

# A1 Birtley to Coal House

## Scheme Number: TR010031

### Applicant's Response to ExA's Second Written Questions - Appendix 2.0M - Structure Options Report 10 - Retaining Wall Structures

Planning Act 2008

Rule 8(1)(b)

Infrastructure Planning (Examination Procedure Rules) 2010



Infrastructure Planning

Planning Act 2008

**The Infrastructure Planning  
(Examination Procedure Rules)  
2010**

A1 Birtley to Coal House  
Development Consent Order 20[xx]

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Questions - Appendix 2.0M - Structure Options  
Report 10 - Retaining Wall Structures**

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<b>Rule number:</b>	Rule 8(1)(b)
<b>Planning Inspectorate Scheme Reference</b>	TR010031
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<b>Author:</b>	A1 Birtley to Coal House Project Team, Highways England

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Rev 0	20 April 2020	Application Issue

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# A1

## **Birtley to Coal House Improvement Scheme**

**Structure Option Report 10**

**Retaining Wall Structures**

# A1 BIRTLEY TO COAL HOUSE IMPROVEMENT SCHEME

## STRUCTURE OPTION REPORT 10 RETAINING WALL STRUCTURES

**Highways England**



**Date: April 2018**

Project No: HE PIN 551462  
WSP Ref: 70015226

Prepared for:

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Major Projects Project Manager	Nicola Wilkes
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## EXECUTIVE SUMMARY

WSP have been commissioned under the CDF contract to progress the Stage 3 Preliminary Design works to increase the capacity of the route between A1 Junction 65 (Birtley) and Junction 67 (Coal House). The scheme involves upgrading the existing Dual 2-Lane All-Purpose provision to a Dual 3-Lane All-Purpose Provision for this section of the road.

To accommodate the improvements to the A1 highway alignment, 10No. new retaining wall structures shall be required. 6No. retaining walls (referenced RW 1-6) are required along the mainline, and 4No. retaining walls are required within the central reserve (reference CRW1-4) to accommodate the level difference between the northbound and southbound carriageway.

This Structures Options Report has been prepared to assess the constraints/challenges associated with the construction of the new earth retaining structures.

The following assumptions/constraints, have been considered when assessing the retaining wall options.

- Provision of cost effective/simple solutions
- Minimise land take to ensure this is as low as reasonably practical
- Minimise disruption to traffic on the mainline and ensure a minimum of 2No. running lanes in both directions can be maintained during the works
- Ensure disruption to local residents and business is as low as reasonably practical
- All services potentially impacting the works shall be protected or diverted accordingly
- VRS shall be provided at the top of retaining walls to prevent errant vehicles from falling
- Retaining walls directly adjacent to a traffic face shall be provided with a smooth face (clad or otherwise) in accordance with the requirements of TD19/06 irrespective of a safety barrier provision
- Where practical retaining walls less than 1.5m retaining height shall be considered to be contractor designed elements
- The gradient to embankment is currently based on the provision of 1:3 slopes. At this stage 1:3 slopes are acceptable where class 2 cohesive material is to be placed, but can increase the gradient of the slope to 1 in 2.5 where a granular material is imported and placed. Slopes of 1:3 have been used to reduce the retained height where possible. The maximum permitted gradient of embankment slopes shall be reviewed upon further detailed geotechnical investigation and analysis

Various retaining wall options (Sheet Piled/Contiguous Bored Piled/RC Cantilever/King Post Wall/RE Wall) have been assessed and compared to provide retention of ground along the mainline.

The limited retained height within the central reserve (min 0.3m/Max 1.0m), due to the level differences between the northbound and southbound carriageway, limits the options to either Option 1 – Wide Variable Concrete Step Barrier or Option 2 RC Ground Beam.

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Based on the study to date, it is recommended the following retaining wall options be reviewed and developed further during the detailed design phase of the scheme.

REFERENCE	CHAINAGE ON MAINLINE	LOCATION	APPROX LENGTH (M)	MIN RETAINED HT (M)	MAX RETAINED HT(M)	AVERAGE RETAINED HT (M)	OPTIMUM SOLUTION
RW 1	0+340 TO 0+560	MAINLINE/ A1 SOUTHBOUND	220	1.50	2.50	2.00	RC WALL/COST £550K
RW2	0+325 TO 0+420	MAINLINE/ A1 NORTHBOUND	100	0.30	1.70	1.00	SHEET PILED WALL/COST £300K
RW3	0+650 TO 0+796	MAINLINE/ A1 NORTHBOUND ADJACENT TO THE ON SLIP J67	146	1.50	6.00	3.25	REINFORCED EARTH WALL/COST £750K
RW4	0+940 TO 1+060	MAINLINE/ A1 NORTHBOUND ADJACENT TO THE OFF SLIP J67	125	1.50	4.30	2.80	REINFORCED EARTH WALL/COST £350K
RW5	0+940 TO 1+060	MAINLINE/ A1 SOUTHBOUND ADJACENT TO THE ONSLIP J67	120	1.50	3.00	2.25	CONTIGUOUS BORED PILES/COST £450K
RW6	4+140 TO 4+400	MAINLINE/ A1 SOUTHBOUND ADJACENT TO THE OFFSLIP J65	260	1.50	2.50	2.00	KINGPOST WALL/ COST £500K
CRW1	0+515 TO 0+615	CENTRAL RESERVE	100	0.30	0.36	-	TBC-SEE BELOW*
CRW2	1+950 TO 2+220	CENTRAL RESERVE	270	0.30	1.00	-	TBC-SEE BELOW*
CRW3	2+420 TO 2+705	CENTRAL RESERVE	285	0.30	0.50	-	TBC-SEE BELOW*
CRW4	3+270 TO 3+690	CENTRAL RESERVE	420	0.30	0.80	-	TBC-SEE BELOW*
	<p>* Due to the limited retained height and simplicity of the options, it is considered that either option will be classified as a CAT0 structure in accordance with BD2/12 Technical Approval of Highway Structures (no AIP required) and will be classified as low risk construction work that can be readily accommodated as part of the scheme improvement works. Further review, taking into considering the carriageway/VRS design and construction interface to determine the preferred option (1 or 2) to sustain the level difference in the central reserve.</p>						

The following should be undertaken to verify the finding of this report and clarify works to be developed at detailed design stage;

- Further site investigation to determine the location of services and the impact they may have on the retaining wall works.
- Review of the carriageway/VRS design and construction to confirm the retaining solution best suited within the central reserve. Although it is noted due to the retained height this work is not anticipated to be onerous.

# 1. INTRODUCTION

## 1.1 PROJECT BACKGROUND

1.1.1 WSP have been commissioned by Highways England to develop the preliminary design for the A1 Birtley to Coal House scheme.

1.1.2 The scheme forms part of the Newcastle Gateshead Western Bypass (NGWB) which is located on the A1 between J65 (Birtley) and J80 (Seaton Burn). It is a part of the Highways England's strategic road network serving the metropolitan area of Tyne and Wear.

1.1.3 This project is located between J65 (Birtley) and J67 (Coal House) on the NGWB and is approximately 4.2km in length. The existing carriageways comprise:

- Southbound: Two lanes between Coal House and Eighton Lodge with an additional climbing lane between Smithy Lane and Eighton Lodge and three lanes between Eighton Lodge and Birtley; and
- Northbound: Two lanes with a lane gain/lane drop between Birtley and Eighton Lodge and two lanes between Eighton Lodge and Coal House.

1.1.4 The A1 NGWB is one of the most congested highway links in the North-East Region with more than 110,000 vehicles using the route every day on the busiest section. As a result of this travel demand on the route there are a number of issues relating to: journey time delays; journey time reliability; route resilience; safety; environmental impacts and development pressures.

1.1.5 Improvements to the A1 NGWB have long been acknowledged as a requirement for economic growth in the region within both local and national policy documents and reflected in the consensus of opinion amongst regional stakeholders that something needs to be done to address the issues to facilitate the economic growth of the region. The route has been identified as a 'hot-spot' requiring Government investment to deliver infrastructure improvements.

1.1.6 Traffic in the region is forecast to grow in the future, largely due to a number of proposed development sites to be delivered through the Newcastle Approved Plan. This additional traffic demand will further exacerbate the issues on the A1 NGWB with traffic modelling work indicating the likely extent of the impacts.

1.1.7 In an attempt to fully understand and address the issues a number of studies have been undertaken in recent years and these include:

- TAMMS Multi Modal Study (2002);
- Access to Tyne and Wear DaSTS study (2010);
- North East DaSTS Strategic Connectivity Study Report (2010);
- Newcastle City Deal (2012);
- HA Pilot Based Strategy Report (2013);
- A1 Newcastle and Gateshead Western Bypass – Exploration of Dual 3-Lane Provisions Initial Infrastructure Report (2013);

- DRAFT Route-based strategy: Evidence Report London to Scotland East (February 2014);
- The Gateshead and Newcastle Council Core Strategy & Urban Core AAP Draft Infrastructure Delivery Plan has also been used, as well as the Appraisal Specification Report (ASR) for this feasibility study; and
- A1 Newcastle/Gateshead Western Bypass Feasibility Study (2014).

- 1.1.8 The Feasibility Study undertaken in 2014 followed Steps 1 to 10 of the Transport Appraisal Process (TAP) from the Transport Appraisal Guidance (TAG). Stage 1 of the Feasibility Study (Steps 1 to 4 of the TAP) included a comprehensive review of all of the previous studies outlined above to determine the existing issues on the route and prioritise the sections which most urgently needed attention.
- 1.1.9 Following the prioritisation of sections, Stage 2 (Steps 5 to 9 of the TAP) looked at developing interventions to address the issues highlighted in Stage 1. Interventions were processed through the Early Appraisal Sifting Tool (EAST) and the best performing interventions were put forward through the Options Appraisal Process and scheme cost estimates were produced by the Highways England Commercial Team.
- 1.1.10 At Stage 3 of the process (Step 10), a Strategic Outline Business Case (SOBC) was produced for the options which performed well at the Options Assessment Stage.
- 1.1.11 Stages 1 & 2 of the Feasibility Study identified the following sections of the route which should be given priority:
- J65 – J67 A1 Birtley to Coal House (including Allerdene Railway Bridge);
  - J71 – J73 A1 Metrocentre to Derwenthaugh; and
  - J74 – J79 A1 Scotswood to North Brunton.
- At Stage 3, SOBC's were produced for the following schemes:
- J65 – J67 A1 Birtley to Coal House (including Allerdene Railway Bridge); and
  - J74 – J79 A1 Scotswood to North Brunton.
- 1.1.12 Both schemes were announced in the Autumn Statement in December 2014 as schemes that should be taken forward into the Roads Investment Strategy (RIS).
- 1.1.13 The completion of the Feasibility Study concluded PCF Stage 0 (Strategy, Shaping and Prioritisation) for both schemes.
- 1.1.14 The A1 Birtley to Coal House scheme concluded PCF Stage 1 (Option Identification) in April 2016 and two options were considered at PCF Stage 2 (Option Selection). PCF Stage 2 (Option Selection) concluded in the July 2017 that "Option 1a with the offline replacement of Allerdene Bridge should be the recommended route" [2].

## 1.2 PREFERRED ROUTE

- 1.2.1 Between J65 (Birtley) and J66 (Eighton Lodge), the carriageway is to be widened mostly symmetrically on each side of the carriageway by 1 lane, resulting in 3 lanes plus lane gain/drop.
- 1.2.2 The existing speed limits of 50mph southbound from J67 (Coal House) to Smithy Lane overbridge, 70mph southbound from Smithy Lane to J65 (Birtley) and 50mph throughout the northbound carriageway will be retained. Demolition and reconstruction of North Dene footbridge will be required to accommodate the widening. At J66 (Eighton Lodge) there are 3 underbridges that will also require widening.
- 1.2.3 Allerdene Bridge will be replaced approximately 40m south of its current location, continuing to use the existing structure to maintain two lanes of traffic while the new bridge is constructed. Kingsway Viaduct will also be widened but no changes will be made to the Lamesley Roundabout at J67 (Coal House).

## 1.3 PRELIMINARY DESIGN

- 1.3.1 Following the development of the PCF Stage 2 (Option Selection) traffic model there was a requirement to amend the design to include 4 lanes southbound through J66 (Eighton Lodge). This design change is documented in detail in technical note *BTN05: TD 22/06 Mainline Lane Configuration - Final Assessment* (dated 8<sup>th</sup> May 2017) [3]. The current design requires asymmetrical widening whereby the southbound carriageway, is now;

North of J67 (Coal House) – 3 lanes;  
Through J67 (Coal House) – 3 lanes;  
Between J67 (Coal House) and J66 (Eighton Lodge) – 4 Lanes;  
Between J66 (Eighton Lodge) and J65 (Birtley) – 4 lanes; and  
South of J65 (Birtley) – 3 lanes.

- 1.3.2 The scheme is planned to go to public consultation in February 2018, subsequently the design shall be updated further to accommodate feedback. This design will go through the process of obtaining a Development Consent Order (DCO) with a planned start of work in late 2020.

## 1.4 REPORT OBJECTIVES

- 1.4.1 This Structures Options Report has been prepared to assess the constraints/challenges associated with the construction of the new earth retaining structures.
- 1.4.2 The report shall provide a recommendation for the retaining structure considered to be most feasible at each discrete location.
- 1.4.3 Upon confirmation and sign off, this report shall provide Highways England with sufficient information/justification for seeking approval/funding to progress the scheme within the next stage of development.

## 2. NEW RETAINING WALL LOCATIONS AND DESIGN CONSTRAINTS

### 2.1 HIGHWAY ALIGNMENT

- 2.1.1 Proposed improvements to the highway alignments shall comprise widening of the existing carriageway between J65 (Birtley) and J67 (Coal House) with a lane gain/lane drop between the junctions on both northbound and southbound carriageways.
- 2.1.2 In the vicinity of the Allerdene bridge works, the A1 is to be re-aligned to the south (Allerdene Bridge proposed new location) where the traffic is carried over the East Coast Mainline between J66 (Eighton Lodge) and J67 (Coal House) with the retention of both junctions.
- 2.1.3 The widening is generally proposed to be to the north of the existing A1 (from junction 65 to 66), with the retention of the existing edge of the northbound carriageway.

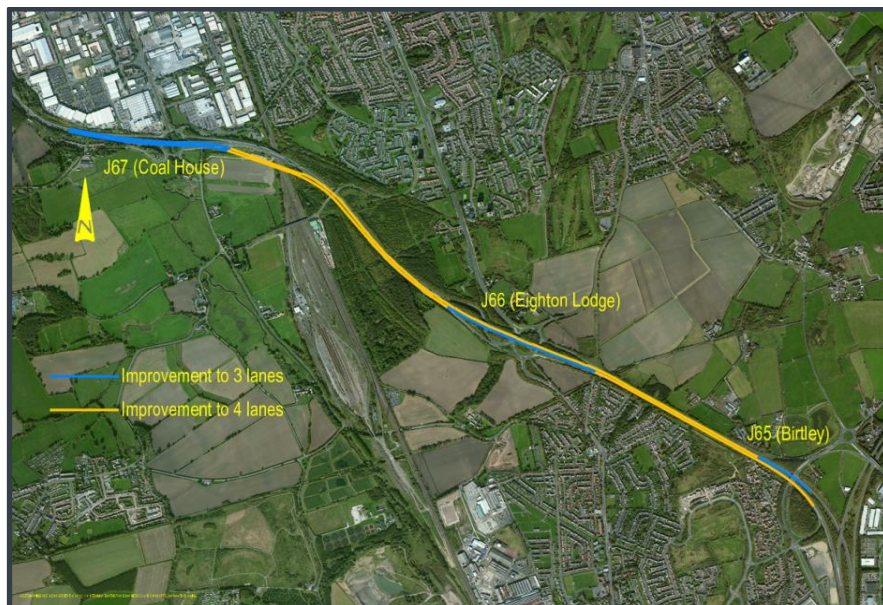


Figure 1 - Proposed Lane Configuration

- 2.1.4 The southbound carriageway will be 50mph with an urban all-purpose cross section from J67 (Coal House) to Smithy Lane approximately, and beyond this to J65 (Birtley), the speed limit will be 70mph with a rural all-purpose cross section. The northbound carriageway will be 50mph to dual 3-lane urban all-purpose cross-section throughout the length of the scheme.



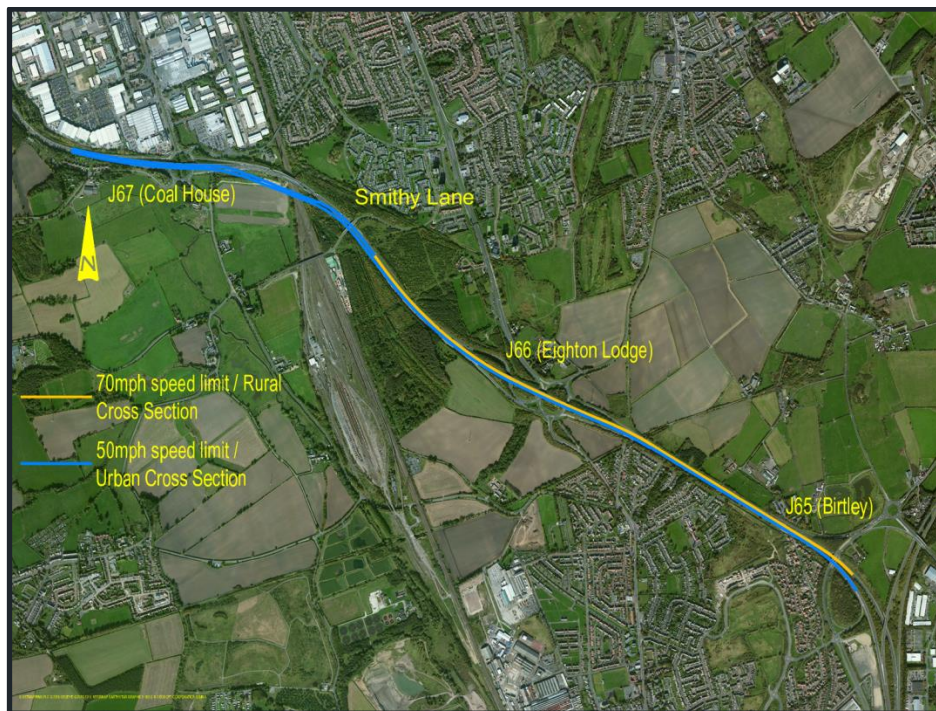


Figure 2. Proposed Speed Limits

- 2.1.5 To accommodate the aforementioned improvements to the A1 highway alignment and also minimise additional land take to as low as reasonably practical, 10No. new retaining wall structures shall be required.
- 2.1.6 Refer to Appendix B for plans providing the following information:
- Discrete location of each retaining wall
  - Approximate length of each retaining wall
  - Approximate max/min retained heights of each discrete retaining wall
- 2.1.7 In summary 6No. retaining wall structures (referenced RW 1-6) are required along the mainline, and 4No. retaining walls are required within the central reserve (reference CRW1-4) to accommodate the level difference between the northbound and southbound carriageway.
- 2.1.8 The following are some of the key constraints and assumptions made in assessing the retaining wall options at each discrete location.

## **2.2 CONTRACTOR DESIGNED WALLS <1.5M**

- 2.2.1 As discussed/agreed with the HE SES, the extent of the discrete mainline retaining wall lengths have been determined such that where practical, retaining walls with an effective retained height of less than 1.5m shall be considered to be contractor designed elements.
- 2.2.2 This is considered acceptable on the basis that BD2/12 only recognises retaining structures greater than 1.5m retained height as official highway structures. In this instance it shall be the contractors responsibility to propose a suitable construction method that can be readily transitioned/tied into the main retaining wall structures discussed in this SOR.
- 2.2.3 Refer to the location plans in appendix B for the extent of consultant and contractor designed wall extent at each discrete location.

## **2.3 STATUTORY UNDERTAKERS INFORMATION**

- 2.3.1 Details of existing services within the scheme boundary are shown on the following service information plans provided in Appendix C-1:
- HE551462-WSP-VUT-BCH-DR-D-00001
  - HE551462-WSP-VUT-BCH-DR-D-00002
  - HE551462-WSP-VUT-BCH-DR-D-00003
- 2.3.2 Refer to Appendix C-2 for details of the services potentially impacted by the proposed new retaining walls.
- 2.3.3 Further investigation/surveys are required to confirm the line and level of existing services and the level of disruption caused in relation to cost/programme.
- 2.3.4 At this stage it is assumed all services potentially impacting the retaining wall works will be suitably protected/diverted to accommodate the works on site.

## 2.4 VRS AND PEDESTRIAN PARAPET ARRANGEMENT

### WALLS PROPOSED TO RETAIN THE HIGHWAY

- 2.4.1 At this stage it has been assumed that all retaining wall structures that could result in errant vehicles falling from height shall be safe guarded with a minimum N2 containment level vehicle restraint system in accordance with TD19/06. Retaining walls with a VRS would need to be designed to sustain impact/accidental loads transmitted from the attached VRS.
- 2.4.2 Alternatively safety barriers positioned in the verge could remove the requirement for a VRS needing to be fixed along the top of the wall. This would result in retaining structures no longer requiring design for the onerous vehicle impact loading, allowing for a more cost effective retaining structure being provided due to the reduced section size/embedment depth etc.

### WALLS PROPOSED TO RETAIN LAND ADJACENT TO THE HIGHWAY

- 2.4.3 As agreed with the HE SES, all new retaining structures retaining land adjacent to the highway shall be provided with a smooth face up to 1.5m high in accordance with the definition provided in TD19/06 irrespective of a safety barrier provision.

*“A ‘smooth’ face may include a surface that may have an irregular surface finish subject to the maximum amplitude of the steps and undulations in the surface not exceeding 30 mm when measured with respect to a plane through the peaks. The plane must be broadly parallel to the road alignment. A structure that has a 25 mm wide chamfered construction joint in its surface would be regarded as smooth.”*

- 2.4.4 In addition all walls adjacent to the highway will be designed for the accidental actions caused by road vehicles and provide the accidental impact loading on supporting structures.

2.4.5 The assumed VRS requirements at each discrete retaining wall location is tabulated below:

**Table 1. VRS requirement for retaining walls**

REFERENCE	CHAINAGE ON MAINLINE	LOCATION	VRS REQUIREMENTS
RETAINING WALL 1	0+340 TO 0+560	MAINLINE/ A1 SOUTHBOUND	<ul style="list-style-type: none"> <li>■ Wall retains the highway</li> <li>■ N2 parapet system required (to be confirmed at later design stage).</li> </ul>
RETAINING WALL 2	0+325 TO 0+420	MAINLINE/ A1 NORTHBOUND	<ul style="list-style-type: none"> <li>■ Wall retains the highway</li> <li>■ N2 parapet system required (to be confirmed at later design stage).</li> </ul>
RETAINING WALL 3	0+650 TO 0+796	SLIP ROAD/ A1 NORTHBOUND	<ul style="list-style-type: none"> <li>■ Wall retains the main highway and also faces the traffic face of the slip road</li> <li>■ N2 parapet system required to the top of the wall (to be confirmed at later design stage).</li> <li>■ Smooth traffic face required (min 1.5m high) to the traffic face irrespective if safeguarded by a safety barrier provision</li> </ul>
RETAINING WALL 4	0+940 TO 1+060	MAINLINE/ A1 NORTHBOUND	<ul style="list-style-type: none"> <li>■ Wall retains the main highway and also faces the traffic face of the slip road</li> <li>■ N2 parapet system required to the top of the wall (to be confirmed at later design stage).</li> <li>■ Smooth traffic face required (min 1.5m high) to the traffic face irrespective if safeguarded by a safety barrier provision (to be confirmed at detailed design)</li> </ul>
RETAINING WALL 5	0+940 TO 1+060	MAINLINE/ A1 SOUTHBOUND	<ul style="list-style-type: none"> <li>■ Wall retains the main highway and also faces the traffic face of the slip road</li> <li>■ N2 parapet system required to the top of the wall (to be confirmed at later design stage).</li> <li>■ Smooth traffic face required (min 1.5m high) to the traffic face irrespective if safeguarded by a safety barrier provision (to be confirmed at detailed design)</li> </ul>
RETAINING WALL 6	4+140 TO 4+400	MAINLINE/ A1 SOUTHBOUND	<ul style="list-style-type: none"> <li>■ Wall retains land adjacent to the highway</li> <li>■ N1 parapet system as a stand-alone item required at the top of the wall adjacent to a private access road (to be confirmed at later design stage).</li> <li>■ Smooth traffic face required (min 1.5m high) to the traffic face irrespective if safeguarded by a safety barrier provision (to be confirmed at detailed design)</li> </ul>

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REFERENCE	CHAINAGE ON MAINLINE	LOCATION	VRS REQUIREMENTS
CR RETAINING WALL 1	0+515 TO 0+615	CENTRAL RESERVE	<ul style="list-style-type: none"> <li>■ It is anticipated that there will not be a requirement for vehicular restraint system at the top of the retaining wall.</li> </ul>
CR RETAINING WALL 2	1+950 TO 2+220	CENTRAL RESERVE	<ul style="list-style-type: none"> <li>■ It is anticipated that there will not be a requirement for vehicular restraint system at the top of the retaining wall.</li> </ul>
CR RETAINING WALL 3	2+420 TO 2+705	CENTRAL RESERVE	<ul style="list-style-type: none"> <li>■ It is anticipated that there will not be a requirement for vehicular restraint system at the top of the retaining wall.</li> </ul>
CR RETAINING WALL 4	3+270 TO 3+690	CENTRAL RESERVE	<ul style="list-style-type: none"> <li>■ It is anticipated that there will not be a requirement for vehicular restraint system at the top of the retaining wall.</li> </ul>

# 3. RETAINING WALL OPTIONS

## 3.1 ASSUMPTIONS/CONSTRAINTS

3.1.1 The following assumptions/constraints have been considered when assessing the retaining wall options.

- Provision of cost effective/simple solutions
- Minimise land take to ensure this is as low as reasonably practical
- Minimise disruption to traffic on the mainline and ensure a minimum of 2No. running lanes in both directions can be maintained during the works
- Ensure disruption to local residents and business is as low as reasonably practical
- All services potentially impacting the works shall be protected or diverted accordingly
- VRS shall be provided at the top of retaining walls to prevent errant vehicles from falling
- Retaining walls directly adjacent to a traffic face shall be provided with a smooth face (clad or otherwise) in accordance with the requirements of TD19/06 irrespective of a safety barrier provision
- Where practical retaining walls less than 1.5m retaining height shall be considered to be contractor designed elements
- The gradient to embankment is currently based on the provision of 1:3 slopes. At this stage 1:3 slopes are acceptable where class 2 cohesive material is to be placed, but can increase the gradient of the slope to 1 in 2.5 where a granular material is imported and placed. Slopes of 1:3 have been used to reduce the retained height where possible. The maximum permitted gradient of embankment slopes shall be reviewed upon further detailed geotechnical investigation and analysis

3.1.2 The following options have been considered to provide retention of ground:

### **Mainline**

- Option A – Sheet Pile Wall
- Option B – Bored Pile Wall
- Option C – RC Retaining Wall
- Option D – King Post Wall
- Option E – Reinforced Earth Wall

3.1.3 **Central Reserve**

- Option 1 – Wide Variable Concrete Step Barrier
- Option 2 – RC Ground Beam

- 3.1.4 Gravity type retaining structures such as gabion and mass concrete walls, which rely on their mass to resist pressure from the load behind, were not considered to be feasible at any of the mainline locations. The reasons for these wall types being discounted is they generally require a considerable foundation footprint and large open excavation for construction. This extent of the open excavation would potentially encroach onto the A1 mainline and impact traffic management, making it difficult to maintain the minimum levels of traffic during construction.
- 3.1.5 Another reason for gabions not being suitable is they are not compatible with the provision of a VRS system being fixed to the top surface (prevent falls from height). Gabions would also not satisfy the requirement to provide a smooth traffic face.

## **3.2 OPTION A – SHEET PILE WALL**

- 3.2.1 The sheet piled walls would utilise Z-sections, with the retained and embedded height changing along the length of the wall to suit the retained height.
- 3.2.2 Steel sheet piles would need to be weathering, include a sacrificial thickness, or be otherwise protected over their design life from rusting caused by the presence of groundwater.
- 3.2.3 A reinforced concrete capping beam would be provided to the head of the sheet piles. A proprietary VRS system will be required at the top of the capping beam in some locations. In other locations, a proprietary tubular handrail system would be installed.
- 3.2.4 According to TD19/06 a smooth surface would be required for sections that are adjacent to the traffic and this would extend for at least 1.5m above the adjacent carriageway level.
- 3.2.5 A drainage or weep hole system would need to be provided in the sheet pile wall to prevent build-up of water behind the wall and avoid adverse uplift on the carriageway. During the detailed design of the retaining walls appropriate drained parameters based on the intrusive ground investigation results will be considered. Drainage is required to prevent pore water pressure build up behind the retaining wall.
- 3.2.6 Table 2 discusses further the advantages and disadvantages of Option A-Sheet Pile Walls.

**Table 2. Sheet Piles Advantages and Disadvantages Table**

TECHNIQUE	ADVANTAGES	DISADVANTAGES	SUITABILITY TO SCHEME / COMMENTS
OPTION A (SHEET PILE WALL)	<ul style="list-style-type: none"> <li>■ Takes up little lateral space, no additional excavation required.</li> <li>■ Deep excavation will not be required to construct the retaining wall. Piles can be installed from existing ground level and then excavation or backfilling carried out as necessary to achieve desired ground levels on each side of the wall. Slope grading can be carried out immediately after installation.</li> <li>■ Less spoil and backfill material than the other options, requiring fewer delivery vehicles to dispose of soil off-site.</li> <li>■ No temporary works are required to support the existing ground.</li> <li>■ Easier and faster installation compared to the other options. Fast installation reducing the period of disruption to residents around the site.</li> <li>■ No open excavations and fewer temporary slopes (less risk to health and safety).</li> <li>■ Materials handled by machines, reduces manual handling.</li> <li>■ Suitable for larger heights to be retained.</li> </ul>	<ul style="list-style-type: none"> <li>■ Increase in capital cost due to the requirement for specialist equipment.</li> <li>■ Difficult to provide an efficient design to sustain retained heights in excess of 3m retained height.</li> <li>■ Cannot penetrate hard stratum / obstructions.</li> <li>■ Durability of steel sheet piles is not as good as RC options considering design life of 120 years.</li> <li>■ May generate significant vibration and noise in close proximity to adjacent residential area.</li> <li>■ Requirement for cladding, increasing capital and maintenance cost.</li> <li>■ Requirement for piling platform. Risks associated with temporary works installation/ use.</li> </ul>	<ul style="list-style-type: none"> <li>■ Suitable for use in areas of the scheme where there is little space between the line of the retaining wall and the carriageway or site boundary.</li> <li>■ Cost effective solution for retaining walls up to 3m retained height.</li> </ul>



### 3.3 OPTION B –BORED PILED WALL

- 3.3.1 The length of the retaining structure would be divided into sections with larger pile diameters and greater embedment used for piles retaining a greater height of embankment. Smaller pile diameters and less embedment would be used for smaller retained heights to provide a more cost effective solution.
- 3.3.2 Similar to option A, bored piles would be installed from ground level using the “top down” method of construction thereby significantly reducing the extent of open excavations whilst allowing for installation within a constrained working area.
- 3.3.3 The use of a contiguous bored pile walls is considered to be the most appropriate form of construction for large retained heights in excess of 3m, particularly where piles are required to penetrate through hard stratum (limitation of sheet piles). The main disadvantage of this option is that the piles are spaced at approximately 150mm apart therefore a structural concrete facing will be required to prevent soil being washed through the gaps onto the adjacent carriageway/land.
- 3.3.4 Secant bored pile wall construction comprising hard pile (reinforced) and soft pile (non-reinforced) piles where the soft piles are used to seal the gap between the hard piles to provide a watertight solution, would enable a cheaper form of facing to be adopted. However contiguous bored piles are preferred over secant bored piles on this scheme due to the following:
- As the spacing between the hard piles is increased. Secant piles would require a larger diameter of hard piles and a greater quantity of reinforcement than an equivalent contiguous bored piled wall option.
  - The programme/complexity for installation is greater due to the need to install both soft and hard piles resulting in greater number of piles and movement of installation plant.
  - Whilst the facing could be more cost effective with a secant pile, a facing of sorts is still required. It is assumed the exposed bored pile face would not be left exposed due to reduced aesthetic appearance and reputational damage to Highways England. Therefore the overall benefits of a secant wall is negated.
- 3.3.5 A reinforced concrete capping beam would be provided to the head of the contiguous bored piles upon which a VRS/handrail system can be readily attached.
- 3.3.6 Table 3 discusses further the advantages and disadvantages of Option B-Bored Pile Walls.

**Table 3. Bored Pile Advantages and Disadvantages Table**

TECHNIQUE	■ ADVANTAGES	■ DISADVANTAGES	■ SUITABILITY TO SCHEME / COMMENTS
OPTION B (BORED PILE WALL)	<ul style="list-style-type: none"> <li>■ Suitable for all heights to be retained.</li> <li>■ Takes up little lateral space, no additional excavation required.</li> <li>■ Less disruption to the adjacent soil.</li> <li>■ Absence of vibration ensures minimal impact on adjacent structures and services.</li> <li>■ Deep excavation will not be required to construct the retaining wall. Piles can be installed from existing ground level and then excavation or backfilling carried out as necessary to achieve desired ground levels on each side of the wall. Slope grading can be carried out immediately after installation.</li> <li>■ Extensive temporary works are not required to support the existing ground.</li> </ul>	<ul style="list-style-type: none"> <li>■ Expensive to install given the need for specialist equipment.</li> <li>■ Not as cost effective as other retaining wall options for retained heights less than 3m.</li> <li>■ Cladding to piles is required. This is due to the presence of small clearance gaps between the piles. The requirement for cladding increases capital and maintenance costs.</li> <li>■ The reinforcement is not optimally placed and therefore requires more reinforcement per metre length than a conventional reinforced concrete wall.</li> <li>■ Requirement for piling platform. Risks associated with temporary works installation/ use.</li> </ul>	<ul style="list-style-type: none"> <li>■ Suitable for use in areas of the scheme where there is little space between the line of the retaining wall and the carriageway or site boundary.</li> <li>■ Whilst suitable for use on all retained heights. Contiguous bored piled walls are considered to be most cost effective for retained heights in excess of 3m.</li> </ul>

### 3.4 OPTION C – CANTILEVER REINFORCEMENT CONCRETE RETAINING WALL

- 3.4.1 Cantilever reinforced concrete walls utilise the weight of the backfill soil to provide stability (sliding and overturning). Depending on the retained height, reinforced concrete walls could comprise either cast in-situ (greater than 3m retained height) or pre-cast construction (less than 3m retained height). The height and thickness of the wall could change to suit the retained height providing a more cost effective solution.
- 3.4.2 To enable the reinforced concrete wall to be constructed, excavation is required past the final plane of retained soil (albeit significantly less than gravity type walls). In the temporary condition, the ground behind the retaining wall will require retaining either by installing temporary sheet piling or by benching of the slope.
- 3.4.3 Drainage or weep hole system would be required through the wall to prevent build-up of water behind the wall and avoid adverse uplift on the carriageway. During the detailed design of the retaining walls appropriate drained parameters based on the intrusive ground investigation results will be considered. Drainage is required to prevent pore water pressure build up behind the retaining wall.
- 3.4.4 Table 4 discusses further the advantages and disadvantages of Option C - Cantilever Reinforcement Concrete Retaining Wall.

**Table 4. Reinforced Concrete Advantages and Disadvantages Table**

TECHNIQUE	ADVANTAGES	DISADVANTAGES	SUITABILITY TO SCHEME / COMMENTS
OPTION C (CANTILEVER REINFORCED CONCRETE WALL)	<ul style="list-style-type: none"> <li>■ Ease of installation. Precast wall units for smaller retained heights (up to 3m) would significantly reduce complexities associated with insitu construction operations and further expedite the construction programme.</li> <li>■ Good surface finish achievable using formwork, requiring no additional cladding.</li> <li>■ Reinforcement is optimally placed in the wall faces giving better use of materials.</li> <li>■ Reinforcement cages can be constructed to a size applicable for lifting by crane or alternatively fixed manually on site.</li> <li>■ Increased construction alignment flexibility as the wall can be constructed with a slight curve to match the A1 alignment if necessary.</li> </ul>	<ul style="list-style-type: none"> <li>■ For larger heights, the construction of cantilevers retaining walls would result in deep and wide open excavations that would impact TM provisions.</li> <li>■ Not suitable where limited access/space constraints exist.</li> <li>■ Sensitive to suitable founding strata.</li> <li>■ Additional backfill material is required behind retaining walls to construct foundation, also requires more deliveries to site.</li> <li>■ Temporary works are required to excavate past the final retained soil surface and then profile or temporarily retain the soil behind.</li> <li>■ The overall construction duration is increased particularly for walls retaining in excess of 3m due to the requirement for additional excavation, temporary work installation and extensive in-situ construction work.</li> </ul>	<ul style="list-style-type: none"> <li>■ Suitable for use where there is sufficient excavation space at the retaining wall locations within impacting land boundaries and traffic management.</li> <li>■ Would provide a cost effective simple solution for walls with a retained height less than 3m (based on the option to install precast units).</li> </ul>

### 3.5 OPTION D – KING POST WALL

- 3.5.1 King post walls are isolated steel columns or beams that are installed along the proposed new retaining wall alignment at typical centres ranging between 1-3m. Between the piles panelling/lagging is inserted to retain the material between each of the piles. The panelling can be made from a variety of materials, normally pre-cast concrete (between 150-180mm thick).
- 3.5.2 The construction sequence generally comprises the following:
- Concrete piles being installed to the toe of the king post pile
  - Steel H sections are plunged into the concrete to required verticality/alignment and level
  - Precast concrete panels are installed between the steel sections once the concrete has hardened.
- 3.5.3 The retained height of the king post retaining wall can be varied along the length of the wall to suit the retained height. A drainage system is required behind the panelling for the king post retaining wall to prevent build-up of water behind the wall and excess seepage through the panels.
- 3.5.4 King post piles would need to be galvanised, include a sacrificial thickness, or be otherwise protected over their design life from rusting caused by the presence of road salt and water spray from passing vehicles.
- 3.5.5 This type of wall is considered suitable at locations where lateral loads and the retained height are not significant. In addition the wall would need to be safeguarded by a safety barrier as the panels (limited thickness) would not be able to be designed to sustain vehicle impact loading.

3.5.6 Table 5 discusses further the advantages and disadvantages of Option D – King Post Wall

**Table 5. King Post Advantages and Disadvantages Table**

TECHNIQUE	■ ADVANTAGES	■ DISADVANTAGES	■ SUITABILITY TO SCHEME / COMMENTS
OPTION D (KING POST WALL)	<ul style="list-style-type: none"> <li>■ At reduced retained heights (circa 2.5m) King post walls provide a cost effective economical solution in comparison to other retaining walls</li> <li>■ Can be installed around obstructions and under low headroom.</li> <li>■ Can penetrate hard stratum/obstructions.</li> <li>■ Usually quick to install.</li> <li>■ Choice of type and dimensions of infill panels. Use of precast concrete planks will eliminate any in-situ concrete on site.</li> <li>■ Can be installed within a constrained working area.</li> </ul>	<ul style="list-style-type: none"> <li>■ Structurally inefficient above 2.5m retained height and where subjected to excessive lateral loads (vehicle surcharge loading).</li> <li>■ Greater deflection than other wall options</li> <li>■ Additional requirement for back of wall drainage prevent seepage through panels.</li> <li>■ Larger distance between the king post sections give large panel lengths, reducing flexibility to match the proposed alignment and sloping retained side ground profile.</li> <li>■ Durability of king post piles is not as good as RC options considering design life of 120 years.</li> <li>■ Only applicable if safeguarded behind a VRS.</li> </ul>	<ul style="list-style-type: none"> <li>■ Suitable to be used in areas of the scheme where there is little space between the line of the retaining wall and the carriageway or site boundary.</li> <li>■ Suitable to use where high bedrock expected (cost effective alternative to bored piled walls) and where the height and lateral loads are limited.</li> </ul>

### 3.6 OPTION E – REINFORCED EARTH WALL

3.6.1 Reinforced earth retaining walls comprise a combination of a compacted fill (often granular and free draining) reinforced with plastic or galvanised metal straps/grids which are attached to a facing system. The chosen facing system is dependent on the face angle required. For vertical/near-vertical walls, the facing systems is generally either a concrete segmental block or interlocking panelling, which can be supplied in a variety of finishes.

3.6.2 No foundation is required below the reinforced earth, although depending on the underlying ground conditions, ground improvement may be required. A concrete levelling pad is required at the base of the facing system to provide a level surface from which to build upon.

3.6.3 The height and alignment of the reinforced earth retaining wall can be varied along the length of the wall to suit the retained height. A drainage system may be required at the base of the reinforced earth block and/or behind the facing system to prevent build-up of water within the wall.

3.6.4 Precast reinforced concrete parapet support slabs can be fixed to the top of the wall to accommodate a VRS appropriate to the adjacent carriageway risks.

3.6.5 Table 6 discusses further the advantages and disadvantages of Option E – Reinforced Earth Wall

**Table6. Reinforced Earth Wall Advantages and Disadvantages Table**

TECHNIQUE	■ ADVANTAGES	■ DISADVANTAGES	■ SUITABILITY TO SCHEME / COMMENTS
OPTION E (REINFORCED EARTH WALL)	<ul style="list-style-type: none"> <li>■ Structural flexibility.</li> <li>■ Requires very little working area in front of wall. Reduce disruption to and from operational A1 main line and slip road.</li> <li>■ Cost effective solution due to simplicity of construction and limited requirement for complex plant and equipment.</li> <li>■ Rapid and economical form of construction can reduce the overall scheme construction programme.</li> <li>■ Typically founded at shallow depth, no pilling required.</li> <li>■ Requires no footing beyond the front face of the wall.</li> <li>■ Can be constructed entirely from the backfill side of the wall, requiring no equipment or scaffolding in front of the wall.</li> <li>■ Variety of possible finishes increases aesthetic appearance.</li> </ul>	<ul style="list-style-type: none"> <li>■ Excessive working room is required behind the wall to facilitate construction.</li> <li>■ Because of shallow foundation depth, the reinforced earth wall location may be subject to settlement issues.</li> <li>■ Requires high quality backfill to be correctly compacted and testing of layers is essential to remove any issue with future settlement.</li> <li>■ Subject to out of plane movements and settlements if fill not correctly compacted.</li> </ul>	<ul style="list-style-type: none"> <li>■ Provides a cost effective solution due to the rapid construction techniques that can be deployed.</li> <li>■ Suitability is dependent on sufficient working room and adequate control of potential settlement.</li> </ul>

### 3.7 CENTRAL RESERVE RETAINING WALL OPTIONS

3.7.1 The limited retained height within the central reserve due to the level difference between the northbound and southbound carriageway suggest the retaining wall options will be limited to either of the following.

