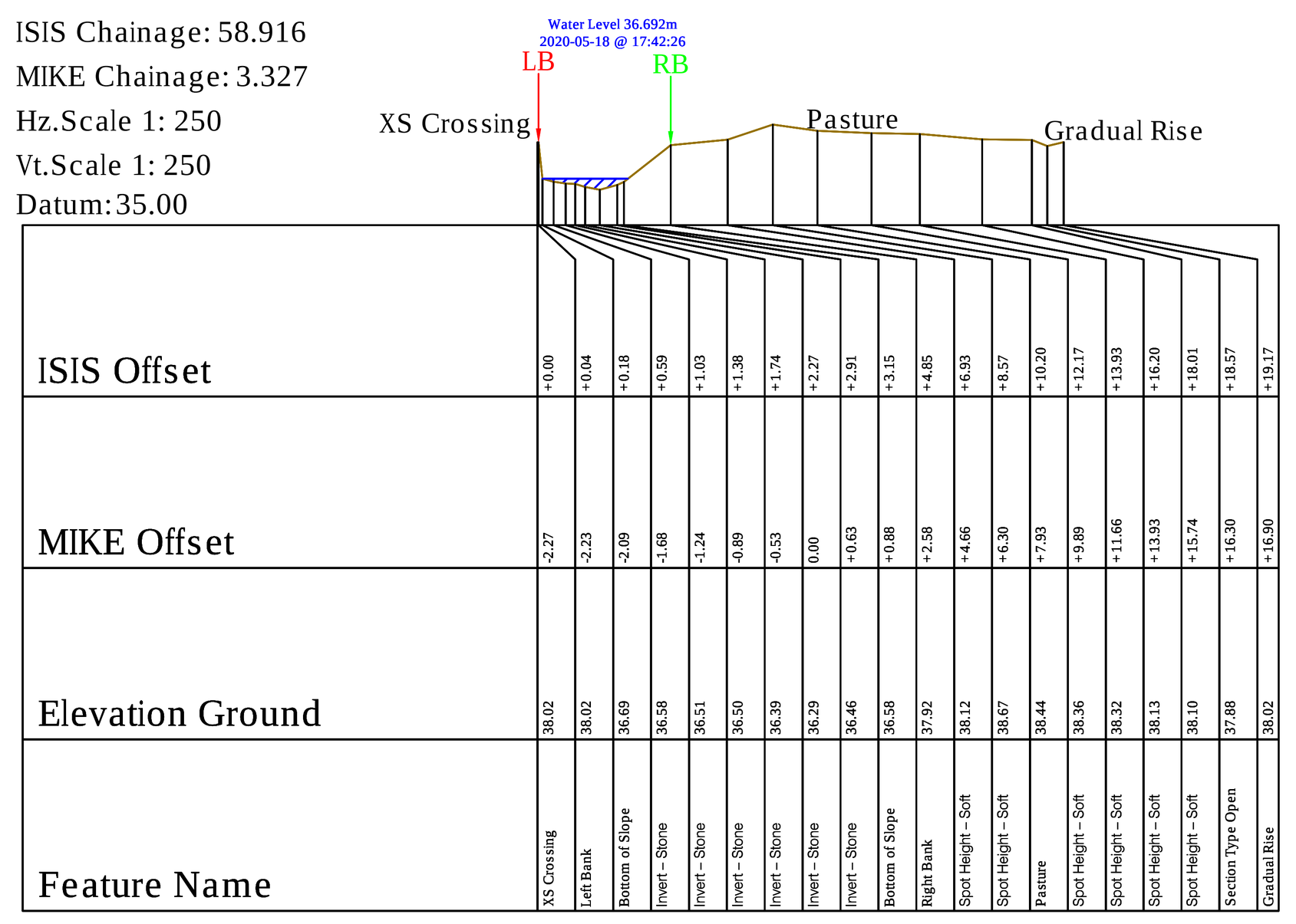
Laser Scanning, Rectified Photography
Kildare Cork Belfast London

Client : AECOM
Project : MSL34881 N63 - Abbeyknockmoy
Date : 26.05.20
Scale : AS SHOWN
Description : LONG SECTION
Drawing Number : **MSL34881_R2_LS_1**

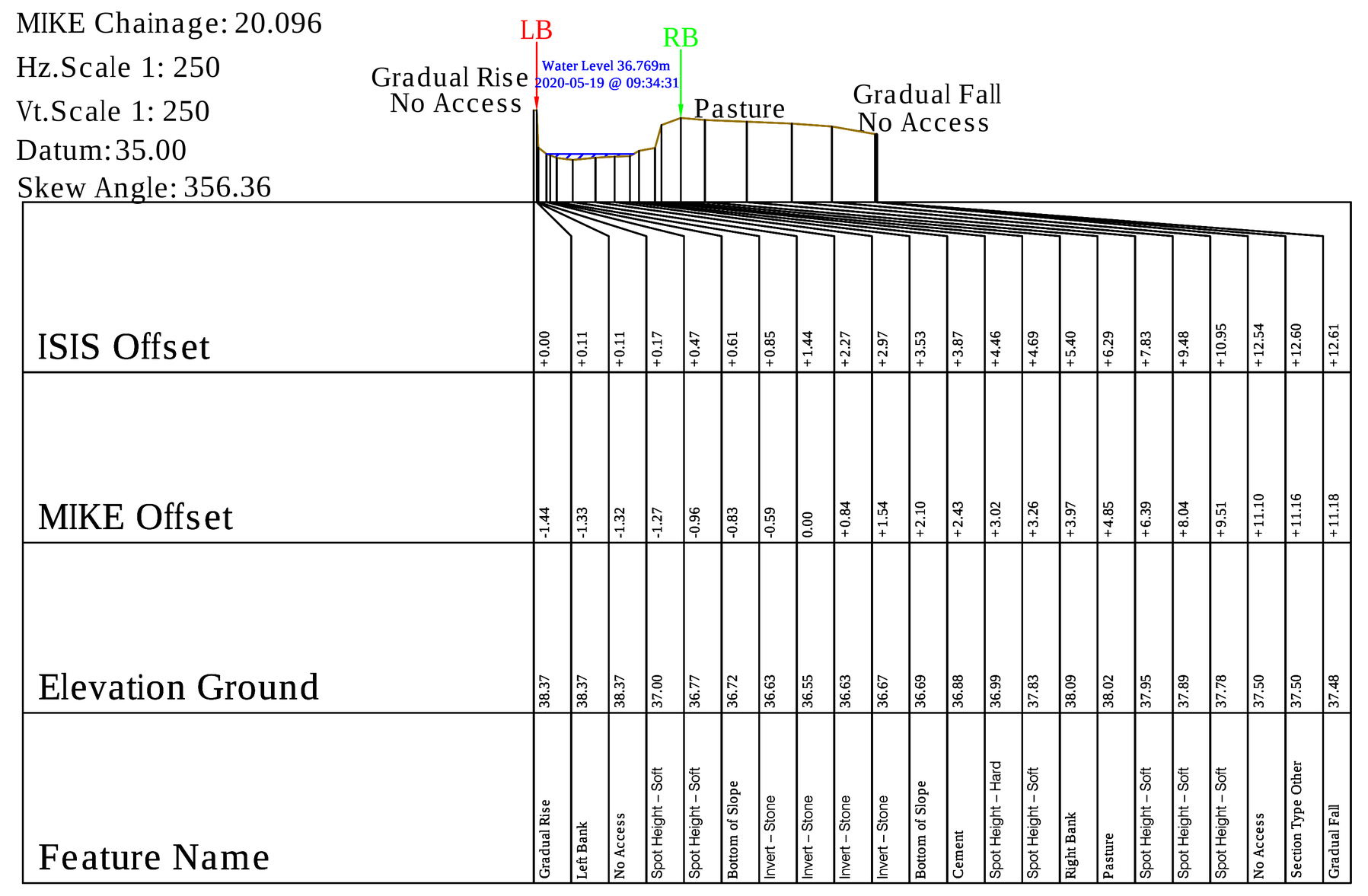
Weir Long Section
Crest: LS02.00040
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:30.00



