AQUIND Limited

APPENDIX 3.2

Marine Worst Case Scenarios

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TABLES

APPENDIX 3.2 MARINE WORST-CASE SCENARIOS

1.1 ROUTE PREPARATION

1.1.1.1 Route preparation activities will take a maximum of 30 months. This is because they can generally be no more than a maximum of 1-12 months (depending on activity) before the start of cable installation activities, which will take place intermittently over two years. Table 1 summarises the worst-case scenario in terms of route preparation that is being considered for the Proposed Development. It is anticipated that a combination of these methods will be applied throughout the Marine Cable Corridor.

Table 1 - Route preparation worst case scenario

Activity	Timing	Disturbance / Footprint	Equipment
PLGR	Maximum of 12 months before each cable installation campaign	The grapnel may be pulled along the seabed for 108 km of Marine Cable Corridor. Width of grapnel = 1 m Area of disturbance = 216,000 m^2	Multicat / tug
Boulder Removal	Within 2 – 3 months of starting cable installation	The presence of boulders has been identified along 19.9 km (19%) of the UK Marine Cable Corridor. The plough will be used in the first pass, a grab will then be used pick up any that have not been cleared. Total width of plough = 15 m, may be used to produce a swathe of up to 80 m wide. Area of disturbance = 1,288,000 m^2	Rock grab vessel Plough support vessel
Sediment Clearance through Dredging / Sediment Displacement	Phased to be as close to cable installation as possible	Sediment clearance may be required for the following: Clearance of sandwaves and large ripples;	TSHD or MFE

Activity	Timing	Disturbance / Footprint	Equipment
		At HDD entry/exit points; and; At cable joint location on the seabed. The estimated volume of seabed sediment (that includes the above scenarios) to be cleared is 1,700,000 m^3. Sandwave (and large ripple) clearance is required along an estimated 7.9 km of the Marine Cable Corridor. The area of disturbance includes a dredging corridor width of 80 m and batter slopes at the edge of the excavation of approximately a further 35 m on each side (a total of 150 m wide). Area of disturbance = 1,185,000 m^2	
Sediment Deposit	In parallel with sediment clearance	Deposit 1,700,000 m^3 of cleared sediment within Marine Cable Corridor via surface release from barge hatches.	TSHD
Rock / Mattress Placement for uneven seabed	Within 1 – 12 months of cable installation,	Placement of rock / mattressing along up to 10 km (9%) of marine cable route. Footprint of infrastructure = 120,000 m^2	Rock placement vessel / mattress installation vessel
Crossing Preparation (pre-lay)	Within 2 – 12 months of cable installation, with crossing construction undertaken after	Two pre-lay rock berms, each approximately 30 m long and 10 m wide. Total footprint = 600 m^2 Height of rock berm = 0.5 m	Survey vessel Rock placement vessel

Activity	Timing	Disturbance / Footprint	Equipment
	cable installation.		
HDD Entry / Exit pits	At start of HDD operations	If required, entry / exit pits may be necessary to position the drill casing and protect the HDD end cap whilst minimising impacts on navigation depth. These will be location specific, but as worst case assumes a single pit (rather than 4 discrete pits) approximately 60 m x 15 m and 3 m deep. Total volume = 2,700m^3.	Long-reach excavator (barge mounted or marinised)

1.2 CABLE BURIAL

1.2.1.1 Depending on the burial technique adopted, burial of the marine cables can be undertaken simultaneously to cable lay or undertaken pre/post-lay. Table 2 summarises the worst-case scenarios in terms for cable burial along the whole Marine Cable Route.

Table 2 - Cable burial worst case scenario for two bundled cable pairs

Activity	Disturbance / Footprint	Equipment
Cable Burial	The worst-case scenario includes the burial of up to 107.9 km of the marine cables using one or a combination of the following methods: **Plough Trenching – up to 108 km of Marine Cable Corridor** Width of plough trench = 0.35m (non-displacement plough share width) Area of surface disturbance = 938,730 m2 Volume of trench disturbed = 79,980m3. **Jet Trenching – up to 20 km of Marine Cable Corridor** Width of jet trench assumed to be configured to 0.35m between jet swords, 0.5m overall Width of tracks = 0.8 m x 2	Cable lay barge Anchor handler vessels Burial support vessel Guard vessel