- Option 1 – Wide Variable Concrete Step Barrier
- Option 2 – RC Ground Beam

3.7.2 Option 1 requires the installation of a proprietary pre-cast variable concrete step barrier that has a dual purpose of providing adequate VRS containment and limited ground retention up to 300mm retained height.

3.7.3 Option 2 is based on the provision of a reinforced concrete ground beam where ground retention is expected to be between 300-1000mm. The ground beam could comprise either cast in-situ or pre-cast construction.

## 4. GEOTECHNICAL INFORMATION

- 4.1.1 A Geotechnical Design Report is not yet available for the project and will be prepared, following completion of the ground investigation that is currently being undertaken on the site. The GDR will define suitable parameters for the design and acceptable retaining solutions,
- 4.1.2 Within this options report, a selection of appropriate retaining solutions have been considered based on the records and findings for the site location, taken from the Preliminary Sources Study Report (PSSR) for the wider Birtley to Coalhouse Scheme (HA544664-WSP-HGT-S01-RP-GE-0600-P-01).
- 4.1.3 Below is a summary of the ground conditions in the vicinity of the six mainline retaining walls and the four central reservation retaining walls. The ground conditions are based on the historical ground investigation data from the British Geological Survey (BGS) and Highways Agency Geotechnical Data Management System (HA GDMS). Once the scheme specific ground investigation has been undertaken the ground conditions will be updated accordingly.
- 4.1.4 Given the proximity of the proposed retaining walls to the existing carriageway and their locations on existing slopes, it is not feasible to conduct a comprehensive ground investigation for each specific retaining wall. As such, some supplementary ground investigation may be required during detailed design, or at the start of construction to confirm assumptions made.
- 4.1.5 Table 7 below presents the anticipated ground conditions at each of the retaining wall locations.

**Table7: Anticipated ground conditions at each proposed retaining wall location**

RETAINING WALL	GROUND CONDITIONS
RETAINING WALL 1 (RW1)	<ul style="list-style-type: none"> <li>■ Made ground: embankment fill from the construction of the A1 carriageway; over,</li> <li>■ Alluvium: between 2.9 m and 4.0 m thick and comprising soft to firm brown grey silty locally sandy clay and brown fine to coarse gravel; over,</li> <li>■ Glaciolacustrine deposits: thickness not proven, maximum proven thickness 11.7 m and comprising firm grey brown laminated clay locally silty laminated clay; over,</li> <li>■ Pennine Middle Coal Measures bedrock, although the depth to this stratum has not been proven in the historical borehole records obtained.</li> <li>■ Groundwater strikes were recorded on the available historical borehole records between 14.1 and 6.45 m AOD. No historical groundwater monitoring results have been obtained.</li> </ul>



RETAINING WALL	GROUND CONDITIONS
RETAINING WALL 2 (RW2)	<ul style="list-style-type: none"> <li>■ Made ground: embankment fill from the construction of the A1 carriageway; over,</li> <li>■ Alluvium: between 2.9 m and 4.0 m thick and comprising firm brown grey silty clay; over,</li> <li>■ Glaciolacustrine deposits: thickness not proven, maximum proven thickness 14.6 m and comprising firm grey brown laminated clay, locally silty laminated clay; over,</li> <li>■ Pennine Middle Coal Measures bedrock, although the depth to this stratum has not been proven in the historical borehole records obtained.</li> <li>■ Groundwater strikes were recorded on the available historical borehole records between 14.1 and 6.45 m AOD. No historical groundwater monitoring results have been obtained.</li> </ul>
RETAINING WALL 3 (RW3)	<ul style="list-style-type: none"> <li>■ Made ground: embankment fill from the construction of the A1 carriageway; over,</li> <li>■ Alluvium: between 2.9 m and 4.0 m thick and comprising soft to firm brown silty sandy clay, clayey sand and gravel, and dark grey silty sand; over,</li> <li>■ Glaciolacustrine deposits: thickness not proven, maximum proven thickness 11.7 m and comprising soft to firm grey brown laminated slightly silty clay; over,</li> <li>■ Pennine Middle Coal Measures bedrock, although the depth to this stratum has not been proven in the historical borehole records obtained.</li> <li>■ Groundwater strikes were recorded on the available historical borehole records between 9.3 and 6.7 m AOD. No historical groundwater monitoring results have been obtained.</li> </ul>
RETAINING WALL 4 AND 5 (RW4&5)	<ul style="list-style-type: none"> <li>■ Made ground: embankment fill from the construction of the A1 carriageway; over,</li> <li>■ Alluvium: between 0.6 m and 2.0 m thick and comprising soft to stiff grey brown sandy clay; over,</li> <li>■ Glaciolacustrine deposits: thickness not proven, maximum proven thickness 36.9 m and comprising soft to stiff grey brown laminated silty clay; over,</li> <li>■ Pennine Middle Coal Measures bedrock, although the depth to this stratum has not been proven in the historical borehole records obtained.</li> <li>■ Groundwater strikes were recorded on the available historical borehole records between 9.5 and 1.9 m AOD. No historical groundwater monitoring results have been obtained.</li> </ul>

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RETAINING WALL	GROUND CONDITIONS
RETAINING WALL 6 (RW6)	<ul style="list-style-type: none"> <li>■ Made ground: embankment fill from the construction of the A1 carriageway; over,</li> <li>■ Glacial Till: between 2.8 m and 7.8 m thick and comprising firm to stiff orange brown slightly sandy slightly gravelly clay, gravel is sandstone, siltstone, mudstone and coal; over,</li> <li>■ Weathered Pennine Middle Coal Measures: between 0.1 m and 0.3 m and comprising brown medium to coarse sand and gravel of sandstone; over,</li> <li>■ Pennine Middle Coal Measures bedrock: thickness not proven, maximum proven thickness 5.1 m.</li> <li>■ No groundwater strikes were recorded on the available historical borehole records. No historical groundwater monitoring results have been obtained.</li> <li>■ A number of coal seams are recorded beneath the retaining wall, however no evidence of mine workings are recorded on the available borehole logs. The shallowest coal seams are the High Main (approximately 67 m AOD), Metal seam (approximately 60 m AOD) and Five Quarter (approximately 50 m AOD)</li> </ul>
CENTRAL RESERVATION RETAINING WALL 1 (CRW1)	<ul style="list-style-type: none"> <li>■ Made ground: existing embankment fill; over,</li> <li>■ Alluvium: between 2.9 m and 4.0 m thick and comprising firm grey brown clay; over,</li> <li>■ Glaciolacustrine deposits: thickness not proven, maximum proven thickness 14.6 m and comprising firm grey brown silty laminated clay; over,</li> <li>■ Pennine Middle Coal Measures bedrock, although the depth to this stratum has not been proven in the historical borehole records obtained.</li> <li>■ Groundwater strikes were recorded on the available historical borehole records between 14.1 and 6.5 m AOD. No historical groundwater monitoring results have been obtained.</li> </ul>
CENTRAL RESERVATION RETAINING WALL 2 (CRW2)	<ul style="list-style-type: none"> <li>■ Made ground: up to 2.5 m thick, over,</li> <li>■ Glacial Till: between 2.4 m and 5.4 m thick and firm to stiff orange brown slightly sandy slightly gravelly clay, gravel is sandstone, siltstone, mudstone and coal; over,</li> <li>■ Weathered Pennine Middle Coal Measures: between 0.8 m and 1.9 m and comprising very stiff grey brown silty clay tending to weak siltstone; over,</li> <li>■ Pennine Middle Coal Measures bedrock: thickness not proven, maximum proven thickness 14.0 m.</li> <li>■ No groundwater strikes were recorded on the available historical borehole records. No historical groundwater monitoring results have been obtained.</li> <li>■ A number of coal seams are recorded beneath the retaining wall, however no evidence of mine workings are recorded on the available borehole logs. The shallowest coal seams are the High Main (approximately 67 m AOD), Metal seam (approximately 60 m AOD) and Five Quarter (approximately 50 m AOD).</li> <li>■</li> </ul>

RETAINING WALL	GROUND CONDITIONS
CENTRAL RESERVATION RETAINING WALL 3 (CRW3)	<ul style="list-style-type: none"> <li>■ Made ground: up to 2.7 m thick, over,</li> <li>■ Glacial Till: between 1.6 m and 5.6 m thick and comprising firm to stiff brown sandy clay, grey silty clay, dark brown gravelly clay with localised sandstone boulders; over,</li> <li>■ Weathered Pennine Middle Coal Measures: approximately 2.0 m thick and comprising brown clayey sand and stiff to very stiff grey brown silty clay; over,</li> <li>■ Pennine Middle Coal Measures bedrock: thickness not proven, maximum proven thickness 12.0 m.</li> <li>■ No groundwater strikes were recorded on the available historical borehole records. No historical groundwater monitoring results have been obtained.</li> <li>■ A number of coal seams are recorded beneath the retaining wall, however no evidence of mine workings are recorded on the available borehole logs. The shallowest coal seams are the High Main (approximately 67 m AOD), Metal seam (approximately 60 m AOD) and Five Quarter (approximately 50 m AOD).</li> </ul>
CENTRAL RESERVATION RETAINING WALL 4 (CRW4)	<ul style="list-style-type: none"> <li>■ Made ground: approximately 2.0 m thick; over,</li> <li>■ Glacial Till: approximately 5.8 m thick and comprising firm to stiff orange brown slightly sandy slightly gravelly clay, gravel is sandstone, siltstone, mudstone and coal; over,</li> <li>■ Pennine Middle Coal Measures bedrock: thickness not proven, maximum proven thickness 22.7 m.</li> <li>■ No groundwater strikes were recorded on the available historical borehole records. No historical groundwater monitoring results have been obtained.</li> <li>■ A number of coal seams are recorded beneath the retaining wall, however no evidence of mine workings are recorded on the available borehole logs. The shallowest coal seams are the High Main (approximately 67 m AOD), Metal seam (approximately 60 m AOD) and Five Quarter (approximately 50 m AOD).</li> </ul>

## 4.2 RISKS ASSOCIATED WITH RETAINING WALL WORKS

4.2.1 The geotechnical risks for the wider site are presented within the PSSR. These risks have been reviewed and further assessed in the 'Live' Project Risk Registers. Pertinent geotechnical risks in relation to the proposed retaining walls are summarised in Table below.

**Table 8: Geotechnical risks of proposed retaining walls**

RISK CAUSE	RISK EVENT	PRIMARY RISK IMPACT	RISK RATING*	
<b>ENGINEERING PROPERTIES OF THE GROUND</b>	THERE IS A RISK THAT THE GROUND MODEL, AND THE BEHAVIOUR OF SUCH, IS DIFFERENT (WORSE) FROM THAT ASSUMED AT THIS STAGE.	<b>CONSTRUCTION</b> DELAYS AND REMEDIAL DESIGN REQUIREMENTS, AND POTENTIAL COST AND PROGRAMME IMPLICATIONS. <b>MAINTENANCE</b> INCREASED DEFLECTIONS/MOVEMENTS OVER THE LIFESPAN OF THE RETAINING STRUCTURES, INCREASED MAINTENANCE AND POTENTIAL REMEDIAL MEASURE REQUIREMENTS.	<b>MEDIUM</b>	
<b>INSTABILITY OF EXISTING EARTHWORKS</b>	THERE IS A RISK THAT THE PROPOSED WORKS MAY UNDERMINE/DESTABILISE EXISTING EARTHWORKS.		<b>MEDIUM</b>	
<b>INSTABILITY OF EXISTING EARTHWORKS</b>	THERE IS A RISK THAT THE EXISTING EARTHWORKS AT THE SITE ARE NOT AS STABLE AS ASSUMED AT THIS STAGE.		<b>MEDIUM</b>	
<b>GROUNDWATER</b>	THERE IS A RISK THAT THE GROUNDWATER MODEL IS DIFFERENT (WORSE) FROM THAT ASSUMED AT THIS STAGE.		<b>MEDIUM</b>	
<b>CONTAMINATED SOILS</b>	THERE IS A RISK THAT THE ASSESSMENT OF CONTAMINATED SOILS UNDERTAKEN AT THIS STAGE IS NOT ACCURATE.		<b>MEDIUM</b>	
<b>INSTABILITY CAUSED BY SHALLOW MINE WORKINGS</b>	THERE IS A RISK THAT THE STRUCTURE WILL BE ADVERSELY IMPACTED BY COLLAPSE OF SHALLOW COAL MINE WORKINGS, WHICH MAY REQUIRE GROUTING DURING CONSTRUCTION.		<b>CONSTRUCTION</b> DELAYS AND REMEDIAL DESIGN REQUIREMENTS, AND POTENTIAL COST AND PROGRAMME IMPLICATIONS.	<b>MEDIUM</b>
<b>CONSTRUCTABILITY OF CHOSEN RETAINING WALL SOLUTIONS</b>	THERE IS A RISK THAT THE PROPOSED RETAINING WALL SOLUTIONS ARE NO LONGER SUITABLE DUE TO THE UNCERTAINTY OF THE GROUND CONDITIONS, SUCH AS ROCKHEAD BEING HIGHER THAN ANTICIPATED, BOULDERS AND OTHER OBSTRUCTIONS BEING PRESENT.		<b>CONSTRUCTION</b> DELAYS AND REMEDIAL DESIGN REQUIREMENTS, AND POTENTIAL COST AND PROGRAMME IMPLICATIONS.	<b>MEDIUM</b>
<b>UNEXPLODED ORDNANCE (UXO)</b>	THE SITE IS LOCATED WITHIN AN AREA OF LOW BOMB RISK, THERE IS A RISK THAT UXO MIGHT BE ENCOUNTERED BENEATH THE SITE.	<b>CONSTRUCTION</b> DELAYS AND REQUIREMENT FOR SAFE DEACTIVATION / DISPOSAL.	<b>Low</b>	
<b>BURIED SERVICES</b>	THERE IS A RISK THAT BURIED SERVICES MIGHT BE ENCOUNTERED DURING EXCAVATION OF PROPOSED FOUNDATIONS.	<b>CONSTRUCTION</b> DELAYS AND POTENTIAL COST AND PROGRAMME IMPLICATIONS.	<b>MEDIUM</b>	

### 4.3 DETAILS OF ADDITIONAL GROUND INVESTIGATION REQUIRED TO INFORM THE DETAILED DESIGN PROCESS

- 4.3.1 The additional proposed ground investigation has been scoped and is currently being undertaken. Drawings HE551462-WSP-HGT-BCH-DR-GE-00023 to HE551462-WSP-HGT-BCH-DR-GE-00033 shows the exploratory hole locations of the proposed ground investigation required to inform the detailed design of the retaining wall. The proposed ground investigation includes the following:
- Cable percussion boreholes to rock head to identify ground conditions within the superficial deposits and confirm rockhead levels;
  - Rotary cored boreholes to determine rock quality and strength to 9 m below rock head;
  - Rotary open hole boreholes for an additional 15 m to investigate the presence of coal seams and historical mining;
  - Window sample; and,
  - Installation of piezometer data loggers to monitor the groundwater levels.
- 4.3.2 Each of the above ground investigation methodologies may be undertaken at the same location / exploratory hole through follow-on methods, i.e. cable percussion to rockhead; follow-on with rotary core from rockhead to 12m below rockhead; and follow-on with open hole to proposed borehole depth. The current proposed ground investigation includes 15 (fifteen) exploratory hole locations.
- 4.3.3 The ground investigation shall be reported in a Ground Investigation Report (in line with HD 22/08) once completed.
- 4.3.4 Given the proximity of the proposed retaining walls to the existing carriageway and their locations on existing slopes, it is not feasible to conduct a comprehensive ground investigation for each specific retaining wall. As such, some supplementary ground investigation may be required during detailed design, or at the start of construction to confirm assumptions made.
- 4.3.5 The final retaining wall solutions shall be determined through assessment of the deflections and bending moments of the walls, bearing capacity of the founding materials (influenced by the ultimate limit state), settlement analysis of the foundations (influenced by serviceability limit state) and interaction with the existing structure.

# 5. COMPARISON OF RETAINING WALL OPTIONS

## 5.1 GENERAL

5.1.1 The various mainline retaining wall options (A-E) have been assessed and compared relative to the working constraints identified at each location. The review has also included high level early buildability input from the HE support contractor (COSTAIN). Based on the study to date a preferred retaining wall option at each discrete location has been identified for further consideration/development at detailed design.

5.1.2 All construction costing information (excluding preliminaries) provided in this section is based on previous similar type works and subject to further verification and analysis. The Highways England cost estimating team has not been consulted for any construction costing information in this study.

## 5.2 MAINLINE RETAINING WALL 1

5.2.1 Key geometric details of this retaining wall include (approximate):

- Total length 220m
- Min height 1.50m
- Max height 2.50m
- Average height 2.00m

5.2.2 This wall would retain the construction of the A1 southbound alignment. The buildability review has indicated the three most suitable solutions at this location are:

- Option A Sheet Piled Wall (Estimated Construction Cost £650k)
- Option C Insitu RC Wall (Estimated Construction Cost £600k)
- Option C Precast RC Wall (estimated Construction Cost £550k)

5.2.3 Due to the limited retained height, contiguous bored piled walls (option B) would not provide a cost effective solution at this location. The excavation and access to construct a Reinforced Earth wall would be in excess of the working room available. The king post wall would not be adequate due to the excess lateral loads (due to earth pressure and live load surcharge) to be sustained by the structure.

5.2.4 Option C Precast RC Wall is considered to provide the most cost effective solution. The limited insitu works would simplify buildability and most likely reduce the programmed retaining wall works at this location. Refer to Appendix D-1 for the outline GA.

## 5.3 MAINLINE RETAINING WALL 2

5.3.1 Key geometric details of this retaining wall include (approximate):

- Total length 100m
- Min height 0.30m
- Max height 1.70m
- Average height 1.00m

5.3.2 This wall would retain the construction of the A1 southbound alignment. The limited working room at this location negates all options requiring open excavated areas for construction (Options D: RC Retaining wall and E: Reinforced Earth options). The limited retained height means contiguous bored piled walls (option B) would not provide a cost effective solution at this location.

5.3.3 Based on the above the optimum solution inclines towards a sheet piled wall which can be constructed in a restricted working areas minimising impact on the traffic management during construction.

5.3.4 The estimated construction cost of Option A Sheet Piled Wall is £300k. Refer to Appendix D-2 for the outline GA.

## 5.4 MAINLINE RETAINING WALL 3

5.4.1 Key geometric details of this retaining wall include (approximate):

- Total length 146m
- Min height 1.50m
- Max height 6.00m
- Average height 3.25m

5.4.2 This wall would retain the construction of the A1 northbound alignment and face the adjacent on slip traffic. The buildability review has indicated the two most suitable options at this location are:

- Option B Contiguous Bored Piled Wall (Estimated Construction Cost £1.8million)
- Option E Reinforced Earth Wall (Estimated Construction Cost £750k)

- 5.4.3 The excessive retained height at this location makes option A (Sheet Piles), C (Cantilever Retaining Walls) and D (King post) not adequate for installation at this location.
- 5.4.4 Option B would allow for a retaining wall to be installed that is aligned tight to the verge edge minimising additional land take for construction whilst also maintaining the required traffic management on the mainline.
- 5.4.5 Option E Reinforced Earth Wall would provide a more cost effective solution, however this option would require greater land take (increase lateral clearance to the running lane) to facilitate access for construction and also allow for the minimum levels of traffic to be maintained during construction.
- 5.4.6 On the basis the additional land take is within acceptable limits, it is considered Option E Reinforced Earth walls would provide the optimum solution in relation to cost and buildability. Refer to Appendix D-3 for the outline GA.

## 5.5 MAINLINE RETAINING WALL 4

- 5.5.1 Key geometric details of this retaining wall include (approximate):
- Total length 125m
  - Min height 1.50m
  - Max height 4.30m
  - Average height 2.80m
- 5.5.2 This wall would retain the construction of the A1 northbound alignment and face the adjacent off slip road traffic. The buildability review has indicated the two most suitable options at this location are:
- Option C RC Wall (Estimated Construction Cost £800k)- comprise both insitu and precast construction
  - Option E Reinforced Earth Wall (Estimated Construction Cost £350k)
- 5.5.3 Option A Sheet Piled Walls is considered to not be feasible due to the shallow depth of hard stratum that would prevent the driving of sheet piles to the required embedment depth. Also, due to the nature of the sheet pile composition/ material, it will make them unfeasible to support excessive deflection as a result of retaining height. Option B Contiguous bored piles was not considered in detail at this location as it would provide an expensive solution in comparison to the averaged retained height to be maintained.
- 5.5.4 Option C and E are considered to provide the most suitable retaining wall solution on the basis the increased construction footprint could be accommodated, whilst allowing for the desired traffic management to be maintained on the mainline during construction.
- 5.5.5 It is considered that Option E Reinforced Earth Wall would provide the optimum cost effective solution at this location. Refer to Appendix D-4 for the outline GA.



## 5.6 MAINLINE RETAINING WALL 5

5.6.1 Key geometric details of this retaining wall include (approximate):

- Total length 120m
- Min height 1.50m
- Max height 3.00m
- Average height 2.25m

5.6.2 This wall would retain the construction of the A1 southbound alignment and face the adjacent on slip road traffic. The buildability review has indicated the most suitable option at this location is:

- Option B Contiguous Bored Piled Wall (Estimated Construction Cost £450k)

5.6.3 The buildability review highlighted retaining wall options requiring a large construction footprint (Option C: Cantilever RC Wall and Option E: Reinforced Earth) would not be feasible due to the restricted working area and the need to maintain traffic on the mainline during construction.

5.6.4 Option D was also not considered in detail as the anticipated loading would make it difficult for a king post solution to work structurally and also remain cost effective.

5.6.5 Option A sheet piled wall is not considered feasible as this type of structure could only be installed for a short length, 40m of the total 120m length. This is due to a change in stratum whereby hard material would be encountered for circa 80m which would prevent sheets from being installed to the desired embedment depth. Also, due to the nature of the sheet pile composition/ material, it will make them unfeasible to support the excessive deflection as a result of the retaining height. A combination of sheet and contiguous bored piles is also not considered feasible due to the disruption/complexity associated with the transition from sheet piles to contiguous bored piled walls.

5.6.6 At this stage it is considered the contiguous bored pile wall would provide the most effective buildable solution at this location. Refer to Appendix D-5 for the outline GA.

## 5.7 MAINLINE RETAINING WALL 6

5.7.1 Key geometric details of this retaining wall include (approximate):

- Total length 260m
- Min height 1.50m
- Max height 2.50m
- Average height 2.00m

5.7.2 This wall would retain the earthwork cutting adjacent to the A1 southbound offslip road. The shallow depth hard stratum would make Option A Sheet Piles impractical for installation at this location. The limited retained height would result in a contiguous bored pile wall option providing a solution that would be too expensive (circa £900k).

5.7.3 The limited space in relation to the highway boundary would result in Options C: Cantilever retaining wall and Option E: Reinforced Earth wall requiring additional land take beyond the current highway boundary and are therefore not considered feasible.

5.7.4 Option D: King post wall would provide the optimum cost effective solution at this location whilst allowing for the wall to be constructed without the need for additional land take.

5.7.5 The estimated construction cost of Option D King post wall is £500k. Refer to Appendix D-6 for the outline GA.

## 5.8 CENTRAL RESERVE RETAINING WALLS

5.8.1 The current geometric requirements for the 4No. discrete central reserve retaining walls identified for the improvement works is provided below:

- Central Reserve Retaining wall 1 (CRW1) - Length 100m/ Min & Max Ht 0.3m and 0.36m
- Central Reserve Retaining wall 2(CRW2) - Length 270m/ Min & Max Ht 0.3m and 1.00m
- Central Reserve Retaining wall 3(CRW3) – Length 285m/ Min & Max Ht 0.3m and 0.50m
- Central Reserve Retaining wall 4(CRW4) – Length 420m/ Min & Max Ht 0.3m and 0.80m

5.8.2 The central reserve retaining wall Option 1 Variable Step Barrier and Option 2 Ground Beam, are considered to provide the most cost effective/optimum solutions in this location. The choice between the options will be directly governed by the retained height requirements at each location.

5.8.3 Due to the limited retained height and simplicity of the options, it is considered that either option will be classified as a CAT0 structure in accordance with BD2/12 Technical Approval of Highway Structures (no AIP required) and will be classified as low risk construction work that can be readily accommodated as part of the scheme improvement works.

5.8.4 Further review, taking into considering the phasing of the new carriageway construction is required prior to confirming the preferred option to sustain the level difference in the central reserve.

# 6. CONCLUSION & RECOMMENDATIONS

## 6.1 CONCLUSION

6.1.1 To accommodate the improvements to the A1 highway alignment, 10No. new retaining wall structures shall be required. 6No. Retaining wall structure (referenced RW 1-6) are required along the mainline, and 4No. Retaining walls are required within the central reserve (reference CRW1-4) to accommodate the level difference between the northbound and southbound carriageway.

6.1.2 The following assumptions/constraints, have been considered when assessing the retaining wall options.

- Provision of cost effective/simple solutions
- Minimise land take to ensure this is as low as reasonably practical
- Minimise disruption to traffic on the mainline and ensure a minimum of 2No. running lanes in both directions can be maintained during the works
- Ensure disruption to local residents and business is as low as reasonably practical
- All services potentially impacting the works shall be protected or diverted accordingly
- VRS shall be provided at the top of retaining walls to prevent errant vehicles from falling
- Retaining walls directly adjacent to a traffic face shall be provided with a smooth face (clad or otherwise) in accordance with the requirements of TD19/06 irrespective of a safety barrier provision
- Where practical retaining walls less than 1.5m retaining height shall be considered to be contractor designed elements
- The gradient to embankment is currently based on the provision of 1:3 slopes. At this stage 1:3 slopes are acceptable where class 2 cohesive material is to be placed, but can increase the gradient of the slope to 1 in 2.5 where a granular material is imported and placed. Slopes of 1:3 have been used to reduce the retained height where possible. The maximum permitted gradient of embankment slopes shall be reviewed upon further detailed geotechnical investigation and analysis

- 6.1.3 Various retaining wall options (Sheet Piled/Contiguous Bored Piled/RC Cantilever/King Post Wall/RE Wall) have been assessed and compared to provide retention of ground along the mainline.
- 6.1.4 The limited retained height within the central reserve (min 0.3m/Max 1.0m) due to the level difference between the northbound and southbound carriageway limits the options to either Option 1 – Wide Variable Concrete Step Barrier or Option 2 RC Ground Beam
- 6.1.5 Option 1 requires the installation of a proprietary pre-cast variable concrete step barrier that has a dual purpose of providing adequate VRS containment and limited ground retention up to 300mm retained height. Option 2 is based on the provision of a reinforced concrete ground beam where ground retention is expected to be between 300-1000mm. The ground beam could comprise either cast in-situ or pre-cast construction.

## 6.2 RECOMMENDATION

- 6.2.1 Based on the study to date it is recommended the following retaining wall options be reviewed and developed further during the detailed design phase of the scheme.

REFERENCE	CHAINAGE ON MAINLINE	LOCATION	APPROX LENGTH (M)	MIN RETAINED HT (M)	MAX RETAINED HT(M)	AVERAGE RETAINED HT (M)	OPTIMUM SOLUTION
RW 1	0+340 TO 0+560	MAINLINE/ A1 SOUTHBOUND	220	1.50	2.50	2.00	RC WALL/COST £550K
RW2	0+325 TO 0+420	MAINLINE/ A1 NORTHBOUND	100	0.30	1.70	1.00	SHEET PILED WALL/COST £300K
RW3	0+650 TO 0+796	MAINLINE/ A1 NORTHBOUND ADJACENT TO THE ON SLIP J67	146	1.50	6.00	3.25	REINFORCED EARTH WALL/COST £750K
RW4	0+940 TO 1+060	MAINLINE/ A1 NORTHBOUND ADJACENT TO THE OFF SLIP J67	125	1.50	4.30	2.80	REINFORCED EARTH WALL/COST £350K
RW5	0+940 TO 1+060	MAINLINE/ A1 SOUTHBOUND ADJACENT TO THE ONSLIP J67	120	1.50	3.00	2.25	CONTIGUOUS BORED PILES/COST £450K
RW6	4+140 TO 4+400	MAINLINE/ A1 SOUTHBOUND ADJACENT TO THE OFFSLIP J65	260	1.50	2.50	1.70	KINGPOST WALL/ COST £500K
CRW1	0+515 TO 0+615	CENTRAL RESERVE	100	0.30	0.36	-	TBC-SEE BELOW*
CRW2	1+950 TO 2+220	CENTRAL RESERVE	270	0.30	1.00	-	TBC-SEE BELOW*
CRW3	2+420 TO 2+705	CENTRAL RESERVE	285	0.30	0.50	-	TBC-SEE BELOW*
CRW4	3+270 TO 3+690	CENTRAL RESERVE	420	0.30	0.80	-	TBC-SEE BELOW*
	* Due to the limited retained height and simplicity of the options, it is considered that either option will be classified as a CAT0 structure in accordance with BD2/12 Technical Approval of Highway Structures (no AIP required) and will be classified as low risk construction work that can be readily accommodated as part of the scheme improvement works. Further review, taking into considering the carriageway/VRS design and construction interface to determine the preferred option (1 or 2) to sustain the level difference in the central reserve.						

The following should be undertaken to verify the finding of this report and clarify works to be developed at detailed design stage;

- Further site investigation to determine the location of services and the impact they may have on the retaining wall works
- Review of the carriageway/VRS design and construction to confirm the retaining solution best suited within the central reserve. Although it is noted due to the retained height this work is not anticipated to be onerous.

# Appendix A

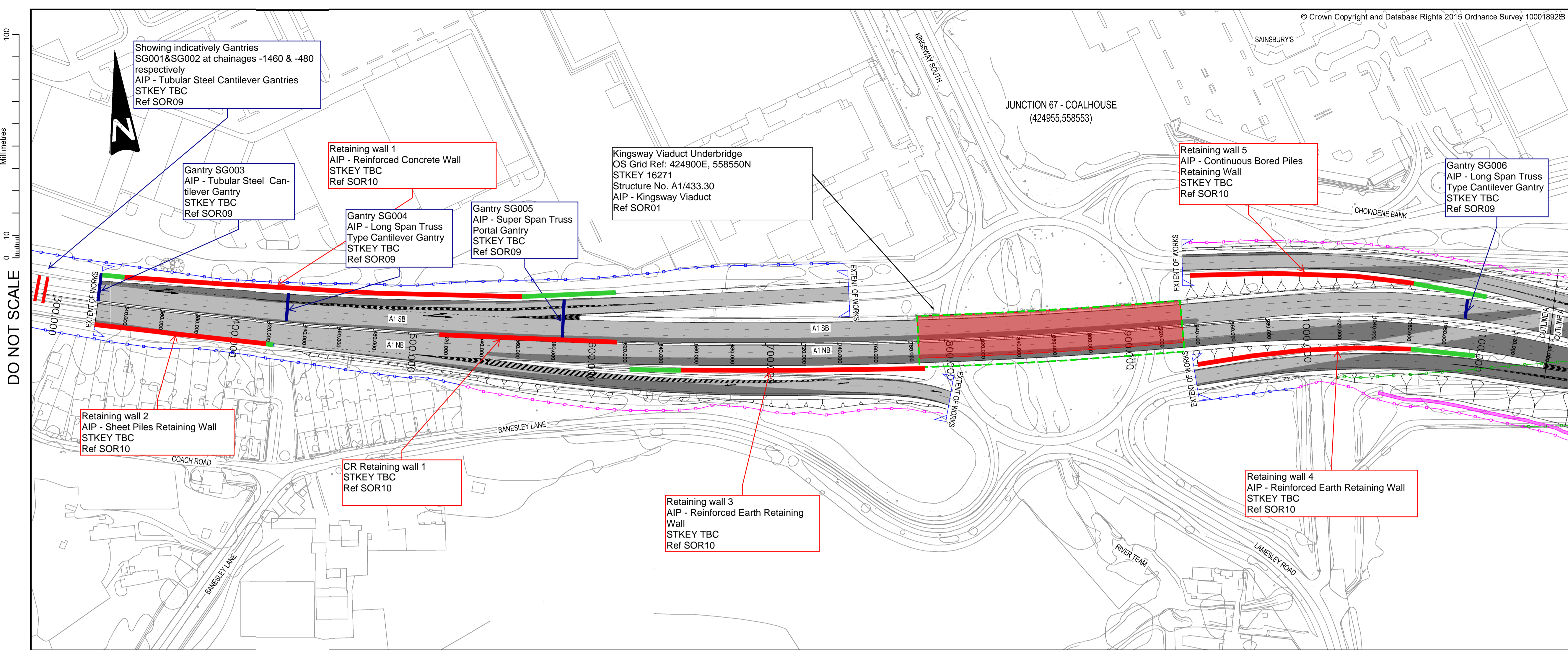
INDICATIVE SCHEMATIC PLANS OF THE PREFERRED ROUTE

APPENDIX A-1

**INDICATIVE SCHEMATIC PLANS OF THE PREFERRED  
ROUTE**

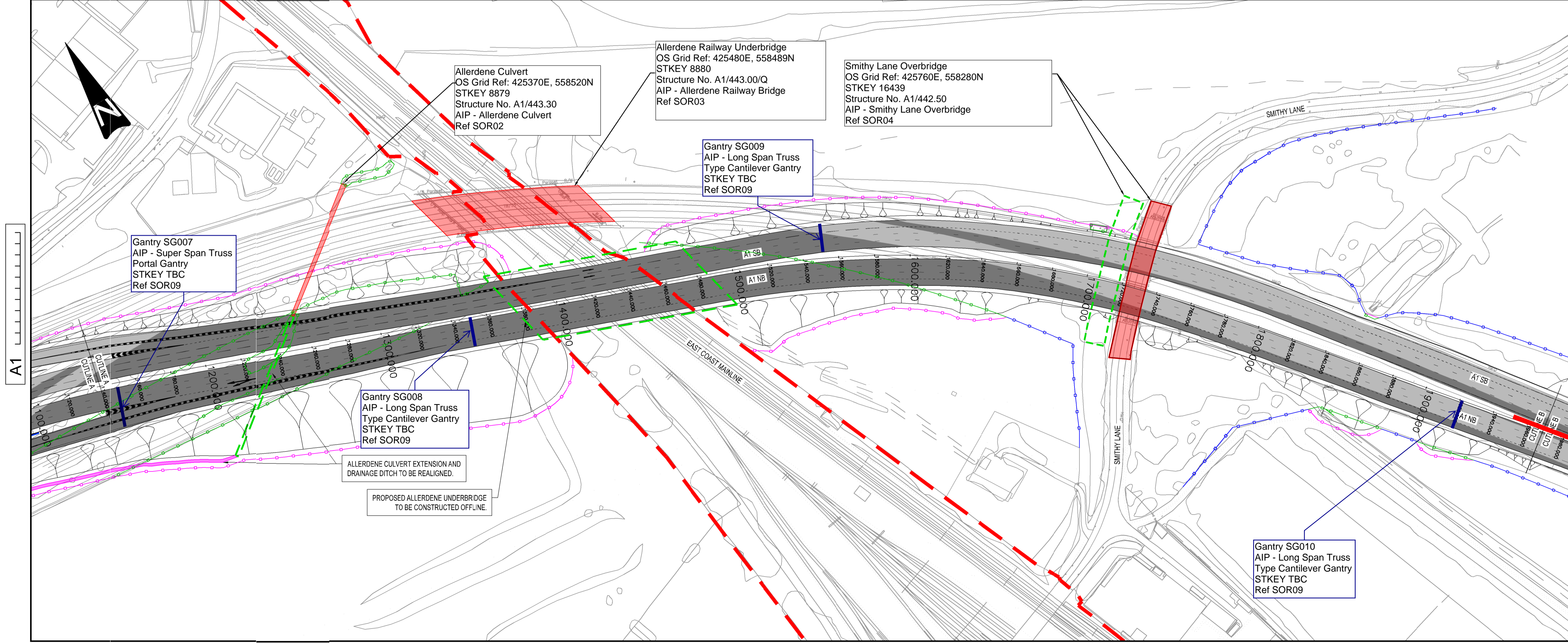
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DO NOT SCALE



**KEY**

- EXISTING STRUCTURE
- PROPOSED STRUCTURE
- PROPOSED RETAINING WALL
- PROPOSED HIGHWAYS FENCE LINE
- RETAINED EXISTING HIGHWAYS FENCE LINE
- REMOVED EXISTING HIGHWAYS FENCE LINE
- NEW CARRIAGEWAY CONSTRUCTION
- EXISTING CARRIAGEWAY TO BE RETAINED
- PROPOSED DRAINAGE DITCH
- NETWORK RAIL LAND BOUNDARY




P01	05/09/16	FOR INFORMATION	JAC		
P02	07/09/16	MINOR AMENDMENTS TO BMS & STRUCTURES CHANGE ADDED	JWL	CP	NGR
P03	07/09/16	ISSUED FOR PUBLIC CONSULTATION	JWL	SG	NGR
P04	10/02/17	DESIGN DEVELOPMENT POST PUBLIC CONSULTATION	JWL	SG	NGR
Rev.	Date	Description	By	Chkd	Apprd

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Project Title **A1 BIRTLEY TO COALHOUSE**

Drawing Title **OPTION 1A - OFFLINE REPLACEMENT OF ALLERDENE RAILWAY BRIDGE WITH RETENTION OF COAL HOUSE JCT GENERAL ARRANGEMENT SHEET 1 OF 3**

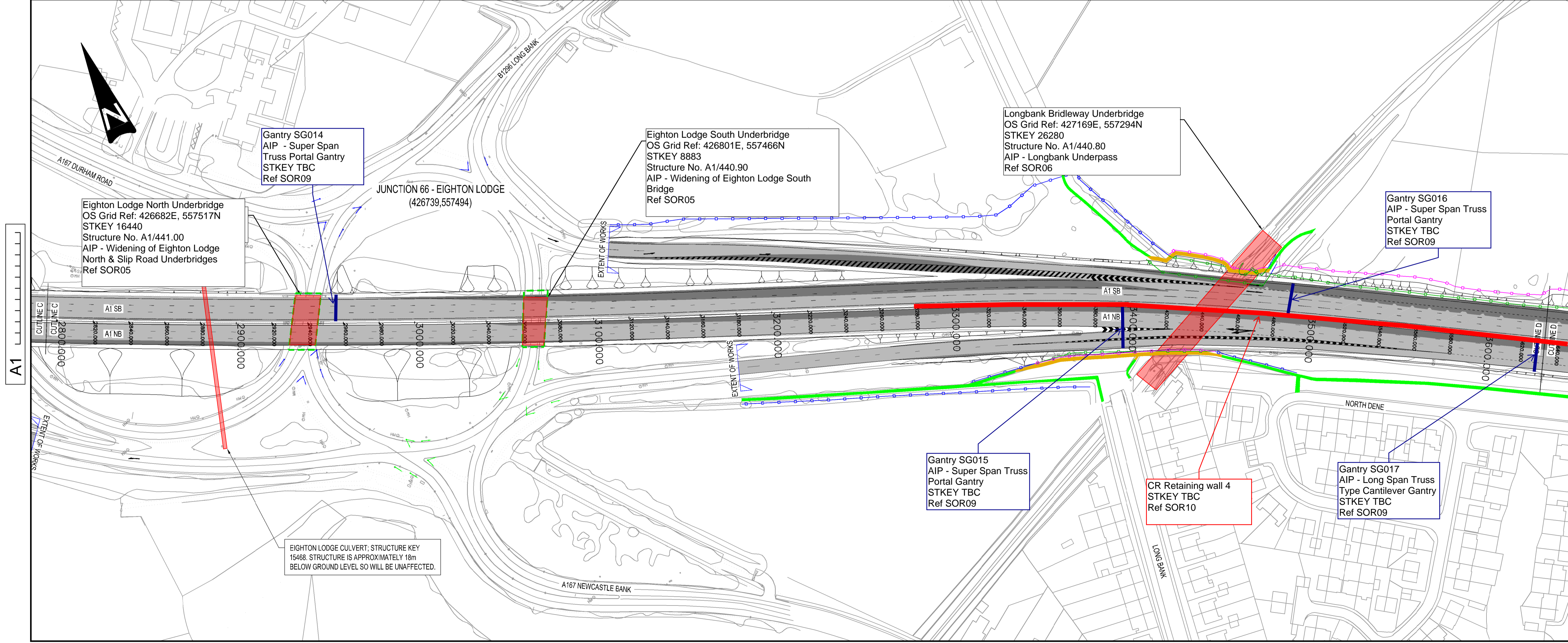
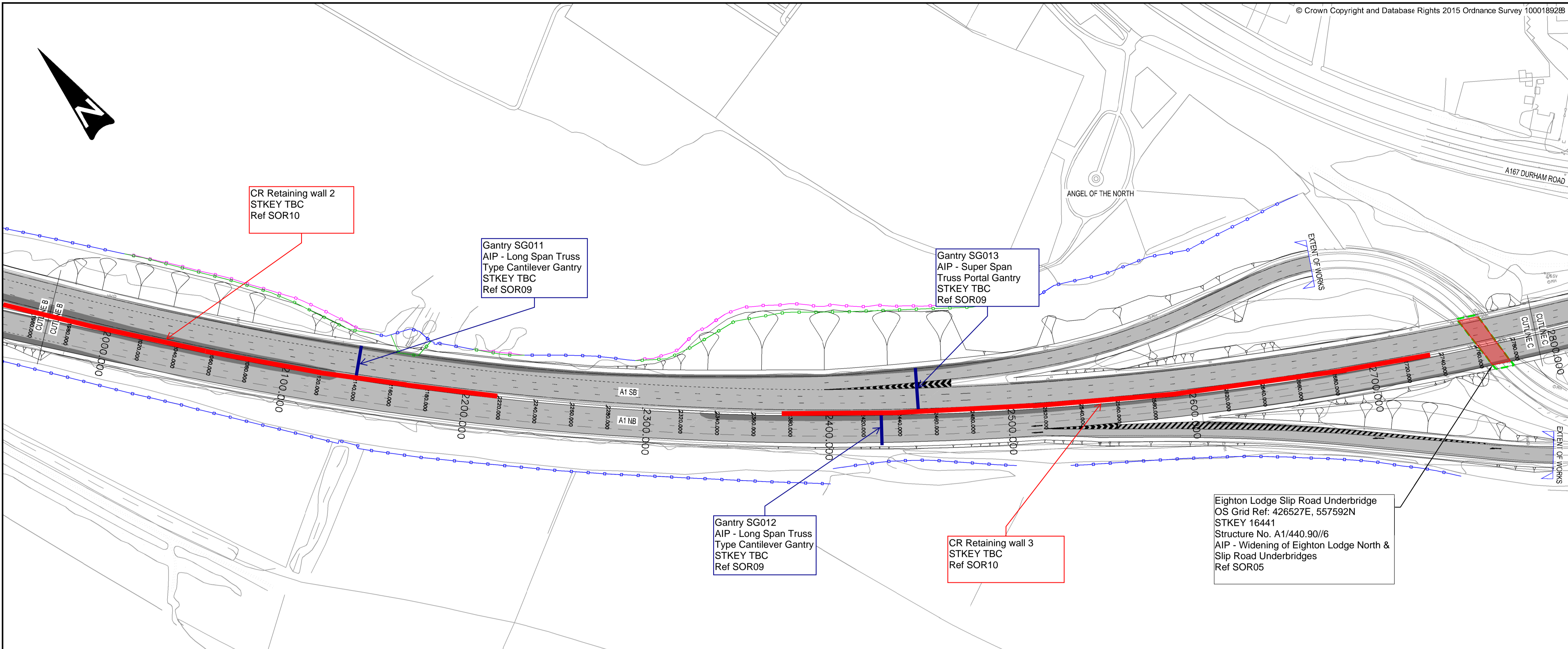
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Drawing Number	HE551462	Project	BCH	Originator	WSP	Volume	HGN	Project Ref. No.	
Location	DR	Type	D	Role	10004	Number		Revision	P04



