

REPORT



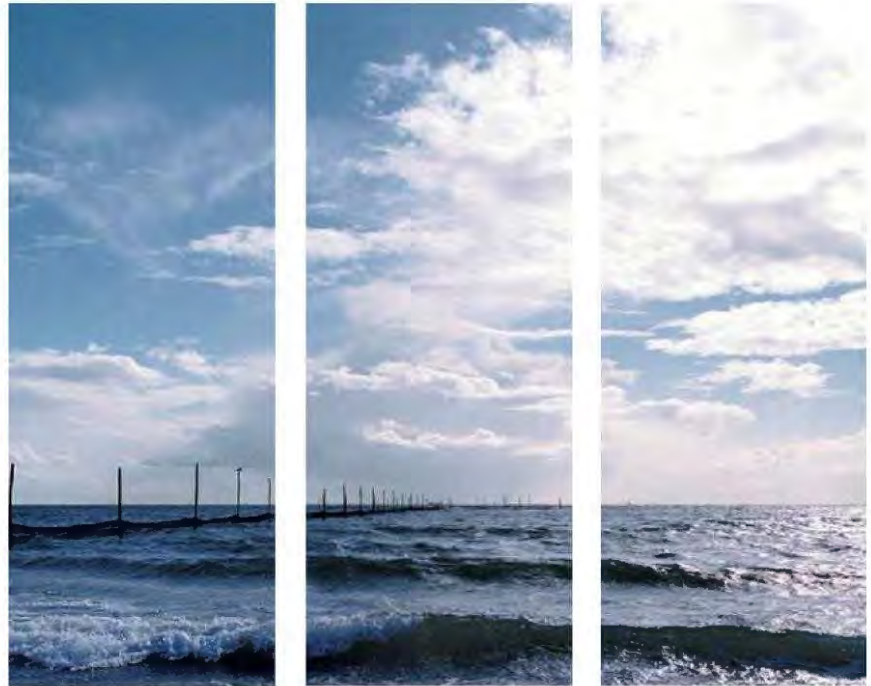
Race Bank Offshore Wind Farm

Export Cable Installation Plan Part V: Flood Defence Consent Application

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Race Bank Export Cable Installation 2016

Sea Defence Breach & Reinstatement
Consent Application Study Report

March 2016

DONG Energy RB (UK) Limited

DONG
energy


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Race Bank Export Cable Installation 2016

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Contents

Chapter	Title	Page
1	Introduction	1
1.1	Scope of Document	1
1.2	Background	1
1.3	Datum and Coordinates	2
2	Geotechnical Considerations	5
2.1	Ground Conditions	5
2.2	Groundwater	6
3	Sea Defence Breach and Reinstatement Operations	7
3.1	Introduction	7
3.2	Overview of operations	8
3.3	Project design parameters	20
3.4	Construction sequence	23
3.5	Detailed Methodology	41
4	Flood Risk and Management	74
4.1	Introduction	74
4.2	Flood defences and levels	74
4.3	Flood Risk Management Approach	74
5	References	75
	Appendices	76
	Appendix A. Emergency Flood Response Plan (EFRP)	77
	Appendix B. Programme	128
	Appendix C. Drawings	130
	Appendix D. Sea levels (predicted tides and extreme sea levels)	158
	Appendix E. Thermal Resistivity Requirements	164
	Appendix F. Decommissioning Provisions	170

1 Introduction

1.1 Scope of Document

The purpose of this document is to present the methodologies, plans and mitigation measures for the proposed sea defence breach and reinstatement operations to support the application for Environment Agency (EA) Flood Defence Consent (FDC).

This document should be read in conjunction with the following associated documents:

- Construction Management Plan (CMP)
- Traffic Management Plan (TMP)
- Emergency Flood Response Plan (EFRP) – in Appendix A
- Monitoring Plan (MP)
- Export Cable Installation Plan (ECiP)

For information a note setting out decommissioning provisions for the cables that would be installed beneath the sea defences, following the end of the operational life of the wind farm, is provided at Appendix F.

1.2 Background

The proposed breach and reinstatement location is located on the primary sea defences north of Sutton Bridge, Lincolnshire (see Figure 1.1 and Figure 1.2). The site is located approximately 800m east of the location of the two cables installed for the Lincs Offshore Wind Farm project (Lincs) and within the same consent boundary as the previously approved cable installation location for the Race Bank project.

The first power cable for Lincs was installed east of the mouth of the River Nene in August 2011, approximately 1 km to the west of the Site, and the second was installed in 2012. An engineered breach was formed through the primary sea defence at the Lincs site location. The embankment was re-constructed following cable installation and reinstatement is being monitored post completion for 5 years post-construction.

The primary sea defence was constructed in the late 1960s to early 1970s. It was raised in the late 1970s. The present day crest level of the primary sea defence is at approximately +7.7 m AOD with a crest width between approximately 4.5 and 6 m, a seaward and landward toe level of +4.2 m AOD and +3.3 m AOD respectively. The slope of the seaward and landward slopes vary but are typically 1 in 3 and 1 in 2 respectively. A secondary sea defence is situated approximately 400m south of the primary defence and has a crest elevation of approximately +6.15 m AOD.

Access to the site is from a secure gate near the mouth of the east bank of the River Nene close to the East Lighthouse (also known as the Peter Scott Lighthouse). The gate is accessed from the single lane East Bank road that runs along the east bank of the River Nene to the settlement of Sutton Bridge. A concrete apron-type single track lane provides vehicular access from the gate to the boundary between Field No. 1 and Field No. 2. These two fields between the primary and secondary sea defence is currently used for arable farming.

An access bridge and two existing access ramps allow safe access on and off the primary sea defence. The location of these is shown in Figure 1.2.

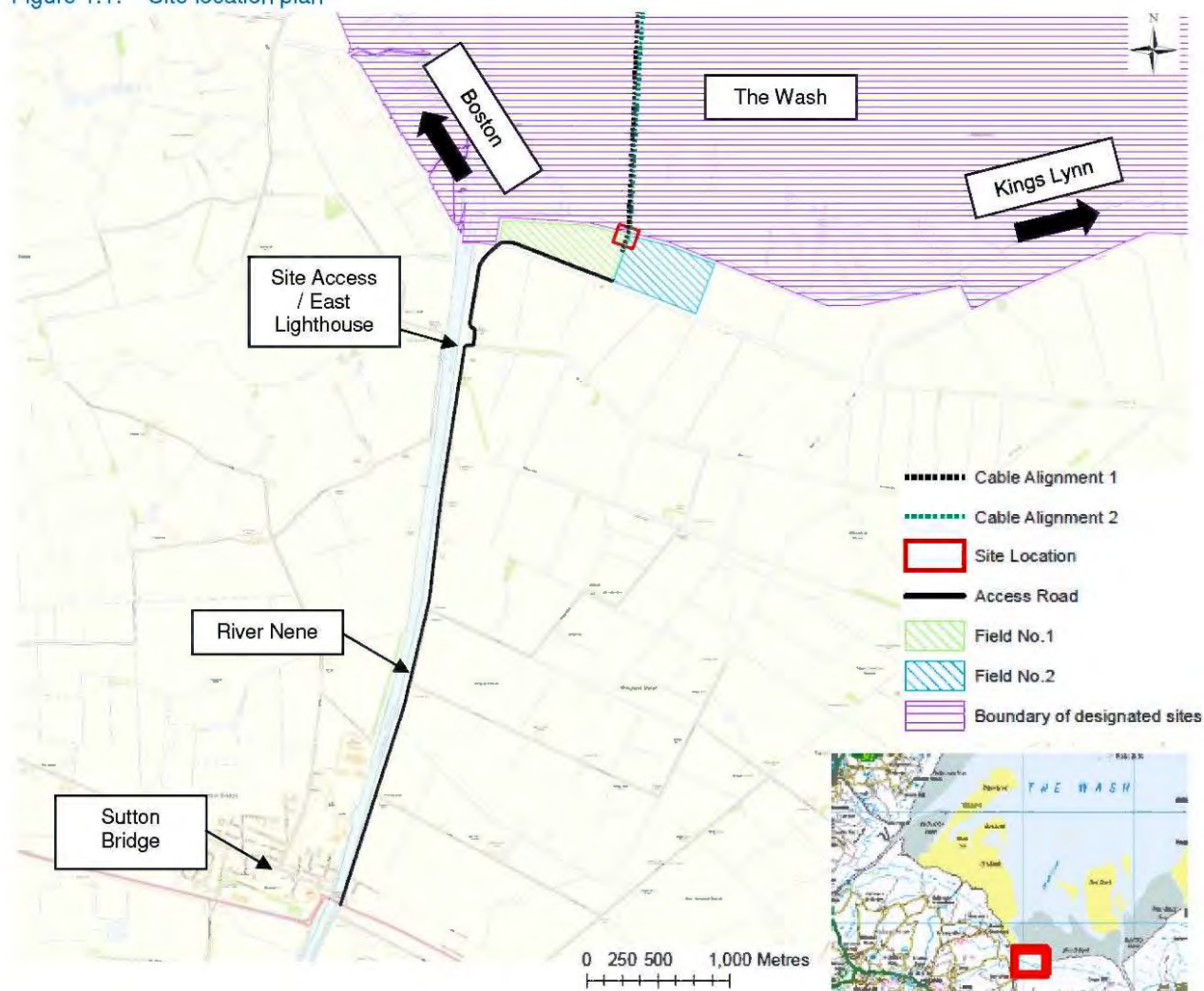
The foreshore is designated salt marsh which forms part of the Site of Special Scientific Interest (SSSI), Special Protection Area (SPA), RAMSAR site, the Wash & North Norfolk Coast Special Area of Conservation (SAC) and the Wash National Nature Reserve. The administrative landward boundary of the designated salt marsh follows the centreline of the primary sea defence. The Peter Scott Public Right of Way (Peter Scott Way) follows the top of the primary sea defence with access via a gate close to the mouth of the River Nene.

1.3 Datum and Coordinates

All levels in this document are in metres relative to Ordnance Datum Newlyn (ODN or AOD).

All coordinates in this document are in metres and refer to OSGB 1936.

Figure 1.1: Site location plan



Source: MMD-357166-C-DR-00-XX-0001. © Crown copyright and database rights (2015) Ordnance Survey

Figure 1.2: Site location plan. Cable alignment 2 (also called Circuit 2 will be the first cable to be installed).



Source: Aerial image: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

2 Geotechnical Considerations

2.1 Ground Conditions

Intrusive investigations have been undertaken on the proposed cable alignment corridors by Fugro Engineering Seacore Limited (FESCL) in October 2012 and in August 2014, with the latter presented in their report titled Report on Ground Investigation with Geomodel, Geotechnical Parameters and Geohazard Assessment dated 13th February 2015. The relevant factual data comes from the following phases of work:

Table 2.1: Exploratory Holes in vicinity of Breach crossing (see Figure 2.1).

Exploratory Hole ID	Date	Undertaken by
BH 503, 504, 505, 506	October 2012	Fugro Seacore Ltd
BH 09	August 2014	FESCL

Source: FESCL, 2014

Figure 2.1 shows the locations of the boreholes presented in Table 2.1. Table 2.2 presents the interpreted ground profile at the primary sea defence. Borehole 505 was located at the crest of the primary sea defence in the approximate position of the cable alignments. BH 503 and BH 504 were located on the flat area between the access bridge and the sea defence. BH09 which was carried out in August 2014 was located at the northeast corner of Field No.1 and is in line with the proposed cable alignment. A plan is presented in the Geotechnical Investigation Report (FESCL, 2014) and in Figure 2.1 below.

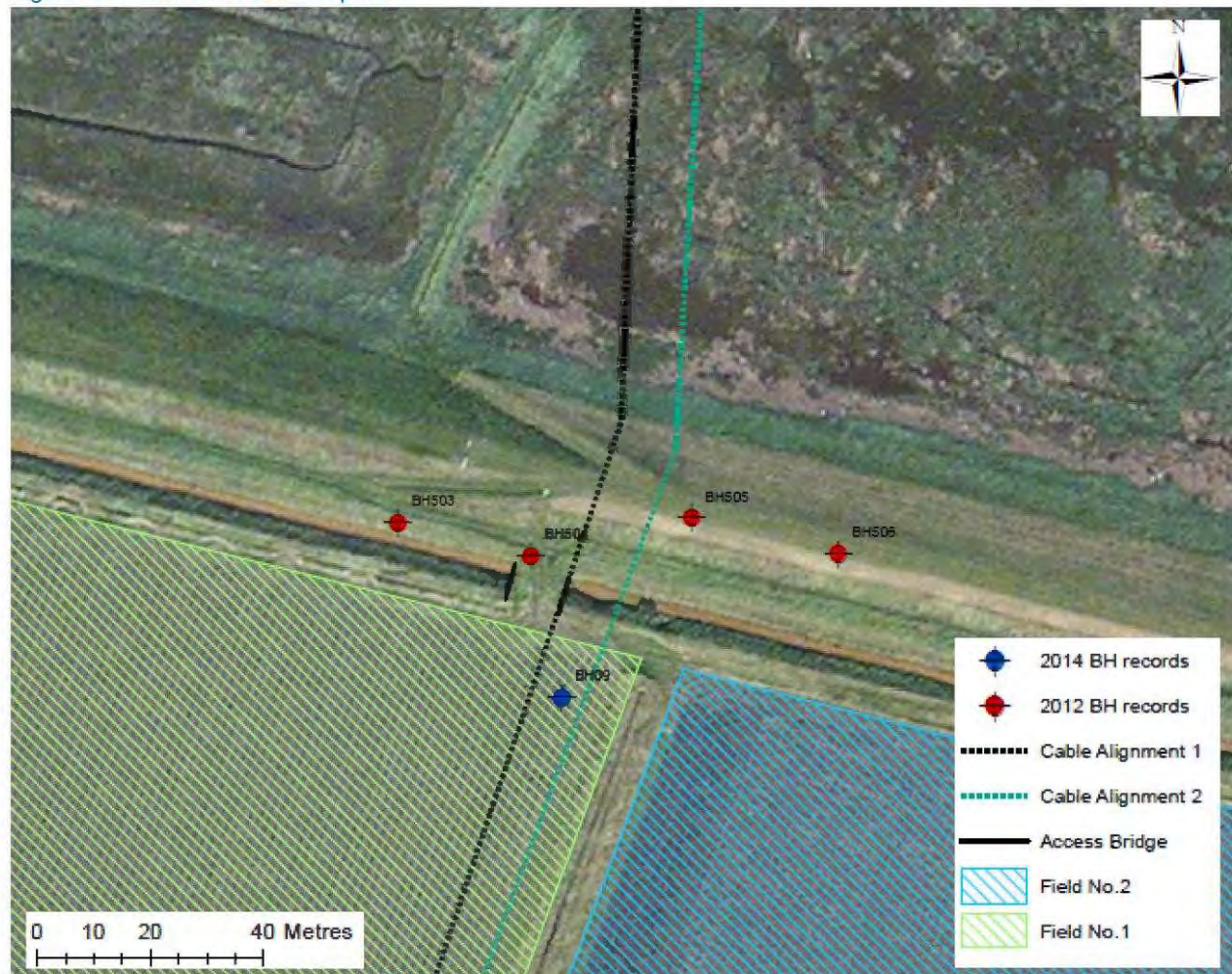
The sea defence material as seen in BH 505 is recorded as Made Ground composed of grey brown to greyish brown with red staining sandy silty clay to sandy (locally very sandy) silt. Natural ground beneath this level is at approximately +3.0m AOD and as shown in BH 505, 503, 504 and BH09 the top 1.0-1.2m (+3.0m to +1.8m AOD) is soft to firm sandy silt to silty clay with varying amounts of vegetation and rootlets penetrating down and pockets of black of black silt and sand. This is underlain by loose dark grey silty fine sand to approximately +1.2m AOD where it then becomes loose to medium dense before becoming dense sand at approximately 0.0m AOD.

Table 2.2: Ground profile at sea defence crossing

Stratum Name	Description	Top Level of Stratum (m AOD)	Base Level of Stratum (m AOD)
Bund material – firm	Firm to stiff grey brown sandy silty clay	+7.7	+7.2
Bund material – soft	Very soft to firm grey brown sandy silty clay	+7.2	2.9 to 3.2
Alluvial clay	Soft to firm grey silty clay	2.9 to 3.2	1.8 to 2.0
Alluvial sand (loose)	Loose dark grey fine sand	1.8 to 2.0	1.2 to 0.2
Alluvial sand (dense)	Dense dark grey fine sand	0.0 to 0.2	-14
Lowestoft Till	Brown grey gravelly clay/sandy clay	-14	-35
Kimmeridge Clay	Dark grey sandy clay	-35	Not Proven

Source: FESCL 2014

Figure 2.1: Borehole location plan



Source: Data adapted from FESCL, 2014

2.2 Groundwater

The data presented in Geotechnical Investigation Report (FESCL, 2014) indicates that during winter months, the groundwater level is expected to be in the range of +1.7m to +2.3m AOD, whilst in summer this is expected to be +1.0m to +1.9m AOD.

3 Sea Defence Breach and Reinstatement Operations

3.1 Introduction

Two high voltage 220kV cables (Circuit 2 first, then Circuit 1) will be installed across a short section of the existing sea defence embankment north of Sutton Bridge, Lincolnshire. The sea defence embankment will be temporarily lowered over two periods to allow installation of both cable circuits, before reinstated back to the original embankment geometry and, as a minimum, its original ground condition. Between the two cable installations the sea defence will be reinstated to a level of +5.15m AOD with a temporary flood defence barrier installed with a defence level of at least +7.70m AOD. Enhancement of the embankment in terms of its main function, a sea defence, will be carried out as summarised in Section 3.2.5 below.

An overview of the breach and reinstatement operations is given in Section 3.2 below, followed by the key project design parameters. A storyboard illustrating the planned sequence of works is provided in Section 3.4 with associated dates and durations. Finally, detailed methodologies for each construction sequence presented in the storyboard are provided in Section 3.5.

The outline Programme for the works is attached in Appendix B. The task names used in the programme cross reference to the sequence numbers presented in the storyboard and in the heading titles in Section 3.5.

3.2 Overview of operations

3.2.1 Summary

The operations involve temporarily lowering the sea defence embankment to two levels. First the sea defence will be lowered to allow a working platform to be constructed to allow the Contractor to install two alignments of sheet piled walls (referred to as 'Platform Level'; +5.15m AOD). After installation of the sheet piles, material will be excavated between the sheet piled walls to form a sloped trench (see Figure 3.1) that will retain the surrounding embankment and natural ground material such that the cable laying operations can take place and cable protection installed prior to reinstatement. Excavating a sloped trench means the sea defence can be reinstated back to the working platform more quickly compared to the time to do the same for a single 11m wide trench. This minimises the flood risk during the breach works.

Two cables will be installed at the base of the trench with a horizontal separation of 10m (see Figure 3.1). Cable alignment 2 (Circuit 2) will be installed first and Cable alignment 1 (Circuit 1) installed last. After installation of the first cable, the sloped trench will be reinstated temporarily back to the working platform level and a temporary flood defence barrier deployed until operations commence for the second cable landing approximately 5 weeks later. The trench will then be re-excavated creating a sloped trench on the western side of the piled trench to allow Circuit 1 to be installed and the trench reinstated. Following this, the sea defence will be reinstated back to its original profile with reinstatement enhancements carried out (see Section 3.2.5) and the landside sheet piles removed and the sea defence sheet piles cut to at least 1m below existing ground level. Finally the long term monitoring points are installed and 10-year post-construction monitoring period commencing.

3.2.2 Breach

The sea defence will be breached using traditional earthworks methods to form an open cutting through the sea defence embankment. Access requirements for plant to carry out the required works on the sea defence are detailed in Section 3.5.1.4. This section of the report provides a summary of the breach methodology, excavation volumes and the anticipated scale of the breach.

All excavated slopes will be excavated to a safe working profile. Mott MacDonald has undertaken conceptual design of the breach solution including slope stability analysis to determine the safe working slope angle for the anticipated ground conditions. Based on Mott MacDonald's calculations the minimum safe working slope is a 1 in 3 profile. The dimensions of the breach presented below are based on this safe working slope. If more favourable conditions are found on site then the footprint of the breach will be smaller.

The level of running water in the ditch is expected to be variable depending on weather conditions, but at worst will be at top of the ditch (+2.9m AOD). Groundwater level monitoring indicates that water will be present within the ditch and potentially at the base of the trench (trench level is +2.3m AOD), with the level dependent on the season. A pumping system suitable for de-watering the trench will be stored on site in the site compound and used to pump the water from the base of the excavation when required.

As described in Section 3.2.1, the breach involves a phasing of works in order to lower the sea defence to the final cable burial depth. Two temporary excavation levels are described in this document

- Platform level (+5.15m AOD) – see Figure 3.2

The platform level is the level that the sea defence will be lowered first (from existing ground level). This level provides a flat wide working platform for installation of the two lines of sheet piles.

A platform level for sheet piling is not required landward of the sea defence due to the inherent nature of the lower lying ground, more favourable ground conditions for a deeper pile installation and less restrictions/more space for plant movement.

The total volume of excavated material to create the open cutting to platform level has been estimated as 900m³.

At the crest of the open cutting the width of the excavation is approximately 38m (this width varies across the extent of the sea defence).

At platform level the width of the open cutting in line with the sea defence crest is 23m with a 1 in 3 slope (this width varies across the extent of the sea defence). This 23m wide platform level includes the typical 11m separation between the two lines of sheet pile walls as well as two 6m wide access areas for plant movement either side of the sheet pile walls before the excavation slopes back up to +7.7m AOD. At the seaward toe of the sea defence the western sheet pile wall alignment diverges to provide sufficient room for the Sunfish cable laying tool's plough. This leads to a separation increase of up to approximately 13m. The cable separation of 10m is unchanged.

- Trench level (+2.3m AOD) – see Figure 3.2.

The trench level is the level at which the two cables will be installed. It is termed 'trench' level because a trench supported by sheet pile walls will be formed to excavate to this level. Short term temporary propping may be required to support the sheet piled trench at the ditch where retained heights are greater than at the sea defence. Across the footprint of the sea defence the trench level will be at +2.3m AOD apart from a short distance (~4m length) seaward of the landward toe of the sea defence. Landward of the sea defence the trench level varies from a maximum of +2.3m AOD down to -1.6m AOD below the existing drainage ditch.

As described in Section 3.2.1 a sloped trench will be excavated for each cable installation. The width of the trench at platform level is in general 11m from sheet pile to sheet pile centreline. The sloped trench will have a 2m flat base before the 1 in 3 profile back up to platform level.

The total volume of the material to be excavated to form the sloped trench is:

- Sea defence footprint (+2.3m AOD; 2.85m retained height): approximately 350m³
- Ditch area (trench level and retained height varies): approximately 450m³

The proposed excavation works represent the minimum breach extents without compromising the stability of the defence and meeting relevant health and safety/safe working requirements.

Figure 3.1: Illustrative figure of the sloped trench to be excavated between the two lines of sheet piles. The red region shows the sloped trench and the hatch region shows the area to be excavated to form the sloped trench.

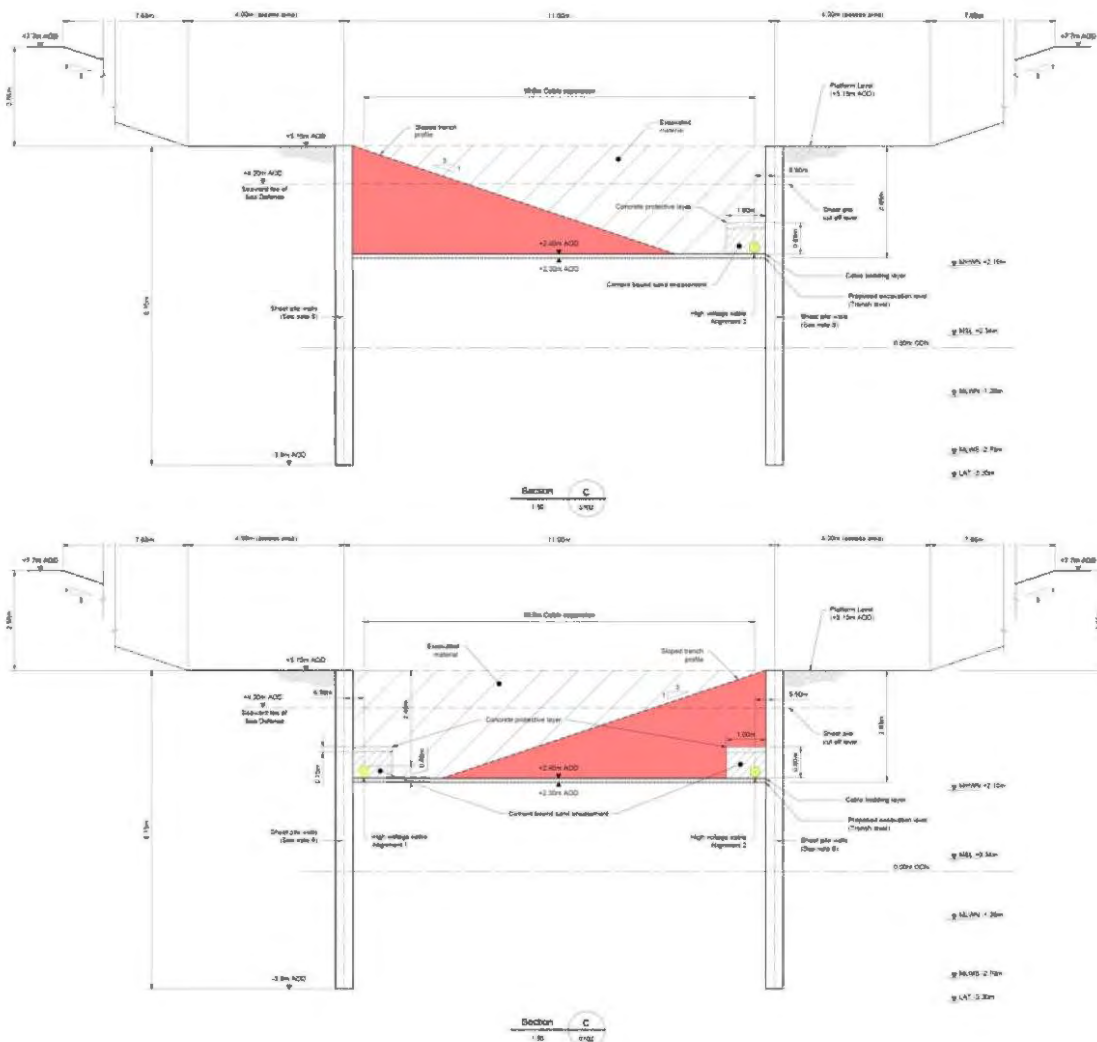
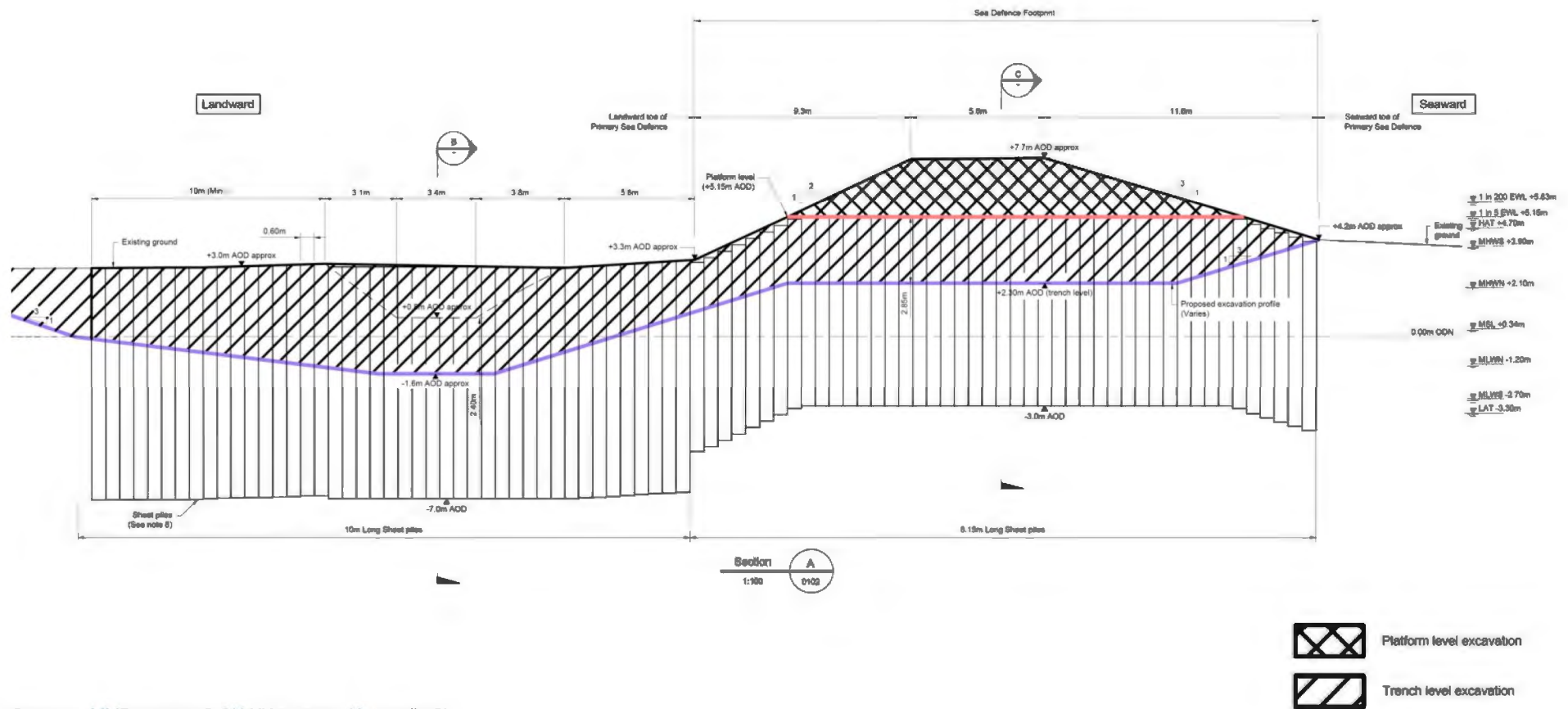


Figure 3.2: Illustrative figure of the platform level (red) and trench levels (blue) across the sea defence and ditch area.



Source: MMD-357166-C-SK-XX-00-0023 (Appendix C)

3.2.3 Flood risk management

The flood risk will be proactively managed during the entirety of the breach and reinstatement operations. Both proactive and reactive flood risk mitigation measures have been developed with the latter developed such that they can be rapidly deployed within the notice period of the high tide notifications issued by the Environment Agency's Flood Warning Duty Officer, FWDO (i.e. within 36 hours).

The three levels of high tide notifications, the issue of information and chain of command have all been developed in consultation with the Environment Agency. The triggers for each level of high tide notification are based on forecast water levels (combined astronomical tide and surge) at the West Lighthouse gauge with water levels referenced to metres above Ordnance Datum (m AOD).

3.2.3.1 Reactive measures

The management of flood risk on site during the works is detailed in the outline Emergency Flood Response Plan (EFRP) provided in Appendix A. A summary of the Emergency Flood Response reactive measures is listed out below. Full Contractor compliance with the EFRP will be ensured by DONG Energy under the contract for the works.

To monitor water levels on site during the Works the Contractor will install two tide gauge boards (see 3.5.1.6 for further details).

Table 3.1: Summary of EFRP reactive measures and high tide notification trigger levels.

Ref	Description of the reactive measure	Temporary defence level provided	High tide notification level to trigger the reactive measure	Estimated duration to implement
RM1	- Earthworks reinstatement to platform level +5.15m AOD (6m wide crest berm); and - Installation of single height temporary flood defence barrier at the toe of the sea defence¹	+5.15m AOD	AMBER (+3.8m AOD)	~13 hrs
RM2	- Earthworks reinstatement to platform level to +5.15m AOD (6m wide crest berm); - Installation of a waterproof polyethylene sheet for erosion protection; and - Installation of a double height temporary flood defence barrier.	+7.70m AOD	RED (+4.70m AOD)	~27.5 hrs

Source: Outline Emergency Flood Response Plan (see Appendix A)

¹ The bags will not be placed seaward of the seaward toe of the sea defence.

As described in Section 3.2.2 above, the Works involve temporary lowering the crest of the sea defence embankment from +7.70m AOD to two levels; Platform Level (+5.15m AOD); and Trench Level (+2.3m AOD). Reinstatement of the sea defence from either of these two temporary levels will take place under three scenarios, described as:

■ **Emergency reinstatement:**

Emergency reinstatement involves the deployment of one of the three reactive measures in accordance with the Emergency Flood Response Action in the EFRP (i.e. RM1 or RM2 are deployed following receipt and review of the respective high tide notification and associated data).

■ **Interim reinstatement:**

Interim reinstatement covers the entire period between the two cable installations (i.e. Construction Sequence No.14 (CS14) to CS-23; a period of approximately 38.5 days).

- Interim reinstatement is described as the deployment of RM2 (defence level to at least +7.7m AOD) followed by further landward reinstatement (backfill and compaction of material up to platform level in accordance with the permanent reinstatement requirements in Section 3.2.5) across the sea defence embankment and drainage ditch to provide a temporary flood defence.

■ **Permanent reinstatement:**

- Permanent reinstatement describes the final reinstatement works to the sea defence, i.e. back to the original profile and crest elevation with the sea defence enhancements as described in Section 3.2.5 of this document.

3.2.3.2 Phased Excavation and reinstatement of the sea defence to trench level

The phased excavation and reinstatement operations for breaching and then reinstating the sea defence and area landward of the sea defence has been developed to reduce the period that the sea defence is temporarily lowered to the trench level (i.e. minimising the flood risk). The phased excavation and reinstatement is described below.

A two phased approach to excavation and reinstatement across the sea defence and landward of it (i.e. the ditch area) has been developed. This significantly reduces the period that the sea defence is temporarily lowered to the trench level (+2.3m AOD) from the platform level (+5.15m AOD). A two phased approach reduces this period from approximately 14 days to what has been estimated will be completed in 5.5 days for each cable installation. The two cable installations are separated by a period of approximately 5 weeks due to (1) the requirement for the cable laying barge to re-load the second length of high voltage cable and (2) awaiting spring tides to access the anchor position offshore. The excavation and reinstatement phasing is summarised below:

■ **Phase 1 – Excavation, cable installation and reinstatement at the sea defence**

Phase 1 Excavation (e.g. CS-8 and CS-23):

- Sea defence excavated from +5.15m AOD (platform level) to +2.3m AOD (trench level). The extent of the excavated area across the sea defence is illustrated by the red bounded area in Figure 3.3 below. This leaves a temporary defence level at the landward toe of the sea defence of approximately 4.48m AOD. As described in Section 3.2.1 a sloped trench is excavated

between the sheet piles. The concrete bedding layer is installed at trench level prior to the cable installation described next.

Phase 1 Cable Installation (e.g. CS-12 and CS-27)

- Sunfish commences salt marsh cable burial and moves offshore. Once sunfish is ~100m offshore the buried cable at the toe of the sea defence is exposed by hand digging the material around the cable within the salt marsh. The footprint of this temporary excavation in the salt marsh is approx. 23m². The depth varies across this footprint and results in an estimated volume of around 11.7m³ of sediment for each cable installation (see Figure 3.3). The excavation is expected to extend approximately 3.9m seaward of the sea defence toe and 9.8m in width along the toe of the sea defence (note, the footprint is not square in plan form).
- Relocation of the cable to trench level and installation of the cement bound sand and concrete protective cover.

Once the cable protection is installed across to the seaward toe of the sea defence, the temporary excavation is backfilled back to its original condition. The material will be reinstated by means of hand tools to minimise disturbance to the saltmarsh, replacing soil in the natural sequence of horizons it was originally excavated in.

- **Phase 1 Reinstatement (e.g. CS-13 and CS-29):**

Reinstatement of only a 6m wide crest berm to an elevation of +5.15m AOD at the seaward half of the sea defence footprint. This is the area shown in Figure 3.3 below bounded by a dashed red line on the leeward side. The 6m crest berm provides sufficient space for the temporary flood defence barrier to be installed whilst minimising the backfilling and compaction works.

■ **Phase 2 – Excavation, cable installation and reinstatement at the drainage ditch**

Phase 2 Excavation (e.g. CS-16 and CS-30):

Drainage ditch area and remaining portion of the sea defence excavated to trench level. This is the blue bounded area in Figure 3.3 below. This phase of excavation occurs after Phase 1 Reinstatement has been completed.

Phase 2 Cable Installation (e.g. CS-17 and CS-31):

Relocation of cable to trench level and installation of cement bound sand and concrete protective cover.

Phase 2 Reinstatement (e.g. CS-18 or CS-32):

Reinstatement of the drainage ditch area to ground level and the remaining portion of the sea defence to +5.15m AOD such that the entire sea defence is now back to platform level. This is the red bounded area in Figure 3.3 below.

The period that the sea defence is temporarily lowered, for both cable installations is defined in the storyboard and outline programme (Appendix B).

3.2.4 Cable laying operations

Once phase 1 excavation of the trench at sea defence is complete, the Offshore Cable Installation Contractor will manage the installation of the cable including installation of a bedding layer and cable protection. Phase 1 reinstatement will then take place. The full detailed cable installation methodology is presented in Section 3.3 of the Export Cable Installation Plan (ECiP) (DONG Energy, 2016). A summary of the ECiP phased nearshore operations is set out below.

Operation 1 of 5: Installation of trackway across the salt marsh

In addition to the trackway (timber bog mats) installed on the landward side of the sea defence utilised for access and pile installation works, an aluminium trackway will be installed from the seaward side of the sea defence out to KP 1.2. Two trackway installation are required; the east trackway is required for the first cable installation (circuit 2) and the west trackway for the second cable installation (circuit 1). A geotextile membrane will be rolled out by hand along the trackway installation route which is located as a minimum 6m west from the planned cable installation route (see MMD-357166-C-DR-00-XX-0019 and MMD-357166-C-DR-00-XX-0020 for indicative trackway plans), on top of which the 3 m wide aluminium trackway will be lifted into place also from the toe of the sea defence outwards. No plant associated with laying and recovery of the trackway will come into contact with the saltmarsh since the plant will always be on the trackway that has been sequentially placed.

Placement of the trackway will take approximately 5 days to complete subject to daylight and tides. Noise will be minimal during this operation and only result from the above vehicles plus hammering of holding stakes only. The east trackway for circuit two is scheduled to be in place for 15 days, inclusive of the time taken to install and recovery. Five days will be required for recovery. Post installation of the second cable installation and Sunfish burial, the west trackway will be utilised for minor salt marsh restoration access before recovery of the trackway from the seaward location towards the sea defence.

Operation 2 of 5: Approach of offshore cable laying tool ('Sunfish') to toe of the sea defence

After the arrival of the offshore cable installation vessel and the transport barge, Sunfish and Moonfish (the cable laying tools) will be unloaded and located in line with the cable installation route. Sunfish will commence driving towards the sea defence along the cable installation route. As the vehicle moves, cable rollers will be automatically deployed along the route at 3m spacing. In addition to the roller installation, the Sunfish will install the winch wire messenger rope. The Sunfish will stop at the toe of the sea defence and locate the plough share within the trench excavated between the walls of the sheet piles.

Operation 3 of 5: Pulling in of the cable from the offshore cable laying barge (CLB) via Sunfish (still at the sea defence toe) to a winch located in Field No.2.

Once the Sunfish is in position at the sea defence, the messenger rope will be connected to the winch wire, which is located within Field No.2. The barge will commence to recover the messenger and haul the winch wire back towards the cable installation vessel. Where the winch wire passes over the sea defence

breach through the reduced height of the crest, the winch wire will be supported by cable rollers and up to 3 excavators (see Section 3.5.1.3 for a full list of plant associated with works on the sea defence). The winch wire will be connected to the cable end on the installation vessel.

The cable is routed out of the turning carousel over the vessel cable chute, through Moonfish cable highway before reaching the rollers laid on the mud/sand flats. The cable will be pulled back towards the shore via the winch. When the cable reaches the Sunfish, it passes over the cable highway, through the plough share, through the sea defence and up to the winch in Field No.2. The cable is secured and the winch tension reduced

Operation 4 of 5: Burial of the cable in the salt marsh as Sunfish moves away from the sea defence toe towards the offshore CLB.

Prior to commencement of the salt marsh burial by Sunfish, the cable will be temporarily secured at the sea defence location to ensure back tension for the burial operation. The plough share will be lowered within the sheet pile zone and lowered to burial depth (1.5m to top of product). Sunfish will commence tracking offshore. As the machine tracks forward, the cable ahead rises off the rollers and the rollers are recovered onto Sunfish. The rollers are located within cassette frames located below the cable highway. The angled plough share is designed to slice through the salt marsh, simultaneously lifting and inserting the export cable at a depth of 1.5m and subsequently lowering the overlaying sediment and vegetation back into place in its original position, minimising disturbance to the salt marsh soil and vegetation structure. The salt marsh cable burial is planned to take place in one continuous burial during a single low tide per cable.

Operation 5 of 5: Relocation of the cable onto the bedding layer and installation of cable protection prior to being backfilled (see Appendix E for further details on the concrete protective cover).

Once the cable burial across the salt marsh has reached 100 metres offshore, the temporary back tension can be released. The cable will be disconnected from the winch. At this time the cable will be relocated into the prepared trench through the sea defence (formed by the Phase 1 excavation works), with the landward length still across Field No.2. This operation will require coordinated movement of the cable supported by mechanical excavators and rollers. The cable will be moved slowly and in short sections to ensure continuous control of the bending radius restrictions. Once completed, Phase 1 reinstatement works will take place. This includes temporary excavation within the salt marsh to expose the cable to install the concrete protective cover all the way to the seaward toe of the sea defence (see Section 3.2.3.2 for further details).

Phase 2 operations (excavation, cable laying and protection and reinstatement landward of the sea defence) will take place following completion of Phase 1 operations. For the first cable installation, this only commences after the temporary flood defence barrier has been installed. The cable will be located parallel to the installation route into the transition jointing bays for burial operations to be carried out after completion of the sea defence breach reinstatement programme.

3.2.5 Reinstatement and enhancement of the sea defence

The total volume of excavated material for the works has been estimated as 1700m³. A surplus of material is anticipated once works are completed. This is due to (1) the expectation that some of the excavated material from the sea defence footprint does not meet the minimum acceptance criteria for reinstatement and (2) the installation of cable and associated concrete protection which will displace material that would otherwise be reinstated. A provision for a volume of imported material meeting the minimum acceptance criteria will be in place prior to any excavation works commencing to ensure that enough material is available for delivery to site rapidly to replace any in-situ material found to be non-compliant. Any surplus of material will be used in accordance with the handling method detailed in an approved site waste management plan that will be developed by the Contractor prior to works commencing. Further details on the provision for imported compliant material is provided in item number 3 below.

To ensure long-term integrity of the sea defence over the footprint of the works, the scope of permanent reinstatement works has been enhanced. The principles of these 'enhancements' have been developed in consultation with the Environment Agency as the asset operational management authority. The series of reinstatement enhancements are summarised below:

- All excavated material from within the footprint of the sea defence embankment (from seaward to landward toe lines) will be reinstated back to its original condition or better, including below the face of the exposed embankment slope (i.e. seaward slope). In order to meet the condition that has been described as 'original or better', this will be achieved by setting minimum acceptance criteria for backfilled material and compaction of that material. The 'Reinstatement Quality Assurance' of the reinstatement is set out below and will be followed by the Contractor and monitored by the Employer's Representative (site supervisor) during the entirety of the works:
 1. Test the in-situ material² (in-situ and rapid turnaround laboratory sampling) to define the target criteria (hereon referred to as the 'baseline criteria') for reinstatement i.e. tests for dry density and moisture content to determine the minimum degree of compaction to be achieved for permanent reinstatement.
 - 2. All material excavated from the footprint of the sea defence will be reinstated with Class 2 general fill (as defined in Series 600 of the Highways Agency Volume 1 Specification for Highways Works of the Manual of Contract Documents for Highways Works (MCDHW) ("*Series 600 Specification*")). The specification for the Class 2 general fill is provided in Table 3.2 below (hereon referred to as 'project Class 2 fill'). Any excavated material not meeting this minimum specification will not be re-used in the sea defence embankment and be replaced with imported project Class 2 fill. Based on borehole records (FESCL, 2014) the material below +4.2m is expected to be Silt. In accordance with the Reinstatement Quality Assurance outlined here, this material will be removed from the footprint of the sea defence for waste management and reinstated with project Class 2 fill.
 3. The Contractor will have in place the sourced and identified delivery of 1700m³ (100%) of project Class 2 fill from a local supplier which will be identified prior to works commencing. As part of the provision, a minimum of 350m³ (20%) imported material will be stored on site prior to the

² An in-situ method is proposed due to the limited availability of site data to define the criteria.

commencement of excavation works. As excavated the material will be tested and if found to be unsuitable (to project Class 2 fill) then this volume of material will be estimated and an equal volume of imported material will be delivered to site by trucks. Each load is to be inspected and in the event that there is doubt that the material will meet the project Class 2 fill specification, the material is to be either rejected or stored on site until additional testing is carried out to confirm its suitability.

4. All imported and suitable excavated material (to project Class 2 fill) will be stored in separate designated stockpiles within the Contractor's site compound. Material will be segregated into three broad stockpiles; (1) topsoil, (2) sea defence material, and (3) existing ground. Stockpiles will be protected from the elements and managed in accordance with Series 600 Specification requirements and Defra Guidance for Successful Reclamation of Mineral and Waste Sites (2005)³.

■ **Compaction acceptance criteria:**

Excavated slopes of the sea defence will be benched prior to backfilling and compaction. Backfill material will be placed in horizontal layers and compacted to a thickness of no more than 200mm to ensure there are no planes of weakness in the sea defence.

From the baseline criteria as determined on site, the contractor is to meet the following:

- a dry density of at least the baseline criteria
- a moisture content within a range that ensures compaction levels can be achieved to meet baseline criteria
- air voids not greater than the baseline criteria
- an undrained shear strength consistent with or better than measured during excavation, but no less than the baseline criteria

For natural granular ground, the contractor is to meet the following:

- a dry density of >90% of the baseline criteria
- the material is to be compacted such that a CBR (as measured with a MEXE probe or similar) exceeds 15%.

The required number of passes to achieve adequate compaction will be dependent on the selected compaction plant and shall be based on Series 600 requirements and then validated through density testing carried out during filling operations. Compaction of the backfilled sloped trench and will be achieved with the use of up to 4 compaction rollers ranging in size from 12T to 1T trench rollers. Compaction within the sheet pile corrugations will be achieved with the use of a small handheld tamping rod.

Adequate compaction of the side slopes to the sea defence embankment shall be achieved by overfilling, followed by compacting and then trimming back to the required profile.

To allow for post-compaction settlement at the crest of the sea defence embankment, the open cutting across the crest will be overfilled by 100mm.

- Installation of grass reinforcement / erosion protection on the seaward slope of the embankment and, if necessary, the drainage ditch (further details presented in Section 3.5.36).

³ <http://webarchive.nationalarchives.gov.uk/20090306103114/http://www.defra.gov.uk/farm/environment/land-use/reclamation/guidance-full.pdf>

Table 3.2: Minimum acceptance criteria (project Class 2 fill specification) for the sea defence embankment fill (imported and/or re-used).

Criteria	Limit / Range
Clay content	15% to 40%
Liquid Limit (LL)	25% to 70%
Plasticity Index (PI)	10% to 40%
Moisture content	Optimum moisture content (OMC) $\pm 3\%$
Compacted Air Voids	Less than 10%
Maximum particle size	<20%
Compacted undrained shear strength	75kPa

Source: Specified fill material is a bespoke range of a Class 2 general fill material to the Series 600 Specification. The upper limit of clay (40%) is lower than the 100% limit for a standard Class 2 fill. This lower upper limit still meets permeability requirements of a Class 2 fill however the higher percentage of more granular material ensures it can be placed safely at an angle of 1 in 3 (i.e. to meet reinstatement angles of the existing embankment slopes).

3.3 Project design parameters

The breach and reinstatement solution presented in the drawings and described in this document has been designed to meet the following design criteria, technical engineering limits and stakeholder requirements:

- Environment Agency requirements for a cable depth below the toe level of the sea defence (below +3.3m AOD) to the maximum practicable level for the project.
- thermal performance of the cable
 - the manufactured high voltage 220kV copper cable has a maximum burial depth of 5m to invert of cable without thermal enhancement and up to a maximum of 8m to invert of cable with thermal enhancement (see dimensions on Figure 3.4).
 - 10m horizontal cable separation for thermal resistivity requirements (see Appendix E for further detail on thermal resistivity requirements).
- Allowance for climate change over the design life of the cable - a conservative 2m allowance for sea level rise over the design life of the project has been assumed as a worst-case scenario to conceptually design a potential future sea defence geometry and footprint (referred to as a 'potential future provision'). This has been undertaken to identify the maximum cable burial depth possible across the sea defence and ditch in their current geometry. The potential future provision option is illustrated in Figure 3.4.
- salt marsh burial methodology – The burial depth at the seaward toe of the sea defence is limited to the maximum cable burial depth possible by the cable laying tool (Sunfish tool) used to bury the cable across the salt marsh. Sunfish has been designed for up to a 1.5m burial to crown of cable;
- Management of flood risk – limit the size / depth of the breach such that it can be rapidly reinstated within the timeframe of the advance notice of flood warnings (within 36 hours);

technical engineering limits – geotechnical, structural and hydraulic stability, feasibility/driveability of sheet piling given the anticipated ground conditions, buildability of the solution and site access constraints. In addition, requirement for an unsupported trench (i.e. un-propped trench) due to the cable laying methodology. The impacts of the design parameters on the final designed cable burial depth have been

illustrated in Figure 3.4, including the conceptual geometry of the potential future provision to illustrate the key constraints on the finalised cable burial depth profile across the sea defence and drainage ditch.

The cable burial depth has been designed to meet the requirements outlined above. As shown in Figure 3.4 the maximum cable burial depth across the sea defence for both cables will be +2.3m AOD (to cable invert). Landward of the sea defence more favourable ground conditions allow for a deeper cable installation. The platform level is shown at +5.15m AOD. This level provides a suitable working platform for the piling operations and is at the limit of a safe un-propped sheet piled wall trench design. Short term temporary propping may be required to support the sheet piled trench at the ditch where retained heights are greater than at the sea defence.

The level of the working platform has also been designed to reduce the flood risk during the breach operations. If the platform level was any lower, flood risk would be heightened and the increase in the sheet pile retained height would require sheet pile toe levels to a depth that cannot be guaranteed in Mott MacDonald's expert opinion. For an un-propped trench and anticipated ground conditions below the sea defence, an excavation level of greater than +2.3m AOD (therefore a retained height greater than 2.85m) is considered beyond the safe limit of sheet piling drivability requirements when also accounting for plant size / site access constraints.

Landward of the sea defence the cable profile generally follows the existing ground profile dropping to a maximum burial depth of -1.6m AOD directly below the ditch. A greater burial depth is proposed landward of the sea defence due to a combination of:

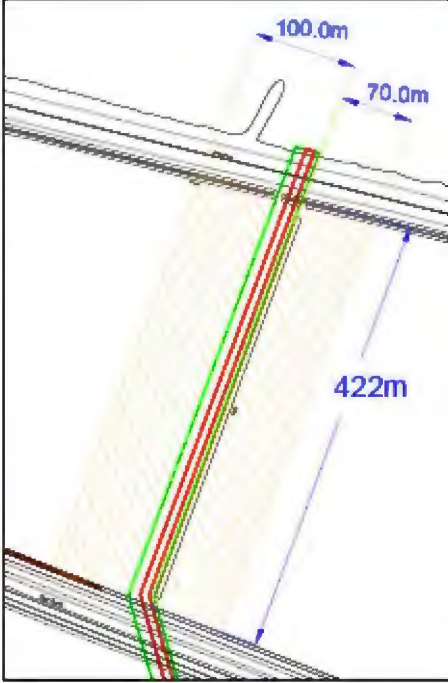
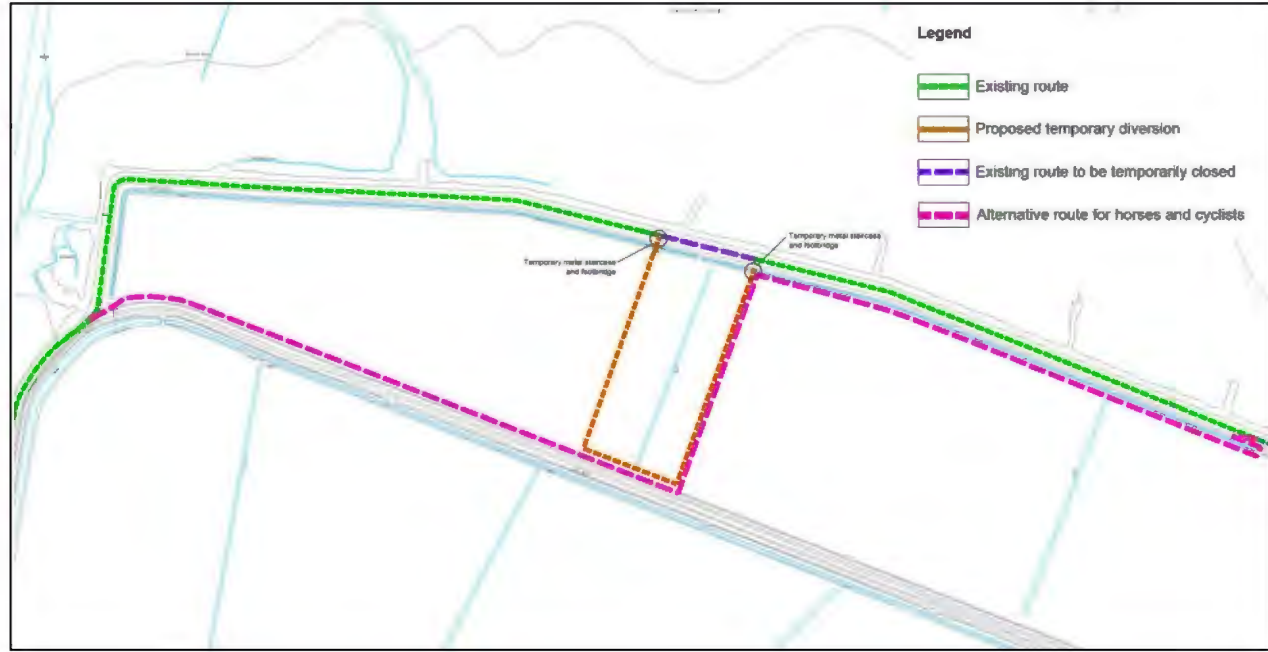
- deeper cable burial below the ditch (minimum of 2m from crown of cable to bottom of ditch)
- improved ground conditions for piling; and
- to account for future landward realignment of the existing drainage ditch.