ID:R2.00055
Type: Open
ISIS Chainage: 58.916
MIKE Chainage: 3.327
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00

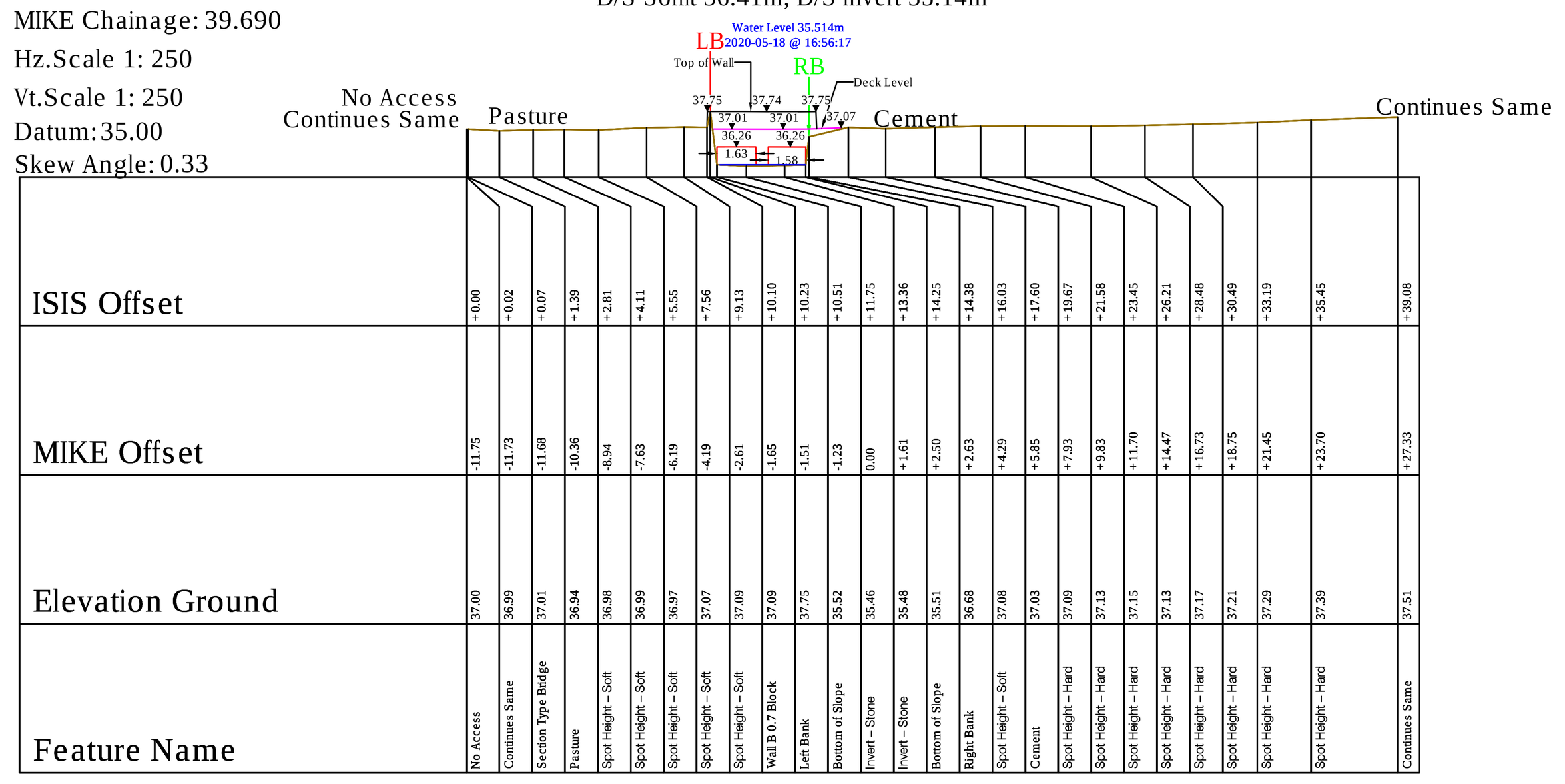


ID:R2.00040
Type: Other
ISIS Chainage: 42.146
MIKE Chainage: 20.096
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00
Skew Angle: 356.36