- KEY**
- EXISTING STRUCTURE
  - PROPOSED STRUCTURE
  - PROPOSED HIGHWAYS FENCE LINE
  - EXISTING HIGHWAYS FENCE LINE
  - REMOVED EXISTING HIGHWAYS FENCE LINE
  - NEW CARRIAGEWAY CONSTRUCTION
  - EXISTING CARRIAGEWAY TO BE RETAINED
  - PROPOSED FOOTPATH DIVERSION
  - EXISTING FOOTPATH
  - PROPOSED SIGNAL
  - EXISTING SIGNAL

DO NOT SCALE

Millimetres  
0 10 100



A1

Rev.	Date	Description	By	Chkd	Appd
P01	05/09/16	FOR INFORMATION	JAC		
P02	07/09/16	MINOR AMENDMENTS TO DWGS & STRUCTURES CHANGE ADDED	JWL	CP	NGR
P03	07/09/16	ISSUED FOR PUBLIC CONSULTATION	JWL	SG	NGR
P04	10/02/17	DESIGN DEVELOPMENT POST PUBLIC CONSULTATION	JWL	SG	NGR

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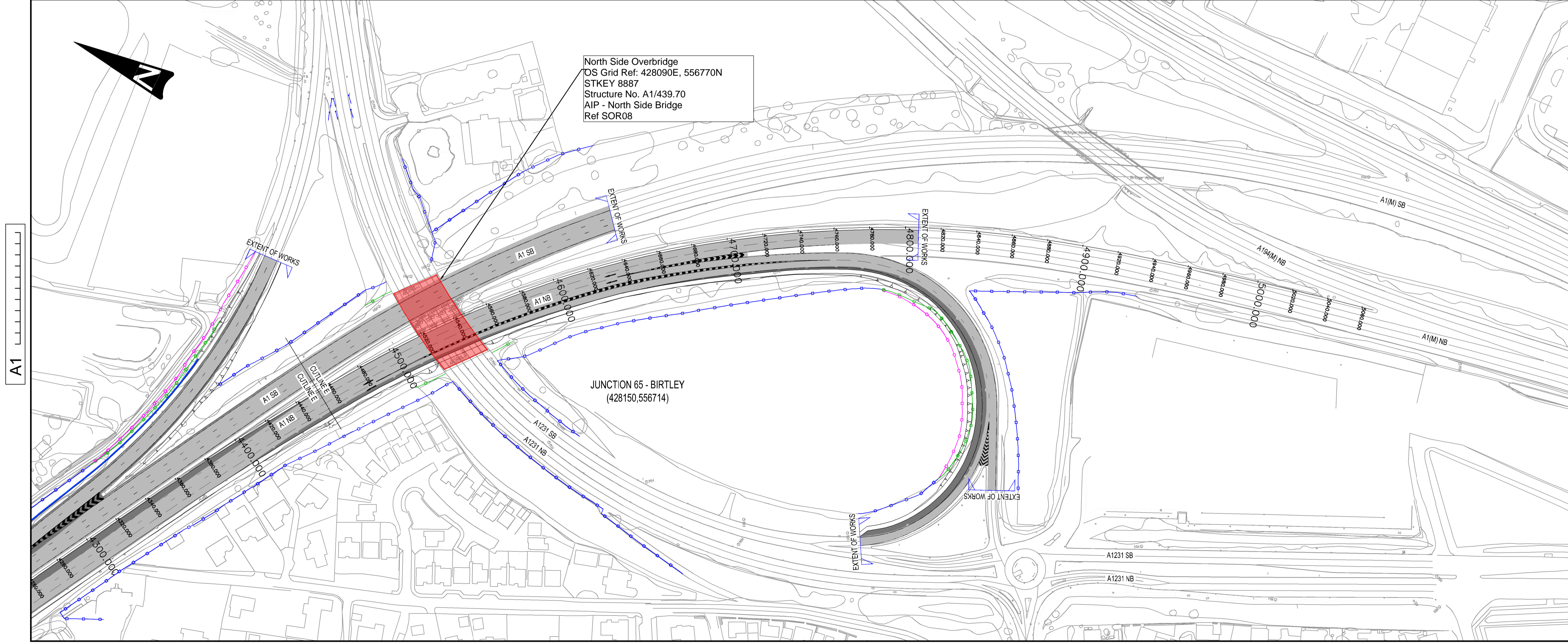
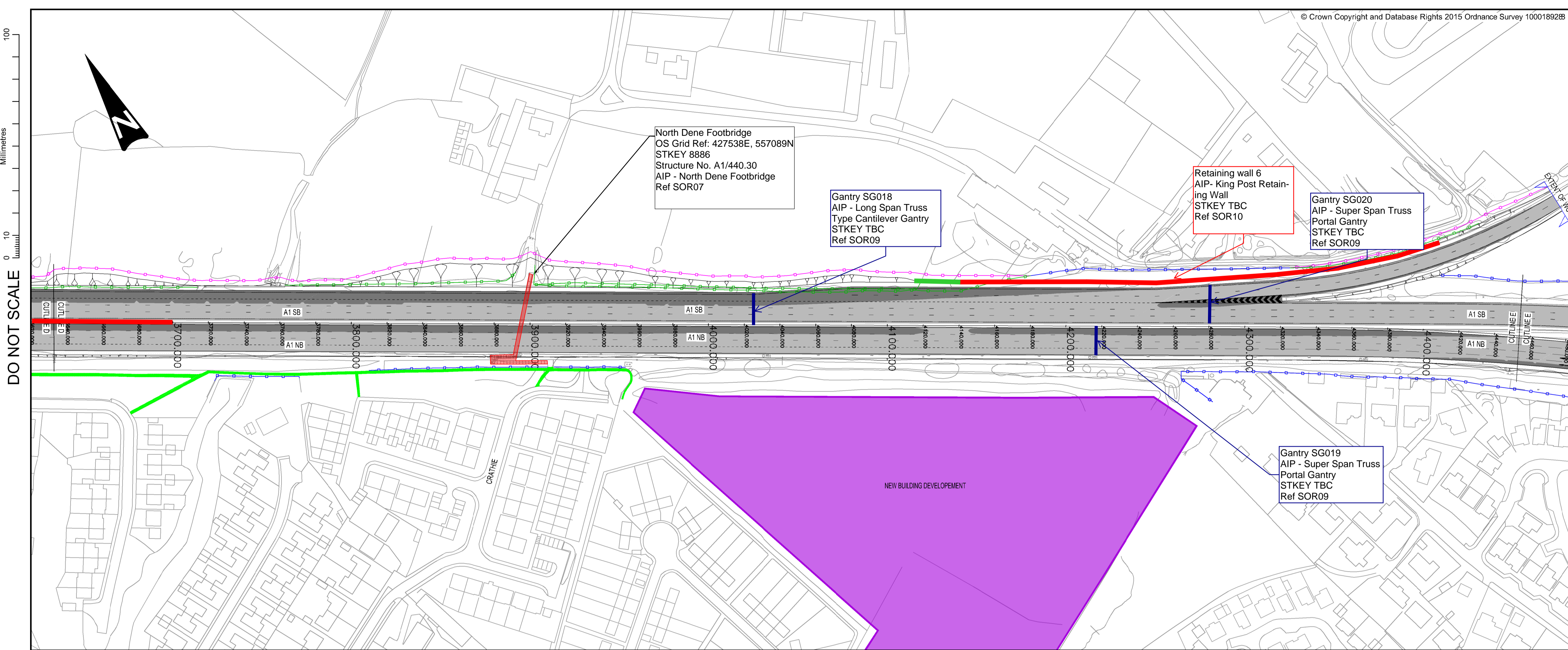
**highways england**

Project Title: **A1 BIRTLEY TO COALHOUSE**

Drawing Title: **OPTION 1A - OFFLINE REPLACEMENT OF ALLERDENE RAILWAY BRIDGE WITH RETENTION OF COAL HOUSE JCT GENERAL ARRANGEMENT SHEET 2 OF 3**

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Drawing Number: HE551462	Project: BCH	Originator: WSP	Volume: HGN	Project Ref. No.: ---
Location: DR	Type: D	Role: 10005	Number: P04	Revision: ---



KEY

- EXISTING STRUCTURE
- PROPOSED RETAINING WALL
- PROPOSED HIGHWAYS FENCE LINE
- EXISTING HIGHWAYS FENCE LINE
- REMOVED EXISTING HIGHWAYS FENCE LINE
- NEW CARRIAGEWAY CONSTRUCTION
- EXISTING CARRIAGEWAY TO BE RETAINED
- PROPOSED FOOTPATH DIVERSION
- EXISTING FOOTPATH
- PROPOSED SIGNAL
- EXISTING SIGNAL

DO NOT SCALE

A1

Rev.	Date	Description	By	Chkd	Appd
P01	05/09/16	FOR INFORMATION	JAC		
P02	07/09/16	MINOR AMENDMENTS TO DIMS & STRUCTURES CHANGE ADDED	JWL	CP	NGR
P03	07/09/16	ISSUED FOR PUBLIC CONSULTATION	JWL	SG	NGR
P04	10/02/17	DESIGN DEVELOPMENT POST PUBLIC CONSULTATION	JWL	SG	NGR

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Project Title **A1 BIRTLEY TO COALHOUSE**

Drawing Title **OPTION 1A - OFFLINE REPLACEMENT OF ALLERDENE RAILWAY BRIDGE WITH RETENTION OF COAL HOUSE JCT GENERAL ARRANGEMENT SHEET 3 OF 3**

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Drawing Status **INITIAL STATUS OR WIP** Suitability **S0**

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Location	DR	Type	D	Role	10006	Number		Revision	P04

# Appendix B

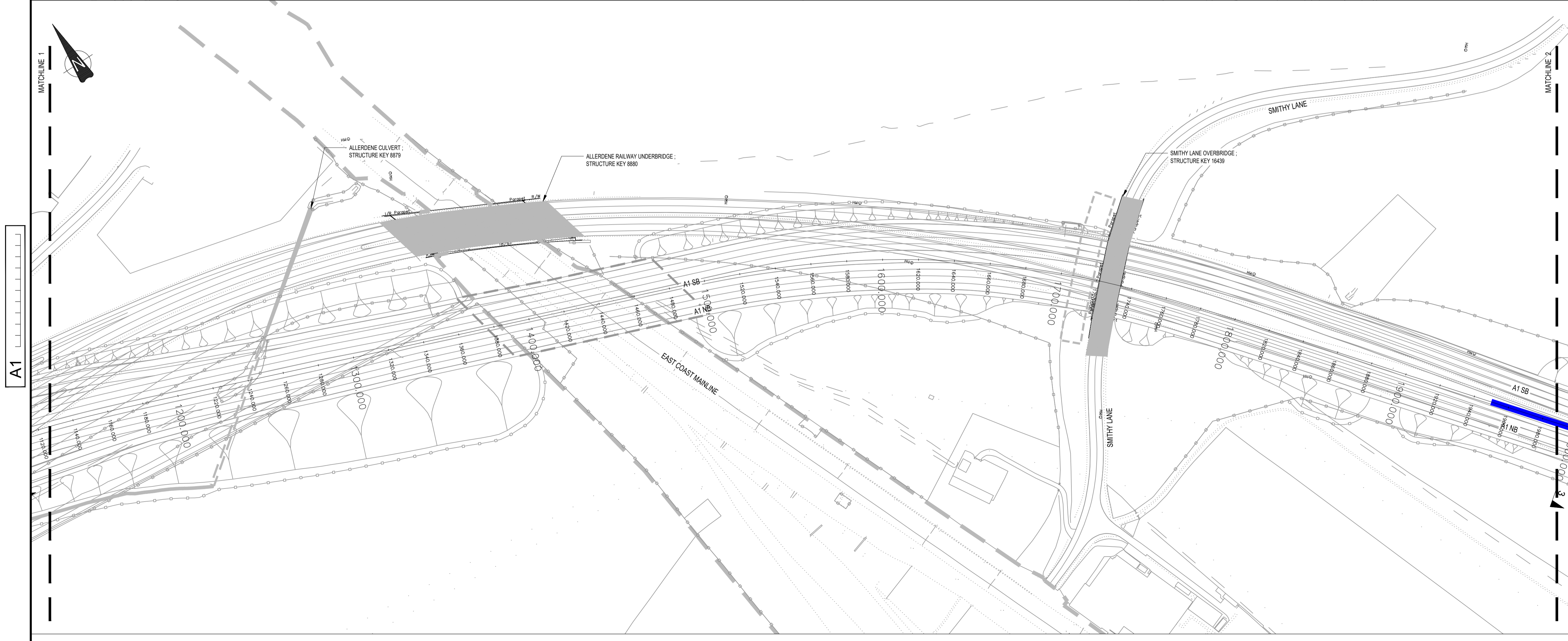
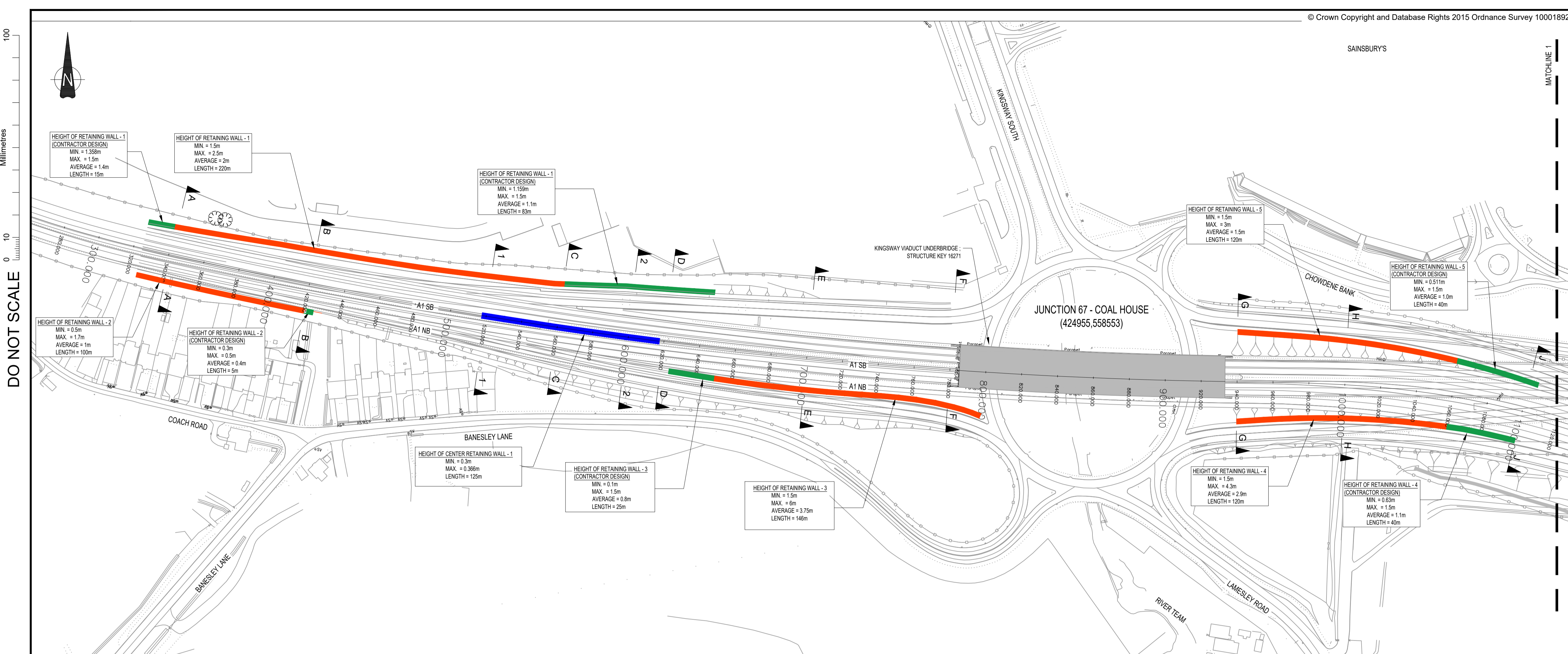
**PLANS & CROSS SECTIONS OF THE PROPOSED NEW RETAINING  
WALLS**

APPENDIX B-1

PLANS OF THE NEW RETAINING WALLS

1. THIS DRAWING HIGHLIGHTS RETAINING WALL STRUCTURAL CONSIDERATION ON A1 BIRTLEY TO COALHOUSE STRENGTHENING WORKS.

- KEY:
- █ PROPOSED RETAINING WALLS ≥ 1.5m HEIGHT
  - █ PROPOSED RETAINING CENTER WALL
  - █ PROPOSED RETAINING WALLS ≤ 1.5m (CONTRACTOR DESIGN)



DO NOT SCALE

A1

Rev.	Date	Description	By	Chkd	App'd
P02	10/04/18	AREAS BELOW 1.5m CONTRACTOR DESIGN	RA	MT	HM
P01	02/02/18	FOR INFORMATION	RA	MT	HM

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Client **Working on behalf of**  
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Project Title **A1 BIRTLEY TO COALHOUSE**

Drawing Title **RETAINING WALL STRUCTURES SHEET 1 OF 3**

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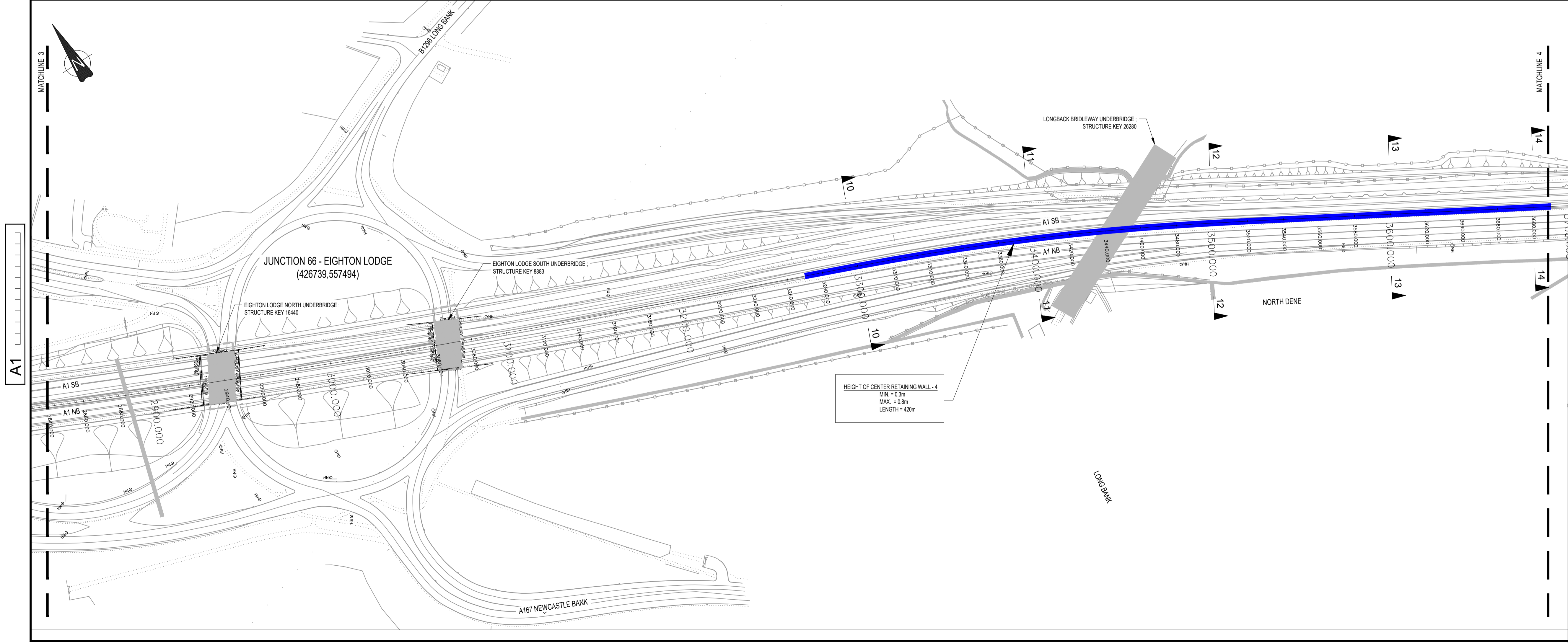
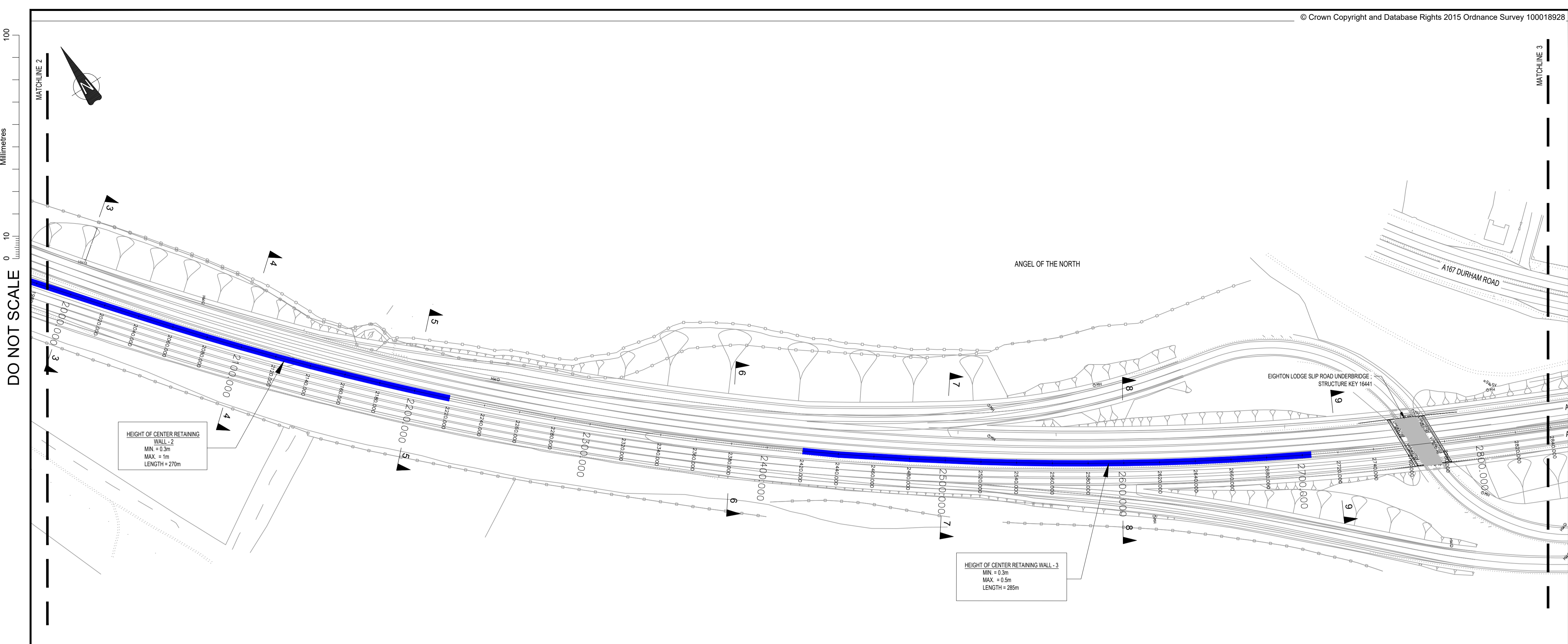
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HE551462	BR008	WSP	SBR	
Location	Type	Role	Number	Revision
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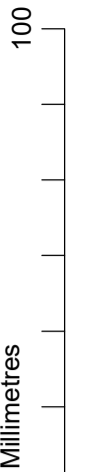
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KEY:

- █ PROPOSED RETAINING WALLS ≥ 1.5m HEIGHT
- █ PROPOSED RETAINING CENTER WALL
- █ PROPOSED RETAINING WALLS ≤ 1.5m (CONTRACTOR DESIGN)



DO NOT SCALE



A1



Rev.	Date	Description	By	Chkd	App'd
P02	10/04/18	AREAS BELOW 1.5m CONTRACTOR DESIGN	RA	MT	HM
P01	02/02/18	FOR INFORMATION	RA	MT	HM

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Client

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**highways  
england**

Project Title: **A1 BIRTLEY TO COALHOUSE**

Drawing Title: **RETAINING WALL STRUCTURES SHEET 2 OF 3**

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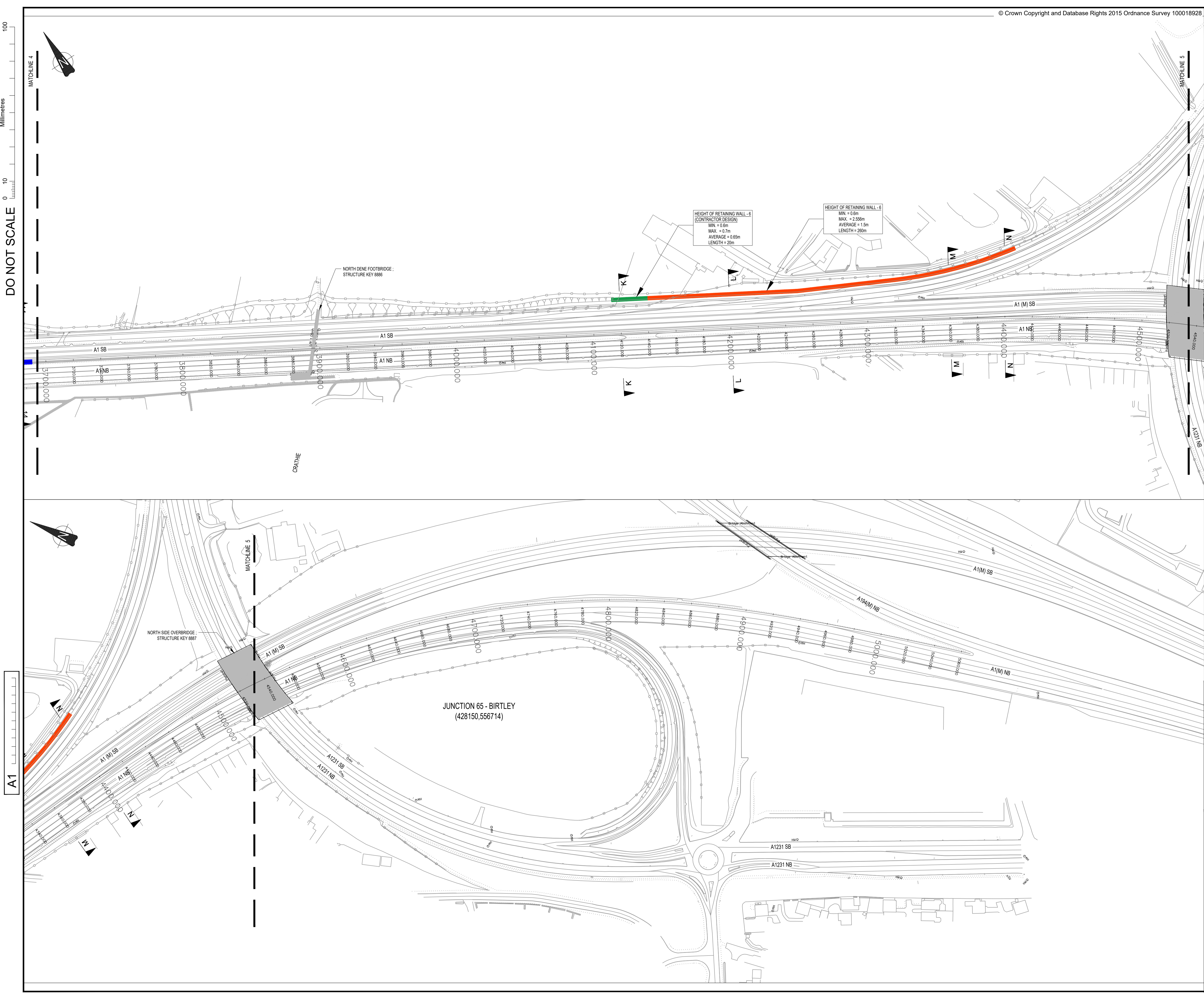
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Location	Type	Role	Number	Revision
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1. THIS DRAWING HIGHLIGHTS RETAINING WALL STRUCTURAL CONSIDERATION ON A1 BIRTLEY TO COALHOUSE STRENGTHENING WORKS.

KEY:

- █ PROPOSED RETAINING WALLS ≥ 1.5m HEIGHT
- █ PROPOSED RETAINING CENTER WALL
- █ PROPOSED RETAINING WALLS ≤ 1.5m (CONTRACTOR DESIGN)



DO NOT SCALE

A1

Rev.	Date	Description	By	Chkd	App'd
P02	10/04/18	AREAS BELOW 1.5m CONTRACTOR DESIGN	RA	MT	HM
P01	02/02/18	FOR INFORMATION	RA	MT	HM

**wsp**

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wsp.com

Client

Working on behalf of  
**highways  
england**

Project Title **A1 BIRTLEY TO COALHOUSE**

Drawing Title **RETAINING WALL STRUCTURES SHEET 3 OF 3**

Scale	Drawn	Checked	Approved	Authorised
1:1000	R.Ayre	M.Tziolas	H.Mistry	N.Rawcliffe
Original Size	Date	Date	Date	Date
A1	10/04/18	10/04/18	10/04/18	10/04/18

Drawing Status **FIT FOR COORDINATION** Suitability **S1**

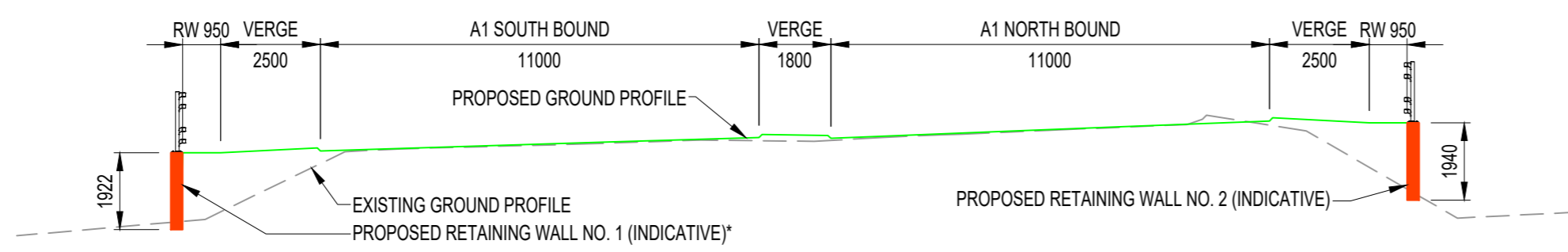
Project	Originator	Volume	Project Ref. No.
HE551462	WSP	SBR	
Location	Type	Role	Number
BR008	DR	S	00003
			P02

APPENDIX B-2

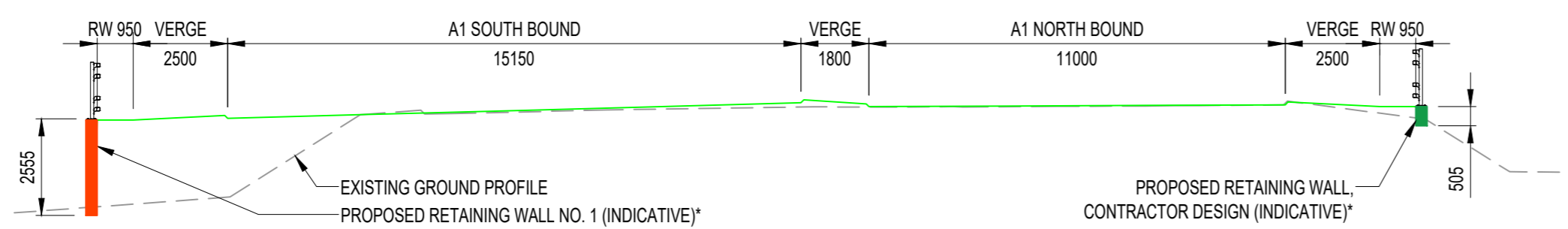
**CROSS SECTIONS AT THE NEW RETAINING WALL  
LOCATIONS**

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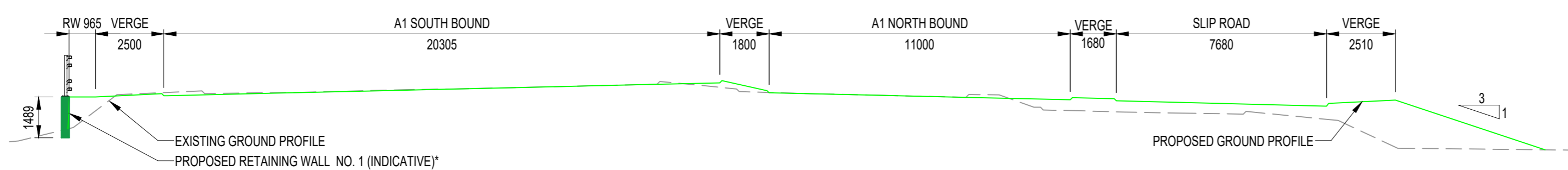




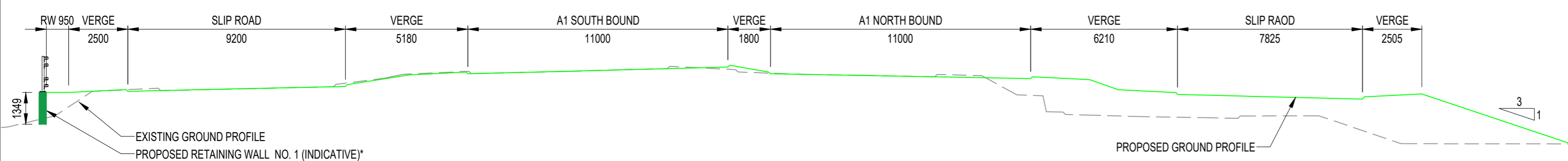
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SCALE 1:150



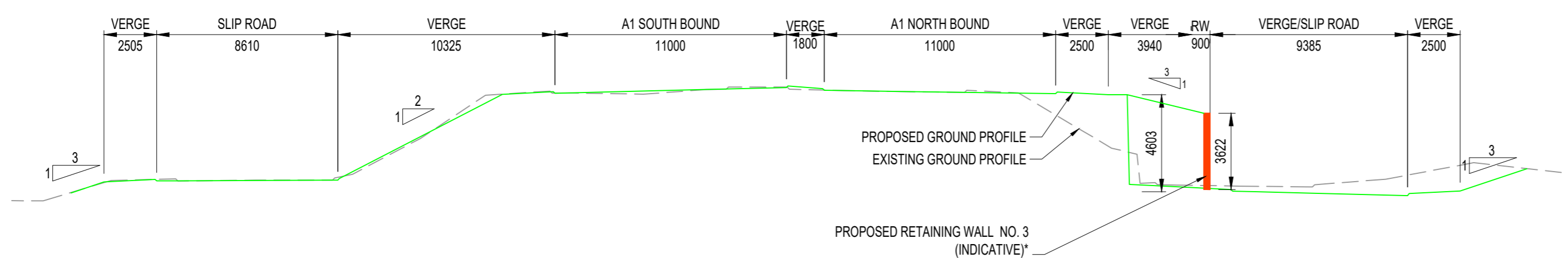
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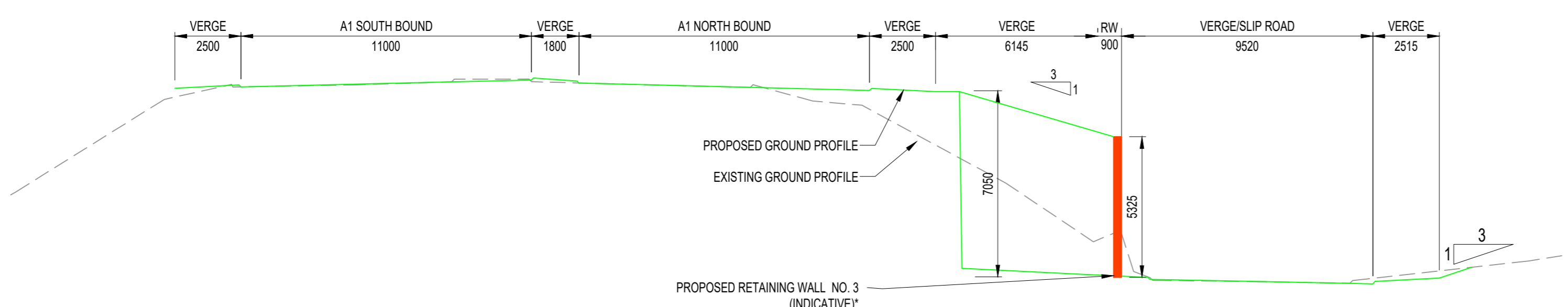
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SCALE 1:150



SECTION D-D @ Ch620  
SCALE 1:150



SECTION E-E @ Ch700  
SCALE 1:200



SECTION F-F @ Ch780  
SCALE 1:150

- NOTES**
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
  2. ALL LEVELS ARE IN METER A.O.D., UNLESS NOTED OTHERWISE.
  3. DO NOT SCALE IN CASE OF ANY DOUBTS, OMISSIONS, OR ERRORS. SEEK CLARIFICATION FROM THE DESIGNER.
  4. FOR LOCATION OF CROSS SECTIONS REFER TO LOCATION PLAN DRAWING NO. T.B.C.