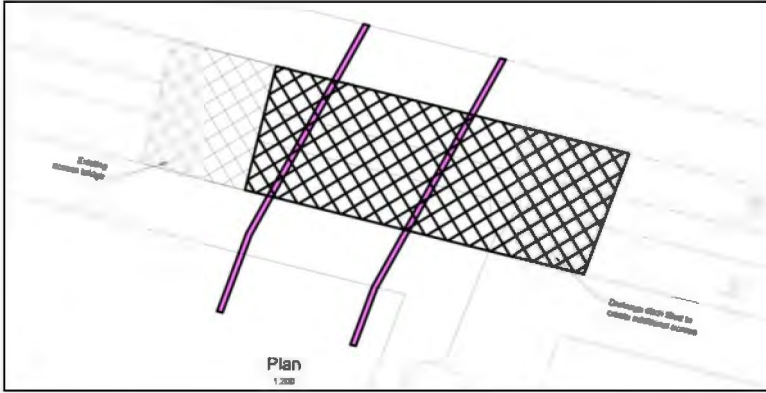
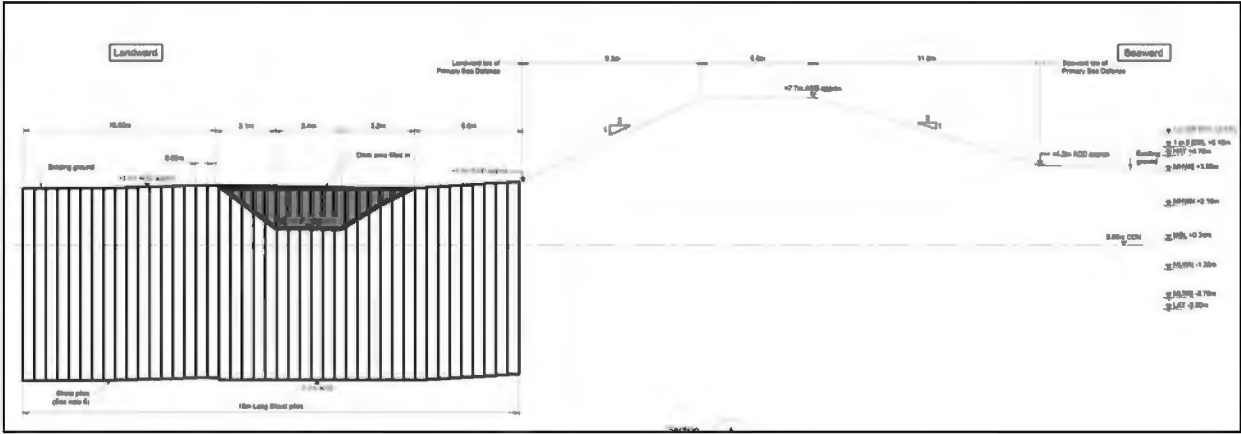
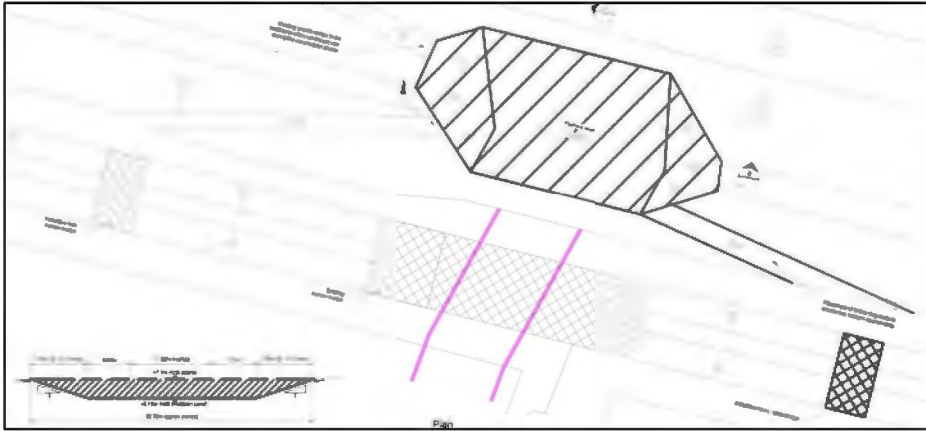
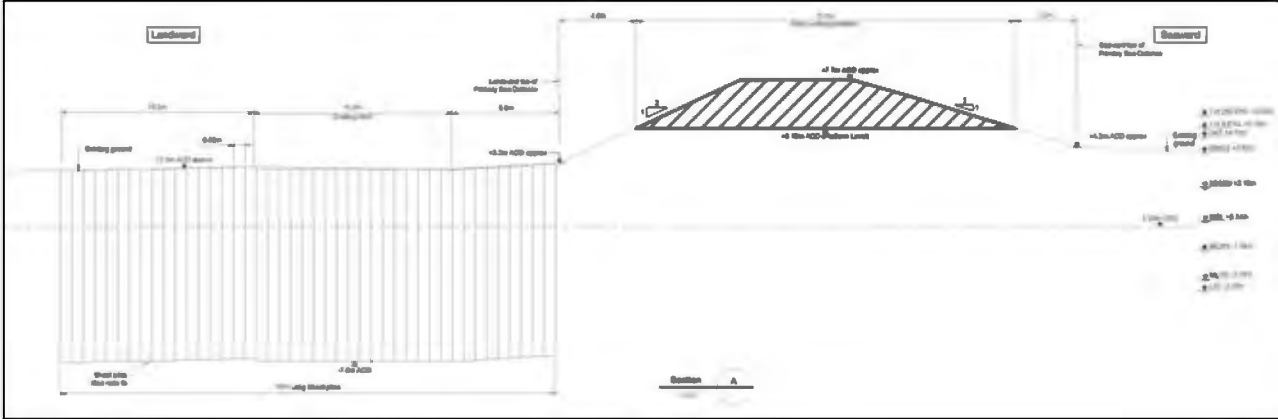
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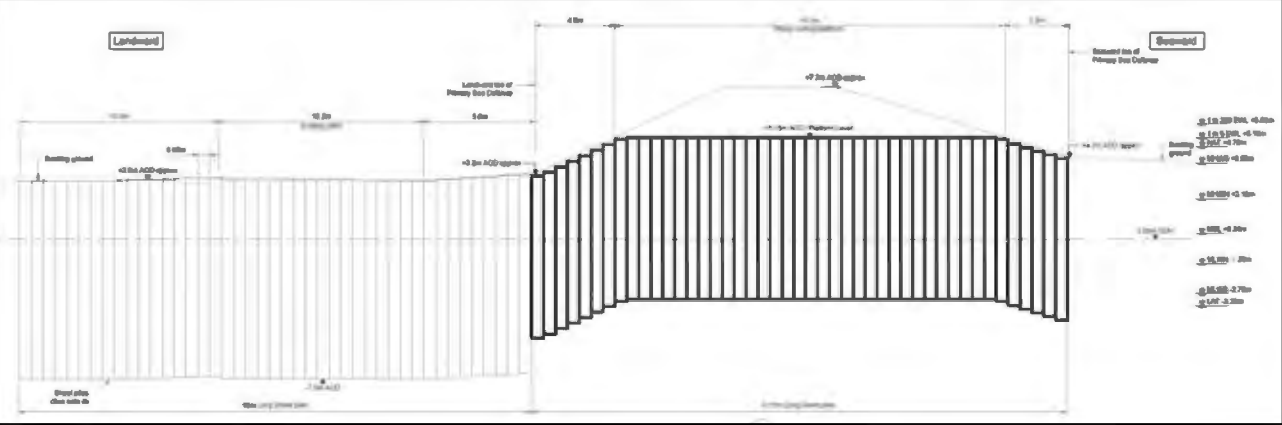
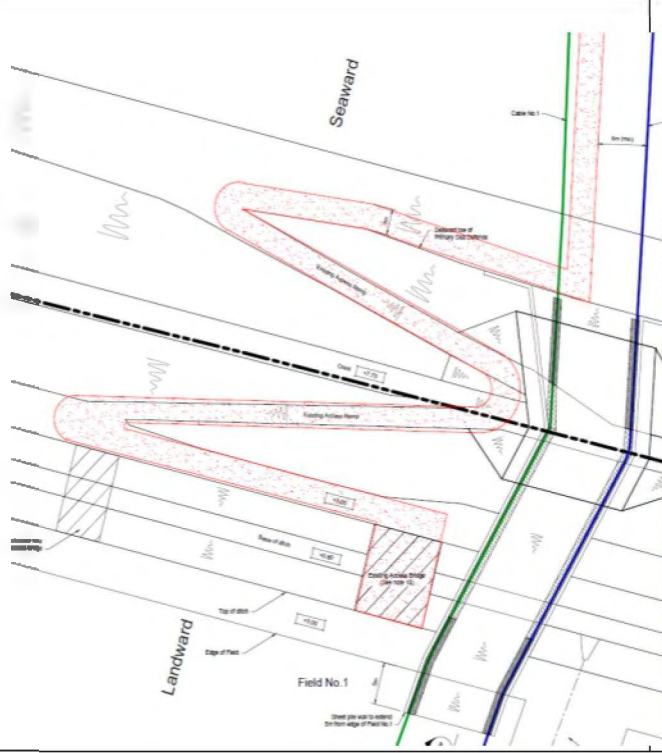
3.4 Construction sequence

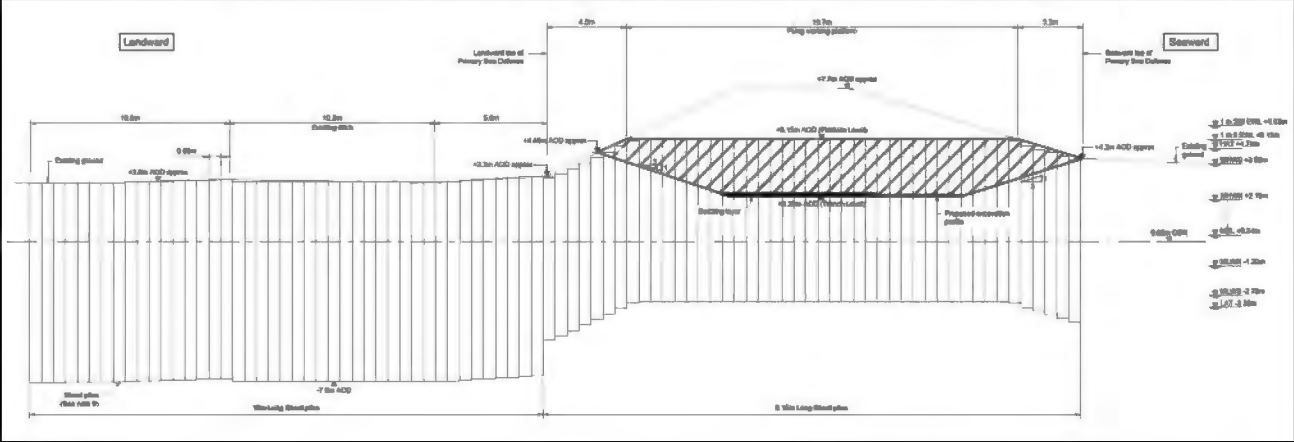
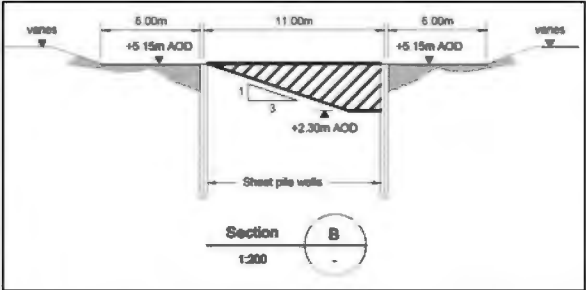
An outline step-by-step construction sequence is illustrated below as a storyboard including planned dates and durations for each operation. Full size construction sequence drawings are provided in Appendix C. The construction sequence reference numbers (e.g. CS-1) cross-reference to the task references in the Programme in Appendix B and headings used in the detailed methodology section of this document (see Section 3.5).

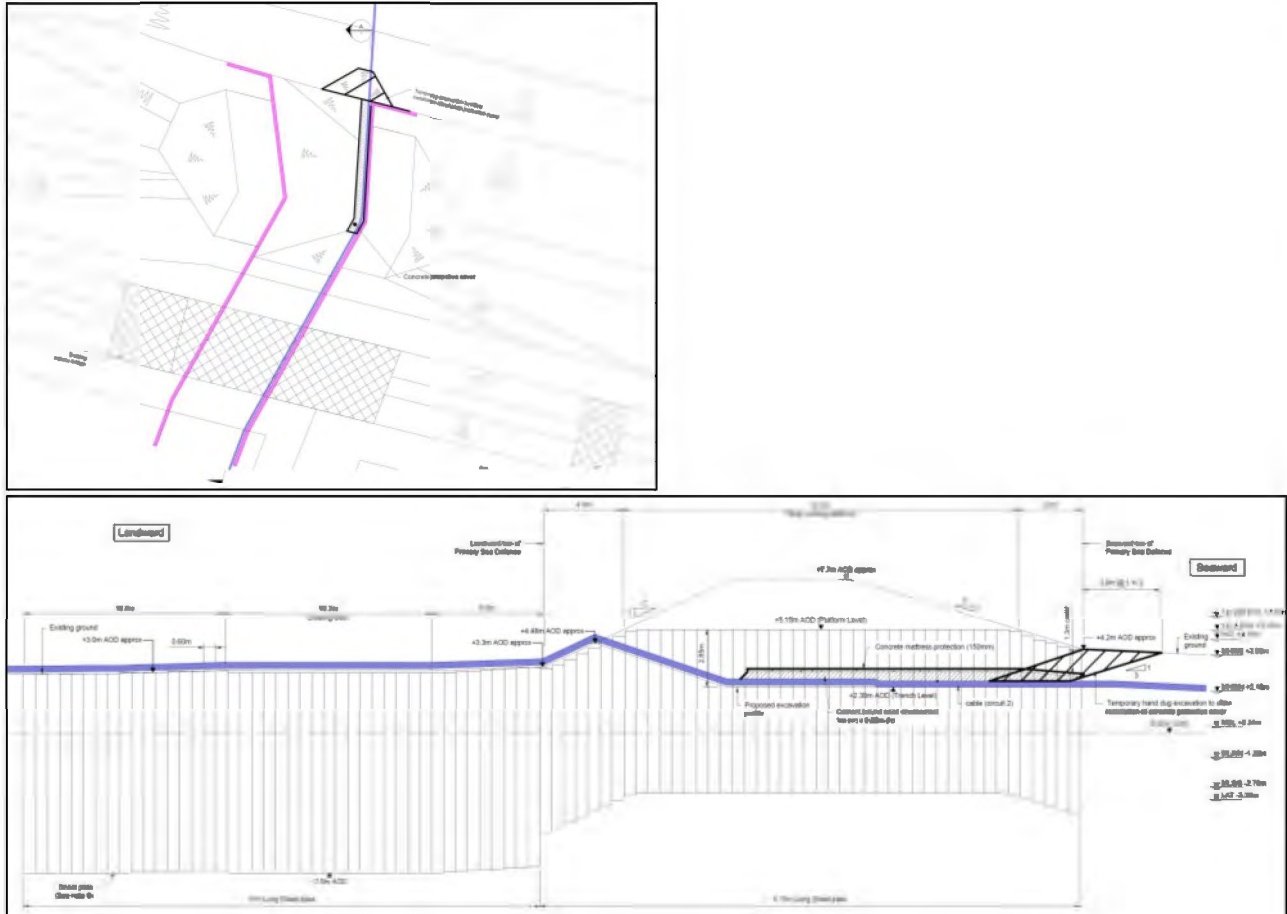
Offshore operations outside the FDC scope have been included in the construction sequence for completeness (these have been greyed out in the storyboard).

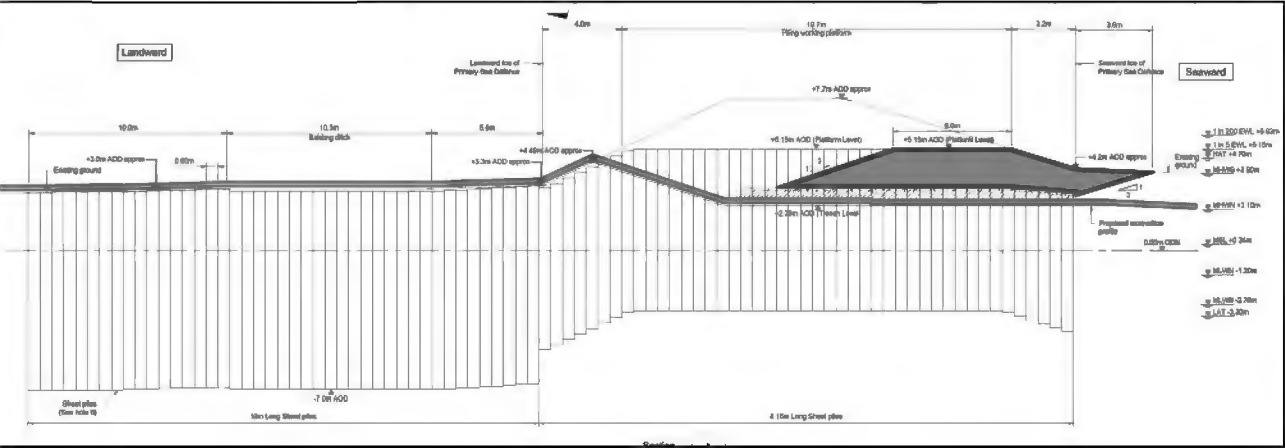
Ref	Operation	Date	Duration	Plan / Section / Image	Summary of works
COMMENCEMENT OF FIRST CABLE BREACH, LAYING AND REINSTATEMENT OPERATIONS					
CS-1	Site Establishment	31 st March - 16 th April	17 days		- Contractor mobilises to site - Site working area setup by the Contractor, including site compound, installation of ground protection (timber big mats), construction of new access bridges and three ditch crossings between Field No 1 and No 2, de-vegetation and erection of site boundary fencing. At this stage the site working area does not encompass the sea defence and the Peter Scott Way remains open to the public. - Equipment, earthworks material and plant for the temporary flood defence barrier system is delivered and stored in the northwest corner of the site working area and a practise drill carried out. - Sheet piles delivered and stored in the site compound. - Installation of the cable pulling winch in Field No.2 - Construction monitoring points installed and baseline measurements taken - Installation of two tide gauge boards
CS-2	Footpath diversion and boundary fencing installed across sea defence	17 th April	1 day		- The Peter Scott Way is closed and diverted around the site working area and information/notice boards erected. - The proposed diversion will route around the edge of the site compound and reconnect with the PRoW west of the site working area. - Two temporary metal staircases will be erected on the landward slopes of the sea defence along with two temporary footbridges where the diverted route crosses the existing drainage ditch. - The site working area is extended across the sea defence and additional boundary fencing is installed. - No lighting, no walkway and only 1 side fencing are foreseen.

CS-3	Installation of landside sheet piles	17-20 th April	4 days	 Plan 1:200  Landward Seaward	- The drainage ditch will be in-filled with sand (as shown) and compacted with 1 in 3 slopes required starting 5m away from the sheet piles. - A pumping system will be installed to manage the flow of water at the ditch both prior to installation of the landside sheet piles. - Both lines of sheet piles are installed landward of the sea defence as shown in the figure. - Piling plant will install the sheet piles from landward of the landward toe of the sea defence and/or Field No.1. Ground protection (bog mats) will be used to spread the load of the piling plant during the piling operations. - Sheet piles will be installed to ground level across the footprint of the sea defence.
CS-4	Excavation of sea defence to Platform Level (+7.7m AOD to +5.15m AOD)	20-22 nd April	2.5 days	 Plan  Landward Seaward	- Works commence on the footprint of the sea defence. - Prior to the excavation works commencing, a secondary access ramp on the eastern side of the breach location as shown in the figure is built. This will be formed by building out from the landward slope of the sea defence with sand, again compacted and bog mats placed. In addition a new access bridge is required across the drainage ditch for plant to access this new access ramp. - The sea defence is excavated to lower the crest level from +7.7m AOD to the Platform Level (+5.15m AOD). - Earth moving plant will work from the crest and landward of the sea defence toe. No plant will work seaward of the sea defence seaward toe. - The open cutting created will be approximately 38m wide at the crest and 23m at the base (i.e. at platform level). - Excavated slopes will not be benched until reinstatement operations, but will be cut to a stable slope for the encountered material, anticipated to be a 1 in 3 slope. - Excavated material will be transported by a dumper to designated stockpiles in the site compound and protected from the elements. - Sampling and in-situ testing will be carried out in order to assess the compliance of the excavated material for backfilling. The samples will be collected and tested in a UKAS-approved laboratory with rapid turnaround specified. If the excavated material does not meet the project Class 2 fill (see Section 3.2.5) then this excavated non-compliant material will not be used for backfilling, but only imported compliant material used.

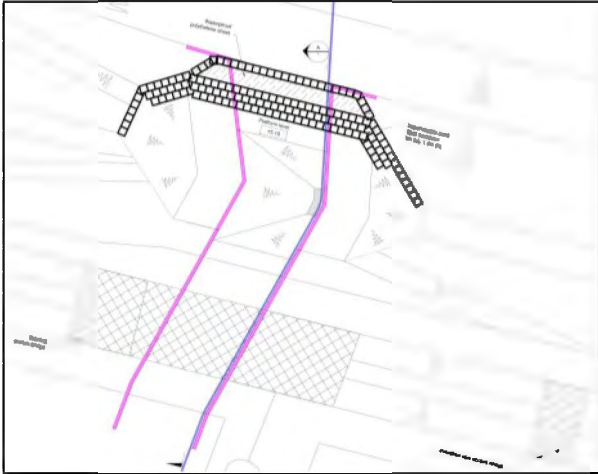
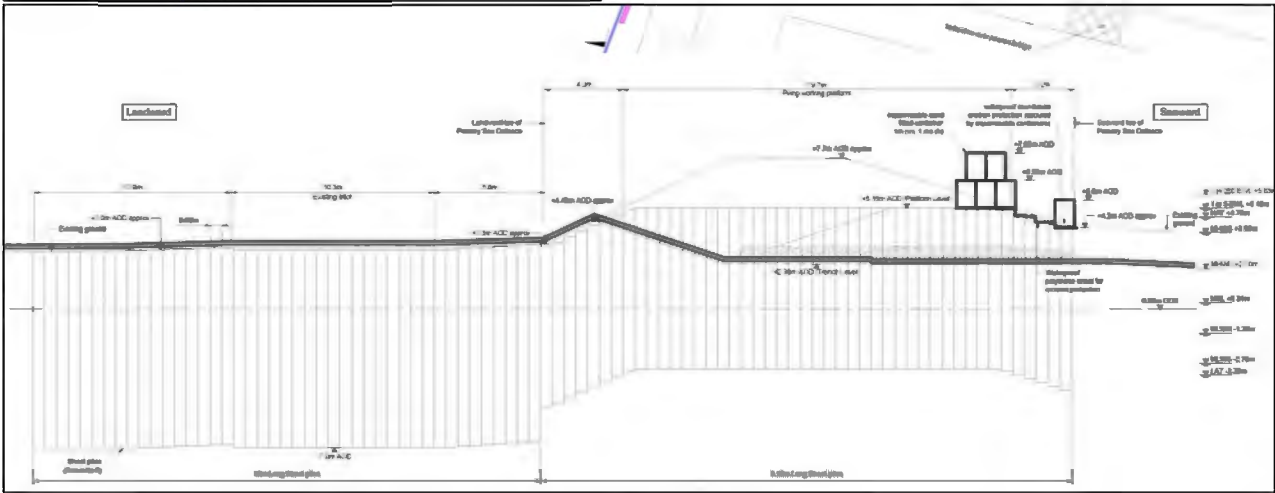
CS-5	Installation of sea defence sheet piles	23-28 th April	6 days	 	• Sheet piles are installed across the sea defence by piling plant on the working platform created in CS-4. • Both lines of sheet piles will be installed across the sea defence footprint as shown in the figure, with the seaward lines parallel to the seaward toe to support the ground during the arrival of the Sunfish tool at sea defence and temporary hand dug excavation to temporarily expose the cable to install the concrete protective cover to the seaward toe of the sea defence (see CS-12 for further details). • Piling plant will install the sheet piles from the Platform Level (+5.15m AOD). Ground protection (bog mats) will be installed to spread the load of piling plant during the piling operations. • Sheet piles will be installed to platform level across the footprint of the sea defence.
CS-6	Offshore arrival of cable laying barge	26-27 th April	2 days		Operations cover the offshore cable installation and therefore have not been detailed in this Consents Application Study Report.
CS-7	Installation of East Trackway across salt marsh and sea defence	26 th April – 10 th May	15 days		• Trackway will be installed across the sea defence access routes and across the salt marsh. Seaward of the sea defence crest a membrane with aluminium trackway will be installed as shown on indicative plan. Landward of the sea defence crest, timber bog mats will be installed. The plan does not show full extent of trackway that will be placed across the salt marsh required for the Sunfish approach, cable pulling and offshore installation operations • Trackway installation will take place from 26th April – 30th April and remain in place from 26th April – 10th May.

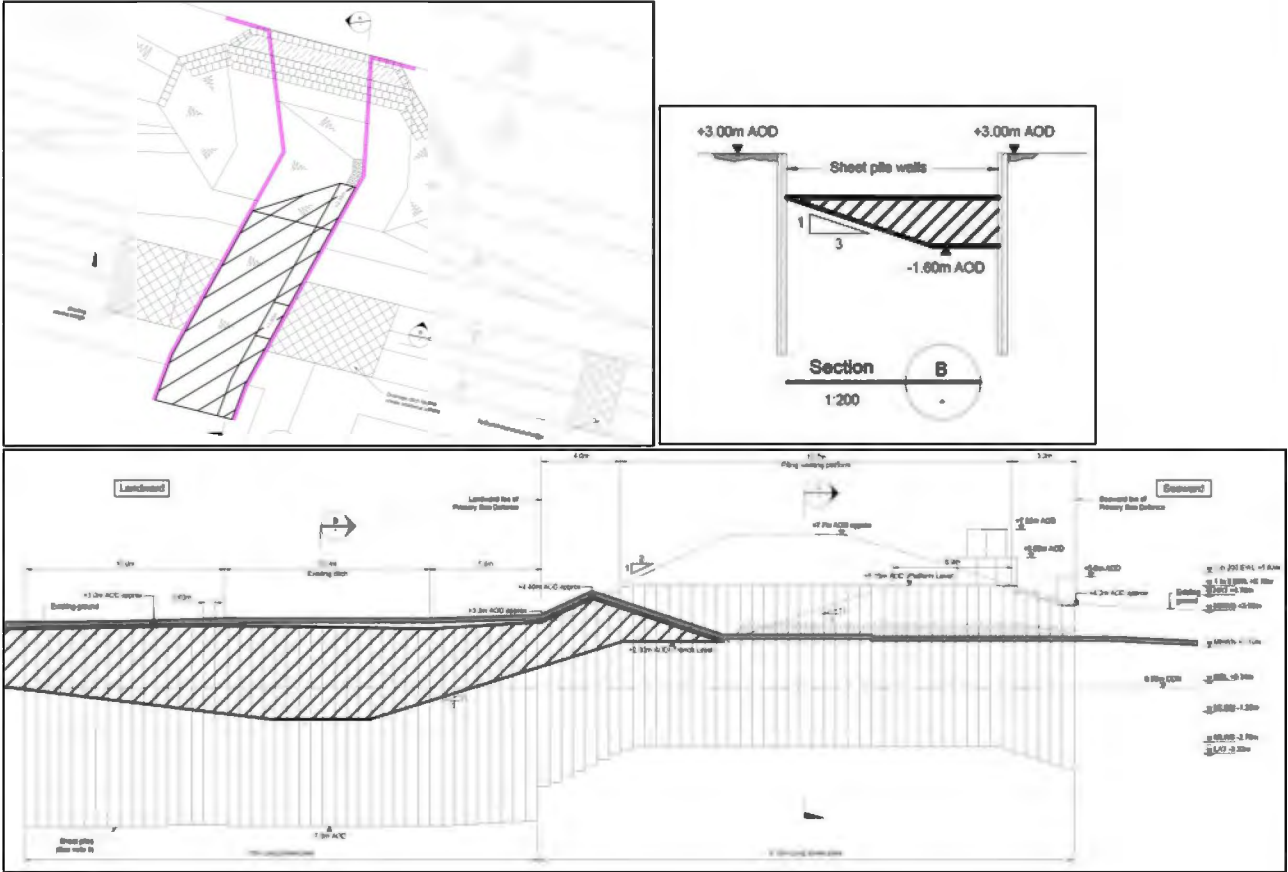
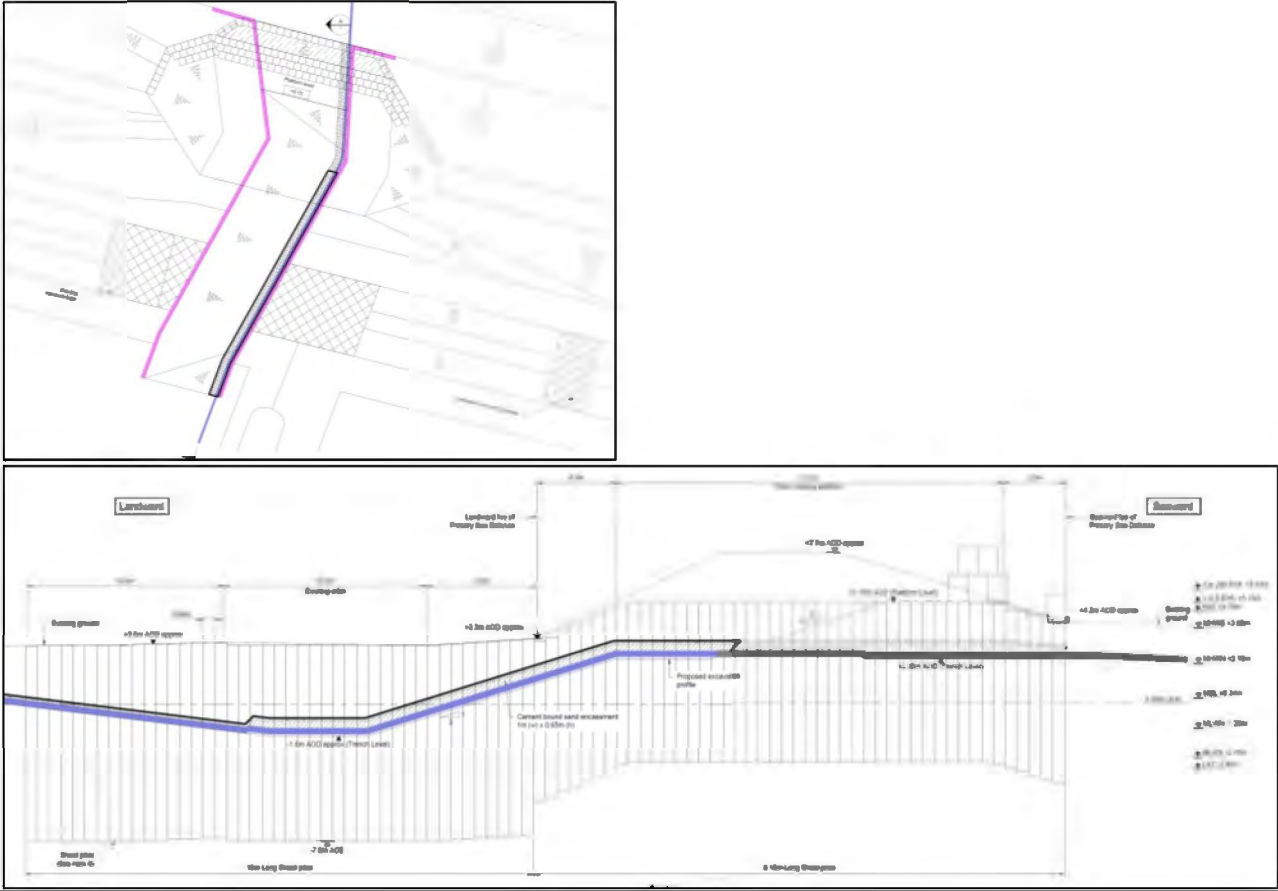
CS-8	Circuit 2 - Phase 1 Excavation: Sea defence excavated to +2.3m AOD (trench level) & installation of concrete bedding layer	29 th April – 1 st May	2 days		- This is the first of two phases of excavation across the sea defence and drainage ditch for Circuit 2 (first cable installation) to lower the ground level to the required cable burial depth. See Section 3.2.3.2 for further details. - This first phase of excavation involves excavation of almost all of the sea defence footprint (as shown in the figures) to lower the sea defence level to trench level (+2.3m AOD) with a landward ground level still at approximately +4.48m AOD. - This operation will not commence if a flood warning has been issued (see the EFRP in Appendix A). If a high tide notification is issued, only the 6m wide crest berm will be reinstated. - Prior to excavation of the trench a groundwater pumping system will be installed within the extent of the trench to manage water levels as the sea defence is lowered to the final trench level. - Earth moving plant (up to 35T) will work within the trench and on the 6m wide platforms either side of the sheet piles. Operations will start from the landside and move towards the sea such that the seaward portion is the last to be removed. No plant will be positioned seaward of the sea defence toe. - Not all the trench will be lowered to +2.3m AOD. At the position of Circuit 2 (first cable to be installed), a 1 in 3 sloped trench will be excavated that creates a 2m (min) horizontal surface at trench level to allow cable laying operations to take place. - The cable bedding layer will be installed once the sloped trench has been cut. - Excavated material will be transported by dumpers (up to 20T) to designated stockpiles in the site compound and protected from the elements. - In situ testing and sampling will be carried out in order to demonstrate the compliance of the excavated material for backfilling. Sediment samples will be collected and tested in a UKAS-approved laboratory with rapid turnarounds specified to confirm material compliance.
CS-9	Sunfish approaches sea defence laying rollers along cable route	1 st May	1 day	CLB indicates the position of the cable laying barge 	Operations cover the offshore cable installation and therefore have not been detailed in this Consents Application Study Report

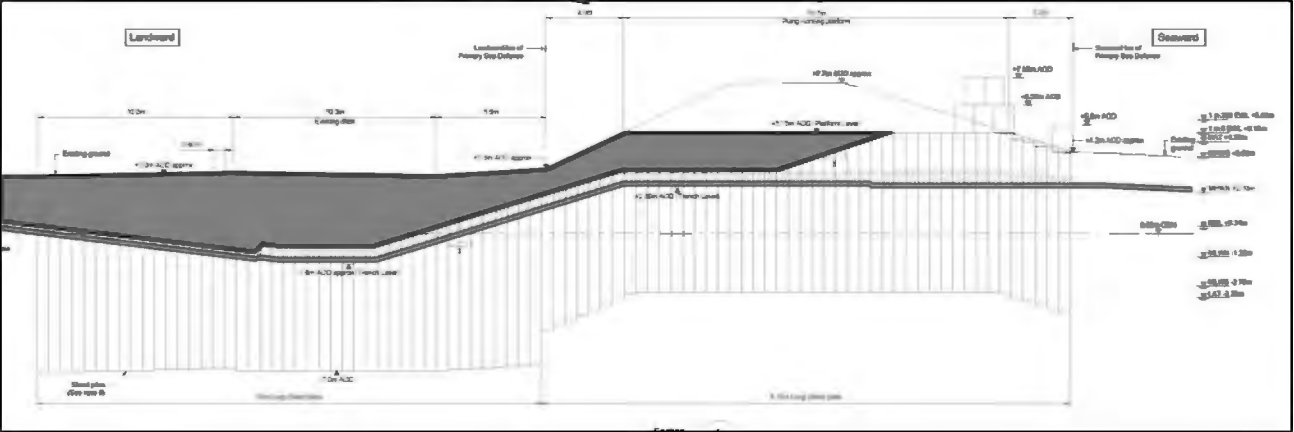
CS-10	Sunfish at toe of sea defence & cable pull operations in Field No.2	2 nd May	1 day		Operations cover the offshore cable installation and therefore have not been detailed in this Consents Application Study Report
CS-11	Cable installation across salt marsh by Sunfish tool	3 rd May	1 day	-	The cable is installed to a depth of 1.5m below ground level from the toe of the sea defence offshore towards the cable laying barge. The cable laying tool (Sunfish) will commence burial from the position as shown in the section. This minimises the excavation footprint on the salt marsh.
CS-12	Circuit 2 - Phase 1 Cable Installation: Cable relocated into trench, cement bound sand and concrete protection installed	3 rd May	1 day		- Sunfish commences salt marsh cable burial and moves offshore. Once sunfish is ~100m offshore, the buried cable at the toe of the sea defence is exposed by hand digging the material around the cable within the salt marsh. The footprint of this temporary excavation in the salt marsh is approx. 23m². The depth varies across this footprint and results in an estimated volume of around 11.7m³ of sediment for each cable installation. - The cable is relocated from the alignment that placed it into Field No.2, into its final burial position and depth in the seaward half of the sea defence. - At this point, the cable is placed at trench level in the seaward half of the sea defence and on the ground surface across the landward half and into Field No. 1 and 2. - The cable protection (cement bound sand encasement and concrete protective cover) is installed over the cable as shown in the figure across the seaward half of the sea defence footprint. - The concrete protective cover will extend to the seaward toe of the sea defence, where a cover of at least 1.3m will be achieved. - No plant will be positioned seaward of the sea defence toe.

CS-13	Circuit 2 - Phase 1 Reinstatement: Backfill & compaction of sea defence to +5.15m AOD (platform level) – 6m wide crest bund	4 th May	1 day		• This is the first of two phases of reinstatement across the sea defence and drainage ditch. See Section 3.2.3.2 for further details. A two phased approach allows the defence level at platform level to be constructed more rapidly than if a single phased operation was adopted. • This first phase of reinstatement involves benching the slopes, backfilling and then compaction of compliant sea defence material to reinstate the sloped trench created in CS-8 from trench level (+2.3m AOD) back to platform level (+5.15m AOD). • Compliant backfill material is transported by dumpers (up to 20T) from the segregated stockpiles in the site compound and backfilled / compacted in layers no more than 200mm. • Each reinstated layer will be compacted by compaction plant in accordance with the Highways Series 600 Specification. • The extent of reinstatement will be less than the extent of excavation as part of CS-8. Reinstatement will be as shown in the figures. This will be to construct a 6m wide crest berm at platform level (+5.15m) with 1 in 3 slopes to trench level. This 6m wide berm provides sufficient width for deployment of the temporary flood defence barrier. • This sequence includes the backfill of the temporary excavated footprint on the salt marsh back to its original condition with the original excavated salt marsh material. The material will be reinstated by means of hand tools to minimise disturbance to the saltmarsh, replacing soil in the natural sequence of horizons it was originally excavated in. • Earth moving plant (up to 35T) will work within the trench or on the 6m wide platforms either side of the sheet piles and work in a landward direction. No plant will be positioned seaward of the sea defence toe.
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COMPLETION OF FIRST CABLE BREACH (CIRCUIT 2), LAYING AND REINSTATEMENT OPERATIONS

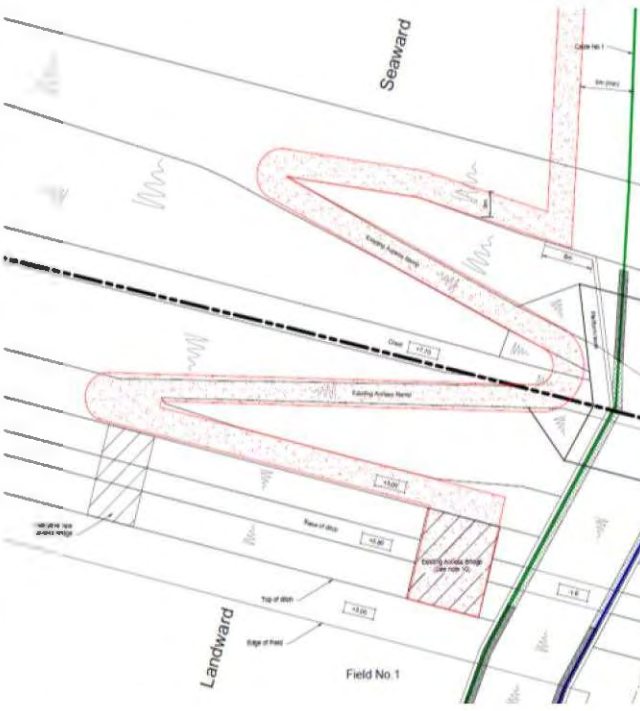
CS-14	Deployment of temporary flood defence (defence level to +7.7m AOD or higher)	5 th May – 12 th June	38.5 days	 	- Following reinstatement of the trench to the platform level (CS-13) interim reinstatement will be undertaken. This involves deployment of reactive measure 2 (RM2) as set out in the EFRP to provide a temporary flood defence level up to at least +7.7m AOD. - Interim reinstatement will remain in place for the entire period between the two breach/cable laying operations, approximately a 5 week period. - The Footpath Diversion will remain in place over this period.
CS-15	Recovery of East Trackway	5-10 th May	6 days	 	The aluminium trackway installed seaward of the sea defence crest and across the salt marsh during CS-7 is removed. The timber bog mat trackway will remain in place for the duration of the sea defence breach and reinstatement works.

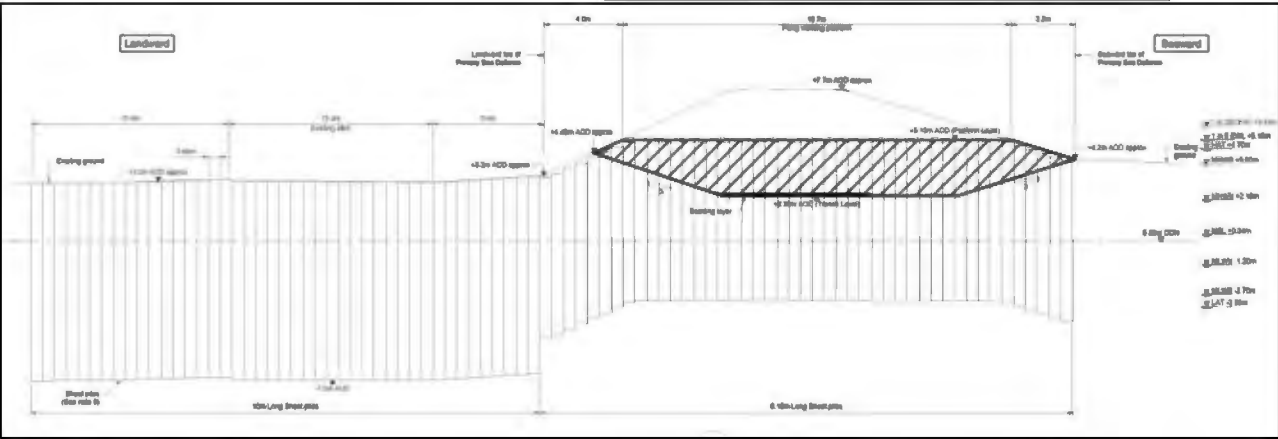
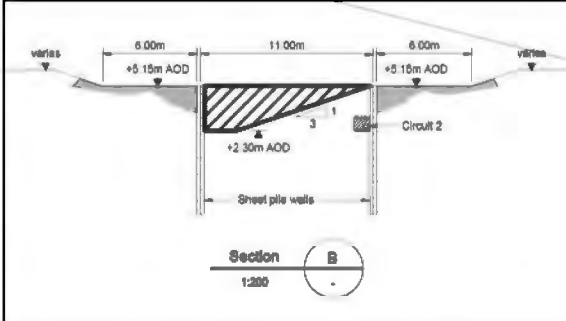
CS-16	Circuit 2 - Phase 2 Excavation: Landward side of sea defence and drainage ditch area excavated to trench level & installation of concrete bedding layer	5-7 th May	3 days		• This is the second of two phases of excavation across the sea defence and drainage ditch for Circuit 2 (first cable installation). • This second phase of excavation involves excavation of the landward half of the sea defence and the drainage ditch area into Field No.1 (as shown in the figures). Prior to this operation commencing, the temporary flood defence barrier will be in place and this will remain in place until commencement of Circuit 1 breach operations. • Prior to excavation of the trench a groundwater pumping system will be installed within the extent of the trench to manage water levels as the sea defence is lowered to the final trench level. • Earth moving plant (up to 35T) will work within the trench or on the 6m wide platforms either side of the sheet piles and work in a landward direction into Field No.1. • Not all the trench will be lowered to +2.3m AOD. At the position of Circuit 2, a 1 in 3 sloped trench will be excavated that creates a 2m (min) horizontal surface at trench level to allow cable laying operations to take place. • The cable bedding layer will be installed once the sloped trench has been cut. • Excavated material will be transported by dumpers (up to 20T) to designated stockpiles in the site compound and protected from the elements. • In situ testing and sampling will be carried out in order to demonstrate the compliance of the excavated material for backfilling. Sediment samples will be collected and tested in a UKAS-approved laboratory with rapid turnarounds specified to confirm material compliance.
CS-17	Circuit 2 - Phase 2 Cable Installation: Cable relocated into trench, cement bound sand and concrete protection installed	7 th May	1 day		• The cable is relocated from the alignment that placed it into Field No.2, into its final burial position and depth in the landward half of the sea defence and across the drainage ditch into Field No.1. • The cable protection (cement bound sand encasement and concrete protective cover) is installed over the cable as shown in the figure across the landward half of the sea defence footprint and the drainage ditch into Field No.1.

CS-18	Circuit 2 - Phase 2 Reinstatement: Backfill & compaction of sea defence and drainage ditch area	8-12 th May	4.5 days	 	• This is the second of two phases of reinstatement across the sea defence and drainage ditch. See Section 3.2.3.2 for further details. • This second phase of reinstatement involves benching the slopes, backfilling and then compaction of the landward half of the sea defence (with compliant sea defence material) and the drainage ditch area to reinstate the sloped trench created in CS-16 from trench level back to platform level (+5.15m AOD) at the sea defence and back to existing ground level across the drainage ditch and into Field No.1. • For the sea defence reinstatement, compliant backfill material is transported by dumpers (up to 20T) from the segregated stockpiles in the site compound and backfilled / compacted in layers no more than 200mm. Each reinstated layer will be compacted by compaction plant in accordance with the Highways Series 600 Specification. • For the drainage ditch area and Field No.1, excavated material is reinstated in the reverse order to which it was removed so as to reinstate the ground to its original condition. • Earth moving plant (up to 35T) will work within the trench or on the 6m wide platforms either side of the sheet piles and work in a landward direction back to Field No.1 with the access bridge reinstated between the trench sheet pile walls.
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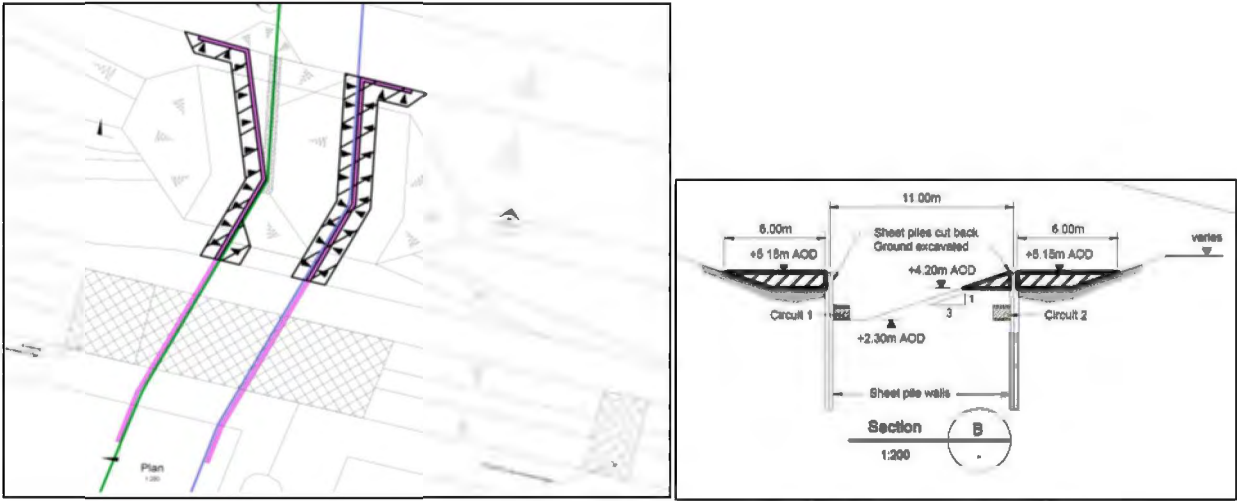
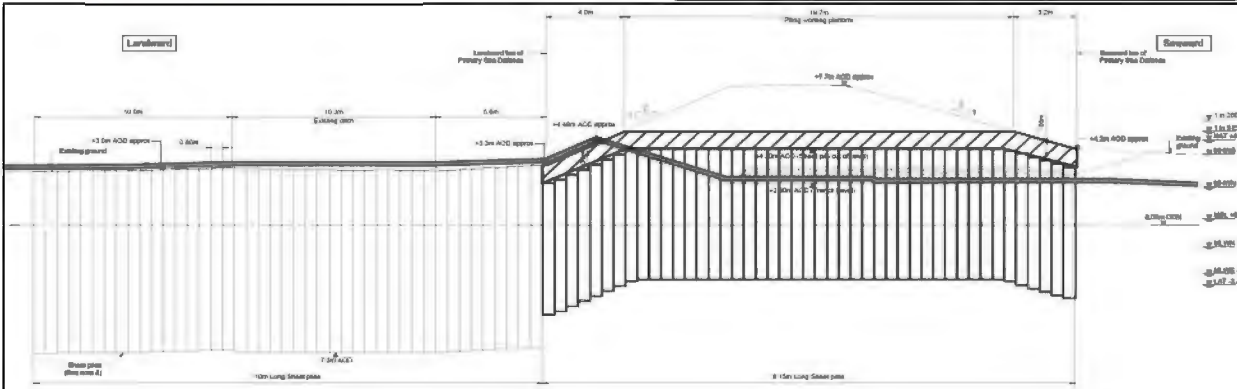
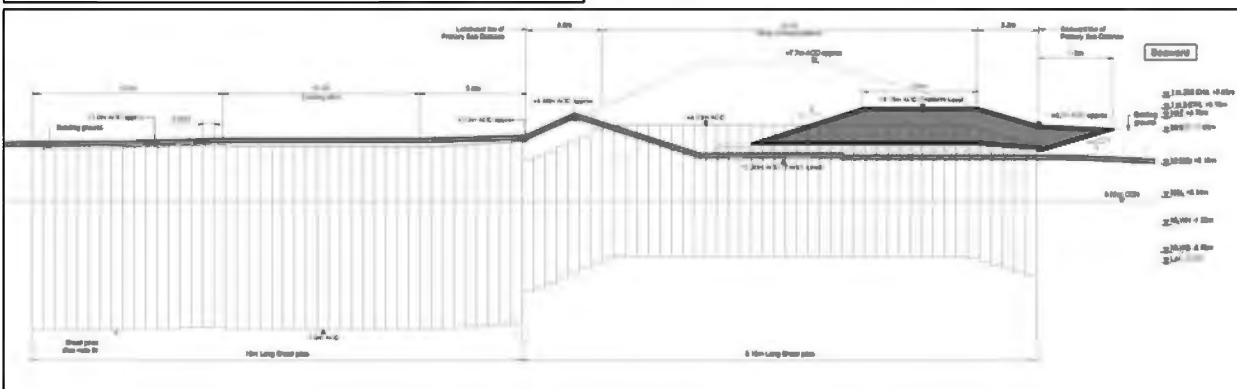
CS-19	Offshore cable installation continues	6-21 st May	16 days	-	Operations cover the offshore cable installation and therefore have not been detailed in this Consents Application Study Report
CS-20	Cable laying barge transits to Belgium to load second cable	22-29 th May	8 days	-	Operations cover the offshore cable installation and therefore have not been detailed in this Consents Application Study Report
CS-21	Cable laying barge on standby (awaiting suitable tides to reach cable landing position) followed by arrival of cable laying barge to KP2.0	30 th May - 11 th June	13 days	-	Operations cover the offshore cable installation and therefore have not been detailed in this Consents Application Study Report

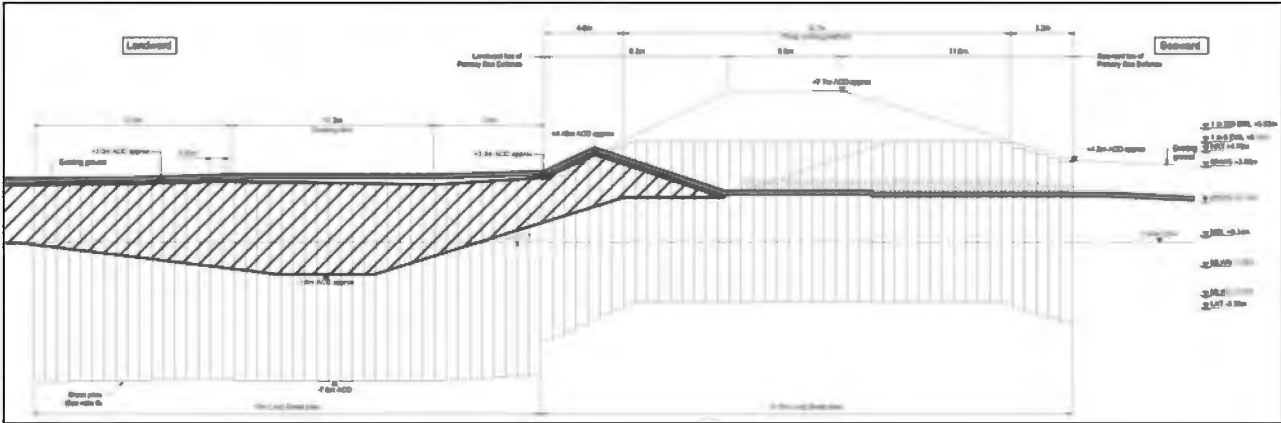
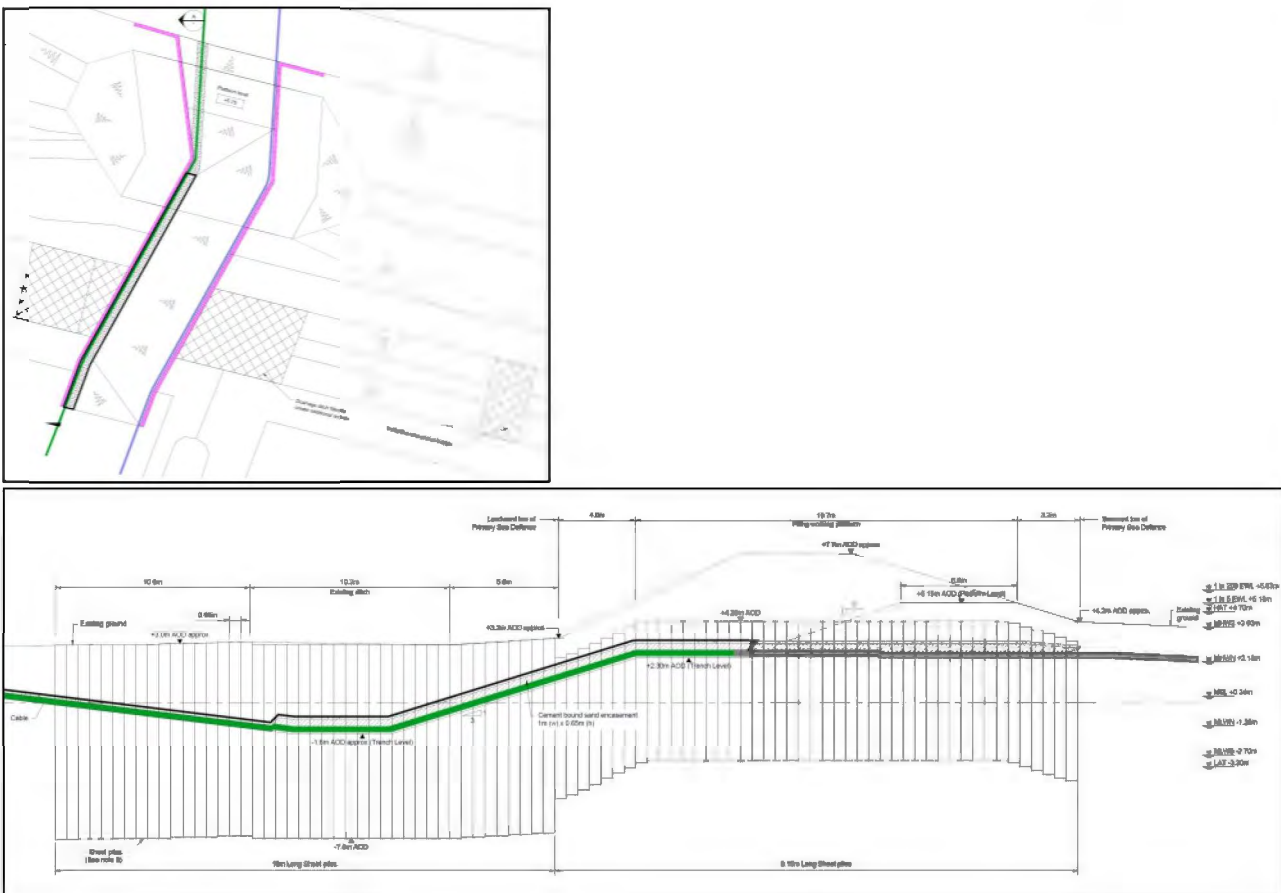
COMMENCEMENT OF SECOND CABLE BREACH (CIRCUIT 1), LAYING AND REINSTATEMENT OPERATIONS