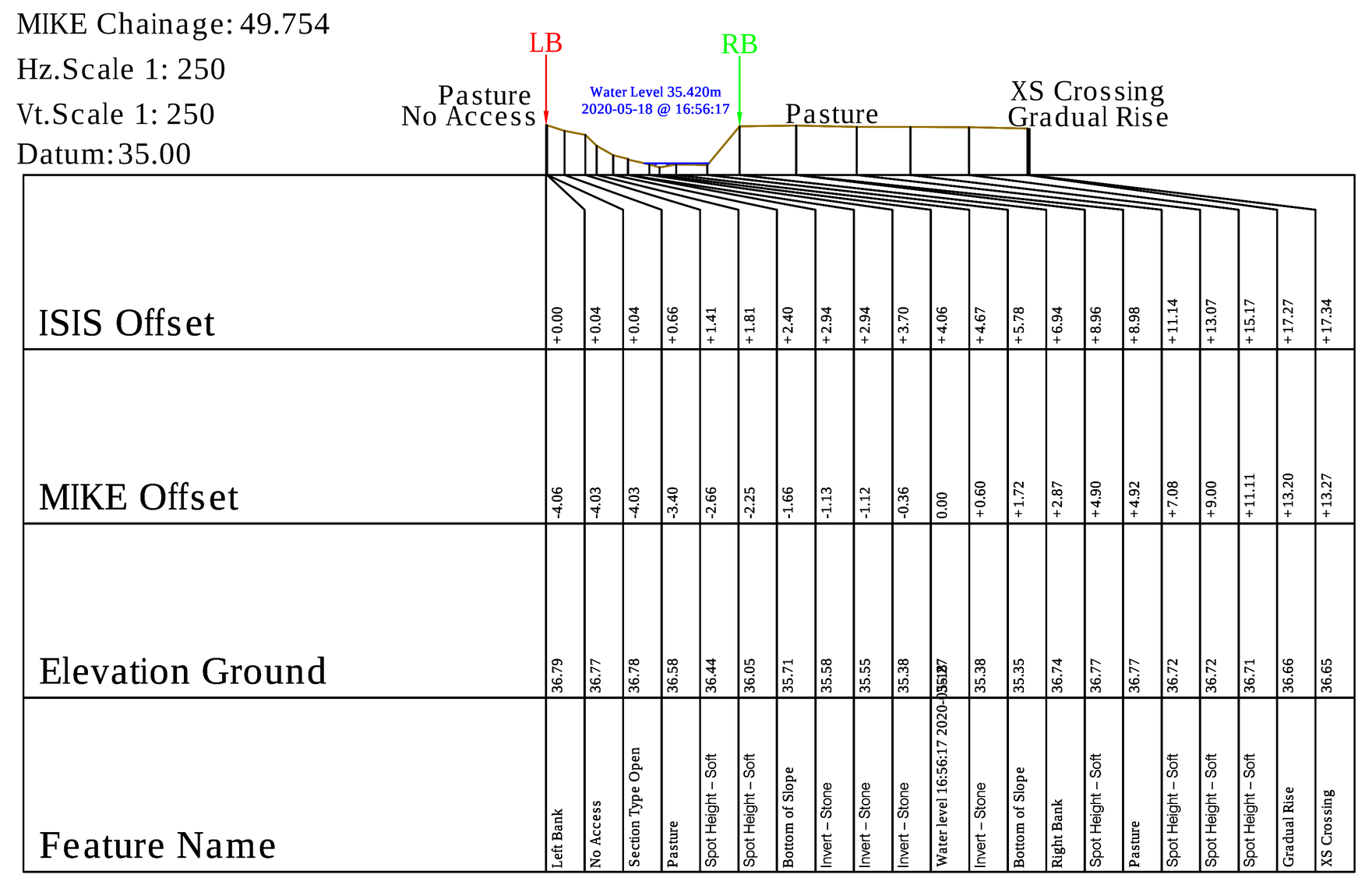


ID:R2.00020
Type: Bridge
ISIS Chainage: 22.552
MIKE Chainage: 39.690
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00
Skew Angle: 0.33

BRIDGE (Other Face Similar)
(Structure Width = 4.1m)
D/S Soffit 36.41m, D/S Invert 35.14m



ID:R2.00010
Type: Open
ISIS Chainage: 12.489
MIKE Chainage: 49.754
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum:35.00



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LEGEND

cross section details

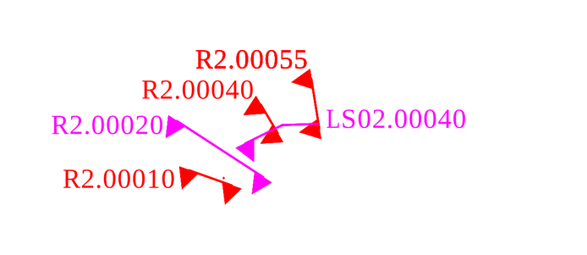
	River Profile	LB	Left Bank
	Water Level	RB	Right Bank
	Ground Level		Building Line
	Road Line		Wall Line
	Wall Line		Fence Line
	Bridge Line		Pipe Profile

No. 318

THE SURVEY ASSOCIATION

Supply-Line empowered by Achilles

Map Sheet Layout:

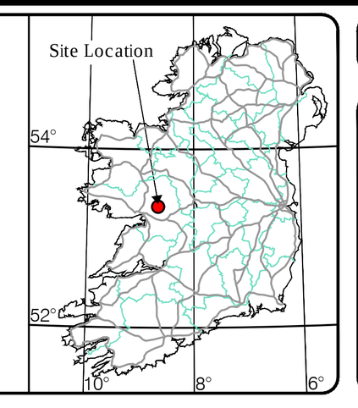


Map Sheet 0000

North

DATUM:
- Malin Hd.
GRID SYSTEM:
- ING

Site Location



Surveyed by : MSL		Date:	MAY 2020
Drawn by : CE		Date:	MAY 2020
Checked by : BK		Date:	26.05.20

Revisions

No.	Date	Description
0	26.05.20	First Drawing

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Kildare Cork Belfast London

Client :	AECOM
Project :	MSL34881 N63 - Abbeyknockmoy
Date : 26.05.20	Scale : AS SHOWN
Description :	CROSS SECTIONS
Drawing Number :	MSL34881_R2_XS_01

Drawing Number	Drawing Title
N63-ACM-PH03-0500-DR-DR-0550	Surveyed Cross Sections; Sheet 1 of 3
N63-ACM-PH03-0500-DR-DR-0551	Surveyed Cross Sections; Sheet 2 of 3
N63-ACM-PH03-0500-DR-DR-0552	Surveyed Cross Sections; Sheet 3 of 3
N63-ACM-PH03-0500-DR-DR-0555	Baseline Flood Extents; 1% AEP
N63-ACM-PH03-0500-DR-DR-0556	Baseline Flood Extents; 1% AEP; Manning's 'n' +20%
N63-ACM-PH03-0500-DR-DR-0557	Baseline Flood Extents; 1%+CC AEP (MRFS)
N63-ACM-PH03-0500-DR-DR-0558	Baseline Flood Extents; 0.1% AEP
N63-ACM-PH03-0500-DR-DR-0560	Proposed, No Mitigation Flood Extents; 1% AEP
N63-ACM-PH03-0500-DR-DR-0561	Proposed, No Mitigation Flood Extents; 1%+CC AEP (MRFS)
N63-ACM-PH03-0500-DR-DR-0562	Proposed, No Mitigation Flood Extents; 1% AEP
N63-ACM-PH03-0500-DR-DR-0563	Depth Difference, Baseline - Proposed No Mitigation; 1% AEP
N63-ACM-PH03-0500-DR-DR-0565	Proposed, Mitigation Flood Extents; 1% AEP
N63-ACM-PH03-0500-DR-DR-0566	Proposed, Mitigation Flood Extents; 1%+CC AEP (MRFS)
N63-ACM-PH03-0500-DR-DR-0567	Proposed, Mitigation Flood Extents; 1% AEP
N63-ACM-PH03-0500-DR-DR-0568	Depth Difference, Baseline - Proposed Mitigation; 1% AEP
MSL34881_R1_LS_1	River Reach 1 - Long Section
MSL34881_R1_XS_01	River Reach 1 - Cross Sections - Sheet 1 of 6
MSL34881_R1_XS_02	River Reach 1 - Cross Sections - Sheet 2 of 6
MSL34881_R1_XS_03	River Reach 1 - Cross Sections - Sheet 3 of 6
MSL34881_R1_XS_04	River Reach 1 - Cross Sections - Sheet 4 of 6
MSL34881_R1_XS_05	River Reach 1 - Cross Sections - Sheet 5 of 6
MSL34881_R1_XS_06	River Reach 1 - Cross Sections - Sheet 6 of 6
MSL34881_R2_LS_1	River Reach 2 - Long Section
MSL34881_R2_XS_01	River Reach 2 - Cross Sections