- KEY**
- PROPOSED GROUND PROFILE
  - EXISTING GROUND PROFILE
  - PROPOSED RETAINING WALLS ≥ 1.5m HEIGHT
  - PROPOSED RETAINING WALLS ≤ 1.5m HEIGHT (CONTRACTOR DESIGN)

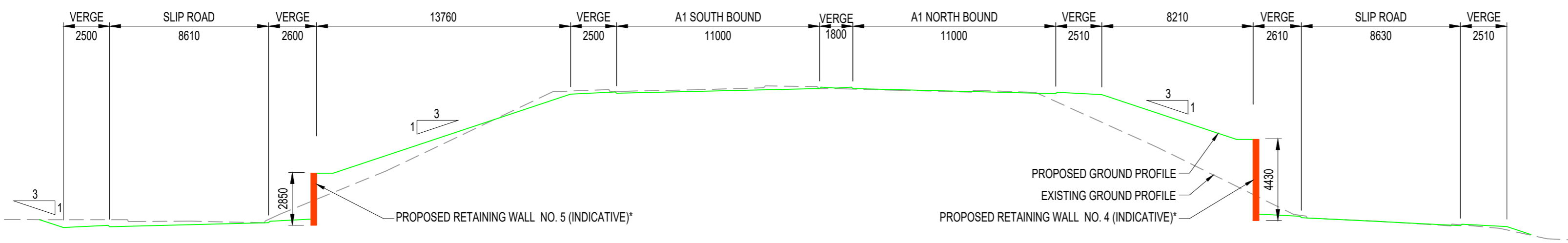
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P01	31/01/18	FOR INFORMATION	AS	MT	HM



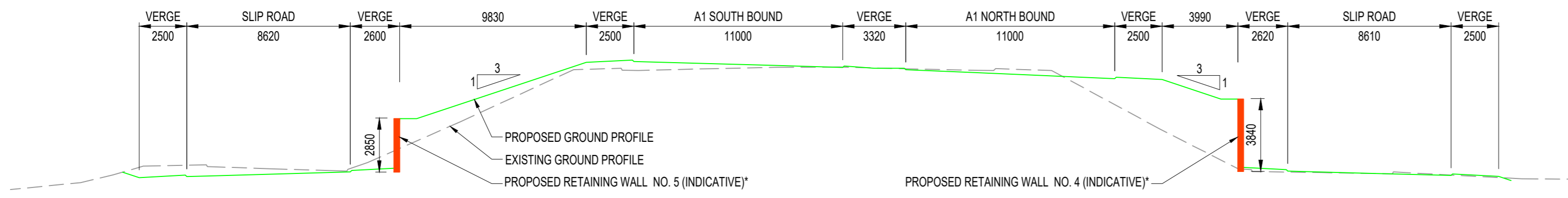
Three White Rose Office Park, Millshaw Park Lane, Leeds, LS11 0DL, UK  
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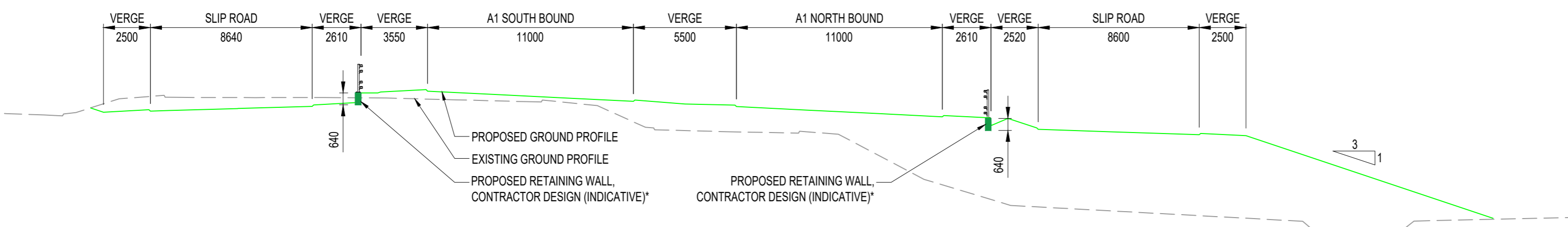
Project Title <b>A1 BIRTLEY TO COALHOUSE</b>					
Drawing Title <b>RETAINING WALL CROSS SECTIONS (SHEET 1 OF 5)</b>					
Scale AS SHOWN	Drawn R. Ayre	Checked M. Tziolas	Approved H. Mistry	Authorised H. Mistry	
Original Size A1	Date 20/04/18	Date 20/04/18	Date 20/04/18	Date 20/04/18	
Drawing Status <b>FOR INFORMATION</b>					Suitability <b>S1</b>
Drawing Number HE551462		Project Originator WSP		Project Volume SBR	
Location BR008		Type/Role DR S		Number 0004	
Project Ref. No. P02					Revision



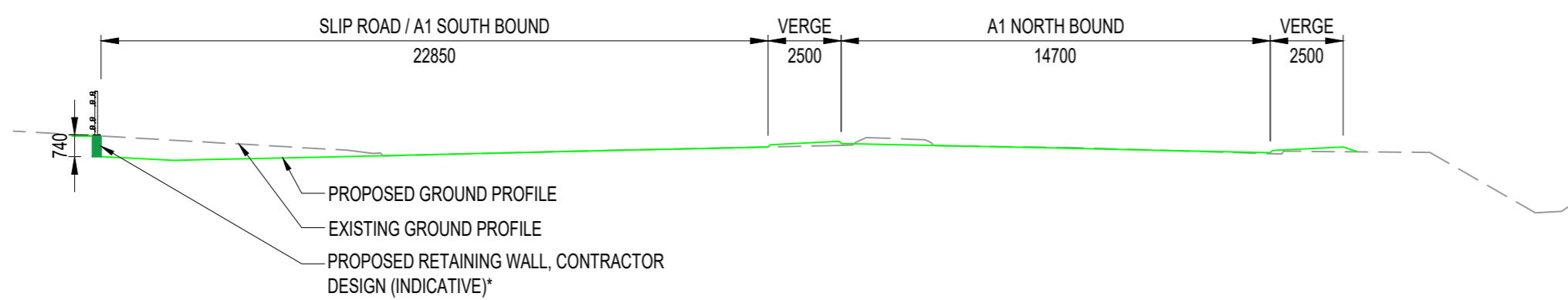
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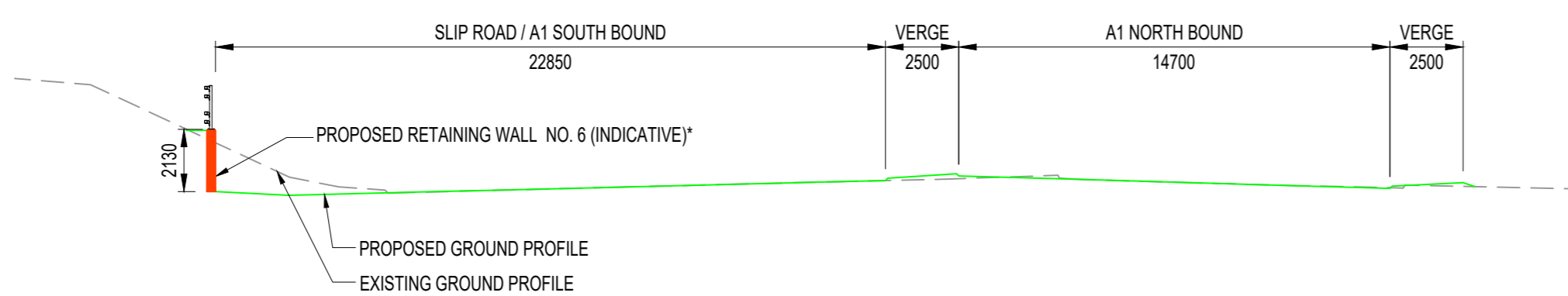
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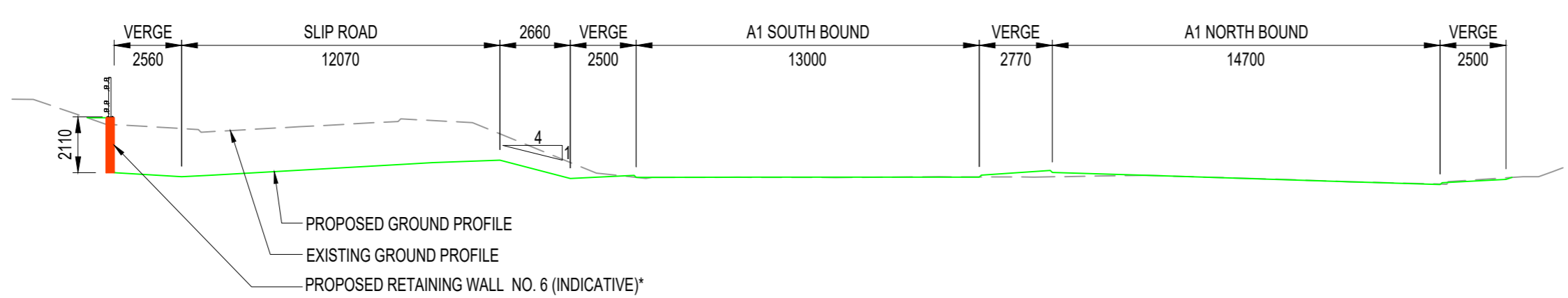
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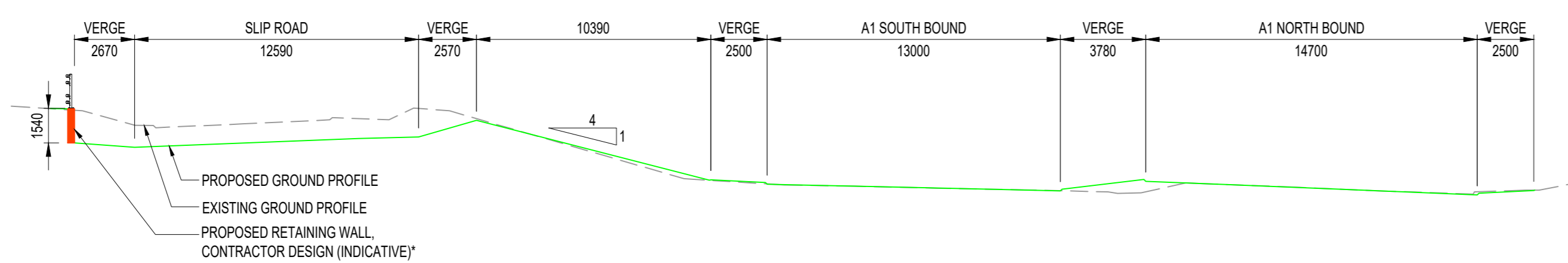
SECTION K-K @ Ch4120  
SCALE 1:200



SECTION L-L @ Ch4200  
SCALE 1:200



SECTION M-M @ Ch4360  
SCALE 1:200



SECTION N-N @ Ch4400  
SCALE 1:200

- NOTES**
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
  2. ALL LEVELS ARE IN METER A.O.D., UNLESS NOTED OTHERWISE.
  3. DO NOT SCALE IN CASE OF ANY DOUBTS, OMISSIONS, OR ERRORS. SEEK CLARIFICATION FROM THE DESIGNER.
  4. FOR LOCATION OF CROSS SECTIONS REFER TO LOCATION PLAN DRAWING NO. T.B.C.

- KEY**
- PROPOSED GROUND PROFILE
  - EXISTING GROUND PROFILE
  - PROPOSED RETAINING WALLS ≥ 1.5m HEIGHT
  - PROPOSED RETAINING WALLS ≤ 1.5m HEIGHT (CONTRACTOR DESIGN)

Rev.	Date	Description	By	Chk'd	App'd
P02	20/04/18	AREAS BELOW 1.5m CONTRACTOR DESIGN	RA	MT	HM
P01	31/01/18	FOR INFORMATION	AS	MT	HM



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Client: **Working on behalf of**  
**highways england**

Project Title: **A1 BIRTLEY TO COALHOUSE**

Drawing Title: **RETAINING WALL CROSS SECTIONS (SHEET 2 OF 5)**

Scale	Drawn	Checked	Approved	Authorised
AS SHOWN	R. Ayre	M. Tziolas	H. Mistry	H. Mistry
Original Size	Date	Date	Date	Date
A1	20/04/18	20/04/18	20/04/18	20/04/18



Drawing Status: **FOR INFORMATION** Suitability: **S1**

Drawing Number	Project	Originator	Volume	Project Ref. No.
HE551462	SBR	WSP	SBR	
Location	Type	Role	Number	Revision
BR008	DR	S	0005	P02

NOTES

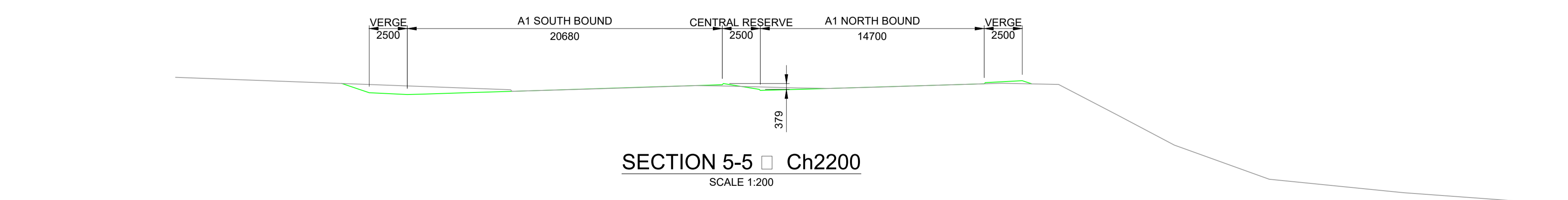
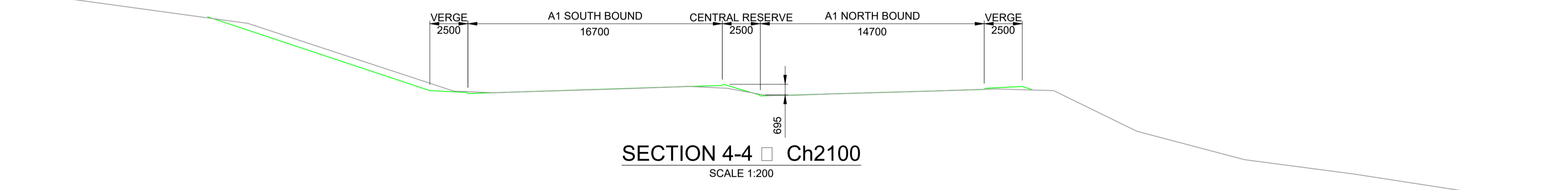
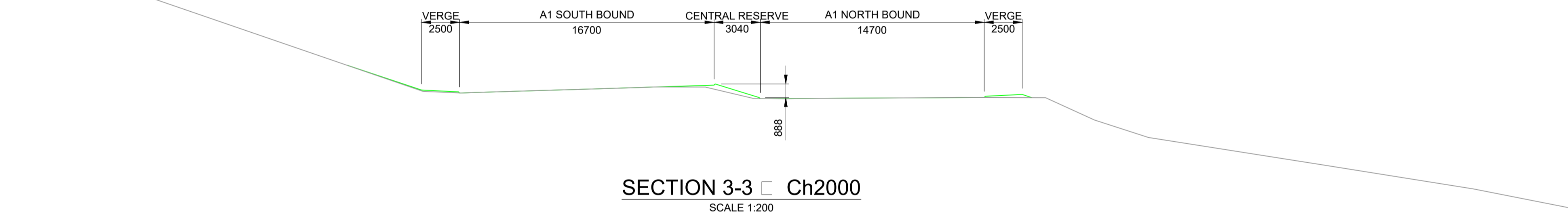
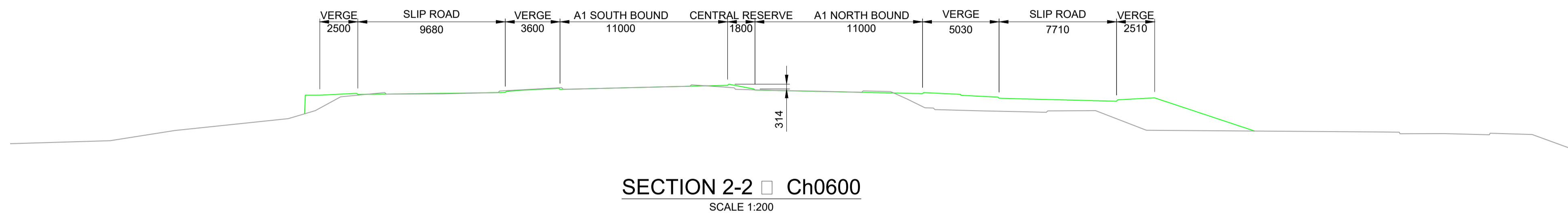
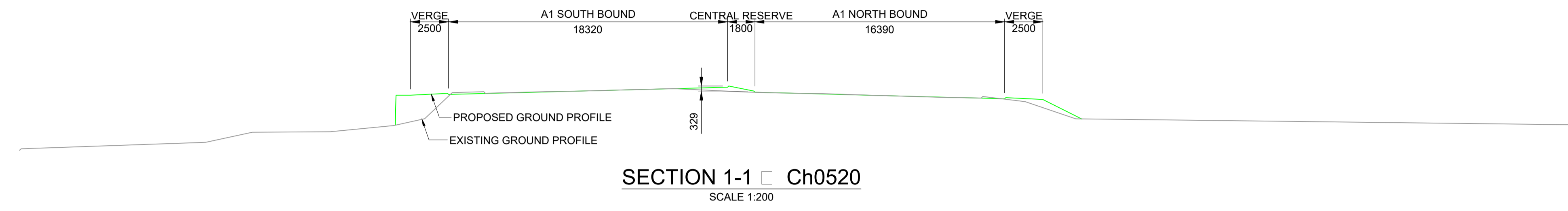
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
2. ALL LEVELS ARE IN METER A.O.D., UNLESS NOTED OTHERWISE.
3. DO NOT SCALE IN CASE OF ANY DOUBTS, OMISSIONS, OR ERRORS. SEEK CLARIFICATION FROM THE DESIGNER.
4. FOR LOCATION OF CROSS SECTIONS REFER TO DRAWING NO. T.B.C.

KEY

PROPOSED GROUND PROFILE:   
 EXISTING GROUND PROFILE: 

DO NOT SCALE

Millimetres  
100  
10  
0



A1

Rev.	Date	Description	By	Chk'd	App'd
P01					

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Client

Working on behalf of  


Project Title: **A1 BIRTLEY TO COALHOUSE**

Drawing Title: **CENTRAL RESERVE RETAINING WALLS CROSS SECTIONS SHEET 1 OF 3**

Scale	Drawn	Checked	Approved	Authorised
1:1000	R.Ayre	M.Tziolas	H.Mistry	N.Rawcliffe
Original Size	Date	Date	Date	Date
A1	02/02/18	02/02/18	02/02/18	02/02/18


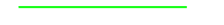
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Drawing Number	Project	Originator	Volume	Project Ref. No.
HE551462	DR	WSP	SBR	
Location	Type	Role	Number	Revision
BR008	DR	S	0006	P01

**NOTES**

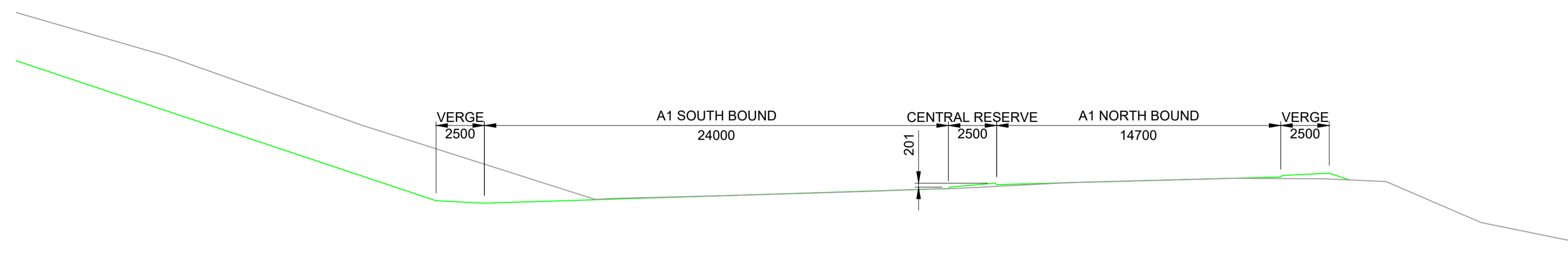
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2. ALL LEVELS ARE IN METER A.O.D., UNLESS NOTED OTHERWISE.
3. DO NOT SCALE IN CASE OF ANY DOUBTS, OMISSIONS, OR ERRORS. SEEK CLARIFICATION FROM THE DESIGNER.
4. FOR LOCATION OF CROSS SECTIONS REFER TO DRAWING NO. T.B.C.

**KEY**

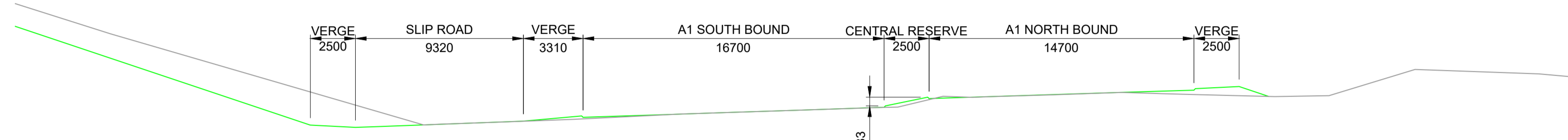
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DO NOT SCALE

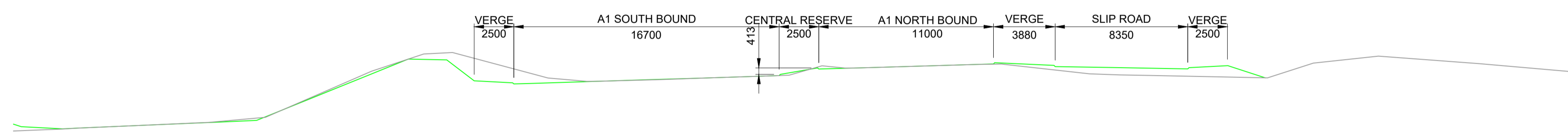
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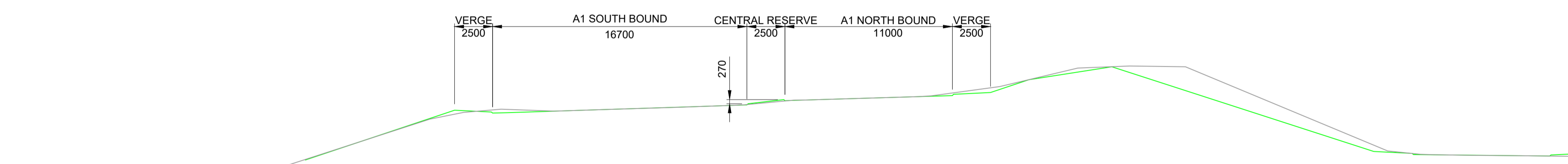
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SCALE 1:200



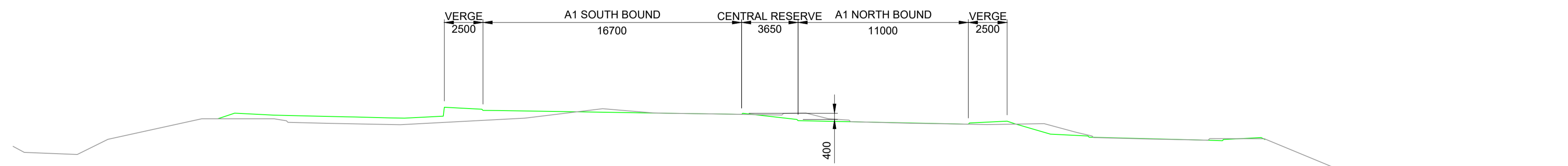
**SECTION 7-7** □ Ch2500  
SCALE 1:200



**SECTION 8-8** □ Ch2600  
SCALE 1:200



**SECTION 9-9** □ Ch2720  
SCALE 1:200



**SECTION 10-10** □ Ch3300  
SCALE 1:200

Rev.	Date	Description	By	Chk'd	App'd
P01					

  
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Project Title **A1 BIRTLEY TO COALHOUSE**

Drawing Title **CENTRAL RESERVE RETAINING WALLS  
 CROSS SECTIONS  
 SHEET 2 OF 3**

Scale	Drawn	Checked	Approved	Authorised
1:1000	R.Ayre	M.Tziolas	H.Mistry	N.Rawcliffe
Original Size	Date	Date	Date	Date
A1	02/02/18	02/02/18	02/02/18	02/02/18



Drawing Status **FIT FOR COORDINATION** Suitability **S1**

Project	Originator	Volume	Project Ref. No.
HE551462	WSP	SBR	
Location	Type	Role	Number
BR008	DR	S	00007
			P01

**NOTES**

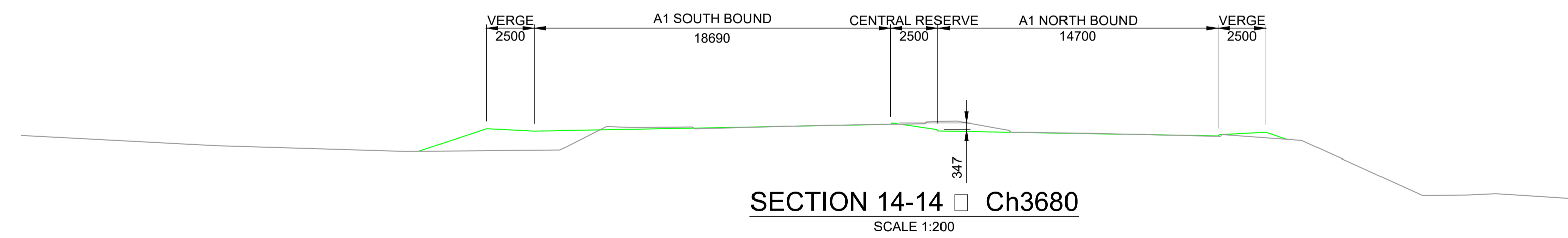
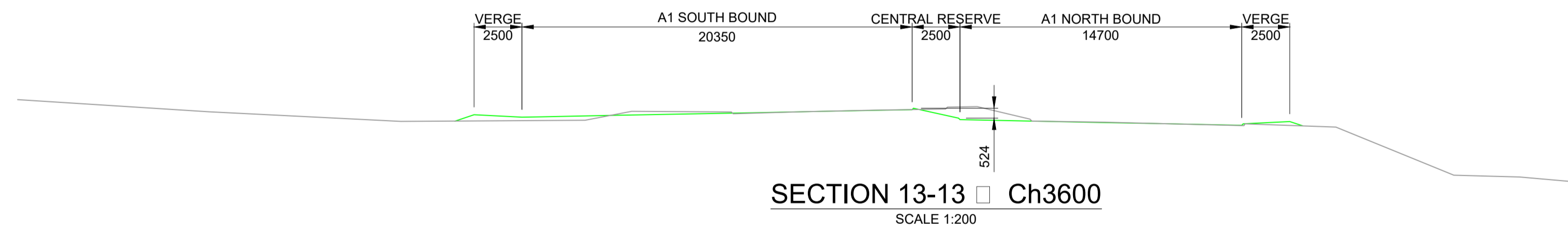
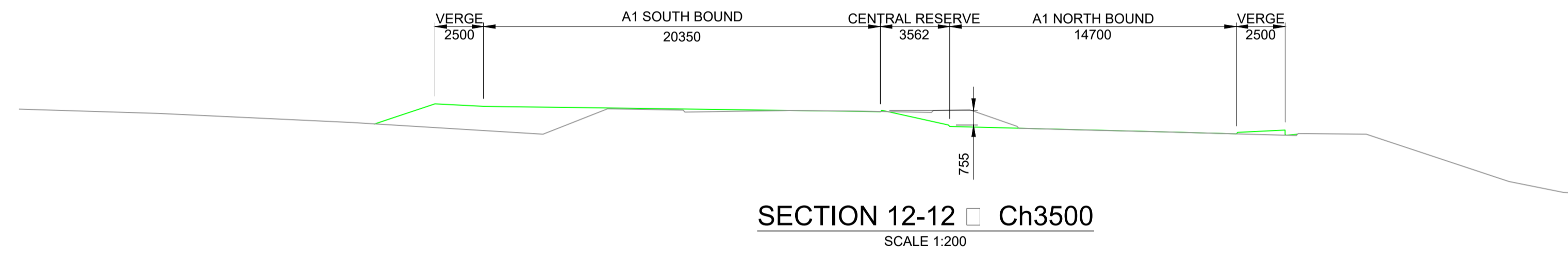
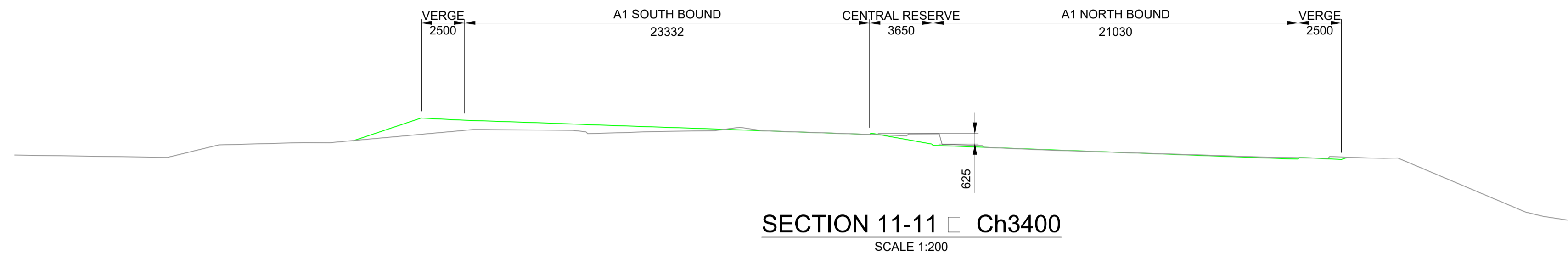
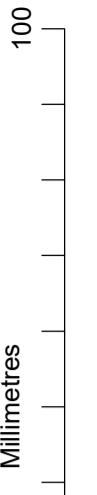
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
2. ALL LEVELS ARE IN METER A.O.D., UNLESS NOTED OTHERWISE.
3. DO NOT SCALE IN CASE OF ANY DOUBTS, OMISSIONS, OR ERRORS. SEEK CLARIFICATION FROM THE DESIGNER.
4. FOR LOCATION OF CROSS SECTIONS REFER TO DRAWING NO. T.B.C.

**KEY**

PROPOSED GROUND PROFILE:   
 EXISTING GROUND PROFILE: 

DO NOT SCALE

A1



Rev.	Date	Description	By	Chk'd	App'd
P01					



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Project Title **A1 BIRTLEY TO COALHOUSE**

Drawing Title **CENTRAL RESERVE RETAINING WALLS  
CROSS SECTIONS  
SHEET 3 OF 3**

Scale	Drawn	Checked	Approved	Authorised
1:1000	R.Ayre	M.Tziolas	H.Mistry	N.Rawcliffe
Original Size	Date	Date	Date	Date
A1	02/02/18	02/02/18	02/02/18	02/02/18

Drawing Status **FIT FOR COORDINATION** Suitability **S1**

Project	Originator	Volume	Project Ref. No.
HE551462	WSP	SBR	
Location	Type	Role	Number
BR008	DR	S	00008

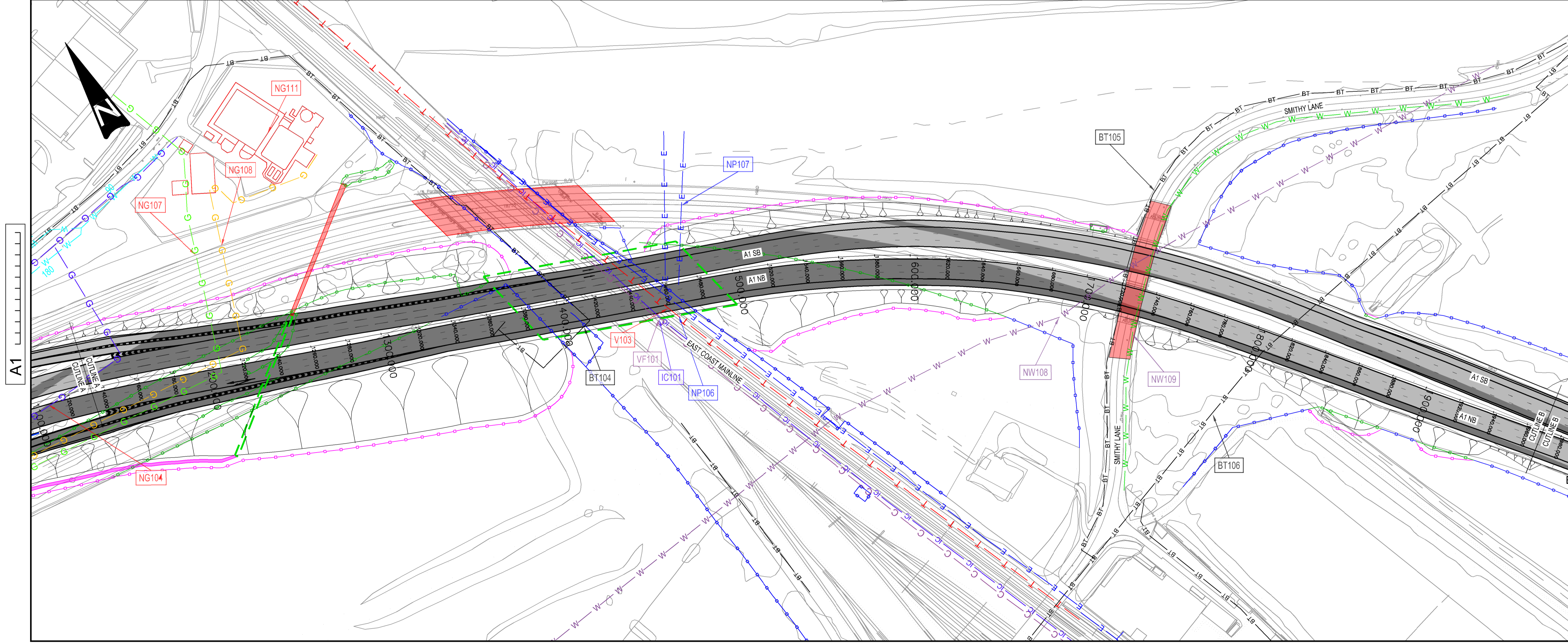
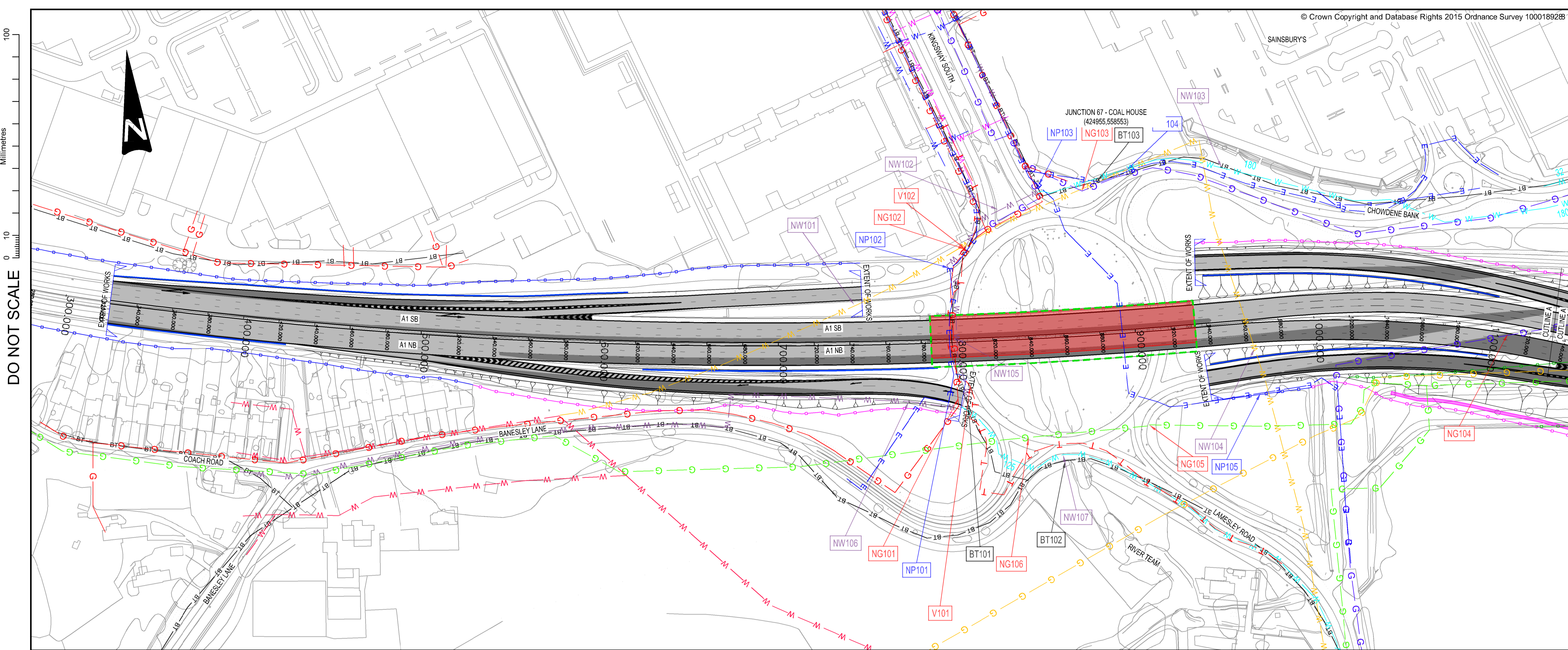
Revision **P01**

# Appendix C

STATUTORY UNDERTAKES INFORMATION

APPENDIX C-1

**STATUTORY UNDERTAKERS DRAWINGS**



**KEY**

[Red solid line]	EXISTING STRUCTURE
[Green dashed line]	PROPOSED STRUCTURE
[Blue solid line]	PROPOSED RETAINING WALL
[Pink dashed line]	PROPOSED HIGHWAYS FENCE LINE
[Blue dashed line]	EXISTING HIGHWAYS FENCE LINE
[Black solid line]	NEW CARRIAGEWAY CONSTRUCTION
[Grey solid line]	EXISTING CARRIAGEWAY TO BE RETAINED
[Pink solid line]	PROPOSED DRAINAGE DITCH
[Yellow solid line]	PROPOSED FOOTPATH DIVERSION
[Green solid line]	EXISTING FOOTPATH
[Black line with 'BT']	BT DUCT
[Blue line with 'IC']	INSTALCOM
[Red line with 'W']	NORTHUMBRIAN WATER COMBINED
[Pink line with 'W']	NORTHUMBRIAN WATER FOUL
[Yellow line with 'W']	NORTHUMBRIAN WATER ABANDONED
[Blue line with 'W']	NORTHUMBRIAN WATER SURFACE
[Purple line with 'W']	NORTHUMBRIAN WATER TREATED
[Cyan line with 'W']	NORTHUMBRIAN WATER DISTRIBUTION
[Light green line with 'W']	NON NORTHUMBRIAN WATER PRIVATE
[Red line with 'G']	NORTHERN GAS LOW PRESSURE
[Blue line with 'G']	NORTHERN GAS MEDIUM PRESSURE
[Green line with 'G']	NORTHERN GAS INTERMEDIATE PRESSURE
[Orange line with 'G']	NORTHERN GAS REGIONAL HIGH PRESSURE
[Red line with 'T']	VIRGIN MEDIA CABLE
[Blue line with 'E']	NORTHERN POWER GRID CABLE
[Purple line with 'C']	VODAFONE CABLE
[Box with 'IC01']	UTILITY REFERENCE

- NOTES**
1. LOCATION OF SERVICE PLANT SHOWN ON THIS DRAWING HAS BEEN OBTAINED FROM CC STATUTORY UNDERTAKERS RETURNS AND IS SHOWN INDICATIVELY. THE STATUTORY UNDERTAKERS ARE TO SATISFY THEMSELVES OF THE LOCATION AND EXTENTS OF SERVICE PLANT.
  2. REFER TO SECTION 3.10 OF THE TECHNICAL APPRAISAL REPORT FOR DETAILS OF THE DIVERSION WORKS PROPOSED.
  3. ALL DIAMETERS OF WATER MAINS ARE MEASURED IN MILLIMETERS UNLESS OTHERWISE STATED.

**IMPORTANT WARNING**

THE INFORMATION CONCERNING THE LOCATION AND/OR DEPTH OF THE PUBLIC UTILITY APPARATUS IS PROVIDED ON THIS DRAWING AS AN INDICATIVE GUIDE ONLY. NO GUARANTEE AS TO THEIR CORRECTNESS IS GIVEN OR IMPLIED.

THESE DRAWINGS SHOULD NOT BE RELIED UPON IN THE EVENT OF EXCAVATIONS OR OTHER WORKS MADE NEAR TO THE APPARATUS, WHICH MAY EXIST AT VARIOUS DEPTHS AND MAY DEVIATE FROM THE MARKED ROUTE. IT SHOULD ALSO BE NOTED THAT A SINGLE LINE SHOWN ON THE PLAN MAY INDICATE THE PRESENCE OF MORE THAN ONE CABLE.

THE CONTRACTOR IS REQUIRED TO ENSURE THAT THE LOCATIONS OF BELOW GROUND SERVICES ARE ESTABLISHED/CONFIRMED ON SITE PRIOR TO ANY EXCAVATIONS OR OTHER WORKS WHICH MAY AFFECT THE EXISTING SERVICES.