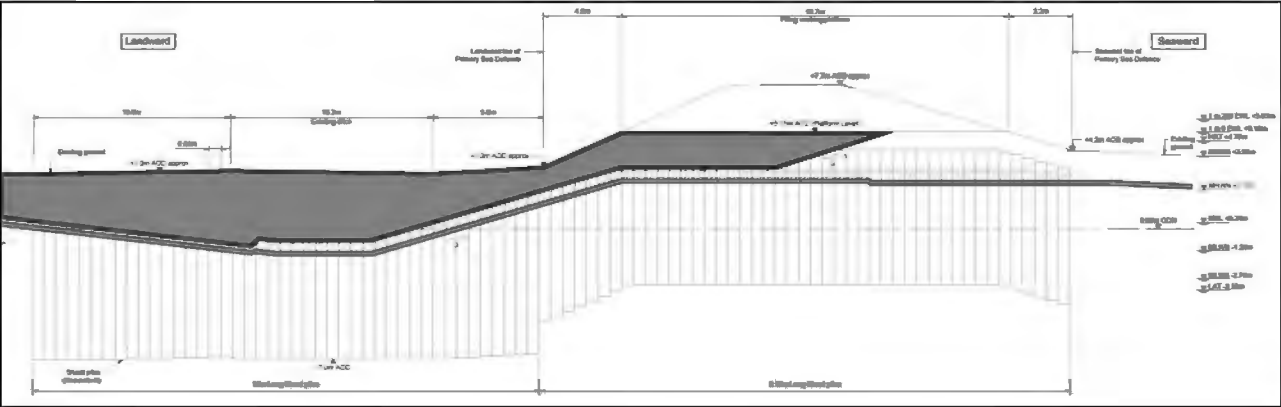
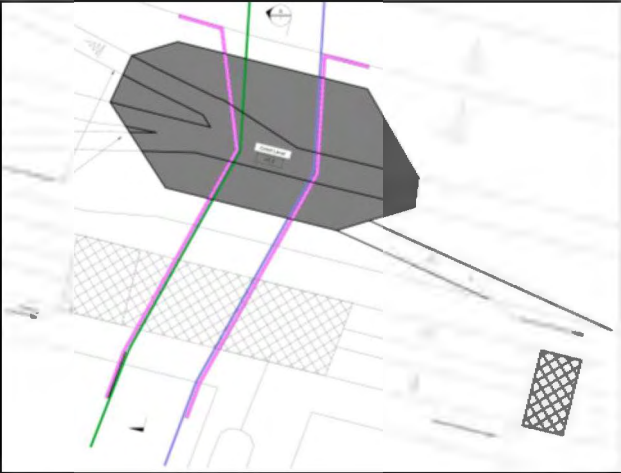
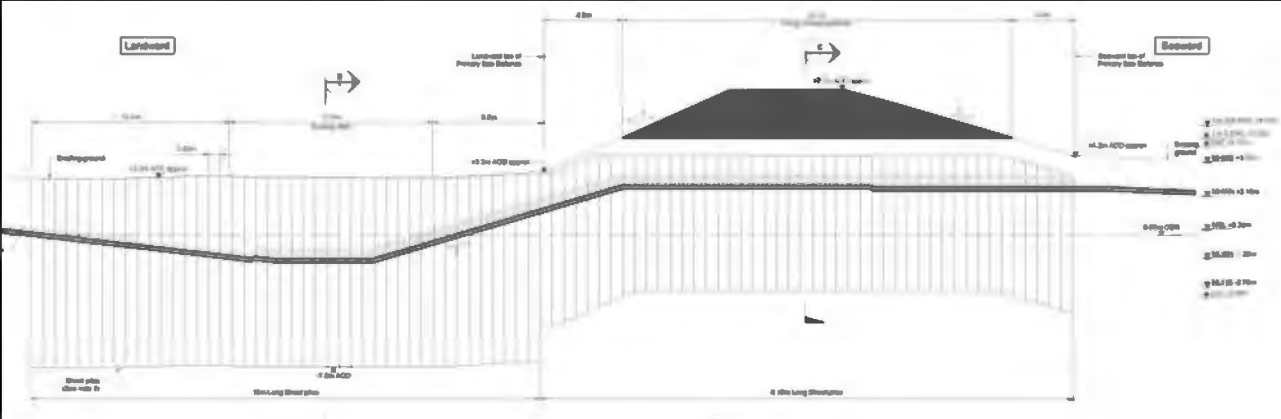
CS-22	Installation of West Trackway across salt marsh and sea defence	9-25 th June	17 days	  	- Trackway will be installed across the sea defence access routes and across the salt marsh. Seaward of the sea defence crest a membrane with aluminium trackway will be installed as shown on indicative plan. Landward of the sea defence crest, timber bog mats will be installed. The plan does not show full extent of trackway that will be placed across the salt marsh required for the Sunfish approach, cable pulling and offshore installation operations. - Trackway installation will take place from 9 – 13th June and remain in place from 9 – 25th June.
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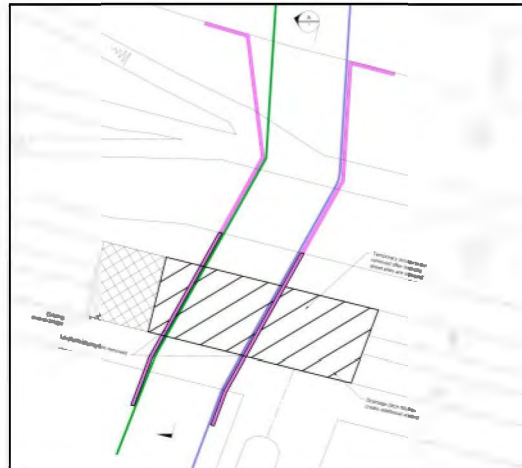
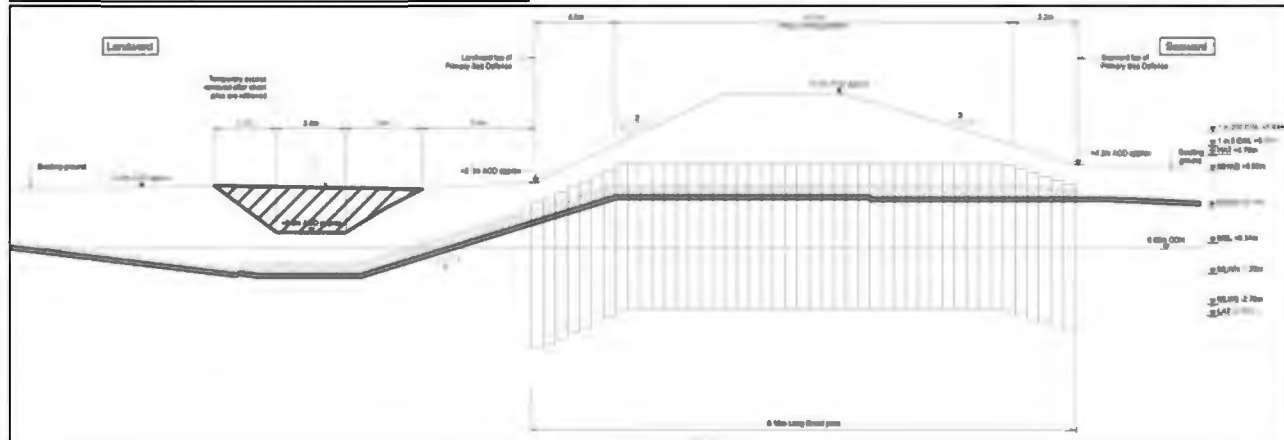
CS-23	Removal of temporary flood defence from the sea defence (CS-14) & Circuit 1 - Phase 1 Excavation: Sea defence excavated to +2.3m AOD (trench level) & installation of concrete bedding layer	12-14 th June	2 days		- Removal of the temporary flood defence. This operation will not commence if a flood warning has been issued (see the EFRP in Appendix A). The flood defence bags will be removed ahead of any excavation works. Therefore the estimated duration presented here for this sequence excludes the time to remove the bags. Bags will be removed the day before planned excavation works (subject to no forecast high tides) to prevent any delays during the excavation works ahead of the Sunfish tool arrival. - This is the first of two phases of excavation across the sea defence and drainage ditch for Circuit 1 (second cable installation) to lower the ground level to the required cable burial depth. See Section 3.2.3.2 for further details. - This first phase of excavation involves excavation of almost all of the sea defence footprint (as shown in the figures) to lower the sea defence level to trench level (+2.3m AOD) with a landward ground level still at approximately +4.48m AOD. - This operation will not commence if a flood warning has been issued (see the EFRP in Appendix A). If a high tide notification is issued, only the 6m wide crest berm will be reinstated. - Prior to excavation of the trench a groundwater pumping system will be installed within the extent of the trench to manage water levels as the sea defence is lowered to the final trench level. - Earth moving plant (up to 35T) will work within the trench or on the 6m wide platforms either side of the sheet piles. Operations will start from the landside and move towards the sea such that the seaward portion is the last to be removed. No plant will be positioned seaward of the sea defence toe. - Not all the trench will be lowered to +2.3m AOD. At the position of Circuit 1 (first cable to be installed), a 1 in 3 sloped trench will be excavated that creates a 2m (min) horizontal surface at trench level to allow cable laying operations to take place. - The cable bedding layer will be installed once the sloped trench has been cut. - Excavated material will be transported by dumpers (up to 20T) to designated stockpiles in the site compound and protected from the elements. In situ testing and sampling will be carried out in order to demonstrate the compliance of the excavated material for backfilling. Sediment samples will be collected and tested in a UKAS-approved laboratory with rapid turnarounds specified to confirm material compliance.
CS-24	Sunfish approaches sea defence laying rollers along cable route	14 th June	1 day		Operations cover the offshore cable installation and therefore have not been detailed in this Consents Application Study Report

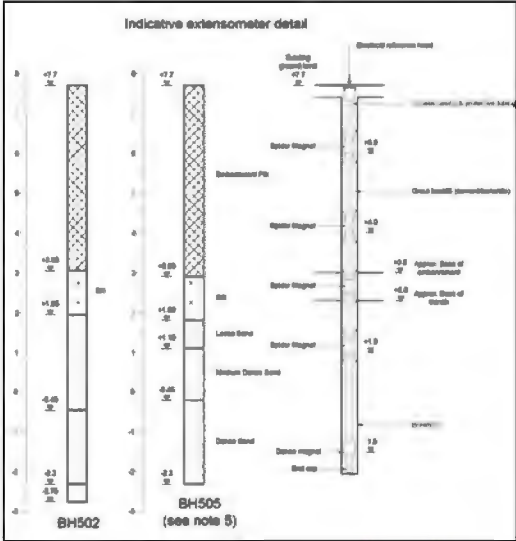
CS-25	Sunfish at toe of sea defence & cable pull operations in Field No.2	15 th June	1 day		Operations cover the offshore cable installation and therefore have not been detailed in this Consents Application Study Report
CS-26	Cable installation across salt marsh by Sunfish tool	16 th June	1 day	-	- The cable is installed to a depth of 1.5m below ground level from the toe of the sea defence offshore towards the cable laying barge. - The cable laying tool (Sunfish) will commence burial from the position as shown in the section. This minimises the excavation footprint on the salt marsh.
CS-27	Circuit 1 - Phase 1 Cable Installation: Cable relocated into trench, cement bound sand and concrete protection installed	16 th June	1 day		- Sunfish commences salt marsh cable burial and moves offshore. Once sunfish is ~100m offshore, the buried cable at the toe of the sea defence is exposed by hand digging the material around the cable within the salt marsh. The footprint of this temporary excavation in the salt marsh is approx. ~23m². The depth varies across this footprint and results in an estimated volume of around 11.7m³ of sediment for each cable installation. - The cable is relocated from the alignment that placed it into Field No.2, into its final burial position and depth in the seaward half of the sea defence. - At this point, the cable is placed at trench level in the seaward half of the sea defence and on the ground surface across the landward half and into Field No. 1 and 2. - The cable protection (cement bound sand encasement and concrete protective cover) is installed over the cable as shown in the figure across the seaward half of the sea defence footprint. - The concrete protective cover will extend to the seaward toe of the sea defence, where a cover of at least 1.3m will be achieved. - No plant will be positioned seaward of the sea defence toe.

CS-28	Sheet piles across sea defence cut to final cut off level (+4.2m AOD at the crest and lower at the seaward and landward slopes)	16 th June	1 day	 	- The 6m banks at platform level either side of the trench will be temporarily lowered to allow sheet piles to be cut. - Plant will work between the lines of sheet piles working landward. The seaward lengths of the sheet piles will be cut first such that the backfilling and compaction operations can commence earlier than if all sheet piles were cut first. - As shown, sheet piles will be cut to a level of +4.2m AOD across the sea defence and to a level that provides a 1m clearance between final reinstatement level (i.e. existing ground level) and the top of the sheet pile. - To prevent operations in the designated salt marsh the operation to cut the sheet piles to the cut off level will be different for the return walls (sheet piles at the toe of the sea defence). The area landward of these piles will be excavated for access. Then the top of the pile connected to an excavator arm before the sheet piles are cut at the cut off level. The operative then leaves the excavation before it is backfilled. This is followed by the retrieval of the 1m cut length of sheet pile from the ground by the excavator, before the ground is compacted.
CS-29	Circuit 1 - Phase 1 Reinstatement: Backfill & compaction of sea defence to +5.15m AOD (platform level) – 6m wide crest bund	17 th June	1 day	 	- This is the first of two phases of reinstatement across the sea defence and drainage ditch for Circuit 1 (second cable installation). See Section 3.2.3.2 for further details. A two phased approach allows the defence level at platform level to be constructed more rapidly than if a single phased operation was adopted. - This first phase of reinstatement involves benching the slopes, backfilling and then compaction of compliant sea defence material to reinstate the sloped trench created in CS-23 from trench level (+2.3m AOD) back to platform level (+5.15m AOD). - Compliant backfill material is transported by dumpers (up to 20T) from the segregated stockpiles in the site compound and backfilled / compacted in layers no more than 200mm. - Each reinstated layer will be compacted by compaction plant in accordance with the Highways Series 600 Specification. - The extent of reinstatement will be less than the extent of excavation as part of CS-23. Reinstatement will be as shown in the figures. This will be to construct a 6m wide crest berm at platform level (+5.15m) with 1 in 3 slopes to trench level. This 6m wide berm provides sufficient width for deployment of the temporary flood defence barrier. - This sequence includes the backfill of the temporary excavated footprint on the salt marsh back to its original condition with the original excavated salt marsh material. The material will be reinstated by means of hand tools to minimise disturbance to the saltmarsh, replacing soil in the natural sequence of horizons it was originally excavated in. - Earth moving plant (up to 35T) will work within the trench or on the 6m wide platforms either side of the sheet piles and work in a landward direction. No plant will be positioned seaward of the sea defence toe.

CS-30	Circuit 1 - Phase 2 Excavation: Landward side of sea defence and drainage ditch area excavated to trench level & installation of concrete bedding layer	18-20 th June	3 days	 	• This is the second of two phases of excavation across the sea defence and drainage ditch for Circuit 2 (first cable installation). • This second phase of excavation involves excavation of the landward half of the sea defence and the drainage ditch area into Field No.1 (as shown in the figures). Prior to this operation commencing, the temporary flood defence barrier will be in place and this will remain in place until commencement of Circuit 1 breach operations. • Prior to excavation of the trench a groundwater pumping system will be installed within the extent of the trench to manage water levels as the sea defence is lowered to the final trench level. • Earth moving plant (up to 35T) will work within the trench or on the 6m wide platforms either side of the sheet piles and work in a landward direction into Field No.1. • Not all the trench will be lowered to +2.3m AOD. At the position of Circuit 2, a 1 in 3 sloped trench will be excavated that creates a 2m (min) horizontal surface at trench level to allow cable laying operations to take place. • The cable bedding layer will be installed once the sloped trench has been cut. • Excavated material will be transported by dumpers (up to 20T) to designated stockpiles in the site compound and protected from the elements. • In situ testing and sampling will be carried out in order to demonstrate the compliance of the excavated material for backfilling. Sediment samples will be collected and tested in a UKAS-approved laboratory with rapid turnarounds specified to confirm material compliance.
CS-31	Circuit 1 - Phase 2 Cable Installation: Cable relocated into trench, cement bound sand and concrete protection installed	20 th June	1 day		• The cable is relocated from the alignment that placed it into Field No.2, into its final burial position and depth in the landward half of the sea defence and across the drainage ditch into Field No.1. • The cable protection (cement bound sand encasement and concrete protective cover) is installed over the cable as shown in the figure across the landward half of the sea defence footprint and the drainage ditch into Field No.1.

CS-32	Circuit 1 - Phase 2 Reinstatement: Backfill & compaction of sea defence and drainage ditch area	21-25 th June	4.5 days	 	• This is the second of two phases of reinstatement across the sea defence and drainage ditch. See Section 3.2.3.2 for further details. • This second phase of reinstatement involves benching the slopes, backfilling and then compaction of the landward half of the sea defence (with compliant sea defence material) and the drainage ditch area to reinstate the sloped trench created in CS-16 from trench level back to platform level (+5.15m AOD) at the sea defence and back to existing ground level across the drainage ditch and into Field No.1. • For the sea defence reinstatement, compliant backfill material is transported by dumpers (up to 20T) from the segregated stockpiles in the site compound and backfilled / compacted in layers no more than 200mm. Each reinstated layer will be compacted by compaction plant in accordance with the Highways Series 600 Specification. • For the drainage ditch area and Field No.1, excavated material is reinstated in the reverse order to which it was removed so as to reinstate the ground to its original condition. • Earth moving plant (up to 35T) will work within the trench or on the 6m wide platforms either side of the sheet piles and work in a landward direction back to Field No.1 with the access bridge reinstated between the trench sheet pile walls.
CS-33	Full Reinstatement: Sea defence reinstated back to crest level (+7.7m AOD)	24-28 th June	5 days	 	• The sea defence is reinstated back to +7.7m AOD. • Excavated slopes will be benching for preparation for backfilling and compliant backfill material is transported from the stockpiles in the site compound and backfilled and compacted in layers no more than 200mm. • Each reinstated layer will be compacted by compaction plant in accordance with the Highways Series 600 Specification. • Earth moving plant will work from the crest and area landward of the landward sea defence toe. No plant will work seaward of the sea defence seaward toe. • Once works are complete the eastern access ramp will be removed and the vegetation and slopes reinstated back to the original condition as recorded in the pre-condition survey.

CS-34	Recovery of West Trackway and salt marsh remedial works	18-25 th June	8 days			- The aluminium trackway installed seaward of the sea defence crest and across the salt marsh during CS-22 is removed. The timber bog mat trackway will remain in place for the duration of the sea defence breach and reinstatement works. - The trackway across the sea defence will be removed following completion of any required salt marsh remedial works. This is anticipated to be between 18-25th June.
COMPLETION OF SECOND CABLE BREACH (CIRCUIT 1), LAYING AND REINSTATEMENT OPERATIONS						
CS-35	Removal of landside sheet piles	25-29 th June	4 days	 		- Sheet piles previously installed landward of the landward toe of the sea defence will be removed. - Piling plant will be positioned landward of the landward toe of the sea defence and/or Field No.1. Ground protection (bog mats) will be installed to spread the load during pile removal operations. - After the sheet piles have been removed from the landside area all apart from the most western access bridges are removed and the ground reinstated back to its original condition.
CS-36	Turfing, Topsoil/ seeding and grass reinforcement	25-26 th June	1 day	-		- Pre-seeded protection matting will be placed on the landward and seaward slopes of the sea defence. - Imported turf will be installed at the crest of the sea defence. - Top soil will be applied to each side of the drainage ditch. - Up until demobilisation the reinstated turf and topsoil will be watered daily.

CS-37	Extensometer installed and post-construction monitoring commences	25 th June – 25 th June 2026	1 day – 10 years	 	- Following CS-36, long term monitoring points will be installed. - A soil extensometer will be installed at the centreline of the sea defence to monitor vertical movements and lateral and longitudinal deformation. This will be installed between the 25-26th June 2016. - Long term monitoring undertaken by an independent third party initial daily, becoming weekly and then yearly up to 10 years post completion.
CS-38	End of footpath diversion, re-opening of Peter Scott Way	29-30 th June	1 day	-	- The site working area is reduced back to the extent of the site compound and boundary fences removed from the footprint of the sea defence. - The sole remaining access bridge (new western most access bridge) will be removed and the ground reinstated back to its original condition. - The Peter Scott Way is re-opened to the public.
CS-39	Offshore cable installation continues	21 st June – 6 th July	16 days	-	Outside FDC scope.
CS-40	Demobilisation of breach equipment	25 th June – 6 th July	7 days	-	- Contractor commences demobilisation from site. - Plant and excess material are removed from the site compound. - Site compound remains in use for the onshore cable installation operations

3.5 Detailed Methodology

3.5.1 CS-1: Site establishment

Programme: 31st March-16th April (17 days)

3.5.1.1 Working area

The site working area encompasses an area 100m west and 70m east of the ditch between Field No.1 and No.2, and from the toe of the sea defence to the access road on the southern boundary of Field No.1 and No.2.

3.5.1.2 Site compound

A site compound for the breach and reinstatement operations will be set up within the working area in Field No.1. This will take 17 days and take place between 31st March and 16th April 2016. Ground protection matting (timber bog mats between 150mm to 250mm thick and 1m x 5m) up to two thick, will be placed within the site compound area to protect the existing ground in Field No.1 from damage. Under the agreement with the landowner the existing ground cannot be trimmed or hard-core placed. These mats will be placed prior to the mobilisation of the earth moving and sheet piling equipment.

The compound will include a site office, welfare facilities, storage areas for plant, equipment, and imported and temporarily stored materials. All plant, equipment and earthworks material required for the emergency flood response measures will be stored in the northwest corner of the site compound, i.e in a location that allows a rapid response. The floor level for all site office(s) / cabins will be raised by 300mm above existing ground levels to minimise flood risk to occupants should an extreme event result in a breach in the sea defence.

The site compound will be used for all operations (breach and cable landing) and remain in place for the duration of the operations. The planned demobilisation date for the sea defence breach related plant is between 29th June and 6th July 2016.

3.5.1.3 Plant and movement

The anticipated plant brought to site for the purpose of excavation, cable installation, reinstatement, piling and emergency flood response operations are presented below. Stock images of a number of the key plant from the plant list are included in Figure 3.5 below.

Plant list:

- 2 x 35t hydraulic excavators - (eg Komatsu PC350)
- 1 x 22t excavator - (eg Komatsu PC 210)
- 1 x 13t LGP JS 130 excavator

- 1 x 14 t Komatsu PC138 with rubber pads on the tracks
- 3 x 10t capacity rubber tracked dumpers
- 1 x 45 t hydraulic excavator
- 5 x 14t dumpers
- 2 x 10t compaction roller
- 2 x 5t compaction roller
- 1 x Wheel loader (bulldozer)
- 10m tele-handler
- 1 x Crawler Crane (Hitachi KH 180-3 or similar) for piling and installation of precast concrete slabs and other cable protection elements.
- 1 x Crawler Crane (Liebherr HS895 or similar) for handling of flood defence sand filled containers above the sea defence.
- 1 x Mobile Crane (Grove RT540E or similar) for handling of sheet piles and precast elements within the site compound.
- HGV for material supply (including sheet piles)
- 2 x Amphibious Soft Terrain Backhoe MA200 – Operating Weight 21.6Te (Approximate Dimensions [m] 2.65W x 12L x 5.8H)
- Road sweeping equipment
- Fuel trucks

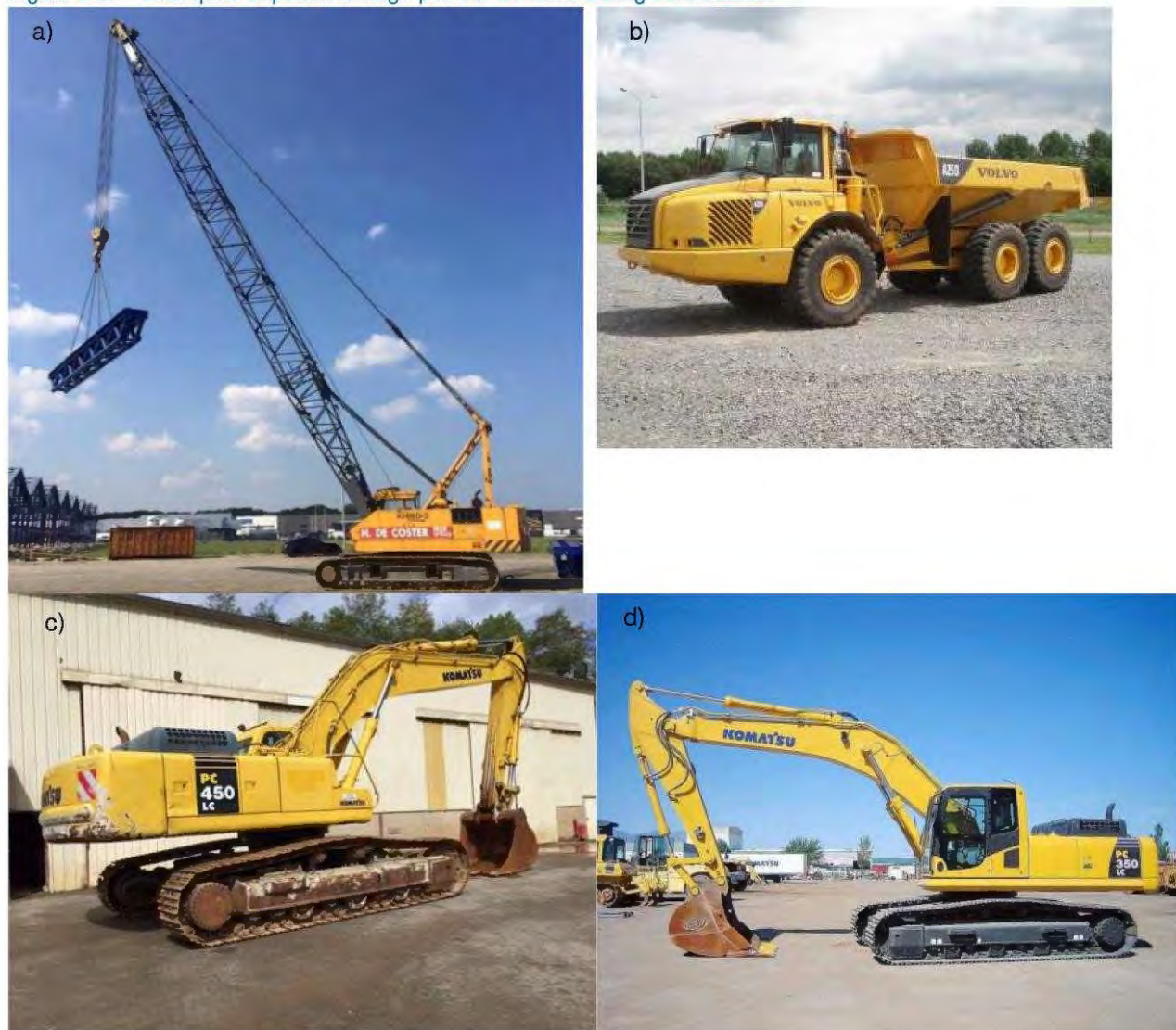
Bearing capacity calculations have been undertaken to confirm the mobility of the proposed plant on the foreseen ground conditions on the sea defence. Many of the plant will be fitted with wider than standard tracks to spread the load, and bog mats will be used where required to ensure ground pressures do not exceed the mobility limits. The maximum anticipated ground pressure is based on the piling plant of 0.60kg/cm^2 (~60 kPa).

The additional equipment is envisaged for the works:

- 1 x PTC 60 HFV Vibrohammer (or smaller) and associated power pack for installation and removal of sheet piling (used with the crawler crane above)
- Crane equipment
- Cutting torch
- Welding machines
- Position and Survey Systems
- Sheet pile frame
- 3 pumps and 2 power packs

All deliveries will be made using the dedicated access road and will comply with outline Traffic Management Plan included in the Flood Defence Consent associated documentation. Materials and equipment will be stored in designated, separated areas within the site compound.

Figure 3.5: Examples of potential large plant to be used during construction





- a) Crawler Crane Hitachi KH180-3
- b) Volvo A25D Dumper Truck
- c) Hydraulic Excavator Komatsu PC450
- d) Hydraulic Excavator Komatsu PC350
- e) Mobile Crane Grove RT540E
- f) Amphibious Soft Terrain Backhoe Hitachi MA200

3.5.1.4 Site access

The site compound and work areas will be managed by the Contractor. Site boundary fencing will mark out the extents of the site working area and site security will control access to and from the site from the concrete access road along the southern boundary of Field No.1.

It has been agreed between the local landowner and Environment Agency that planned maintenance works at the site will be halted during the site operations. These include maintenance operations by the Environment Agency on the sea defence and by the local landowner for farming operations in Field No. 1 and No.2.

Prior to the excavation works on the sea defence the vegetation across the working area of the sea defence will be trimmed for ecological management and installation of construction monitoring points.

All delivery trucks will be brought from the concrete hard standing area located along the East Bank road into the site compound. Further details on the traffic management are outlined in the FDC associated documentation (Traffic Management Plan).

All access bridges and ramps across the drainage ditch and landward of the sea defence crest will be protected by the use of bog mats. Seaward of the sea defence crest (including the sea defence crest) access routes will be protected by aluminium trackway. An indicative plan of the trackway is presented in CS-7 (East Trackway) and CS-22 (West Trackway) of the storyboard and in Appendix C.

Prior to any creation of accesses over the exiting drainage ditches, a pumping system will be installed and the drainage ditch pumped dry. Settlement tanks will be installed within the working area to remove silts and fines from the water before it is discharged back into the drainage ditch on the west side of the access bridges.

No plant undertaking the breach and reinstatement operations will work from seaward of the sea defence seaward toe. For cable installation operations seaward of the sea defence, plant required for trackway installation/removal and nearshore cable installation operations will work beyond the toe. This is detailed in the EPiC (see associated Flood Defence Consent documentation).

Following completion of the breach and reinstatement works the drainage ditch will be reinstated back to its original condition.

Further details of the proposed access for the Works are described below.

3.5.1.4.1 Sea defence and drainage ditch

Plant access across the ditch and to the crest of the sea defence is required. The existing access bridge as shown in MMD-357166-C-DR-00-XX-0102 in Appendix C is subject to a final stability assessment by the Contractor. Additional access bridges are to be constructed across the drainage ditch to the sea defence as shown in MMD-357166-C-DR-00-XX-0300.

The drainage ditch between and either side of the proposed sheet piles alignment will be in-filled by sand with 1 in 3 slopes required starting 5m away from the sheet piles. The sand will be compacted and bog mats placed to spread the load of plant. This will form the main access for plant during the Works. An additional section of the drainage ditch will be in-filled with sand, again compacted and bog mats placed.

For cable pulling operations and installation of the concrete protective cover slabs this can only be safely carried out from the platform level above the trench level (i.e. from the 6m wide plant access platforms either side of the sheet piles). The existing ramp to the west of the breach location will be utilised for plant access to the western 6m platform and will also be used by earth moving plant when the defence is initially lowered from 7.7m AOD to 5.15m AOD (see CS-4). The access ramps will be modified as the works progress to allow continued access.

A secondary ramp is required to mirror the access on the eastern side of the breach location as shown in MMD-357166-C-DR-00-XX-0301. This will be formed by building out from the landward slope of the sea defence with sand, again compacted and bog mats placed (~75m² area in two layers). A slope of between 1 in 10 and 1 in 12 will be achieved. This eastern ramp will be approximately 3m wide by 30m long and rise from ~3.3m AOD to platform level (+5.15m AOD). The volume of material to form this eastern access has been estimated as ~85m³. In addition a new access bridge at the base of the new eastern access ramp is required for plant access from Field No.2, across the drainage ditch to this new access ramp. The berm between the landward toe of the sea defence and the crest of the ditch is too narrow for safe plant movement when the new access ramp in place. The installation and reinstatement methodology for this access bridge is the same as presented above for the other new access bridges.

Once works are complete this eastern access ramp will be removed and the vegetation and slopes reinstated back to the original condition as recorded in the pre-condition survey.

3.5.1.4.2 Field No.1 and No.2

The drainage ditch between Field No. 1 and No. 2 will be in-filled and flumed in up to three locations to allow access between the two fields as the works progress. Fluming the ditch involves the installation of a pipe at the base of the ditch prior to the ditch being backfilled so flows in the ditch can be maintained. Access to Field No.2 is required as prior to the commencement of works on the sea defence the cable pulling winch will be installed in Field No.2, and also provides access to the new eastern most access bridge and ramp.

3.5.1.5 Installation of construction monitoring

During construction, temporary monitoring points are to be installed as soon as practical with initial readings taken twice daily. Ground monitoring points will be hand dug in and comprise temporary stakes with nails. The stakes will be installed to an elevation of approximately 300mm above ground level to allow readings to be taken easily. All monitoring points are positioned on ground/slopes not subject to excavation or plant movement. The indicative position of construction monitoring locations is shown on MMD-357166-C-DR-00-XX-0104 in Appendix C.

During construction, the Contractor, the Employer's Representative and DONG Energy will review the monitoring data. Should significant ground movements be observed during the construction phase the associated site works shall be halted and a full assessment carried out to confirm the reactive measure(s).

Table 3.3: Monitoring requirements during construction.

Type	Number	Location	Monitoring frequency	Proposed trigger limits	Comments
Wooden stakes at existing ground level with nails for monitoring targets	Up to 36 locations	As per MMD-357166-C-DR-00-XX-0104	Twice daily during the construction phase.	Yellow 20mm Red 40mm	Testing frequency to be altered subject to any ground movements
Prism targets	Up to 4 locations	As per MMD-357166-C-DR-00-XX-0104	Twice daily during the construction phase.	Yellow 5mm Red 15mm	Pre-mobilisation assessment of the bridge condition to be carried out. Testing frequency to be altered subject to any movements

In the event of a 'Yellow' trigger breach, monitoring frequency will be doubled and the site supervisor will be contacted by the Contractor to agree a strategy to avoid further movement. In the event of 'Red' trigger breach, works will stop immediately and the site supervisor will be contacted by the Contractor to agree remedial measures.

3.5.1.6 Tide gauge board

The Contractor shall install a standard design tide gauge board on site to monitor water levels. Calibration marks will comply with British Standard (BS) 3680-7:2000 'Method of measurement of liquid flow in open channels'. Two boards will be installed approximately 50m east of the cable alignments, at the toe of the seaward face of the sea defence embankment. The Contractor will seek assistance from specialist manufacturer for the design and installation of the tide gauge board. The board material will be plastic or aluminium strips with calibrated markings and location should allow for fluctuation in the surface water system to be manually monitored. Any screws used will be stainless steel. The strip will be fixed to treated timber post driven into the seaward embankment until refusal and/or as recommended by manufacturer. The boards will be referenced to Ordnance Datum and used to monitor the difference between the EA FWDO forecast water levels and water levels at the site. Through the use of two boards, the range of calibration marks will be from ground level at the toe of the sea defence (approximately +4.2m AOD) up to +6m AOD.

3.5.2 CS-2 Footpath diversion and boundary fencing installed across sea defence

Programme: 17th April (1 day)

3.5.2.1 Footpath Diversion

A temporary footpath diversion of the Peter Scott Way is required during the sea defence operations. The footpath route will be diverted meeting the requirements of the Footpath Diversion Order granted by the Local Authority. The Footpath Diversion Order has been submitted in January 2016.

The diversion route will relocate the Peter Scott Way around the site compound and working area. Two temporary metal staircases will be erected on the landward slopes of the sea defence along with two temporary footbridges where the diverted route crosses the existing drainage ditch. The temporary diversion route and position of the access stairs are shown in Figure 3.6 below.

Diversion signage will be required at the two locations where the footpath is to be diverted from the crest of the sea defence. These will be placed on the temporary access stairs. A project information board will also be placed at the gate to the Public Right of Way near to the Peter Scott Lighthouse.

No lighting, no walkway and only 1 side fencing are foreseen.

3.5.2.2 Boundary fencing

Standard Heras mesh fencing panels or similar will be installed around the boundary of the site compound and site working area. Heras fencing with Heras Stormguard stabilisation system will be installed on the sea defence where wind loading will be greatest. The extent of fencing will be phased as the works progress. During site establishment only fencing around the compound will be installed. This will allow the Peter Scott Way to remain open until piling works commence. Prior to piling works, fencing will be extended from site compound around the entire site working area (i.e. over the sea defence and to the sea

defence toe), with the fencing at the sea defence toe relocated during breach and reinstatement works at toe and arrival of the Sunfish tool. Heras Airmesh or similar fencing with Heras Stormguard will be used at the sea defence crest to visually screen off works taking place prior to May 2016.

The fencing is to meet the following requirements:

- Freestanding stabilisation system.
- Compatible with mesh and hoardings.
- Wind resistance up to 100mph.
- Zero trip foot
- Meets BS5975

The screening is to meet the following requirements:

- Lightweight and transparent fabric
- Fire tested to DIN 4102-B1.
- Material is to be hemmed and eyeleted

Figure 3.6: Temporary footpath diversion route plan (top) and proposed access stairs detail (bottom)



Source: Proposed Footpath Diversion 2016 RPS Group (Figure 2216-0125)

3.5.3 CS-3 Installation of landside sheet piles

Programme: 17-20th April (4 days)

Steel sheet piling will be installed across the drainage ditch to the toe of the sea defence first. See MMD-357166-C-DR-XX-00-0102 (Plan) and XX-00-0202 (Section) for supporting plans.

For the anticipated ground conditions, excavation depths and ground loading, sheet piles generally up to 10m in length are likely to be required for the sheet pile walls across the drainage ditch. The final design length is subject to final design by the Contractor. Based on calculations undertaken by Mott MacDonald, 10m is the maximum foreseen pile length to provide an un-propped sheet piled wall solution for the required cable burial depth.

In order to install piles of such length though the anticipated ground conditions, a crawler crane (Hitachi KH 180-3 or similar) will be required. The crane will be fitted with a PTC 60 HFV Vibrohammer (or smaller) and associated power pack. Bog mats will be used to spread the load of the crawler crane when installing the piles across the sea defence. The top of the piles will be driven to ground level.

A mobile crane (Grove RT540E or similar) will be positioned in Field No.1 and will be used for handling of sheet piles. Piles will be lifted in batches onto the sea defence for installation by the crawler crane. See CS-1 for details of plant.

All operatives and plant are to be excluded from working close to the crest/base of slopes to reduce the risk injury and of slope instability. As a minimum this will be a 1m offset from the crest/base of slopes. The Contractor's Method Statement will include the extent of these exclusion zones, which are dependent on the final selected Contractor's plant.

3.5.4 CS-4 Excavation of sea defence to Platform Level (+7.7m AOD to +5.15m AOD)

Programme: 20-22nd April (2.5 days)

To create a piling working platform the top 2.55m of the sea defence will be removed by forming an open cutting across the crest and slopes of the embankment. The extent of the open cutting is shown in drawing MMD-357166-C-DR-00-XX-0102 in Appendix C. The open cutting will be machine excavated to a level of +5.15m AOD with approximately 1 in 3 sloping batters. The open cutting will be typically 38m wide at the crest and typically 23m wide at its base, i.e. at the working platform level.

Removing the top 2.55m of the sea defence where the cable burial depth is greatest allows a reduced sheet piled wall retaining height to be achieved such that propping is not required which would add significant complexities and risk to the cable laying operations.

The existing access ramps on the landward and seaward slopes of the sea defence will be modified to allow continued access during the operations. Minor modifications will be required, in the order of 5m to 10m but no more than half the length of the existing ramp, with re-profiling works carried out by an excavator. The indicative modified layout of the access ramps is shown in the drawings (Appendix C). Following the reinstatement of the sea defence back to +7.7m AOD (see CS-33) the ramps will be reinstated to their original condition or if the material excavated is unsuitable with imported compliant earthworks material (see CS-4).

All operatives and plant are to be excluded from working close to the crest/base of slopes to reduce the risk injury and of slope instability. As a minimum this will be a 1m offset from the crest/base of slopes. The Contractor's Method Statement will include the extent of these exclusion zones, which are dependent on the final selected Contractor's plant.

3.5.4.1 Stockpiling

Topsoil will first be stripped from the area to be excavated. Excavated subsoil will then be transported from the sea defence and ditch area to designated stockpiles in the site compound where they will be protected from the elements/weather. As material is excavated it will be segregated into three broad stockpiles; (1) topsoil, (2) sea defence material, and (3) existing ground. Stockpiles shall be managed as per Series 600 Specification requirements and Defra Guidance for Successful Reclamation of Mineral and Waste Sites (2005)⁴.

A provision for 1700m³ (100% the total estimated material required to be excavated) of suitable material (to project Class 2 fill) will be in place for the works. A minimum of 350m³ (20% of the total estimated material required to be excavated) of suitable (to project Class 2 fill) material will be stored on site from the

⁴ <http://webarchive.nationalarchives.gov.uk/20090306103114/http://www.defra.gov.uk/farm/environment/land-use/reclamation/guidance-full.pdf>

commencement of works on the sea defence embankment so that in an emergency situation, the trench can be filled to platform level without any risk of delay.

3.5.4.2 Testing and sampling

At regular centres across the excavation, or at locations chosen by the Engineer on site, and at 0.4m vertical centres, in situ testing and sampling will be carried out as follows:

- In situ testing will comprise bulk density and moisture content testing and will be determined by means of a Nuclear Density Gauge (NDG) to determine Dry Density; or
- Sand Replacement Testing (SRT) and moisture content as determined by a laboratory.
- Hand shear vane (HSV) tests for undrained shear strength will also be carried out.

These tests will determine the baseline limit of the existing ground and provide target criteria for reinstatement. Limited GI data is presented below:

Table 3.4: Available Compaction Test Results

Formation	Optimum Moisture Content (%) (Number of Tests)	Dry Density (Mg/m ³) (Number of Tests)
Sea Defence Material	17-18 (2)	16.4-16.7 (2)
Holocene Alluvium	18 (1)	16.1 (1)

Source: FESCL, 2104

Samples will be collected for laboratory classification (index properties and grading) and 2.5kg proctor compaction, the purpose of which will be to determine the relationship between the degree of compaction of the embankment fill and its moisture content. Testing will be carried out by a UKAS-approved soil testing laboratory with turnaround times specified to obtain results as soon as practicable and prior to backfilling and reconstruction of the sea defence embankment in order to demonstrate the adequacy of the compaction and provide construction quality assurance. Records of the assessment and compliance testing will be provided to the Environment Agency for their information.

The working platform will be created between the two cable alignments such that the piling plant can install both sheet piled walls from within the excavated open cutting. Sheet piling along the seaward toe for up to 6m length is required to support the ground during the arrival of the Sunfish tool at sea defence (as shown in plan drawing XX-00-0102). The working platform will be designed by the contractor and will account for the bearing pressure of the plant, ground conditions and follow the principles of the BRE470 Guidance 'Working platforms for tracked plant'⁵.

3.5.5 CS-5 Installation of sea defence sheet piles

Programme: 23-28th April (6 days)

Following the formation of the piling platform level across the sea defence embankment (CS-4), sheet piles will be installed from the platform level for the proposed trench across the sea defence embankment. Return walls will be provided at the seaward toe along the sea defence embankment to provide support to the sea defence embankment for arrival of the Sunfish tool at sea defence (as shown in plan drawing XX-00-0102).

Beneath the sea defence embankment sheet piles of the order of 8.15m in length are required. Sheet piles up to 10m may be required, this is subject to detailed design by the Contractor. The sheet piles will be designed to support the proposed trench excavation without propping or bracing, i.e. as cantilever walls. Short term temporary propping may be required to support the sheet piled trench at the ditch where retained heights are greater than at the sea defence. The pile section size is to be designed for both the support of the trench excavation sides as well as the driveability.

3.5.5.1 Plant

In order to install piles of such length though the anticipated ground conditions, a crawler crane (Hitachi KH 180-3 or similar) will be required. The crane will be fitted with a PTC 60 HFV Vibrohammer (or smaller) and associated power pack. Bog mats will be used to spread the load of the crawler crane when installing the piles across the sea defence. The top of the piles will be driven to ground level.

⁵ <http://www.fps.org.uk/fps/guidance/platforms/BRE470%20Review%20Summary.pdf>

A mobile crane (Grove RT540E or similar) will be positioned in Field No.1 and will be used for handling of sheet piles. Piles will be lifted in batches onto the sea defence for installation by the crawler crane. See CS-1 for details of plant.

All operatives and plant are to be excluded from working close to the crest/base of slopes to reduce the risk injury and of slope instability. As a minimum this will be a 1m offset from the crest/base of slopes. The Contractor's Method Statement will include the extent of these exclusion zones, which are dependent on the final selected Contractor's plant.

3.5.5.2 Groundwater

The tops of the piles installed into the ditch may be designed with cut off levels higher than the envisaged water level within the ditch. The level of running water in the ditch is expected to be variable depending on weather conditions, but at worst will be at top of the ditch (+2.9m AOD). Groundwater level monitoring indicates that water will be present within the ditch, with the level dependent on the season. A pumping system suitable for pumping water from one side of the ditch to the other will be brought to site and will be used when required. The contractor is to assess the pumping requirements and determine the most suitable pump size. Prior to excavation of the trench (after the sea defence is lowered to platform level and sheet piles are installed) a groundwater pumping system will be installed within the extent of the trench. The groundwater pump will be installed when required and removed when ground water levels are drawn down below the proposed trench level. Groundwater pumping is required for two reasons:

- (1) to prevent pooling water at the base of the trench, which would impede general excavation works, cable laying operations and concrete works; and
- (2) to reduce pore water pressures in the soil to allow the trench slopes to be excavated and remain stable at a 1 in 3 slope.

3.5.6 CS-6 Offshore arrival of cable laying barge

Programme: 26-27th April (2 days)

See Section 3.2.4.

3.5.7 CS-7 Installation of east trackway across salt marsh and sea defence

Programme: 26th April – 10th May (15 days)

See Section 3.2.4.

Trackway will be installed across the sea defence access routes and across the salt marsh. Seaward of the sea defence crest a membrane with aluminium trackway will be installed as shown on indicative plan in MMD-357166-C-SK-00-XX-0019 in Appendix C (note, the plan is indicative only and does not show full

offshore extent of trackway required for the Sunfish approach, cable pulling and offshore installation operations). Landward of the sea defence crest, timber bog mats will be installed.

The East Trackway will be installed from 26th April – 30th April and be in-situ from 26th April – 10th May.

3.5.8 CS-8 Circuit 2 - Phase 1 Excavation: Sea defence excavated to +2.3m AOD (trench level) & installation of concrete bedding layer

Programme: 29th April – 1st May (2 days)

This is the first of two phases of excavation across the sea defence and drainage ditch for Circuit 2 (first cable installation) to lower the ground level to the required cable burial depth. See Section 3.2.3.2 for further details. This first phase of excavation involves excavation of almost all of the sea defence footprint (as shown in MMD-357166-C-DR-00-XX-0303 in Appendix C) to lower the sea defence level to trench level (+2.3m AOD) with a landward ground level still at approximately +4.48m AOD.

This operation will not commence if a flood warning has been issued (see the EFRP in Appendix A). If a high tide notification is issued, only the 6m wide crest berm will be reinstated.

Prior to excavation of the trench a groundwater pumping system will be installed within the extent of the trench to manage water levels as the sea defence is lowered to the final trench level.

Earth moving plant (up to 35T) will work within the trench and on the 6m wide platforms either side of the sheet piles. Operations will start from the landside and move towards the sea such that the seaward portion is the last to be removed. No plant will be positioned seaward of the sea defence toe.

Not all the trench will be lowered to +2.3m AOD. At the position of Circuit 2 (first cable to be installed), a 1 in 3 sloped trench will be excavated that creates a 2m (min) horizontal surface at trench level to allow cable laying operations to take place. See Section 3.2.2 and Figure 3.1 for further details of the sloped trench arrangement. The cable bedding layer will be installed once the sloped trench has been cut.

Excavation and testing requirements will be carried out as described in CS-4. Excavated material will be transported by dumpers (up to 20T) to designated stockpiles in the site compound and protected from the elements. In situ testing and sampling will be carried out in order to demonstrate the compliance of the excavated material for backfilling. Sediment samples will be collected and tested in a UKAS-approved laboratory with rapid turnarounds specified to confirm material compliance.

Once the excavation of the sloped trench at the ditch and sea defence is complete, the Offshore Cable Installation Contractor will manage the installation of the cable including installation of a bedding layer and cable protection.

3.5.9 CS-9 Sunfish approaches sea defence laying rollers along cable route

Programme: 1st May (1 day)

See Section 3.2.4.

3.5.10 CS-10 Sunfish at toe of sea defence & cable pulling operations in Field No.2

Programme: 2nd May (1 day)

See Section 3.2.4.

3.5.11 CS-11 Cable installation across salt marsh by Sunfish tool

Programme: 3rd May (1 day)

See Section 3.2.4.

The cable for Circuit 2 is installed first and installed to a depth of 1.5m below ground level from the toe of the sea defence offshore towards the cable laying barge.

The cable laying tool (the Sunfish tool) will commence burial from the position as shown in Figure 3.4. Installing the cable using the Sunfish tool from the toe of the sea defence seawards minimises the footprint of excavation works on the designated salt marsh.

3.5.12 CS-12 Circuit 2 - Phase 1 Cable Installation: Cable relocated into trench, cement bound sand & concrete protection installed

Programme: 3rd May (1 day)

Sunfish commences salt marsh cable burial and moves offshore. Once sunfish is ~100m offshore, the buried cable at the toe of the sea defence is exposed by hand digging the material around the cable within the salt marsh. The footprint of this temporary excavation in the salt marsh is approx. 23m². The depth varies across this footprint and results in an estimated volume of around 11.7m³ of sediment for each cable installation.

The cable is relocated from the alignment that placed it into Field No.2, into its final burial position and depth in the seaward half of the sea defence. At this point, the cable is relocated onto the previously installed bedding layer at trench level in the seaward half of the sea defence and on the ground surface across the landward half and into Field No. 1 and 2.

The cable protection (cement bound sand encasement and concrete protective cover) is installed over the cable as shown in drawing MMD-357166-C-DR-00-XX-0304 (Appendix C) across the seaward half of the sea defence footprint.

In areas where the cable burial depth will be greater than 5m, accounting for the potential future provision works (see Section 3.3), a block of concrete bound sand (CBS) encasing the cable will be installed (up to 0.65m thick and 1m wide). See Appendix E for further details on the CBS and concrete protection proposed. The additional cable protection will be installed over the top of the CBS and will extend to the seaward toe of the sea defence,

The CBS will also extend to the seaward toe of the sea defence where the thickness is up to 0.75m before reducing as the CBS approaches the seaward toe. By installing CBS to the toe, the concrete protective cover can be installed above the level of the cable, therefore reducing the footprint of the hand-dug excavation on the salt marsh.

As shown on MMD-357166-C-DR-00-XX-0304 concrete protective cover in the form the pre-fabricated concrete protective cover (up to 150mm thick) will be installed over the length of cable. The concrete protective cover will be installed on top of the CBS to provide additional protection once the CBS has cured (within 24 hours of pouring). At the seaward toe a cover of at least 1.3m to the existing ground level will be achieved.

The cable protection has two roles, one to reduce the risk of cable strike from potential future sea defence enhancement operations by the Environment Agency and two, to improve the thermal characteristics of the material around the cable to ensure the cable meets performance requirements at burial depths greater than 3m (5m if the sea defence is enhanced during the operational life of the cable – see Section 3.3).

No plant will be positioned seaward of the sea defence toe.

3.5.13 CS-13 Circuit 2 - Phase 1 Reinstatement: Backfill & compaction of sea defence to +5.15m AOD (platform level) – 6m wide crest bund

Programme: 4th May (1 day)

This is the first of two phases of reinstatement across the sea defence and drainage ditch. See Section 3.2.3.2 for further details. A two phased approach allows the defence level at platform level to be constructed more rapidly than if a single phased operation was adopted. This first phase of reinstatement involves benching the slopes, backfilling and then compaction of compliant sea defence material to reinstate the sloped trench created in CS-8 from trench level (+2.3m AOD) back to platform level (+5.15m AOD).

Compliant backfill material is transported by dumpers (up to 20T) from the segregated stockpiles in the site compound and backfilled / compacted in layers no more than 200mm.

Each reinstated layer will be compacted by compaction plant in accordance with the Highways Series 600 Specification.

The extent of reinstatement will be less than the extent of excavation as part of CS-8. Reinstatement will be as shown in MMD-357166-C-DR-00-XX-0305. This will be to construct a 6m wide crest berm at platform level (+5.15m) with 1 in 3 slopes to trench level. This 6m wide berm provides sufficient width for deployment of the temporary flood defence barrier.

This sequence includes the backfill of the temporary excavated footprint on the salt marsh back to its original condition with the original excavated salt marsh material. The material will be reinstated by means of hand tools to minimise disturbance to the saltmarsh, replacing soil in the natural sequence of horizons it was originally excavated in.

Earth moving plant (up to 35T) will work within the trench or on the 6m wide platforms either side of the sheet piles and work in a landward direction. No plant will be positioned seaward of the sea defence toe.

Reinstatement and testing requirements/compliance criteria will be carried out as described below.

3.5.13.1 Backfilling

Backfilling of the sloped trench will be carried out from the lowest point of the excavation upwards, i.e. starting at the base of the sloped trench and proceeding in horizontal layers approximately 150-200mm up until the platform level at the sea defence. Material will be backfilled into the sloped trench by compacting in layers in accordance with the Series 600 Specification.

The ground below the sea defence embankment will be reconstructed using only the following materials:

- Excavated material from the footprint of the sea defence if meeting the minimum specification of the project Class 2 fill; and if material does not meet this minimum criteria
- Imported fill material with specified minimum properties in order to meet project Class 2 fill.

3.5.13.2 Compaction

Backfill material will be placed in horizontal layers and compacted to a thickness of no more than 200mm using plant as described below, tested in-situ and sampled as described in Section 3.5.4.2. Compaction shall be deemed adequate if the soil achieves the Acceptance Criteria as defined below.

From the baseline criteria as determined on site, the contractor is to meet the following:

- For cohesive material, the compaction of the fill must result in:
 - a dry density of at least the baseline criteria
 - a moisture content not greater than the baseline criteria
 - undrained shear strength consistent with, or better than obtained through testing during excavation of the embankment and trench; or
 - Less than 10% air voids and an undrained shear strength consistent with or better than measured during excavation, but no less than 40kPa.

- For natural granular ground, the contractor is to meet the following:
 - A dry density of >90% of the baseline criteria
 - the material is to be compacted such that a CBR (as measured with a MEXE probe or similar) exceeds 15%.

Compaction of the backfill within the sloped trench will be achieved with the use of two compaction rollers, one 12T and one 1T trench roller that meet the requirements of the Series 600 Specification, depending on the achieved stiffness of the stockpiled fill material used for reinstatement. The in-situ (i.e. existing) degree of compaction will be calculated based on test results from in-situ and laboratory sampling carried out after excavation of the sea defence material. Results from the tests carried out will be used such that the reinstated material, as a minimum standard, matches the in-situ compaction condition. The required number of passes to achieve adequate compaction will be dependent on the selected compaction plant and shall be based on Series 600 requirements and then validated through density testing carried out during backfilling operations. Compaction within the sheet pile corrugations will be achieved with the use of a small handheld tamping rod.

3.5.13.3 Compliance Testing

At regular centres across the sea defence embankment, or at locations chosen by the Engineer on site, and at 0.4m vertical centres, in situ testing and sampling will be carried out as follows:

- Nuclear density probes (NDP) with moisture content to determine Dry Density;
- Sand replacement testing (SRT) for bulk density (if NDG not used) and laboratory moisture content to determine Dry Density;
- Hand shear vane (HSV) tests for undrained shear strength.

Any layers found to not be compliant will be rerolled and re-tested. In the event of further non-conformance, the material will be removed and either re-processed to improve its properties, or removed from site with compliant imported material used to meet the shortfall.

Additional testing may be requested at any time during the reinstatement on any material that is believed to have deteriorated since excavation, or where the material does not appear visually to be meeting the acceptance criteria despite the test results. Records of the testing carried out will be provided to the Environment Agency for their record.

3.5.14 CS-14 Deployment of temporary flood defence

Programme: 5th May – 12th June (38.5 days)

Following reinstatement of the trench to the platform level (CS-13) the temporary flood defence (Reactive Measure 3 in the EFRP in Appendix A) will be deployed across the sea defence to protect the site from flooding between the two breach/cable laying operations. Sufficient bags will be installed to provide a defence level up to at least +7.70m AOD. Further details on the emergency flood risk response measures are provided in Appendix A.

All plant, equipment and earthworks material required for the emergency flood response measures will be stored in the northwest corner of the site compound, i.e in a location close to the sea defence that allows a rapid response. The impermeable bags will be set up and filled with sand on site in the staging area until they are required. A single crawler crane (Liebherr HS895 or similar) will be used for handling of the impermeable bags. This will lift the bags from the staging area onto the sea defence with one 14T excavator with rubber pads used to place the bags into their final position.

The Footpath Diversion will remain in place over this period.

3.5.15 CS-15 Recover east trackway

Programme: 5-10th May (6 days)

The aluminium east trackway installed seaward of the sea defence crest and across the salt marsh during CS-7 is removed following completion of reinstatement operations for the first cable. The timber bog mat trackway will remain in place for the duration of the sea defence breach and reinstatement works.

3.5.16 CS-16 Circuit 2 - Phase 2 Excavation: Landward side of sea defence & drainage ditch area excavated & installation of concrete bedding layer

Programme: 5-7th May (3 days)

This is the second of two phases of excavation across the sea defence and drainage ditch for Circuit 2 (first cable installation). This second phase of excavation involves excavation of the landward half of the sea defence and the drainage ditch area into Field No.1 (as shown in MMD-357166-C-DR-00-XX-0307). Prior to this operation commencing, the temporary flood defence barrier will be in place and this will remain in place until commencement of Circuit 1 breach operations.

Prior to excavation of the trench a groundwater pumping system will be installed within the extent of the trench to manage water levels as the sea defence is lowered to the final trench level.

Earth moving plant (up to 35T) will work within the trench or on the 6m wide platforms either side of the sheet piles and work in a landward direction into Field No.1.