Appendix C Model Results

Cross Section Reference	Baseline; 1% AEP Flood Level (mAOD)	Manning's 'n' +20%; 1% AEP Flood Level (mAOD)	Difference, Manning's 'n' - Baseline; 1% AEP (mm)	Baseline; 1%+CC AEP Flood Level (mAOD)	Difference, 1%+CC AEP - 1% AEP (mm)	Baseline; 0.1% AEP Flood Level (mAOD)	Difference, 0.1% AEP - 1% AEP (mm)	Cross Section Reference	No Mitigation; 1% AEP Flood Level (mAOD)	Difference, No Mitigation - Baseline; 1% AEP (mm)	No Mitigation; 1%+CC AEP Flood Level (mAOD)	Difference, No Mitigation - Baseline; 1%+CC AEP (mm)	No Mitigation; 0.1% AEP Flood Level (mAOD)	Difference, No Mitigation - Baseline; 0.1% AEP (mm)	Cross Section Reference	Mitigation; 1% AEP Flood Level (mAOD)	Difference, Mitigation - Baseline; 1% AEP (mm)	Difference, Mitigation - No Mitigation; 1% AEP (mm)	Mitigation; 1%+CC AEP Flood Level (mAOD)	Difference, Mitigation - Baseline; 1%+CC AEP (mm)	Difference, Mitigation - No Mitigation; 1%+CC AEP (mm)	Mitigation; 0.1% AEP Flood Level (mAOD)	Difference, Mitigation - Baseline; 0.1% AEP (mm)	Difference, Mitigation - No Mitigation; 0.1% AEP (mm)
R1.00023	35.744	35.750	6	35.915	171	35.981	237	R1.00023	35.741	-3	35.913	-1	35.975	-6	R1.00023	35.745	1	4	35.909	-5	-4	35.978	-3	3
R1.00040	36.224	36.313	89	36.343	119	36.395	171	R1.00040	36.214	-9	36.336	-7	36.385	-10	R1.00040	36.217	-7	3	36.333	-10	-3	36.388	-8	3
R1.00136	36.746	36.881	135	36.859	113	36.907	161	R1.00136	36.740	-6	36.855	-5	36.900	-7	R1.00136	36.745	-1	5	36.854	-5	0	36.905	-3	5
R1.00137	37.005	37.116	110	37.105	100	37.151	146	R1.00137	37.001	-4	37.102	-3	37.145	-6	R1.00137	37.004	-1	3	37.100	-5	-1	37.148	-3	3
R1.00139_1	38.526	38.504	-22	38.579	53	38.603	77	R1.00139_1	38.526	0	38.580	1	38.602	-1	R1.00139_1	38.526	0	-1	38.576	-3	-4	38.600	-3	-2
R1.00139_2	38.513	38.493	-20	38.563	50	38.586	73	R1.00139_2	38.513	0	38.564	1	38.585	-1	R1.00139_2	38.513	0	0	38.560	-3	-4	38.583	-3	-2
R1.00140	38.471	38.459	-12	38.512	41	38.531	60	R1.00140	38.472	1	38.512	0	38.529	-2	R1.00140	38.471	0	-1	38.508	-4	-4	38.527	-4	-2
R1.00190	38.506	38.517	10	38.553	47	38.576	69	R1.00190	38.507	0	38.554	1	38.574	-2	R1.00190	38.506	-1	-1	38.550	-3	-4	38.573	-3	-2
R1.00240	38.619	38.646	27	38.689	70	38.722	102	R1.00240	38.620	1	38.693	4	38.723	2	R1.00240	38.618	-1	-2	38.687	-2	-6	38.720	-1	-3
R1.00290	38.693	38.729	36	38.772	79	38.810	116	R1.00290	38.695	1	38.777	5	38.812	2	R1.00290	38.693	-1	-2	38.770	-2	-7	38.808	-1	-3
R1.00340	38.729	38.771	43	38.811	82	38.849	120	R1.00340	38.729	1	38.815	4	38.850	1	R1.00340	38.729	0	-1	38.809	-2	-6	38.848	-1	-2
R1.00390	38.780	38.826	46	38.862	82	38.899	119	R1.00390	38.780	0	38.864	3	38.898	-1	R1.00390	38.780	0	0	38.859	-3	-6	38.896	-3	-2
R1.00440	38.815	38.860	45	38.893	77	38.929	114	R1.00440	38.814	-2	38.895	2	38.926	-3	R1.00440	38.815	-1	1	38.889	-3	-5	38.927	-2	1
R1.00490	38.838	38.884	47	38.910	72	38.949	111	R1.00490	38.835	-3	38.911	1	38.943	-6	R1.00490	38.837	-1	2	38.908	-2	-3	38.945	-4	2
R1.00540	38.871	38.921	50	38.944	73	38.983	112	R1.00540	38.869	-1	38.947	3	38.978	-5	R1.00540	38.870	-1	1	38.943	-1	-4	38.980	-3	2
R1.00590	38.915	38.969	54	38.992	76	39.029	113	R1.00590	38.918	3	38.999	7	39.031	2	R1.00590	38.917	2	-1	38.994	3	-4	39.031	2	-1
R1.00640	38.938	39.001	64	39.011	73	39.047	110	R1.00640	38.936	-1	39.014	3	39.046	-2	R1.00640	38.938	1	2	39.012	1	-2	39.047	0	1
R1.00690	39.010	39.079	69	39.090	80	39.127	117	R1.00690	39.019	9	39.105	15	39.142	15	R1.00690	39.014	4	-4	39.093	3	-11	39.132	6	-9
R1.00740	39.105	39.181	75	39.190	85	39.227	121	R1.00740	39.124	19	39.225	35	39.264	38	R1.00740	39.114	8	-11	39.201	11	-24	39.241	15	-23
R1.00790	39.203	39.288	85	39.282	78	39.335	132	R1.00790	39.225	22	39.341	59	39.390	55	R1.00790	39.205	1	-20	39.302	20	-39	39.357	22	-33
R1.00840	39.291	39.385	94	39.390	99	39.441	150	R1.00840	39.325	34	39.456	67	39.511	70	R1.00840	39.304	13	-21	39.411	21	-46	39.467	26	-44
R1.00875	39.368	39.464	96	39.477	109	39.532	164	R1.00875	39.399	31	39.534	57	39.586	54	R1.00875	39.376	9	-22	39.486	10	-47	39.550	18	-36
R1.00890	39.402	39.498	96	39.515	113	39.568	166																	
								R1.00940_DS	39.483	N/A	39.660	N/A	39.731	N/A	R1.00940_DS	39.452	N/A	-31	39.597	N/A	-63	39.667	N/A	-64
								R1.00940_US	39.503	N/A	39.680	N/A	39.751	N/A	R1.00940_US	39.471	N/A	-32	39.617	N/A	-63	39.686	N/A	-65
R1.00940	39.487	39.583	96	39.606	119	39.659	172	R1.00940	39.524	37	39.697	91	39.766	108	R1.00940	39.491	5	-32	39.634	28	-63	39.702	43	-65
R1.00990	39.532	39.635	103	39.652	120	39.710	178	R1.00990	39.615	83	39.815	163	39.900	190	R1.00990	39.562	30	-53	39.719	67	-96	39.795	85	-105
R1.01040	39.603	39.714	112	39.738	135	39.799	196	R1.01040	39.682	79	39.892	154	39.978	179	R1.01040	39.635	33	-46	39.805	67	-87	39.885	86	-93