	Area of surface disturbance = 84,000 m2 Volume of trench disturbed = 2 (pairs of cables) x 0.5m (overall jet sword width) x target depth of lowering = 85,200 m3 This does not allow for any attempts at remedial burial if initial burial method does not achieve target depth of lowering. This does not include any jet tool use for uncovering in service or OOS cables. **Mechanical Trenching – up to 108 km of corridor** Width of trench = 0.5 m Width of both tracks = 4 m Area of surface disturbance = = 971,100 m2 Volume of trench disturbed = 114,250 m3 **Moorings** All burial methods (except TSHD) may require the use of anchor spreads. The worst case is assumed to be a 6-point mooring, based on 5t Stevpris anchors (individual anchor dimension = 4.2m x 4.6m) In a worst case, the anchor could be moved every 400m, therefore 270 movements, therefore a total area of 46,368 m^2	

1.3 NON-BURIAL PROTECTION

1.3.1.1 Table 3 summarises the worst-case scenarios in terms of non-burial cable protection measures along the whole length of the Marine Cable Corridor using one or a combination of the measures.

Table 3 - Non-burial protection measures along the Marine Cable Corridor worst case scenario for two bundled cable pairs

Activity	Duration / Timing	Disturbance / Footprint	Equipment
Non-burial Protection		Non-burial protection along 8 km (7%) of the Marine Cable Route using one or a combination of the following cable protection measures. An allowance has also been	Mattress installation vessel Rock placement vessel

Activity	Duration / Timing	Disturbance / Footprint	Equipment
		added to include an additional 10% (11 km) non-burial contingency, in case predicted burial depths are not met during construction and/or if further non- burial protection is required during maintenance/repair activities during operation. **Concrete/frond mattressing** – up to 19 km Width of protection = 6 m Height of protection = 0.3 m Total footprint of mattressing = 228,000 m^2 **Rock Placement** - up to 19 km Width of protection = 10 m Height of protection = 1 m Total footprint of protection =380,000 m^2 These parameters do not include protection used as seabed preparation, HDD exit pits or for the cable crossing design.	
Cable Crossing Protection measures (Post-lay)		Installation of two post-lay rock berms. Each berm up to approximately 6 m wide and 600 m long. Height of berm above seabed (or pre-lay berm) = 0.5 m Total footprint = 7,200 m^2	Rock placement vessel Mattress installation vessel

Activity	Duration / Timing	Disturbance / Footprint	Equipment
Horizontal Directional Drilling Exit/Entry Point Protection Measures	After HDD and installation of end caps, until cable installation. Non-burial protection could be in place for up to 12 months. It would be removed as part of the cable pull / installation process.	Rock or mattress protection may be installed at HDD exit/entry points. These may be as 4 discrete locations or as a single berm covering all 4 exit points. Backfill HDD entry / exit pit with previously removed material. Height of berm = 0.5 m – will be located in existing pit to ensure navigable depth is maintained. Length of berm = 15 m Width of berm = 60 m Total footprint of protection = 900 m^2	Mattress or rock placement vessel

1.4 LANDFALL INSTALLATION

1.4.1.1 Table 4 summarises the worst-case scenario for Landfall installation.

Table 4 - Landfall installation worst case scenario

Activity	Duration / Timing	Disturbance / Footprint	Equipment
HDD	41 weeks drilling plus 2 weeks for end cap installation	**Intertidal Area** HDD will pass under intertidal area below seabed surface from TJB to marine entry / exit point. No footprint/disturbance between the ends. **Marine works to install HDD ducts** Four individual ducts will be drilled. Jack-up barge will be placed at up **to four** locations. Typical jack-up barge will possess 4 legs, each leg approximately 1.4 m diameter. Temporary casing support frame comprising 2 trestles spaced 12 m apart at each location. Each trestle has a footprint of 3 m^2. 1200 m^3 of drilling fluid per duct. Total of 4,800 m^3 for four ducts. Drilling fluid will be made up of water (>90%), bentonite (~7%), Xanthan gum (<0.5%) to ensure it meets with Cefas's requirement. Ducts will be spaced approximately 15 m apart. Exit point to be defined, but likely between KP1.0 and 1.6. 36" casing driven approximately 24m into the seabed at an angle of 10-12 degrees, therefore reaching a maximum depth of approximately 5 m below seabed level.	Jack up barge Drilling rig

1.5 OPERATION, MAINTENANCE AND DECOMMISSIONING

1.5.1.1 The Proposed Development has been designed so that maintenance of the marine cables is not required during its operational lifetime. Should maintenance works be required, it is anticipated that the relevant section of the marine cable will be recovered using methods like those employed during installation. As such, the worst-case scenario described above, in relation to cable installation, is relevant for the operation and maintenance of the Proposed Development although works would be of shorter duration. Similarly, prior to decommissioning, a decommissioning plan will be produced to identify and evaluate the appropriate decommissioning methodology for the Proposed Development, part of which will assess the environmental implications which will likely be evaluated against a worst-case scenario.