Not all the trench will be lowered to +2.3m AOD. At the position of Circuit 2, a 1 in 3 sloped trench will be excavated that creates a 2m (min) horizontal surface at trench level to allow cable laying operations to take place. See Section 3.2.2 and Figure 3.1 for further details of the sloped trench arrangement.

The cable bedding layer will be installed once the sloped trench has been cut.

Excavated material will be transported by dumpers (up to 20T) to designated stockpiles in the site compound and protected from the elements.

In situ testing and sampling will be carried out in order to demonstrate the compliance of the excavated material for backfilling. Sediment samples will be collected and tested in a UKAS-approved laboratory with rapid turnarounds specified to confirm material compliance.

3.5.17 Circuit 2 - CS-17 Phase 2 Cable Installation: Cable relocation, installation of cement bound sand & concrete protective layer

Programme: 5-10th May (1 day)

The cable is relocated from the alignment that placed it into Field No.2, into its final burial position and depth in the landward half of the sea defence and across the drainage ditch into Field No.1.

The cable protection (cement bound sand encasement and concrete protective cover) is installed over the cable as shown in the figure across the landward half of the sea defence footprint and the drainage ditch into Field No.1.

3.5.18 CS-18 Circuit 2 - Phase 2 Reinstatement: Backfill & compaction of sea defence and drainage ditch area

Programme: 8-12th May (4.5 days)

This is the second of two phases of reinstatement across the sea defence and drainage ditch. See Section 3.2.3.2 for further details. This second phase of reinstatement involves benching the slopes, backfilling and then compaction of the landward half of the sea defence (with compliant sea defence material) and the drainage ditch area to reinstate the sloped trench created in CS-16 from trench level back to platform level (+5.15m AOD) at the sea defence and back to existing ground level across the drainage ditch and into Field No.1.

For the sea defence reinstatement, compliant backfill material is transported by dumpers (up to 20T) from the segregated stockpiles in the site compound and backfilled / compacted in layers no more than 200mm.

Each reinstated layer will be compacted by compaction plant in accordance with the Highways Series 600 Specification.

For the drainage ditch area and Field No.1, excavated material is reinstated in the reverse order to which it was removed so as to reinstate the ground to its original condition.

Earth moving plant (up to 35T) will work within the trench or on the 6m wide platforms either side of the sheet piles and work in a landward direction back to Field No.1 with the access bridge reinstated between the trench sheet pile walls.

3.5.19 CS-19 Offshore cable installation continues

Programme: 6-21st May (16 days)

See section 3.2.4.

3.5.20 CS-20 Cable laying barge transits to Belgium to load second cable

Programme: 22-29th May (8 days)

See section 3.2.4.

3.5.21 CS-21 Cable laying barge on standby (awaiting suitable tides to reach cable landing position)

Programme: 30th May – 11th June (13 days)

Subject to weather and surge levels, the cable laying barge will be on standby from 30th May – 6th June and will arrive at KP2.0 between 6-11th June. KP2.0 is the position offshore of the sea defence that the barge will remain in during nearshore cable laying operations.

3.5.22 CS-22 Installation of west trackway across salt marsh and sea defence

Programme: 9-25th June (17 days)

See section 3.2.4.

Trackway will be installed across the sea defence access routes and across the salt marsh. Seaward of the sea defence crest a membrane with aluminium trackway will be installed as shown on indicative plan in MMD-357166-C-SK-00-XX-0020 in Appendix C (note, the plan is indicative only and does not show full offshore extent of trackway required for the Sunfish approach, cable pulling and offshore installation operations). Landward of the sea defence crest, timber bog mats will be installed.

The West Trackway will be installed from 9-13th June and be in-situ between 9-25th June. This period also includes the duration for anticipated remedial works to the salt marsh following completion of the nearshore cable installation works.

3.5.23 CS-23 Removal of temporary flood defence from the sea defence (CS-14) & Circuit 1 - Phase 1 Excavation: Sea defence excavated to +2.3m AOD (trench level) & installation of concrete bedding layer

Programme: 12-14th June (2 days)

Before any excavation works commence, the temporary flood defence barrier installed between the two cable laying operations is removed. This operation will not commence if a flood warning has been issued (see the EFRP in Appendix A). The flood defence bags will be removed ahead of any excavation works. Therefore the estimated duration presented here for this sequence excludes the time to remove the bags. Bags will be removed the day before planned excavation works (subject to no forecast high tides) to prevent any delays during the excavation works ahead of the Sunfish tool arrival. The same plant used to deploy the bags will be used to remove them. The bags will be stored in the northwest corner of the site compound such that they can be rapidly re-mobilised in an emergency flood response situation. The operation described below will not commence if a flood warning has been issued (see the EFRP in Appendix A).

CS-23 is the first of two phases of excavation across the sea defence and drainage ditch for Circuit 1 (second cable installation) to lower the ground level to the required cable burial depth. See Section 3.2.3.2 for further details. This first phase of excavation involves excavation of almost all of the sea defence footprint (as shown in MMD-357166-C-DR-00-XX-0310) to lower the sea defence level to trench level (+2.3m AOD) with a landward ground level still at approximately +4.48m AOD.

Prior to excavation of the trench a groundwater pumping system will be installed within the extent of the trench to manage water levels as the sea defence is lowered to the final trench level.

Earth moving plant (up to 35T) will work within the trench and on the 6m wide platforms either side of the sheet piles. Operations will start from the landside and move towards the sea such that the seaward portion is the last to be removed. No plant will be positioned seaward of the sea defence toe.

Not all the trench will be lowered to +2.3m AOD. At the position of Circuit 1 (first cable to be installed), a 1 in 3 sloped trench will be excavated that creates a 2m (min) horizontal surface at trench level to allow cable laying operations to take place. The cable bedding layer will be installed once the sloped trench has been cut.

Excavated material will be transported by dumpers (up to 20T) to designated stockpiles in the site compound and protected from the elements.

In situ testing and sampling will be carried out in order to demonstrate the compliance of the excavated material for backfilling. Sediment samples will be collected and tested in a UKAS-approved laboratory with rapid turnarounds specified to confirm material compliance. Excavation and testing requirements are carried out as described CS-4.

3.5.24 CS-24 Sunfish approaches sea defence laying rollers along cable route

Programme: 14th June (1 day)

See section 3.2.4.

3.5.25 CS-25 Sunfish at toe of sea defence & cable pull operations in Field No.2

Programme: 15th June (1 day)

See section 3.2.4.

3.5.26 CS-26 Cable installation across salt marsh by Sunfish tool

Programme: 16th June (1 day)

See section 3.2.4.

The cable laying operations offshore of the sea defence are carried out as described in CS-11 but this time for Circuit 1.

3.5.27 CS-27 Circuit 1 - Phase 1 Cable Installation: Cable relocated into trench, cement bound sand and concrete protection installed

Programme: 16th June (1 day)

The second cable (Circuit 1) is relocated in the excavated trench and concrete protection installed as described in CS-12.

3.5.28 CS-28 Sheet piles across sea defence cut to final cut off level (+4.2m AOD at the crest and lower at the seaward and landward slopes)

Programme: 16th June (1 day)

The sheet piles installed through the sea defence embankment will not be removed and will be cut and then buried as part of the reinstatement operation. Below the crest of the sea defence the top level of the piles will be cut at +4.2m AOD. Adjacent to the landward and seaward sea defence toes, the sheet piles

will be cut off to a level that maintains a minimum of 1m vertical cover between the final reinstatement profile of the sea defence (i.e. existing ground level) and the top of the sheet piles. The final cut off level is shown on drawing MMD-357166-C-DR-00-XX-0202 in Appendix C. The seaward lengths of the sheet piles will be cut first such that the backfilling and compaction operations can commence earlier than if all sheet piles were cut first.

For the piles running almost perpendicular to the sea defence, the ground either side of the piles (the 6m banks at platform level) will be cut back to a safe temporary angle (at least 1(v):2(h)) from the base of the cut off level. The piles will then be cut down at the seaward extent first and the Contractor will progress landwards. Once the sheet piles have been cut down to the required level, the area originally cut back will be backfilled and benched into the existing sea defence in accordance with methods described in CS-13.

To prevent operations in the designated salt marsh the operation to cut the sheet piles to the cut off level will be different for the return walls (sheet piles at the toe of the sea defence). The area landward of these piles will be excavated for access. Then the top of the pile connected to an excavator arm before the sheet piles are cut at the cut off level. The operative then leaves the excavation before it is backfilled. This is followed by the retrieval of the 1m cut length of sheet pile from the ground by the excavator, before the ground is compacted.

Plant will work between the lines of sheet piles working landward from the seaward toe of the sea defence.

3.5.29 CS-29 Circuit 1 - Phase 1 Reinstatement: Backfill & compaction of sea defence to +5.15m AOD (platform level) – 6m wide crest bund

Programme: 17th June (1 day)

This is the first of two phases of reinstatement across the sea defence and drainage ditch for Circuit 1 (second cable installation). See Section 3.2.3.2 for further details. A two phased approach allows the defence level at platform level to be constructed more rapidly than if a single phased operation was adopted. This first phase of reinstatement involves benching the slopes, backfilling and then compaction of compliant sea defence material to reinstate the sloped trench created in CS-23 from trench level (+2.3m AOD) back to platform level (+5.15m AOD).

Compliant backfill material is transported by dumpers (up to 20T) from the segregated stockpiles in the site compound and backfilled / compacted in layers no more than 200mm.

Each reinstated layer will be compacted by compaction plant in accordance with the Highways Series 600 Specification.

The extent of reinstatement will be less than the extent of excavation as part of CS-23. Reinstatement will be as shown in MMD-357166-C-DR-00-XX-0313. This will be to construct a 6m wide crest berm at platform

level (+5.15m) with 1 in 3 slopes to trench level. This 6m wide berm provides sufficient width for deployment of the temporary flood defence barrier.

This sequence includes the backfill of the temporary excavated footprint on the salt marsh back to its original condition with the original excavated salt marsh material. The material will be reinstated by means of hand tools to minimise disturbance to the saltmarsh, replacing soil in the natural sequence of horizons it was originally excavated in.

Earth moving plant (up to 35T) will work within the trench or on the 6m wide platforms either side of the sheet piles and work in a landward direction. No plant will be positioned seaward of the sea defence toe.

Reinstatement and testing requirements/compliance criteria will be carried as per the permanent works requirements in CS-13.

3.5.30 CS-30 Circuit 1 - Phase 2 Excavation: Landward side of sea defence & drainage ditch area excavated & installation of concrete bedding layer

Programme: 18-20th June (3 days)

This is the second of two phases of excavation across the sea defence and drainage ditch for Circuit 2 (first cable installation). This second phase of excavation involves excavation of the landward half of the sea defence and the drainage ditch area into Field No.1 (as shown in MMD-357166-C-DR-00-XX-0314). Prior to this operation commencing, the temporary flood defence barrier will be in place and this will remain in place until commencement of Circuit 1 breach operations.

Prior to excavation of the trench a groundwater pumping system will be installed within the extent of the trench to manage water levels as the sea defence is lowered to the final trench level.

Earth moving plant (up to 35T) will work within the trench or on the 6m wide platforms either side of the sheet piles and work in a landward direction into Field No.1.

Not all the trench will be lowered to +2.3m AOD. At the position of Circuit 2, a 1 in 3 sloped trench will be excavated that creates a 2m (min) horizontal surface at trench level to allow cable laying operations to take place.

The cable bedding layer will be installed once the sloped trench has been cut.

Excavated material will be transported by dumpers (up to 20T) to designated stockpiles in the site compound and protected from the elements.

In situ testing and sampling will be carried out in order to demonstrate the compliance of the excavated material for backfilling. Sediment samples will be collected and tested in a UKAS-approved laboratory with rapid turnarounds specified to confirm material compliance.

3.5.31 CS-31 Circuit 1 - Phase 2 Cable Installation: Cable relocation, installation of cement bound sand & concrete protective layer

Programme: 20th June (1 day)

The cable is relocated from the alignment that placed it into Field No.2, into its final burial position and depth in the landward half of the sea defence and across the drainage ditch into Field No.1.

The cable protection (cement bound sand encasement and concrete protective cover) is installed over the cable as shown in the figure across the landward half of the sea defence footprint and the drainage ditch into Field No.1.

3.5.32 CS-32 Circuit 1 - Phase 2 Reinstatement: Backfill & compaction of sea defence and drainage ditch area

Programme: 21-25th June (4.5 days)

This is the second of two phases of reinstatement across the sea defence and drainage ditch. See Section 3.2.3.2 for further details. This second phase of reinstatement involves benching the slopes, backfilling and then compaction of the landward half of the sea defence (with compliant sea defence material) and the drainage ditch area to reinstate the sloped trench created in CS-16 from trench level back to platform level (+5.15m AOD) at the sea defence and back to existing ground level across the drainage ditch and into Field No.1.

For the sea defence reinstatement, compliant backfill material is transported by dumpers (up to 20T) from the segregated stockpiles in the site compound and backfilled / compacted in layers no more than 200mm. Each reinstated layer will be compacted by compaction plant in accordance with the Highways Series 600 Specification.

For the drainage ditch area and Field No.1, excavated material is reinstated in the reverse order to which it was removed so as to reinstate the ground to its original condition.

Earth moving plant (up to 35T) will work within the trench or on the 6m wide platforms either side of the sheet piles and work in a landward direction back to Field No.1 with the access bridge reinstated between the trench sheet pile walls.

3.5.33 CS-33 Full Reinstatement: Sea defence reinstated back to crest level (+7.7m AOD)

Programme: 24-28th June (5 days)

Following reinstatement to platform level the sea defence embankment will be reinstated to the original ground profile. Reinstatement and testing requirements/compliance criteria will be carried out as described in CS13, but materials are to meet the criteria as set out below.

From the baseline criteria as determined on site, the contractor is to meet the following:

- For cohesive material, the compaction of the fill must result in:
 - a dry density of at least the baseline criteria
 - a moisture content not greater than the baseline criteria
 - undrained shear strength consistent with, or better than obtained through testing during excavation of the embankment and trench; or
 - Less than 10% air voids and an undrained shear strength consistent with or better than measured during excavation, but no less than 40kPa.

Excavated slopes will be benched in layers no more than 200mm for preparation for backfilling to ensure there are no planes of weakness in the sea defence.

The sea defence embankment will be reconstructed using only the following materials:

- fill material originating from the embankment; or
- Imported fill material with specified minimum properties as specified as agreed with the Environment Agency. These properties are established in order to meet permeability requirements of the sea defence as well as the slope stability requirements.

Adequate compaction of the side slopes to the sea defence embankment shall be achieved by overfilling, followed by compacting and then trimming back to the required profile. To allow for post-compaction settlement at the crest of the sea defence embankment, the open cutting at this location shall be overfilled by 100mm as discussed with the Environment Agency.

Earth moving plant will work from the crest and area landward of the landward sea defence toe. No plant will work seaward of the sea defence seaward toe.

Once works are complete the eastern access ramp will be removed and the vegetation and slopes reinstated back to the original condition as recorded in the pre-condition survey.

3.5.34 CS-34 Recover east trackway and salt marsh remedial works

Programme: 18-25th June (8 days)

The aluminium west trackway installed seaward of the sea defence crest and across the salt marsh during CS-22 is removed following completion of reinstatement operations for the second cable and any required salt marsh remedial works. This is anticipated to be between 18-25th June.

The timber bog mat trackway will remain in place for the duration of the sea defence breach and reinstatement works.

3.5.35 CS-35 Removal of landside sheet piles

Programme: 25-29th June (4 days)

The previously installed sheet piles in the area landward of the sea defence landward toe (see CS-3) will be removed. The flood defence impermeable bags will be used to prevent water flooding the ditch whilst the sheet piles are removed around the drainage ditch. The sheet piles will be removed in combination with reinstatement operations in the ditch area (CS-32). Following the removal of the sheet piles the flood defence bags, pump system and access bridges across the ditch between and either side of the sheet piles will be removed and stored back in the site compound.

If ground conditions in the ditch area deteriorate and there is risk of instability due to the bearing pressure of the plant (as used for installation and as detailed in CS-1), then piles these will be cut off to a sufficient depth below existing ground level. Cut off level are anticipated to be 100-200mm below underside of topsoil or deeper but would be confirmed with approval from the landowner.

After the sheet piles have been removed from the landside area all apart from the most western access bridges are removed and the ground reinstated back to its original condition.

3.5.36 CS-36 Turfing, Topsoil/ seeding and grass reinforcement

Programme: 25-26th June (1 day)

After the earthworks are completed as described above, topsoiling/seeding, turfing and erosion protection will be carried out.

Topsoil will be won from site (if deemed suitable for reuse). If the existing stockpiled topsoil is found not to be suitable, a Class 5B (SHW) imported topsoil will be used. Any surplus topsoil material shall be removed from site or partitioned as landscaping fill within the site boundary. Topsoil will be in accordance with BS 3882:2007 'Specification for topsoil and requirements for use', and BS 4428:1989 'Code of practise for general landscape operations'.

Prior to topsoiling, a check on the acceptability of the surfaces to be topsoiled will be undertaken. Topsoil will be applied to the sea defence slopes and will contain a pre-defined seed mix that will be agreed with Natural England and the EA prior to reinstatement being completed.

Seeds will be delivered to the site in bags provided by the seed merchant and stored in a weather-tight and properly ventilated structure. Fresh seed shall be purchased for each growing season. Seed purchased for previous season shall not be used.

Imported turf will be applied to the crest area of the sea defence. Topsoil/seeding will be applied to each side of the drainage ditch.

The seaward slope of the embankment and, if necessary, the slopes of the drainage ditch will be overlain by a soft engineering, grass reinforcement / erosion protection. This erosion protection will be an Open EnKaMat® system or similar and accepted by the Engineer on site. Erosion protection will be pinned and folded back over compacted topsoil.

Erosion protection will be laid lengthways with overlaps, if required, such that the upper mat overlaps the lower mat in the direction of anticipated water flow. The minimum lap will be 250mm and pinned at 2m centres along the joint.

The storage and handling of the EnKaMat® system shall be in accordance with the manufacturing guide for the system used. Rolls of the EnKaMat® system shall be securely stored in the Contractor's site compound and not be stacked more than two rolls high.

The laying of the EnKaMat® system shall be in accordance with the manufacturing laying guide for the system used. In general, the slope shall be excavated for preparation for laying, then the area seeded in accordance with the seed mix in this ER and then matting laid, anchor trenches backfilled and compacted prior to securing overlaps with pins as specified above.

Post reinstatement, all areas where topsoil, turf and grass reinforcement has been placed will be inspected and watered daily for two weeks following installation.

3.5.37 CS-37 Extensometer installed and post-construction monitoring commences

Programme: 25th June – 25th June 2028 (1 day – 10 years)

A topographic survey will quantify any long term surface settlements on the embankment in the vicinity of the cable installation location. However, in order to monitor the settlement of the reconstructed embankment directly above the cable trench at depth a magnetic extensometer and 7 permanent survey stations will be installed on the sea defence.

In addition to a programme of topographic surveys, extensometer readings and a visual inspection will be taken. The long term monitoring and inspection will be undertaken and reviewed by an independent party

as agreed with the Environment Agency. Further details, including frequency of measurements, are provided in the FDC associated documents (Monitoring Plan). A summary is presented below.

3.5.37.1 Extensometer

The extensometer will monitor vertical movements, and lateral and longitudinal deformation of the soil within the reinstated sea defence embankment and backfilled trench. The indicative detail and position of the extensometer is shown on MMD-357166-C-DR-00-XX-0105 in Appendix C.

The extensometer will be installed between the locations of the two cables, to a depth approximately +1.5m AOD above their installed position, and installed flush to the crest of the sea defence. The extensometer will be installed from the crest of the embankment using a cable percussive boring rig. The plan location of the cable trench centre line will be marked out on the embankment crest. The cable percussive rig will be able to set up within 75mm of the target location and the borehole will be vertical provided no obstructions are encountered during boring. The borehole will be formed using 'open hole' drilling techniques (no samples will be required) and the rate of boring will be compatible with the need to establish the precise depth at which changes in the soil type occur.

The base of the extensometer will terminate in dense sand. As the extensometer relies on a series of magnets to determine precise levels, a datum magnet is installed at the base of the hole on the outside of an access casing. Spider magnets are to be installed at key elevations within the ground profile. The locations of the spider magnets will be revised or confirmed following a review of the ground profile encountered in the borehole, however it is anticipated that there will be:

- A datum magnet at approximately -1.5m AOD
- A spider magnet at
 - +1.0m AOD
 - +2.5m AOD (cable level)
 - +4.0m AOD (base of embankment toe level)
 - +6.0m AOD

It is not determined yet whether readings will be taken manually using a probe and reel unit, or if a remote monitoring solution can be used. This will be determined prior to the installation of the extensometer, and is dependent on consistency of mobile signal strength in this location (it is understood to be variable).

The borehole will be backfilled with a 1 to 4 (cement/bentonite) grout, mixed to a creamy pumpable consistency, and the installation will be robustly capped with concrete and a lockable cast iron stopcock cover, suitable for a minimum service life of 10 years.

The extensometer will be manually recorded in-situ. On completion of the installation, three consecutive sets of base readings will be taken (from the bottom up) which record the depth of the target magnets relative to the top of the extensometer tube. The top of the extensometer tube will be surveyed into Ordinance Datum, and relative to a local stable datum.

3.5.37.2 Survey stations

7 No. permanent survey stations will be installed on the sea defence post-construction (SS01, SS02, SS03, SS04, SS05, SS06 and SS07). SS01 and SS06 will be installed 50m westwards and eastwards of the breach location respectively in order to monitor seasonal vertical movement of the embankment due to swelling and shrinkage.

The survey stations will comprise a 300mm long steel survey ground marker, installed flush to the surface and installed following full reinstatement of the sea defence including topsoiling and re-turfing. The survey stations will be hand dug in.

The indicative detail and position of the survey stations is shown on MMD-357166-C-DR-00-XX-0105 in Appendix C. The survey stations will be located as follows:

Table 3.5: Post construction monitoring locations

ID	Location (relative to centre of cable install location/sea defence crest)
SS01	50m westwards along crest
SS02	25m westwards east along crest
SS03	3.5m westwards along crest
SS04	3.5m eastwards along crest
SS05	22m eastwards along crest
SS06	50m eastwards along crest
SS07	12m southwards on landward toe

Source: FDC associated documents (Post Construction Monitoring Plan)

3.5.38 CS-38 End of footpath diversion, re-opening of Peter Scott Way

Programme: 29-30^h June (1 day)

Following installation of the post-monitoring survey stations and extensometer, the site working area will be reduced back to the extent of the site compound and boundary fences removed from the footprint of the sea defence.

The sole remaining access bridge (new western most access bridge) will be removed and the ground reinstated back to its original condition.

The two access staircases on the landward slopes of the sea defence and two temporary footbridges across the drainage ditch will be dismantled. Finally notice boards taken down prior to the re-opening of the Peter Scott Way to the public.

3.5.39 CS-39 Offshore cable installation continues

Programme: 21st June – 6th July (16 days)

3.5.40 CS-40 Demobilisation of breach equipment

Programme: 29th June – 6th July (7 days)

The contractor commences demobilisation from site. Plant and excess material are removed from the site compound. The site compound will remain in use for the onshore cable installation operations and full demobilisation will follow completion of the onshore operations.

4 Flood Risk and Management

4.1 Introduction

Predicted tide levels at the Site for the consented offshore construction window (May to August 2016) are provided in Appendix D along with tide level information.

4.2 Flood defences and levels

The primary sea defence is comprised of an earth embankment with a grass surface to the front, rear and crest. There is no additional erosion protection to the crest or rear faces of the embankment other than the grass of a prescribed mix.

The existing defence level of the primary sea defence varies between 7.60 m and 7.80 m. The defence level at the proposed site location is between 7.70 m and 7.80 m at the west (Cable alignment 1 / Circuit 1) and east (Cable alignment 2 / Circuit 2) cable alignments respectively. This is based on integration of recent topographical survey data provided by DONG Energy (LSTC Onshore Topographic Survey, 2014).

Table 4.1 presents the defence levels and other geometrical features of the primary sea defence. They have assisted in evaluating the current standard of protection and in the subsequent development of the mitigation measures presented in the EFRP in Appendix A.

Table 4.1: Existing topographic details of the primary sea defence

Section	Crest level (m AOD)	Crest width (m)	Slope (V:H)		Toe level (m AOD)	
			Seaward	Landward	Seaward	Landward
Cable Alignment 1	+7.70	5.75	1 in 3.3	1 in 2.15	+4.16	+3.30
Cable Alignment 2	+7.80	4.45	1 in 3.5	1 in 2.25	+4.16	+3.32

Source: LSTC Onshore Topographic Survey, 2014

The lowest defence level is +7.70m AOD and is linked to the seaward edge of the defence crest for Cable Alignment 1.

A secondary sea defence is situated approximately 400m south of the primary sea defence and has a crest elevation of approximately +6.15m AOD (Flood Risk Assessment (FRA), Halcrow 2013). Between the primary and secondary sea defences there is an enclosed area (approx. 200 Ha) which is used for arable farming. It is understood that the secondary defence is no longer maintained by the Environment Agency.

4.3 Flood Risk Management Approach

The flood risk management approach is described in the Emergency Flood Response Plan (EFRP) in Appendix A.

5 References

DONG Energy, 2016 – Export Cable Installation Plan (ECiP), version x

Fugro Engineering Services (FESCL), 2014 – Race Bank Geotechnical Investigation 2014

Halcrow, 2013 – Race Bank Offshore Wind Farm – Flood Risk Assessment, RB-D-CE-001-0000-000000-026, Centrica (RBW) Limited. Halcrow, 2013

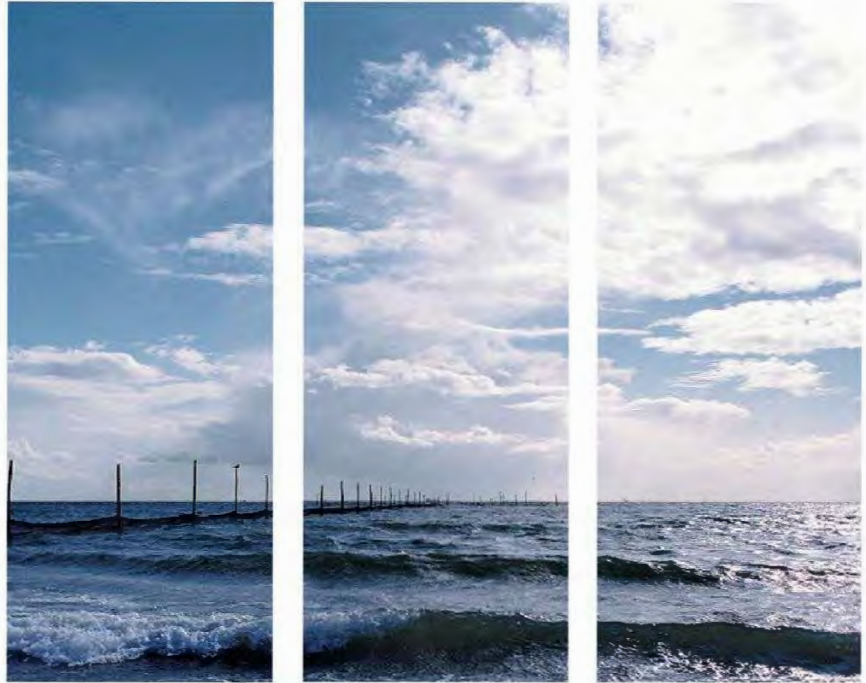
MML, 2015 – Race Bank Export Cable Installation 2016 Sea Defence Breach Study Report, Rev B1.1. Mott MacDonald Limited (MML), Nov 2015

MML, 2016 – Race Bank Export Cable Installation 2016 Emergency Flood Response Plan (EFRP) Rev A2.1. Mott MacDonald Limited (MML), March 2016

Appendices

Appendix A. Emergency Flood Response Plan (EFRP)	77
Appendix B. Programme	128
Appendix C. Drawings	130
Appendix D. Sea levels (predicted tides and extreme sea levels)	158
Appendix E. Thermal Resistivity Requirements	164
Appendix F. Decommissioning Provisions	170

Appendix A. Emergency Flood Response Plan (EFRP)



Race Bank Export Cable Installation 2016

Sea Defence Breach & Reinstatement
Emergency Flood Response Plan (EFRP)

March 2016

DONG Energy RB (UK) Limited

Race Bank Export Cable Installation 2016

Sea Defence Breach & Reinstatement
Emergency Flood Response Plan (EFRP)

March 2016

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Information class: Standard

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Contents

Chapter Title	Page
1	Scope and responsibilities
1.1	Scope of document
1.2	Overview of this EFRP
1.3	Period of validity
1.4	Datum
1.5	Contacts and chain of command
1.6	Parties and Responsibilities
2	Proactive measures
2.1	High tide notifications
2.2	Additional proactive measures
3	Reactive measures
3.1	Temporary flood defence barrier system
3.2	Reactive Measure 1 (RM1) – Reinstatement defence to +5.15m AOD
3.3	Reactive Measure 2 (RM2) – Temporary flood defence up to at least +7.70m AOD
3.4	Summary
4	Emergency Flood Response Actions
4.1	“BE PREPARED” EFRA
4.2	AMBER stage EFRA
4.3	RED stage EFRA
5	References
Appendices	29
Appendix A.	Emergency Flood Response Action Flow Chart
Appendix B.	Daily Progress Report (DPR) template
Appendix C.	High tide notifications and outline programme of works
Appendix D.	Drawings

1 Scope and responsibilities

1.1 Scope of document

The scope of this Emergency Flood Response Plan (EFRP) is to provide the Contractor whom is responsible for the breach and reinstatement Works with an outline management plan that will be followed to ensure flood protection during the construction of the Race Bank Export Cable Installation project. A final response plan will be developed by the Contractor that will be tailored to be appropriate for the final construction methodology.

The Contractor will be responsible for implementing the EFRP as presented in this document. One hard copy, as a minimum, of the Contractor's final EFRP will be available in the Contractor's site office during the entirety of the Works.

This and the Contractor's final EFRP will be treated as a 'live' document and will be subject to amendment(s), if required, as the Works progress. Any amendment will be developed by the Contractor for approval by all key parties to the EFRP as defined in Section 1.4.

1.2 Overview of this EFRP

The Consents Application Study Report (CASR) (MML, 2016) sets out the detailed methodology of the breach and reinstatement operations (the "Works"). The Works require temporary lowering of the sea defence embankment to two levels:

- Platform Level (+5.15m AOD); and
- Trench Level (+2.3m AOD)

The period that the sea defence is temporarily lowered to the two levels defined above are detailed in the CASR (MML, 2016). Reinstatement of the sea defence can be described as three cases:

- Emergency reinstatement (scope of this EFRP)
- Interim reinstatement (scope of this EFRP)
- Permanent reinstatement (outside the scope of this EFRP)

This EFRP sets out the scope of the flood risk management strategy, responsibilities and chain of command (Section 1), proactive and reactive measures (Section 2 and Section 3 respectively) and the Emergency Flood Response Actions (EFRA in Section 4) that the Contractor will comply with as part of the management of flood risk during the entirety of the Works.

Each of the reactive measures described in Section 3 are considered in each response action.

Response actions as defined in this EFRP will be implemented by the Contractor after receipt of one of three high tide notifications issued through an automated-email report by the Environment Agency's (EA) Flood Warning Duty Officer (FWDO) (Section 2.1). Responsibilities for the parties to the emergency actions have been included in the flow diagram on Figure 2.

The table below presents the three high tide notification stages and the associated reactive measures that will be implemented by the Contractor.

Table 1. Reactive measures associated to each high tide notification level.

Emergency flood response actions	Reactive Measures
"Be Prepared" EFRA	No Action ('on alert' status)
Amber Stage EFRA	Reactive measure 1 (RM1)
Red Stage EFRA	Reactive measure 2 (RM2)

1.3 Period of validity

The measures of the EFRP are valid from the Commencement Date to the Completion Date as defined in the Contract for the Works.

1.4 Datum

All levels in this document are in metres relative to Ordnance Datum Newlyn (ODN or AOD). This is the datum that all high tides and water levels are reference to for the Works.

1.5 Contacts and chain of command

The Contractor will set up a regular communication system with his team with regards to high tide notifications including but not limited to the daily progress reports. The Contractor will assign an EFRP site officer who will be the sole point of contact for receiving EA's FWDO's reports and direct calls. A call from the EA's FWDO system will happen when a high tide notification associated with a RED stage is forecasted (see Section 2.1). The Contractor's communication system will also allow them to share relevant information with the key contacts, including but not limited to:

- Contractor's responsible site officer (this could be the same as EFRP site officer);

- Employer's site officer;
- Engineer site supervisor; and
- Cable laying barge master.

The contact details for the parties as defined in this EFRP are listed below. These are subject to change and contact details will be confirmed or updated prior to commencement of site operations and as Works progress.

- Employer's site officer:
 - o Contact: Chris Ensom
 - o Telephone: 02078115892
 - o Mobile: 07711 642116
 - o Email: XCENS@dongenergy.co.uk
- Engineer's site supervisor:
 - o Contact: to be confirmed
 - o Telephone: to be confirmed
 - o Mobile: to be confirmed
 - o Email: to be confirmed
- Cable laying barge master:
 - o Contact: to be confirmed
 - o Telephone: to be confirmed
 - o Mobile: to be confirmed
- Environment Agency's FWDO:
 - o Contact: to be confirmed
 - o Telephone: to be confirmed
 - o Mobile: to be confirmed
 - o Email: to be confirmed
- Contractor's EFRP site officer:
 - o Contact: to be confirmed
 - o Telephone: to be confirmed
 - o Mobile: to be confirmed
 - o Email: to be confirmed

1.6 Parties and Responsibilities

This section describes the key parties that will participate in the Works and their responsibilities to the EFRP. An organogram of parties and their roles are presented below in Figure 1. A flow diagram that sets out the responsibilities and actions of each party is also included in Figure 2.

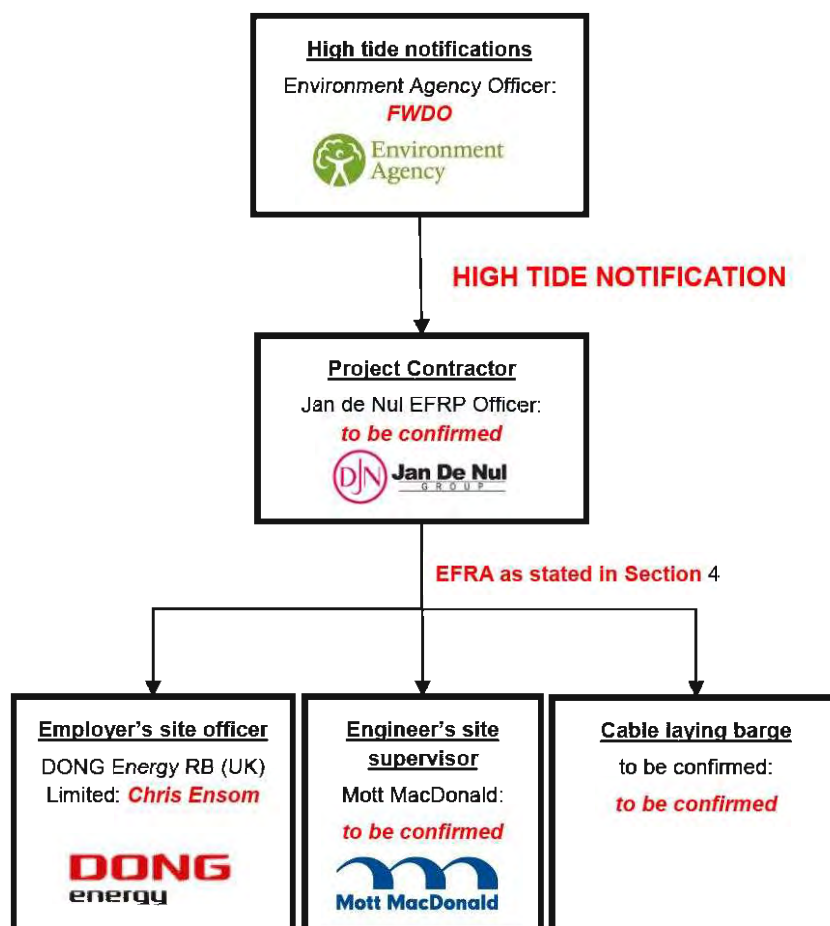


Figure 1. Chain of communication organogram. The Employer has the final responsibility to instruct the ceasing and recommencement of the Works.

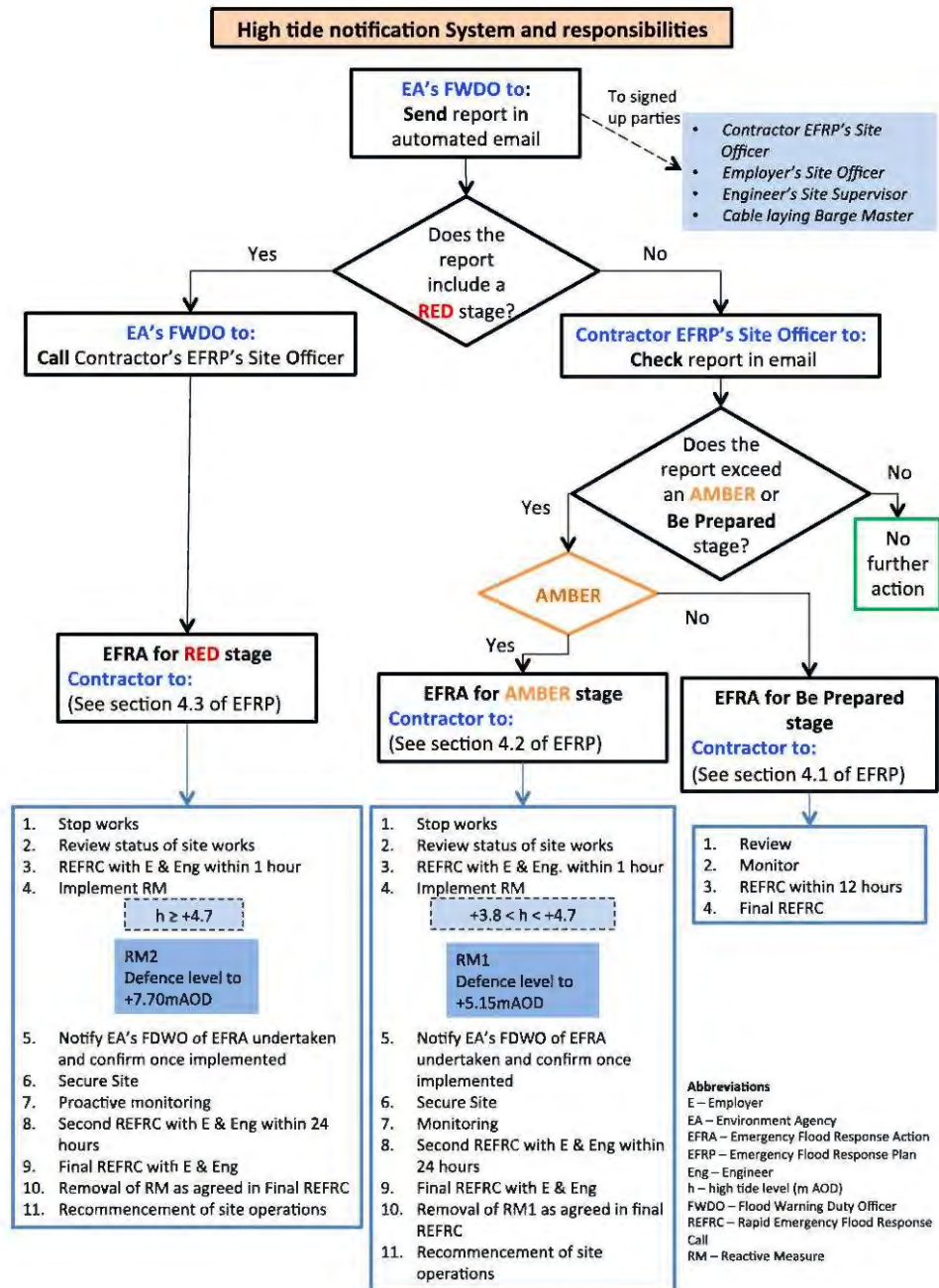


Figure 2. Flow diagram which shows the responsibilities and actions of the main key parties (i.e. EA and Contractor) to comply with the present EFRP (see Appendix A)

1.6.1 Environment Agency

Trigger levels for three levels of high tide notification are proposed in Section 2.1 and are subject to agreement by the EA. The trigger levels have been set relative to water levels recorded at the West Lighthouse gauge location as detailed in Section 2.1.1.

The EA will set up an automated email report showing the 36 hours deterministic forecast against the three aforementioned trigger levels. The report will be emailed to the parties that sign up to the EA's FWDO system every day (up to 4 times a day with updated forecast information on each – sent at 0515, 1115, 1715 and 2115 GMT), regardless of whether or not the forecast will meet the threshold levels.

Only the RED level will involve a phone call from the FWDO to the Contractor in addition to the email.

1.6.2 Contractor

Even though different parties will be signed up to receive high tide notifications from the EA's FWDO, the Contractor's EFRP site officer onsite will be the sole point of contact for phone communications from the EA's FWDO if a RED alert is forecasted. Then, the Contractor's EFRP site officer will be responsible for communicating the relevant information to the rest of the parties in order to follow the EFRA as stated in Section 4.

For "Be prepared" and "AMBER" levels, there will be no other active measure from the EA than the reported email. It is then the Contractor's responsibility to assess every report emailed by the EA and check if the high tide level exceeds the "Be Prepared" and/or "AMBER" stage levels. If so, the Contractor will follow the EFRAs accordingly (see Section 4). For both the AMBER and RED alert levels, the Contractor will contact the EA's FWDO to:

1. confirm the EFRA to be undertaken; and
2. confirm the EFRA has been completed (i.e. the reactive measure(s) are in place

Following the procedures set up in the EFRA, the Contractor is responsible for implementing the proactive and reactive measures as detailed in this EFRP. The Contractor is responsible for ensuring that the reactive measures can be implemented 24 hours a day, 7 days a week.

The Contractor will issue daily progress reports (DPR) for the Works that include an updated list of inductions, toolbox talks and emergency practise drills undertaken as well as a list of plant and equipment on site specifically for the deployment of the emergency flood response measures. In addition, the DPR will include records of any high tide notifications received and emergency flood response actions undertaken or commenced that day. A DPR template from the Employer is included in Appendix B of this EFRP.

The Contractor's DPR will be issued to the EA, Employer and Engineer (see Section 1.4 for contacts).

The Contractor will install a standard design tide gauge board on site to monitor water levels. Calibration marks will comply with British Standard (BS) 3680-7:2000 'Method of measurement of liquid flow in open channels'. Up to two boards will be installed approximately 50m east of the cable alignments, at the toe of the seaward face of the sea defence embankment. The Contractor will seek assistance from specialist manufacturer for the design and installation of the gauge board. Material should be plastic or aluminium strips with calibrated markings and location should allow for fluctuation in the surface water system to be manually monitored. Any screws used will be stainless steel. The strip will be fixed to treated timber post driven into the seaward embankment until refusal and/or as recommended by manufacturer. The boards will be referenced to Ordnance Datum and used to monitor the difference between the EA FWDO forecast water levels and water levels at the site. Through the use of two boards, the range of calibration marks will be from ground level at the toe of the sea defence (approximately +4.2m AOD) up to +6m AOD.

The Contractor will comply with the Construction (Design and Management) Regulations 2015 (CDM 2015) and submit a Construction Phase Plan to the Employer and Engineer for approval as directed in the contract. The Contractor will ensure that the plan meets the requirements of the CDM 2015 regulations and this EFRP.

1.6.3 Employer

The Employer is DONG Energy RB (UK) Limited. The Employer's site officer will be on site during the Works.

Following a Rapid Emergency Flood Response Call (REFRC) from the Contractor (see Section 4), the Employer's site officer and Engineer's

site supervisor will provide assistance to the Contractor on further actions depending on the type of high tide notification issued via the EA's FWDO.

The Employer has the final responsibility to instruct the ceasing and recommencement of the Works.

1.6.4 Engineer and Engineer's site supervisor

The Engineer is the person or company as stated in the Contract. The Engineer's site supervisor will be present during the breach and reinstatement operations at the site.

The Engineer will review the Contractor's Construction Phase Plan associated method statements and risk assessments to ensure they meet the requirements of this EFRP.

The Engineer's site supervisor will be on site to witness emergency practise drills carried out by the Contractor. Daily site records (DSR) will be produced by the Engineer and issued to the Employer. DSRs will include records of any high tide notifications received and emergency flood response actions undertaken.

2 Proactive measures

This section describes the proactive food risk management measures.

2.1 High tide notifications

The EA's FWDO will issue an automated email including a report which will show the 36-hour Deterministic forecast against the three high tide notification trigger levels.

The three levels of high tide notifications are based on a set of trigger levels relative to the forecast water level (astronomical + surge) at the West Lighthouse gauge location (see Section 2.1.1).

The EA's report will be emailed by the EA's FWDO every day up to four times a day at 0515, 1115, 1715 and 2115 GMT to the Contractor's EFRP Officer and any other parties signed up to receive them for the entirety of the Works. This will include a minimum of two site personnel (the Contractor's EFRP Officer and the Engineer's Site Supervisor).

Each high tide notification will have a defined set of actions that the Contractor will follow (see EFRA in Section 4). The three high tide notifications and forecast system used by the EA's FWDO are:

- "Be Prepared" stage high tide notification
 - 36-hour Deterministic forecast
- AMBER stage high tide notification
 - 36-hour Deterministic forecast
- RED stage high tide notification
 - 36-hour Deterministic forecast and 5-day Probabilistic forecast

The Contractor will be responsible for checking whether there is a "Be Prepared" and/or "AMBER" high tide notifications in the reported email and to take the appropriate EFRA as set out in Section 4.

The 5-day Probabilistic forecast will be reviewed by the EA's FWDO for the RED stage high tide notification only. If water levels are forecast to exceed the RED stage trigger level then the EA's FWDO will call the Contractor's EFRP site officer. The Contractor will then implement the EFRA for the RED stage notification as set out in Section 4. The three levels of high tide notifications and associated trigger levels are presented in Section 0, 2.1.3 and 2.1.4 below. The associated EFRA for each high tide notification is presented in Section 4.

A list of dates that the high tide notification threshold levels is predicted to be exceeded during the Works is presented in the three respective notification sections below (a full list is provided in Appendix C).

Appendix C also presents the surge level that would be required on top of the astronomical tide level in order to exceed the “Be Prepared”, “AMBER” and “RED” stage notifications trigger levels during the critical period of the Works. An extract of the tidal curves is presented in Figure 3 and Figure 4 below where the predicted tidal levels and envisaged installation periods are highlighted for circuit 1 and circuit 2 respectively.

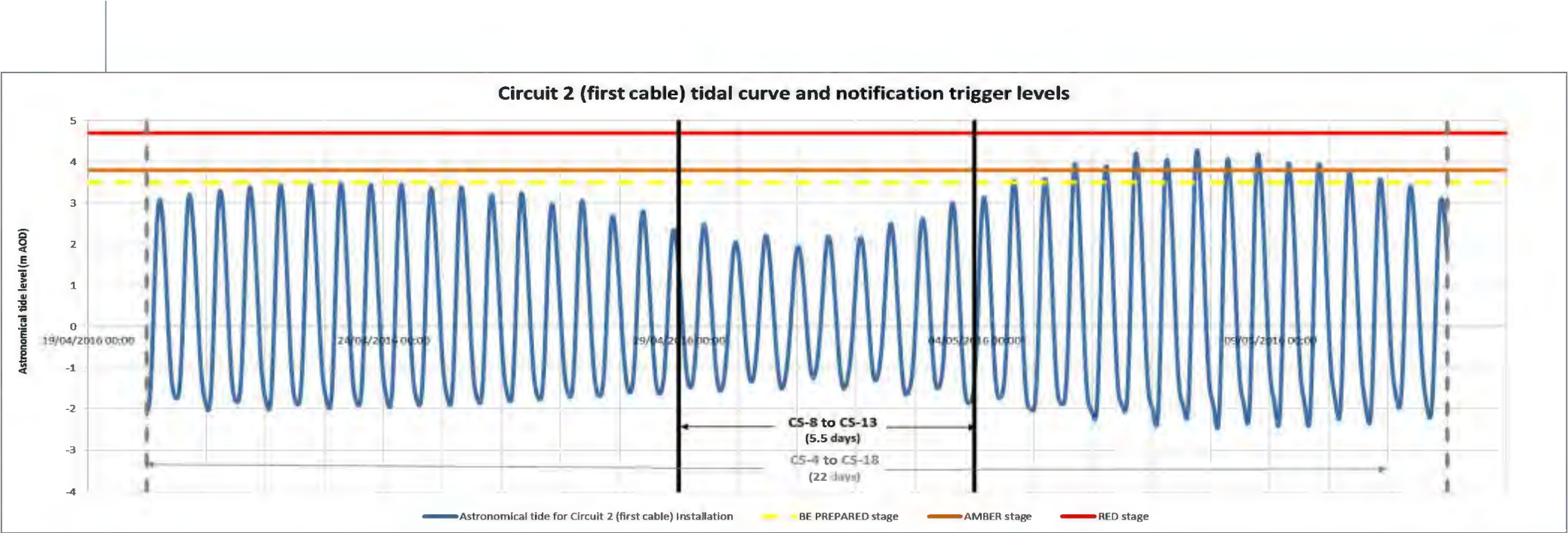


Figure 3. Tidal curve and high tide notification levels during the first cable installation works (Circuit 2). Detailed information on the dates and levels for each trigger level is included in Appendix C. “CS” stands for construction sequence stages, (i.e. 5.5 days when the installation of the cable is envisaged).

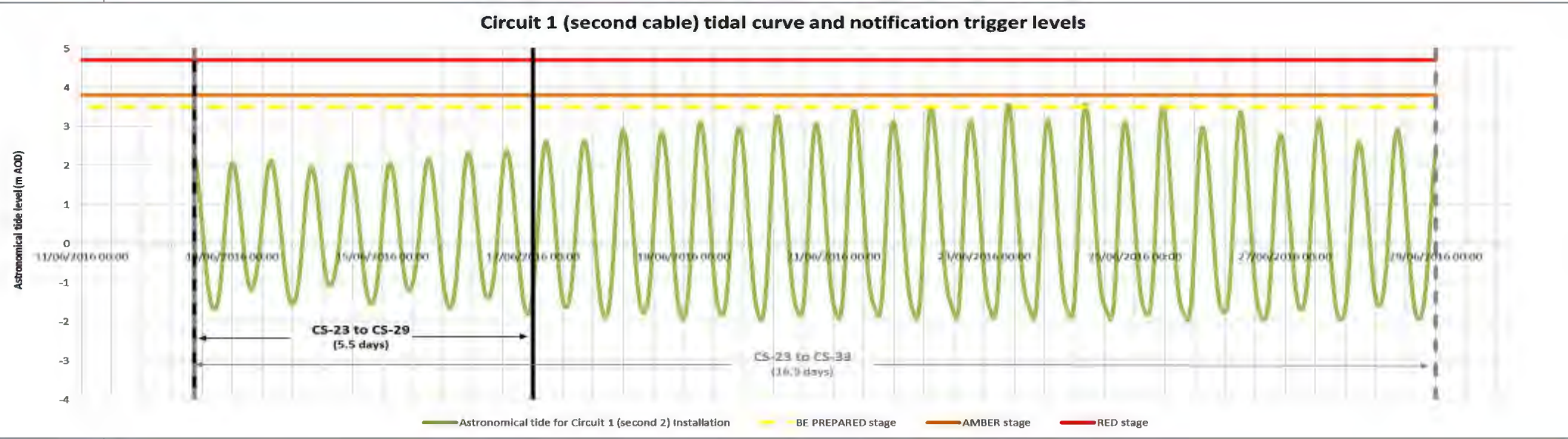


Figure 4. Tidal curve and high tide notification levels during the second cable installation works (Circuit 1). Detailed information on the dates and levels for each trigger level is included in Appendix C. “CS” stands for construction sequence stages, (i.e. 5.5 days when the installation of the cable is envisaged).

2.1.1 Tidal levels and reference

The tidal information issued by the EA's FWDO will be based on water levels at the West Lighthouse gauge with water levels referenced to metres above Ordnance Datum (m AOD).

All astronomical tide levels or predicted water level (astronomical + surge) data issued by the EA or EA's FWDO will be based on data at the West Lighthouse gauge.

The tide levels at West Lighthouse gauge have been compared to the tide levels at the Outer Westmark Knock gauge that will be used by the Contractor for the offshore cable installation Works (this gauge location is closest to the cable laying barge position). A time-series data set from April to September 2016 has been used for comparison purposes. A summary of the differences is presented in Table 2.1 along with the standard tide levels for the West Lighthouse and Outer Westmark Knock gauges.

Table 2.1: Tide levels for the West Lighthouse and Outer Westmark Knock gauges

Reference	West Lighthouse (m AOD) ¹	Outer Westmark Knock (m AOD)	Difference
HAT	4.63	4.70	-0.07
MHWS	3.80	3.90	-0.10
MHWN	1.96	2.10	-0.14
MSL	0.17	0.34	-0.17
MLWN	-1.33	-1.20	-0.13
MLWS	-2.80	-2.70	-0.10
LAT	-3.38	-3.30	-0.08

Source: ¹EA supplied data (3rd February 2016) for the West Lighthouse gauge compared and analysed by MML to the Outer Westmark Knock gauge.

2.1.2 “BE PREPARED” high tide notification:**Trigger level +3.50m AOD**

A “Be Prepared” high tide notification will be issued when forecast water levels are equal to or exceed +3.50m AOD.

Astronomical tide levels are predicted to exceed +3.50m AOD on the following dates (based on tidal predictions at West Lighthouse gauge):

- 06/04/2016 to 11/04/2016 (6 days)
- 04/05/2016 to 10/05/2016 (7 days)
- 03/06/2016 to 09/06/2016 (7 days)
- 23/06/2016 to 25/06/2016 (3 days)
- 03/07/2016 to 08/07/2016 (6 days)
- 21/07/2016 to 25/07/2016 (5 days)
- 03/08/2016 to 07/08/2016 (5 days)
- 18/08/2016 to 24/08/2016 (7 days)

2.1.3 AMBER stage high tide notification:**Trigger level +3.80m AOD**

An AMBER stage high tide notification will be issued when forecast water levels are equal to or exceed +3.80m AOD.

Astronomical tide levels are predicted to exceed +3.80m AOD on the following dates:

- 06/04/2016 to 11/04/2016 (6 days)
- 05/05/2016 to 09/05/2016 (5 days)
- 04/06/2016 to 07/06/2016 (4 days)
- 22/07/2016 to 24/07/2016 (3 days)
- 19/08/2016 to 23/08/2016 (5 days)

2.1.4 RED stage high tide notification:**Trigger level +4.70m AOD**

A RED stage high tide notification will be issued when forecast water levels are equal to or exceed +4.70m AOD.

Based on astronomical tidal predictions, a RED stage high tide notification will only be issued when a storm surge is forecast, as the highest predicted astronomical tide level at West Lighthouse during the programme for the Works is 4.35m AOD (21/08/2016).

2.2 Additional proactive measures

In addition to the high tide notifications, the Contractor will comply with the following proactive flood risk mitigation measures during the entirety of the Works:

- The Platform Level across the sea defence will not be excavated to an elevation lower than +5.15m AOD;
- The Trench Level will not be excavated to an elevation lower than +2.30m AOD;
- The Contractor will have stored on site at all times during the Works, at least 350m³ of imported or excavated from onsite backfill material the quality of which will, meet the minimum acceptance criteria as stated in the Performance Specification for the Works included in the Employer's Requirements. This volume is associated to the volume of material required to reinstate the trench back to Platform Level (+5.15m AOD) for the emergency reinstatement case. This material volume will be stockpiled separately such that it is available for use 24 hours a day, 7 days a week. Plant for transport, backfilling and compaction will also be available on site at all times during the Works;
- Monitor real-time data and forecasts, stating relevant information in the DPR as appropriate including but not limited to:
 - Real-time and forecasts of significant wave height at nearby sites (WaveNet website); and
 - Monitor weather warnings and forecasts at least every 24 hours (Met Office website¹).
- Communication with the Cable laying barge. The offshore cable installation Contractor will also monitor weather warnings, in particular wind and wave forecasts. Should bad weather be forecast the cable laying barge will seek shelter. Therefore, in addition to the above proactive measures, the Contractor for the sea defence breach and reinstatement Works will be in daily communication with the cable laying barge by radio and/or other means (i.e. internet) with the installation of a booster unit if required, meaning that continued and reliable communication between them is guaranteed.
- Carry out at an emergency flood response practise drill to train staff and test the speed and method of deployment and removal of the flood defence barrier system (see Section 3). The emergency practise drill will be in the form of a simulation on site, within the Contractors CDM area, with both the Engineer's site supervisor and the EA's representative present so as to satisfy himself as well as

¹ www.metoffice.co.uk

the EA and Employer of the efficiency of the EFRP and the Contractor's own ability to perform the response given the case. The scale of the practise drill is to be agreed on site between the key parties to this EFRP. By simulating the EFRP, the Contractor will be able to:

- validate the Emergency Response Plan;
- develop the staff competences and train them in carrying out their roles within the plan; and
- test well-established good practice construction and/or emergency procedures on this particular site
- The Contractor will develop a site evacuation plan to identify safe access and egress routes. This should include any person(s) who may work between the primary and secondary sea defence e.g. agriculture workers.
- Toolbox talks/Inductions about the EFRP will be given to all staff onsite before the commencement of the Works and also to visitors and new staff as the work progress.
 - The EFRP toolbox talk should include the relevant information addressed in this EFRP in order to provide training and competence to the workmanship onsite. Also, the Contractor will make sure that people involved have clearly agreed, recorded and rehearsed plans, actions and responsibilities included in this EFRP.
 - As a minimum, the site induction should cover the site location and Works in respect to the flood risk, location of the EFRP and the EFRAs and responsibility of key parties. If a reactive measure has been deployed, a post-event toolbox talk will be given to the staff in order to provide outcomes and/or lesson learnt. The level of the site induction will depend upon the status of the individual and the parts of the site that they will be accessing e.g. high commands on the Emergency Plan communication chain will be subjected to a full EFRP induction, whereas visitors who will be accompanied at all times will be subject to a condensed version of the such induction.