PRIOR TO ANY WORKS ON SITE, THE CONTRACTOR SHALL REFER TO:  
 H5147 - AVOIDING DANGER FROM UNDERGROUND SERVICES (BY HSE)  
 H5185 - HEALTH & SAFETY IN EXCAVATIONS (BY HSE)  
 CONSTRUCTION INFORMATION SHEET (CIS) 4 - SAFETY IN EXCAVATIONS (BY HSE)  
 GENERAL SERIES (GS) 6 - AVOIDANCE OF DANGER FROM OVERHEAD ELECTRIC LINES (BY HSE)

22/05/17					
P01	22/05/17	JSM/T		J.S	SG NGR
P02	23/05/17	Design update, N2011 added		J.S	SG NGR
Rev.	Date	Description	By	Chk'd	App'd

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 Tel: +44 (0)113 395 6200

**PARSONS BRINCKERHOFF**

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Client **Working on behalf of**  
**highways england**

Project Title **A1 BIRTLEY TO COALHOUSE**

Drawing Title **OPTION 1A - OFFLINE REPLACEMENT OF ALLERDENE RAILWAY BRIDGE EXISTING STATUTORY UNDERTAKERS APPARATUS SHEET 1 OF 3**

Scale	1:1250	Drawn	J.Singh	Checked	S.Ghosh	Approved	N.Rawcliffe	Authorised	---
Original Size	A1	Date	23/05/17	Date	23/05/17	Date	23/05/17	Date	---
Drawing Status	INITIAL STATUS OR WIP								S0
Drawing Number	HE551462	Project	BCH	Originator	WSP	Volume	VUT	Project Ref. No.	
Location	DR	Type	D	Role	00001	Number		Revision	P02

Millimetres  
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**DO NOT SCALE**

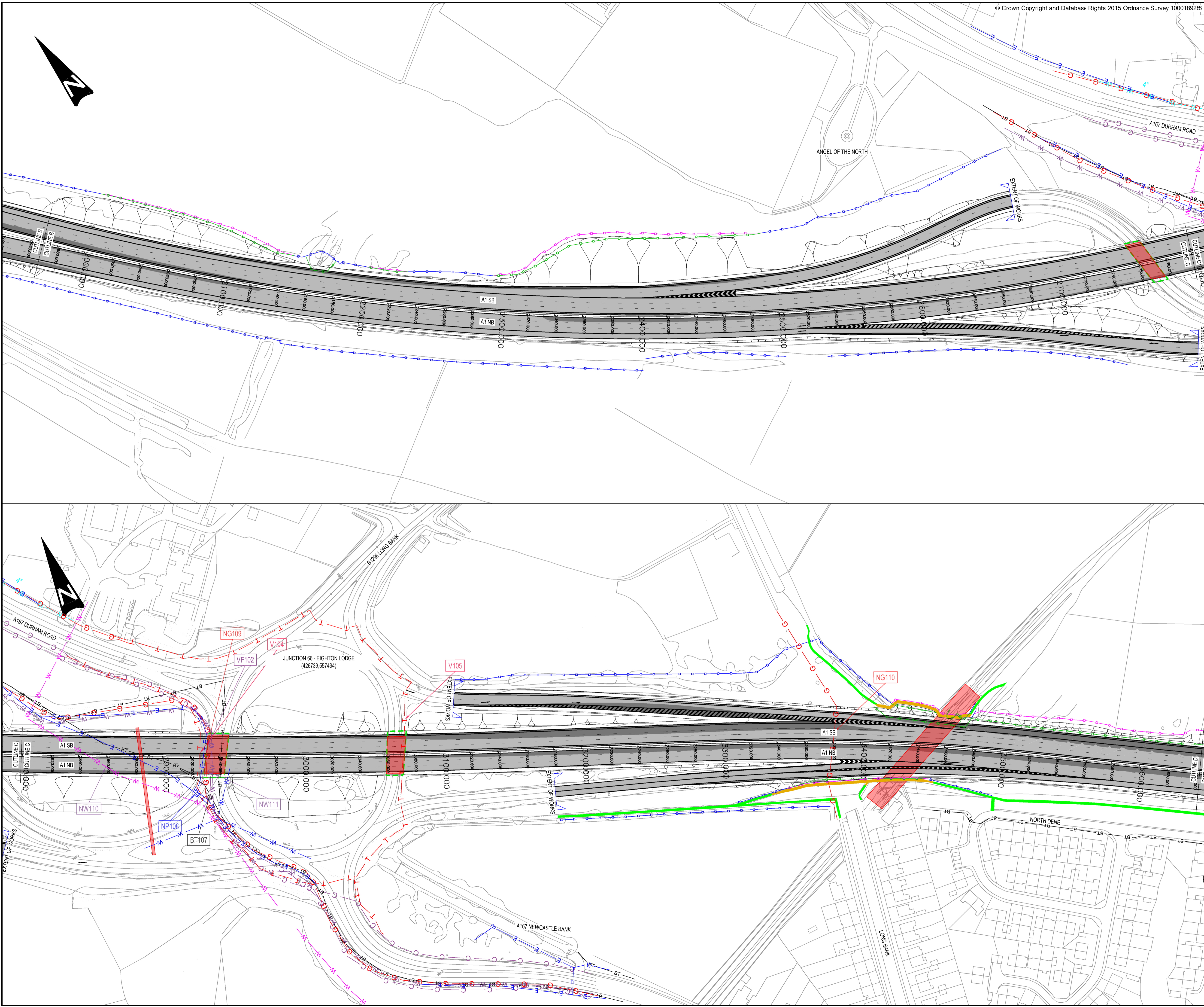
**A1**



DO NOT SCALE

Millimetres

0 10 100



KEY

	EXISTING STRUCTURE
	PROPOSED STRUCTURE
	PROPOSED RETAINING WALL
	PROPOSED HIGHWAYS FENCE LINE
	EXISTING HIGHWAYS FENCE LINE
	NEW CARRIAGEWAY CONSTRUCTION
	EXISTING CARRIAGEWAY TO BE RETAINED
	PROPOSED DRAINAGE DITCH
	PROPOSED FOOTPATH DIVERSION
	EXISTING FOOTPATH
	BT DUCT
	INSTALCOM
	NORTHUMBRIAN WATER COMBINED
	NORTHUMBRIAN WATER FOUL
	NORTHUMBRIAN WATER ABANDONED
	NORTHUMBRIAN WATER SURFACE
	NORTHUMBRIAN WATER TREATED
	NORTHUMBRIAN WATER DISTRIBUTION
	NON NORTHUMBRIAN WATER PRIVATE
	NORTHERN GAS LOW PRESSURE
	NORTHERN GAS MEDIUM PRESSURE
	NORTHERN GAS INTERMEDIATE PRESSURE
	NORTHERN GAS REGIONAL HIGH PRESSURE
	VIRGIN MEDIA CABLE
	NORTHERN POWER GRID CABLE
	VODAFONE CABLE
	UTILITY REFERENCE

- NOTES
1. LOCATION OF SERVICE PLANT SHOWN ON THIS DRAWING HAS BEEN OBTAINED FROM C2 STATUTORY UNDERTAKERS RETURNS AND IS SHOWN INDICATIVELY. THE STATUTORY UNDERTAKERS ARE TO SATISFY THEMSELVES OF THE LOCATION AND EXTENTS OF SERVICE PLANT.
  2. REFER TO SECTION 3.10 OF THE TECHNICAL APPRAISAL REPORT FOR DETAILS OF THE DIVERSION WORKS PROPOSED.
  3. ALL DIAMETERS OF WATER MAINS ARE MEASURED IN MILLIMETERS UNLESS OTHERWISE STATED.

**IMPORTANT WARNING**

THE INFORMATION CONCERNING THE LOCATION AND/OR DEPTH OF THE PUBLIC UTILITY APPARATUS IS PROVIDED ON THIS DRAWING AS AN INDICATIVE GUIDE ONLY. NO GUARANTEE AS TO THEIR CORRECTNESS IS GIVEN OR IMPLIED.

THESE DRAWINGS SHOULD NOT BE RELIED UPON IN THE EVENT OF EXCAVATIONS OR OTHER WORKS MADE NEAR TO THE APPARATUS, WHICH MAY EXIST AT VARIOUS DEPTHS AND MAY DEVIATE FROM THE MARKED ROUTE. IT SHOULD ALSO BE NOTED THAT A SINGLE LINE SHOWN ON THE PLAN MAY INDICATE THE PRESENCE OF MORE THAN ONE CABLE.

THE CONTRACTOR IS REQUIRED TO ENSURE THAT THE LOCATIONS OF BELOW GROUND SERVICES ARE ESTABLISHED/CONFIRMED ON SITE PRIOR TO ANY EXCAVATIONS OR OTHER WORKS WHICH MAY AFFECT THE EXISTING SERVICES.

PRIOR TO ANY WORKS ON SITE, THE CONTRACTOR SHALL REFER TO:  
 HSC47 - AVOIDING DANGER FROM UNDERGROUND SERVICES (BY HSE)  
 HSE185 - HEALTH & SAFETY IN EXCAVATIONS (BY HSE)  
 CONSTRUCTION INFORMATION SHEET (CIS) 4 - SAFETY IN EXCAVATIONS (BY HSE)  
 GENERAL SERIES (GS) 6 - AVOIDANCE OF DANGER FROM OVERHEAD ELECTRIC LINES (BY HSE)

22/05/17					
P01	22/05/17	JHW/T	J.S	SG	NGR
P02	23/05/17	Design update, NDR 111 added	J.S	SG	NGR
Rev.	Date	Description	By	Chkd	Apprd

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 Tel: +44 (0)113 395 6200

**PARSONS BRINCKERHOFF**

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Client **Working on behalf of**  
**highways england**

Project Title **A1 BIRTLEY TO COALHOUSE**

Drawing Title **OPTION 1A - OFFLINE REPLACEMENT OF ALLERDENE RAILWAY EXISTING STATUTORY UNDERTAKERS APPARATUS SHEET 2 OF 3**

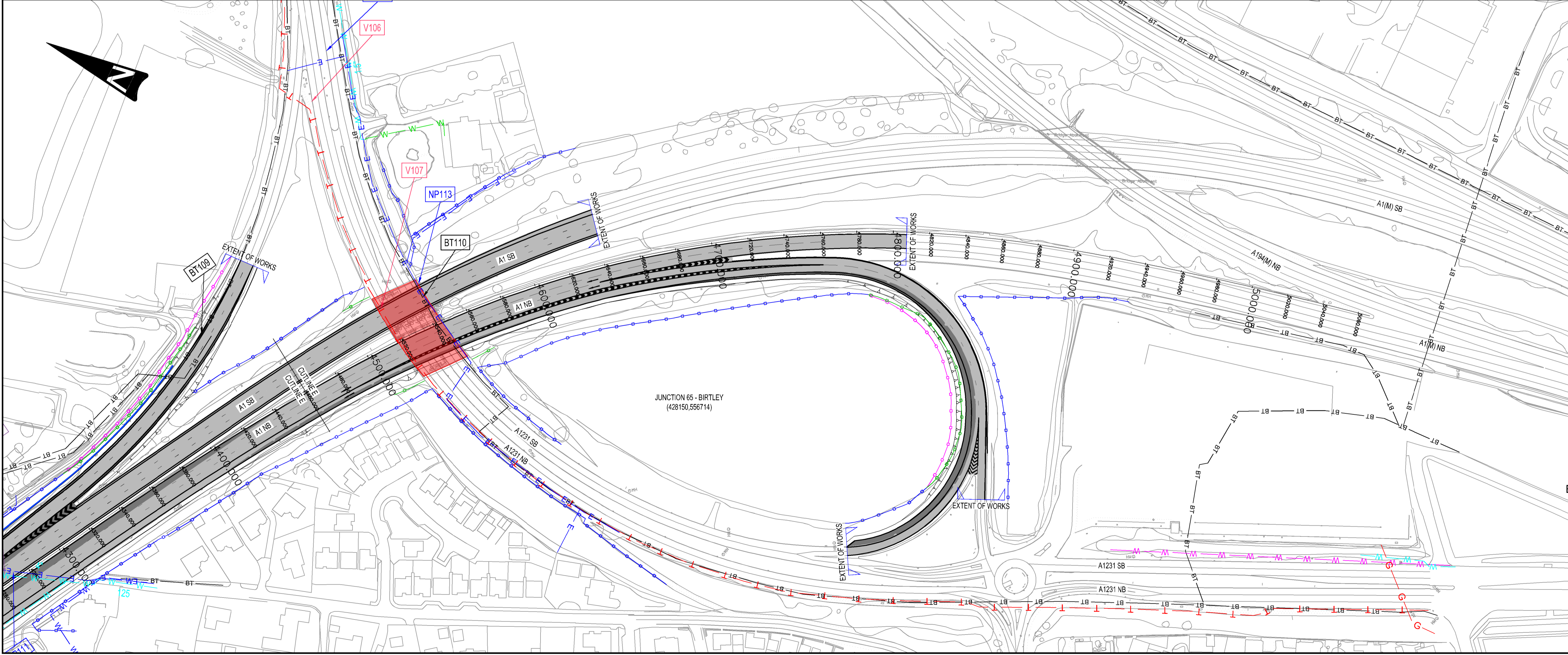
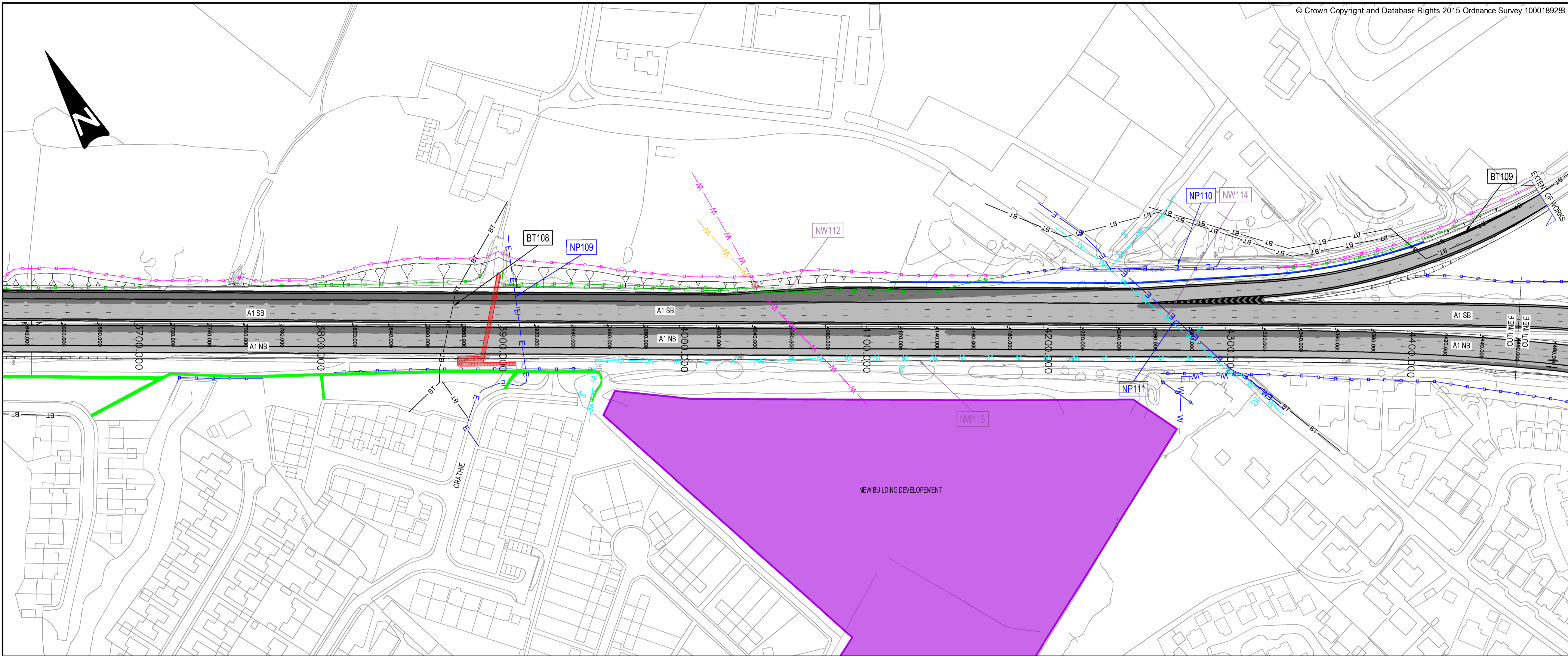
Scale	1:1250	Drawn	J.Singh	Checked	S.Ghosh	Approved	N.Rawcliffe	Authorised	---
Original Size	A1	Date	23/05/17	Date	23/05/17	Date	23/05/17	Date	---
Drawing Status	INITIAL STATUS OR WIP								S0

Drawing Number	HE551462	Project	BCH	Originator	WSP	Volume	VUT	Project Ref. No.	
Location	DR	Type	D	Role	00002	Number	P02	Revision	

DO NOT SCALE

Millimetres

0 10 100



A1

KEY	
	EXISTING STRUCTURE
	PROPOSED STRUCTURE
	PROPOSED RETAINING WALL
	PROPOSED HIGHWAYS FENCE LINE
	EXISTING HIGHWAYS FENCE LINE
	NEW CARRIAGEWAY CONSTRUCTION
	EXISTING CARRIAGEWAY TO BE RETAINED
	PROPOSED DRAINAGE DITCH
	PROPOSED FOOTPATH DIVERSION
	EXISTING FOOTPATH
	BT DUCT
	INSTALCOM
	NORTHUMBRIAN WATER COMBINED
	NORTHUMBRIAN WATER FOUL
	NORTHUMBRIAN WATER ABANDONED
	NORTHUMBRIAN WATER SURFACE
	NORTHUMBRIAN WATER TREATED
	NORTHUMBRIAN WATER DISTRIBUTION
	NON NORTHUMBRIAN WATER PRIVATE
	NORTHERN GAS LOW PRESSURE
	NORTHERN GAS MEDIUM PRESSURE
	NORTHERN GAS INTERMEDIATE PRESSURE
	NORTHERN GAS REGIONAL HIGH PRESSURE
	VIRGIN MEDIA CABLE
	NORTHERN POWER GRID CABLE
	VODAFONE CABLE
	UTILITY REFERENCE

- NOTES**
1. LOCATION OF SERVICE PLANT SHOWN ON THIS DRAWING HAS BEEN OBTAINED FROM C2 STATUTORY UNDERTAKERS RETURNS AND IS SHOWN INDICATIVELY. THE STATUTORY UNDERTAKERS ARE TO SATISFY THEMSELVES OF THE LOCATION AND EXTENTS OF SERVICE PLANT.
  2. REFER TO SECTION 3.10 OF THE TECHNICAL APPRAISAL REPORT FOR DETAILS OF THE DIVERSION WORKS PROPOSED.
  3. ALL DIAMETERS OF WATER MAINS ARE MEASURED IN MILLIMETERS UNLESS OTHERWISE STATED.

**IMPORTANT WARNING**

THE INFORMATION CONCERNING THE LOCATION AND/OR DEPTH OF THE PUBLIC UTILITY APPARATUS IS PROVIDED ON THIS DRAWING AS AN INDICATIVE GUIDE ONLY. NO GUARANTEE AS TO THEIR CORRECTNESS IS GIVEN OR IMPLIED.

THESE DRAWINGS SHOULD NOT BE RELIED UPON IN THE EVENT OF EXCAVATIONS OR OTHER WORKS MADE NEAR TO THE APPARATUS, WHICH MAY EXIST AT VARIOUS DEPTHS AND MAY DEVIATE FROM THE MARKED ROUTE. IT SHOULD ALSO BE NOTED THAT A SINGLE LINE SHOWN ON THE PLAN MAY INDICATE THE PRESENCE OF MORE THAN ONE CABLE.

THE CONTRACTOR IS REQUIRED TO ENSURE THAT THE LOCATIONS OF BELOW GROUND SERVICES ARE ESTABLISHED/CONFIRMED ON SITE PRIOR TO ANY EXCAVATIONS OR OTHER WORKS WHICH MAY AFFECT THE EXISTING SERVICES.

PRIOR TO ANY WORKS ON SITE, THE CONTRACTOR SHALL REFER TO:  
 HSG47 - AVOIDING DANGER FROM UNDERGROUND SERVICES (BY HSE)  
 HGS185 - HEALTH & SAFETY IN EXCAVATIONS (BY HSE)  
 CONSTRUCTION INFORMATION SHEET (CIS) 8 - SAFETY IN EXCAVATIONS (BY HSE)  
 GENERAL SERIES (GS) 6 - AVOIDANCE OF DANGER FROM OVERHEAD ELECTRIC LINES (BY HSE)

Rev.	Date	Description	By	Chkd	Appd
	22/05/17				
P01	22/05/17	JSM/T	J.S	SG	NGR
P02	23/05/17	Design update, NW111 added	J.S	SG	NGR

**WSP** Three White Rose Office Park, Millshaw Park Lane, Leeds, LS11 0DL  
 Tel: +44 (0)113 395 6200

**PARSONS BRINCKERHOFF**

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Client **Working on behalf of**

**highways england**

Project Title **A1 BIRTLEY TO COALHOUSE**

Drawing Title **OPTION 1A - OFFLINE REPLACEMENT OF ALLERDENE RAILWAY BRIDGE EXISTING STATUTORY UNDERTAKERS APPARATUS SHEET 3 OF 3**

Scale	Drawn	Checked	Approved	Authorised
1:1250	J.Singh	S.Ghosh	N.Rawcliffe	---
Original Size	Date	Date	Date	Date
A1	23/05/17	23/05/17	23/05/17	---

Drawing Status **INITIAL STATUS OR WIP** Suitability **S0**

Drawing Number	Project	Originator	Volume	Project Ref. No.
HE551462	BCH	WSP	VUT	
Location	Type	Role	Number	Revision
BCH	DR	D	00003	P02

APPENDIX C-2

**TABULATED OVERVIEW SERVICES IMPACTING THE NEW  
RETAINING WALLS**

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**Table C 1 Services Potentially Impacted by the Proposed New Retaining Walls**

NUMBER	CHAINAGE ON MAINLINE	LOCATION	EXISTING SERVICES	PROPOSED DIVERSIONARY WORKS
Retaining Wall 1	0+325 to 0+643	Mainline/ A1 Southbound	<ul style="list-style-type: none"> <li>No services known to be carried through the proposed Retaining Wall 1 (TBC)</li> </ul>	<ul style="list-style-type: none"> <li>No proposed services identified at the proposed Retaining Wall 1 (TBC)</li> </ul>
Retaining Wall 2	0+325 to 0+426	Mainline/ A1 Northbound	<ul style="list-style-type: none"> <li>No services known to be carried through the proposed Retaining Wall 2 (TBC)</li> </ul>	<ul style="list-style-type: none"> <li>No proposed services identified at the proposed Retaining Wall 2 (TBC)</li> </ul>
Retaining Wall 3	0+625 to 0+796	Mainline/ A1 Northbound	<ul style="list-style-type: none"> <li>Northumbria Water Abandoned (NW101) is buried on Retaining Wall 3 at approx. Chainage 0+660. The service located on J67 (Coal House). Runs along the North side of the roundabout from Chowdene Bank crossing the SB exit slip, main carriageway &amp; NB entry slip.</li> <li>Northern Gas Low Pressure (NG101) is buried adjacent to Retaining Wall 3 at approx. Chainage 0+795. The proposed service will be located on J67 (Coal House) roundabout. Crosses NB entry slip near exit from roundabout.</li> <li>Northern Powergrid Cable (NP101) is buried adjacent to Retaining Wall 3 at approx. Chainage 0+795. The proposed service will be located on J67 (Coal House) roundabout. Crosses NB entry slip near roundabout and goes on to run along west side of roundabout.</li> <li>British Telecommunications Duct (BT101) is buried adjacent to Retaining Wall 3 at approx. Chainage 0+795. The proposed service will be located on J67 (Coal House) roundabout. BT apparatus runs along West side of roundabout. Running North to South.</li> </ul>	<ul style="list-style-type: none"> <li>(NW101) Abandoned sewer from Banesley Lane, Lady Park.</li> <li>Norther Gas New Main 124m x 180mm PE LP. The proposed service will be buried adjacent to Retaining Wall 3 at approx.. Chainage 0+795. The proposed service will be located on J67 (Coal House) roundabout. Runs along outside of roundabout and runs up West side of Kingsway South.</li> <li>(NG101) Abandon 16m x 6" SI – BTMR and lay 26m x 180mm PE LP</li> <li>(BT101) Openreach plan to be diverted out of affected area.</li> <li>(V101) Construct FW6 chamber in new footway. Demolish existing chamber and run split duct through to new chamber. Lower ducting where carriageway is to widened. Lay 2 x 96mm duct configuration in new footway from existing chamber to proposed FW6.</li> <li>(NW105) Water Main Diversion has been proposed to be installed (TBC)</li> </ul>

NUMBER	CHAINAGE ON MAINLINE	LOCATION	EXISTING SERVICES	PROPOSED DIVERSIONARY WORKS
			<ul style="list-style-type: none"> <li>■ Virgin Media Cable (V101) is buried adjacent to Retaining Wall 3 at approx. Chainage 0+795. The proposed service will be located on J67 (Coal House) roundabout. Runs along West side of roundabout, crossing by the exit from roundabout on the NB entry slip.</li> <li>■ Northumbria Water Treated (NW105) is buried adjacent to Retaining Wall 3 at approx. Chainage 0+795. The proposed service will be located on J67 (Coal House) roundabout. Runs along West side of roundabout.</li> </ul>	
Retaining Wall 4	0+940 to 1+100	Mainline/ A1 Northbound	<ul style="list-style-type: none"> <li>■ Northumbria Water Abandoned (NW104) is buried on Retaining Wall 4 at approx. Chainage 0+965. The service located on J67 (Coal House). Crosses main carriageway and two slip roads just South of junction.</li> <li>■ Northern Gas Low Pressure (NG104) is buried on Retaining Wall 4 at approx.. Chainage 1+060. The service located on J67 (Coal House). Crosses SB entry slip, main carriageway and NB exit slip.</li> </ul>	<ul style="list-style-type: none"> <li>■ (NW 104) Abandoned sewer from Lamesley.</li> </ul>
Retaining Wall 5	0+940 to 1+105	Mainline/ A1 Southbound	<ul style="list-style-type: none"> <li>■ Northumbria Water Abandoned (NW104) is buried on Retaining Wall 5 at approx.. Chainage 0+950. The service located on J67 (Coal House). Crosses main carriageway and two slip roads just South of junction.</li> </ul>	<ul style="list-style-type: none"> <li>■ (NW 104) Abandoned sewer from Lamesley.</li> </ul>
Retaining Wall 6	4+114 to 4+410	Mainline/ A1 Southbound	<ul style="list-style-type: none"> <li>■ Northern Powergrid Cable (NP111) is buried on Retaining Wall 6 at approx. Chainage 4+250. The service located on North of J65 (Birtley). Crosses the carriageway next to Bowes inline Hotel and runs along Northside (housing estate).</li> </ul>	<ul style="list-style-type: none"> <li>■ (NW114) Water Main Diversion has been proposed to be installed (TBC)</li> <li>■ (BT109) British Telecommunication Duct to be slewed out of the proposed road widening</li> </ul>

NUMBER	CHAINAGE ON MAINLINE	LOCATION	EXISTING SERVICES	PROPOSED DIVERSIONARY WORKS
			<ul style="list-style-type: none"> <li>■ Northumbria Water Distribution (NW 114) is buried on Retaining Wall 6 at approx.. Chainage 4+245.The service located on Bowes Incline Hotel. Crosses main carriageway and slip roads near hotel.</li> <li>■ British Telecommunications Duct (BT109) is buried on Retaining Wall 6 at approx. Chainage 4+400. The service located on J65 (Birtley) Southbound exit slip. Runs along the slip road.</li> </ul>	
CR Retaining Wall 1	0+515 to 0+615	Central Reserve	<ul style="list-style-type: none"> <li>■ No services known to be carried through the proposed CR Retaining Wall 1 (TBC)</li> </ul>	<ul style="list-style-type: none"> <li>■ No proposed services identified at the proposed Retaining Wall 1 (TBC)</li> </ul>
CR Retaining Wall 2	1+950 to 2+220	Central Reserve	<ul style="list-style-type: none"> <li>■ No services known to be carried through the proposed CR Retaining Wall 2 (TBC)</li> </ul>	<ul style="list-style-type: none"> <li>■ No proposed services identified at the proposed Retaining Wall 2 (TBC)</li> </ul>
CR Retaining Wall 3	2+370 to 2+735	Central Reserve	<ul style="list-style-type: none"> <li>■ No services known to be carried through the proposed CR Retaining Wall 3 (TBC)</li> </ul>	<ul style="list-style-type: none"> <li>■ No proposed services identified at the proposed Retaining Wall 3 (TBC)</li> </ul>
CR Retaining Wall 4	3+270 to 3+690	Central Reserve	<ul style="list-style-type: none"> <li>■ Northern Gas low pressure (NG 110) is buried on CR Retaining Wall 4 at approx. Chainage 3+380. The service located on South of J66 (Eighton Lodge). Crosses SB entry slip, main carriageway and NB exit slip road.</li> </ul>	

# Appendix D

**RETAINING WALLS PROPOSED GENERAL ARRANGEMENT  
DRAWINGS**

APPENDIX D-1

RETAINING WALL 1 (RW1) GENERAL ARRANGEMENT





APPENDIX D-2

RETAINING WALL 2 (RW2) GENERAL ARRANGEMENT

GENERAL NOTES

- STRUCTURAL RETAINING WALL DETAILS PROVIDED ON THIS DRAWING IS INDICATIVE ONLY BASED ON LIMITED INFORMATION AVAILABLE TODAY.
- THE SIZE OF STRUCTURAL ELEMENTS ARE BASED ON PRELIMINARY CALCULATION AND PREVIOUS SIMILAR TYPE WORKS. ALL INFORMATION IS SUBJECT TO DETAILED DESIGN PRIOR TO FINAL CONFIRMATION.
- DETAILS PROVIDED ARE FOR INFORMATION ONLY. INDICATIVE CONSTRUCTION COST ESTIMATES ARE BASED ON PREVIOUS SIMILAR TYPE WORKS.
- THE FOLLOWING CRITICAL INFORMATION IS REQUIRED TO VERIFY THE FEASIBILITY OF THE PROPOSED OPTION AND DEVELOPED THIS FURTHER AT DETAILED DESIGN (IF PREFERRED)
  - TOPOGRAPHICAL SURVEY - CONFIRM GEOMETRIC PARAMETER AND SITE CONSTRAINTS
  - SITE INVESTIGATION INFORMATION - CONFIRM FOUNDATION PARAMETERS
  - LIAISON WITH HIGHWAY ENGLAND - CONFIRM STRUCTURAL REQUIREMENTS
  - LIAISON WITH STATUTORY UNDERTAKERS - CONFIRM EXISTING/ NEW SERVICES IMPACTED BY THE WORKS.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
- ALL LEVELS ARE IN METERS UNLESS NOTED OTHERWISE.
- DO NOT SCALE IN CASE OF ANY DOUBTS, OMISSIONS OR ERRORS SEEK DESIGNER CLARIFICATION.
- FOR BOREHOLE INFORMATION REFER TO GROUND INVESTIGATION REPORT



PILE TYPE	SHEET PILE SECTION MODULUS (cm <sup>4</sup> /m)	WALL THICKNESS (cm)
AZ 32-750	3200	511

SHEET PILE TABLE

KEY

- LIMITS OF LAND TO BE ACQUIRED OR USED PERMANENTLY OR TEMPORARILY
- PROPOSED LAYOUT- DESIGN FIX 3: REV 2 (16/08/2017)
- LAND TO BE USED FOR CONSTRUCTION, MAINTENANCE AND OPERATION CURRENTLY OWNED BY SECRETARY OF STATE
- LAND TO BE PERMANENTLY ACQUIRED FOR CONSTRUCTION, MAINTENANCE AND OPERATION
- THIRD PARTY LAND TEMPORARILY REQUIRED DURING CONSTRUCTION
- AREA NOT INCLUDED WITHIN THE DCO BOUNDARY

SAFETY, HEALTH AND ENVIRONMENTAL SYMBOL LEGEND

- INDICATES A RESIDUAL RISK AS A WARNING
- IN ADDITION TO THE HAZARD/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS
- RISK REFERENCE:
- REF 004 - POORER ANTICIPATED GROUND CONDITIONS LEADING TO EXCESSIVE STRUCTURAL MOVEMENT
  - REF 005 - PROPOSED STRUCTURAL WORKS CAUSING INSTABILITY TO EXISTING EARTHWORKS
  - REF 006 - PROPOSED STRUCTURE BEING ADVERSELY IMPACTED BY COLLAPSE OF COAL MINE WORKING BELOW FOUNDATION
  - REF 007 - CONTAMINATED LAND
  - REF 008 - HIGHER THAN ANTICIPATED GROUNDWATER LEADING TO EXCESSIVE STRUCTURAL MOVEMENT

Rev.	Date	Description	By	Chk'd	App'd
P02	10/04/18	AREAS BELOW 1.5m CONTRACTOR DESIGN	RA	MT	HM
P01	31/01/18	FOR INFORMATION	AS	MT	HM

Three White Rose Office Park, Millshaw Park Lane, Leeds, LS11 0DL, UK  
T +44 (0) 113 395 6200, F +44 (0) 113 395 6201  
wsp.com

Client

Working on behalf of

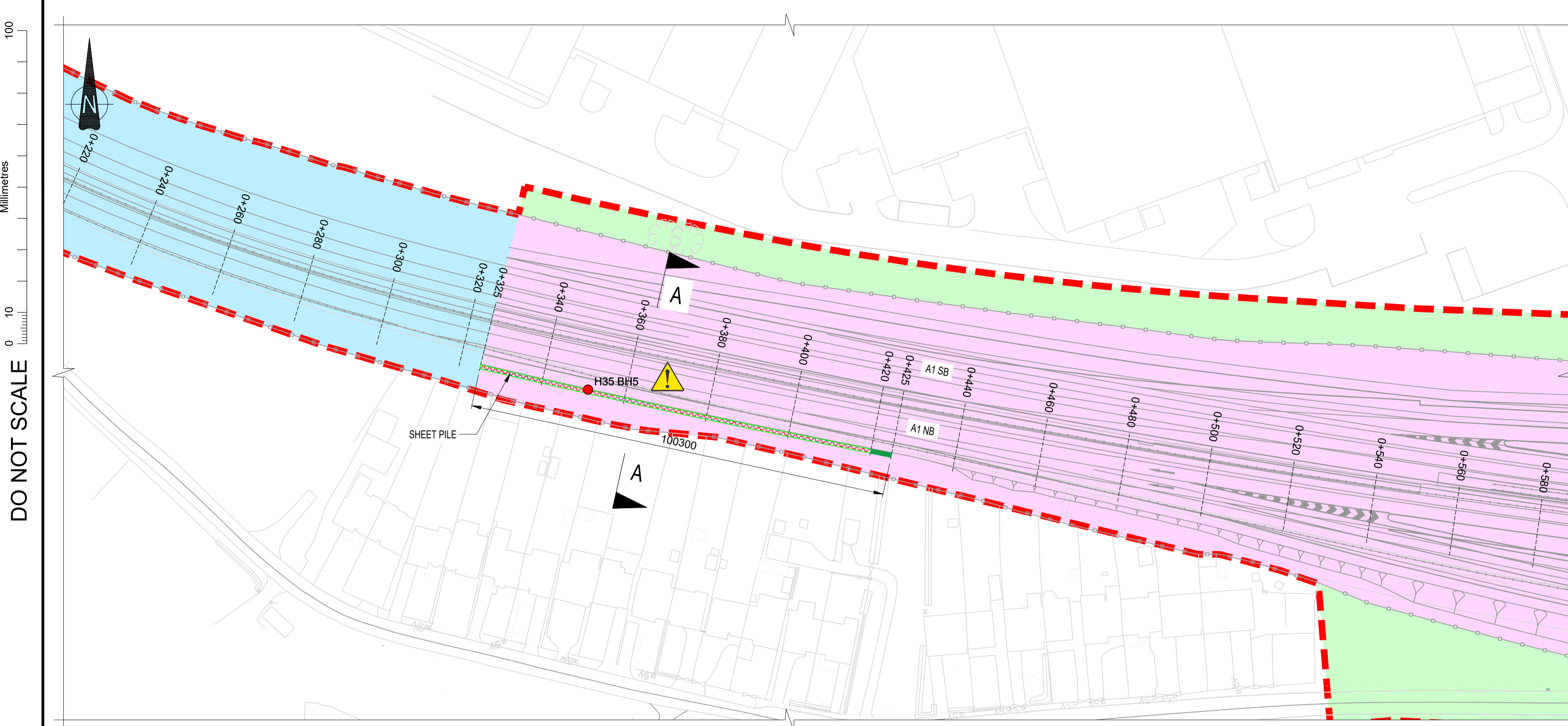
Project Title: A1 BIRTLEY TO COALHOUSE

Drawing Title: RETAINING WALL 2 (STKEY 00002) GENERAL ARRANGEMENT

Scale	Drawn	Checked	Approved	Authorised
AS SHOWN	R. Ayre	M.Tziolas	H. Mistry	H. Mistry

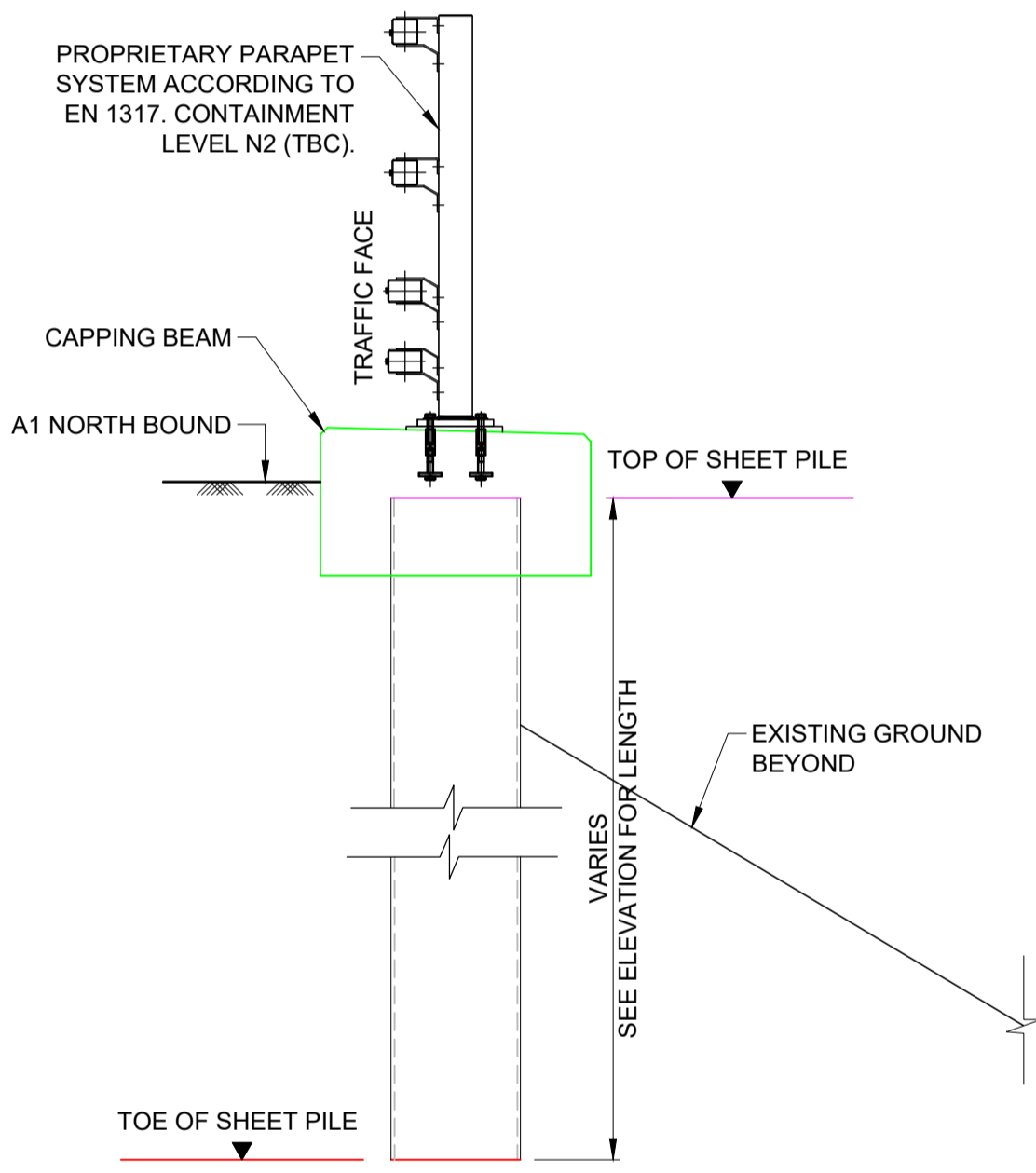
Drawing Status: FOR INFORMATION  
Suitability: S1

Project	Originator	Volume	Project Ref. No.
HE551462	WSP	SBR	
Location	Type	Role	Number
BR008	DR	S	00010



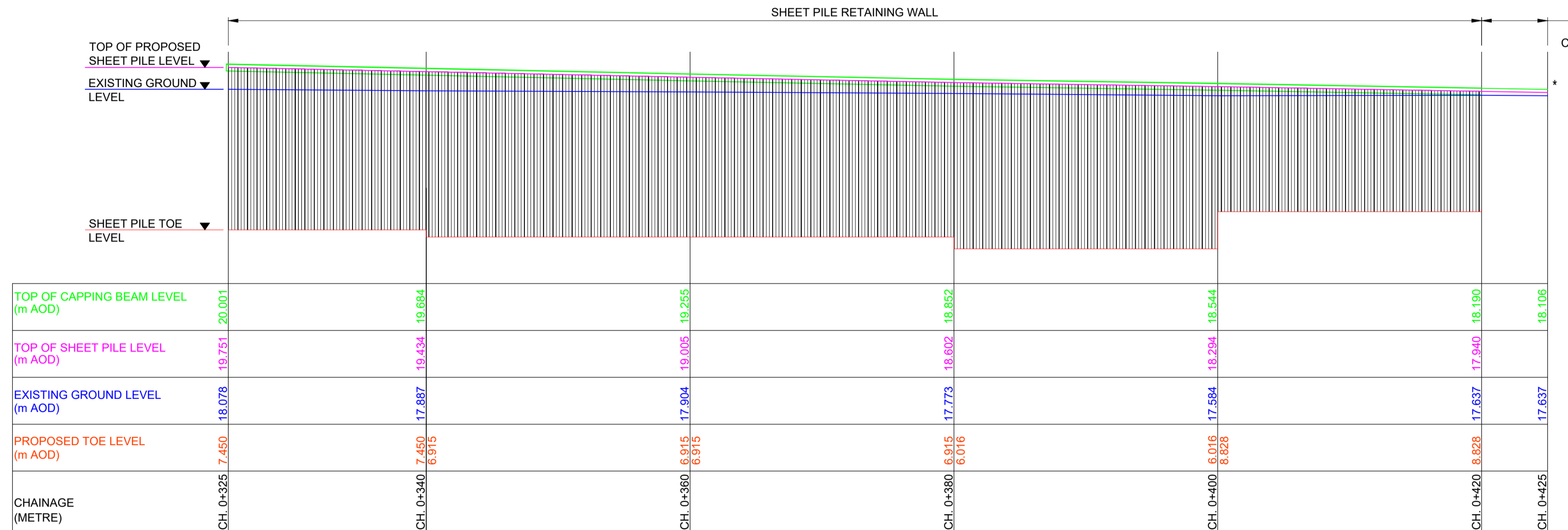
PLAN OF RETAINING WALL 2

SCALE 1:750



SECTION A-A

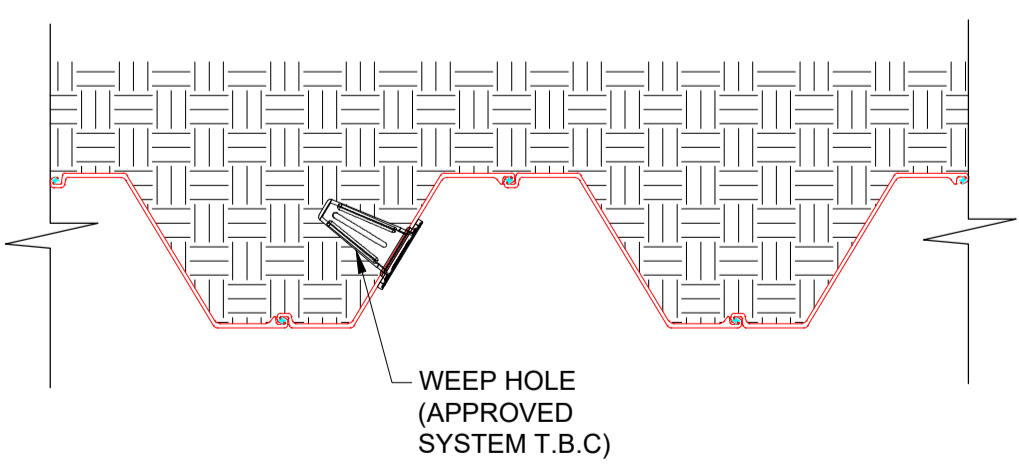
SCALE 1:25



ELEVATION OF RETAINING WALL 2

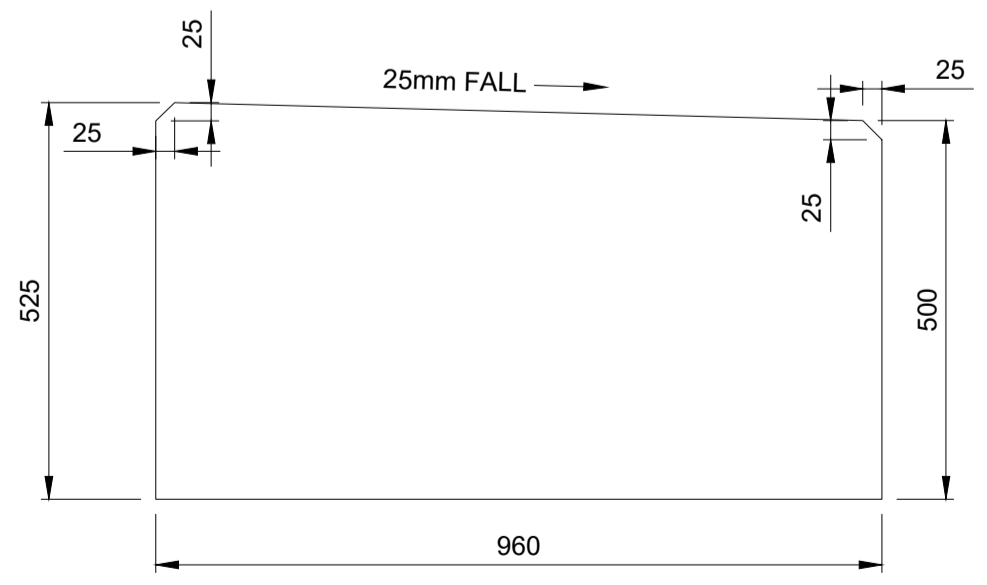
SCALE 1:250

\*CONTRACTOR SHALL BE RESPONSIBLE FOR THE DESIGN OF RETAINING STRUCTURES LESS THAN 1.5m RETAINED HEIGHT. THE STRUCTURE SHALL HAVE A SMOOTH TRAFFIC FACE IN ACCORDANCE WITH TD19/06. THE CONTRACTOR SHALL ALSO BE RESPONSIBLE FOR THE PROVISION OF A SMOOTH TRANSITION BETWEEN THE RETAINING STRUCTURE ≤1.5m & ≥1.5m