R1.01090	39.644	39.766	122	39.786	142	39.852	208	R1.01090	39.716	72	39.930	144	40.018	166	R1.01090	39.671	28	-44	39.843	57	-87	39.928	77	-89
R1.01140	39.731	39.847	116	39.867	136	39.930	199	R1.01140	39.787	56	39.985	118	40.074	144	R1.01140	39.755	24	-33	39.916	50	-69	39.995	65	-79
R1.01190	39.853	39.941	88	39.960	107	40.012	158	R1.01190	39.886	33	40.042	82	40.117	106	R1.01190	39.868	15	-17	39.991	31	-51	40.057	46	-60
R1.01240	39.946	40.022	76	40.040	94	40.085	139	R1.01240	39.966	20	40.097	57	40.162	77	R1.01240	39.955	9	-10	40.060	20	-36	40.117	32	-45
R1.01290	40.010	40.095	86	40.101	91	40.143	134	R1.01290	40.024	15	40.143	43	40.200	57	R1.01290	40.018	8	-7	40.115	14	-29	40.165	22	-35
R1.01340	40.103	40.197	95	40.204	102	40.249	146	R1.01340	40.114	12	40.232	28	40.285	36	R1.01340	40.108	5	-6	40.211	7	-22	40.261	12	-24
R1.01390	40.168	40.272	105	40.270	102	40.313	146	R1.01390	40.177	10	40.290	21	40.338	25	R1.01390	40.175	7	-3	40.276	6	-15	40.322	9	-16
R1.01440	40.338	40.456	118	40.454	116	40.503	165	R1.01440	40.343	5	40.467	12	40.515	12	R1.01440	40.340	2	-2	40.455	0	-12	40.507	4	-7
R1.01490	40.519	40.617	98	40.633	114	40.688	169	R1.01490	40.521	2	40.639	6	40.688	0	R1.01490	40.521	2	0	40.631	-2	-8	40.683	-5	-5
R1.01540	40.546	40.653	108	40.659	113	40.709	163	R1.01540	40.548	2	40.665	6	40.708	-1	R1.01540	40.547	1	-1	40.655	-3	-9	40.705	-4	-2
R1.01560_DS	40.684	40.727	43	40.805	121	40.874	190	R1.01560_DS	40.690	6	40.808	3	40.872	-2	R1.01560_DS	40.696	12	6	40.801	-4	-6	40.871	-3	-1
R1.01560_US	40.787	40.856	70	40.966	179	41.051	264	R1.01560_US	40.794	8	40.969	3	41.048	-3	R1.01560_US	40.791	5	-3	40.960	-6	-9	41.048	-3	-1
R1.01560	40.977	41.027	50	41.148	171	41.236	259	R1.01560	40.983	6	41.152	4	41.234	-3	R1.01560	40.980	3	-3	41.142	-6	-10	41.233	-4	-1
R1.01590	41.064	41.148	84	41.274	210	41.382	319	R1.01590	41.074	10	41.282	7	41.378	-4	R1.01590	41.068	4	-6	41.266	-8	-15	41.376	-7	-2
R1.01640	41.132	41.237	105	41.351	219	41.466	334	R1.01640	41.135	3	41.357	6	41.460	-6	R1.01640	41.132	0	-2	41.344	-7	-13	41.460	-6	0
R1.01690	41.229	41.347	118	41.438	209	41.555	326	R1.01690	41.234	5	41.443	5	41.545	-9	R1.01690	41.230	2	-4	41.428	-10	-15	41.545	-10	-1
R1.01740	41.300	41.409	110	41.485	186	41.589	290	R1.01740	41.296	-4	41.491	6	41.578	-11	R1.01740	41.296	-4	0	41.478	-8	-13	41.578	-11	0
R1.01790	41.391	41.512	121	41.544	153	41.657	267	R1.01790	41.376	-14	41.542	-2	41.634	-23	R1.01790	41.379	-12	3	41.516	-28	-26	41.638	-20	4
R1.01840	41.503	41.631	127	41.660	157	41.751	248	R1.01840	41.509	6	41.653	-7	41.732	-19	R1.01840	41.506	3	-3	41.621	-39	-32	41.749	-2	17
R1.01890	41.583	41.704	121	41.731	148	41.832	249	R1.01890	41.574	-9	41.730	-1	41.813	-18	R1.01890	41.594	11	20	41.682	-48	-48	41.831	0	18
R1.01940	41.658	41.784	126	41.797	139	41.874	215	R1.01940	41.646	-12	41.794	-3	41.853	-21	R1.01940	41.646	-13	-1	41.766	-31	-28	41.870	-4	17
R1.01990	41.763	41.860	97	41.907	144	41.974	211	R1.01990	41.757	-6	41.906	-2	41.961	-13	R1.01990	41.767	4	10	41.886	-21	-19	41.975	1	14
R1.02040	41.759	41.874	115	41.884	126	41.946	188	R1.02040	41.746	-13	41.881	-3	41.944	-3	R1.02040	41.745	-14	-1	41.862	-23	-20	41.945	-2	1
R1.02090	41.856	41.978	122	41.993	136	42.051	195	R1.02090	41.850	-7	41.990	-3	42.043	-8	R1.02090	41.850	-6	0	41.974	-19	-16	42.050	-1	6
R1.02140	42.001	42.129	128	42.136	135	42.188	187	R1.02140	41.994	-7	42.132	-4	42.179	-8	R1.02140	41.994	-6	1	42.118	-18	-14	42.185	-3	6
R1.02190	42.121	42.243	122	42.255	134	42.313	192	R1.02190	42.121	0	42.254	-1	42.304	-9	R1.02190	42.127	6	6	42.245	-10	-9	42.314	1	11
R1.02240	42.247	42.382	135	42.384	137	42.442	195	R1.02240	42.244	-3	42.382	-2	42.438	-4	R1.02240	42.249	2	5	42.375	-9	-7	42.446	4	8
R1.02290	42.382	42.513	131	42.523	141	42.580	199	R1.02290	42.381	-1	42.524	1	42.584	3	R1.02290	42.379	-3	-2	42.518	-5	-6	42.584	4	0
R2.00010	36.372	36.350	-22	36.393	21	36.402	30	R2.00010	36.377	4	36.400	7	36.408	6	R2.00010	36.376	4	0	36.398	5	-2	36.408	6	-1
R2.00015	36.476	36.492	16	36.495	19	36.503	27	R2.00015	36.480	4	36.501	6	36.509	6	R2.00015	36.480	3	0	36.499	4	-2	36.508	5	-1
R2.00020	37.935	37.871	-64	38.015	80	38.052	117	R2.00020	37.939	4	38.027	12	38.064	12	R2.00020	37.938	3	-1	38.020	5	-7	38.060	8	-4
R2.00032	37.814	37.777	-36	37.876	63	37.905	91	R2.00032	37.817	3	37.886	10	37.915	10	R2.00032	37.816	3	0	37.881	5	-6	37.911	7	-3
R2.00040	38.595	38.528	-67	38.683	88	38.725	130	R2.00040	38.598	3	38.696	12	38.736	12	R2.00040	38.597	3	-1	38.688	4	-8	38.732	7	-5
R2.00055	38.526	38.504	-22	38.579	53	38.603	77	R2.00055	38.526	0	38.580	1	38.602	-1	R2.00055	38.526	0	-1	38.576	-3	-4	38.600	-3	-2