3 Reactive measures

The reactive measures are the emergency flood defence options to be implemented by the Contractor for the temporary management of flood risk:

- For emergency reinstatement, RM1 or RM2 will be implemented depending on the level of high tide notification issued by the EA's FWDO (see Section 4).
- For interim reinstatement, RM2 (defence level to at least +7.7m AOD) will be implemented followed by full reinstatement (backfill and compaction of material up to platform level) across the sea defence embankment and drainage ditch to provide a temporary flood defence for the period between the two cable installations.

This section describes the method, deployment requirements and indicative layout of the three reactive food risk management measures:

- Reactive Measure 1 (RM1) – defence level to at least +5.15m AOD
 - Earthworks reinstatement to platform level (6m wide crest berm); and
 - Installation of single height temporary flood defence barrier at the toe of the sea defence²
- Reactive Measure 2 (RM2) – Defence to at least +7.70m AOD
 - Earthworks reinstatement to platform level +5.15m AOD (6m wide crest berm);
 - Installation of a waterproof polyethylene sheet for erosion protection; and
 - Installation of a double height temporary flood defence barrier at platform level.

The temporary flood defence barrier system that will be deployed is the same for RM1 and RM2 and this is described in Section 3.1. This is followed by a description of the methodology for implementing RM1 and RM2 in Section 3.2, 0 and 3.3 respectively. A summary of the reactive measures is then provided in Section 3.4.

3.1 Temporary flood defence barrier system

The temporary flood defence barrier system will be the 'Quick High Wall' system by UK Flood Defences, unless otherwise approved by the Engineer. The Quick High Wall system (QHW) is a temporary flood defence barrier that consists of the arrangement of impermeable bags filled with material (e.g. sand) and stackable to the required height. They are units specially recommended for protection in river breach,

² The bags will not be placed seaward of the seaward toe of the sea defence.

coastal erosion, and/or bank strengthening and are available in two large bag sizes:

- QWH1: 1m (w) x 1m (d) x 1m (h)
- QWH2: 1m (w) x 1m (d) x 1.4m (h)

QWH2 is the preferred type to be used as placement of two QWH2 bags at platform level will meet the requirement for a defence level to at least 7.7m AOD. See Figure 5 and

Table 2 for the standard dimensions and material specification requirements for the QWH bag.

The Contractor will be required to create benches to the slope of the embankment in order to achieve a flat surface to install the bags. The Contractor will not place any QWH bags on the saltmarsh i.e. seawards the seaward toe of the sea defence embankment. In the situations where bog mats or similar ground protection is installed, this shall be removed prior to placing the QWH bags.

For RM2 the Contractor will install, prior to placing the temporary flood defence bags, a waterproof polyethylene sheet that will cover the previously excavated seaward slope of the sea defence embankment up to the +5.15m AOD (as indicatively shown in Figure 7). The sheet will minimise the risk of erosion to the slopes where the natural erosion protection (topsoil and vegetation) has been removed. The sheet will be fixed by placing filled impermeable bags (i.e. QWH bags) around the perimeter of the sheet. An area of approximately 100m² of waterproof polythene sheet would be required (see Figure 7).

The temporary flood defence bags will be stored on site in the Contractor's site compound, filled with sand or other locally won material such that they can be rapidly deployed.

All plant, equipment and earthworks material required for the emergency flood response measures will be stored in the northwest corner of the site compound, i.e. in a location close to the sea defence that allows a rapid response. The impermeable bags will be set up and filled with sand on site in the staging area until they are required. A single crawler crane (Liebherr HS895 or similar) will be used for handling of the impermeable bags. This will lift the bags from the staging area onto the sea defence with one 14T excavator with rubber pads used to place the bags into their final position. The Contractor will have in place a contingency method of transporting the bags from the site compound to the sea defence in case high winds prevent the bags being lifted by the crane method detailed above.

The QWH supplier has been consulted to identify a suitable duration to load and deploy the temporary flood defence. This has been estimated as 4 minutes per metre run. This has been used to provide indicative timeframes to deploy RM1 and RM2 in Section 3.2, 0 and 3.3 respectively.

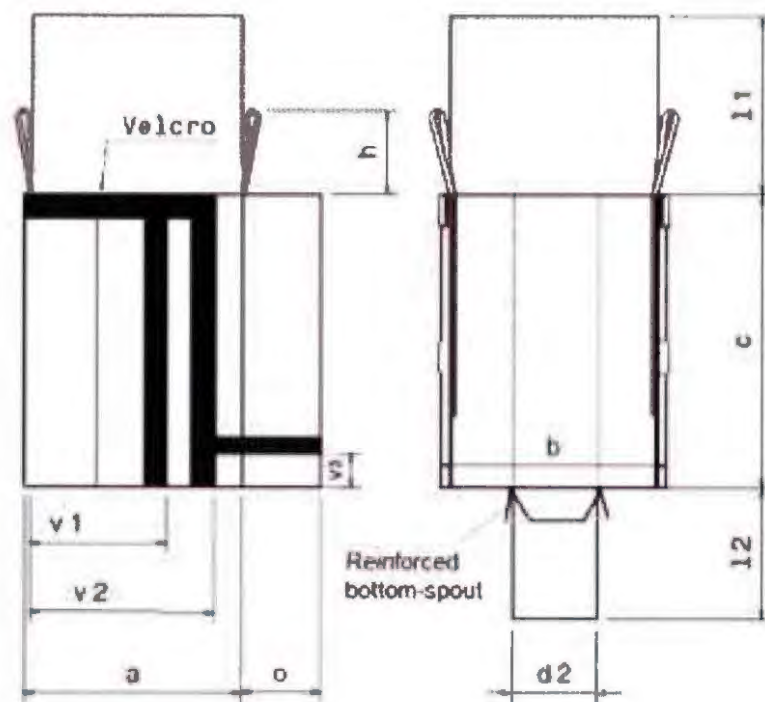


Figure 5. Quick Wall High bag dimensions

Source: UK Flood Defences Ltd. Part Number UKFL 2280124

Table 2: 1.4m Bag Size specification

Description	Size Specification
Length (inside)	960mm
Width (inside)	960mm
Height (inside)	1400mm
Length overlapping fabric o	900mm
Velcro v1, v2, v3	See suppliers specification
Velcro min width	100mm
Length skirt l1	900mm (rolled)
Length bottom spout l2	500mm
Diameter bottom spout d2	500mm (reinforced)
Loops length h	400mm
Safe working load	2000Kg

Source: UK Flood Defences Ltd. Part Number UKFL2280124

3.2 Reactive Measure 1 (RM1) – Reinstall defence to +5.15m AOD

RM1 involves two main operations:

1. backfilling the trench between sheet piles up to the +5.15m AOD only; and
2. installation of a temporary flood defence barrier by deploying a series of impermeable sand filled containers (25-30 bags approx.) landwards the toe of the sea defence (+4.20m AOD).

For (1) the plant will backfill and then compact the backfilled material to create a 6m wide crest berm (at platform level) with 1 in 3 slopes back down to trench level and the sea defence toe (see Figure 6). Plant will work within the trench and work in a landward direction with no plant working seaward of the sea defence seaward toe. The backfill material, operation and compaction operations will be carried out by the Contractor in accordance with the requirements as considered in the Performance Specification included in the Employer's Requirements for the Works.

During the Works only half of the material between the sheet piles will be excavated to allow a minimum of a 2m trench to install the cable. At platform level this will create a 6m x 11m crest footprint for installation of bags and movement of plant. The required volume of material for RM1 has been conservatively estimated as 220m³.

For more information on the cross section along the embankment refer to drawing MMD-357166-C-DR-00-XX-0401 in Appendix D.

Using a rate of fill equal to 20m^3 per hour, the timeframe needed for concluding with the fill results in approx. **11 hours**.

For (2), approximately 25-30 units of the impermeable bags considered in this EFRP will be positioned at the toe of the sea defence (See Figure 6). No bags will be placed seaward of the seaward toe of the sea defence. Assuming a deployment of 4 minutes per metre run, the duration to install the required number of bags has been estimated as **~2 hours**.

The number of bags, volume of material and duration to deploy has been estimated to confirm that RM1 can be deployed within the 36-hour high tide notification notice period. The total duration to implement RM1 has been conservatively estimated as **~13 hours**.

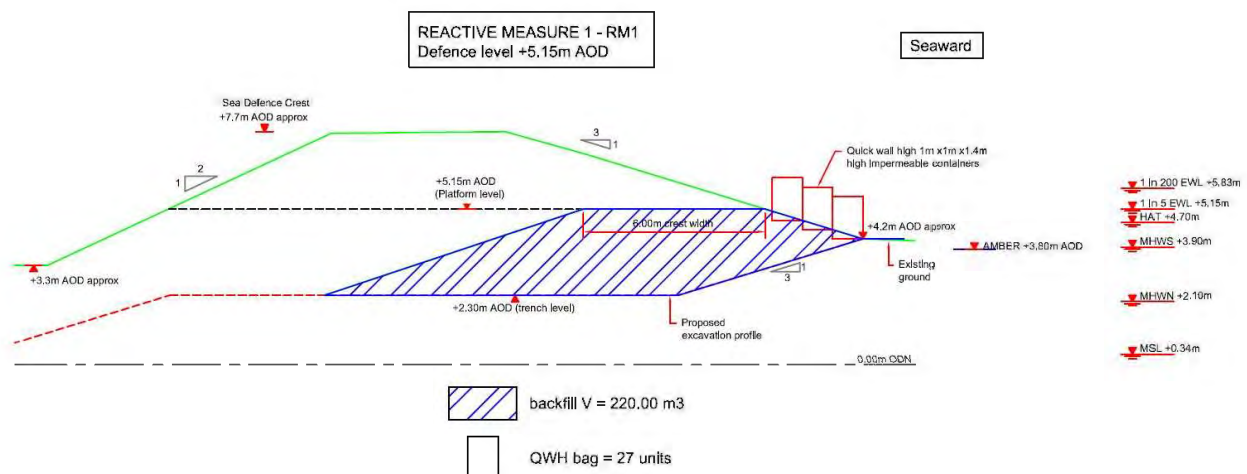


Figure 6. Dimensions of the bund associated to RM1 and cross-section for the arrangement of the bags

3.3 Reactive Measure 2 (RM2) – Temporary flood defence up to at least +7.70m AOD

RM2 involves operation (1) and (2) detailed in RM1 above followed by installation of a temporary flood defence barrier by deploying a series of impermeable sand filled containers to a double bag height from platform level and placement of a waterproof polyethylene sheet for erosion protection (as described in Section 3.1).

The indicative general arrangement including the polythene for erosion protection and elevation for RM2 are shown in Figures 7 and 8 respectively.

For RM2, impermeable bags will be positioned on top of the platform level (+5.15m AOD), surrounding the outer edge of the open trench and at the toe to secure the waterproof polythene sheet as arranged in RM1.

In consultation with the QWH supplier, a pyramid design, 3no. bags per meter run (two at the bottom and one on top) would be sufficient. However, a worst-case approach has been adopted where 5no. bags per meter run across the trench are to be placed (three at the bottom and two on top).

A total of approximately 245 (QWH) bags³ would be required for the installation of RM2. The Contractor will install the flood defence barrier up to at least +7.70m AOD. Based on the timescale for deployment in Section 3.1 this would take in the region of **16.5 hours**. Therefore the total duration to implement RM2 has been conservatively estimated as **~27.5 hours**.

³ 245 bags is inclusive of the 125-30 bags required for the installation of RM1

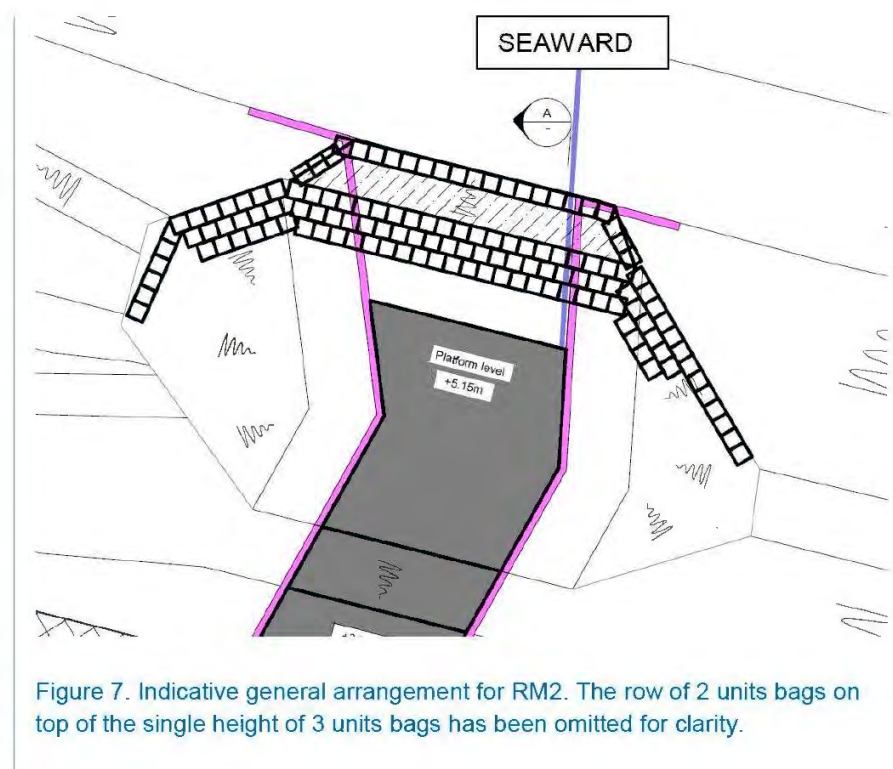


Figure 7. Indicative general arrangement for RM2. The row of 2 units bags on top of the single height of 3 units bags has been omitted for clarity.

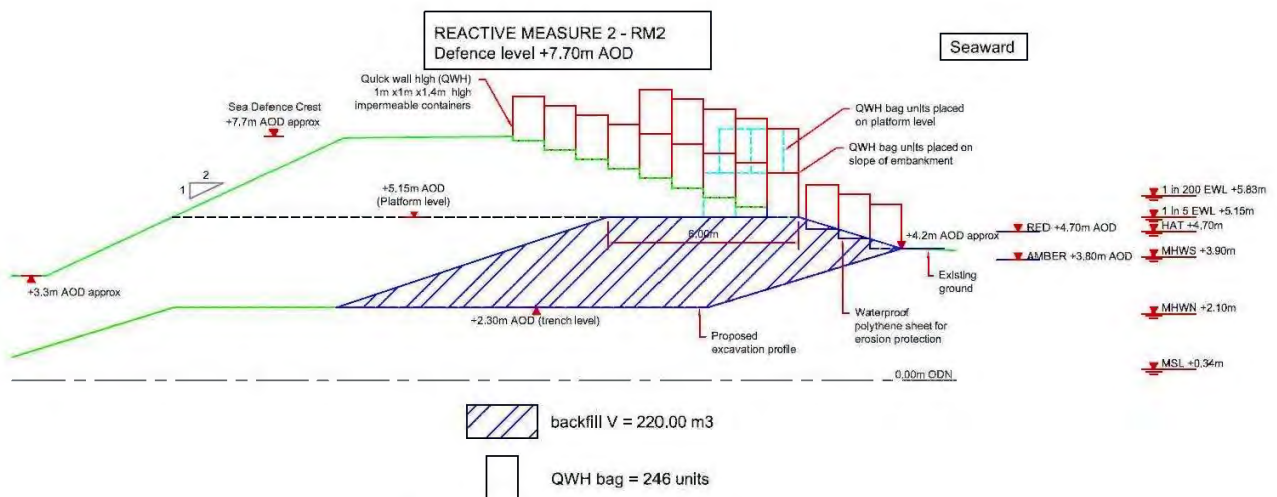


Figure 8. Dimensions of the bund associated to RM2 and cross-section for the arrangement of the bags for RM2

Source: MMD-357166-C-DR-00-XX-0400 and MMD-357166-C-DR-00-XX-0401 in Appendix D.

3.4 Summary

A summary of the reactive measures, associated trigger level and minimum achieved defence levels are presented in the Table 3 below:

Table 3. Summary table of reactive measures

Ref	Description of the reactive measure	Temporary defence level provided	High tide notification level to trigger the reactive measure	Estimated duration to implement
RM1	- Earthworks reinstatement to platform level +5.15m AOD (6m wide crest berm); and - Installation of single height temporary flood defence barrier at the toe of the sea defence⁴	+5.15m AOD	AMBER (+3.8m AOD)	~13 hrs
RM2	- Earthworks reinstatement to platform level +5.15m AOD (6m wide crest berm); - Installation of a waterproof polyethylene sheet for erosion protection; and - Installation of a double height temporary flood defence barrier.	+7.70m AOD	RED (+4.70m AOD)	~27.5 hrs

The Contractor will have on site enough impermeable containers, material, plant and equipment capable to deploy RM1 or RM2 within the 36-hour notice period. The Contractor will be responsible for designing the final flood risk mitigation measures, developing and implementing the detailed construction phase EFRP that as a minimum meet the principles of this EFRP. Based on the indicative design as presented in this EFRP the following is required:

- Volume of backfill material for RM1 and RM2 stored on site: 350m³
- ~245 no. QHW2 bags
- At least 50% of the flood defence bags erected and filled with material in the site compound such that they are ready to be rapidly deployed.
- Plant and equipment stored in the site compound to rapidly to deploy RM1 or RM2.
- Waterproof polyethylene sheet: ~100m²

The number of bags, volume of material and deployment duration have been conservatively estimated in this outline EFRP to confirm that RM1 and RM2 can be deployed within the 36-hour high tide notification

⁴ The bags will not be placed seaward of the seaward toe of the sea defence.

notice period. The estimated duration to deploy RM1 and RM2 are as follows:

1. RM1: 11 hours + 2 hours = **13 hours**
2. RM2: 11 hours + 16.5 hours = **27.5 hours**

The durations above do not account for concurrent activities that the Contractor may be able to achieve on site to ensure the deployment times for the reactive measures are significantly quicker than the conservative estimate presented above.

4 Emergency Flood Response Actions

This section describes the Emergency Flood Response Actions (EFRA). The EFRA is dependent upon the level of high tide notification issued. The three EFRA's are:

- "BE PREPARED" EFRA (Section 4.1)
- AMBER stage EFRA (Section 4.2)
- RED stage EFRA (Section 4.3)

Each EFRA involves a series of key actions. The "Be Prepared" EFRA is described as a 'on alert' status with no reactive measure implemented. The AMBER and RED EFRA's involve implementation of one of the reactive measures as defined in Section 3 of this EFRP.

4.1 "BE PREPARED" EFRA

The Contractor's EFRP Officer shall review the daily high tide notification email and data. If the forecast water level exceeds the defined trigger level for the "Be Prepared" stage notification the Contractor will:

1. **Review** current status of site operations
2. **Monitor** real-time data, forecasts and warnings (see Section 2.2) at least every 6 hours.
3. Setup a Rapid Emergency Flood Response Call (REFRC) with the Employer's site officer and Engineer's site supervisor **within 12 hours** of the notification (i.e. 24 hours before the flood risk) to discuss if further action is required and to review the updated high tide notifications (hour 6 and hour 12);
4. Notify the EA's FWDO if action is to be taken; and
5. **Final REFRC** with the Employer's site officer and Engineer's site supervisor once notification is no longer valid. Unless otherwise agreed, no additional actions.

4.2 AMBER stage EFRA

The Contractor's EFRP Officer shall review the daily high tide notification email and data. If the forecast water level exceeds the defined trigger level for the AMBER stage notification the Contractor will:

1. **Immediately** cease works on the sea defence embankment;
2. **Review** current status of site operations;
3. Setup a Rapid Emergency Flood Response Call (REFRC) with the Employer's site officer and Engineer's site supervisor **within 1 hour** of the notification;
4. Unless otherwise agreed during the REFRC, **Implement RM1** (in place 6 hours prior to flood risk);
5. **Notify** the EA's FDWO of the EFRA to be undertaken and inform them once RM1 is in place;

6. **Secure** the site and site compound;
7. **Monitor** real-time data, forecasts and warnings (see Section 2.2) at least every 6 hours;
8. Second REFRC with Employer's site officer and Engineer's site supervisor **within 24 hours** of notification (i.e. 12 hours before flood risk). Unless otherwise agreed, no additional actions;
9. **Final REFRC** with Employer's site officer and Engineer's site supervisor once the AMBER notification is no longer valid;
10. Unless otherwise agreed during the second REFRC, **RM1 removed** at the time when the AMBER notification is no longer valid; and
11. Unless otherwise agreed during the final REFRC, **re-commencement** of site operations.

4.3 RED stage EFRA

Upon notice of an RED stage notification from the EA's FDWO, the Contractor will:

1. **Immediately** cease works on the sea defence embankment;
2. **Review** current status of site operations;
3. Setup a Rapid Emergency Flood Response Call (REFRC) with the Employer's site officer and Engineer's site supervisor **within 1 hour** of the notification;
4. Unless otherwise agreed during the REFRC, **Implement RM2** (in place at least 6 hours prior to flood risk);
5. **Notify** the EA's FDWO of EFRA to be undertaken and inform them once RM2 is in place;
6. **Secure** the site and site compound;
7. **Monitor** real-time data, forecasts and warnings (see Section 2.2) at least every 6 hours;
8. Second REFRC with Employer's site officer and Engineer's site supervisor **within 24 hours** of notification (i.e. 12 hours before flood risk). Unless otherwise agreed no additional actions;
9. **Final REFRC** with Employer's site officer and Engineer's site supervisor once the notification for the RED and AMBER stage are no longer valid; and
10. Unless otherwise agreed during the final REFRC, **RM2 removed** at the time when the RED and AMBER stage notification is no longer valid; and
11. Unless otherwise agreed during the final REFRC, **re-commencement** of site operations.

5 References

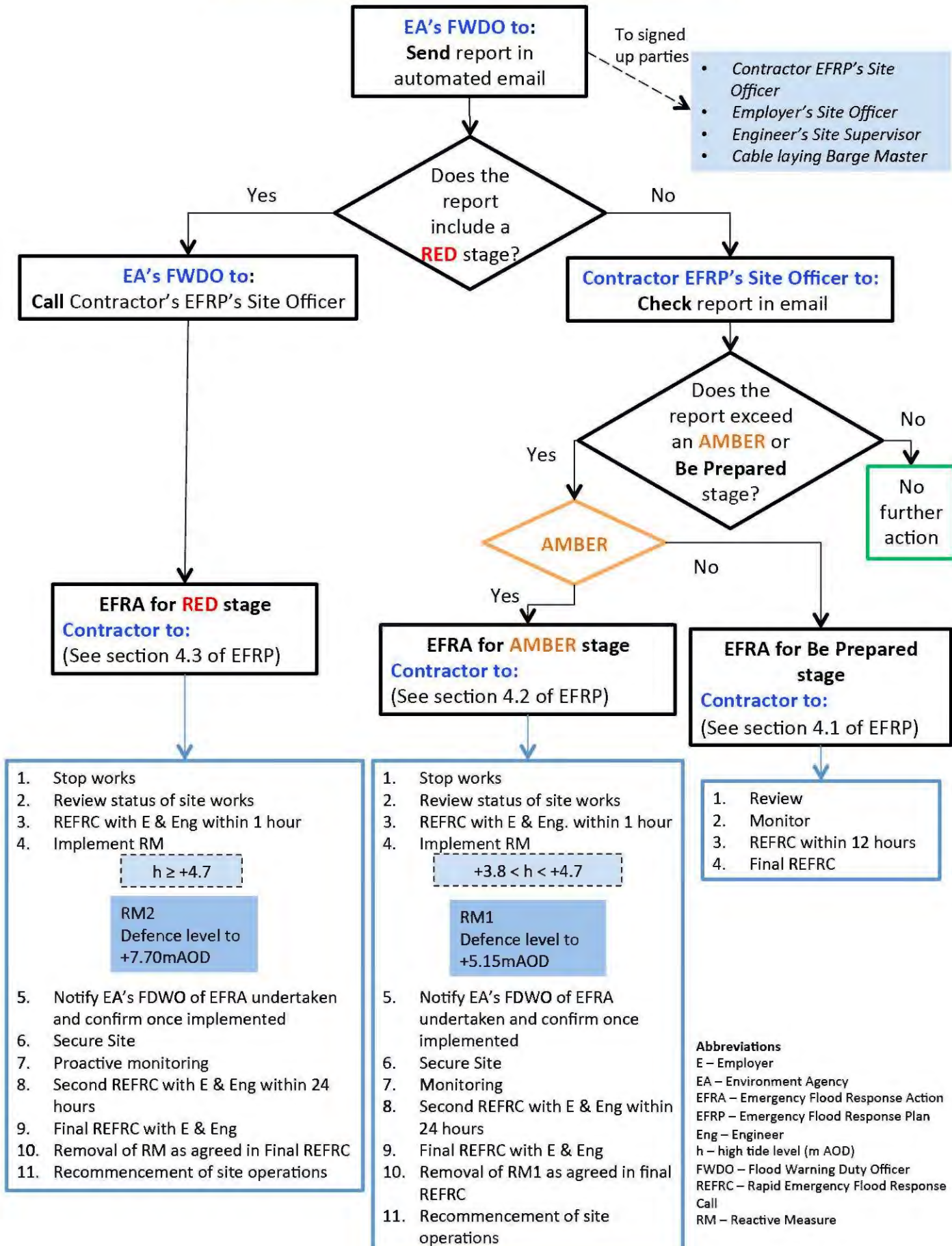
Mott MacDonald Limited (MML), 2016 – 357166_011/Race Bank Export Cable Installation 2016 Sea Defence Breach and Reinstatement Consent Application Study Report, January 2016.

Appendices

Appendix A. Emergency Flood Response Action Flow Chart	30
Appendix B. Daily Progress Report (DPR) template	32
Appendix C. High tide notifications and outline programme of works	36
Appendix D. Drawings	41

Appendix A. Emergency Flood Response Action Flow Chart

High tide notification System and responsibilities



Appendix B. Daily Progress Report (DPR) template

DONG Energy RB (UK)
Limited 5 Howick Place,
SW1P 1WG, London,
United Kingdom



Daily Progress Report

Project	DONG Energy, Embankment Breaching Works	Date	xx.xx.xx
Ref	DPR001/xx/xxxx	Page	1 of x
Location	Race Bank Construction Compound		

Time Arrived Site		Time left site	
Weather / tidal conditions			
Contractors present on site			
Visitors to site			
Notes			
Activities undertaken			
Construction Phase Monitor Record			
Geotechnical Observations			
H&S Issues			
Environmental Issues			
Points for clarification			
Forward program			
Outstanding actions			

Photographic Record {Examples are from the Halcrow report – a similar level of detail will be provided}



Compaction of 1st reinstatement layer through breach (looking west) and sand replacement



Compaction of 1st reinstatement layer through breach (looking east) and nuclear



Testing and compaction of 2nd and 3rd reinstatement layers (looking



Compaction and testing of 3rd reinstatement layer (looking west).



Compaction and testing of 4th reinstatement layer (looking west).



Retrieval of 100mm bogmat units. Trencher/cable layer Nessie III at the seaward edge of the saltmarsh.

	
Compaction and testing of 5 th reinstatement layer (looking east).	Close up of sand replacement test with nuclear density equipment.
	
Compaction of Saturday's 5 th and final reinstatement layer (looking east).	Day's completion of embankment reinstatement (looking north from compound). Approx level achieved 6.6mAOD.

Author xxxxx

Date: xx/xx/2016

Distribution List: [TO BE AGREED]

DONG Energy	Ian Renshaw – Environment and Consents	Issued
	Chris Ensom – Installation Manager	
	Flemming Johannsson – Package Manager	
	Luke Bridgeman – Project Manager	
	TBC – Site Manager 1	
	TBC – Site Manager 2	
Environment Agency	TBA	
Natural England	TBA	
Marine Management Organisation	TBA	
Others	TBA	

Appendix C. High tide notifications and outline programme of works

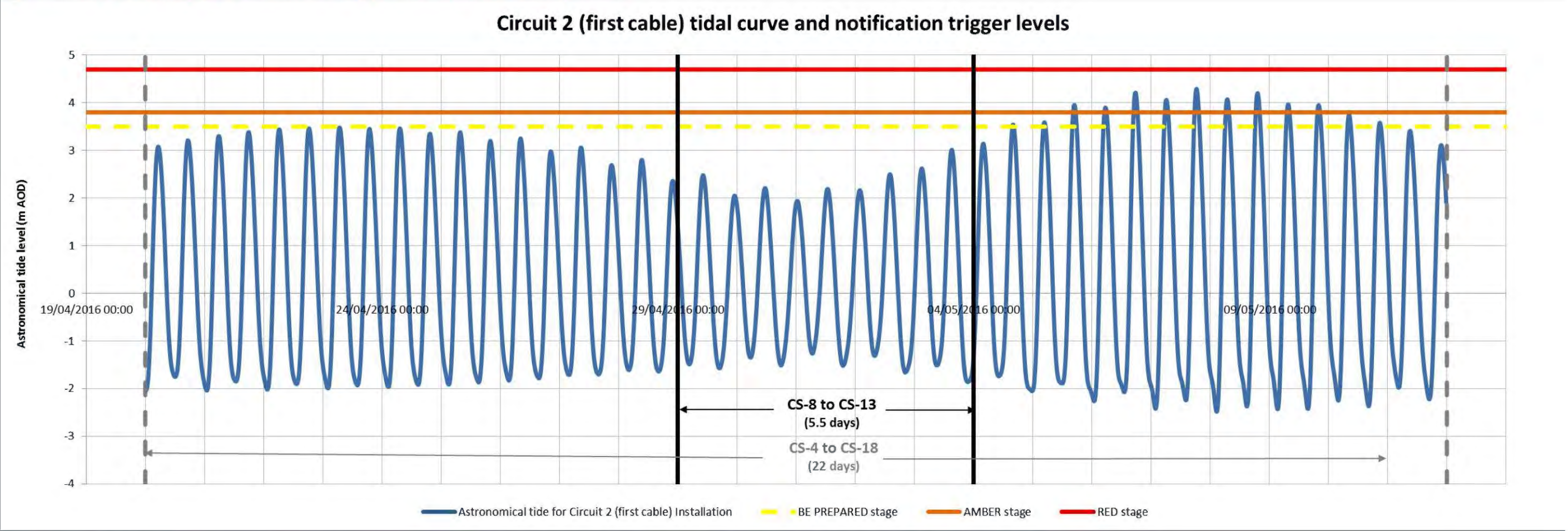
This appendix lists the dates and time periods that “Be Prepared”, and AMBER stage notifications would be issued based on the outline programme for the Works. Astronomical tide levels do not exceed the RED stage notification level during the entire period of works at the site, therefore not dates and time periods are presented here. The required surge levels to coincide with high tide to result in water levels exceeding the defined trigger levels (including the RED trigger level) are also presented.

Figure C.1 and Figure C.2 present the predicted tidal curve over the period when the sea defence is temporary lowered below +7.7m AOD. Figure C.1 presents this for the Circuit 2 (first cable) installation, from construction sequence 4 (CS-4) to CS-18 and Figure C.2 for the Circuit 1 (second cable) installation, CS-23 to CS-33 (see MML, 2016 for further details on the construction sequence references). The surge levels required on top of the high tides for the period when the sea defence is temporarily lowered to trench level (+2.3m AOD) are presented in Table C.1 and Table C.2 for Circuit 2 and Circuit 1 respectively

The full list of dates and time periods when predicted tide levels exceed the defined high tide notification trigger levels are presented in the Table C.3 (Circuit 2) and Table C.4 (Circuit 1).

Predicted tide levels presented in this EFRP are based on EA supplied data (3rd February 2016) for the West Lighthouse gauge.

Figure C.1: Tidal curve and high tide notification levels during the first cable installation works (Circuit 2)

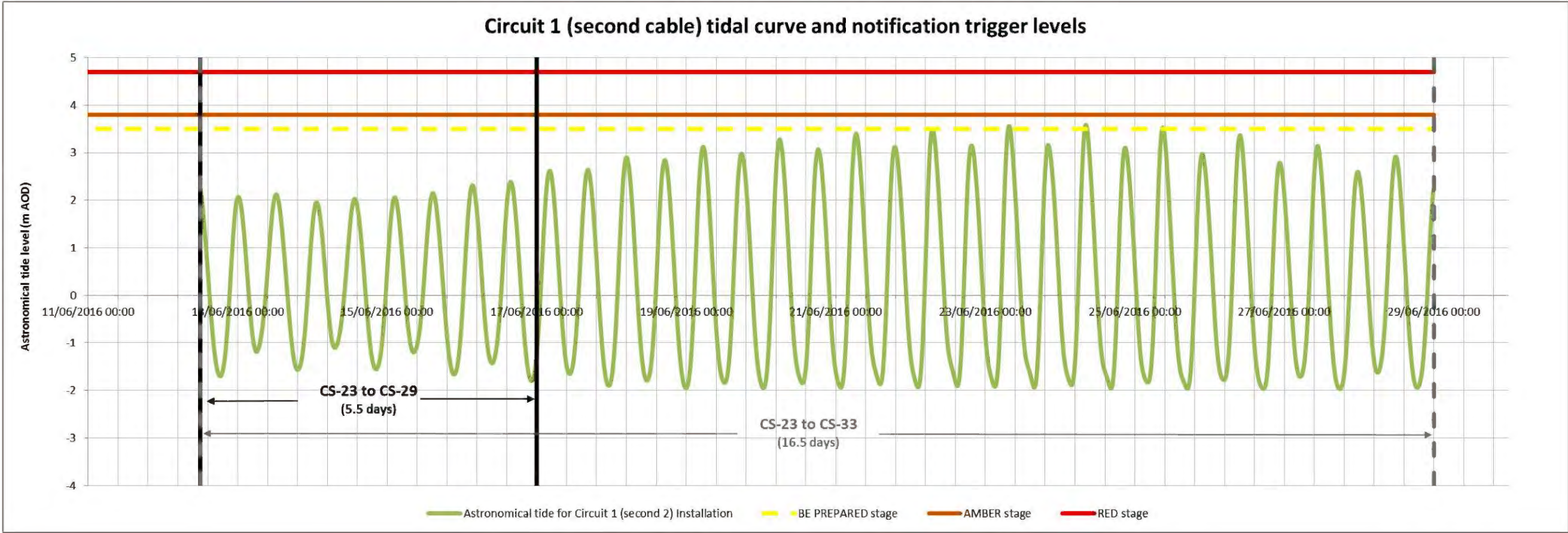


Source: EA supplied data (3rd February 2016) for the West Lighthouse gauge. Programme dates are based on the outline programme for the Works (MML, 2016) not accounting for weather delays on site.

Table C.1: Predicted astronomical high tides and associated surge levels required to exceed the high tide notification trigger levels between CS-8 and CS-13 only, during the Circuit 2 (first cable) installation period. Tidal predicted based on levels at West Lighthouse tidal gauge.

Date	High tide level (m AOD)	Surge level required to exceed notification trigger levels (m)		
		"Be Prepared" stage (trigger = +3.5m AOD)	"AMBER" stage (trigger = +3.8m AOD)	"RED" stage (trigger = +4.7m AOD)
29/04/2016	2.48	1.02	1.32	2.22
29/04/2016	2.05	1.45	1.75	2.65
30/04/2016	2.21	1.29	1.59	2.49
01/05/2016	1.94	1.56	1.86	2.76
01/05/2016	2.19	1.31	1.61	2.51
02/05/2016	2.16	1.34	1.64	2.54
02/05/2016	2.50	1.00	1.30	2.20
03/05/2016	2.62	0.88	1.18	2.08
03/05/2016	3.01	0.49	0.79	1.69
04/05/2016	3.14	0.36	0.66	1.56
04/05/2016	3.54	-0.04	0.26	1.16

Figure C.2: Tidal curve and high tide notification levels during the second cable installation works (Circuit 1)



Source: EA supplied data (3rd February 2016) for the West Lighthouse gauge. Programme dates are based on the outline programme for the Works (MML, 2016) not accounting for weather delays on site.

Table C.2: Predicted astronomical high tides and associated surge levels required to exceed the high tide notification trigger levels between CS-23 and CS-29 only, during the Circuit 1 (second cable) installation period. Tidal predicted based on levels at West Lighthouse tidal gauge.

Date)	High tide level (m AOD)	Surge level required to exceed notification trigger levels (m)		
		"Be Prepared" stage (trigger = +3.5m AOD)	"AMBER" stage (trigger = +3.8m AOD)	"RED" stage (trigger = +4.7m AOD)
13/06/2016	2.12	1.38	1.68	2.58
14/06/2016	1.95	1.55	1.85	2.75
14/06/2016	2.03	1.47	1.77	2.67
15/06/2016	2.06	1.44	1.74	2.64
15/06/2016	2.15	1.35	1.65	2.55
16/06/2016	2.31	1.19	1.49	2.39
16/06/2016	2.38	1.12	1.42	2.32
17/06/2016	2.62	0.88	1.18	2.08
17/06/2016	2.64	0.86	1.16	2.06
18/06/2016	2.90	0.60	0.90	1.80
18/06/2016	2.84	0.66	0.96	1.86

Table C.3: Dates and time periods when tide levels exceed the AMBER stage level during the programmed first cable installation (Circuit 2); CS-4 to CS-18. Astronomical tide levels do not exceed the RED stage notification level during the entire period of works at the site.

Date and time (GMT)	Tide level (m AOD)
05/05/16 16:30	3.87
05/05/16 16:45	3.95
05/05/16 17:00	3.95
05/05/16 17:15	3.88
06/05/16 05:15	3.87
06/05/16 05:30	3.9
06/05/16 05:45	3.87
06/05/16 17:00	3.89
06/05/16 17:15	4.1
06/05/16 17:30	4.2
06/05/16 17:45	4.21
06/05/16 18:00	4.14
06/05/16 18:15	4.01
06/05/16 18:30	3.81
07/05/16 05:45	3.92
07/05/16 06:00	4.04
07/05/16 06:15	4.06
07/05/16 06:30	4.01
07/05/16 06:45	3.9
07/05/16 17:45	3.94
07/05/16 18:00	4.16
07/05/16 18:15	4.27
07/05/16 18:30	4.29
07/05/16 18:45	4.23
07/05/16 19:00	4.09
07/05/16 19:15	3.9
08/05/16 06:30	3.97
08/05/16 06:45	4.06
08/05/16 07:00	4.07
08/05/16 07:15	4.01
08/05/16 07:30	3.88
08/05/16 18:30	3.84
08/05/16 18:45	4.06
08/05/16 19:00	4.17
08/05/16 19:15	4.2

Date and time (GMT)	Tide level (m AOD)
08/05/16 19:30	4.14
08/05/16 19:45	4.02
08/05/16 20:00	3.85
09/05/16 07:15	3.89
09/05/16 07:30	3.96
09/05/16 07:45	3.96
09/05/16 08:00	3.88
09/05/16 19:30	3.8
09/05/16 19:45	3.92
09/05/16 20:00	3.95
09/05/16 20:15	3.91
09/05/16 20:30	3.81

Source: EA supplied data (3rd February 2016) for the West Lighthouse gauge. Programme dates are based on the outline programme for the Works not accounting for weather delays on site.

Table C.4: Dates and time periods when tide levels exceed the AMBER stage level during the programmed second cable installation (Circuit 1); CS-23 to CS-33. Astronomical tide levels do not exceed the RED stage notification level during the period of works at the site.

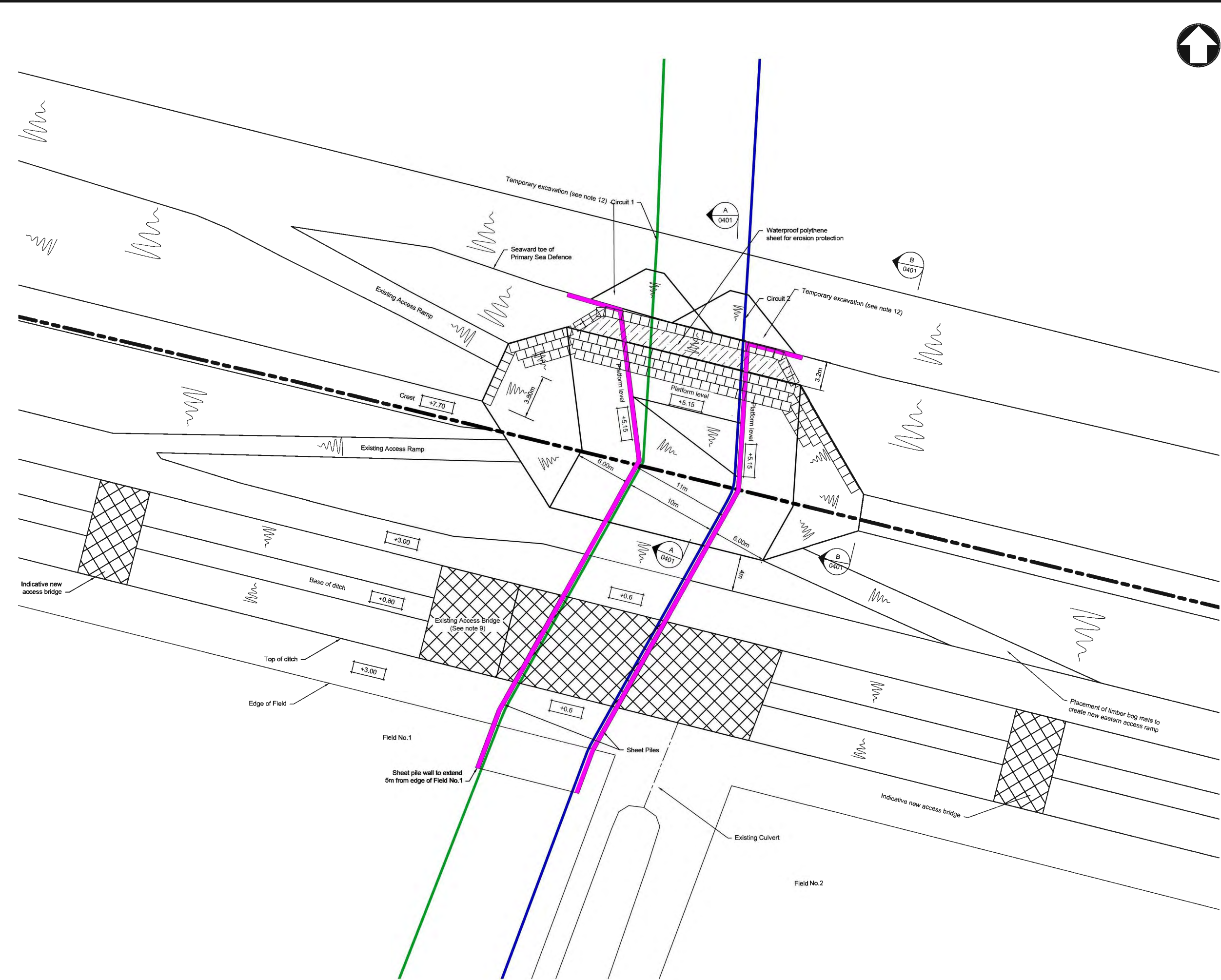
Date and time (GMT)	Tide level (m AOD)
N/A – there are no periods when astronomical tide levels are predicted to exceed the AMBER stage trigger level during the Circuit 1 (second cable) installation	

Source: EA supplied data (3rd February 2016) for the West Lighthouse gauge. Programme dates are based on the outline programme for the Works not accounting for weather delays on site.

Appendix D. Drawings

Attached to this EFRP are the following drawings:

3. MMD-357166-C-DR-00-XX-0400 – EFRP General Arrangement for reactive measure 2 (RM2)
4. MMD-357166-C-DR-00-XX-0401 – EFRP Sections for reactive measure 2 (RM2)



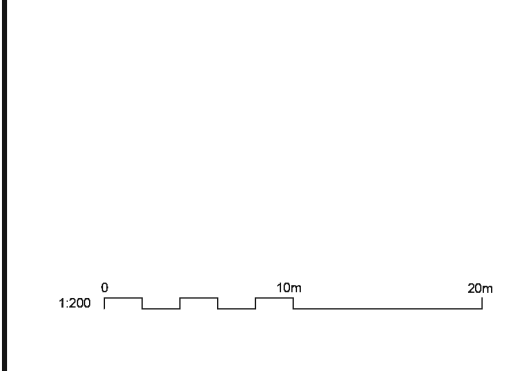
Plan
1:200

- Notes
1. All dimensions are in metres unless noted otherwise.
 2. All levels are in metres relative to Ordnance Datum Newlyn (ODN) unless noted otherwise.
 3. All positions are in metres relative to OSGB 36.
 4. Reference drawings only. Not to be used for construction.
 5. Topographic data reproduced from LSTC Onshore Topographic Survey (2014) & Fugro Geophysical Investigation (2014).
 6. See MMD-348992-C-DR-00-XX-0001 and MMD-348992-C-DR-00-XX-0002 for the Site Plan and Topographic Plan respectively.
 7. Soil slopes shall be cut at no steeper than 1:3.
 8. Final layout & position of new access ramps to be developed by the Contractor & approved by the Employers Representative.
 9. Stability of existing access bridge to be assessed by the Contractor in accordance with the Specification.
 10. The reactive measure shown is Reactive Measure 3 as detailed in the "Race Bank Export Cable Installation 2016: Emergency Flood Response Plan" (Document No 357168_012).
 11. Cable bedding layer and cement bound sand (CBS) shall be installed prior to laying concrete protective cover. See reference drawing for full extent of CBS and concrete protective cover.
 12. Temporary hand-digging operation to allow installation of concrete protective cover within the sea defence, covered under ECiP and Appropriate Assessment.

Key to symbols

	Cable Alignment No. 1 (Circuit 1, second cable installation)
	Cable Alignment No. 2 (Circuit 2, first cable installation)
	Landward Boundary of designated sites
	Extent of open excavation
	Extent of sheet piles
	Cable bedding layer
	Cable concrete protective cover
	ODN indicative level
	Access Bridge

Reference drawings
MMD-357168-C-DR-00-XX-0401 - Sections



P3	07.03.16	CM	Minor amendments	MW	RT
P2	25.02.16	IAS	First issue	MW	RT
P1	04.02.16	IAS	Preliminary issue	MW	RT
Rev	Date	Drawn	Description	Ch'k'd	App'd

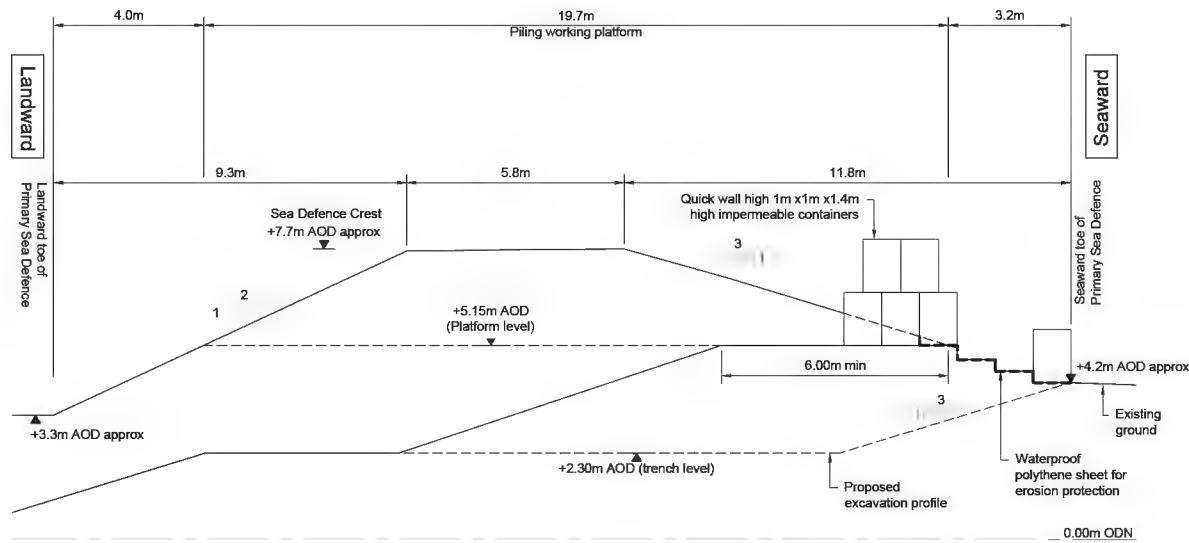
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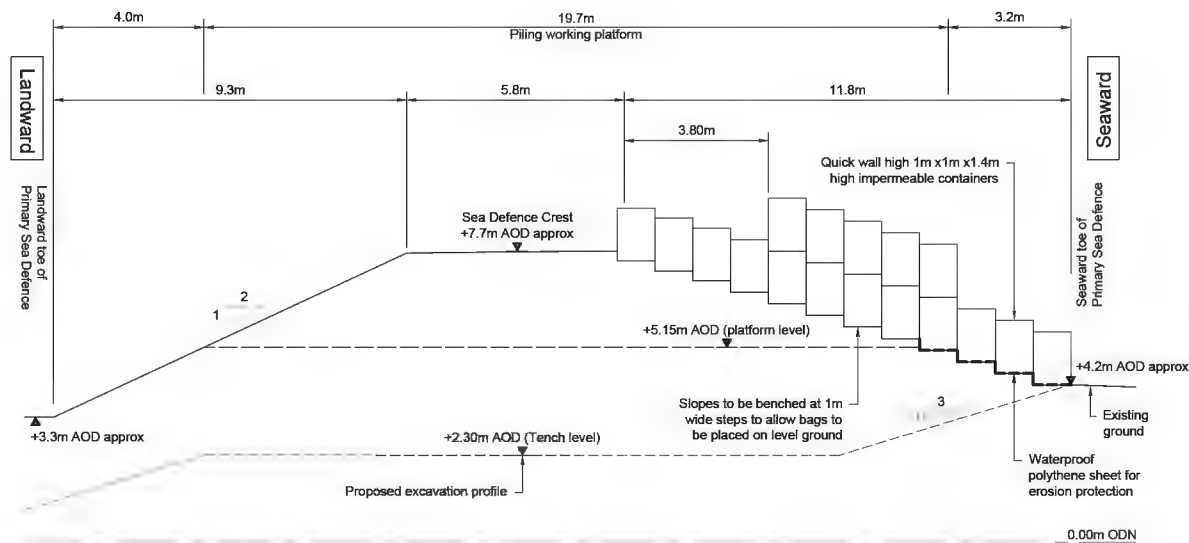
Title
**Race Bank Export Cable Installation
Sea Defence Breach
Emergency Flood Response Plan
(EFRP)
General Arrangement**

Designed	E Shaw-Smith	ESS	Eng check	M Wearmouth	MW
Drawn	I A Sussex	IAS	Coordination	M Wearmouth	MW
Dwg check	C Moreno	CM	Approved	R Turner	RT
Scale at A1	Status	Rev	Security		
1:200	PRE	P2	STD		
Drawing Number					
MMD-357166-C-DR-00-XX-0400					



- 1 in 200 EWL +5.83m
- 1 in 5 EWL +5.15m
- HAT +4.70m
- MHWS +3.90m
- MHWN +2.10m
- MSL +0.34m
- MLWN -1.20m
- MLWS -2.70m
- LAT -3.30m

Section A
1:100



- 1 in 200 EWL +5.83m
- 1 in 5 EWL +5.15m
- HAT +4.70m
- MHWS +3.90m
- MHWN +2.10m
- MSL +0.34m
- MLWN -1.20m
- MLWS -2.70m
- LAT -3.30m

Elevation B
1:100

- Notes
- All dimensions are in metres unless noted otherwise.
 - All levels are in metres relative to Ordnance Datum Newlyn (ODN) unless noted otherwise.
 - All positions are in metres relative to OSGB 36.
 - Reference drawings only. Not to be used for construction.
 - Topographic data reproduced from LSTC Onshore Topographic Survey (2014) & Fugro Geophysical Investigation (2014).
 - Water levels based on the Race Bank Export Cable Installation Sea Defence Breach Study Report (MML 2015).
 - See MMD-348992-C-DR-00-XX-0001 and MMD-348992-C-DR-00-XX-0002 for the Site Plan and Topographic Plan respectively.
 - The reactive measure shown is Reactive Measure 3 as detailed in the "Race Bank Export Cable Installation 2016: Emergency Flood Response Plan" (Document No 357166_012)

Key to symbols

- Existing Ground Level
- Proposed excavation profile
- Waterproof Polythene sheet
- Quick wall high impermeable container

1:100 0 5m 10m

Reference drawings

MMD-357166-C-DR-00-XX-0400 - General Arrangement

P2	25.02.16	IAS	First Issue	MW	RT
P1	04.02.16	IAS	Preliminary issue	MW	RT
Rev	Date	Drawn	Description	Ch'kd	App'd

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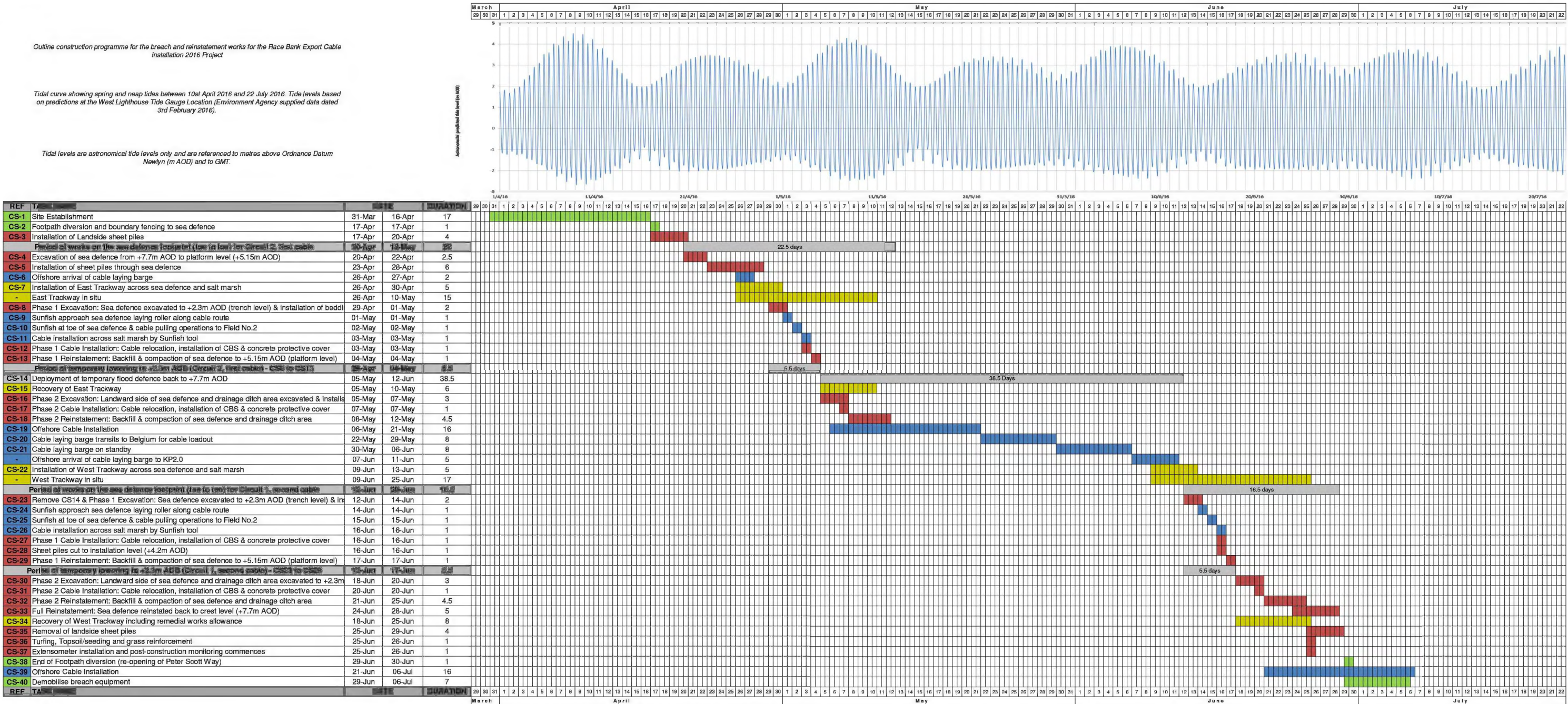
Race Bank Export Cable Installation
Sea Defence Breach
Emergency Flood Response Plan
(EFRP)
Sections

Designed	E Shaw-Smith	ESS	Eng check	M Wearnmouth	MW
Drawn	I A Sussex	IAS	Coordination	M Wearnmouth	MW
Dwg check	C Moreno	CM	Approved	R Turner	RT
Scale at A1	Status	Rev	Security		
As Shown	PRE	P2	STD		

Drawing Number
MMD-357166-C-DR-00-XX-0401

Appendix B. Programme

OUTLINE CONSTRUCTION PROGRAMME

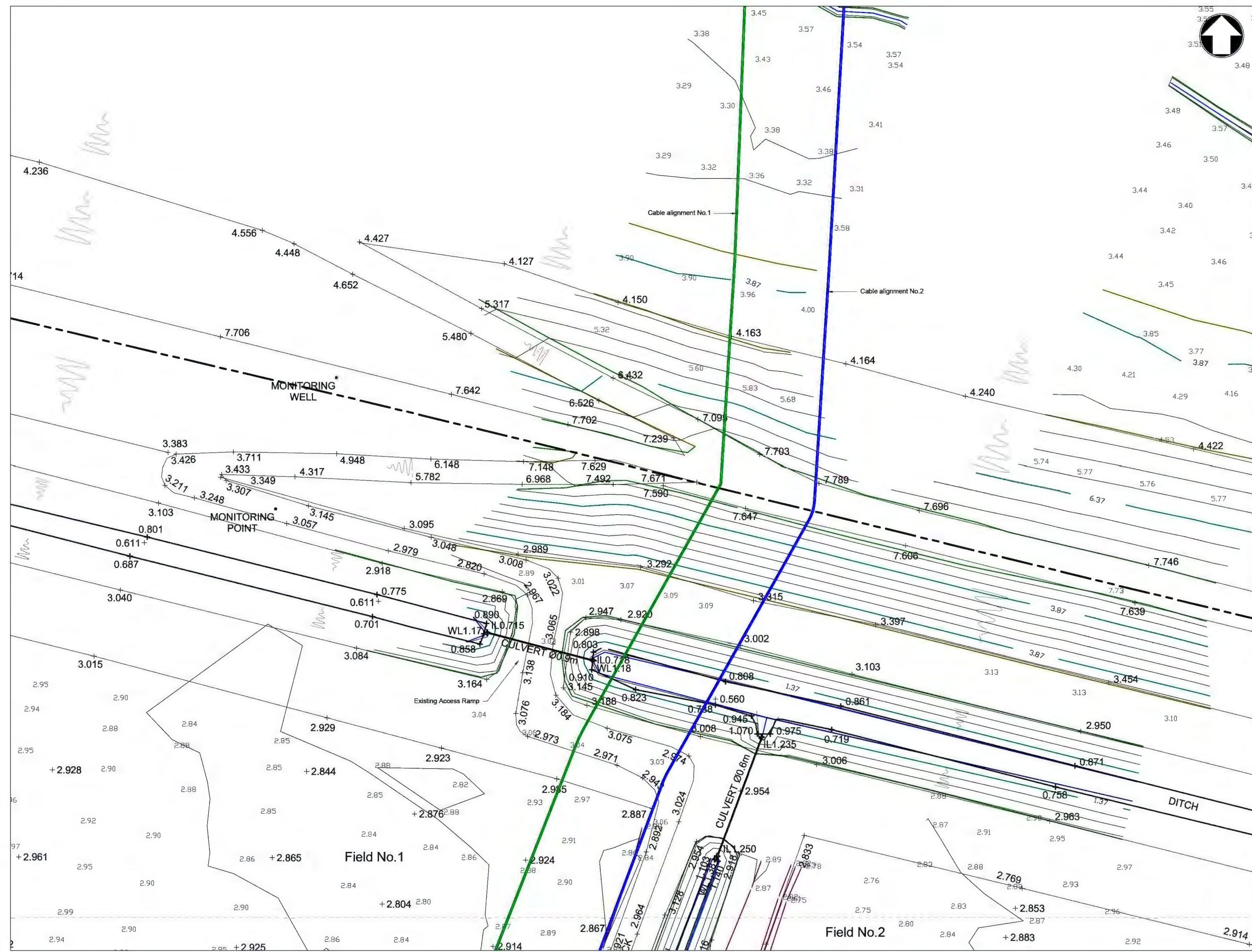


OUTLINE CONSTRUCTION PROGRAMME

Appendix C. Drawings

The following drawings are presented in this Appendix:

- Site Plan – MMD-357166-C-DR-00-XX-0001
- Topographic Plan – MMD-357166-C-DR-00-XX-0002
- General Arrangement – MMD-357166-C-DR-00-XX-0102
- Indicative Construction Monitoring Location Plan – MMD-357166-C-DR-00-XX-0104
- Indicative Post Construction Monitoring Location Plan – MMD-357166-C-DR-00-XX-0105
- Sections – MMD-357166-C-DR-00-XX-0202
- Full size Constraints drawing (as referenced in Section 3.3) - MMD-357166-C-SK-00-XX-0018
- Full size indicative trackway plans
 - East trackway - MMD-357166-C-SK-00-XX-0019
 - West trackway - MMD-357166-C-SK-00-XX-0020
- Full size Construction Sequence drawings (as referenced in the storyboard):
 - MMD-357166-C-DR-00-XX-0300 to MMD-357166-C-DR-00-XX-0318



Plan
1:200

- Notes
1. All dimensions are in metres unless noted otherwise.
 2. All levels are in metres relative to Ordnance Datum Newlyn (ODN) unless noted otherwise.
 3. All positions are in metres relative to OSGB36.
 4. Topographic data reproduced from LSTC Onshore Topographic Survey (2014) & Fugro Geophysical Investigation (2014).
 5. Circuit 2 and Circuit 1 are installed in two separate operations, approximately 5 weeks apart. See "Race Bank Export Cable Installation 2016 Consents Application Study Report" (Document No.: 357266_01) for further details on the construction sequence.
 6. See Fugro Engineering Seacore Limited (FESCL) October 2012 and August 2014 reports for available Ground Investigation information.