TYPICAL DETAIL OF AZ SHEET PILES

SCALE NTS



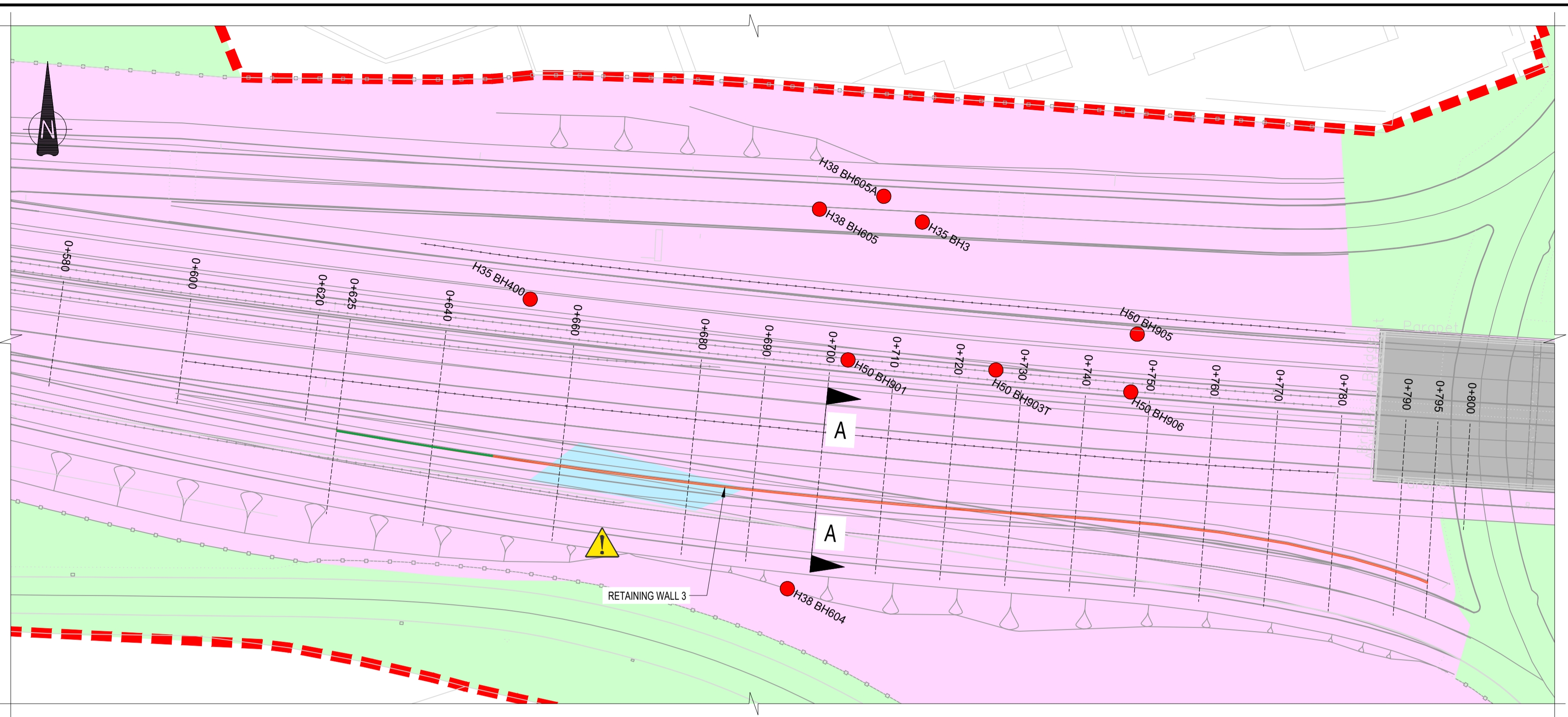
CAPPING BEAM DETAILS (INDICATIVE)

SCALE 1:10

APPENDIX D-3

RETAINING WALL 3 (RW3) GENERAL ARRANGEMENT

DO NOT SCALE  
 Millimetres  
 0 10 100



**LOCATION OF RETAINING WALL 3**  
 SCALE NTS

**\*CONTRACTOR SHALL BE RESPONSIBLE FOR THE DESIGN OF RETAINING STRUCTURES LESS THAN 1.5m RETAINED HEIGHT. THE STRUCTURE SHALL HAVE A SMOOTH TRAFFIC FACE IN ACCORDANCE TO 19/06. THE CONTRACTOR SHALL ALSO BE RESPONSIBLE FOR THE PROVISION OF A SMOOTH TRANSITION BETWEEN THE RETAINING STRUCTURE ≤1.5m & ≥1.5m**

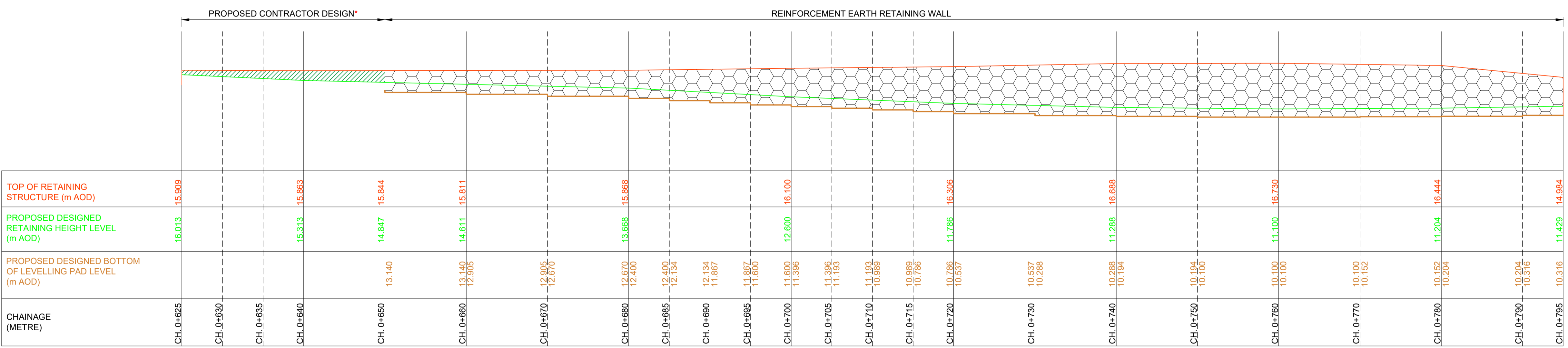
**GENERAL NOTES**

- STRUCTURAL RETAINING WALL DETAILS PROVIDED ON THIS DRAWING IS INDICATIVE ONLY BASED ON LIMITED INFORMATION AVAILABLE TODAY.
- THE SIZE OF STRUCTURAL ELEMENTS ARE BASED ON PRELIMINARY CALCULATION AND PREVIOUS SIMILAR TYPE WORKS. ALL INFORMATION IS SUBJECT TO DETAILED DESIGN PRIOR TO FINAL CONFIRMATION.
- DETAILS PROVIDED ARE FOR INFORMATION ONLY. INDICATIVE CONSTRUCTION COST ESTIMATES ARE BASED ON PREVIOUS SIMILAR TYPE WORKS.
- THE FOLLOWING CRITICAL INFORMATION IS REQUIRED TO VERIFY THE FEASIBILITY OF THE PROPOSED OPTION AND DEVELOPED THIS FURTHER AT DETAILED DESIGN (IF PREFERRED)
  - TOPOGRAPHICAL SURVEY - CONFIRM GEOMETRIC PARAMETER AND SITE CONSTRAINTS
  - SITE INVESTIGATION INFORMATION - CONFIRM FOUNDATION PARAMETERS
  - LIAISON WITH HIGHWAY ENGLAND - CONFIRM STRUCTURAL REQUIREMENTS
  - LIAISON WITH STATUTORY UNDERTAKERS - CONFIRM EXISTING/ NEW SERVICES IMPACTED BY THE WORKS.
- ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
- ALL LEVELS ARE IN METERS UNLESS NOTED OTHERWISE.
- DO NOT SCALE IN CASE OF ANY DOUBTS, OMISSIONS OR ERRORS SEEK DESIGNER CLARIFICATION.
- FOR BOREHOLE INFORMATION REFER TO GROUND INVESTIGATION REPORT

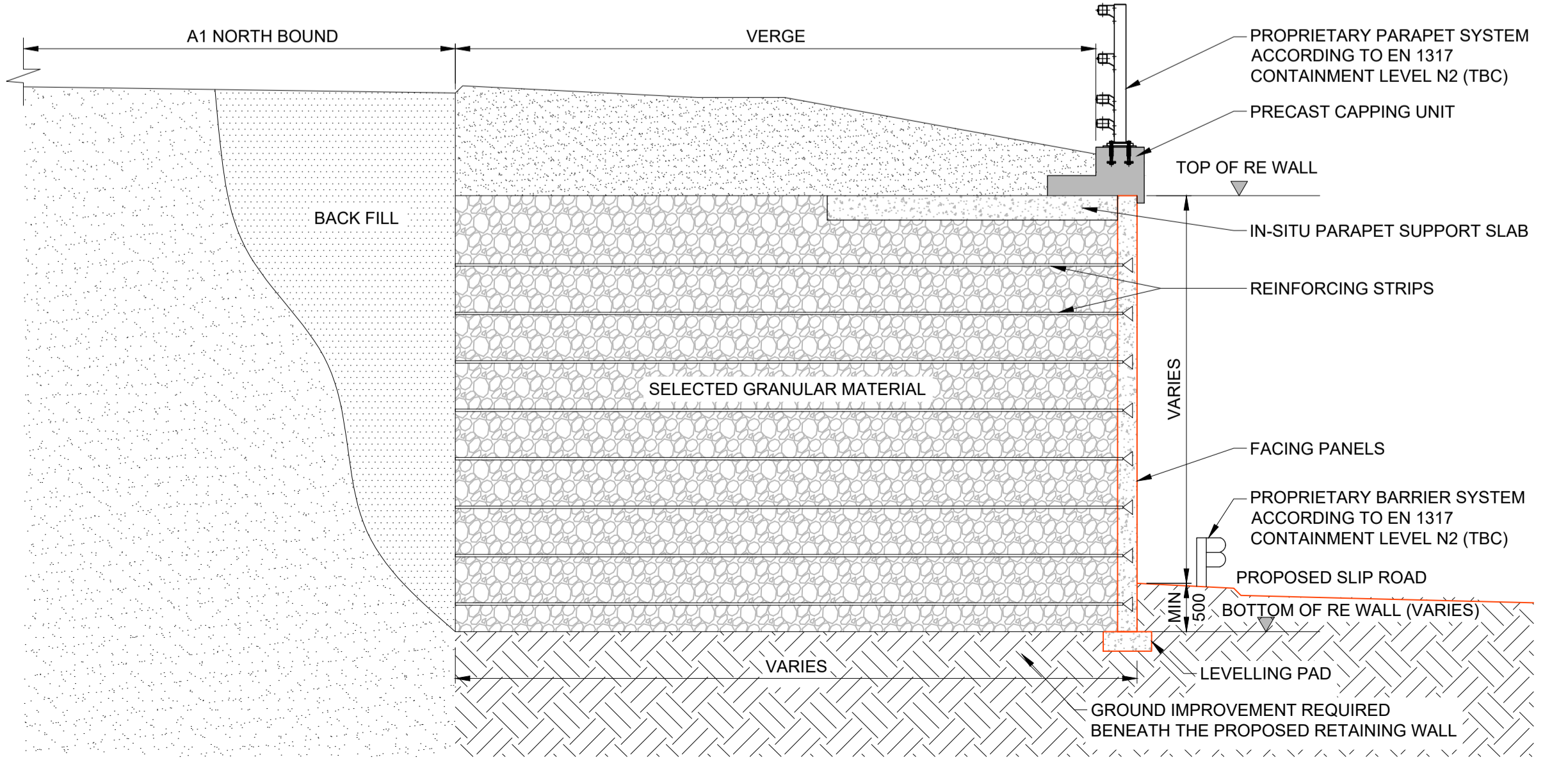
**KEY**

- LIMITS OF LAND TO BE ACQUIRED OR USED PERMANENTLY OR TEMPORARILY
- PROPOSED LAYOUT- DESIGN FIX 3: REV 2 (16/08/2017)
- LAND TO BE USED FOR CONSTRUCTION, MAINTENANCE AND OPERATION CURRENTLY OWNED BY SECRETARY OF STATE
- LAND TO BE PERMANENTLY ACQUIRED FOR CONSTRUCTION, MAINTENANCE AND OPERATION
- THIRD PARTY LAND TEMPORARILY REQUIRED DURING CONSTRUCTION
- AREA NOT INCLUDED WITHIN THE DCO BOUNDARY

**PLAN OF RETAINING WALL 3**  
 SCALE 1:500



**ELEVATION OF RETAINING WALL 3**  
 SCALE 1:300



**TYPICAL SECTION A-A**  
 SCALE 1:50

**SAFETY, HEALTH AND ENVIRONMENTAL SYMBOL LEGEND**

INDICATES A RESIDUAL RISK AS A WARNING

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS

**RISK REFERENCE:**

REF 001 - RISK ASSOCIATED WITH WORKING AT HEIGHT  
 REF 002 - WORKING ADJACENT TO LIVE TRAFFIC  
 REF 004 - WORKING ADJACENT TO SERVICES, DAMAGE TO EXISTING SERVICES, ELECTROCUTION  
 REF 011 - BRIDGEWALL INTERFACE, DIFFERENTIAL SETTLEMENT

Ref	Date	Description	By	Chkd	App'd
P02	10/04/18	AREAS BELOW 1.5m CONTRACTOR DESIGN	RA	MT	HM
P01	30/01/18	FOR INFORMATION	AS	MT	HM

**wsp**

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 wsp.com

Client: Working on behalf of **highways england**

Project Title: **A1 BIRTLEY TO COALHOUSE**

Drawing Title: **RETAINING WALL 3 (STKEY 00003) GENERAL ARRANGEMENT**

Scale	Drawn	Checked	Approved	Authorised
AS SHOWN	R. Ayre	M.Tziolas	H. Mistry	H. Mistry
Original Size	Date	Date	Date	Date
A1	10/04/18	10/04/18	10/04/18	10/04/18
Drawing Status	FOR INFORMATION			Suitability S1
Drawing Number	Project	Originator	Volume	Project Ref. No.
HE551462	BR008	WSP	SBR	
Location	Type	Role	Number	Revision
	DR	S	00011	

APPENDIX D-4

RETAINING WALL 4 (RW4) GENERAL ARRANGEMENT

GENERAL NOTES

- STRUCTURAL RETAINING WALL DETAILS PROVIDED ON THIS DRAWING IS INDICATIVE ONLY BASED ON LIMITED INFORMATION AVAILABLE TODAY.
- THE SIZE OF STRUCTURAL ELEMENTS ARE BASED ON PRELIMINARY CALCULATION AND PREVIOUS SIMILAR TYPE WORKS. ALL INFORMATION IS SUBJECT TO DETAILED DESIGN PRIOR TO FINAL CONFIRMATION.
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- THE FOLLOWING CRITICAL INFORMATION IS REQUIRED TO VERIFY THE FEASIBILITY OF THE PROPOSED OPTION AND DEVELOPED THIS FURTHER AT DETAILED DESIGN (IF PREFERRED)
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  - SITE INVESTIGATION INFORMATION - CONFIRM FOUNDATION PARAMETERS
  - LIAISON WITH HIGHWAY ENGLAND - CONFIRM STRUCTURAL REQUIREMENTS
  - LIAISON WITH STATUTORY UNDERTAKERS - CONFIRM EXISTING/ NEW SERVICES IMPACTED BY THE WORKS.
- ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
- ALL LEVELS ARE IN METERS UNLESS NOTED OTHERWISE.
- DO NOT SCALE IN CASE OF ANY DOUBTS, OMISSIONS OR ERRORS SEEK DESIGNER CLARIFICATION.
- FOR BOREHOLE INFORMATION REFER TO GROUND INVESTIGATION REPORT

KEY

- LIMITS OF LAND TO BE ACQUIRED OR USED PERMANENTLY OR TEMPORARILY
- PROPOSED LAYOUT- DESIGN FIX 3: REV 2 (16/08/2017)
- LAND TO BE USED FOR CONSTRUCTION, MAINTENANCE AND OPERATION CURRENTLY OWNED BY SECRETARY OF STATE
- LAND TO BE PERMANENTLY ACQUIRED FOR CONSTRUCTION, MAINTENANCE AND OPERATION
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SAFETY, HEALTH AND ENVIRONMENTAL SYMBOL LEGEND

INDICATES A RESIDUAL RISK AS A WARNING  
 IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS

RISK REFERENCE:

REF 001 - RISK ASSOCIATED WITH WORKING AT HEIGHT
REF 002 - WORKING ADJACENT TO LIVE TRAFFIC
REF 004 - WORKING ADJACENT TO SERVICES, DAMAGE TO EXISTING SERVICES, ELECTROCUTION
REF 011 - BRIDGE/WALL INTERFACE, DIFFERENTIAL SETTLEMENT

Rev.	Date	Description	By	Chkd	App'd
P02	10/04/18	AREAS BELOW 1.5m CONTRACTOR DESIGN	RA	MT	HM
P01	30/01/18	FOR INFORMATION	AS	MT	HM

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 wsp.com

Client

Working on behalf of

Project Title **A1 BIRTLEY TO COALHOUSE**

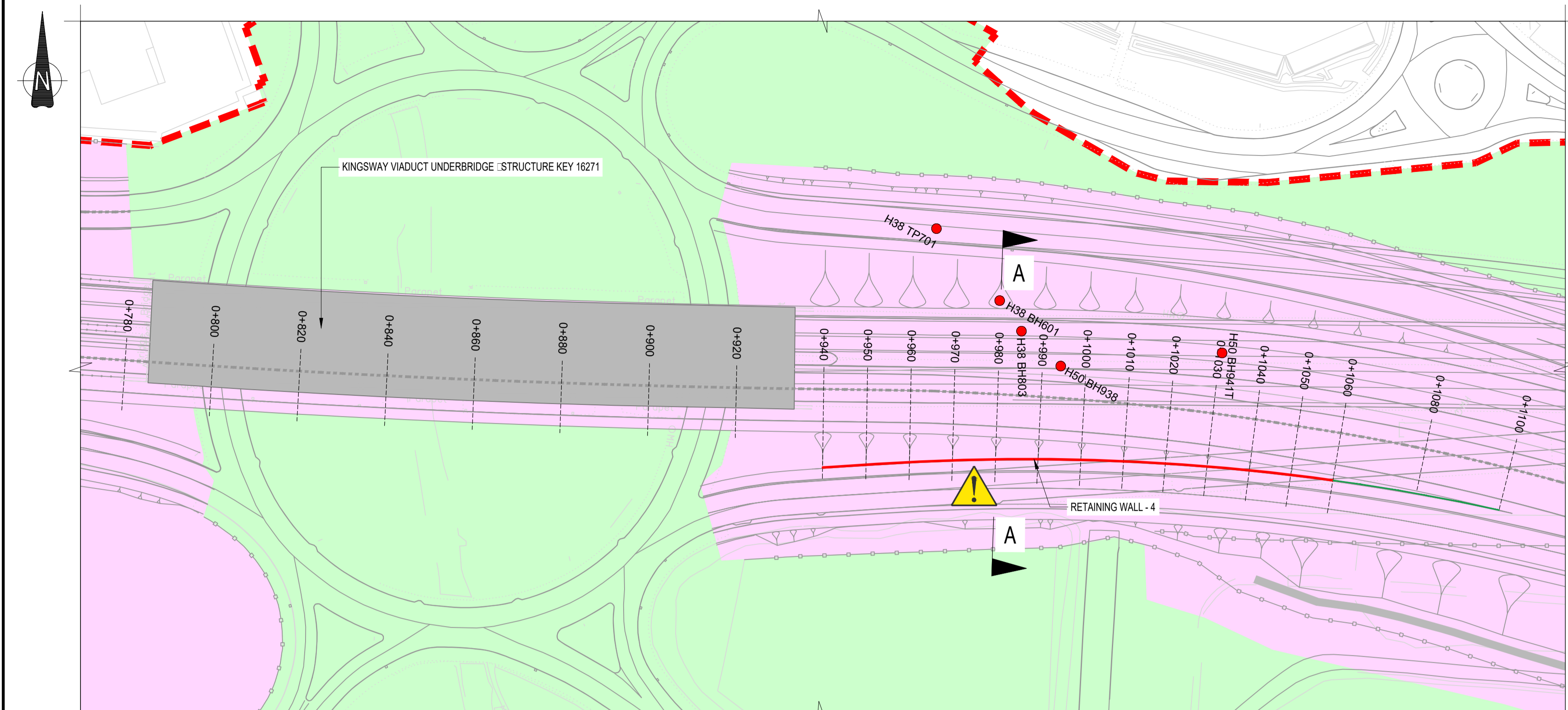
Drawing Title **RETAINING WALL 4 (STKEY 00004) GENERAL ARRANGEMENT**

Scale	Drawn	Checked	Approved	Authorised
AS SHOWN	R. Ayre	M.Tziolas	H. Mistry	H. Mistry
Original Size	Date	Date	Date	Date
A1	10/04/18	10/04/18	10/04/18	10/04/18

Drawing Status **FOR INFORMATION** Suitability **S1**

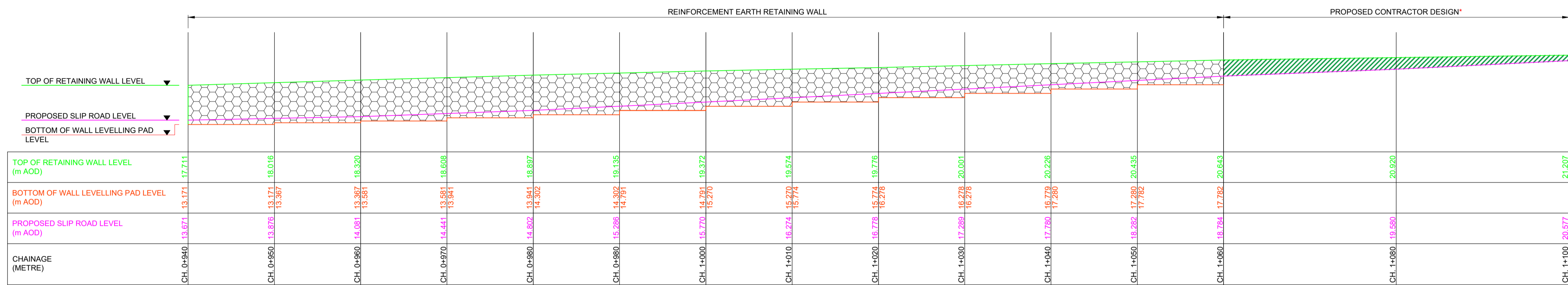
Drawing Number	Project	Originator	Volume	Project Ref. No.
HE551462	DR	WSP	SBR	
Location	Type	Role	Number	Revision
BR008	DR	S	00012	P02

DO NOT SCALE

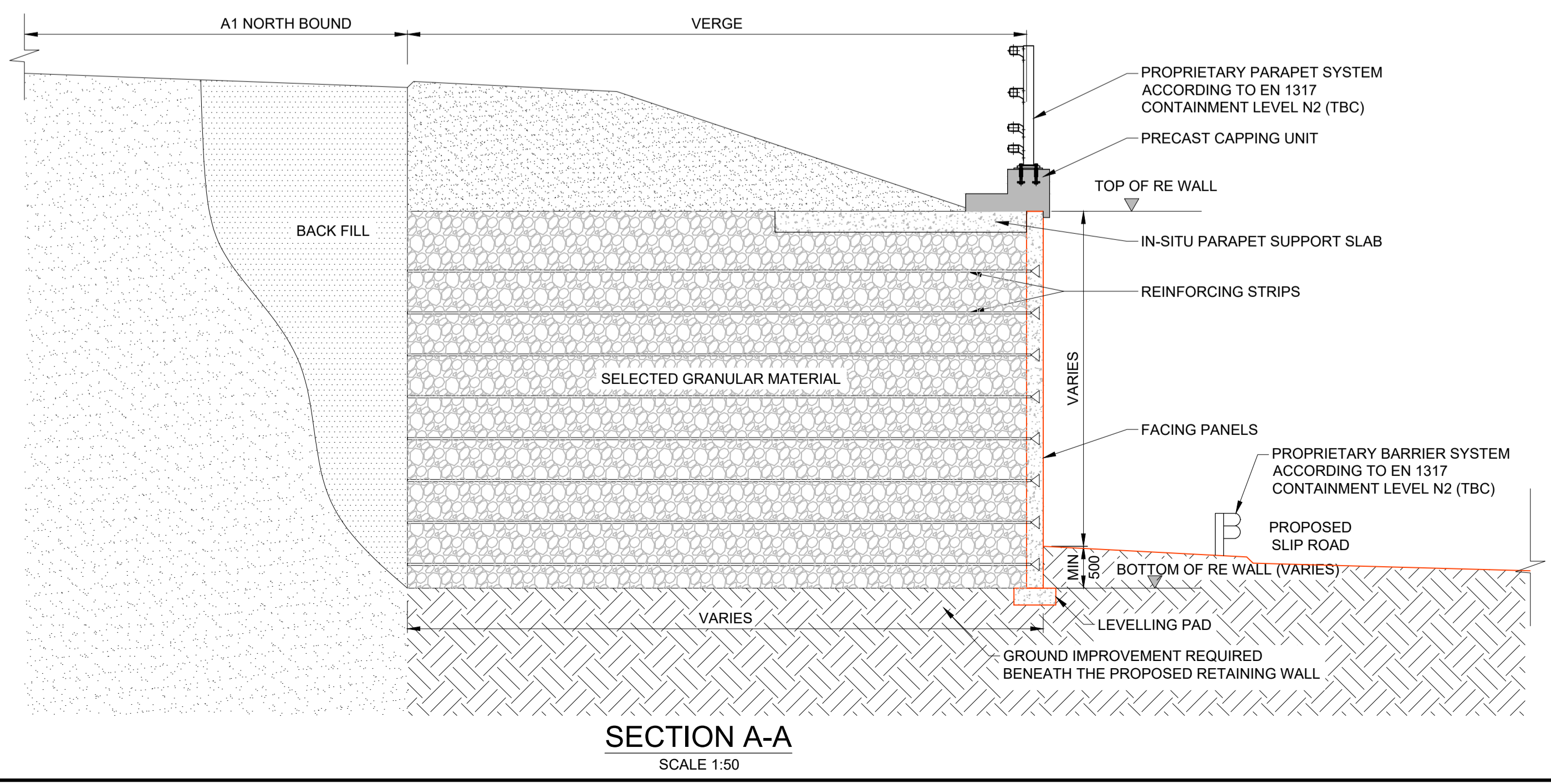


CONTRACTOR SHALL BE RESPONSIBLE FOR THE DESIGN OF RETAINING STRUCTURES LESS THAN 1.5m RETAINED HEIGHT. THE STRUCTURE SHALL HAVE A SMOOTH TRAFFIC FACE IN ACCORDANCE TO 19/06. THE CONTRACTOR SHALL ALSO BE RESPONSIBLE FOR THE PROVISION OF A SMOOTH TRANSITION BETWEEN THE RETAINING STRUCTURE ≤1.5m & ≥1.5m

**PLAN OF RETAINING WALL 4**  
SCALE 1:750



**ELEVATION OF RETAINING WALL 4**  
SCALE 1:300



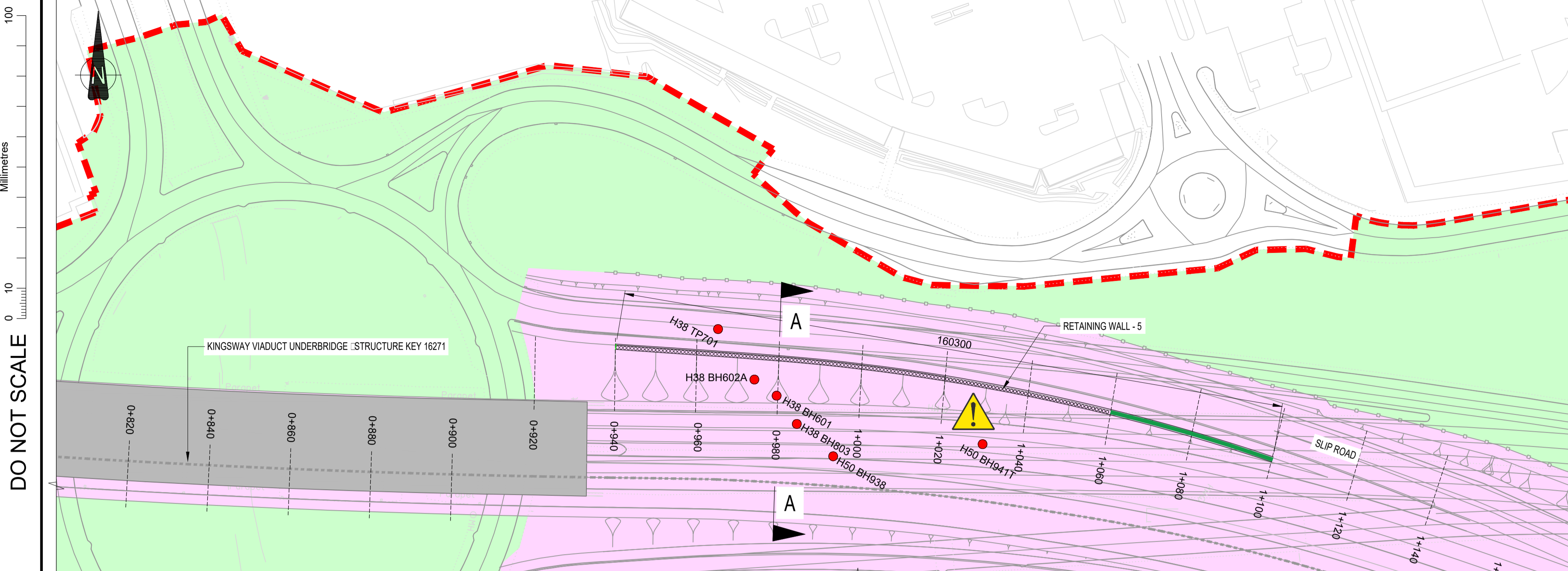
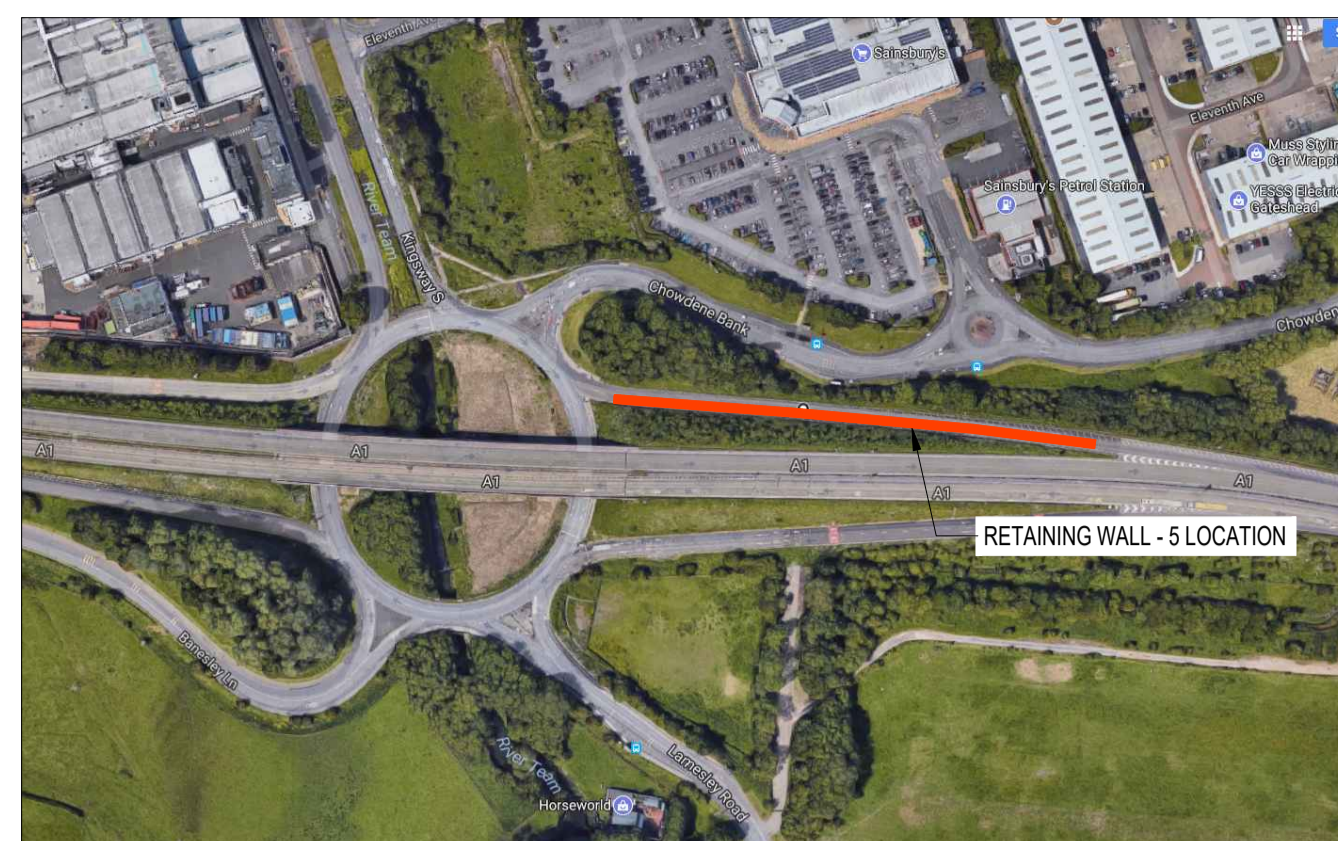
**SECTION A-A**  
SCALE 1:50

APPENDIX D-5

RETAINING WALL 5 (RW5) GENERAL ARRANGEMENT



- STRUCTURAL RETAINING WALL DETAILS PROVIDED ON THIS DRAWING IS INDICATIVE ONLY BASED ON LIMITED INFORMATION AVAILABLE TODAY.
- THE SIZE OF STRUCTURAL ELEMENTS ARE BASED ON PRELIMINARY CALCULATION AND PREVIOUS SIMILAR TYPE WORKS. ALL INFORMATION IS SUBJECT TO DETAILED DESIGN PRIOR TO FINAL CONFIRMATION.
- DETAILS PROVIDED ARE FOR INFORMATION ONLY. INDICATIVE CONSTRUCTION COST ESTIMATES ARE BASED ON PREVIOUS SIMILAR TYPE WORKS.
- THE FOLLOWING CRITICAL INFORMATION IS REQUIRED TO VERIFY THE FEASIBILITY OF THE PROPOSED OPTION AND DEVELOPED THIS FURTHER AT DETAILED DESIGN (IF PREFERRED)
  - TOPOGRAPHICAL SURVEY - CONFIRM GEOMETRIC PARAMETER AND SITE CONSTRAINTS
  - SITE INVESTIGATION INFORMATION - CONFIRM FOUNDATION PARAMETERS
  - LIAISON WITH HIGHWAY ENGLAND - CONFIRM STRUCTURAL REQUIREMENTS
  - LIAISON WITH STATUTORY UNDERTAKERS - CONFIRM EXISTING/ NEW SERVICES IMPACTED BY THE WORKS.
- ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
- ALL LEVELS ARE IN METERS UNLESS NOTED OTHERWISE.
- DO NOT SCALE IN CASE OF ANY DOUBTS, OMISSIONS OR ERRORS SEEK DESIGNER CLARIFICATION.
- FOR BOREHOLE INFORMATION REFER TO GROUND INVESTIGATION REPORT



PLAN OF RETAINING WALL 5  
SCALE 1:750

\*CONTRACTOR SHALL BE RESPONSIBLE FOR THE DESIGN OF RETAINING STRUCTURES LESS THAN 1.5m RETAINED HEIGHT. THE STRUCTURE SHALL HAVE A SMOOTH TRAFFIC FACE IN ACCORDANCE WITH 19/06. THE CONTRACTOR SHALL ALSO BE RESPONSIBLE FOR THE PROVISION OF A SMOOTH TRANSITION BETWEEN THE RETAINING STRUCTURE  $\leq 1.5m$  &  $\geq 1.5m$

KEY

- LIMITS OF LAND TO BE ACQUIRED OR USED PERMANENTLY OR TEMPORARILY
- PROPOSED LAYOUT- DESIGN FIX 3: REV 2 (16/08/2017)
- LAND TO BE USED FOR CONSTRUCTION, MAINTENANCE AND OPERATION CURRENTLY OWNED BY SECRETARY OF STATE
- LAND TO BE PERMANENTLY ACQUIRED FOR CONSTRUCTION, MAINTENANCE AND OPERATION
- THIRD PARTY LAND TEMPORARILY REQUIRED DURING CONSTRUCTION
- AREA NOT INCLUDED WITHIN THE DCO BOUNDARY

SAFETY, HEALTH AND ENVIRONMENTAL SYMBOL LEGEND

- INDICATES A RESIDUAL RISK AS A WARNING
- IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS
- RISK REFERENCE:
- REF 001 - RISK ASSOCIATED WITH WORKING AT HEIGHT
  - REF 002 - WORKING ADJACENT TO LIVE TRAFFIC
  - REF 003 - IN-SITU RC WORKS
  - REF 005 - WORKING ADJACENT TO SERVICES. DAMAGE TO EXISTING SERVICES, ELECTROCUTION
  - REF 013 - LIFTING/ INSTALLATION LARGE REINFORCEMENT CAGES
  - REF 014 - HAVS DUE TO EXCESS PILE CUTTING/ TRIMMING

Rev.	Date	Description	By	Chk'd	App'd
P02	10/04/18	AREAS BELOW 1.5m CONTRACTOR DESIGN	RA	MT	HM
P01	30/01/18	FOR INFORMATION	AS	MT	HM

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Client

Working on behalf of

Project Title  
**A1 BIRTLEY TO COALHOUSE**

Drawing Title  
**RETAINING WALL 5 (STKEY 00005) GENERAL ARRANGEMENT**

Scale	Drawn	Checked	Approved	Authorised
AS SHOWN	R. Ayre	M.Tziolas	H. Mistry	H. Mistry