Reference Point ID	Baseline; 1% AEP Flood Level (mAOD)	Manning's 'n' +20%; 1% AEP Flood Level (mAOD)	Difference, Manning's 'n' - Baseline; 1% AEP (mm)	Baseline; 1%+CC AEP Flood Level (mAOD)	Difference, 1%+CC AEP - 1% AEP (mm)	Baseline; 0.1% AEP Flood Level (mAOD)	Difference, 0.1% AEP - 1% AEP (mm)		Reference Point ID	No Mitigation; 1% AEP Flood Level (mAOD)	Difference, No Mitigation - Baseline; 1% AEP (mm)	No Mitigation; 1%+CC AEP Flood Level (mAOD)	Difference, No Mitigation - Baseline; 1%+CC AEP (mm)	No Mitigation; 0.1% AEP Flood Level (mAOD)	Difference, No Mitigation - Baseline; 0.1% AEP (mm)		Reference Point ID	Mitigation; 1% AEP Flood Level (mAOD)	Difference, Mitigation - Baseline; 1% AEP (mm)	Difference, Mitigation - No Mitigation; 1% AEP (mm)	Mitigation; 1%+CC AEP Flood Level (mAOD)	Difference, Mitigation - Baseline; 1%+CC AEP (mm)	Difference, Mitigation - No Mitigation; 1%+CC AEP (mm)	Mitigation; 0.1% AEP Flood Level (mAOD)	Difference, Mitigation - Baseline; 0.1% AEP (mm)	Difference, Mitigation - No Mitigation; 0.1% AEP (mm)
RP01	40.276	40.346	70	40.356	80	40.392	115		RP01	40.274	-2	40.362	6	40.399	8		RP01	40.272	-4	-2	40.349	-7	-13	40.386	-5	-13
RP02	39.966	40.045	78	40.056	90	40.098	131		RP02	39.981	14	40.106	49	40.167	69		RP02	39.976	10	-5	40.073	17	-32	40.126	28	-41
RP03	39.770	39.867	97	39.887	117	39.944	175		RP03	39.776	7	39.982	95	40.068	124		RP03	39.753	-17	-23	39.911	24	-70	39.993	49	-75
RP04	39.618	39.744	126	39.768	151	39.834	216		RP04	39.695	77	39.920	151	40.010	176		RP04	39.650	33	-45	39.832	63	-88	39.918	84	-93
RP05	39.391	39.481	90	39.501	109	39.546	155		RP05	39.560	169	39.764	264	39.855	309		RP05	39.399	8	-161	39.564	63	-201	39.642	96	-213
RP06	39.258	39.316	57	39.328	70	39.360	101		RP06	No Flood		No Flood		39.125	-234		RP06	39.139	-120	N/A	39.232	-96	N/A	39.266	-93	141
RP07	38.908	38.965	58	38.985	77	39.019	112		RP07	38.892	-16	38.965	-20	38.996	-24		RP07	38.905	-3	13	38.977	-7	13	39.012	-7	16
RP08	38.928	38.989	62	39.007	79	39.043	115		RP08	38.872	-56	38.958	-49	38.992	-51		RP08	38.942	14	70	39.006	-1	48	39.038	-4	46
RP09	38.817	38.871	54	38.900	83	38.936	119		RP09	38.807	-9	38.886	-13	38.919	-17		RP09	38.812	-4	5	38.890	-10	3	38.927	-9	7

Appendix A10:

Air Quality

Appendix A10-1

Air Quality Sensitivity Test

AECOM Imagine it. Delivered.

N63 Liss to Abbey Realignment Scheme

Volume 4: Appendices
Chapter 10: Air Quality Sensitivity Test

Galway County Council

May 2021

Quality information

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1. Introduction

A local air quality assessment sensitivity test was undertaken to determine the effect of applying a higher verification factor of 2, to the modelled road pollutant concentrations. All other aspects of the assessment followed the methodology outlined in Chapter 10.

2. Results

2.1.1 Local Air Quality Assessment

The predicted annual mean concentrations of NO_2, PM_{10} and $PM_{2.5}$ at the selected sensitive receptors in the base year, opening year do-minimum (DM, without the Proposed Road Development) and opening year do-something (DS, with the Proposed Road Development) scenarios are listed in Table 2-1, Table 2-2 and Table 2-3. The tables also provide the predicted change in concentration at the modelled sensitive receptors, and the significance descriptor of the impact as determined by the IAQM guidance.

Table 2-1 Modelled Annual Mean NO_2 Concentrations in µg/m^3 at Sensitive Receptors

ID	Base	DM	DS	DS concentration as a percentage of the EULV	Change	% Change in Concentration Relative to the EULV	Significance
R1	9.2	9.3	7.6	<75%	-1.7	-4.1%	Negligible
R2	6.3	6.2	5.9	<75%	-0.3	-0.7%	Negligible
R3	10.2	10.3	7.1	<75%	-3.3	-8.1%	Slight Positive
R4*	5.0	5.0	5.3	<75%	+0.3	+0.8%	Negligible
R5	5.9	5.8	5.8	<75%	+<0.1	+<0.1%	Negligible

*LTT gap analysis has not been applied to this (non-roadside) receptor

Table 2-2 Modelled Annual Mean PM_{10} Concentrations in µg/m^3 at Sensitive Receptors

ID	Base	DM	DS	DS concentration as a percentage of the EULV	Change	% Change in Concentration Relative to the EULV	Significance
R1	11.8	11.8	11.5	<75%	-0.4	-0.9%	Negligible
R2	11.2	11.3	11.2	<75%	-0.1	-0.2%	Negligible
R3	11.9	11.9	11.3	<75%	-0.6	-1.5%	Negligible
R4	11.0	11.0	11.1	<75%	+0.1	+0.2%	Negligible
R5	11.2	11.2	11.2	<75%	+<0.1	+<0.1%	Negligible

The PM_{10} daily limit value is not predicted to be exceeded at any receptor in any scenario.