- Key to symbols
- Cable Alignment No. 1 (Circuit 1, second cable installation)
 - Cable Alignment No. 2 (Circuit 2, first cable installation)
 - Boundary of Designated Sites

Reference drawings

P1	08.03.16	IAS	Flood Defence Consent Issue	MW	RT
Rev	Date	Drawn	Description	Chk'd	App'd

Mott MacDonald

Mott MacDonald House
8-10 Sydenham Road
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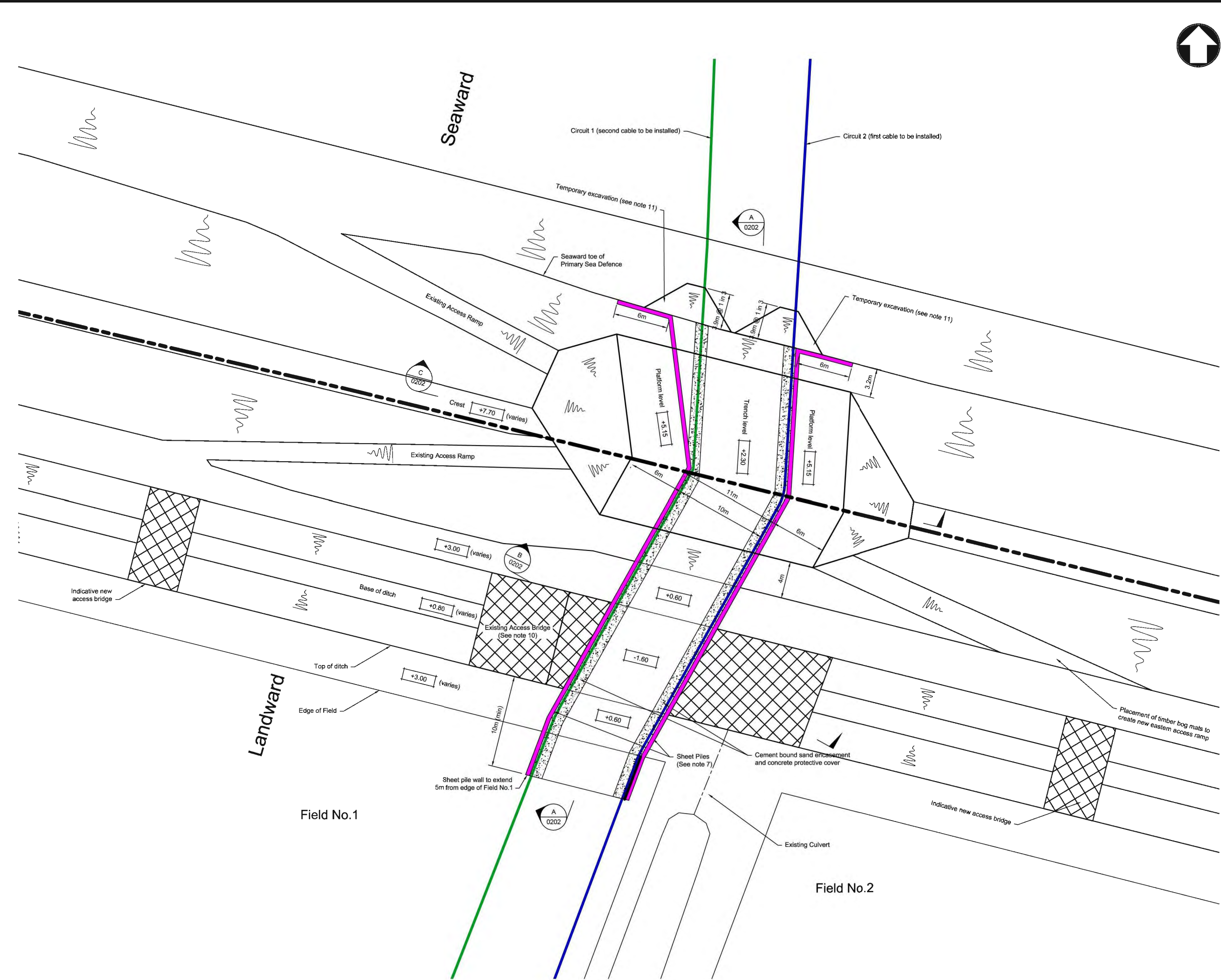
DONG energy

DONG Energy RB (UK) Limited
5 Howick Place SW1P 1WG
London, United Kingdom

Title
Race Bank Export Cable Installation
Sea Defence Breach
Reference Drawings
Topographic Plan

Designed	Eng check	Coordination	MW
Drawn	P M Stames	PMS	MW
Dwg check	M Wearmouth	MW	PJP
Scale at A1	Status	Rev	Security
1:200	APR	P1	STD

Drawing Number
MMD-357166-C-DR-00-XX-0002



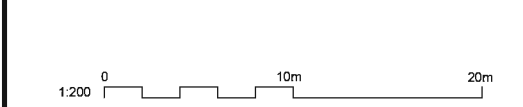
- Notes
1. All dimensions are in metres unless noted otherwise.
 2. All levels are in metres relative to Ordnance Datum Newlyn (ODN) unless noted otherwise.
 3. All positions are in metres relative to OSGB 36.
 4. Reference drawings only. Not to be used for construction. This drawing shall be read in conjunction with the Specification (357166_010 Dong Energy Race Bank Sea Defence Breach & Reinstatement Scope of Works Specification).
 5. Topographic data reproduced from LSTC Onshore Topographic Survey (2014) & Fugro Geophysical Investigation (2014).
 6. At the Sea Defence embankment sheet piles to remain in place after breach and reinstatement operations. Landward of the landward toe of the Sea Defence sheet piles to be removed after cable laying operations.
 7. Soil slopes shall be cut at no steeper than 1:3.
 8. Modifications to existing access ramps to be developed by the Contractor & approved by the Employer's Representative.
 9. Stability of existing access bridge to be assessed by the Contractor in accordance with the "Race Bank Export Cable Installation 2016 Employer's Requirements" (357166_010).
 10. Cable bedding layer and cement bound sand (CBS) shall be installed prior to laying concrete protective cover. See reference drawing for full extent of CBS and concrete protective cover.
 11. Temporary hand-digging operation to allow installation of concrete protective cover within the sea defence, covered under ECIP and Appropriate Assessment (AA). Total area of works shown is 23m² per cable installation. Total area considered under the AA is 24.5m² per cable installation.
 12. Circuit 2 and Circuit 1 are installed in two separate operations, approximately 5 weeks apart. See "Race Bank Export Cable Installation 2016 Consents Application Study Report" (Document No.: 357266_01) for further details on the construction sequence.
 13. At changes in slopes at the formation (trench) level the Contractor shall take into account a minimum 5m bending radius for the installation of the cable.
 14. The western sheet pile wall alignment deviates from the cable alignment seaward of the sea defence crest. The minimum clearance at the toe of the sea defence shall be 3.380m (measured from steel sheet pile to the centre of the cable).
 15. See Fugro Engineering Seacore Limited (FESCL) October 2012 and August 2014 reports for available Ground Investigation information.

Key to symbols

	Cable Alignment No. 1 (Circuit 1, second cable installation)
	Cable Alignment No. 2 (Circuit 2, first cable installation)
	Landward Boundary of designated sites
	Extent of open excavation
	Extent of sheet piles
	Cable bedding layer
	Cable concrete protective cover
	ODN indicative level
	Access Bridge

Reference Drawings

MMD-357166-C-DR-00-XX-0001 - Site Plan
MMD-357166-C-DR-00-XX-0002 - Topography Plan
MMD-357166-C-DR-00-XX-0202 - Sections



P1	08.03.16	IAS	Flood Defence Consent Issue	MW	RT
Rev	Date	Drawn	Description	Ch'kd	App'd

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Client

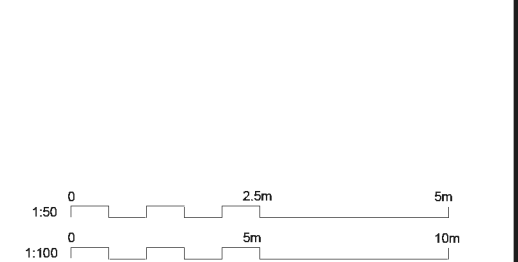
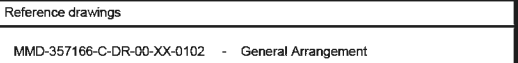
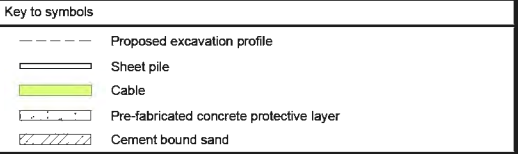
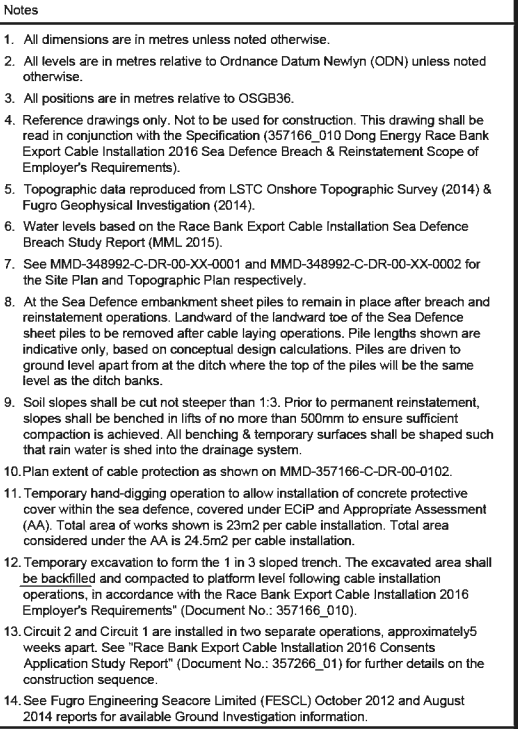
DONG energy

DONG Energy RB (UK) Limited
5 Howick Place SW1P 1WG
London, United Kingdom

Title

**Race Bank Export Cable Installation
Sea Defence Breach
Reference Drawings
General Arrangement**

Designed	E Shaw-Smith	ESS	Eng check	E Shaw-Smith	ESS
Drawn	I A Sussex	IAS	Coordination	M Wearmouth	MW
Dwg check	M Wearmouth	MW	Approved	R Turner	RT
Scale at A1	Status	Rev	Security		
1:200	APR	P1	STD		
Drawing Number					
MMD-357166-C-DR-00-XX-0102					



P1	08.03.16	IAS	Flood Defence Consent Issue	MW	RT
Rev	Date	Drawn	Description	Ch'k'd	App'd



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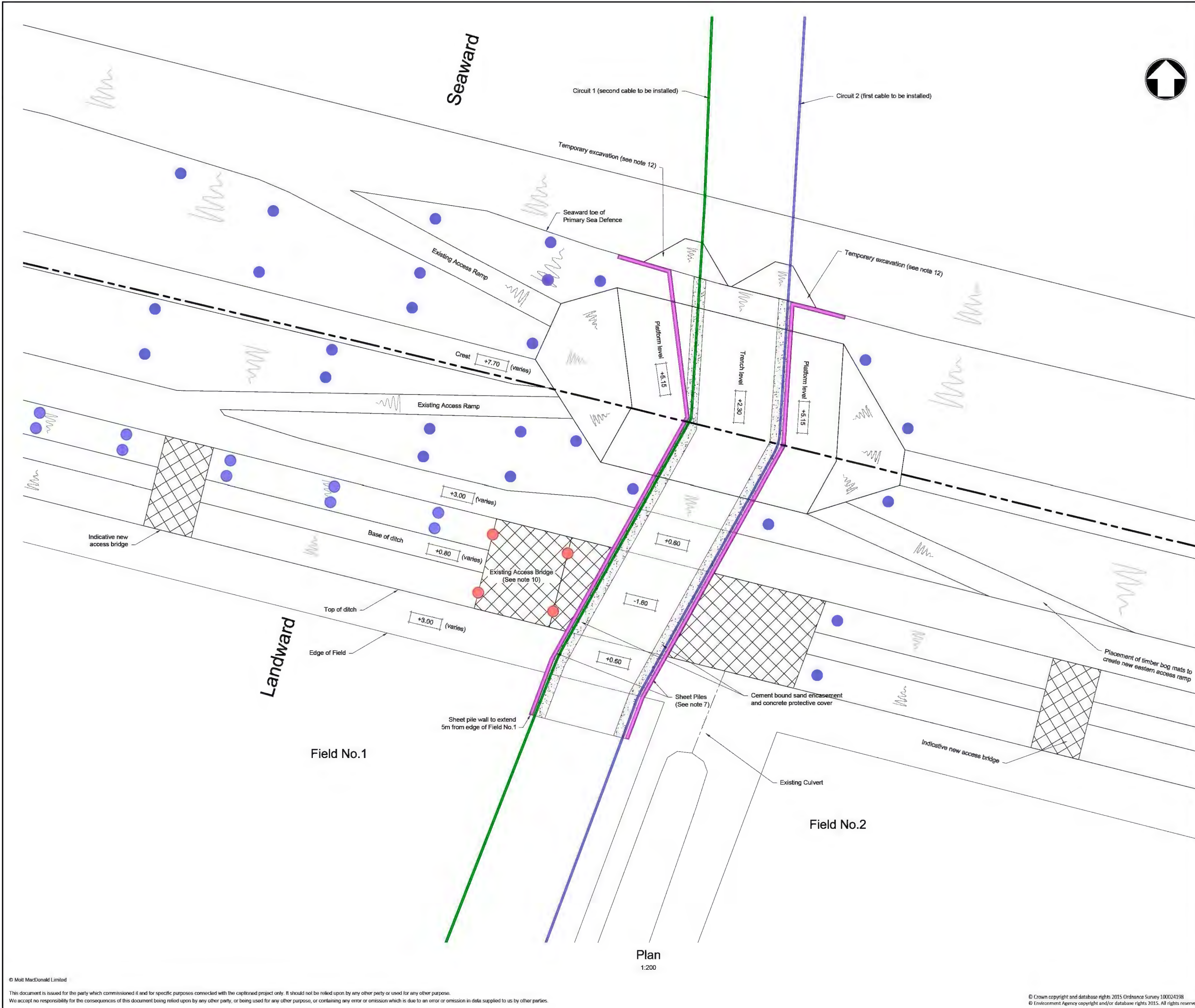
Client

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energy

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5 Howick Place SW1P 1WG
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Title
Race Bank Export Cable Installation
Sea Defence Breach
Reference Drawings
Sections

Designed	E Shaw-Smith	ESS	Eng check	E Shaw-Smith	ESS
Drawn	I. Sussex	IAS	Coordination	M. Wearmouth	MW
Dwg check	M. Wearmouth	MW	Approved	R Turner	RT
Scale at A1	Status		Rev	Security	
As Shown	APR		P1	STD	



Notes

1. All dimensions are in metres unless noted otherwise.
2. All levels are in metres relative to Ordnance Datum Newlyn (ODN) unless noted otherwise.
3. All positions are in metres relative to OSGB36.
4. Indicative drawings only. Not to be used for construction.
5. Topographic data reproduced from LSTC Onshore Topographic Survey (2014) & Fugro Geophysical Investigation (2014).
6. See MMD-357166-C-DR-00-XX-0001 and MMD-257166-C-DR-00-XX-0002 for the Site Plan and Topographic Plan respectively.
7. Circuit 2 and Circuit 1 are installed in two separate operations, approximately 5 weeks apart. See "Race Bank Export Cable Installation 2016 Consents Application Study Report" (Document No.: 357266_01) for further details on the construction sequence.
8. See Fugro Engineering Seacore Limited (FESCL) October 2012 and August 2014 reports for available Ground Investigation information.

Key to symbols

- Cable Alignment No. 1 (Circuit 1, second cable installation)
- Cable Alignment No. 2 (Circuit 2, first cable installation)
- Landward Boundary of designated sites
- Extent of open excavation
- Extent of sheet piles
- Construction Monitoring Points
 - Ground Monitoring Points (Temp stakes with nails)
 - Bridge Monitoring Prisms

Reference drawings

P1	08.03.16	PS	Flood Defence Consent Issue	MW	RT
Rev	Date	Drawn	Description	Ch'k'd	App'd

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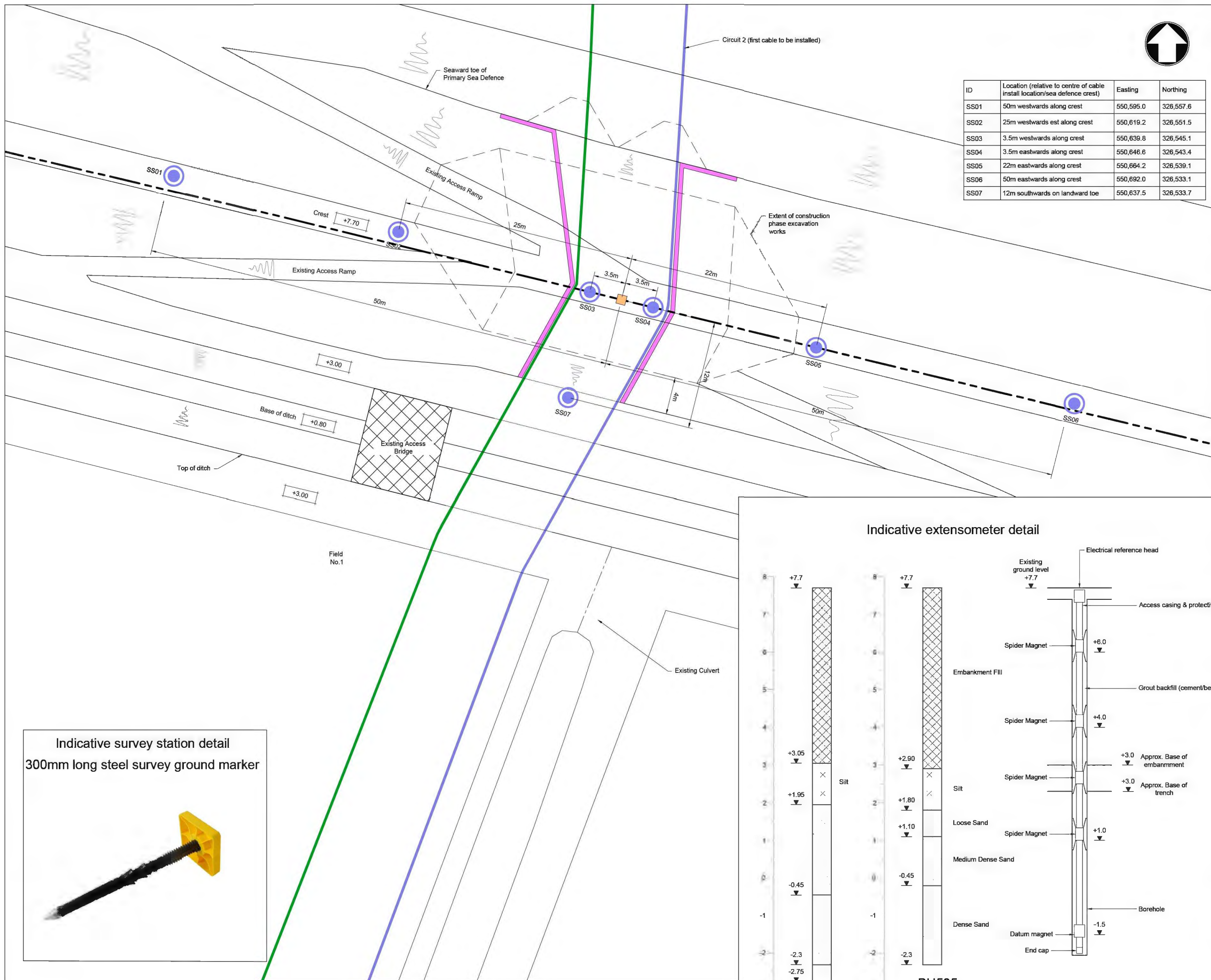
Title

**Race Bank Export Cable Installation
Sea Defence Breach
Reference Drawings
Indicative Construction Monitoring
Location Plan**

Designed	E Shaw-Smith	ESS	Eng check	E Shaw-Smith	ESS
Drawn	P Stames	PS	Coordination	M Wearmouth	MW
Dwg check	M Wearmouth	MW	Approved	P Phipps	PJP
Scale at A1	Status	Rev	Security		
1:200	APR	P1	STD		

Drawing Number

MMD-357166-C-DR-00-XX-0104



ID	Location (relative to centre of cable install location/sea defence crest)	Easting	Northing
SS01	50m westwards along crest	550,595.0	328,557.6
SS02	25m westwards est along crest	550,619.2	328,551.5
SS03	3.5m westwards along crest	550,639.8	328,545.1
SS04	3.5m eastwards along crest	550,646.6	328,543.4
SS05	22m eastwards along crest	550,664.2	328,539.1
SS06	50m eastwards along crest	550,692.0	328,533.1
SS07	12m southwards on landward toe	550,637.5	328,533.7

- Notes
- All dimensions are in metres unless noted otherwise.
 - All levels are in metres relative to Ordnance Datum Newlyn (ODN) unless noted otherwise.
 - All positions are in metres relative to OSGB36.
 - Indicative drawings only. Not to be used for construction.
 - Topographic data reproduced from LSTC Onshore Topographic Survey (2014) & Fugro Geophysical Investigation (2014).
 - See MMD-357166-C-DR-00-XX-0001 and MMD-357166-C-DR-00-XX-0002 for the Site Plan and Topographic Plan respectively.
 - Datum magnet in medium dense / dense sand does not move and thus provides reference for other magnet movements.
 - Borehole and extensometer installed after reinstatement of sea defence embankment.
 - See Race Bank Export Cable Installation 2016 Sea Defence Breach and Reinstatement Consents Application Study Report (Document No.: 357166_011) and associated Consents documentation ("Post-Construction Monitoring Plan") for further details on the proposed monitoring plan.
 - See Fugro Engineering Seacore Limited (FESCL) October 2012 and August 2014 reports for available Ground Investigation information.

- Key to symbols
- Cable Alignment No. 1 (Circuit 1, second cable installation)
 - Cable Alignment No. 2 (Circuit 2, first cable installation)
 - Landward Boundary of designated sites
 - Extent of construction phase excavation works
 - Extent of sheet piles
- Post Construction Monitoring Points
- Survey Stations - 300 mm long steel survey ground marker
 - Extensometer, including level survey monitoring point

Reference drawings

P1	08.03.16	IAS	Flood Defence Consent Issue	MW	RT
Rev	Date	Drawn	Description	Chk'd	App'd

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**Race Bank Export Cable Installation
Sea Defence Breach
Reference Drawings
Indicative Post Construction Monitoring
Location Plan**

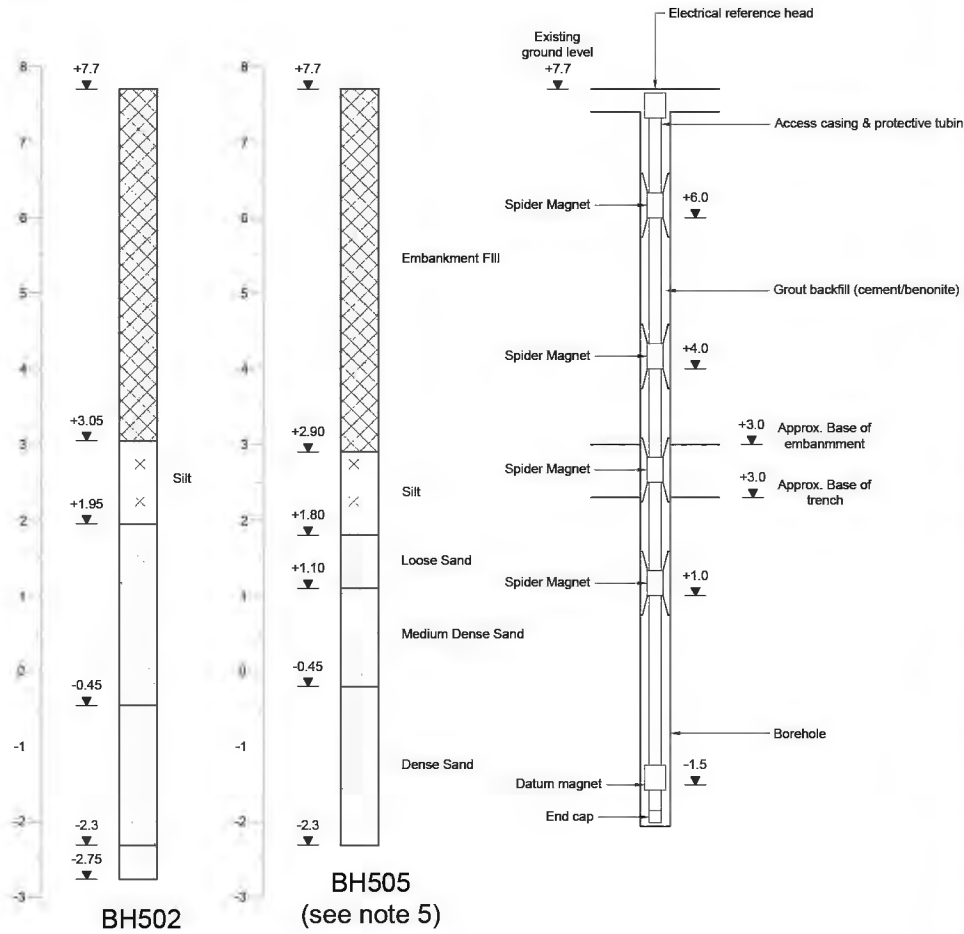
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Drawn	P Stames	PS	Coordination	M Wearmouth	MW
Dwg check	M Wearmouth	MW	Approved	P Phipps	PJP
Scale at A1	Status	Rev	Security		
1:200	APR	P1	STD		

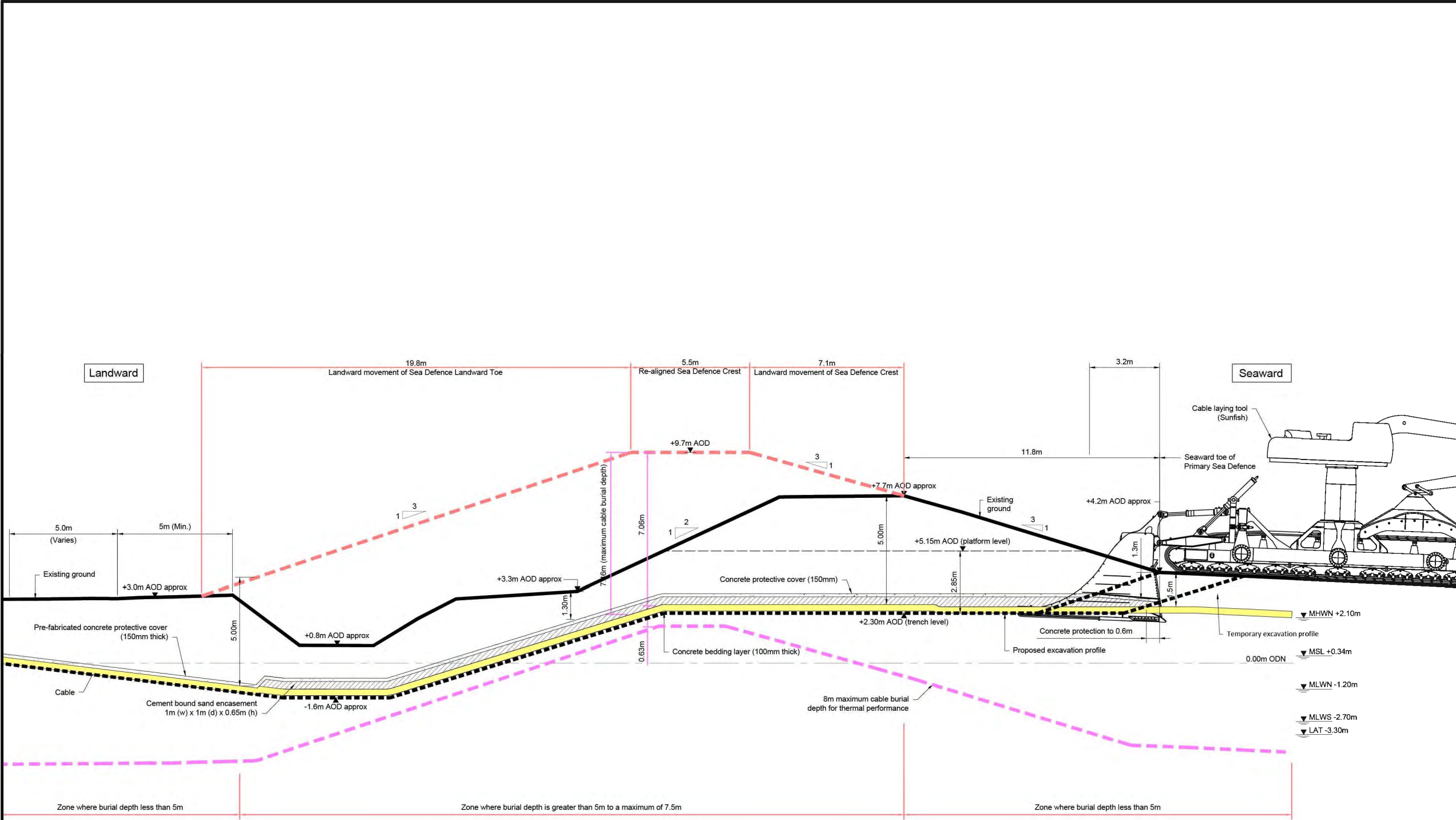
Drawing Number
MMD-357166-C-DR-00-XX-0105

Indicative survey station detail
300mm long steel survey ground marker



Indicative extensometer detail





- Notes
1. All dimensions are in metres unless noted otherwise.
 2. All levels are in metres relative to Ordnance Datum Newlyn (ODN) unless noted otherwise.
 3. All positions are in metres relative to British National Grid.
 4. Conceptual sketch only. Not to be used for construction. This drawing shall be read in conjunction with the Specification (357166_010 Dong Energy Race Bank Sea Defence Breach & Reinstatement Scope of Works Specification).
 5. Topographic data reproduced from LSTC Onshore Topographic Survey (2014) & Fugro Geophysical Investigation (2014).
 6. Water levels based on the Race Bank Export Cable Installation Sea Defence Breach Study Report (MML 2015).
 7. See MMD-348992-C-DR-00-XX-0001 and MMD-348992-C-DR-00-XX-0002 for the Site Plan and Topographic Plan respectively.
 8. Sheet piles not shown for illustrative purposes.

Key to symbols

- Existing Ground Level
- Proposed excavation profile
- Potential future provision profile
- Maximum burial depth profile for thermal requirements
- Cable
- Pre-fabricated concrete protective cover
- Cement bound sand

Reference drawings

0	20.01.16	IAS	Preliminary Issue	MW	RT
Rev	Date	Drawn	Description	Ch'k'd	App'd

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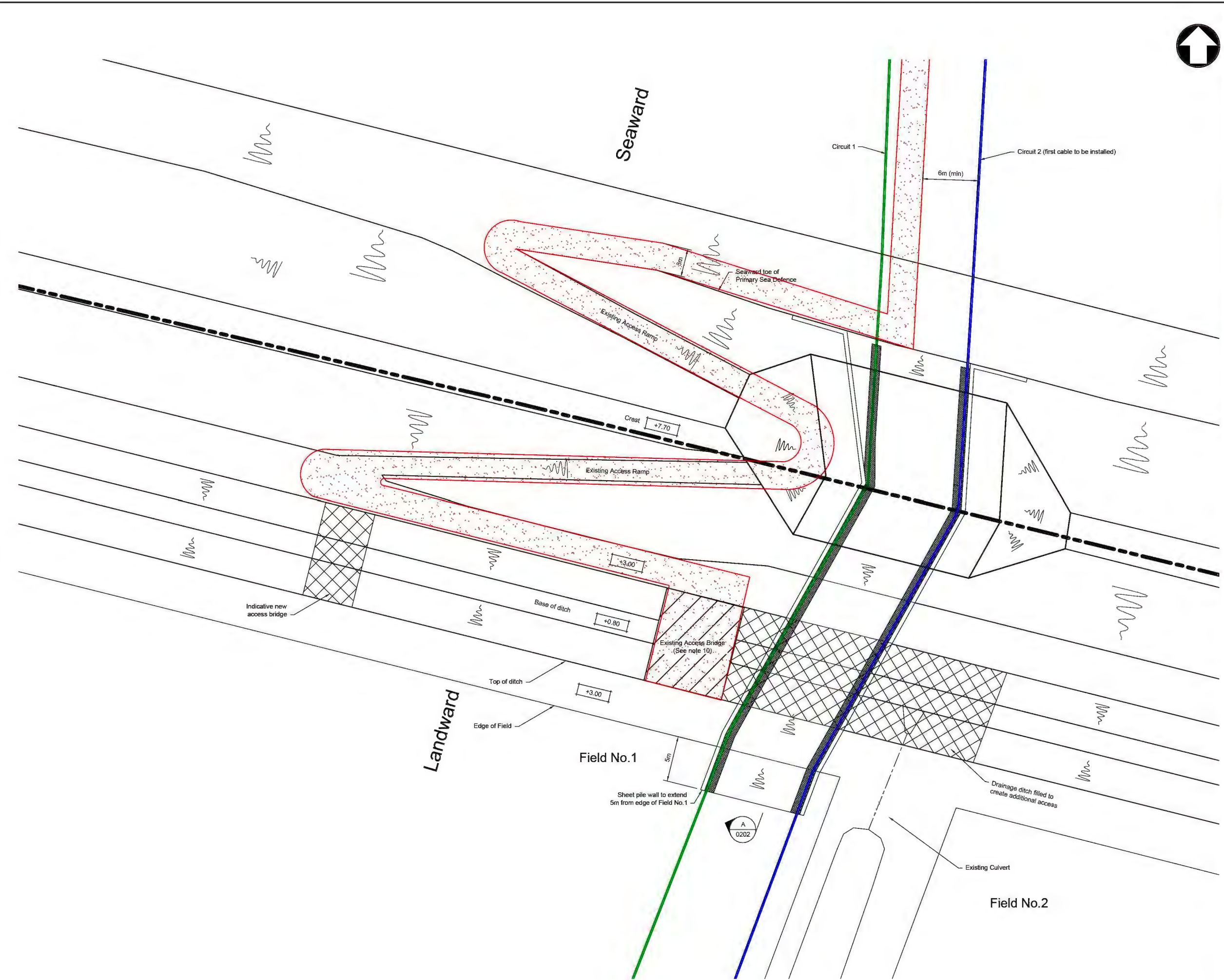
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5 Howick Place SW1P 1WG
London, United Kingdom

Title

Race Bank Export Cable Installation
Sea Defence Breach
Constraints Sketch

Designed	E Shaw-Smith	ESS	Eng check	E Shaw-Smith	ESS
Drawn	I. Sussex	IAS	Coordination	M. Wearmouth	MW
Dwg check	M. Wearmouth	MW	Approved	R Turner	RT
Scale at A1	Status	Rev	Security		
As Shown	PRE	P1	STD		
Drawing Number					
MMD-357166-C-SK-00-XX-0018					



Plan
1:200

Notes

Key to symbols

Reference drawings

P1	22.01.16	IAS	Preliminary Issue	MW	PJP
Rev	Date	Drawn	Description	Ch'kd	App'd

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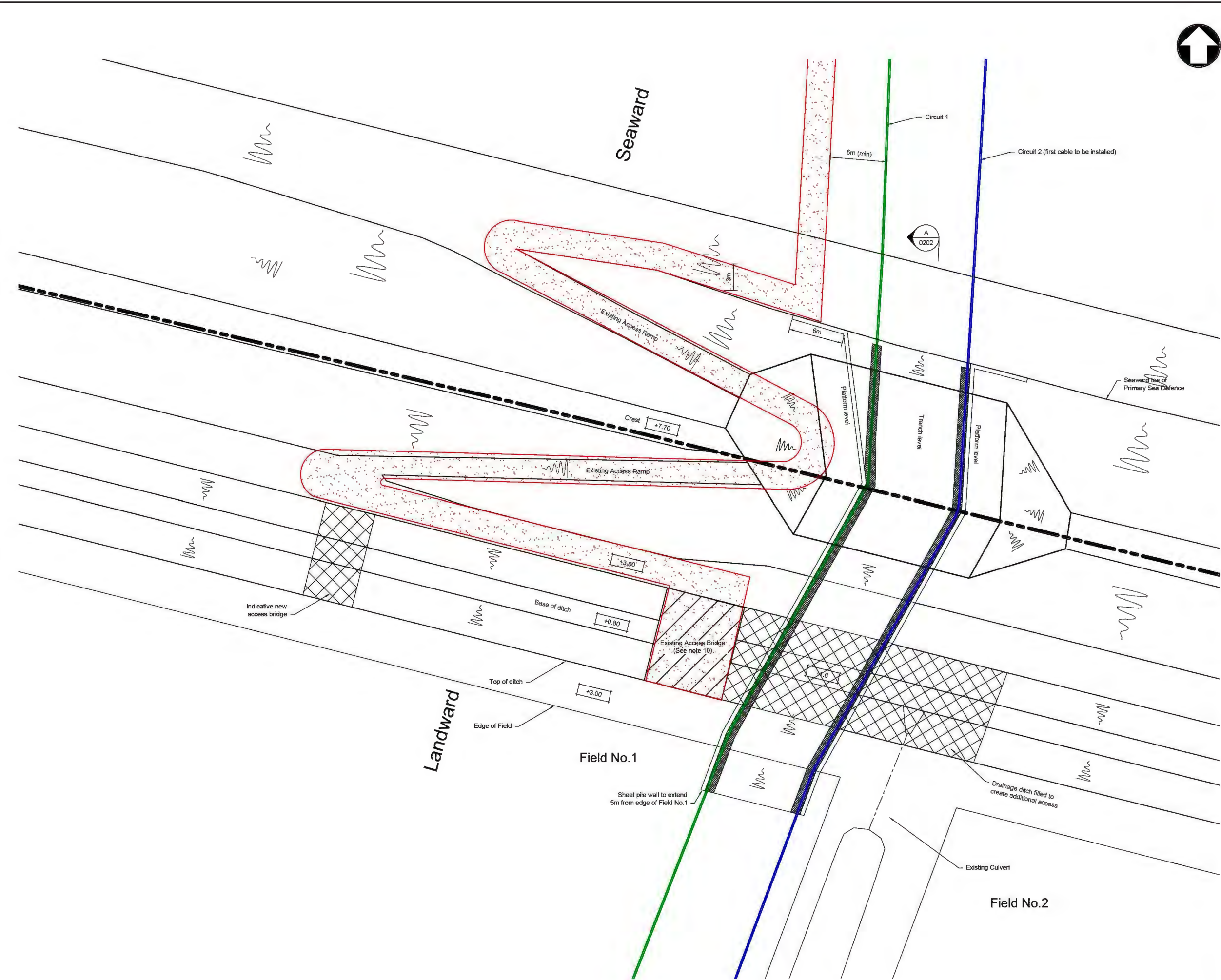
Title

Race Bank Export Cable Installation
Sea Defence Breach
Reference Drawings
Trackway East Cable

Designed	E Shaw-Smith	ESS	Eng check	E Shaw-Smith	ESS
Drawn	I A Sussex	IAS	Coordination	M Wearmouth	MW
Dwg check	M Wearmouth	MW	Approved	R Turner	RT
Scale at A1	Status	Rev	Security		
1:200	PRE	P1	STD		

Drawing Number

MMD-357166-C-SK-00-XX-0019



Plan
1:200

Notes

- All dimensions are in metres unless noted otherwise.
- All levels are in metres relative to Ordnance Datum Newlyn (ODN) unless noted otherwise.
- All positions are in metres relative to British National Grid.
- Indicative drawings only. Not to be used for construction.
- See MMD-357166-C-DR-00-XX-0001 and MMD-357166-C-DR-00-XX-0002 for the Site Plan and Topographic Plan respectively.
- Final layout & position of temporary trackway to be developed by the Contractor & approved by the Employers Representative.

Key to symbols

- Cable Alignment No. 1 (Circuit 1)
- Cable Alignment No. 2 (Circuit 2)
- Landward Boundary of designated sites
- Extent of open excavation
- Extent of sheet piles
- Cement based sand encasement
- Concrete mattress protection
- Aluminum Trackway over membrane
- ODN indicative level
- Access bridge

Reference drawings

1:200 0 10m 20m

P1	22.01.16	IAS	Tender Issue	MW	PJP
Rev	Date	Drawn	Description	Ch'kd	App'd

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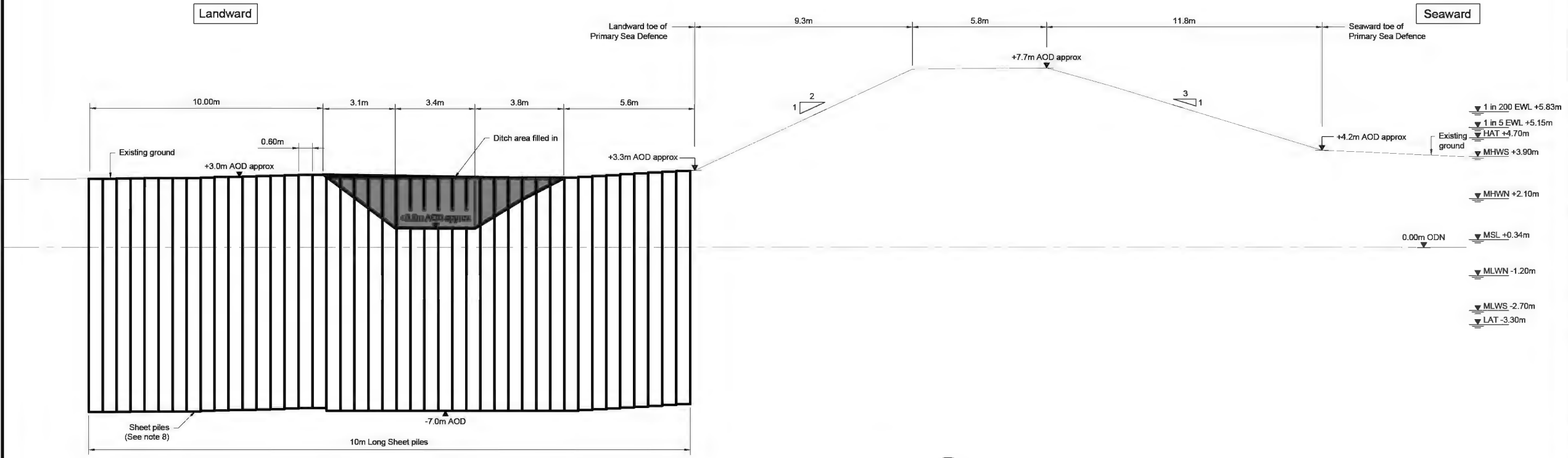
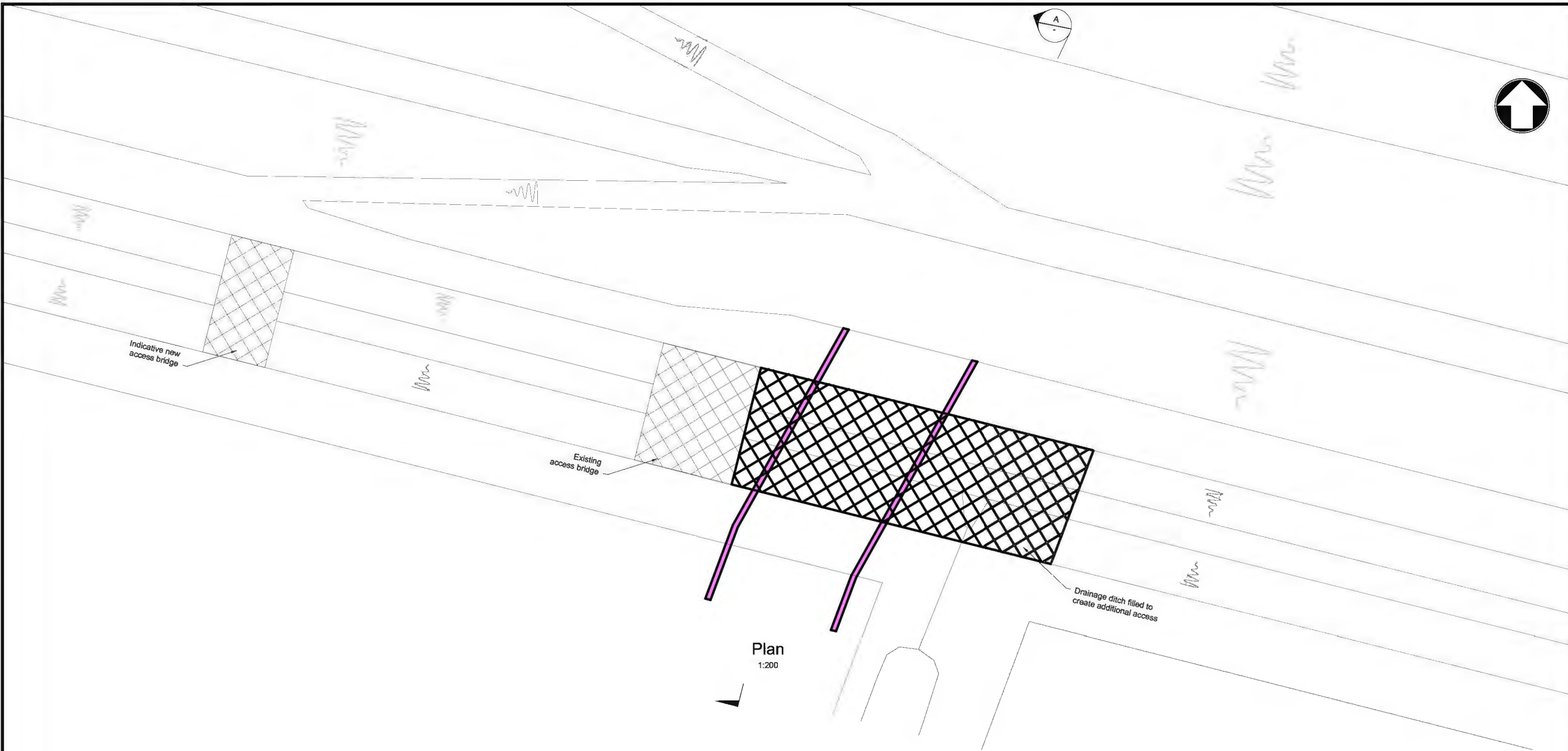
Title

Race Bank Export Cable Installation
Sea Defence Breach
Reference Drawings
Trackway West Cable

Designed	E Shaw-Smith	ESS	Eng check	E Shaw-Smith	ESS
Drawn	I A Sussex	IAS	Coordination	M Wearmouth	MW
Dwg check	M Wearmouth	MW	Approved	R Turner	RT
Scale at A1	Status	Rev	Security		
1:200	PRE	P1	STD		

Drawing Number

MMD-357166-C-SK-00-XX-0020



- Notes
1. All dimensions are in metres unless noted otherwise.
 2. All levels are in metres relative to Ordnance Datum Newlyn (ODN) unless noted otherwise.
 3. All positions are in metres relative to OSGB 36.
 4. Construction sequence drawings only. Not to be used for construction.
 5. Topographic data reproduced from LSTC Onshore Topographic Survey (2014) & Fugro Geophysical Investigation (2014).
 6. Water levels based on the "Race Bank Export Cable Installation 2016 Sea Defence Breach Study Report" (MML 2015).
 7. See MMD-348992-C-DR-00-XX-0001 and MMD-348992-C-DR-00-XX-0002 for the Site Plan and Topographic Plan respectively.
 8. See the storyboard in the "Race Bank Export Cable Installation 2016 Consent Application Study Report" (Document No. "357166_011", MML, 2016) for further details on the construction sequence.
 9. Ditch area to be in-filled for access prior to installation of landside sheet piles.
 10. Pump system for the management of ditch water levels to be in place prior to ditch area being in-filled.
 11. Bog mats used for piling operations to spread plant loads.