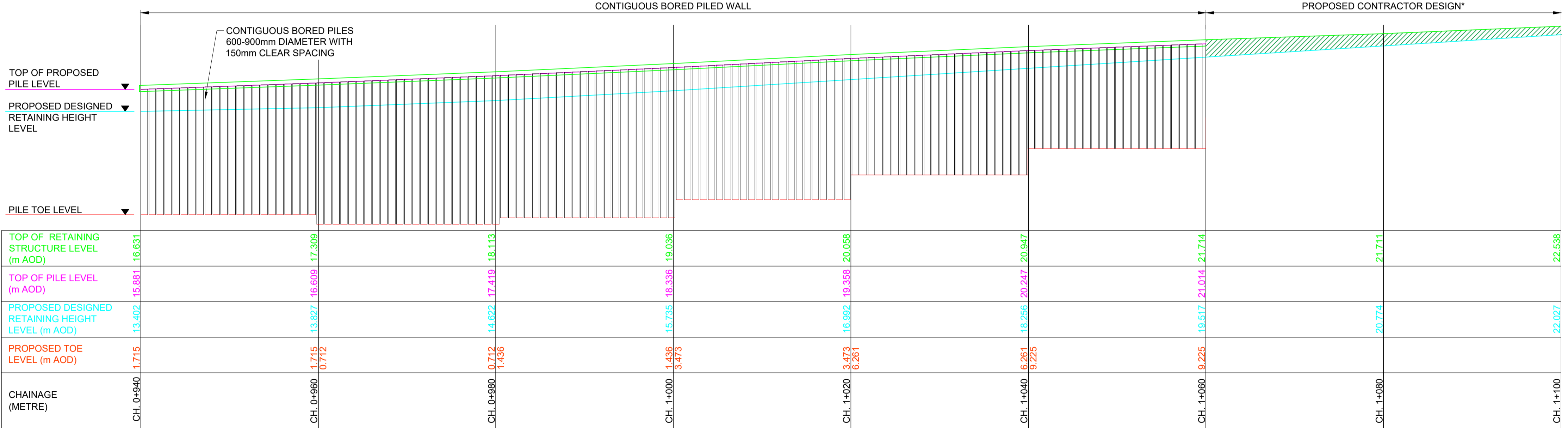
Drawing Status  
**FOR INFORMATION**

Suitability  
**S1**

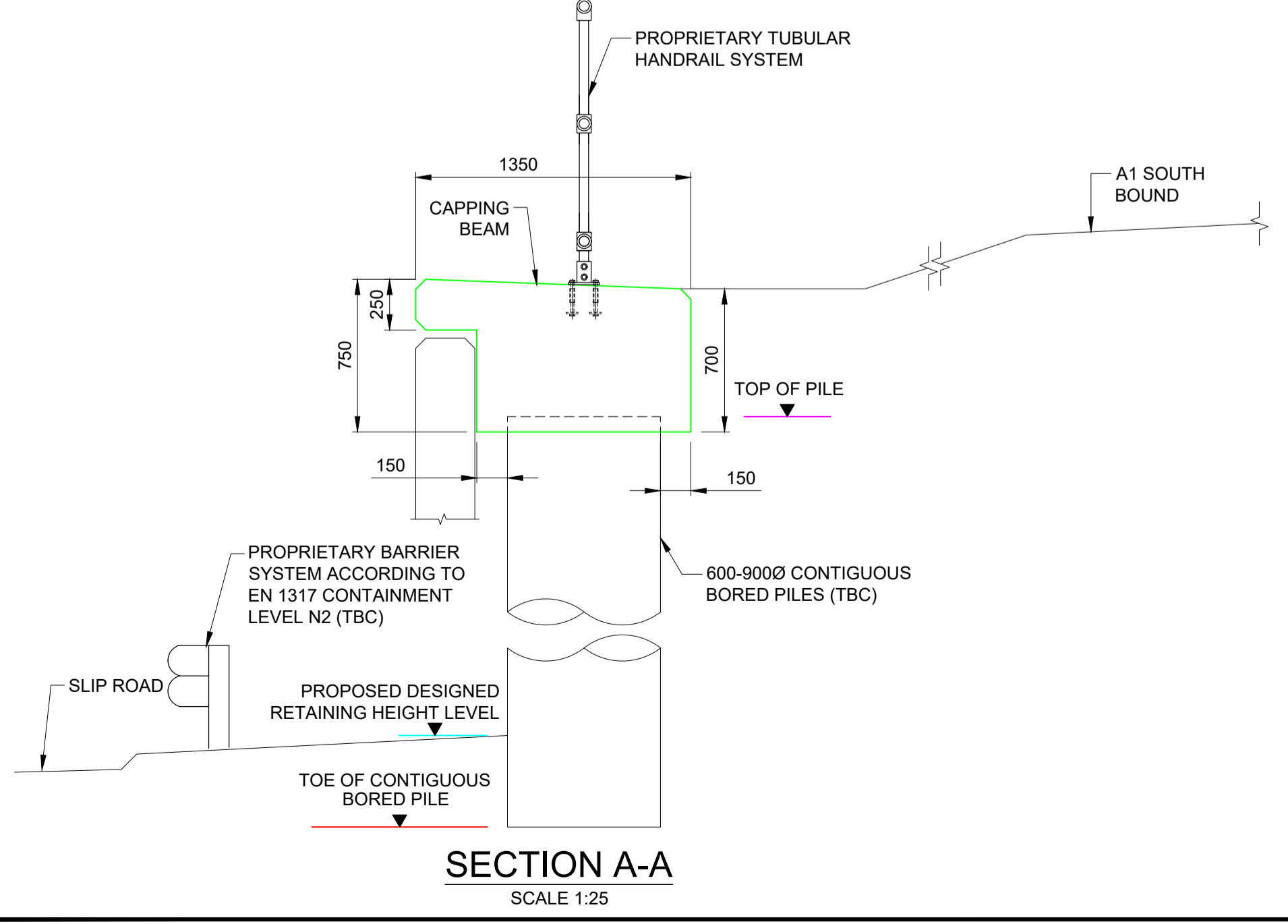
Project	Originator	Volume	Project Ref. No.
HE551462	WSP	SBR	
Location	Type	Role	Number
BR008	DR	S	00013

DO NOT SCALE

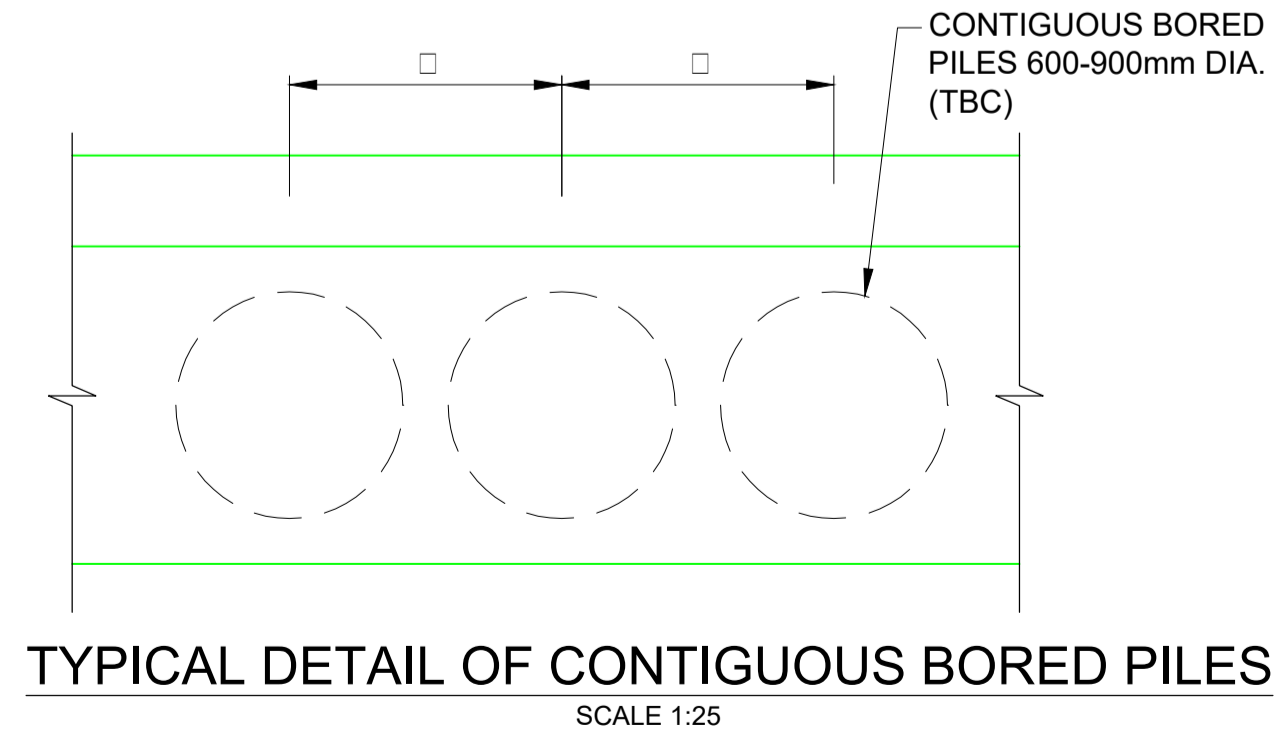
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ELEVATION OF RETAINING WALL 5  
SCALE 1:300



SECTION A-A  
SCALE 1:25



TYPICAL DETAIL OF CONTIGUOUS BORED PILES  
SCALE 1:25

APPENDIX D-6

RETAINING WALL 6 (RW6) GENERAL ARRANGEMENT

GENERAL NOTES

- STRUCTURAL RETAINING WALL DETAILS PROVIDED ON THIS DRAWING IS INDICATIVE ONLY BASED ON LIMITED INFORMATION AVAILABLE TODAY.
- THE SIZE OF STRUCTURAL ELEMENTS ARE BASED ON PRELIMINARY CALCULATION AND PREVIOUS SIMILAR TYPE WORKS. ALL INFORMATION IS SUBJECT TO DETAILED DESIGN PRIOR TO FINAL CONFIRMATION.
- DETAILS PROVIDED ARE FOR INFORMATION ONLY. INDICATIVE CONSTRUCTION COST ESTIMATES ARE BASED ON PREVIOUS SIMILAR TYPE WORKS.
- THE FOLLOWING CRITICAL INFORMATION IS REQUIRED TO VERIFY THE FEASIBILITY OF THE PROPOSED OPTION AND DEVELOPED THIS FURTHER AT DETAILED DESIGN (IF PREFERRED)
  - TOPOGRAPHICAL SURVEY - CONFIRM GEOMETRIC PARAMETER AND SITE CONSTRAINTS
  - SITE INVESTIGATION INFORMATION - CONFIRM FOUNDATION PARAMETERS
  - LIAISON WITH HIGHWAY ENGLAND - CONFIRM STRUCTURAL REQUIREMENTS
  - LIAISON WITH STATUTORY UNDERTAKERS - CONFIRM EXISTING/ NEW SERVICES IMPACTED BY THE WORKS.
- ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
- ALL LEVELS ARE IN METERS UNLESS NOTED OTHERWISE.
- DO NOT SCALE IN CASE OF ANY DOUBTS, OMISSIONS OR ERRORS SEEK DESIGNER CLARIFICATION.
- FOR BOREHOLE INFORMATION REFER TO GROUND INVESTIGATION REPORT

KEY

- LIMITS OF LAND TO BE ACQUIRED OR USED PERMANENTLY OR TEMPORARILY
- PROPOSED LAYOUT- DESIGN FIX 3: REV 2 (16/08/2017)
- LAND TO BE USED FOR CONSTRUCTION, MAINTENANCE AND OPERATION CURRENTLY OWNED BY SECRETARY OF STATE
- LAND TO BE PERMANENTLY ACQUIRED FOR CONSTRUCTION, MAINTENANCE AND OPERATION
- THIRD PARTY LAND TEMPORARILY REQUIRED DURING CONSTRUCTION
- AREA NOT INCLUDED WITHIN THE DCO BOUNDARY

SAFETY, HEALTH AND ENVIRONMENTAL SYMBOL LEGEND

- INDICATES A RESIDUAL RISK AS A WARNING
- IN ADDITION TO THE HAZARD/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS
- RISK REFERENCE:
- REF 001 - OPEN PILE HOLES
  - REF 002 - LIFTING OF LONG STEEL SECTIONS AND HEAVY PRECAST CONCRETE PANELS
  - REF 003 - POOR MATERIAL PROPERTIES
  - REF 004 - EXISTING EARTHWORKS INSTABILITY
  - REF 005 - EXISTENCE OF COAL MINES
  - REF 006 - CONTAINMENT LAND
  - REF 007 - HIGH GROUND WATER LEVEL
  - REF 008 - BEDROCK HIGHER THAN ANTICIPATED LEVEL
  - REF 009 - BEDROCK LOWER THAN ANTICIPATED LEVEL

Rev.	Date	Description	By	Chkd	App'd
P02	10/04/18	AREAS BELOW 1.5m CONTRACTOR DESIGN	RA	MT	HM
P01	30/01/18	FOR INFORMATION	AS	MT	HM

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Project Title **A1 BIRTLEY TO COALHOUSE**

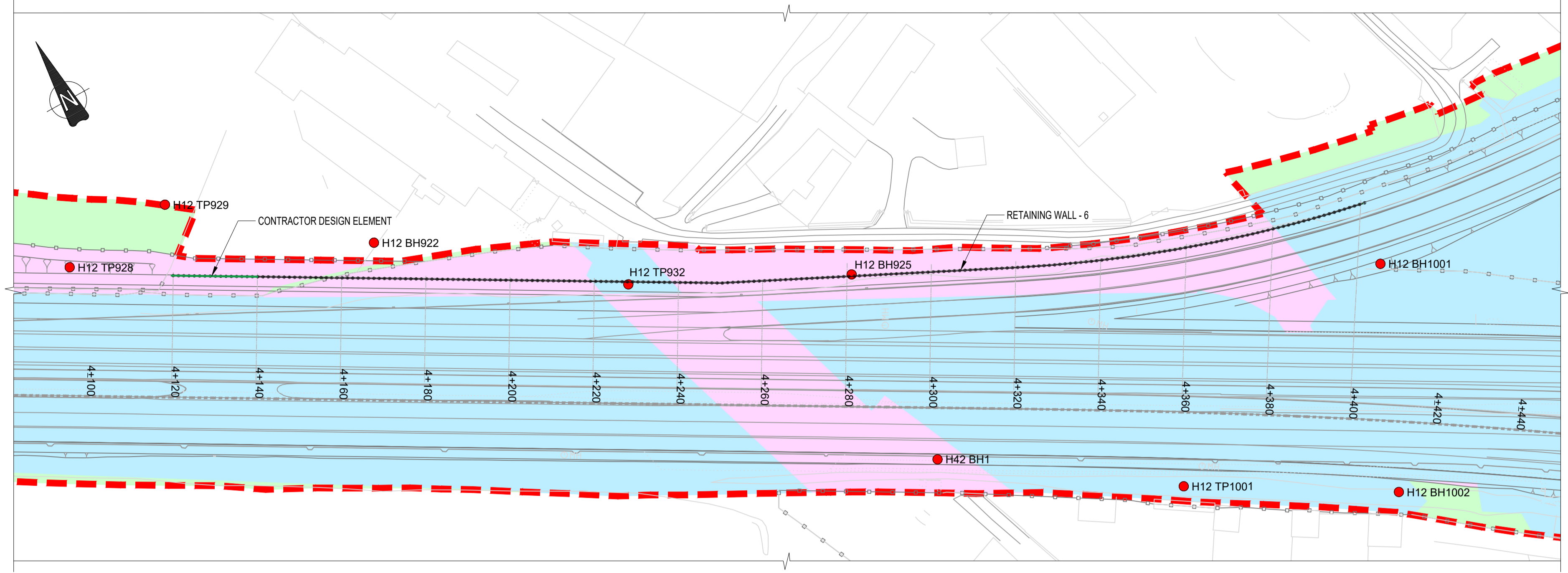
Drawing Title **RETAINING WALL 6 (STKEY 00006) GENERAL ARRANGEMENT**

Scale	Drawn	Checked	Approved	Authorised
AS SHOWN	R.Ayre	M.Tziolas	H. Mistry	H. Mistry
Original Size	Date	Date	Date	Date
A1	10/04/18	10/04/18	10/04/18	10/04/18

Drawing Status **FOR INFORMATION** Suitability **S1**

Project	Originator	Volume	Project Ref. No.
HE551462	WSP	SBR	
Location	Type	Role	Number
BR008	DR	S	00014

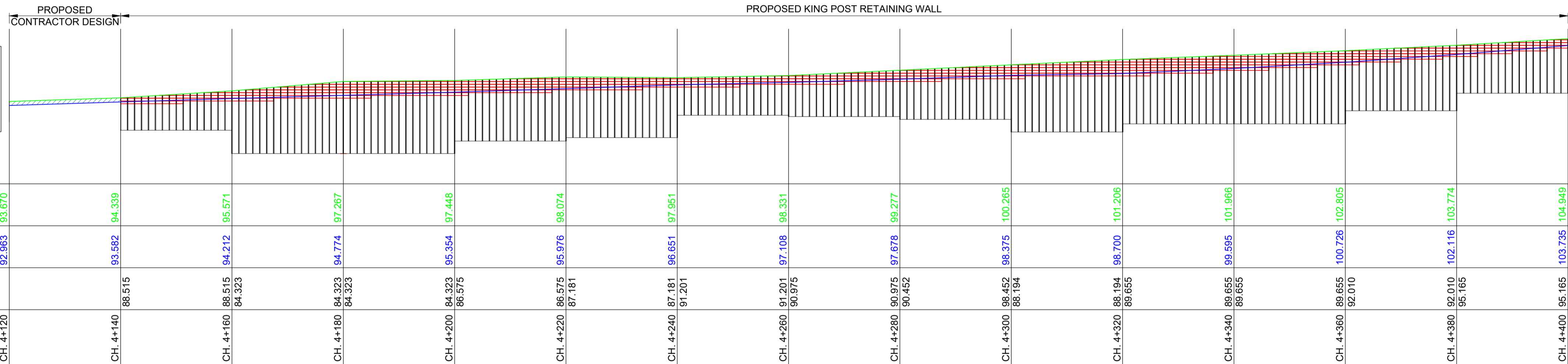
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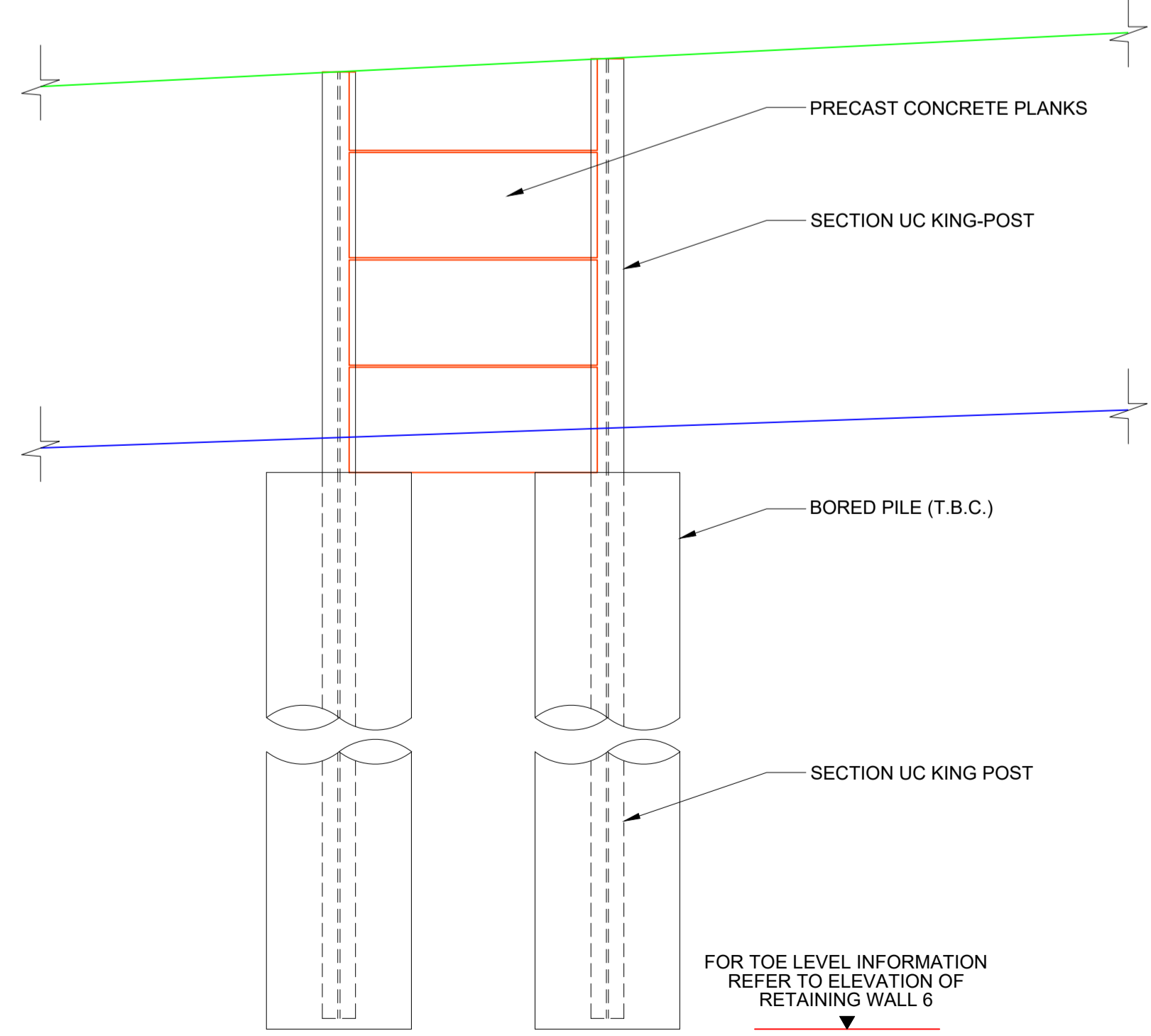
**PLAN OF RETAINING WALL 6**  
SCALE 1:750



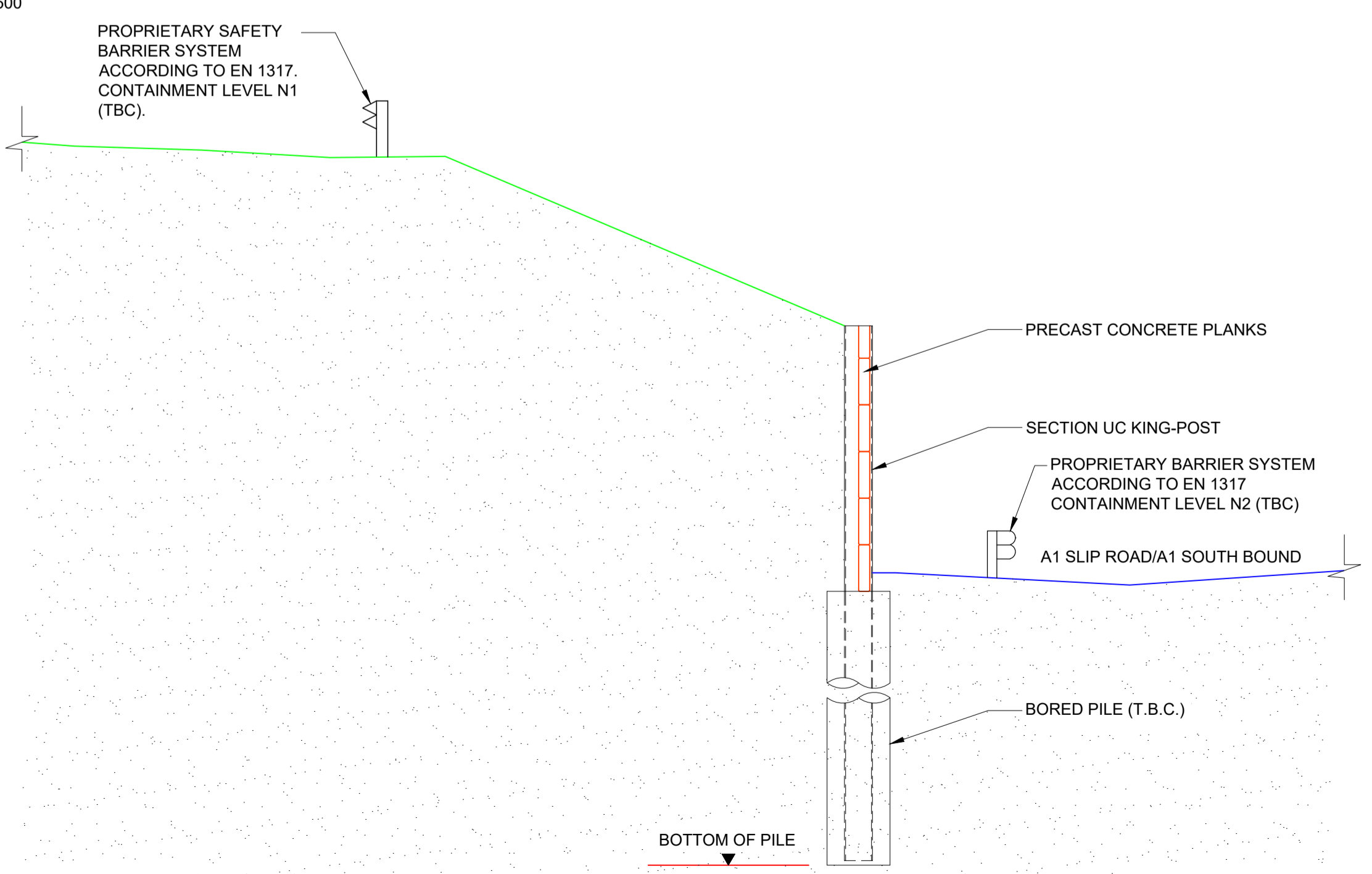
\*CONTRACTOR SHALL BE RESPONSIBLE FOR THE DESIGN OF RETAINING STRUCTURES LESS THAN 1.5m RETAINED HEIGHT. THE STRUCTURE SHALL HAVE A SMOOTH TRAFFIC FACE IN ACCORDANCE WITH 19/06. THE CONTRACTOR SHALL ALSO BE RESPONSIBLE FOR THE PROVISION OF A SMOOTH TRANSITION BETWEEN THE RETAINING STRUCTURE ≤1.5m & ≥1.5m



**ELEVATION OF RETAINING WALL 6**  
SCALE 1:500



**TYPICAL ELEVATION OF KING POST RETAINING WALL**  
SCALE 1:25



**TYPICAL CROSS SECTION**  
SCALE 1:50

# Appendix E

**DESIGN RISK ASSESSMENTS**

APPENDIX E-1

**RW1 DESIGNERS RISK ASSESSMENT**

## Guidance notes (see guidance notes page for more details)

Design risk management should be an integral part of the overall design development and designers should think of it in terms of considering constructability, maintainability, etc. Designers only need to document their consideration of risks in this simple risk register format. There is no requirement for quantitative design risk assessments to be carried out/documentated and these should be avoided

\* Risks should be considered in a logical sequence relating to the location/operational environment, constructability/install ability, operability (normal/emergency), maintainability (inc. routine cleaning, replacement, etc.), and alteration/decommissioning/dismantling/demolition, and should be categorised against those headings,

CIRIA guidance documents C662, C663, C611, C607, etc. provide a useful checklist and detailed guidance on the identification of risks to be considered during design and how those risks might be addressed - see detailed guidance notes for more details

<sup>5</sup> Significant residual risks are those which are unusual, not obvious, difficult to manage, or where critical design assumptions apply. The documentation by designers of residual risks that cover well-known and understood hazards should be avoided

Ref	Risk Category* (and Phase where appropriate, e.g. location/environment, construction, operation, maintenance, alteration/demolition)	Work Element/Location (where appropriate)	Hazard or Risk Issue Identified	Risk Management Owner	Design ERIC Action Required (e.g. hazard elimination/risk mitigation action, information to be provided to others)	Significant Temporary Works Requirements/Management Arrangements and/or any Special Erection/Installation Sequences or Requirements	Design Action Status/Final Resolution Notes (e.g. traceability of ERIC action, communication of significant residual risk, critical design criteria, etc.)	Significant Residual Risk <sup>5</sup> (Y/N)	Date Logged/Reviewed	Raised By
011	Construction	Retaining Wall 1 - Option E (Reinforced Concrete L-Shape Retaining Wall)	Working with reinforced concrete walls require handling of large volumes of concrete including placing at height of shutters for the walls. Shuttering requires significant temporary works. Also large reinforcement cages introduces risks associated with impaling/ heavy lifting of bars, working at heights etc.	Designer	Use of alternative methods (precast units) as abutment walls and foundation reduces in-situ concrete works for the substructure elements. Rebar cages potentially fabricated in controlled works area then lifted into final position which reduces risks.	Design minimises the need for temporary works	Specific construction methods to be defined on drawing and specification.	N	06/02/2018	Michail Tziolas
012	Construction	Retaining Wall 1 - Option E (Reinforced Concrete L-Shape Retaining Wall)	Temporary works to support deep excavations for reinforced concrete wall. Restricted working area to install temp works increases risk of personnel entrapment/injury.	Designer	The use of alternative construction method (piling) as retaining walls eliminates the need for temporary works to support deep excavations. Although the existing ground profile favours bottom up method (L-shape wall) in comparison to top down method (sheet piles). Permanent works take the place of temporary works. 'Top-down' construction eliminates deep unsupported excavations that require temp support although with the existing ground profile this construction method is not feasible.	Contractor to consider any temporary safe guarding measures required at the top of the wall to limit falls from height (installation of parapet).	Appropriate reference on drawing	N	06/02/2018	Michail Tziolas
013	Construction	Retaining Wall 1 - Option E (Reinforced Concrete L-Shape Retaining Wall)	Transport of large components - potential risks associated with the movement of large abnormal loads.	Contractor	Detailed design to ensure the sections of walls (precast L-shape walls) are manageable (not excessively long etc.) to ensure they can be delivered to site with minimal potential logistical risks. precast panels with both dimensions (span and height) greater than 3m cannot easily be delivered to site and a in-situ solution should be used instead.	Contractor to provide assembly area as part of site compound.	By ensuring the length of retaining wall sections are not excessively large, would reduce risk associated with transport and assembly on site.	N	06/02/2018	Michail Tziolas
014	Construction	Retaining Wall 1 - Option E (Reinforced Concrete L-Shape Retaining Wall)	Lifting and installation of heavy precast reinforced L-shape retaining walls, risk associated with the lifting operations and installation of the structural elements.	Contractor	The pre-cast walls are to be specified such that they can be pre-prepared off site and brought to site as required. Risk to be mitigated by minimising weight of units where possible. Appropriate lifting points to be included at detailed design stage aiming to give best stability during lifting condition. Lifting points to be shared with contractor's lift planners at an early stage for review of appropriateness to allow changes to be made as early in the process as possible.	Appropriate crange to be used with a lifting plan to off load and install prec-cast walls.	Risks associated with the lifting/installation of pre-cast walls to be added to drawings. Lifting point information to be shared with contractor. Contractor to implement safe system. Ensure sufficient working space to locate plant and equipment.	Y	06/02/2018	Michail Tziolas
015	Construction/Maintenance	Retaining Wall 1 - Option E (Reinforced Concrete L-Shape Retaining Wall)	Poorer than anticipated engineering properties of the founding strata and material below the retaining wall resulting in movement of the structure beyond its serviceability limits.	Designer	Ground improvement works may be required below the footprint of the retaining wall to ensure the settlement that occurs is within tolerable limits.	An intrusive ground investigation to be undertaken to assess the ground conditions. Groundwater monitoring to be undertaken as part of the investigation. Based of the conclusions from the intrusive ground investigation confirmation of ground improvement works is to be provided.	Ground Investigation Report to be provided. Preliminary design to take account of anticipated settlements and the potential requirement for ground improvement.	Y	21/03/2018	Ruth Jacobs

## Guidance notes (see guidance notes page for more details)

Design risk management should be an integral part of the overall design development and designers should think of it in terms of considering constructability, maintainability, etc. Designers only need to document their consideration of risks in this simple risk register format. There is no requirement for quantitative design risk assessments to be carried out/documentated and these should be avoided

\* Risks should be considered in a logical sequence relating to the location/operational environment, constructability/install ability, operability (normal/emergency), maintainability (inc. routine cleaning, replacement, etc.), and alteration/decommissioning/dismantling/demolition, and should be categorised against those headings,

CIRIA guidance documents C662, C663, C611, C607, etc. provide a useful checklist and detailed guidance on the identification of risks to be considered during design and how those risks might be addressed - see detailed guidance notes for more details

<sup>5</sup> Significant residual risks are those which are unusual, not obvious, difficult to manage, or where critical design assumptions apply. The documentation by designers of residual risks that cover well-known and understood hazards should be avoided

Ref	Risk Category* (and Phase where appropriate, e.g. location/environment, construction, operation, maintenance, alteration/demolition)	Work Element/Location (where appropriate)	Hazard or Risk Issue Identified	Risk Management Owner	Design ERIC Action Required (e.g. hazard elimination/risk mitigation action, information to be provided to others)	Significant Temporary Works Requirements/Management Arrangements and/or any Special Erection/Installation Sequences or Requirements	Design Action Status/Final Resolution Notes (e.g. traceability of ERIC action, communication of significant residual risk, critical design criteria, etc.)	Significant Residual Risk <sup>5</sup> (Y/N)	Date Logged/Reviewed	Raised By
016	Construction	Retaining Wall 1 - Option E (Reinforced Concrete L-Shape Retaining Wall)	The proposed works may undermine / cause instability within the existing earthworks.	Designer	Additional temporary works may be required to prevent instability of existing embankment occurring during construction.	A review of HA GDMS and the Principal Earthwork Inspection records held there. Intrusive investigation undertaken to determine the composition of the existing earthworks.	Temporary works designer to take into account the presence of the existing earthworks.	Y	21/03/2018	Ruth Jacobs
017	Construction/Maintenance	Retaining Wall 1 - Option E (Reinforced Concrete L-Shape Retaining Wall)	The retaining wall may be adversely impacted by the collapse of coal mine working below the retaining wall foundations.	Designer	Grouting of the worked coal seams below the retaining wall, or a basal geogrid to reduce the impact of migrating crown holes on the retaining wall, may be required.	An intrusive ground investigation and coal mining risk assessment to be undertaken to determine the requirement for grouting.	Ground Investigation Report and Coal Mining Risk Assessment reporting to be produced and confirm the need for stabilisation works below the retaining wall foundations.	Y	21/03/2018	Ruth Jacobs

APPENDIX E-2  
**RW2 DESIGNERS RISK ASSESSMENT**

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**Guidance notes** (see guidance notes page for more details)

Design risk management should be an integral part of the overall design development and designers should think of it in terms of considering constructability, maintainability, etc. Designers only need to document their consideration of risks in this simple risk register format. There is no requirement for quantitative design risk assessments to be carried out/documentated and these should be avoided

\* Risks should be considered in a logical sequence relating to the location/operational environment, constructability/install ability, operability (normal/emergency), maintainability (inc. routine cleaning, replacement, etc.), and alteration/decommissioning/dismantling/demolition, and should be categorised against those headings,

CIRIA guidance documents C662, C663, C611, C607, etc. provide a useful checklist and detailed guidance on the identification of risks to be considered during design and how those risks might be addressed - see detailed guidance notes for more details

<sup>§</sup> Significant residual risks are those which are unusual, not obvious, difficult to manage, or where critical design assumptions apply. The documentation by designers of residual risks that cover well-known and understood hazards should be avoided

Ref	Risk Category* (and Phase where appropriate, e.g. location/environment, construction, operation, maintenance, alteration/demolition)	Work Element/Location (where appropriate)	Hazard or Risk Issue Identified	Risk Management Owner	Design ERIC Action Required (e.g. hazard elimination/risk mitigation action, information to be provided to others)	Significant Temporary Works Requirements/Management Arrangements and/or any Special Erection/Installation Sequences or Requirements	Design Action Status/Final Resolution Notes (e.g. traceability of ERIC action, communication of significant residual risk, critical design criteria, etc.)	Significant Residual Risk <sup>§</sup> (Y/N)	Date Logged/Reviewed	Raised By
001	Construction	Retaining Wall 2 - Option A (Sheet Pile Retaining Wall)	Produce high levels of noise during machine and sheet piling driving machine operation.	Contractor	Noise monitoring devices which alert people to a rise in noise level. PPE/ noise protectors to protect people's hearing, preferable to be used for short periods only for specific tasks in noisy spaces. Use of nuisance management strategy.	Reduction in noise generated to a safe level of separation of people from excessive level of noise.	The level of risk from residual noise may be reduced by applying appropriate control.	N	06/02/2018	Michail Tziolas
002	Construction	Retaining Wall 2 - Option A (Sheet Pile Retaining Wall)	Handling of heavy steel sheet pile sections.	Contractor	Specify method of handling that reduces the risk of manual handling.	Contractor to adopt safe method of handling.	No action.	N	06/02/2018	Michail Tziolas
003	Maintenance/Operation	Retaining Wall 2 - Option A (Sheet Pile Retaining Wall)	Errant vehicles/maintenance personnel falling behind retaining wall from the A1 road level.	Operator	It is proposed that either a VRS be fixed along the top of the retaining walls. To limit the risk of falls from height	-	No action.	N	06/02/2018	Michail Tziolas
004	Construction / Maintenance	Retaining wall 2	Poorer than anticipated engineering properties of the material behind and / or in front of the retaining wall resulting in deflections of the structure beyond its serviceability limits.	Designer	Design to take into account the results of the ground investigation, once completed, and sensitivity analysis conducted where uncertainty exists.	An intrusive ground investigation to be undertaken to assess the ground conditions. Based of the conclusions from the intrusive ground investigation suitable design shall be undertaken.	Ground Investigation Report to be provided. Preliminary design to take account of anticipated ground conditions.	Yes	09/04/2018	Ruth Jacobs
005	Construction	Retaining wall 2	The proposed works may undermine / cause instability within the existing earthworks.	Designer	Additional temporary works my be required to prevent instability of the existing embankment occurring during construction of the retaining wall.	A review of HA GDMS and the Principal Earthwork Inspection records held there. Intrusive investigation undertaken to determine the composition of the existing earthworks.	Temporary works designer to take into account the presence of the existing earthworks.	Yes	09/04/2018	Ruth Jacobs
006	Construction / Maintenance	Retaining wall 2	Potential for coal mine workings to cause collapse/increased deflection of the retaining wall.	Designer	Grouting of the worked coal seams below the retaining wall may be required.	An intrusive ground investigation and coal mining risk assessment to be undertaken to determine the requirement for grouting.	Ground Investigation Report and Coal Mining Risk Assessment reporting to be produced and confirm the need for stabilisation works below the length of the retaining wall structure.	Yes	09/04/2018	Ruth Jacobs
007	Construction	Retaining wall 2	Contaminated land or materials on site	Contractor	Assumed good practice will be carried out in site to prevent material becoming contaminated. Unusual smells to be notified to the supervising Engineer for assessment before work continues. Spillage to be dealt with promptly by identified methods. Appropriate PPE and induction.	An intrusive ground investigation to be undertaken to assess the ground conditions, including undertaking geo-environmental testing.	The geo-environmental conditions anticipated to be encountered on site shall be highlighted within the Ground Investigation Report and subsequent design report.	Yes	09/04/2018	Ruth Jacobs
008	Construction	Retaining wall 2	High groundwater levels (including perched groundwater) causing excessive unfavourable actions on retaining structure, leading to greater than anticipated deflection of the embedded wall.	Designer	Design to take into account the results of the ground investigation, once completed, and sensitivity analysis conducted where uncertainty exists.	An intrusive ground investigation to be undertaken to assess the ground conditions. Groundwater monitoring to be undertaken as part of the investigation. Based of the conclusions from the intrusive ground investigation suitable design shall be undertaken.	Ground Investigation Report to be provided. Preliminary design to take account of anticipated groundwater conditions.	Yes	09/04/2018	Ruth Jacobs

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APPENDIX E-3  
**RW3 DESIGNERS RISK ASSESSMENT**

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**Guidance notes** (see guidance notes page for more details)

Design risk management should be an integral part of the overall design development and designers should think of it in terms of considering constructability, maintainability, etc. Designers only need to document their consideration of risks in this simple risk register format. There is no requirement for quantitative design risk assessments to be carried out/documentated and these should be avoided

\* Risks should be considered in a logical sequence relating to the location/operational environment, constructability/install ability, operability (normal/emergency), maintainability (inc. routine cleaning, replacement, etc.), and alteration/decommissioning/dismantling/demolition, and should be categorised against those headings,

CIRIA guidance documents C662, C663, C611, C607, etc. provide a useful checklist and detailed guidance on the identification of risks to be considered during design and how those risks might be addressed - see detailed guidance notes for more details

<sup>§</sup> Significant residual risks are those which are unusual, not obvious, difficult to manage, or where critical design assumptions apply. The documentation by designers of residual risks that cover well-known and understood hazards should be avoided