Table 2-3 Modelled Annual Mean $PM_{2.5}$ Concentrations in µg/m³ at Sensitive Receptors

ID	Base	DM	DS	DS concentration as a percentage of the EULV	Change	% Change in Concentration Relative to the EULV	Significance
R1	4.7	4.8	4.4	<75%	-0.3	-1.3%	Negligible
R2	4.2	4.2	4.2	<75%	-0.1	-0.2%	Negligible
R3	4.8	4.8	4.3	<75%	-0.5	-2.2%	Negligible
R4	4.0	4.0	4.1	<75%	+0.1	+0.3%	Negligible
R5	4.2	4.2	4.2	<75%	+<0.1	+<0.1%	Negligible

The absolute concentrations and changes are larger than in the main assessment. The absolute concentrations are higher by up to 2.7 µg/m³ for NO_2 (DM), by up to 0.5 µg/m³ for PM_{10} (DM) and by up to 0.4 µg/m³ for $PM_{2.5}$ (DM), but concentrations are still well below relevant EULVs. The effect is still negligible for each receptor, apart from R3, which for NO_2 becomes a slight positive effect. However, the concentration at this receptor is well below under the EULV (DM concentration of 10.3 µg/m³ is 26% of the EULV) that overall the effect is still **negligible** and **not significant**.

2.1.2 Designated Sites Assessment

The sensitivity test was also applied to the designated sites assessment. The predicted annual mean concentrations of NO_X and nitrogen deposition rates at the selected sensitive receptors in the base year, opening year do-minimum (DM) and opening year do-something (DS) scenarios are listed in Table 2-4 and Table 2-5. The tables also provide the predicted changes in concentration/deposition rates at the modelled receptors.

Table 2-4 Modelled annual mean NO_X concentrations in µg/m³ at sensitive receptors

ID	Distance from road (m)	Base	DM	DS	Change
E1	26 (site edge)	9.4	9.3	9.9	+0.6
E1	30	9.3	9.2	9.7	+0.5
E1	40	9.1	8.9	9.3	+0.3
E1	50	8.9	8.8	9.0	+0.2
E1	60	8.8	8.6	8.8	+0.2
E1	70	8.7	8.5	8.6	+0.1
E1	80	8.6	8.4	8.5	+0.1
E1	90	8.5	8.3	8.4	+0.1
E1	100	8.4	8.2	8.3	+0.1
E1	110	8.4	8.2	8.2	+0.1

ID	Distance from road (m)	Base	DM	DS	Change
E1	120	8.3	8.1	8.2	+0.1
E1	130	8.3	8.1	8.1	+<0.1
E1	140	8.2	8.1	8.1	+<0.1
E1	150	8.2	8.0	8.1	+<0.1
E1	160	8.2	8.0	8.0	+<0.1
E1	170	8.1	8.0	8.0	+<0.1
E1	180	8.1	8.0	8.0	+<0.1
E1	190	8.1	7.9	8.0	+<0.1
E1	200	8.1	7.9	7.9	+<0.1
E2	6 (road edge)	7.6	7.6	13.5	+5.9
E2	10	7.6	7.6	11.5	+3.9
E2	20	7.6	7.6	9.5	+1.9
E2	30	7.6	7.6	8.9	+1.3
E2	40	7.6	7.6	8.6	+1.0
E2	50	7.6	7.6	8.5	+0.9
E2	60	7.6	7.6	8.3	+0.7
E2	70	7.6	7.6	8.3	+0.7
E2	80	7.6	7.6	8.2	+0.6
E2	90	7.6	7.6	8.1	+0.5
E2	100	7.6	7.6	8.1	+0.5
E2	110	7.6	7.6	8.0	+0.4
E2	120	7.6	7.6	8.0	+0.4
E2	130	7.6	7.6	8.0	+0.4
E2	140	7.6	7.6	7.9	+0.3
E2	150	7.6	7.6	7.9	+0.3
E2	160	7.6	7.6	7.9	+0.3
E2	170	7.6	7.6	7.9	+0.3

ID	Distance from road (m)	Base	DM	DS	Change
E2	180	7.6	7.6	7.9	+0.3
E2	190	7.6	7.6	7.8	+0.2
E2	200	7.6	7.6	7.8	+0.2
E3	3 (road edge)	20.6	21.3	10.6	-10.7
E3	10	13.9	14.1	9.3	-4.8
E3	20	11.2	11.2	8.6	-2.5
E3	30	10.2	10.1	8.3	-1.8
E3	40	9.7	9.6	8.1	-1.4
E3	50	9.3	9.2	8.0	-1.2
E3	60	9.1	9.0	8.0	-1.0
E3	70	9.0	8.8	7.9	-0.9
E3	80	8.8	8.6	7.8	-0.8
E3	90	8.7	8.5	7.8	-0.7
E3	100	8.6	8.4	7.8	-0.6
E3	110	8.5	8.3	7.7	-0.6
E3	120	8.4	8.2	7.7	-0.5
E3	130	8.4	8.1	7.6	-0.5
E3	140	8.3	8.1	7.6	-0.5
E3	150	8.3	8.1	7.6	-0.4
E3	160	8.2	8.0	7.6	-0.4
E3	170	8.2	8.0	7.6	-0.4
E3	180	8.1	8.0	7.6	-0.4
E3	190	8.1	8.0	7.6	-0.3
E3	200	8.1	7.9	7.6	-0.3
E4	12 (site edge)	12.6	12.7	12.7	+<0.1
E4	20	10.6	10.6	10.6	+<0.1
E4	30	9.7	9.6	9.6	+<0.1

ID	Distance from road (m)	Base	DM	DS	Change
E4	40	9.3	9.1	9.1	+<0.1
E4	50	9.0	8.8	8.8	+<0.1

Note: At transect points 50 m and closer to the road, LTT has been applied. At transect points > 50 m from the road, LTT has not been applied.

In all cases the absolute concentration of NO_X is predicted to remain well below the limit value of 30 µg/m^3. Additionally, while there is an increase in concentration of NO_X of >2 µg/m^3 at the nearest point of the transect E2 (6 m and 10 m) to the road, the maximum total NO_X concentration predicted in the DS scenario at this location is 13.5 µg/m^3, which is 45% of the limit value, well under the 90% which would trigger an assessment of significance. Therefore, the effects of the NO_X concentration impacts are considered **negligible** and **not significant** overall.