- Key to symbols
- Circuit 2 (first cable installation) - Cable Alignment No. 2
 - Circuit 1 (second cable installation) - Cable Alignment No. 1
 - Extent of sheet piles
 - Cable bedding layer
 - Cable concrete protective cover
 - ODN indicative level
 - Waterproof Polythene sheet
 - Quick wall high impermeable container
 - Extent of excavation
 - Extent of fill
 - Access bridge

Reference drawings

P3	08.03.16	PS	Flood Defence Consent Issue	MW	RT
P2	23.02.16	PS	Minor Amendments	MW	RT
P1	200116	IAS	Preliminary Issue	MW	PJP
Rev	Date	Drawn	Description	Ch'kd	App'd

P3	08.03.16	PS	Flood Defence Consent Issue	MW	RT
P2	23.02.16	PS	Minor Amendments	MW	RT
P1	200116	IAS	Preliminary Issue	MW	PJP
Rev	Date	Drawn	Description	Ch'kd	App'd

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Client

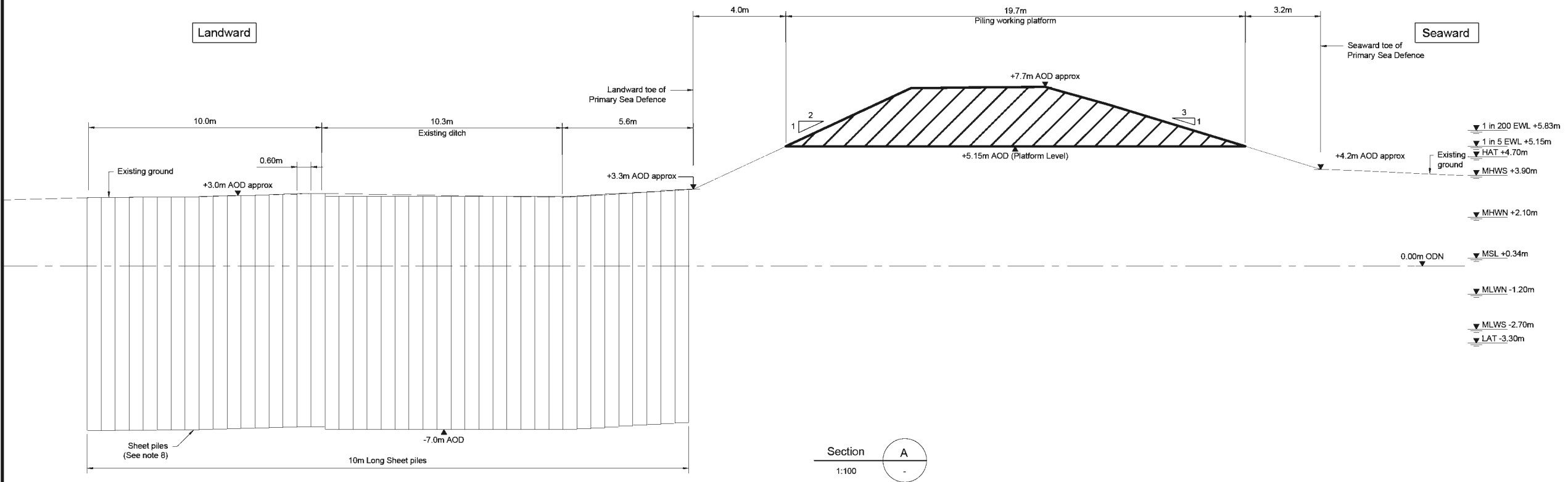
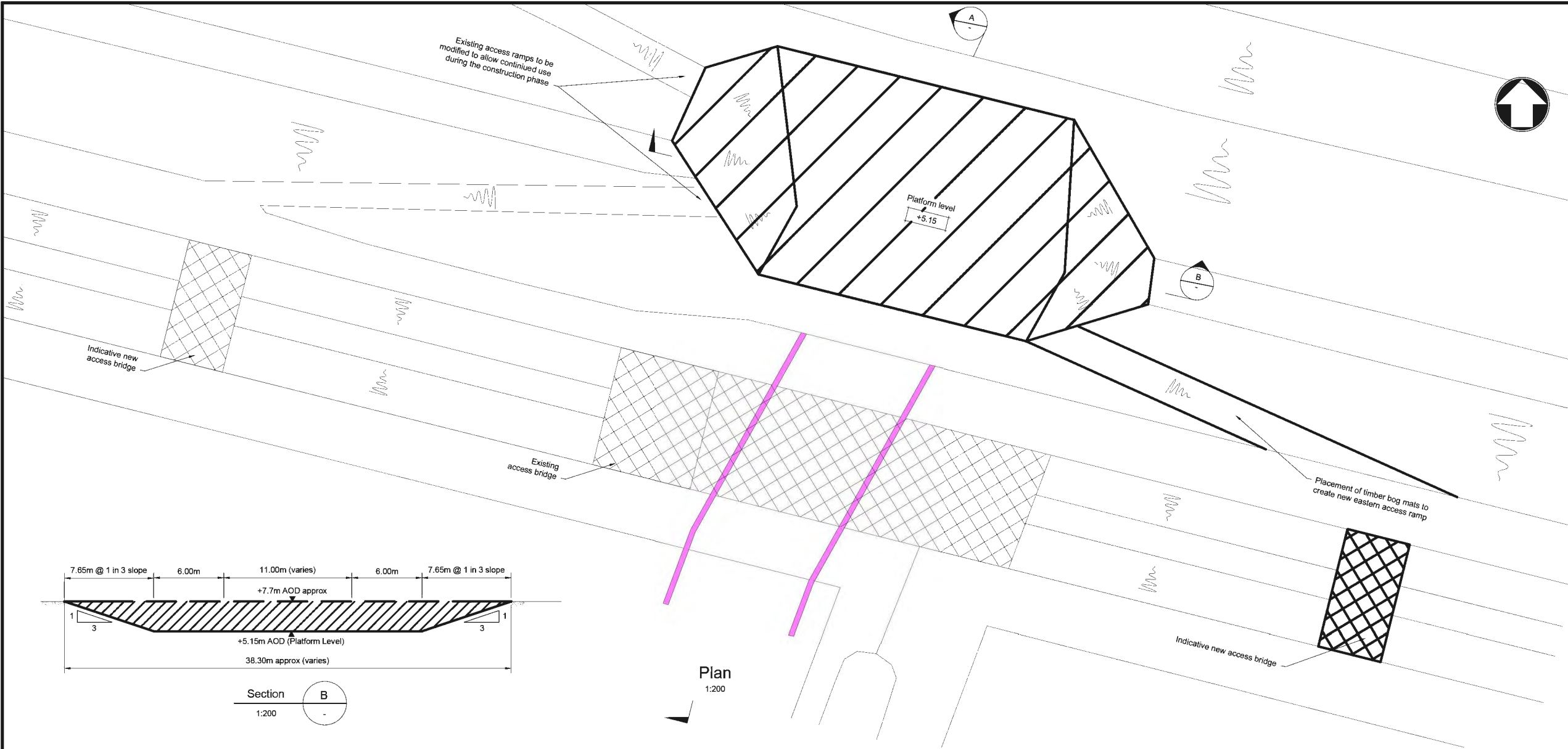
DONG energy

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5 Howick Place SW1P 1WG
London, United Kingdom

Title

Race Bank Export Cable Installation
Sea Defence Breach
Construction Sequence Drawings
Construction Sequence No.2 (CS-2)
Installation of landside sheet piles

Designed	E Shaw-Smith	ESS	Eng check	E Shaw-Smith	ESS
Drawn	I A Sussex	IAS	Coordination	M Wearmouth	MW
Dwg check	M Wearmouth	MW	Approved	R Turner	RT
Scale at A1	Status	Rev	Security		
As shown	PRE	P2	STD		
Drawing Number					
MMD-357166-C-DR-00-XX-0300					



- Notes
1. All dimensions are in metres unless noted otherwise.
 2. All levels are in metres relative to Ordnance Datum Newlyn (ODN) unless noted otherwise.
 3. All positions are in metres relative to OSGB 36.
 4. Construction sequence drawings only. Not to be used for construction.
 5. Topographic data reproduced from LSTC Onshore Topographic Survey (2014) & Fugro Geophysical Investigation (2014).
 6. Water levels based on the "Race Bank Export Cable Installation 2016 Sea Defence Breach Study Report" (MML 2015).
 7. See MMD-348992-C-DR-00-XX-0001 and MMD-348992-C-DR-00-XX-0002 for the Site Plan and Topographic Plan respectively.
 8. See the storyboard in the "Race Bank Export Cable Installation 2016 Consent Application Study Report" (Document No. '357166_011', MML, 2016) for further details on the construction sequence.

- Key to symbols
- Circuit 2 (first cable installation) - Cable Alignment No. 2
 - Circuit 1 (second cable installation) - Cable Alignment No. 1
 - Extent of sheet piles
 - Cable bedding layer
 - Cable concrete protective cover
 - ODN indicative level
 - Waterproof Polythene sheet
 - Quick wall high impermeable container
 - Extent of excavation
 - Extent of fill
 - Access bridge

Reference drawings

P4	08.03.16	PS	Flood Defence Consent Issue	MW	RT
P3	04.03.16	PS	Minor Amendments	MW	RT
P2	23.02.16	PS	Minor Amendments	MW	RT
P1	20.01.16	IAS	Preliminary Issue	MW	PJP
Rev	Date	Drawn	Description	Ch'k'd	App'd

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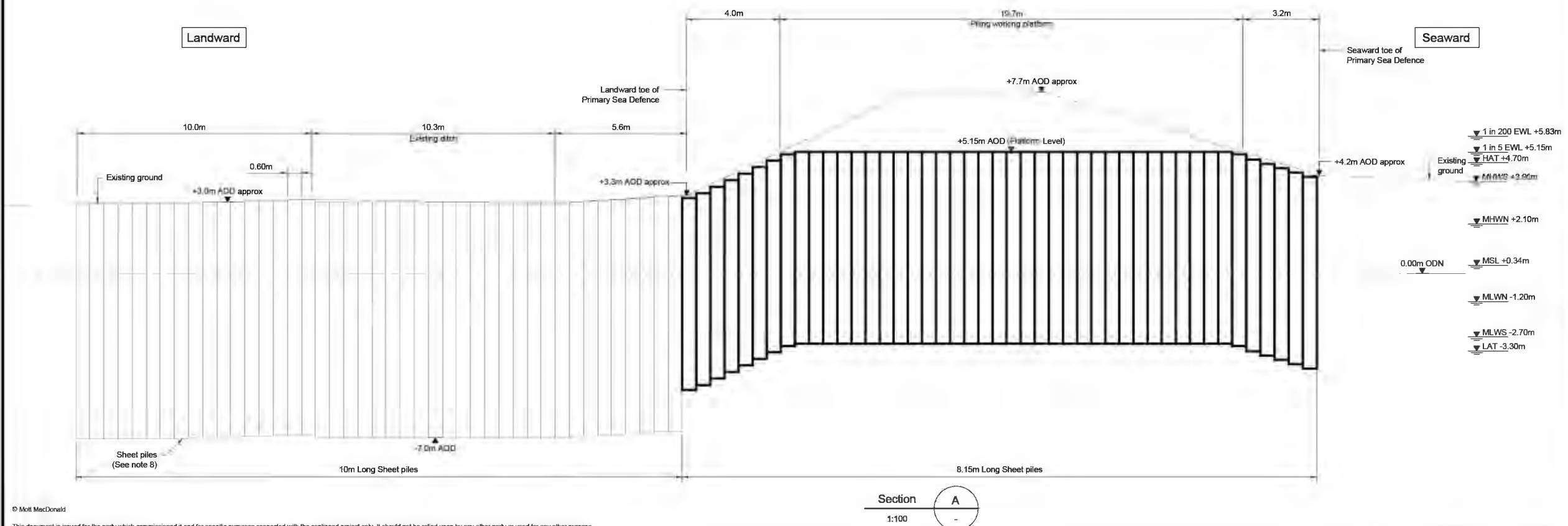
DONG energy

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London, United Kingdom

Title

Race Bank Export Cable Installation
Sea Defence Breach
Construction Sequence Drawings
Construction Sequence No. 4 (CS-4)
Excavate sea defence to Platform Level

Designed	E Shaw-Smith	ESS	Eng check	E Shaw-Smith	ESS
Drawn	I A Sussex	IAS	Coordination	M Wearmouth	MW
Dwg check	M Wearmouth	MW	Approved	R Turner	RT
Scale at A1	Status	Rev	Security		
As shown	APR	P4	STD		
Drawing Number					
MMD-357166-C-DR-00-XX-0301					



- Notes
1. All dimensions are in metres unless noted otherwise.
 2. All levels are in metres relative to Ordnance Datum Newlyn (ODN) unless noted otherwise.
 3. All positions are in metres relative to OSGB 36.
 4. Construction sequence drawings only. Not to be used for construction.
 5. Topographic data reproduced from LSTC Onshore Topographic Survey (2014) & Fugro Geophysical Investigation (2014).
 6. Water levels based on the "Race Bank Export Cable Installation 2016 Sea Defence Breach Study Report" (MML 2015).
 7. See MMD-348992-C-DR-00-XX-0001 and MMD-348992-C-DR-00-XX-0002 for the Site Plan and Topographic Plan respectively.
 8. See the storyboard in the "Race Bank Export Cable Installation 2016 Consent Application Study Report" (Document No. "357166_011", MML, 2016) for further details on the construction sequence.
 9. Bog mats used for piling operations to spread plant loads.

Key to symbols

	Circuit 2 (first cable installation) - Cable Alignment No. 2
	Circuit 1 (second cable installation) - Cable Alignment No. 1
	Extent of sheet piles
	Cable bedding layer
	Cable concrete protective cover
	ODN indicative level
	Waterproof Polythene sheet
	Quick wall high impermeable container
	Extent of excavation
	Extent of fill
	Access bridge

Reference drawings

P4	08.03.16	PS	Flood Defence Consent Issue	MW	RT
P3	04.03.16	PS	Minor Amendments	MW	RT
P2	23.02.16	PS	Minor Amendments	MW	RT
P1	200116	IAS	Preliminary Issue	MW	PJP
Rev	Date	Drawn	Description	Ch'kd	App'd

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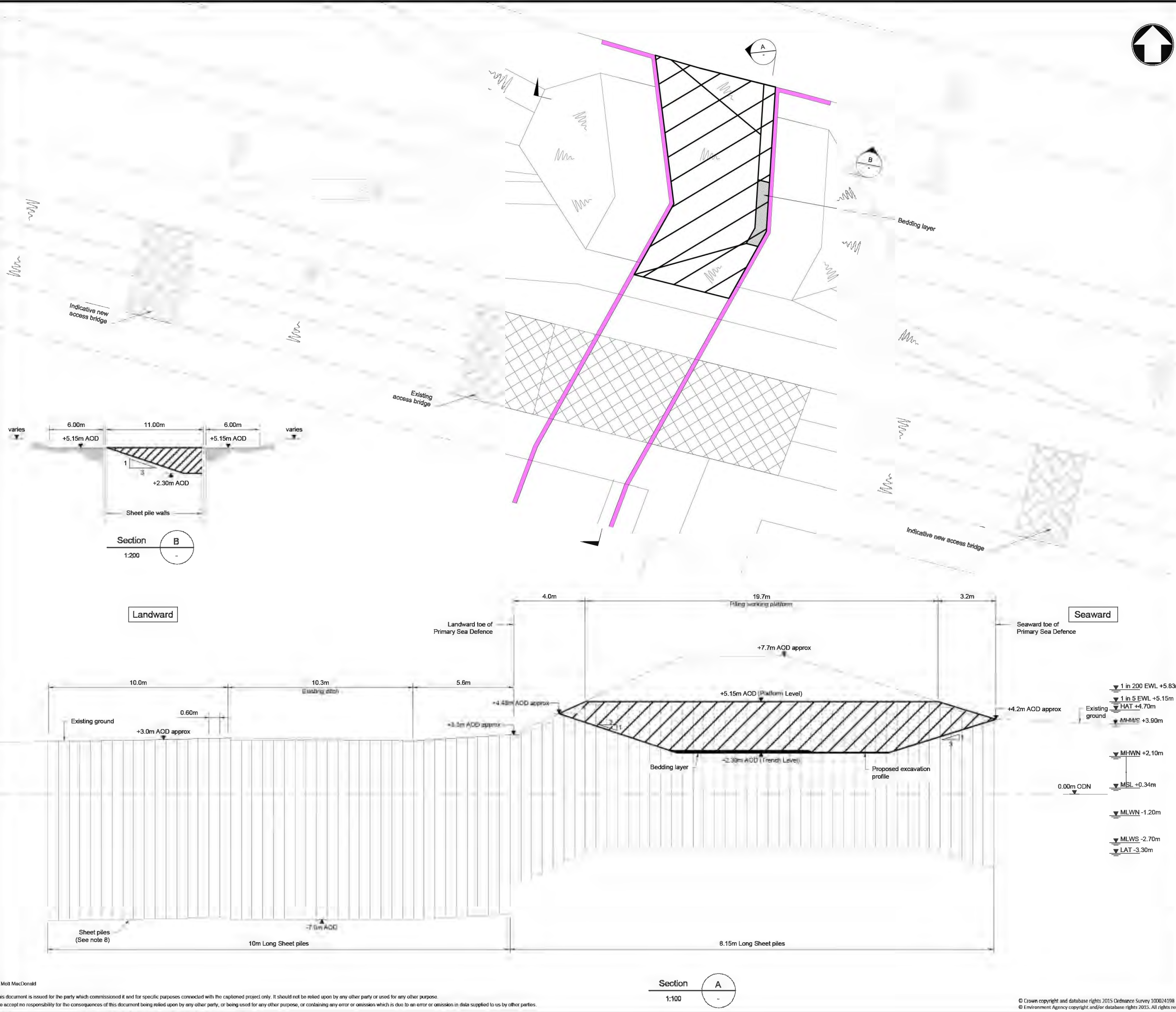
Title

Race Bank Export Cable Installation
Sea Defence Breach
Construction Sequence Drawings
Construction Sequence No.5 (CS-5)
Installation of sea defence sheet piles

Designed	E Shaw-Smith	ESS	Eng check	E Shaw-Smith	ESS
Drawn	I A Sussex	IAS	Coordination	M Warrum	MW
Dwg check	M Warrum	MW	Approved	R Turner	RT
Scale at A1	1:200	Status	APR	Rev	P4
				Security	STD

Drawing Number

MMD-357166-C-DR-00-XX-0302



- Notes
1. All dimensions are in metres unless noted otherwise.
 2. All levels are in metres relative to Ordnance Datum Newlyn (ODN) unless noted otherwise.
 3. All positions are in metres relative to OSGB 36.
 4. Construction sequence drawings only. Not to be used for construction.
 5. Topographic data reproduced from LSTC Onshore Topographic Survey (2014) & Fugro Geophysical Investigation (2014).
 6. Water levels based on the "Race Bank Export Cable Installation 2016 Sea Defence Breach Study Report" (MML 2015).
 7. See MMD-348992-C-DR-00-XX-0001 and MMD-348992-C-DR-00-XX-0002 for the Site Plan and Topographic Plan respectively.
 8. See the storyboard in the "Race Bank Export Cable Installation 2016 Consent Application Study Report" (Document No. "357166_011", MML, 2016) for further details on the construction sequence.
 9. The programmed duration between CS-8 and CS-13 (i.e. the opening of the defences) is 5.5 days.

Key to symbols

	Circuit 2 (first cable installation) - Cable Alignment No. 2
	Circuit 1 (second cable installation) - Cable Alignment No. 1
	Extent of sheet piles
	Cable bedding layer
	Cable concrete protective cover
	ODN indicative level
	Waterproof Polythene sheet
	Quick wall high impermeable container
	Extent of excavation
	Extent of fill
	Access bridge

Reference drawings

P4	08.03.16	PS	Flood Defence Consent Issue	MW	RT
P3	04.03.16	PS	Minor amendments	MW	RT
P2	23.02.16	PS	Construction Sequence Changes	MW	RT
P1	200116	IAS	Preliminary Issue	MW	PJP
Rev	Date	Drawn	Description	Ch'kd	App'd

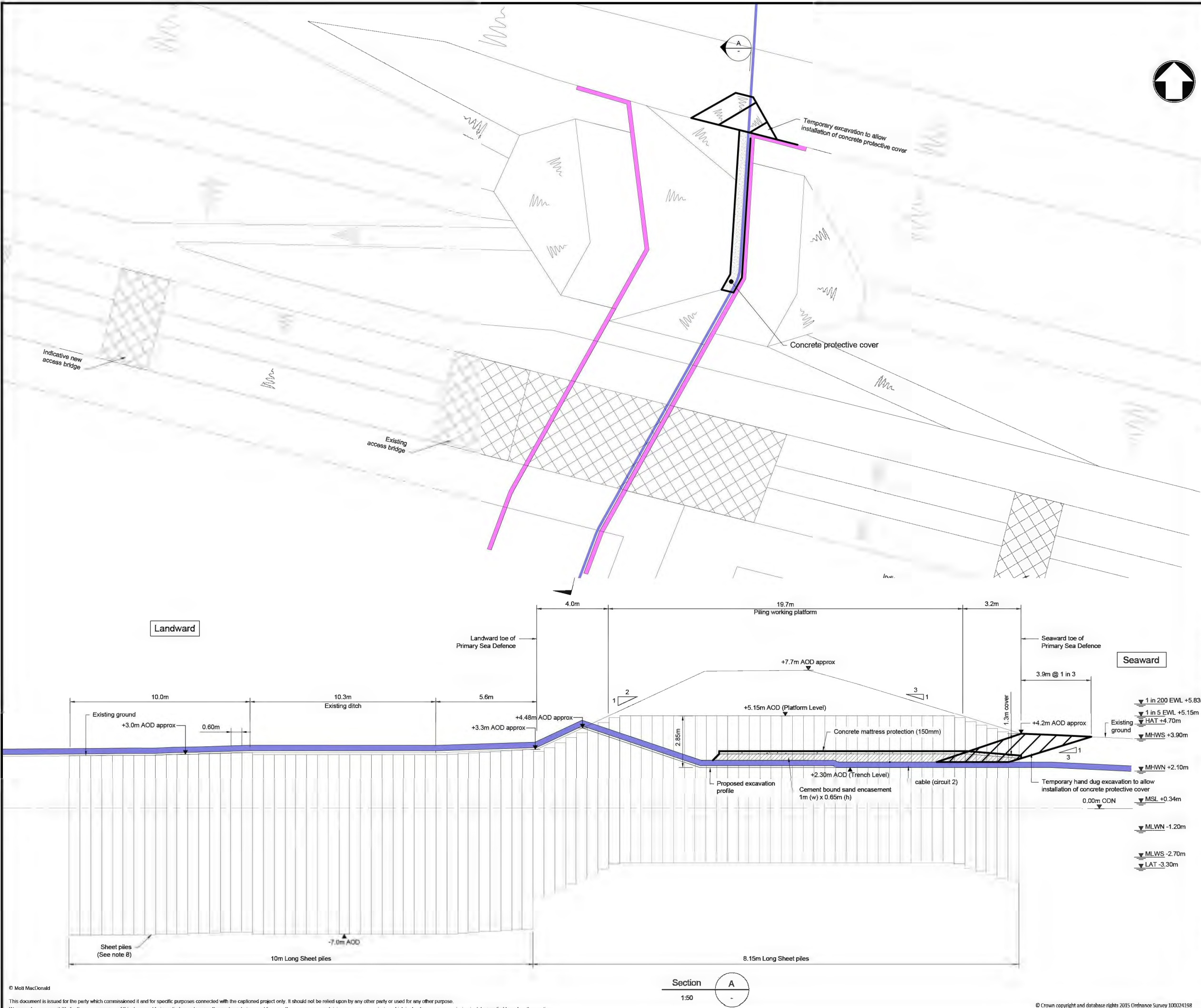
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Task
**Race Bank Export Cable Installation
Sea Defence Breach
Construction Sequence Drawings
Construction Sequence No. 8 (CS-8)
Circuit 2: Phase 1 Excavation**

Designed	E Shaw Smith	ESS	Eng check	E Shaw Smith	ESS
Drawn	I A Sussex	IAS	Coordination	M Wainwright	MW
Dwg check	M Wainwright	MW	Approved	R Turner	RT
Scale at A1	Status	Rev	Security		
As shown	APR	P4	STD		

Drawing Number
MMD-357166-C-DR-00-XX-0303



Notes

- All dimensions are in metres unless noted otherwise.
- All levels are in metres relative to Ordnance Datum Newlyn (ODN) unless noted otherwise.
- All positions are in metres relative to OSGB 36.
- Construction sequence drawings only. Not to be used for construction.
- Topographic data reproduced from LSTC Onshore Topographic Survey (2014) & Fugro Geophysical Investigation (2014).
- Water levels based on the "Race Bank Export Cable Installation 2016 Sea Defence Breach Study Report" (MML 2015).
- See MMD-348992-C-DR-00-XX-0001 and MMD-348992-C-DR-00-XX-0002 for the Site Plan and Topographic Plan respectively.
- See the storyboard in the "Race Bank Export Cable Installation 2016 Consent Application Study Report" (Document No. "357166_011", MML, 2016) for further details on the construction sequence.
- Temporary hand-digging operation to allow installation of concrete protective cover within the sea defence, covered under ECIP and Appropriate Assessment (AA). Total area of works shown is 23m² per cable installation. Total area considered under the AA is 24.5m² per cable installation.

Key to symbols

- Circuit 2 (first cable installation) - Cable Alignment No. 2
- Circuit 1 (second cable installation) - Cable Alignment No. 1
- Extent of sheet piles
- Cable bedding layer
- Cable concrete protective cover
- ODN indicative level
- Waterproof Polythene sheet
- Quick wall high impermeable container
- Extent of excavation
- Extent of fill
- Access bridge

Reference drawings

Rev	Date	Drawn	Description	Ch'kd	App'd
P4	08.03.16	PS	Flood Defence Consent Issue	MW	RT
P3	04.03.16	AJ	Salt marsh hand-dug excavation	MW	RT
P2	23.02.16	PS	Construction Sequence Changes	MW	RT
P1	200116	IAS	Preliminary Issue	MW	PJP

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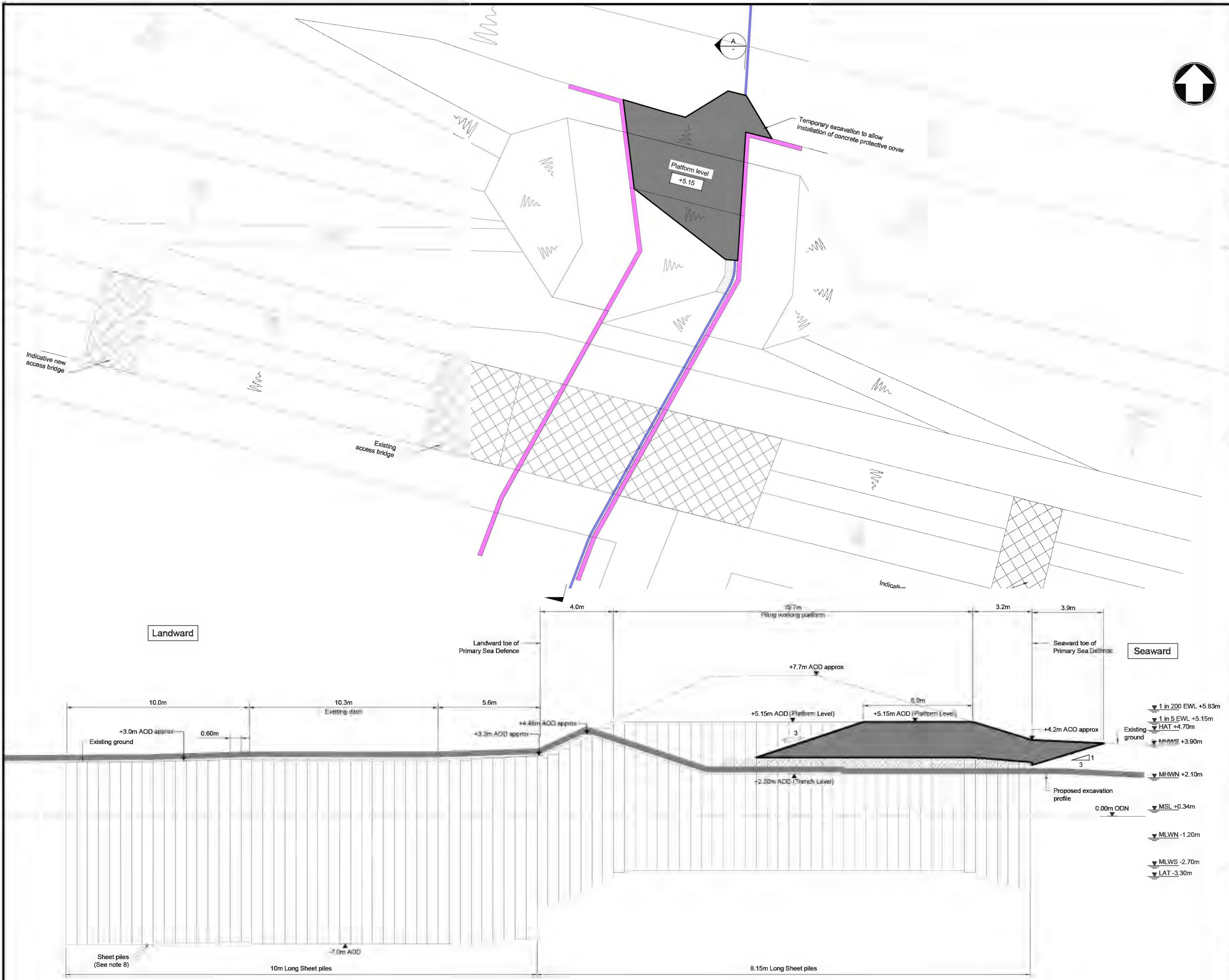
Title

Race Bank Export Cable Installation
Sea Defence Breach
Construction Sequence Drawings
Construction Sequence No. 12 (CS-12)
Circuit 2: Phase 1 Cable Installation

Designed	E Shaw-Smith	ESS	Eng check	E Shaw-Smith	ESS
Drawn	I A Sussex	IAS	Coordination	M Wearmouth	MW
Dwg check	M Wearmouth	MW	Approved	R Turner	RT

Scale at A1: 1:200 Status: APR Rev: P4 Security: STD

Drawing Number: MMD-357166-C-DR-00-XX-0304



Notes

- All dimensions are in metres unless noted otherwise.
- All levels are in metres relative to Ordnance Datum Newlyn (ODN) unless noted otherwise.
- All positions are in metres relative to OSGB 36.
- Construction sequence drawings only. Not to be used for construction.
- Topographic data reproduced from LSTC Onshore Topographic Survey (2014) & Fugro Geophysical Investigation (2014).
- Water levels based on the "Race Bank Export Cable Installation 2016 Sea Defence Breach Study Report" (MML 2015).
- See MMD-348992-C-DR-00-XX-0001 and MMD-348992-C-DR-00-XX-0002 for the Site Plan and Topographic Plan respectively.
- See the storyboard in the "Race Bank Export Cable Installation 2016 Consent Application Study Report" (Document No. "357166_011", MML, 2016) for further details on the construction sequence.
- The programmed duration between CS-8 and CS-13 (i.e. the opening of the defences) is 5.5 days.

Key to symbols

- Circuit 2 (first cable installation) - Cable Alignment No. 2
- Circuit 1 (second cable installation) - Cable Alignment No. 1
- Extent of sheet piles
- Cable bedding layer
- Cable concrete protective cover
- ODN indicative level
- Waterproof Polythene sheet
- Quick wall high impermeable container
- Extent of excavation
- Extent of fill
- Access bridge

Reference drawings

P4	08.03.16	PS	Flood Defence Consent Issue	MW	RT
P3	04.03.16	PS	Salt marsh hard-slag excavation	MW	RT
P2	23.02.16	PS	Construction Sequence Changes	MW	RT
P1	200116	IAS	Preliminary Issue	MW	PJP
Rev	Date	Drawn	Description	Ch'kd	App'd

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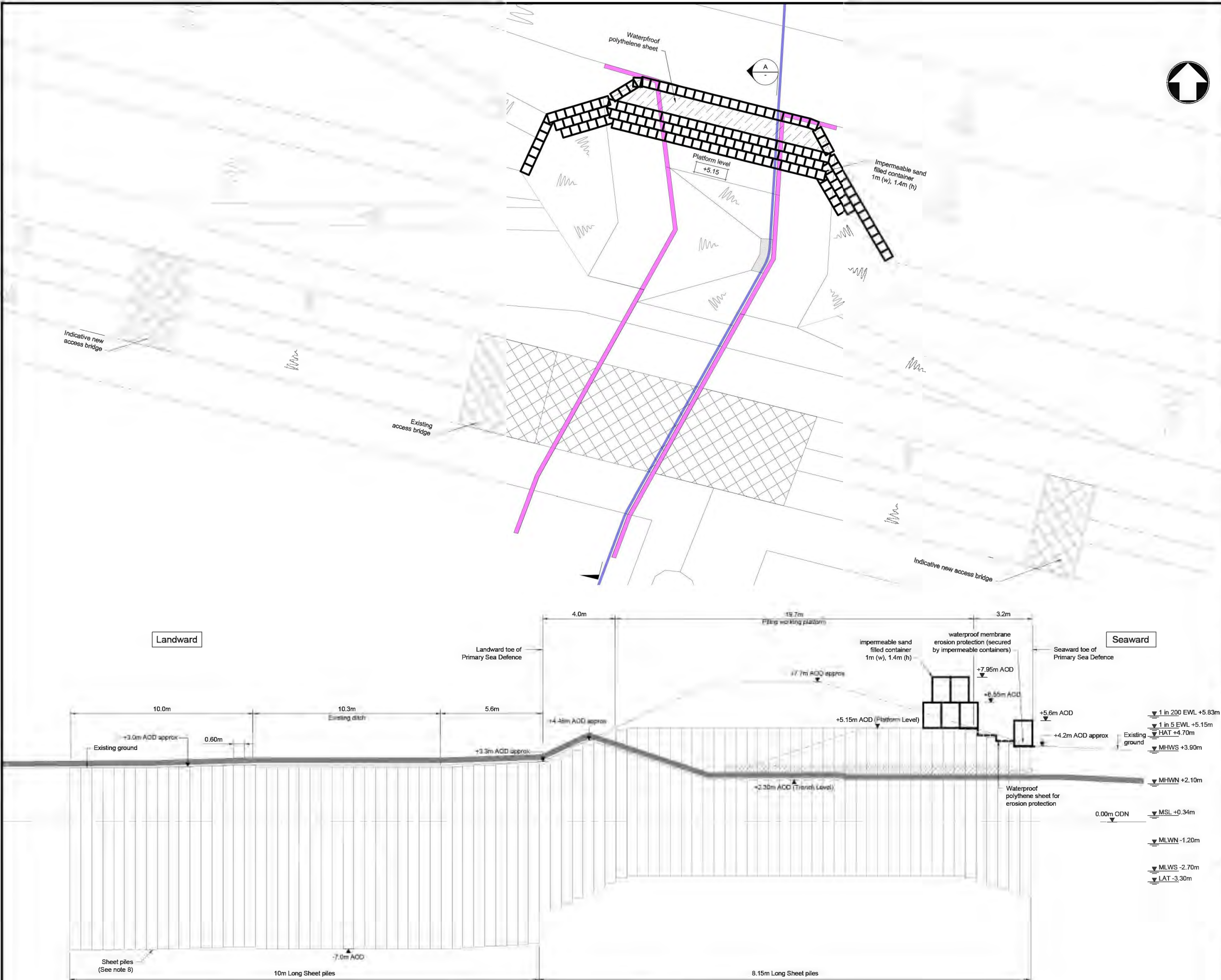
Title

Race Bank Export Cable Installation
Sea Defence Breach
Construction Sequence Drawings
Construction Sequence No. 13 (CS-13)
Circuit 2: Phase 1 Reinstatement

Designed	E Shaw-Smith	ESS	Eng check	E Shaw-Smith	ESS
Drawn	I A Sussex	IAS	Coordination	M Wymouth	MW
Dwg check	M Wymouth	MW	Approved	R Turner	RT
Scale at A1	Status	Rev	Security		
As shown	APR	P4	STD		

Drawing Number

MMD-357166-C-DR-00-XX-0305



- Notes
1. All dimensions are in metres unless noted otherwise.
 2. All levels are in metres relative to Ordnance Datum Newlyn (ODN) unless noted otherwise.
 3. All positions are in metres relative to OSGB 36.
 4. Construction sequence drawings only. Not to be used for construction.
 5. Topographic data reproduced from LSTC Onshore Topographic Survey (2014) & Fugro Geophysical Investigation (2014).
 6. Water levels based on the "Race Bank Export Cable Installation 2016 Sea Defence Breach Study Report" (MML 2015).
 7. See MMD-348992-C-DR-00-XX-0001 and MMD-348992-C-DR-00-XX-0002 for the Site Plan and Topographic Plan respectively.
 8. See the storyboard in the "Race Bank Export Cable Installation 2016 Consent Application Study Report" (Document No. '357166_011', MML, 2016) for further details on the construction sequence.

- Key to symbols
- Circuit 2 (first cable installation) - Cable Alignment No. 2
 - Circuit 1 (second cable installation) - Cable Alignment No. 1
 - Extent of sheet piles
 - Cable bedding layer
 - Cable concrete protective cover
 - ODN indicative level
 - Waterproof Polythene sheet
 - Quick wall high impermeable container
 - Extent of excavation
 - Extent of fill
 - Access bridge

Reference drawings

P4	08.03.16	PS	Flood Defence Consent Issue	MW	RT
P3	04.03.16	PS	Minor Amendments	MW	RT
P2	23.02.16	PS	Minor Amendments	MW	RT
P1	200116	IAS	Preliminary Issue	MW	PJP
Rev	Date	Drawn	Description	Ch'kd	App'd

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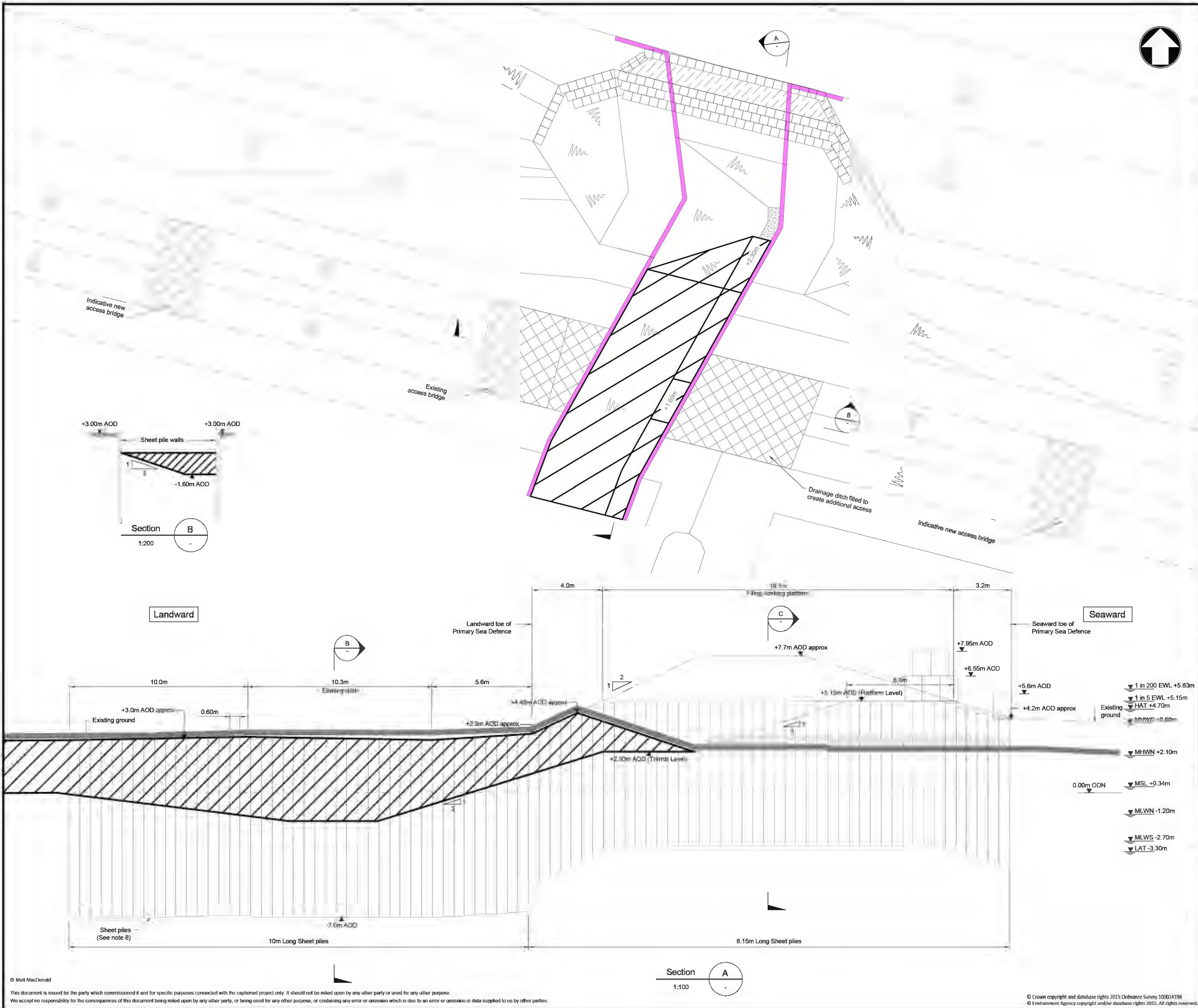
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5 Howick Place SW1P 1WG
London, United Kingdom

**Race Bank Export Cable Installation
Sea Defence Breach
Construction Sequence Drawings
Construction Sequence No.14 (CS-14)
Deployment of temporary flood defence**

Designed	E Shaw Smith	ESS	Eng check	E Shaw Smith	ESS
Drawn	I A Sussex	IAS	Coordination	M Wainwright	MW
Dwg check	M Wainwright	MW	Approved	R Turner	RT
Scale at A1	1:200	Status	APR	Rev	P4
Security	STD				

Drawing Number
MMD-357166-C-DR-00-XX-0306



Notes

- All dimensions are in metres unless noted otherwise.
- All levels are in metres relative to Ordnance Datum Newlyn (ODN) unless noted otherwise.
- All positions are in metres relative to OSGB 36.
- Construction sequence drawings only. Not to be used for construction.
- Topographic data reproduced from LSTC Onshore Topographic Survey (2014) & Fugro Geophysical Investigation (2014).
- Water levels based on the "Race Bank Export Cable Installation 2016 Sea Defence Breach Study Report" (MML 2015).
- See MMD-34892-C-DR-00-XX-0001 and MMD-34892-C-DR-00-XX-0002 for the Site Plan and Topographic Plan respectively.
- See the storyboard in the "Race Bank Export Cable Installation 2016 Consent Application Study Report" (Document No. "357166_011", MML, 2016) for further details on the construction sequence.
- Cable across the ditch area to be relocated prior to phase 2 excavation works commence.

Key to symbols

- Circuit 2 (first cable installation) - Cable Alignment No. 2
- Circuit 1 (second cable installation) - Cable Alignment No. 1
- Extent of sheet piles
- Cable bedding layer
- Cable concrete protective cover
- ODN indicative level
- Waterproof Polythene sheet
- Quick wall high impermeable container
- Extent of excavation
- Extent of fill
- Access bridge

Reference drawings

Rev	Date	Drawn	Description	Ch'kd	App'd
P4	08.03.16	PS	Flood Defence Consent Issue	MW	RT
P3	04.03.16	PS	Minor amendments	MW	RT
P2	23.02.16	PS	Construction Sequence Changes	MW	RT
P1	200116	IAS	Preliminary Issue	MW	PJP

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Race Bank Export Cable Installation
Sea Defence Breach
Construction Sequence Drawings
Construction Sequence No.16 (CS-16)
Circuit 2: Phase 2 Excavation

Designed	E Shaw Smith	ESS	Eng check	E Shaw Smith	ESS
Drawn	I A Sussex	IAS	Coordination	M Wainwright	MW
Dwg check	M Wainwright	MW	Approved	R Turner	RT

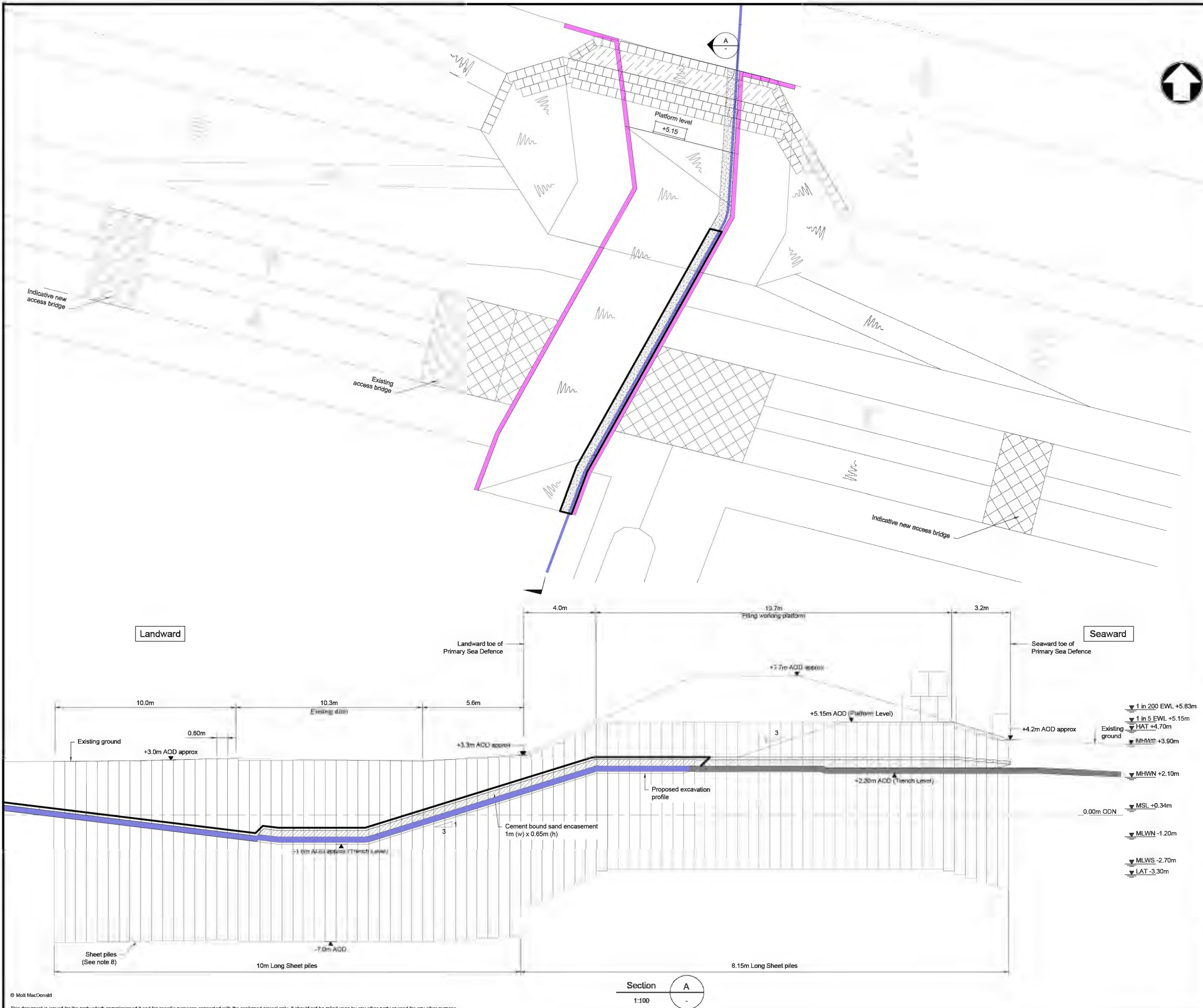
Scale at A1	Status	Rev	Security
1:200	APR	P4	STD

Drawing Number
MMD-357166-C-DR-00-XX-0307

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- Notes
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 2. All levels are in metres relative to Ordnance Datum Newlyn (ODN) unless noted otherwise.
 3. All positions are in metres relative to OSGB 36.
 4. Construction sequence drawings only. Not to be used for construction.
 5. Topographic data reproduced from LSTC Onshore Topographic Survey (2014) & Fugro Geophysical Investigation (2014).
 6. Water levels based on the "Race Bank Export Cable Installation 2016 Sea Defence Breach Study Report" (MML 2015).
 7. See MMD-348992-C-DR-00-XX-0001 and MMD-348992-C-DR-00-XX-0002 for the Site Plan and Topographic Plan respectively.
 8. See the storyboard in the "Race Bank Export Cable Installation 2016 Consent Application Study Report" (Document No. '357166_011', MML, 2016) for further details on the construction sequence.

- Key to symbols
- Circuit 2 (first cable installation) - Cable Alignment No. 2
 - Circuit 1 (second cable installation) - Cable Alignment No. 1
 - Extent of sheet piles
 - Cable bedding layer
 - Cable concrete protective cover
 - ODN indicative level
 - Waterproof Polythene sheet
 - Quick wall high impermeable container
 - Extent of excavation
 - Extent of fill
 - Access bridge

Reference drawings

P4	08.03.16	PS	Flood Defence Consent Issue	MW	RT
P3	004.03.16	AJ	Minor amendments	MW	RT
P2	23.02.16	PS	Construction Sequence Changes	MW	RT
P1	200116	IAS	Preliminary Issue	MW	PJP
Rev	Date	Drawn	Description	Ch'kd	App'd

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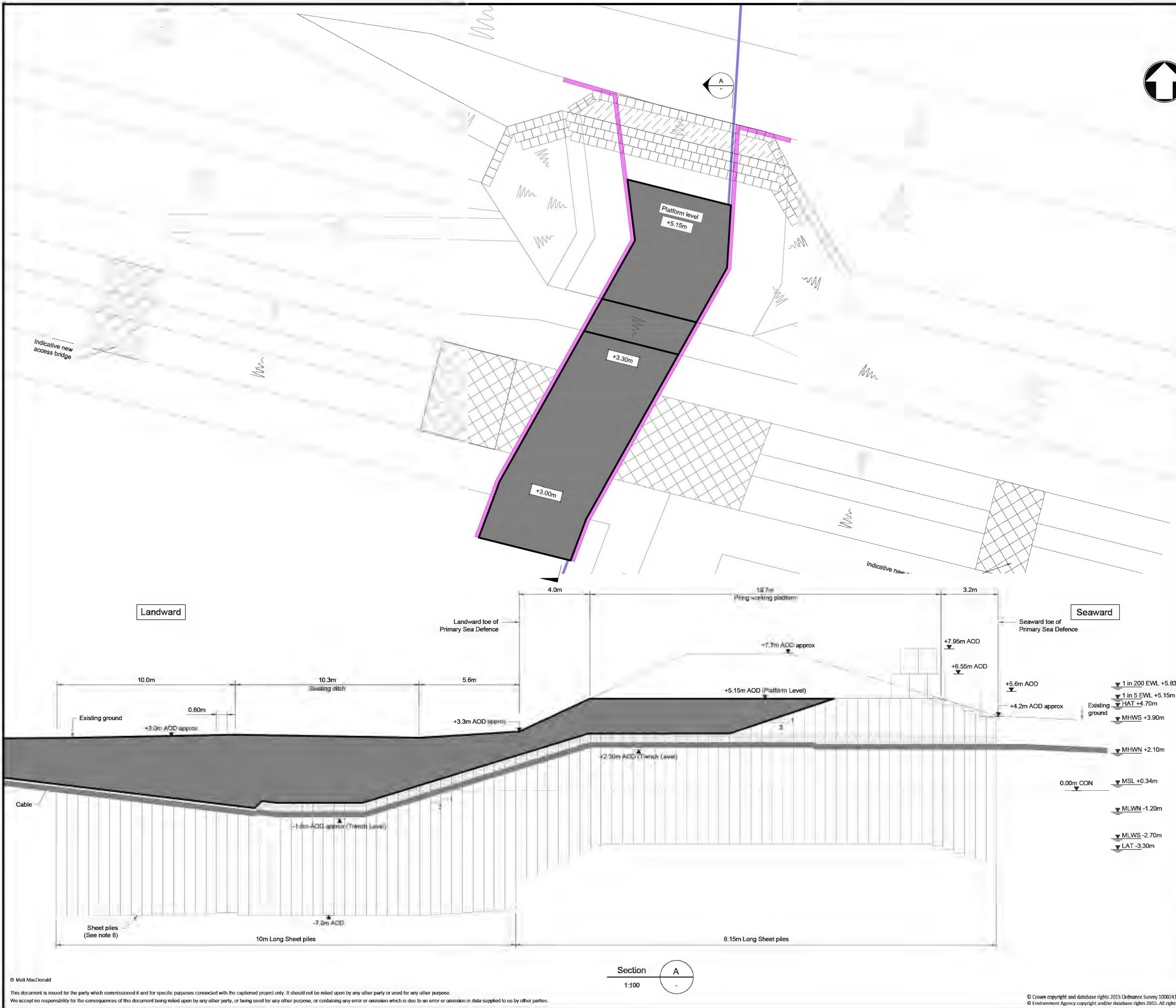
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**Race Bank Export Cable Installation
Sea Defence Breach
Construction Sequence Drawings
Construction Sequence No.17 (CS-17)
Circuit 2: Phase 2 Cable Installation**

Designed	E Shaw-Smith	ESS	Eng check	E Shaw-Smith	ESS
Drawn	I A Sussex	IAS	Coordination	M Wainwright	MW
Dwg check	M Wainwright	MW	Approved	R Turner	RT
Scale at A1	Status	Rev	Security		
As shown	APR	P4	STD		

Drawing Number
MMD-357166-C-DR-00-XX-0308



- Notes
1. All dimensions are in metres unless noted otherwise.
 2. All levels are in metres relative to Ordnance Datum Newlyn (ODN) unless noted otherwise.
 3. All positions are in metres relative to OSGB 36.
 4. Construction sequence drawings only. Not to be used for construction.
 5. Topographic data reproduced from LSTC Onshore Topographic Survey (2014) & Fugro Geophysical Investigation (2014).
 6. Water levels based on the "Race Bank Export Cable Installation 2016 Sea Defence Breach Study Report" (MML 2015).
 7. See MMD-348992-C-DR-00-XX-0001 and MMD-348992-C-DR-00-XX-0002 for the Site Plan and Topographic Plan respectively.
 8. See the storyboard in the "Race Bank Export Cable Installation 2016 Consent Application Study Report" (Document No. '357166_011', MML, 2016) for further details on the construction sequence.

- Key to symbols
- Circuit 2 (first cable installation) - Cable Alignment No. 2
 - Circuit 1 (second cable installation) - Cable Alignment No. 1
 - Extent of sheet piles
 - Cable bedding layer
 - Cable concrete protective cover
 - ODN indicative level
 - Waterproof Polythene sheet
 - Quick wall high impermeable container
 - Extent of excavation
 - Extent of fill
 - Access bridge

Reference drawings

P4	08.03.16	PS	Flood Defence Consent Issue	MW	RT
P3	04.03.16	AJ	Minor amendments	MW	RT
P2	23.02.16	PS	Construction Sequence Changes	MW	RT
P1	200116	IAS	Preliminary Issue	MW	PJP
Rev	Date	Drawn	Description	Chkd	App'd

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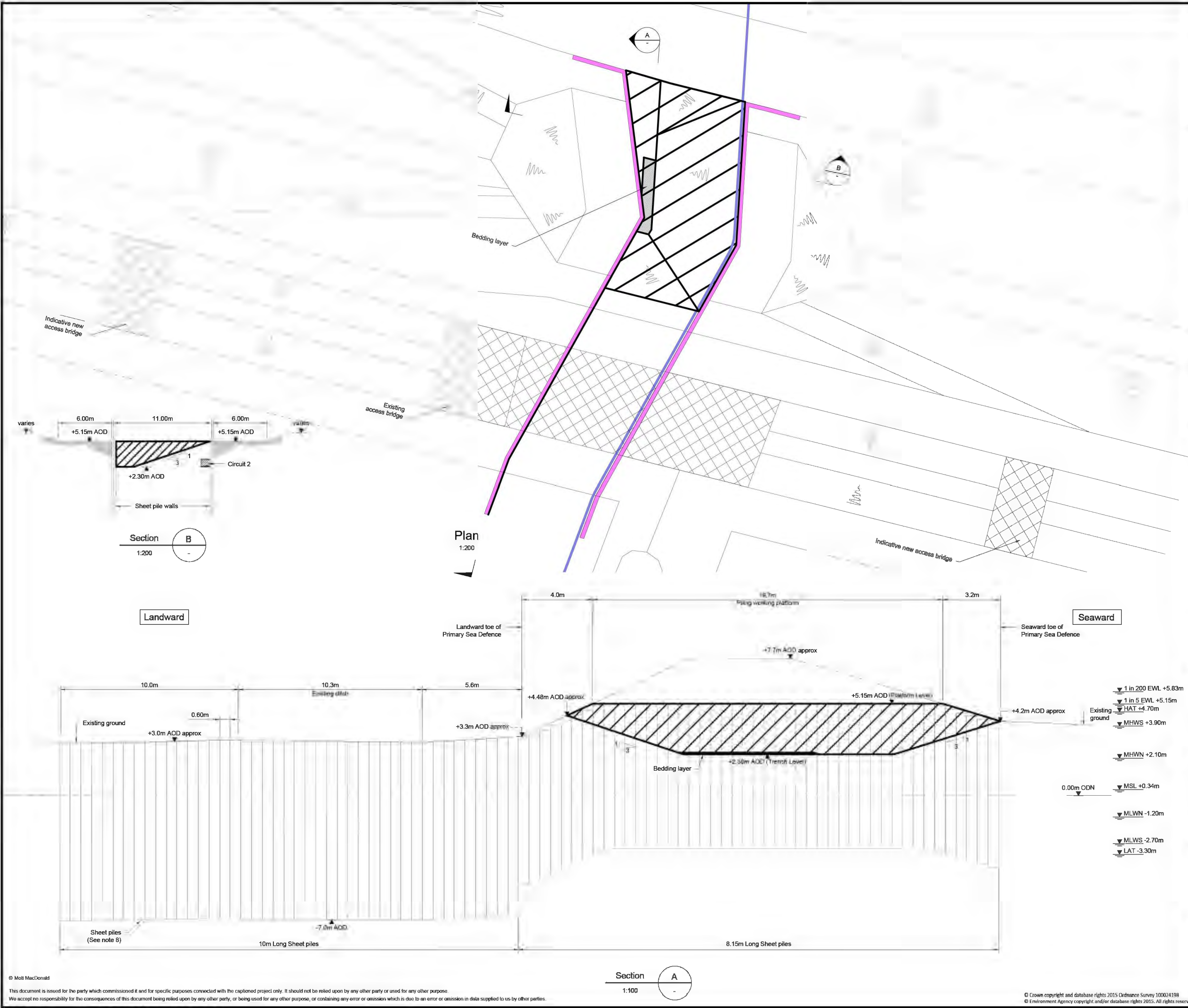
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**Race Bank Export Cable Installation
Sea Defence Breach
Construction Sequence Drawings
Construction Sequence No.18 (CS-18)
Circuit 2: Phase 2 Reinstatement**

Designed	E Shaw-Smith	ESS	Eng check	E Shaw-Smith	ESS
Drawn	I A Sussex	IAS	Coordination	M Wainwright	MW
Dwg check	M Wainwright	MW	Approved	R Turner	RT
Scale at A1	Status	Rev	Security		
As shown	APR	P4	STD		
Drawing Number					
MMD-357166-C-DR-00-XX-0309					



- Notes
1. All dimensions are in metres unless noted otherwise.
 2. All levels are in metres relative to Ordnance Datum Newlyn (ODN) unless noted otherwise.
 3. All positions are in metres relative to OSGB 36.
 4. Construction sequence drawings only. Not to be used for construction.
 5. Topographic data reproduced from LSTC Onshore Topographic Survey (2014) & Fugro Geophysical Investigation (2014).
 6. Water levels based on the "Race Bank Export Cable Installation 2016 Sea Defence Breach Study Report" (MML 2015).
 7. See MMD-348992-C-DR-00-XX-0001 and MMD-348992-C-DR-00-XX-0002 for the Site Plan and Topographic Plan respectively.
 8. See the storyboard in the "Race Bank Export Cable Installation 2016 Consent Application Study Report" (Document No. "357166_011", MML, 2016) for further details on the construction sequence.
 9. The temporary flood defence bags are removed prior to the excavation of the 6m wide crest berm. This operation will not happen if a high tide notification has been issued by the Environment Agency's Flood Warning Duty Officer.
 10. The programmed duration between CS-23 and CS-29 (i.e. the opening of the defences) is 5.5 days.