Ref	Risk Category* (and Phase where appropriate, e.g. location/environment, construction, operation, maintenance, alteration/demolition)	Work Element/Location (where appropriate)	Hazard or Risk Issue Identified	Risk Management Owner	Design ERIC Action Required (e.g. hazard elimination/risk mitigation action, information to be provided to others)	Significant Temporary Works Requirements/Management Arrangements and/or any Special Erection/Installation Sequences or Requirements	Design Action Status/Final Resolution Notes (e.g. traceability of ERIC action, communication of significant residual risk, critical design criteria, etc.)	Significant Residual Risk <sup>§</sup> (Y/N)	Date Logged/Reviewed	Raised By
001	Construction	Retaining Wall 3&4 - reinforced earth wall	Risk associated with working at height	Designer	Design to consider method of construction that reduces the risk of working at height. Pre-fabricated sections proposed to avoid in-situ construction at height.	Temporary work minimised by use of precast materials.	Precast requirements to be defined in the works information.	N	03/04/2018	Michail Tziolas
002	Construction	Retaining Wall 3&4 - reinforced earth wall	Working adjacent to live traffic	Designer	Construction methods with limited working room required and interface with live traffic	TM required to be installed by a competent contractor	Appropriate reference on drawing	Y	03/04/2018	Michail Tziolas
003	Construction	Retaining Wall 3&4 - reinforced earth wall	Live road (A1 main line and slip roads) at risk of falling debris during lifting operation of structural elements.	Contractor	Extra attention to prevent debris falling to A1 carriageway and slip road during lifting operations.	TM to be in place during works with the crane. Contractor to ensure TM details to be approved prior to undertaking site based operations.	Note on drawings to be provided highlighting the need for road closures or traffic management during lifting operations.	Y	03/04/2018	Rakesh Mehta
004	Construction	Retaining Wall 3&4 - reinforced earth wall	Working adjacent to services. Damage to existing services, electrocution.	Contractor	Statutory undertakers information indicate that services are located within the vicinity of retaining walls and may potentially be affected by the works.  Statutory undertakers searches/consultation to be undertaken prior to detailed design (on-going). This is to enable requirements for diversion/protection to be determined. This should be reviewed by contractor prior to undertaking works.	At this stage it is assumed that all services found affecting the proposed retaining wall works shall be diverted/ protected accordingly to progress the retaining wall works on site. During construction, areas to be scanned by trained and competent contractor to confirm no presence of services prior to works. Contractor to locate any services present using hand tools before mechanical excavation can commence. Contractor to also liaise with the statutory undertakers/local authorities and the HE maintenance service providers to locate all services prior to piling or excavation works. Contractor to implement safe system. All excavation to be examined prior to use.	Appropriate note/reference to be put on drawings relating to service location at detailed design.	Y	03/04/2018	Michail Tziolas
005	Construction	Retaining Wall 3&4 - reinforced earth wall	Transport of large components - potential risks associated with the movement of large abnormal loads.	Contractor	Detailed design to ensure the sections of walls (reinforcing strips, etc.) are manageable (not excessively long etc.) to ensure they can be delivered to site with minimal potential logistical risks.	Contractor to provide assembly area as part of site compound.	By ensuring the length of retaining wall sections are not excessively large, would reduce risk associated with transport and assembly on site.	N	03/04/2018	Michail Tziolas
006	Construction	Retaining Wall 3&4 - reinforced earth wall	Site vehicles using public highways to transport excess materials to disposal sites. Mud on roads, airborne contamination during/after transit	Contractor	Identify agreed route where disruption will be minimised and how the works areas will be accessed by construction traffic during the works.	Wheel washing facility to be used on site to minimise mud tracked onto road network. Tarpaulins and straps to be checked before deliveries leave site. Haulage of material to be considered, in particular how to avoid/limit disruption to the traffic during construction.	Contractor to plan all site deliveries and make suppliers aware of these. To be defined in TTM plan.	N	03/04/2018	Michail Tziolas
007	Construction	Retaining Wall 3&4 - reinforced earth wall	Delivery material/structural components on site cause obstruction lead to accidents (collision etc.)	Contractor	Contractor to consider suitable holding areas on site in close proximity to the works.	Contractor to provide a suitable holding area as part of the site compound.	No further action	N	03/04/2018	Michail Tziolas
008	Maintenance	Retaining Wall 3&4 - reinforced earth wall	Struck by traffic during inspection works.	Operator	Safe methods of work should be determined for all required maintenance. Traffic management arrangements to be determined before any work commences. The H&S maintenance file should be consulted whilst planning the required work.	TM to be deployed when undertaking inspection/maintenance type works. Details to be provided in TTM plans.	SSOW to be deployed during inspection/maintenance	N	03/04/2018	Michail Tziolas
009	Maintenance	Retaining Wall 3&4 - reinforced earth wall	Errant slip road vehicles/maintenance personnel falling into the A1 or the slip roads from the raised road levels.	Operator	It is proposed that either a VRS be fixed along the top of the retaining walls. Alternatively a safety barrier will be fixed adjacent to the slip road edge (provide vehicle containment) and a pedestrian parapet be provided along the top or adjacent of the retaining wall (prevent falls from height).	Contractor to determine TM requirements for the installation of parapets. Details to be documented in TTM plans.	Add note on drawing to identify risk.	N	03/04/2018	Michail Tziolas

**Guidance notes** (see guidance notes page for more details)

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\* Risks should be considered in a logical sequence relating to the location/operational environment, constructability/install ability, operability (normal/emergency), maintainability (inc. routine cleaning, replacement, etc.), and alteration/decommissioning/dismantling/demolition, and should be categorised against those headings,

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Ref	Risk Category* (and Phase where appropriate, e.g. location/environment, construction, operation, maintenance, alteration/demolition)	Work Element/Location (where appropriate)	Hazard or Risk Issue Identified	Risk Management Owner	Design ERIC Action Required (e.g. hazard elimination/risk mitigation action, information to be provided to others)	Significant Temporary Works Requirements/Management Arrangements and/or any Special Erection/Installation Sequences or Requirements	Design Action Status/Final Resolution Notes (e.g. traceability of ERIC action, communication of significant residual risk, critical design criteria, etc.)	Significant Residual Risk <sup>§</sup> (Y/N)	Date Logged/Reviewed	Raised By
010	Operation	Retaining Wall 3&4 - reinforced earth wall	Injury to driver upon impact with the retaining wall face.	Operator	Proposed retaining wall to be provided with a smooth finish (in some cases cladding) and a VRS in front according to TD19/06 - this reduces the severity of injury upon vehicular impact.	Contractor to consider temporary works required to fix cladding.	Appropriate reference on drawing	N	03/04/2018	Michail Tziolas
011	Construction	Retaining Wall 3&4 - reinforced earth wall	Transition between reinforced earth embankment and bridge abutment. Greater than tolerable differential settlements.	Designer	Bridge designer and Specialist Reinforced Soil Designer to work closely to ensure interaction is acceptable. Contractor to confirm appointments of specialist RS Wall designer at the earliest opportunity so they can engage with the WSP bridge design team	None	None	Y	06/02/2018	Michail Tziolas
012	Construction / Maintenance	Retaining Wall 3&4 - reinforced earth wall	Poorer than anticipated engineering properties of the founding strata and material below the retaining wall resulting in movement of the structure beyond its serviceability limits.	Designer	Ground improvement works may be required below the footprint of the retaining wall to ensure the settlement that occurs is within tolerable limits.	An intrusive ground investigation to be undertaken to assess the ground conditions. Groundwater monitoring to be undertaken as part of the investigation. Based on the conclusions from the intrusive ground investigation confirmation of ground improvement works is to be provided.	Ground Investigation Report to be provided. Preliminary design to take account of anticipated settlements and the potential requirement for ground improvement.	Y	22/03/2018	Ruth Jacobs
013	Construction	Retaining Wall 3&4 - reinforced earth wall	The proposed works may undermine / cause instability within the existing earthworks.	Designer	Additional temporary works may be required to prevent instability of existing embankment occurring during construction.	A review of HA GDMS and the Principal Earthwork Inspection records held there. Intrusive investigation undertaken to determine the composition of the existing earthworks.	Temporary works designer to take into account the presence of the existing earthworks.	Y	22/03/2018	Ruth Jacobs
014	Construction / Maintenance	Retaining Wall 3&4 - reinforced earth wall	The retaining wall may be adversely impacted by the collapse of coal mine working below the retaining wall foundations.	Designer	Grouting of the worked coal seams below the retaining wall, or a basal geogrid to reduce the impact of migrating crown holes on the retaining wall, may be required.	An intrusive ground investigation and coal mining risk assessment to be undertaken to determine the requirement for grouting.	Ground Investigation Report and Coal Mining Risk Assessment reporting to be produced and confirm the need for stabilisation works below the retaining wall foundations.	Y	22/03/2018	Ruth Jacobs

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APPENDIX E-4

**RW 4 DESIGNERS RISK ASSESSMENT**

**Guidance notes** (see guidance notes page for more details)

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Ref	Risk Category* (and Phase where appropriate, e.g. location/environment, construction, operation, maintenance, alteration/demolition)	Work Element/Location (where appropriate)	Hazard or Risk Issue Identified	Risk Management Owner	Design ERIC Action Required (e.g. hazard elimination/risk mitigation action, information to be provided to others)	Significant Temporary Works Requirements/Management Arrangements and/or any Special Erection/Installation Sequences or Requirements	Design Action Status/Final Resolution Notes (e.g. traceability of ERIC action, communication of significant residual risk, critical design criteria, etc.)	Significant Residual Risk <sup>§</sup> (Y/N)	Date Logged/Reviewed	Raised By
001	Construction	Retaining Wall 3&4 - reinforced earth wall	Risk associated with working at height	Designer	Design to consider method of construction that reduces the risk of working at height. Pre-fabricated sections proposed to avoid in-situ construction at height.	Temporary work minimised by use of precast materials.	Precast requirements to be defined in the works information.	N	03/04/2018	Michail Tziolas
002	Construction	Retaining Wall 3&4 - reinforced earth wall	Working adjacent to live traffic	Designer	Construction methods with limited working room required and interface with live traffic	TM required to be installed by a competent contractor	Appropriate reference on drawing	Y	03/04/2018	Michail Tziolas
003	Construction	Retaining Wall 3&4 - reinforced earth wall	Live road (A1 main line and slip roads) at risk of falling debris during lifting operation of structural elements.	Contractor	Extra attention to prevent debris falling to A1 carriageway and slip road during lifting operations.	TM to be in place during works with the crane. Contractor to ensure TM details to be approved prior to undertaking site based operations.	Note on drawings to be provided highlighting the need for road closures or traffic management during lifting operations.	Y	03/04/2018	Rakesh Mehta
004	Construction	Retaining Wall 3&4 - reinforced earth wall	Working adjacent to services. Damage to existing services, electrocution.	Contractor	Statutory undertakers information indicate that services are located within the vicinity of retaining walls and may potentially be affected by the works.  Statutory undertakers searches/consultation to be undertaken prior to detailed design (on-going). This is to enable requirements for diversion/protection to be determined. This should be reviewed by contractor prior to undertaking works.	At this stage it is assumed that all services found affecting the proposed retaining wall works shall be diverted/ protected accordingly to progress the retaining wall works on site. During construction, areas to be scanned by trained and competent contractor to confirm no presence of services prior to works. Contractor to locate any services present using hand tools before mechanical excavation can commence. Contractor to also liaise with the statutory undertakers/local authorities and the HE maintenance service providers to locate all services prior to piling or excavation works. Contractor to implement safe system. All excavation to be examined prior to use.	Appropriate note/reference to be put on drawings relating to service location at detailed design.	Y	03/04/2018	Michail Tziolas
005	Construction	Retaining Wall 3&4 - reinforced earth wall	Transport of large components - potential risks associated with the movement of large abnormal loads.	Contractor	Detailed design to ensure the sections of walls (reinforcing strips, etc..) are manageable (not excessively long etc.) to ensure they can be delivered to site with minimal potential logistical risks.	Contractor to provide assembly area as part of site compound.	By ensuring the length of retaining wall sections are not excessively large, would reduce risk associated with transport and assembly on site.	N	03/04/2018	Michail Tziolas
006	Construction	Retaining Wall 3&4 - reinforced earth wall	Site vehicles using public highways to transport excess materials to disposal sites. Mud on roads, airborne contamination during/after transit	Contractor	Identify agreed route where disruption will be minimised and how the works areas will be accessed by construction traffic during the works.	Wheel washing facility to be used on site to minimise mud tracked onto road network. Tarpaulins and straps to be checked before deliveries leave site. Haulage of material to be considered, in particular how to avoid/limit disruption to the traffic during construction.	Contractor to plan all site deliveries and make suppliers aware of these. To be defined in TTM plan.	N	03/04/2018	Michail Tziolas
007	Construction	Retaining Wall 3&4 - reinforced earth wall	Delivery material/structural components on site cause obstruction lead to accidents (collision etc.)	Contractor	Contractor to consider suitable holding areas on site in close proximity to the works.	Contractor to provide a suitable holding area as part of the site compound.	No further action	N	03/04/2018	Michail Tziolas
008	Maintenance	Retaining Wall 3&4 - reinforced earth wall	Struck by traffic during inspection works.	Operator	Safe methods of work should be determined for all required maintenance. Traffic management arrangements to be determined before any work commences. The H&S maintenance file should be consulted whilst planning the required work.	TM to be deployed when undertaking inspection/maintenance type works. Details to be provided in TTM plans.	SSOW to be deployed during inspection/maintenance	N	03/04/2018	Michail Tziolas
009	Maintenance	Retaining Wall 3&4 - reinforced earth wall	Errant slip road vehicles/maintenance personnel falling into the A1 or the slip roads from the raised road levels.	Operator	It is proposed that either a VRS be fixed along the top of the retaining walls. Alternatively a safety barrier will be fixed adjacent to the slip road edge (provide vehicle containment) and a pedestrian parapet be provided along the top or adjacent of the retaining wall (prevent falls from height).	Contractor to determine TM requirements for the installation of parapets. Details to be documented in TTM plans.	Add note on drawing to identify risk.	N	03/04/2018	Michail Tziolas

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010	Operation	Retaining Wall 3&4 - reinforced earth wall	Injury to driver upon impact with the retaining wall face.	Operator	Proposed retaining wall to be provided with a smooth finish (in some cases cladding) and a VRS in front according to TD19/06 - this reduces the severity of injury upon vehicular impact.	Contractor to consider temporary works required to fix cladding.	Appropriate reference on drawing	N	03/04/2018	Michail Tziolas
011	Construction	Retaining Wall 3&4 - reinforced earth wall	Transition between reinforced earth embankment and bridge abutment. Greater than tolerable differential settlements.	Designer	Bridge designer and Specialist Reinforced Soil Designer to work closely to ensure interaction is acceptable. Contractor to confirm appointments of specialist RS Wall designer at the earliest opportunity so they can engage with the WSP bridge design team	None	None	Y	06/02/2018	Michail Tziolas
012	Construction / Maintenance	Retaining Wall 3&4 - reinforced earth wall	Poorer than anticipated engineering properties of the founding strata and material below the retaining wall resulting in movement of the structure beyond its serviceability limits.	Designer	Ground improvement works may be required below the footprint of the retaining wall to ensure the settlement that occurs is within tolerable limits.	An intrusive ground investigation to be undertaken to assess the ground conditions. Groundwater monitoring to be undertaken as part of the investigation. Based on the conclusions from the intrusive ground investigation confirmation of ground improvement works is to be provided.	Ground Investigation Report to be provided. Preliminary design to take account of anticipated settlements and the potential requirement for ground improvement.	Y	22/03/2018	Ruth Jacobs
013	Construction	Retaining Wall 3&4 - reinforced earth wall	The proposed works may undermine / cause instability within the existing earthworks.	Designer	Additional temporary works may be required to prevent instability of existing embankment occurring during construction.	A review of HA GDMS and the Principal Earthwork Inspection records held there. Intrusive investigation undertaken to determine the composition of the existing earthworks.	Temporary works designer to take into account the presence of the existing earthworks.	Y	22/03/2018	Ruth Jacobs
014	Construction / Maintenance	Retaining Wall 3&4 - reinforced earth wall	The retaining wall may be adversely impacted by the collapse of coal mine working below the retaining wall foundations.	Designer	Grouting of the worked coal seams below the retaining wall, or a basal geogrid to reduce the impact of migrating crown holes on the retaining wall, may be required.	An intrusive ground investigation and coal mining risk assessment to be undertaken to determine the requirement for grouting.	Ground Investigation Report and Coal Mining Risk Assessment reporting to be produced and confirm the need for stabilisation works below the retaining wall foundations.	Y	22/03/2018	Ruth Jacobs

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APPENDIX E-5

**RW5 DESIGNERS RISK ASSESSMENT**



**Guidance notes** (see guidance notes page for more details)

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Ref	Risk Category* (and Phase where appropriate, e.g. location/environment, construction, operation, maintenance, alteration/demolition)	Work Element/Location (where appropriate)	Hazard or Risk Issue Identified	Risk Management Owner	Design ERIC Action Required (e.g. hazard elimination/risk mitigation action, information to be provided to others)	Significant Temporary Works Requirements/Management Arrangements and/or any Special Erection/Installation Sequences or Requirements	Design Action Status/Final Resolution Notes (e.g. traceability of ERIC action, communication of significant residual risk, critical design criteria, etc.)	Significant Residual Risk <sup>§</sup> (Y/N)	Date Logged/Reviewed	Raised By
001	Construction	Retaining Wall 5 - contiguous bored piles wall	Risk associated with working at height	Designer	Design to consider method of construction that reduces the risk of working at height.	Temporary work minimised by use of top down construction techniques.	Top down method of construction is proposed to reduce working at height when necessary. Top down construction to be defined on the drawings.	Y	06/02/2018	Michail Tziolas
002	Construction	Retaining Wall 5 - contiguous bored piles wall	Working adjacent to live traffic	Designer	Construction methods with limited working room required and interface with live traffic.	TM required to be installed by a competent contractor.	Appropriate reference on drawing.	Y	06/02/2018	Michail Tziolas
003	Construction	Retaining Wall 5 - contiguous bored piles wall	Working with concrete - conventional foundations/ RC cantilever walls require handling of large volumes of concrete including placing at height of shutters for the walls. Shuttering requires significant temporary works. Also large reinforcement cages introduces risks associated with impaling/ heavy lifting of bars, working at heights etc.	Designer	Use of bored piled walls reduces in-situ concrete works for the substructure elements. Piling eliminates shuttering and reduces reinforcement to simpler reinforcement cages that can be prepared and delivered from reinforcement yards off site. This reduces the overall duration of works, hence exposure to risks.	Design minimise need for temporary works.	Top down method of contiguous bored piled walls to be defined on drawing and specification.	Y	06/04/2018	Michail Tziolas
004	Construction	Retaining Wall 5 - contiguous bored piles wall	Live road (A1 main line and slip roads) at risk of falling debris during lifting operation of structural elements.	Contractor	Extra attention to prevent debris falling to A1 carriageway and slip road during lifting operations.	TM to be in place during works with the crane. Contractor to ensure TM details to be approved prior to undertaking site based operations.	Note on drawings to be provided highlighting the need for road closures or traffic management during lifting operations.	N	06/02/2018	Rakesh Mehta
005	Construction	Retaining Wall 5 - contiguous bored piles wall	Working adjacent to services. Damage to existing services, electrocution.	Contractor	Statutory undertakers information indicate that services are located within the vicinity of retaining walls and may potentially be affected by the works.  Statutory undertakers searches/consultation to be undertaken prior to detailed design (on-going). This is to enable requirements for diversion/protection to be determined. This should be reviewed by contractor prior to undertaking works.	At this stage it is assumed that all services found affecting the proposed retaining wall works shall be diverted/ protected accordingly to progress the retaining wall works on site. During construction, areas to be scanned by trained and competent contractor to confirm no presence of services prior to works. Contractor to locate any services present using hand tools before mechanical excavation can commence. Contractor to also liaise with the statutory undertakers/local authorities and the HE maintenance service providers to locate all services prior to piling or excavation works. Contractor to implement safe system. All excavation to be examined prior to use.	Appropriate note/reference to be put on drawings relating to service location at detailed design.	Y	06/02/2018	Michail Tziolas
006	Construction	Retaining Wall 5 - contiguous bored piles wall	Transport of large components - potential risks associated with the movement of large abnormal loads.	Contractor	Detailed design to ensure the sections of walls (reinforcement cages) are manageable (not excessively long etc.) to ensure they can be delivered to site with minimal potential logistical risks.	Contractor to provide assembly area as part of site compound.	By ensuring the length of retaining wall sections are not excessively large, would reduce risk associated with transport and assembly on site.	N	06/02/2018	Michail Tziolas

**Guidance notes** (see guidance notes page for more details)

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007	Construction	Retaining Wall 5 - contiguous bored piles wall	Site vehicles using public highways to transport excess materials to disposal sites. Mud on roads, airborne contamination during/after transit.	Contractor	Identify agreed route where disruption will be minimised and how the works areas will be accessed by construction traffic during the works.	Wheel washing facility to be used on site to minimise mud tracked onto road network. Tarpaulins and straps to be checked before deliveries leave site. Haulage of material to be considered, in particular how to avoid/limit disruption to the traffic during construction.	Contractor to plan all site deliveries and make suppliers aware of these. To be defined in TTM plan.	N	06/02/2018	Michail Tziolas
008	Construction	Retaining Wall 5 - contiguous bored piles wall	Delivery material/structural components on site cause obstruction lead to accidents (collision etc.)	Contractor	Contractor to consider suitable holding areas on site in close proximity to the works	Contractor to provide a suitable holding area as part of the site compound.	No further action	N	06/02/2018	Michail Tziolas
009	Maintenance	Retaining Wall 5 - contiguous bored piles wall	Struck by traffic during inspection works	Operator	Safe methods of work should be determined for all required maintenance. Traffic management arrangements to be determined before any work commences. The H&S maintenance file should be consulted whilst planning the required work	TM to be deployed when undertaking inspection/maintenance type works. Details to be provided in TTM plans.	SSOW to be deployed during inspection/maintenance	N	06/02/2018	Michail Tziolas
010	Maintenance	Retaining Wall 5 - contiguous bored piles wall	Errant slip road vehicles/maintenance personnel falling into the A1 or the slip roads from the raised road levels.	Operator	It is proposed that either a VRS be fixed along the top of the retaining walls. Alternatively a safety barrier will be fixed adjacent to the slip road edge (provide vehicle containment) and a pedestrian parapet be provided along the top or adjacent of the retaining wall (prevent falls from height).	Contractor to determine TM requirements for the installation of parapets. Details to be documented in TTM plans.	Add note on drawing to identify risk.	N	06/02/2018	Michail Tziolas
011	Operation	Retaining Wall 5 - contiguous bored piles wall	Injury to driver upon impact with the retaining wall face.	Operator	Proposed retaining wall to be provided with a smooth finish (in some cases cladding) and a VRS in front according to TD19/06 - this reduces the severity of injury upon vehicular impact.	Contractor to consider temporary works required to fix cladding.	Appropriate reference on drawing.	N	06/02/2018	Michail Tziolas
012	Construction	Retaining Wall 5 - contiguous bored piles wall	Pile failure during excavation of A1 slip road.	Designer	Design to ensure pile design incorporates the 'top-down' construction philosophy with checks at each excavation level.	Sequence of pile installation, to be designed and specified in contract drawings.	Preliminary design indicates that the pile diameter will be 750mm (max retained height approximately 3m). The proposed pile diameter eliminates additional maintenance activities associated with tie back anchors and subsequently limits exposure to H&S risks associated with undertaking maintenance type work on live roads.	N	06/02/2018	Michail Tziolas
013	Construction	Retaining Wall 5 - contiguous bored piles wall	Lifting and installation of long reinforcement cages for piles, risk associated with manual handling of long/heavy rebar.	Contractor	The reinforcement cages are to be specified such that they can be pre-prepared off site and brought to site as required.	Appropriate craneage to be used with a lifting plan to off load and install cages into piles.	Contractor to implement safe system. Ensure sufficient working space to locate plant and equipment. Risks associated with the lifting/installation of long rebar cages to be added to drawings.	Y	06/02/2018	Michail Tziolas
014	Construction	Retaining Wall 5 - contiguous bored piles wall	Hand arm vibration syndrome (HAVS) due to large amount of on site pile cutting/trimming operations. There is a risk to the workforce arising from the final trimming of piles, this is more onerous with the adoption of the top down construction method.	Contractor	Design of piles with empty bores at the top to minimise the removal of concrete	Use of machine rather than hand held tools	Still a residual risk because there will be a small amount of concrete that will need to be broken/cut out. Contractor to develop SSOW/RAMS.	Y	06/02/2018	Michail Tziolas

**Guidance notes** (see guidance notes page for more details)

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\* Risks should be considered in a logical sequence relating to the location/operational environment, constructability/install ability, operability (normal/emergency), maintainability (inc. routine cleaning, replacement, etc.), and alteration/decommissioning/dismantling/demolition, and should be categorised against those headings,

CIRIA guidance documents C662, C663, C611, C607, etc. provide a useful checklist and detailed guidance on the identification of risks to be considered during design and how those risks might be addressed - see detailed guidance notes for more details

<sup>§</sup> Significant residual risks are those which are unusual, not obvious, difficult to manage, or where critical design assumptions apply. The documentation by designers of residual risks that cover well-known and understood hazards should be avoided

Ref	Risk Category* (and Phase where appropriate, e.g.. location/environment, construction, operation, maintenance, alteration/demolition)	Work Element/Location (where appropriate)	Hazard or Risk Issue Identified	Risk Management Owner	Design ERIC Action Required (e.g.. hazard elimination/risk mitigation action, information to be provided to others)	Significant Temporary Works Requirements/Management Arrangements and/or any Special Erection/Installation Sequences or Requirements	Design Action Status/Final Resolution Notes (e.g.. traceability of ERIC action, communication of significant residual risk, critical design criteria, etc.)	Significant Residual Risk <sup>§</sup> (Y/N)	Date Logged/ Reviewed	Raised By
015	Construction	Retaining Wall 5 - contiguous bored piles wall	Adverse environment impact of using bentonite slurry to support temporary excavation if piling is carried out using percussive methods.	Designer	Specify the use of either CFA piling or temporary casing of piles to eliminate use of bentonite.	None	Proposed piling system to be defined in design/AIP.	N	06/02/2018	Michail Tziolas
016	Construction / Maintenance	Retaining Wall 5 - contiguous bored piles wall	Poorer than anticipated engineering properties of the material behind the retaining wall resulting in deflections of the structure beyond its serviceability limits.	Designer	Design to take into account the results of the ground investigation, once completed, and sensitivity analysis conducted where uncertainty exists.	An intrusive ground investigation to be undertaken to assess the ground conditions. Based of the conclusions from the intrusive ground investigation suitable design shall be undertaken.	Ground Investigation Report to be provided. Preliminary design to take account of anticipated ground conditions.	Y	05/04/2018	Ruth Jacobs
017	Construction	Retaining Wall 5 - contiguous bored piles wall	The proposed works may undermine / cause instability within the existing earthworks.	Designer	Additional temporary works my be required to prevent instability of the existing embankment occurring during construction of the retaining wall.	A review of HA GDMS and the Principal Earthwork Inspection records held there. Intrusive investigation undertaken to determine the composition of the existing earthworks.	Temporary works designer to take into account the presence of the existing earthworks.	Y	05/04/2018	Ruth Jacobs
018	Construction / Maintenance	Retaining Wall 5 - contiguous bored piles wall	Potential for coal mines cause collapse/increased deflection of the retaining wall.	Designer	Grouting of the worked coal seams below the retaining wall may be required.	An intrusive ground investigation and coal mining risk assessment to be undertaken to determine the requirement for grouting.	Ground Investigation Report and Coal Mining Risk Assessment reporting to be produced and confirm the need for stabilisation works below the length of the retaining wall structure.	Y	05/04/2018	Ruth Jacobs
019	Construction	Retaining Wall 5 - contiguous bored piles wall	Contaminated land or materials on site	Contractor	Assumed good practice will be carried out in site to prevent material becoming contaminated. Unusual smells to be notified to the supervising Engineer for assessment before work continues. Spillage to be dealt with promptly by identified methods. Appropriate PPE and induction. No notable areas of contaminated land encountered during the SI.	An intrusive ground investigation to be undertaken to assess the ground conditions, including undertaking geo-environmental testing.	The geo-environmental conditions anticipated to be encountered on site shall be highlighted within the Ground Investigation Report and subsequent design report.	Y	05/04/2018	Ruth Jacobs
020	Construction	Retaining Wall 5 - contiguous bored piles wall	High groundwater levels (including perched groundwater) causing excessive unfavourable actions on retaining structure, leading to greater than anticipated deflection of the embedded wall.	Designer	Design to take into account the results of the ground investigation, once completed, and sensitivity analysis conducted where uncertainty exists.	An intrusive ground investigation to be undertaken to assess the ground conditions. Groundwater monitoring to be undertaken as part of the investigation. Based of the conclusions from the intrusive ground investigation suitable design shall be undertaken.	Ground Investigation Report to be provided. Preliminary design to take account of anticipated groundwater conditions.	Y	05/04/2018	Ruth Jacobs

**T446: Design H&S Risk Register**

Project No

Project Name

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**Guidance notes** (see guidance notes page for more details)  
 Design risk management should be an integral part of the overall design development and designers should think of it in terms of considering constructability, maintainability, etc. Designers only need to document their consideration of risks in this simple risk register format. There is no requirement for quantitative design risk assessments to be carried out/documentated and these should be avoided  
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APPENDIX E-6

**RW6 DESIGNERS RISK ASSESSMENT**

**Guidance notes** (see guidance notes page for more details)

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001	Construction	Retaining Wall 6 - Option F (King Post Retaining Wall)	Open pile holes for king posts	Contractor	-	Open pile holes to be protected as part of normal management arrangements of contractor	Risk to be highlighted on drawings provided to the contractor.	Y	06/02/2018	Michail Tziolas
002	Construction	Retaining Wall 6 - Option F (King Post Retaining Wall)	Lifting and installation of long king post piles and precast panels, risk associated with the lifting operations and installation of the structural elements.	Contractor	King posts sections and panels cannot be eliminated, precast panels could be increased in size to minimise number of lifts but weight of individual lift then increases or vice versa lighter lifts but more of them. Contractor to be consulted to determine approach to best reduce risk.	Appropriate craneage to be used with a lifting plan to off load and install king post sections into piles and pre-cast concrete panels.	Contractor to implement safe system. Ensure sufficient working space to locate plant and equipment. Risks associated with the lifting/installation of long steel sections and heavy precast panels to be added to drawings.	Y	06/02/2018	Michail Tziolas
003	Construction / Maintenance	Retaining wall 6	Poorer than anticipated engineering properties of the material in front of and behind the retaining wall resulting in deflections of the structure beyond its serviceability limits.	Designer	Design to take into account the results of the ground investigation, once completed, and sensitivity analysis conducted where uncertainty exists.	An intrusive ground investigation to be undertaken to assess the ground conditions. Based on the conclusions from the intrusive ground investigation suitable design shall be undertaken.	Ground Investigation Report to be provided. Preliminary design to take account of anticipated ground conditions.	Y	05/04/2018	Ruth Jacobs
004	Construction	Retaining wall 6	The proposed works may undermine / cause instability within the existing earthworks and the access road at the crest of the cutting.	Designer	Additional temporary works may be required to prevent instability of the existing cutting occurring during construction.	A review of HA GDMS and the Principal Earthwork Inspection records held there. Intrusive investigation undertaken to determine the composition of the existing earthworks.	Temporary works designer to take into account the presence of the existing earthworks.	Y	05/04/2018	Ruth Jacobs
005	Construction / Maintenance	Retaining wall 6	Potential for coal mines cause collapse/increased deflection of the retaining wall.	Designer	Grouting of the worked coal seams below the retaining wall may be required.	An intrusive ground investigation and coal mining risk assessment to be undertaken to determine the requirement for grouting.	Ground Investigation Report and Coal Mining Risk Assessment reporting to be produced and confirm the need for stabilisation works below the length of the retaining wall structure.	Y	05/04/2018	Ruth Jacobs
006	Construction	Retaining wall 6	Contaminated land or materials on site	Contractor	Assumed good practice will be carried out in site to prevent material becoming contaminated. Unusual smells to be notified to the supervising Engineer for assessment before work continues. Spillage to be dealt with promptly by identified methods. Appropriate PPE and induction. No notable areas of contaminated land encountered during the SI.	An intrusive ground investigation to be undertaken to assess the ground conditions, including undertaking geo-environmental testing.	The geo-environmental conditions anticipated to be encountered on site shall be highlighted within the Ground Investigation Report and subsequent design report.	Y	05/04/2018	Ruth Jacobs
007	Construction	Retaining wall 6	High groundwater levels (including perched groundwater) causing excessive unfavourable actions on retaining structure, leading to greater than anticipated deflection of the embedded wall.	Designer	Design to take into account the results of the ground investigation, once completed, and sensitivity analysis conducted where uncertainty exists.	An intrusive ground investigation to be undertaken to assess the ground conditions. Groundwater monitoring to be undertaken as part of the investigation. Based on the conclusions from the intrusive ground investigation suitable design shall be undertaken.	Ground Investigation Report to be provided. Preliminary design to take account of anticipated groundwater conditions.	Y	05/04/2018	Ruth Jacobs
008	Construction	Retaining wall 6	Depth to bedrock is higher than anticipated along the length of the retaining wall resulting in the pile holes being unable to reach design length.	Designer	Design to take into account the results of the ground investigation, once completed, including any variation in rockhead level	An intrusive ground investigation to be undertaken to assess the ground conditions.	Ground Investigation Report to be provided. Preliminary design to take account of anticipated ground conditions.	Y	05/04/2018	Ruth Jacobs

## T446: Design H&amp;S Risk Register

Project No **70015226**Project Name **A1 Birtley to Coal House Improvement Scheme - Retaining Wall 6**[Provide Feedback](#)**Guidance notes** (see guidance notes page for more details)

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009	Construction	Retaining wall 6	Depth to bedrock is lower than anticipated along the length of the retaining wall resulting in the increase in the length of the pile holes and increased deflection of the retaining wall.	Designer	Design to take into account the results of the ground investigation, once completed, including any variation in rockhead level	An intrusive ground investigation to be undertaken to assess the ground conditions.	Ground Investigation Report to be provided. Preliminary design to take account of anticipated ground conditions.	Y	05/04/2018	Ruth Jacobs

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Issue 1.0

# Appendix F

KEY CORRESPONDENCE WITH HIGHWAYS ENGLAND



APPENDIX F-1

KEY CORRESPONDENCE WITH HIGHWAYS ENGLAND

<b>Structures Options Report</b>	Name of Project:	A1 Birtley to Coalhouse
<b>(Bridges and other Highway Structures)</b>	Name of Bridge/Structure:	Retaining wall Structures Options Report
	Structure Ref No:	N/A

<b>Safety Engineering &amp; Standards (SES) Record Sheet</b>					
Scheme Name:	A1 Birtley to Coalhouse	<b><u>Comments Sheet Document Control</u></b>			
		<b>Comment sheet version</b>	<b>Date HA comment sheet</b>	<b>Date Designer's reply sent</b>	<b>Notes</b>
Document Ref	HA551462-WSP-SRW-BCH-RP-S-0001	A	26/03/18	09/04/18	
		B	09/04/18		
SOR version		C			
		D			
SOR Date	Feb 2018	E			

No	Section	Initial comment (HE response) and further comments on Designer's reply	Designer's reply	Accepted by HE
1	2.1.8	Replace "below" with "following" or reword.	Noted to be amended.	
2	2.3.1 2.3.2 2.3.3	These three paragraphs do not distinguish between walls that are proposed to retain the highway and walls that are proposed to retain land adjacent the highway.  For walls that are to retain land adjacent the highway there are options for their lateral clearance, such as:	Noted to be amended. The retaining walls will differentiate accordingly between the proposed walls that retained the highway and the proposed walls that retain the land adjacent the highway.  All the retaining wall that comprise a VRS at the top of the wall will be designed for loading	Accepted

		<ul style="list-style-type: none"> <li>• Position 4.5m back from carriageway</li> <li>• Position behind VRS</li> <li>• Position wall in line with VRS</li> </ul> <p>As well as “retaining walls with a VRS would need to be designed to sustain impact loading from attached VRS”, retaining walls without VRS that retaining land above the highway would also need to be designed for impact loading.</p>	<p>created from the parapet in the unlikely event of a collision.</p> <p>In addition all the walls will be designed according to BS EN 1991-1-7:2006+A1:2014 and NA+A1:2014 to BS EN 1991-1-7:2006+A1:2014, chapter 4.3.1 Impact on supporting substructures. The above covers the accidental actions caused by road vehicles and provide the accidental impact loading on supporting structures.</p> <p>Details of the above shall be made clear in section 2.3 of the report.</p>	
3	2.3.4	<p>In table 1 for retaining walls 4, 5 and 6 it is stated ”if a smooth surface is not provided then a safety barrier should be placed in front of the wall at a distance which satisfies the working width of the barrier”</p> <p>Whilst this statement is correct, it only really applies when removing barrier in front of existing structures, all new structures should be constructed smooth for the bottom 1.5m regardless of VRS protection.</p>	<p>Noted to be amended.</p> <p>Report shall make it clear the bottom 1.5m of the wall structures shall have a smooth face in accordance with TD19/06 irrespective of a safety barrier provision.</p>	Accepted
4	2.3.5	“safety barrier versus a VRS ?	Typo mistake, the paragraph should of read:	Accepted

			<p><i>“It would be prudent to assess and compare the benefits of providing a safety barrier or a smooth traffic face provision to retaining structures, as this will impact the cost effectiveness and buildability of the proposed retaining wall options.”</i></p> <p>However this paragraph is no longer applicable as comment 3 states that a smooth surface would be provided irrespective of a barrier provision.</p> <p>Text to be amended accordingly.</p>	
5	3.1.2	<p>Options not mentioned are:</p> <ul style="list-style-type: none"> <li>• Reinforced soil slope</li> <li>• Slope regrading</li> <li>• Modular gravity retaining wall</li> </ul>	<p>Reinforced Earth Wall (also known as reinforced soil walls) has been proposed as a solution.</p> <p>At this stage of the project, slope regrading has not been considered. Once a source of material has been sought, increased slope gradients could be considered during the detailed design/construction stage.</p> <p>Steeper earthwork slopes are being advised against at this stage in the project by the landscaping team due to vegetation planting and</p>	Accepted

			<p>maintenance.</p> <p>Modular gravity retaining walls and reinforced soil slopes generally require more extensive temporary excavation and traffic management due to the proximity of the live carriageway during installation. There is also a perceived difficulty in promoting vegetation growth on steep slopes in some locations. Also, modular gravity retaining wall solution requires backfill material which has significant material transportation and will be potentially clash with adjacent works or structures.</p> <p>Clause 3.1.4-3.1.5 of the report provided details of why gravity type walls was not considered in detail for the mainline retaining wall options.</p>	
6	3.2.2	<p>“Galvanised”, Is this practical?  “rusting” (corrosion) caused by presence of ground water, plus salt splash from carriageway.</p>	<p>Typo mistake, reference to galvanised is incorrect. It is proposed that a sacrificial thickness be provided to the sheet piles to counter against corrosion due to ground water.</p> <p>Paragraph 3.2.2 to be amended accordingly.</p>	Accepted
7	3.2.5 3.4.3	<p>Are the drainage or weep holes to prevent build-up of water behind walls to ensure earth pressures behind walls in service are as assumed in design calculations (i.e. drained parameters)?</p>	<p>During the detailed design of the retaining walls appropriate drained parameters based on the intrusive ground investigation results will be considered.</p>	Accepted

			<p>Drainage is required to prevent porewater pressure build up behind the retaining walls.</p> <p>Above to be made clear in clause 3.2.5 and 3.4.3 accordingly.</p>	
8	Table 2 Table 3	Disadvantages and risk: Add need for piling platform	Noted to be amended. Should just read disadvantage. Reference to piling platform to also be added.	Accepted
9	Table 5	Disadvantages and Risk: Add Only suitable when situated behind VRS	Noted to be amended. Should just read disadvantage. Reference regarding the VRS to be incorporated.	Accepted
10	Table 6	In the advantages/disadvantages it is not clear if Reinforced Earth walls are sensitive to ground conditions for their suitability. Statement in disadvantages “requires suitable ground conditions” applies surely to all retaining wall options, except reinforced earth retaining walls are the least sensitive to ground conditions. Please consider rewording.	Noted to be amended to suit the comments.	Accepted
11	5.6.3	Footbridge?	Typo mistake, the amended wording should be: “Footprint”	Accepted
12	General	Retaining wall options such as sheet piles and	Based on further discussions with Shaun and	Accepted

	(Shaun Clarke)	<p>contiguous bored piles are suggested for retained heights as low as 300mm.</p> <p>In the D&amp;B environment of PCF stage 5 it is unlikely that these options will be considered or constructed.</p> <p>Have modular gravity retaining walls been considered for low retained heights?</p> <p>Have regrading of slopes been considered to remove need for retaining walls of low retained height?</p> <p>Has small movements in scheme boundary been considered to remove need for retaining walls of low retained height (we accept that this is not possible or practical in some instances)?</p>	<p>Martin (HE SES Geotech and Structures representatives).</p> <p>The extent of the discrete mainline retaining wall lengths shall be reviewed and where practical retaining walls less than 1.5m retaining height shall be considered to be Contractor designed elements.</p> <p>This is considered acceptable on the basis that BD2/12 only recognises structures greater than 1.5m retained height as official highway structures.</p> <p>In this instance, it will be the Contractors responsibility to use the most suitable construction method (modular gravity wall, slope regrading or remove of retaining wall etc.</p> <p>The SOR shall be reviewed and changes shall be incorporated to both the text and drawings based on the above.</p>	
13	Estimates (Shaun Clarke)	<p>Can you explain how the estimates were calculated. What would usually be considered as the lowest cost option (reinforced earth) is almost twice as expensive as what would usually be considered the highest cost option (bored contiguous piles). For</p>	<p>The cost estimates were based on previous similar type works and high level costing information provided by suppliers who specialise in particular retaining wall systems.</p>	Accepted

		<p>instance: Breakdown on a cost/m basis</p> <p>RW1 320m/£750k = £2.34k/m  RW2 100m/£300k = £3k/m  RW3 171m/£850k = £4.97k/m  RW4 156m/£400k = £2.56k/m  RW5 171m/£500k = £2.92k/m  RW6 300m/£559k = £1.83k/m</p>	<p>We appreciate that if you were to determine the cost based on a m run it would appear that the RE for RW3 and RW4 is expensive. However this would not take into consideration the different heights of the various wall types and therefore does not provide a true cost comparison.</p> <p>For example taking into account the max retained height the cost per m<sup>2</sup> face would approximate to the following:</p> <p>RW1 320m/£750k = £2.34k/m – ht 2.5m –  Approx £1k/m<sup>2</sup> L Cantilever  RW2 100m/£300k = £3k/m – ht 1.6m –  Approx £1.9k/m<sup>2</sup> Sheet Pile  RW3 171m/£850k = £4.97k/m – ht 6.0m –  Approx £0.82k/m<sup>2</sup> RE Wall  RW4 156m/£400k = £2.56k/m – ht 4.2m –  Approx £0.61k/m<sup>2</sup> RE Wall  RW5 171m/£500k = £2.92k/m –ht 2.8m –  Approx £1.05k/m<sup>2</sup> Sheet/Contig wall  RW6 300m/£559k = £1.83k/m – ht 2.5m –  Approx £0.74k/m<sup>2</sup> King Post Wall</p> <p>From the above it would demonstrate that the RE solution would be the most cost effective per m<sup>2</sup> face.</p> <p>The other reason why the contig wall option</p>	
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			<p>(RW5) cost is not as high as maybe expected is because it is part of a hybrid solution (combined Sheet/Contig wall) which further reduces the cost of this option in comparison to if it was a pure contig wall solution.</p> <p>The option costs shall be reviewed during the amendment of the SOR to incorporate HE comments as tabulated.</p> <p>It is expected that the total cost for some of the discrete walls shall reduce as a result of the response to comment no.12.</p>	
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