Table 2-5 Modelled Nitrogen Deposition Rates in kg N/ha/yr at Sensitive Receptors

ID	Distance from road (m)	Base	DM	DS	Change	% Change relative to the low end of critical load range
E1	26 (site edge)	12.1	12.1	12.2	+0.1	+0.3%
E1	30	12.1	12.1	12.2	+<0.1	+0.3%
E1	40	12.1	12.1	12.1	+<0.1	+0.2%
E1	50	12.1	12.1	12.1	+<0.1	+0.1%
E1	60	12.1	12.1	12.1	+<0.1	+0.1%
E1	70	12.1	12.1	12.1	+<0.1	+0.1%
E1	80	12.1	12.1	12.1	+<0.1	+0.1%
E1	90	12.1	12.1	12.1	+<0.1	+<0.1%
E1	100	12.1	12.0	12.1	+<0.1	+<0.1%
E1	110	12.1	12.0	12.0	+<0.1	+<0.1%
E1	120	12.1	12.0	12.0	+<0.1	+<0.1%
E1	130	12.1	12.0	12.0	+<0.1	+<0.1%
E1	140	12.1	12.0	12.0	+<0.1	+<0.1%
E1	150	12.0	12.0	12.0	+<0.1	+<0.1%
E1	160	12.0	12.0	12.0	+<0.1	+<0.1%
E1	170	12.0	12.0	12.0	+<0.1	+<0.1%
E1	180	12.0	12.0	12.0	+<0.1	+<0.1%
E1	190	12.0	12.0	12.0	+<0.1	+<0.1%

ID	Distance from road (m)	Base	DM	DS	Change	% Change relative to the low end of critical load range
E1	200	12.0	12.0	12.0	+<0.1	+<0.1%
E2	6 (road edge)	**12.0**	**12.0**	**12.5**	+0.5	+9.2%
E2	10	**12.0**	**12.0**	**12.3**	+0.3	+6.1%
E2	20	**12.0**	**12.0**	**12.1**	+0.1	+3.0%
E2	30	**12.0**	**12.0**	**12.1**	+0.1	+2.1%
E2	40	**12.0**	**12.0**	**12.1**	+0.1	+1.7%
E2	50	**12.0**	**12.0**	**12.1**	+0.1	+1.4%
E2	60	**12.0**	**12.0**	**12.1**	+0.1	+1.2%
E2	70	**12.0**	**12.0**	**12.1**	+0.1	+1.1%
E2	80	**12.0**	**12.0**	**12.0**	+<0.1	+1.0%
E2	90	**12.0**	**12.0**	**12.0**	+<0.1	+0.8%
E2	100	**12.0**	**12.0**	**12.0**	+<0.1	+0.8%
E2	110	**12.0**	**12.0**	**12.0**	+<0.1	+0.7%
E2	120	**12.0**	**12.0**	**12.0**	+<0.1	+0.6%
E2	130	**12.0**	**12.0**	**12.0**	+<0.1	+0.6%
E2	140	**12.0**	**12.0**	**12.0**	+<0.1	+0.5%
E2	150	**12.0**	**12.0**	**12.0**	+<0.1	+0.5%
E2	160	**12.0**	**12.0**	**12.0**	+<0.1	+0.5%
E2	170	**12.0**	**12.0**	**12.0**	+<0.1	+0.4%
E2	180	**12.0**	**12.0**	**12.0**	+<0.1	+0.4%
E2	190	**12.0**	**12.0**	**12.0**	+<0.1	+0.4%
E2	200	**12.0**	**12.0**	**12.0**	+<0.1	+0.4%
E3	3 (road edge)	**13.0**	**13.1**	**12.2**	-0.8	-16.2%
E3	10	**12.5**	**12.5**	**12.1**	-0.4	-7.3%
E3	20	**12.3**	**12.3**	**12.1**	-0.2	-4.0%
E3	30	**12.2**	**12.2**	**12.1**	-0.1	-2.8%

ID	Distance from road (m)	Base	DM	DS	Change	% Change relative to the low end of critical load range
E3	40	**12.2**	**12.2**	**12.0**	-0.1	-2.2%
E3	50	**12.1**	**12.1**	**12.0**	-0.1	-1.9%
E3	60	**12.1**	**12.1**	**12.0**	-0.1	-1.6%
E3	70	**12.1**	**12.1**	**12.0**	-0.1	-1.4%
E3	80	**12.1**	**12.1**	**12.0**	-0.1	-1.3%
E3	90	**12.1**	**12.1**	**12.0**	-0.1	-1.1%
E3	100	**12.1**	**12.1**	**12.0**	-0.1	-1.0%
E3	110	**12.1**	**12.1**	**12.0**	-<0.1	-0.9%
E3	120	**12.1**	**12.0**	**12.0**	-<0.1	-0.8%
E3	130	**12.1**	**12.0**	**12.0**	-<0.1	-0.8%
E3	140	**12.1**	**12.0**	**12.0**	-<0.1	-0.7%
E3	150	**12.1**	**12.0**	**12.0**	-<0.1	-0.7%
E3	160	**12.0**	**12.0**	**12.0**	-<0.1	-0.6%
E3	170	**12.0**	**12.0**	**12.0**	-<0.1	-0.6%
E3	180	**12.0**	**12.0**	**12.0**	-<0.1	-0.6%
E3	190	**12.0**	**12.0**	**12.0**	-<0.1	-0.5%
E3	200	**12.0**	**12.0**	**12.0**	-<0.1	-0.5%
E4	12	**12.8**	**12.8**	**12.8**	+<0.1	+<0.1%
E4	20	**12.5**	**12.5**	**12.5**	+<0.1	+<0.1%
E4	30	**12.3**	**12.3**	**12.3**	+<0.1	+<0.1%
E4	40	**12.3**	**12.2**	**12.2**	+<0.1	+<0.1%
E4	50	**12.2**	**12.2**	**12.2**	+<0.1	+<0.1%

Note: At transect points 50 m and closer to the road, LTT has been applied. At transect points > 50 m from the road, LTT has not been applied. At E4, the designated habitat does not extend beyond 50 m from the road. Nitrogen deposition rates in **bold** exceed the relevant critical load (low end of the critical load range).

Transects 1 is predicted to remain under its critical load with the Proposed Road Development operational. Transects 2, 3 and 4 are predicted to be above their respective critical loads both with and without the Proposed Road Development operational, as was the case in the main assessment. The project ecologist has been consulted regarding the significance of the effect, which has been found to be **negligible** and **not significant** overall.

3. Conclusion

The outcome of the sensitivity test is that the use of a factor of 2 does not materially affect the outcome of the local air quality assessment and the local air quality effects on human and ecological receptors remains **not significant** overall.