Key to symbols

	Circuit 2 (first cable installation) - Cable Alignment No. 2
	Circuit 1 (second cable installation) - Cable Alignment No. 1
	Extent of sheet piles
	Cable bedding layer
	Cable concrete protective cover
	ODN indicative level
	Waterproof Polythene sheet
	Quick wall high impermeable container
	Extent of excavation
	Extent of fill
	Access bridge

Reference drawings

P4	08.03.16	PS	Flood Defence Consent Issue	MW	RT
P3	04.03.16	AJ	Minor amendments	MW	RT
P2	23.02.16	PS	Construction Sequence Drawings	MW	RT
P1	200116	IAS	Preliminary Issue	MW	PJP
Rev	Date	Drawn	Description	Ch'kd	App'd

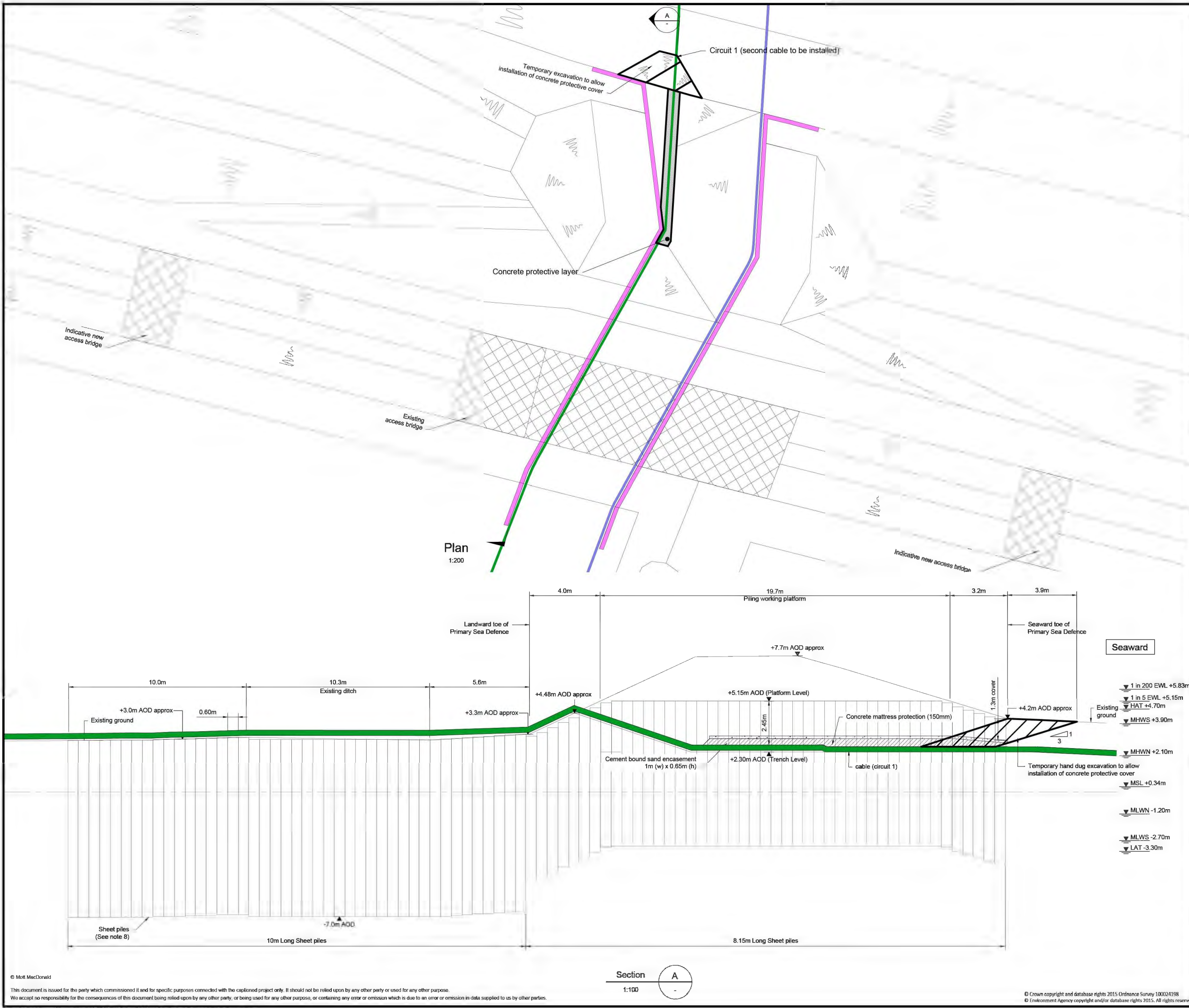
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**Race Bank Export Cable Installation
Sea Defence Breach
Construction Sequence Drawings
Construction Sequence No.23 (CS-23)
Circuit 1: Phase 1 Excavation**

Designed	E Shaw Smith	ESS	Eng check	E Shaw Smith	ESS
Drawn	I A Sussex	IAS	Coordination	M Wainwright	MW
Dwg check	M Wainwright	MW	Approved	R Turner	RT
Scale at A1	Status	Rev	Security		
As shown	APR	P4	STD		

Drawing Number
MMD-357166-C-DR-00-XX-0310



Notes

1. All dimensions are in metres unless noted otherwise.
2. All levels are in metres relative to Ordnance Datum Newlyn (ODN) unless noted otherwise.
3. All positions are in metres relative to OSGB 36.
4. Construction sequence drawings only. Not to be used for construction.
5. Topographic data reproduced from LSTC Onshore Topographic Survey (2014) & Fugro Geophysical Investigation (2014).
6. Water levels based on the "Race Bank Export Cable Installation 2016 Sea Defence Breach Study Report" (MML 2015).
7. See MMD-348992-C-DR-00-XX-0001 and MMD-348992-C-DR-00-XX-0002 for the Site Plan and Topographic Plan respectively.
8. See the storyboard in the "Race Bank Export Cable Installation 2016 Consent Application Study Report" (Document No. "357166_011", MML, 2016) for further details on the construction sequence.
9. Temporary hand-digging operation to allow installation of concrete protective cover within the sea defence, covered under ECiP and Appropriate Assessment (AA). Total area of works shown is 23m2 per cable installation. Total area considered under the AA is 24.5m2 per cable installation.

Key to symbols

- Circuit 2 (first cable installation) - Cable Alignment No. 2
- Circuit 1 (second cable installation) - Cable Alignment No. 1
- Extent of sheet piles
- Cable bedding layer
- Cable concrete protective cover
- ODN indicative level
- Waterproof Polythene sheet
- Quick wall high impermeable container
- Extent of excavation
- Extent of fill
- Access bridge

Reference drawings

Rev	Date	Drawn	Description	Chkd	App'd
P4	08.03.16	PS	Flood Defence Consent Issue	MW	RT
P3	04.03.16	AJ	Salt marsh hand-dug excavation	MW	RT
P2	23.02.16	PS	Construction Sequence Changes	MW	RT
P1	200116	IAS	Preliminary Issue	MW	PJP

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Title

Race Bank Export Cable Installation
Sea Defence Breach
Construction Sequence Drawings
Construction Sequence No.27 (CS-27)
Circuit 1: Phase 1 Cable Installation

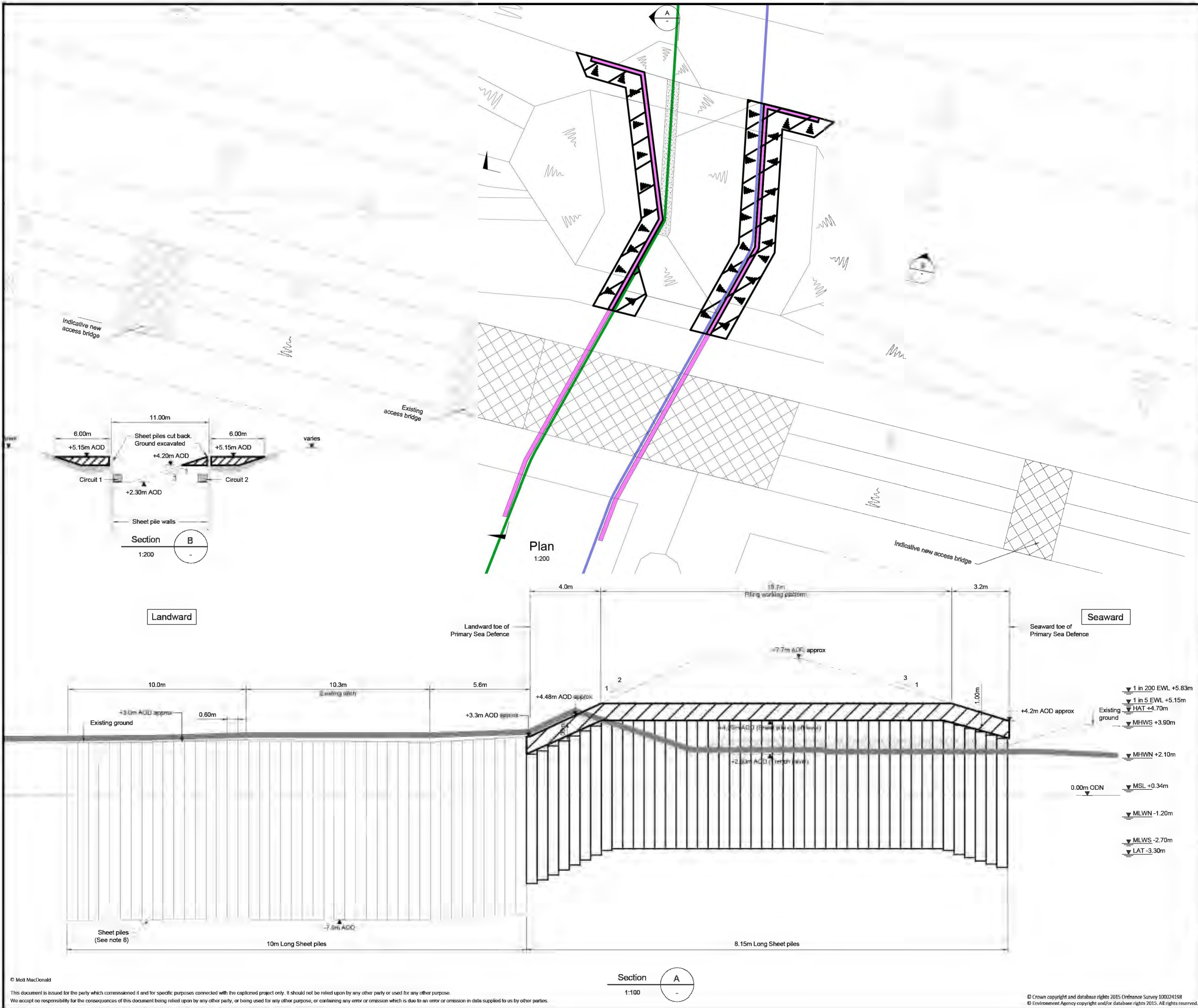
Designed	E Shaw-Smith	ESS	Eng check	E Shaw-Smith	ESS
Drawn	I A Sussex	IAS	Coordination	M Wearmouth	MW
Dwg check	M Wearmouth	MW	Approved	R Turner	RT

Scale at A1

Status	Rev	Security
As shown	APR	P4

Drawing Number

MMD-357166-C-DR-00-XX-0311



Notes

1. All dimensions are in metres unless noted otherwise.
2. All levels are in metres relative to Ordnance Datum Newlyn (ODN) unless noted otherwise.
3. All positions are in metres relative to OSGB 36.
4. Construction sequence drawings only. Not to be used for construction.
5. Topographic data reproduced from LSTC Onshore Topographic Survey (2014) & Fugro Geophysical Investigation (2014).
6. Water levels based on the "Race Bank Export Cable Installation 2016 Sea Defence Breach Study Report" (MML 2015).
7. See MMD-348992-C-DR-00-XX-0001 and MMD-348992-C-DR-00-XX-0002 for the Site Plan and Topographic Plan respectively.
8. See the storyboard in the "Race Bank Export Cable Installation 2016 Consent Application Study Report" (Document No. '357166_011', MML, 2016) for further details on the construction sequence.

Key to symbols

- Circuit 2 (first cable installation) - Cable Alignment No. 2
- Circuit 1 (second cable installation) - Cable Alignment No. 1
- Extent of sheet piles
- Cable bedding layer
- Cable concrete protective cover
- ODN indicative level
- Waterproof Polythene sheet
- Quick wall high impermeable container
- Extent of excavation
- Extent of fill
- Access bridge

Reference drawings

Rev	Date	Drawn	Description	Ch'kd	App'd
P4	08.03.16	PS	Flood Defence Consent Issue	MW	RT
P3	04.03.16	AJ	Salt marsh hardening excavation	MW	RT
P2	23.02.16	PS	Minor Amendments	MW	RT
P1	200116	IAS	Preliminary Issue	MW	PJP

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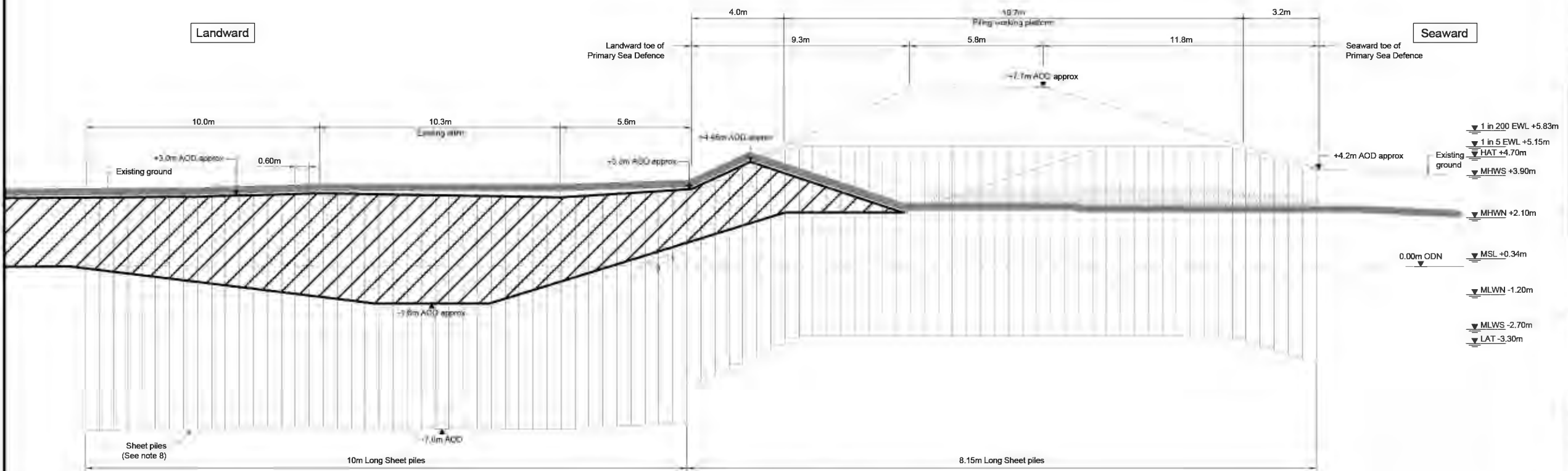
Title

Race Bank Export Cable Installation
Sea Defence Breach
Construction Sequence Drawings
Construction Sequence No.28 (CS-28)
Sheet piles cut to final cut off level

Designed	E Shaw-Smith	ESS	Eng check	E Shaw-Smith	ESS
Drawn	I A Sussex	IAS	Coordination	M Wainwright	MW
Dwg check	M Wainwright	MW	Approved	R Turner	RT
Scale at A1	Status	Rev	Security		
1:200	APR	P4	STD		

Drawing Number

MMD-357166-C-DR-00-XX-0312



- Notes
1. All dimensions are in metres unless noted otherwise.
 2. All levels are in metres relative to Ordnance Datum Newlyn (ODN) unless noted otherwise.
 3. All positions are in metres relative to OSGB 36.
 4. Construction sequence drawings only. Not to be used for construction.
 5. Topographic data reproduced from LSTC Onshore Topographic Survey (2014) & Fugro Geophysical Investigation (2014).
 6. Water levels based on the "Race Bank Export Cable Installation 2016 Sea Defence Breach Study Report" (MML 2015).
 7. See MMD-348992-C-DR-00-XX-0001 and MMD-348992-C-DR-00-XX-0002 for the Site Plan and Topographic Plan respectively.
 8. See the storyboard in the "Race Bank Export Cable Installation 2016 Consent Application Study Report" (Document No. '357166_011', MML, 2016) for further details on the construction sequence.

- Key to symbols
- Circuit 2 (first cable installation) - Cable Alignment No. 2
 - Circuit 1 (second cable installation) - Cable Alignment No. 1
 - Extent of sheet piles
 - Cable bedding layer
 - Cable concrete protective cover
 - ODN indicative level
 - Waterproof Polythene sheet
 - Quick wall high impermeable container
 - Extent of excavation
 - Extent of fill
 - Access bridge

Reference drawings

P3	08.03.16	PS	Flood Defence Consent Issue	MW	RT
P2	23.02.16	PS	Construction Sequence Changes	MW	RT
P1	200116	IAS	Preliminary Issue	MW	PJP
Rev	Date	Drawn	Description	Ch'kd	App'd

P3	08.03.16	PS	Flood Defence Consent Issue	MW	RT
P2	23.02.16	PS	Construction Sequence Changes	MW	RT
P1	200116	IAS	Preliminary Issue	MW	PJP
Rev	Date	Drawn	Description	Ch'kd	App'd

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Race Bank Export Cable Installation
Sea Defence Breach
Construction Sequence Drawings
Construction Sequence No.30 (CS-30)
Circuit 1: Phase 2 Excavation

Designed	E Shaw Smith	ESS	Eng check	E Shaw Smith	ESS
Drawn	I A Sussex	IAS	Coordination	M Wainwright	MW
Dwg check	M Wainwright	MW	Approved	R Turner	RT
Scale at A1	1:200	Status	APR	Rev	P3
Security	STD	Drawing Number	MMD-357166-C-DR-00-XX-0314		



Notes

1. All dimensions are in metres unless noted otherwise.
2. All levels are in metres relative to Ordnance Datum Newlyn (ODN) unless noted otherwise.
3. All positions are in metres relative to OSGB 36.
4. Construction sequence drawings only. Not to be used for construction.
5. Topographic data reproduced from LSTC Onshore Topographic Survey (2014) & Fugro Geophysical Investigation (2014).
6. Water levels based on the "Race Bank Export Cable Installation 2016 Sea Defence Breach Study Report" (MML 2015).
7. See MMD-348992-C-DR-00-XX-0001 and MMD-348992-C-DR-00-XX-0002 for the Site Plan and Topographic Plan respectively.
8. See the storyboard in the "Race Bank Export Cable Installation 2016 Consent Application Study Report" (Document No. '357166_011', MML, 2016) for further details on the construction sequence.

Key to symbols

- Circuit 2 (first cable installation) - Cable Alignment No. 2
- Circuit 1 (second cable installation) - Cable Alignment No. 1
- Extent of sheet piles
- Cable bedding layer
- Cable concrete protective cover
- ODN indicative level
- Waterproof Polythene sheet
- Quick wall high impermeable container
- Extent of excavation
- Extent of fill
- Access bridge

Reference drawings

Rev	Date	Drawn	Description	Ch'kd	App'd
P4	08.03.16	PS	Flood Defence Consent Issue	MW	RT
P3	04.03.16	AJ	Minor amendments	MW	RT
P2	23.02.16	PS	Construction Sequence Changes	MW	RT
P1	200116	IAS	Preliminary Issue	MW	PJP

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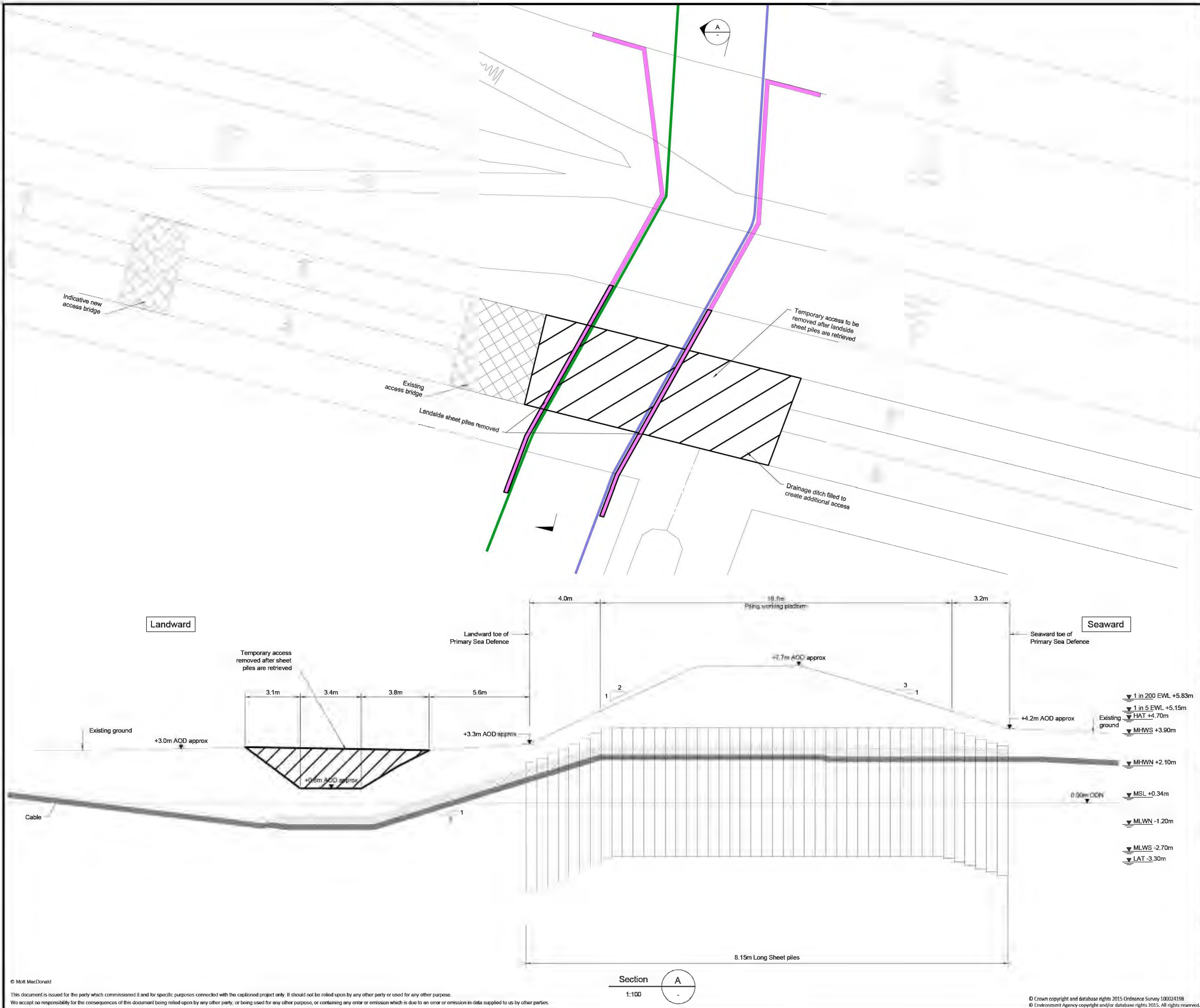
Title

Race Bank Export Cable Installation
Sea Defence Breach
Construction Sequence Drawings
Construction Sequence No.32 (CS-32)
Circuit 1: Phase 2 Reinstatement

Designed	E Shaw-Smith	ESS	Eng check	E Shaw-Smith	ESS
Drawn	I A Sussex	IAS	Coordination	M Wainwright	MW
Dwg check	M Wainwright	MW	Approved	R Turner	RT
Scale at A1	Status	Rev	Security		
As shown	APR	P4	STD		

Drawing Number

MMD-357166-C-DR-00-XX-0316



- Notes
1. All dimensions are in metres unless noted otherwise.
 2. All levels are in metres relative to Ordnance Datum Newlyn (ODN) unless noted otherwise.
 3. All positions are in metres relative to OSGB 36.
 4. Construction sequence drawings only. Not to be used for construction.
 5. Topographic data reproduced from LSTC Onshore Topographic Survey (2014) & Fugro Geophysical Investigation (2014).
 6. Water levels based on the "Race Bank Export Cable Installation 2016 Sea Defence Breach Study Report" (MML 2015).
 7. See MMD-348992-C-DR-00-XX-0001 and MMD-348992-C-DR-00-XX-0002 for the Site Plan and Topographic Plan respectively.
 8. See the storyboard in the "Race Bank Export Cable Installation 2016 Consent Application Study Report" (Document No. "357166_011", MML, 2016) for further details on the construction sequence.
 9. Pump system removed after the all landside sheet piles have been retrieved.
 10. Bog mats used for piling operations to spread plant loads.

- Key to symbols
- Circuit 2 (first cable installation) - Cable Alignment No. 2
 - Circuit 1 (second cable installation) - Cable Alignment No. 1
 - Extent of sheet piles
 - Cable bedding layer
 - Cable concrete protective cover
 - ODN indicative level
 - Waterproof Polythene sheet
 - Quick wall high impermeable container
 - Extent of excavation
 - Extent of fill
 - Access bridge

Reference drawings

P3	08.03.16	PS	Flood Defence Consent Issue	MW	RT
P2	23.02.16	PS	Construction Sequence Changes	MW	RT
P1	200116	IAS	Preliminary Issue	MW	PJP
Rev	Date	Drawn	Description	Ch'kd	App'd



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Client

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Title

Race Bank Export Cable Installation
Sea Defence Breach
Construction Sequence Drawings
Construction Sequence No.35 (CS-35)
Removal of landside sheet piles

Designed	E Shaw-Smith	ESS	Eng check	E Shaw-Smith	ESS
Drawn	I A Sussex	IAS	Coordination	M Wainwright	MW
Dwg check	M Wainwright	MW	Approved	R Turner	RT
Scale at A1	Status	Rev	Security		
As shown	APR	P3	STD		
Drawing Number					
MMD-357166-C-DR-00-XX-0318					

Appendix D. Sea levels (predicted tides and extreme sea levels)

D.1.1 Tides

The UK Hydrographic Office publishes predicted high and low tide levels for primary and secondary harmonic port locations around the UK. The nearest ports are Wisbech Cut (ID 0163A) and the Outer Westmark Knock (ID 0163). The Outer Westmark Knock tide levels have been adopted for this Project. This is considered a conservative approach as predicted tide levels at Outer Westmark Knock are generally 0.1m higher than at Wisbech.

The project tide levels are provided in Table D.1 (MML, 2015). Note, the height of chart datum (CD) relative to ordnance datum (OD) for Outer Westmark Knock (OWK) is not published. The nearest port with CD relative to OD has been adopted (Wisbech Cut; -3.20 m). This has been adopted for Outer Westmark Knock for this project.

Table D.1: Project tide levels

Tide level	Water level (CD)	Water level (OD)
Highest Astronomical Tide (HAT)	7.90 m	4.70 m
Mean High Water Springs (MHWS)	7.10 m	3.90 m
Mean High Water Neaps (MHWN)	5.30 m	2.10 m
Mean Sea Level (MSL)	3.54 m	0.34 m
Mean Low Water Neaps (MLWN)	2.00 m	-1.20 m
Mean Low Water Springs (MLWS)	0.50 m	-2.70 m
Lowest Astronomical Tide (LAT)	-0.10 m	-3.30 m

Source: MML, 2015

D.1.2 Extremes

Extreme sea level data presents the likelihood of an extreme tide level being exceeded in any given year, also referred to as an Annual Exceedance Probability (AEP) or 'return period'. For example the 1 in 20 Return period water level is 5.39 m AOD. This means there is a 1 in 20 (5%) chance of this water level being exceed in any given year.

The design extreme water levels at the Site were extracted from (MML, 2015).

Table D.2: Extreme Water Levels

Return period (years)	2008 Water level (m AOD)	Sea level rise allowance (2008-2016)*	2016 Water level (m AOD)
1 in 1	4.85	0.042	4.89
1 in 2	4.96	0.042	5.00
1 in 5	5.11	0.042	5.15
1 in 10	5.23	0.042	5.27
1 in 20	5.35	0.042	5.39

Return period (years)	2008 Water level (m AOD)	Sea level rise allowance (2008-2016)*	2016 Water level (m AOD)
1 in 25	5.40	0.042	5.44
1 in 50	5.53	0.042	5.57
1 in 75	5.60	0.042	5.64
1 in 100	5.65	0.042	5.69
1 in 150	5.73	0.042	5.77
1 in 200	5.79	0.042	5.83
1 in 250	5.83	0.042	5.87
1 in 300	5.87	0.042	5.91
1 in 500	5.97	0.042	6.01
1 in 1,000	6.11	0.042	6.15
1 in 10,000	6.62	0.042	6.66

Source: MML, 2015

D.1.3 Predicted tide levels

Table D.3: Predicted high tide levels at the Site for May to August 2016. Times are in GMT - add 1 hour for BST

Rank	Date and time (GMT)	Tide level (m AOD)	Rank	Date and time (GMT)	Tide level (m AOD)
1	07/05/2016 18:30:00	4.40	37	05/07/2016 19:00:00	3.80
2	08/05/2016 19:18:00	4.40	38	03/08/2016 06:11:00	3.80
3	21/08/2016 07:50:00	4.30	39	06/08/2016 08:09:00	3.80
4	22/08/2016 08:29:00	4.30	40	19/08/2016 19:05:00	3.80
5	06/05/2016 17:40:00	4.20	41	01/09/2016 05:51:00	3.80
6	08/05/2016 06:59:00	4.20	42	03/06/2016 16:29:00	3.70
7	09/05/2016 20:05:00	4.20	43	04/06/2016 05:09:00	3.70
8	20/08/2016 07:10:00	4.20	44	08/06/2016 20:42:00	3.70
9	07/05/2016 06:16:00	4.10	45	04/07/2016 05:40:00	3.70
10	09/05/2016 07:40:00	4.10	46	04/07/2016 18:10:00	3.70
11	05/06/2016 18:17:00	4.10	47	06/07/2016 19:46:00	3.70
12	06/06/2016 19:08:00	4.10	48	08/07/2016 08:30:00	3.70
13	23/08/2016 09:11:00	4.10	49	21/07/2016 06:51:00	3.70
14	06/06/2016 06:42:00	4.00	50	25/07/2016 09:28:00	3.70
15	07/06/2016 07:25:00	4.00	51	04/08/2016 19:30:00	3.70
16	19/08/2016 06:30:00	4.00	52	18/08/2016 05:48:00	3.70
17	05/05/2016 16:51:00	3.90	53	22/08/2016 21:02:00	3.70
18	06/05/2016 05:31:00	3.90	54	24/08/2016 09:58:00	3.70
19	10/05/2016 08:21:00	3.90	55	05/05/2016 04:45:00	3.60
20	04/06/2016 17:24:00	3.90	56	11/05/2016 09:03:00	3.60
21	05/06/2016 05:56:00	3.90	57	09/06/2016 08:48:00	3.60
22	07/06/2016 19:56:00	3.90	58	22/06/2016 07:08:00	3.60
23	08/06/2016 08:07:00	3.90	59	23/06/2016 07:45:00	3.60
24	05/07/2016 06:27:00	3.90	60	03/07/2016 17:14:00	3.60
25	06/07/2016 07:10:00	3.90	61	07/07/2016 20:28:00	3.60
26	07/07/2016 07:52:00	3.90	62	20/07/2016 06:11:00	3.60
27	22/07/2016 07:30:00	3.90	63	22/07/2016 20:03:00	3.60
28	23/07/2016 08:08:00	3.90	64	02/08/2016 05:26:00	3.60
29	24/07/2016 08:46:00	3.90	65	03/08/2016 18:49:00	3.60
30	04/08/2016 06:53:00	3.90	66	05/08/2016 20:07:00	3.60
31	05/08/2016 07:32:00	3.90	67	07/08/2016 08:42:00	3.60
32	20/08/2016 19:45:00	3.90	68	18/08/2016 18:22:00	3.60
33	21/08/2016 20:23:00	3.90	69	01/09/2016 18:31:00	3.60
34	02/09/2016 06:31:00	3.90	70	02/09/2016 19:06:00	3.60
35	03/09/2016 07:08:00	3.90	71	03/09/2016 19:39:00	3.60
36	10/05/2016 20:52:00	3.80	72	04/05/2016 15:59:00	3.50

Rank	Date and time (GMT)	Tide level (m AOD)	Rank	Date and time (GMT)	Tide level (m AOD)
73	23/05/2016 06:52:00	3.50	112	22/05/2016 18:37:00	3.20
74	24/05/2016 07:25:00	3.50	113	24/05/2016 19:49:00	3.20
75	21/06/2016 06:31:00	3.50	114	19/06/2016 05:15:00	3.20
76	24/06/2016 08:21:00	3.50	115	21/06/2016 18:56:00	3.20
77	09/07/2016 09:09:00	3.50	116	24/06/2016 20:55:00	3.20
78	21/07/2016 19:22:00	3.50	117	19/07/2016 17:56:00	3.20
79	23/07/2016 20:42:00	3.50	118	01/08/2016 04:36:00	3.20
80	02/08/2016 18:04:00	3.50	119	30/08/2016 17:06:00	3.20
81	31/08/2016 05:09:00	3.50	120	04/05/2016 03:56:00	3.10
82	31/08/2016 17:51:00	3.50	121	12/05/2016 09:49:00	3.10
83	22/05/2016 06:19:00	3.40	122	20/05/2016 05:13:00	3.10
84	25/05/2016 07:58:00	3.40	123	20/05/2016 17:23:00	3.10
85	02/06/2016 15:32:00	3.40	124	25/05/2016 20:25:00	3.10
86	03/06/2016 04:20:00	3.40	125	27/05/2016 09:07:00	3.10
87	25/06/2016 08:58:00	3.40	126	20/06/2016 18:15:00	3.10
88	03/07/2016 04:51:00	3.40	127	27/06/2016 10:34:00	3.10
89	20/07/2016 18:41:00	3.40	128	01/07/2016 15:12:00	3.10
90	24/07/2016 21:23:00	3.40	129	02/07/2016 03:57:00	3.10
91	26/07/2016 10:16:00	3.40	130	10/07/2016 09:47:00	3.10
92	06/08/2016 20:41:00	3.40	131	25/07/2016 22:08:00	3.10
93	17/08/2016 05:06:00	3.40	132	27/07/2016 11:14:00	3.10
94	23/08/2016 21:44:00	3.40	133	07/08/2016 21:12:00	3.10
95	11/05/2016 21:41:00	3.30	134	25/08/2016 10:54:00	3.10
96	21/05/2016 05:45:00	3.30	135	30/08/2016 04:21:00	3.10
97	23/05/2016 19:13:00	3.30	136	03/05/2016 15:03:00	3.00
98	26/05/2016 08:30:00	3.30	137	19/05/2016 16:45:00	3.00
99	09/06/2016 21:29:00	3.30	138	01/06/2016 14:30:00	3.00
100	10/06/2016 09:31:00	3.30	139	02/06/2016 03:25:00	3.00
101	20/06/2016 05:52:00	3.30	140	19/06/2016 17:34:00	3.00
102	22/06/2016 19:36:00	3.30	141	25/06/2016 21:37:00	3.00
103	23/06/2016 20:16:00	3.30	142	09/07/2016 21:48:00	3.00
104	26/06/2016 09:41:00	3.30	143	18/07/2016 04:47:00	3.00
105	02/07/2016 16:15:00	3.30	144	31/07/2016 16:10:00	3.00
106	08/07/2016 21:09:00	3.30	145	09/08/2016 09:48:00	3.00
107	19/07/2016 05:29:00	3.30	146	16/08/2016 04:20:00	3.00
108	01/08/2016 17:11:00	3.30	147	24/08/2016 22:34:00	3.00
109	08/08/2016 09:15:00	3.30	148	19/05/2016 04:37:00	2.90
110	17/08/2016 17:38:00	3.30	149	26/05/2016 21:02:00	2.90
111	21/05/2016 17:59:00	3.20	150	00/01/1900 10:18:00	2.90

Rank	Date and time (GMT)	Tide level (m AOD)	Rank	Date and time (GMT)	Tide level (m AOD)
151	18/06/2016 04:37:00	2.90	190	09/08/2016 22:17:00	2.60
152	28/06/2016 11:37:00	2.90	191	10/08/2016 10:29:00	2.60
153	30/06/2016 14:02:00	2.90	192	25/08/2016 23:35:00	2.60
154	18/07/2016 17:13:00	2.90	193	26/08/2016 12:05:00	2.60
155	31/07/2016 03:39:00	2.90	194	02/05/2016 13:57:00	2.50
156	08/08/2016 21:42:00	2.90	195	17/05/2016 15:13:00	2.50
157	16/08/2016 16:53:00	2.90	196	12/06/2016 11:15:00	2.50
158	29/08/2016 16:09:00	2.90	197	29/06/2016 00:38:00	2.50
159	18/05/2016 16:03:00	2.80	198	29/07/2016 01:19:00	2.50
160	00/01/1900 09:52:00	2.80	199	15/08/2016 03:30:00	2.50
161	10/06/2016 22:18:00	2.80	200	15/08/2016 16:03:00	2.50
162	18/06/2016 16:53:00	2.80	201	28/08/2016 14:56:00	2.50
163	26/06/2016 22:27:00	2.80	202	00/01/1900 22:39:00	2.40
164	29/06/2016 12:48:00	2.80	203	31/05/2016 01:14:00	2.40
165	01/07/2016 02:57:00	2.80	204	00/01/1900 23:13:00	2.40
166	26/07/2016 23:01:00	2.80	205	16/06/2016 03:08:00	2.40
167	28/07/2016 12:24:00	2.80	206	16/06/2016 15:22:00	2.40
168	30/07/2016 15:00:00	2.80	207	12/07/2016 11:22:00	2.40
169	12/05/2016 22:39:00	2.70	208	16/07/2016 03:12:00	2.40
170	27/05/2016 21:45:00	2.70	209	16/07/2016 15:36:00	2.40
171	31/05/2016 13:19:00	2.70	210	27/08/2016 13:31:00	2.40
172	01/06/2016 02:25:00	2.70	211	28/08/2016 02:11:00	2.40
173	11/07/2016 10:30:00	2.70	212	13/05/2016 23:49:00	2.30
174	17/07/2016 04:03:00	2.70	213	14/05/2016 11:57:00	2.30
175	29/07/2016 13:43:00	2.70	214	16/05/2016 14:15:00	2.30
176	29/08/2016 03:23:00	2.70	215	17/05/2016 03:06:00	2.30
177	03/05/2016 02:59:00	2.60	216	29/05/2016 23:51:00	2.30
178	13/05/2016 10:45:00	2.60	217	15/06/2016 14:28:00	2.30
179	18/05/2016 03:56:00	2.60	218	11/07/2016 23:15:00	2.30
180	29/05/2016 10:49:00	2.60	219	27/08/2016 00:52:00	2.30
181	30/05/2016 12:01:00	2.60	220	01/05/2016 12:32:00	2.20
182	17/06/2016 03:56:00	2.60	221	02/05/2016 01:50:00	2.20
183	17/06/2016 16:10:00	2.60	222	15/05/2016 13:09:00	2.20
184	27/06/2016 23:27:00	2.60	223	13/06/2016 12:20:00	2.20
185	30/06/2016 01:50:00	2.60	224	14/06/2016 13:26:00	2.20
186	10/07/2016 22:29:00	2.60	225	10/08/2016 23:02:00	2.20
187	17/07/2016 16:26:00	2.60	226	14/08/2016 02:32:00	2.20
188	28/07/2016 00:06:00	2.60	227	15/05/2016 01:00:00	2.10
189	30/07/2016 02:33:00	2.60	228	16/05/2016 02:06:00	2.10

Rank	Date and time (GMT)	Tide level (m AOD)
229	13/06/2016 00:13:00	2.10
230	15/06/2016 02:13:00	2.10
231	13/07/2016 00:09:00	2.10
232	13/07/2016 12:25:00	2.10
233	15/07/2016 02:14:00	2.10
234	15/07/2016 14:38:00	2.10
235	11/08/2016 11:22:00	2.10
236	14/08/2016 15:05:00	2.10
237	01/05/2016 00:10:00	2.00
238	14/06/2016 01:14:00	2.00
239	14/07/2016 01:11:00	2.00
240	14/07/2016 13:32:00	2.00
241	12/08/2016 00:04:00	2.00
242	12/08/2016 12:36:00	1.90
243	13/08/2016 01:21:00	1.90
244	13/08/2016 13:55:00	1.90

Source: MML, 2015. Tide levels presented in this table are based on predicted astronomical tide levels at the Outer Westmark Knock gauge location. Refer to the EFRP (MML, 2016) for predicted tide levels at the site based on the West Lighthouse gauge and related to the detailed construction programme.

Appendix E. Thermal Resistivity Requirements

E.1.1 Introduction

This section summarises provide further information to on the underlying rationale for the breach extent/proportions and to provide further clarification on the thermal resistivity parameters of the project. The note also confirms the final proposed reinforcement proposals atop the cables.

E.1.2 Burial depth restrictions due to thermal dissipation restrictions

Due to electrical resistance within all high voltage cables when current is flowing through the conductor, heat is generated and is dissipated through the cable. With an increase in temperature withheld in the cable due non dissipation, electrical performance is affected, capacity reduced and degradation of the physical properties of the cable increase.

Where cables are enclosed or buried, the surrounding area effects this heat dissipation, this is factored into the design of the cable and transmission. Where cables are buried and in close proximity of other cables, heat dissipation within the surrounding materials can be reduced if sufficient separation is not calculated.

A cable installed 1m beneath the soil surface, will have lower conductor temperature compare to one buried at 5m. The losses are slightly higher at 5m burial compared to 1m, but the heat has longer way to ground level and therefore will the conductor and the soil temperature around the cable be higher.

Figure E.1: Temperature picture at 8m burial, with isotherm around the subsea cable.

The figure above shows the soil temperature in Celsius, around the cable with an 8m burial of the cable. Only one circuit is shown within the example.

The cable is designed with a conductor size for the current capacity required, taking into account thermal condition around the cable with the insulation material set to a maximum operating temperature of 900 C. This allows the cable to be burial to a depth of 5m to the bottom of the cable. With a 5m burial the excavated soil material can be backfilled again.

By increasing the burial depth, the thermal dissipation conditions around the cable must be improved by use of Cement Bound Sand (CBS) to avoid drying out and thereby overheating of the conductor.

Burial down to 5m requires no improvement of the thermal conditions, cable buried between 5m and 8m requires improvement with CBS around the cable, beyond 8m, the cable cannot dissipate heat sufficiently even with added materials and therefore the design limit of the cable has been reached.

The burial depth profile of the cable is shown on MMD-357166-C-DR-00-XX-0102 and MMD-357166-C-DR-00-XX-0202 in Appendix C.

E.1.3 Cable bedding layer

The cable bedding layer is made of a standard basic concrete mixture with normal strength. Cable can be placed on the bedding layer after 24 hours.

The extent of the cable bedding layer is shown on MMD-357166-C-DR-00-XX-0102 and MMD-357166-C-DR-00-XX-0202 in Appendix C.

E.1.4 Cement Bound Sand

A high performance heat conducting concrete mix will be used to improve the thermal properties of the material around the installed cable. Without this material the cable could not be installed to the depth specified without significantly de-rating the cable voltage.

A Powercrete® solution is proposed for the cement bound sand mix. Powercrete® premix is a patented, ready-made concrete with a high thermal conductivity, which is used as a bedding material for high voltage cables. Due to the high thermal conductivity of Powercrete® premix the heat that is produced in the cable loom can be efficiently transferred into the surrounding ground. Thereby the performance of the cable loom increases.

The mix requirements per cubic metre are as follows:

- 1856 kg Powercrete® premix
- ~260 l water
- Density of fresh concrete ~ 2120 kg/m³

The mix will be mixed with water off site and delivered to site in concrete delivery trucks ready to be poured over the cable. Delivery trucks will be positioned within Field No.1 and either grout pumps used or a series of pipes connected to the truck such that the concrete can be poured over the cable in its final burial location.

The curing time for the CBS is less than 24 hours. To minimise the duration that the sea defence is temporarily lowered the CBS will be poured in sections such that the pre-fabricated concrete protection and reinstatement operations can be installed as soon as reasonable practicable.

The specification and technical data sheets for the Powercrete® cement bound sand mix are included at the end of this appendix.

The thermal resistivity of a carefully selected Cement Bound Sand (CBS) for electrical cables has several advantages such as good thermal backfill material and well defined thermal resistivity. It will eliminate the risk of voids or movement caused by thermal expansion. The thermal resistivity of CBS, when hardened is $0.6 \text{ K}^*\text{m}/\text{W}$ compared to normal soil 1.0 to $1.2 \text{ K}^*\text{m}/\text{W}$.

The dimension of the CBS block inclusive concrete slabs (mentioned below) is engineered so the 50°C isotherm is within the bloc to avoid drying out of the surrounding soil.

Backfill around the CBS block can take place 24 hours after pouring and inspection. Phased backfill and compaction of materials will ensure effective thermal dissipation and restoration of the surrounding materials.

The extent of the cement bound sand is shown on MMD-357166-C-DR-00-XX-0102 and MMD-357166-C-DR-00-XX-0202 in Appendix C.

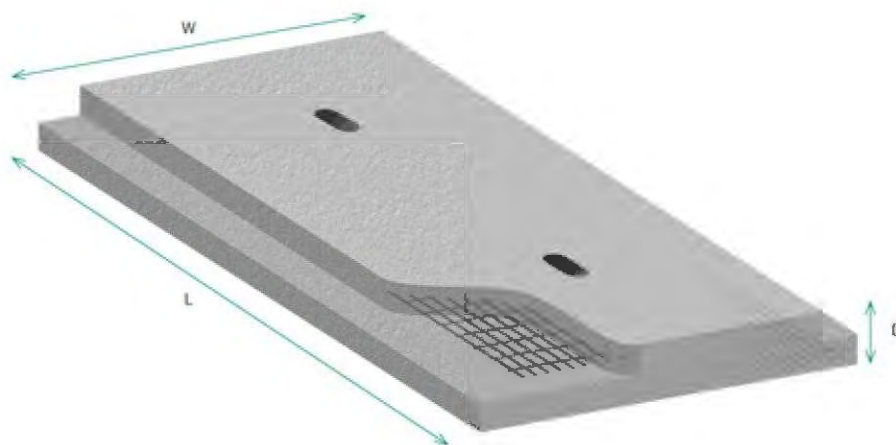
E.1.5 Reinforced Concrete slab (concrete protective cover)

To make a stronger protection of the cable covered by the CBS, reinforced concrete slabs will be placed on top the CBS. The same slabs will be placed on top of the cable outside the CBS block where the burial is less than 5m. The concrete slabs will have thermal resistivity of $0.6 \text{ K}^*\text{m}/\text{W}$.

The protective slabs are made from precast concrete and heavily reinforced with steel. The slabs are designed to protect power cables from damage from above and create a physical barrier should future excavation works be carried out close to the cables. The slabs will be designed and manufactured specifically for this project, with a thickness of 0.15m (D) and 1.0m (W) in width. The slab will be installed in sections, with lengths varying across the profile and will be designed to suit the varying changes in vertical height of the installation to ensure effective coverage. Figure 2 below shows a typical example.

The extent of the cable reinforce concrete slab is shown on MMD-357166-C-DR-00-XX-0102 and MMD-357166-C-DR-00-XX-0202 in Appendix C.

Figure E.2: Artistic impression of the cable protective cover (reinforced concrete slab)



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OPTIMISING CURRENT FLOW USING: **POWERCRETE®**



POWERCRETE – FOR MORE POWER IN THE LINE

HV and UHV cables are frequently built as underground cables. The reasons for this are the reduced need for land area, considerable savings on energy, and the absence of impairment to living areas by pylons. The problem with underground cables lies in the massive generation of heat as the load of the electricity lines is increased. As the cable temperature increases, so does the resistance, resulting in increased capacity loss. Improved power capacity can be achieved using bedding and backfilling materials like Powercrete and CableCem which dissipate the heat being generated into the surrounding soil.

Powercrete is a high-performance heat-conducting concrete, used as a bedding and backfilling material for underground HV and UHV cabling. The special material properties of Powercrete result in low heat transmission resistance. Because of the low thermal resistance, the heat being generated is dissipated effectively, the conductor temperature is reduced efficiently, and as a result the power capability of the cable route is increased.

The consistency of the Powercrete material can be adjusted. For instance, a free-flowing material consistency produces optimal embedding of cables, at the same time requiring low expenditure on compaction.



↑ Powercrete is used in the open ditch



↑ A Powercrete application

PRODUCT ADVANTAGES

- Improved heat dissipation for HV and UHV cables
- High heat conduction also after drying up
- Reduction of the magnetic field strength in the cable route area through cable bundling possible
- Increased power capacity possible
- Reduction of conductor cross-section area possible
- Switch to aluminium conductors possible
- Mitigation of "hot-spots"



AND CABLECEM

CABLECEM – LOWER THERMAL RESISTANCE WITH CABLECEM

CableCem is a heat-conducting special construction material developed as a backfilling material for jacket tube systems. Thanks to its very good free-flow properties, CableCem is outstandingly well-suited for backfilling the residual annular space between the cable and the jacket tube.

The low thermal resistance of CableCem ensures excellent heat dissipation, and thus reduced capacity loss in the cable line. The power capability of the cable route is thus permanently increased. CableCem is offered in various options with a range of thermal resistances.



↑ CableCem in the cable jacket tube system

PRODUCT ADVANTAGES

- Excellent free-flowing properties
- Improved heat dissipation for HV and UHV cables
- Reduction of magnetic field strength in the cable route area through cable bundling possible
- Increased power capacity possible
- Reduction of conductor cross-section area possible
- Switch to aluminium conductors possible
- Mitigation of "hot-spots"
- Cable removable



↑ A CableCem application



← Removal of the cable with a special drilling head

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We would like to stress that achieving the mentioned properties require a suitable production and processing of the building material as well as a proper, state-of-the art preparation on the construction site.

TECHNICAL DATA SHEET

POWERCRETE[®] premix

Description

Powercrete[®] premix is a patented, ready-made concrete with a high thermal conductivity, which is used as a bedding material for high voltage cables. Due to the high thermal conductivity of Powercrete premix the heat that is produced in the cable loom can be efficiently transferred into the surrounding ground. Thereby the performance of the cable loom increases.

Formulation / m³: 1,856 kg Powercrete[®] premix
≈ 260 l water
Density of fresh concrete ≈ 2,120 kg/m³

Mixing procedure: The delivered dry building material just has to be mixed with water, to receive a ready-to-use fresh concrete.

Properties of fresh concrete:

Possible consistency category: F4 (according to EN 12350-5)
Processing time: approx. 1 h

Thermal conductivity:

Wet status ≥ 4.0 W/(m·K)
Dry status ≈ 3.0 W/(m·K)

Compressive strength: (in accordance with DIN EN 196 in MPa)

Age of sample	28 days
Compressive strength [MPa]	≈ 15.0

Status: June 2014

Page 1 of 1

The above data relate to tests under laboratory conditions with the usual metrological tolerances. These along with records of other "suitability tests" are designed to obtain information about the basic suitability of our product in respect of the intended purpose. Even in the case of a project-specific test, the information should not be regarded as a promise of properties with the effect that we can be held responsible for damages resulting from the absence of features and/or properties. Our information therefore does not release customers from the obligation to carry out their own specific tests and take decisions on their own responsibility.

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Appendix F. Decommissioning Provisions

Race Bank Offshore Wind Farm Decommissioning – Cables Beneath the Primary Sea Defences

DONG Energy RB (UK) Limited (DONG Energy) has applied to the Environment Agency for Flood Defence Consent for the installation of 2 x 220kV high voltage electricity cables beneath the primary sea defences at Sutton Bridge, Lincolnshire.

No provision is included in the proposed details for the removal of the cables following the operational life of the project. The Environment Agency has sought confirmation on the position with regard to associated consents, and whether any provision is made in those consents for the removal of the cables.

The project was originally developed by Centrica Renewable Energy Limited (CREL), and it was envisaged that cables would come ashore approximately 800m west of the current proposed location, alongside the installed cables for the Lincs offshore wind farm project. Planning permission was granted under Section 90 of the Town and Country Planning Act for those works, as directed under the overarching Section 36 Consent granted for the project (DECC reference 12.04.09.04/7Ci.

A separate planning permission was granted by South Holland District Council for the landward works, to install and connect the terrestrial cables to the National Transmission System at Walpole Marsh (South Holland District Council reference H18-0122-07ii). That planning permission was subsequently renewed for a further 5 years prior to its expiration, with no material changes, in 2010 (South Holland District Council reference H18-0341-10iii).

No provision for the removal of the cables post-operation at landfall was included as part of those consents. The potential environmental effects of decommissioning were assessed for the terrestrial cable systems only, taken to mean cables installed up to the landward Transition Joint Bay (TJB). Further, and in relation to the landward cable system only, it was stated in the project Environment Statement (paragraph 7.6.23) that *“It is considered unlikely that underground cables would be removed following decommissioning of the wind farms, and there are no plans to do so”*.

Following the issues encountered in 2010 to 2012 with the installation of export cables at landfall for the Lincs offshore wind farm project CREL sought, and received, revised planning permission for the installation of up to four cables in the same location as currently proposed, occupying a larger area and necessitating lowering the sea defences in four separate locations (South Holland District Council reference H18-0102-13iv). Again, no provision was made under that planning permission for the removal of cables north of the landward Transition Joint Bay (TJB). As the Environment Agency is aware Flood Defence Consent was not sought or granted for those works at that time.

As the Environment Agency is aware a revised planning permission is currently being sought from South Holland District Council for the current revised landfall proposals. Following recent discussions with the Environment Agency that application will shortly be updated again with revised material and the final plans. DONG Energy confirm that there is no provision sought under that planning application, as originally submitted or as to be shortly revised, which seeks permission for the removal of the cables beneath the primary sea defence following the operational phase of the project.

It is noted that the transmission assets of the project, which includes the section of cabling that would be installed beneath the primary sea defence, will be divested to an Offshore Transmission

Operator (OFTO), who will have responsibility for the ongoing operation, monitoring and maintenance of those assets. The OFTO, as a Statutory Undertaker for the purposes of the Electricity Act 1989, may benefit from Permitted Development rights under Part 15 of the Town and Country Planning Act 1990, which would grant deemed planning permission for works to those cables during the operational phase of the project.

It is DONG Energy's understanding, however, that any such works would still require a separate Flood Defence Consent from the Environment Agency, provided current legislative requirements remain in place. Works would therefore remain subject to Environment Agency approval, and conditions that the Environment Agency choose to place on any granted Flood Defence Consent, and requirements in associated legal agreements, would remain in place.

In summary, there is no provision in any existing or anticipated project consent that allows for the removal of the proposed cables beneath the primary sea defences without prior Environment Agency approval.

ⁱ <https://itportal.decc.gov.uk/EIP/pages/projects/RaceDecision.pdf>

ⁱⁱ <http://planning.sholland.gov.uk/OcellaWeb/planningDetails?reference=H18-0122-07&from=planningSearch>

ⁱⁱⁱ <http://planning.sholland.gov.uk/OcellaWeb/planningDetails?reference=H18-0341-10&from=planningSearch>

^{iv} <http://planning.sholland.gov.uk/OcellaWeb/planningDetails?reference=H18-0102-13&from=planningSearch>