XLINKS' MOROCCO-UK POWER PROJECT

Environmental Statement

Volume 2, Appendix 4.2: Private Water Supply Desk Based Assessment

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RPS

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Glossary

Term	Meaning
Aquifer	A subsurface layer or layers of rock or other geological strata of sufficient porosity and permeability to allow either a significant flow of groundwater or the abstraction of significant quantities of groundwater.
Environmental Impact Assessment	The process of identifying and assessing the significant effects likely to arise from a project. This requires consideration of the likely changes to the environment, where these arise as a consequence of a project, through comparison with the existing and projected future baseline conditions.
Environmental Statement	The document presenting the results of the Environmental Impact Assessment process.
Horizontal Directional Drilling	Horizontal Directional Drilling (HDD) is a method of installing underground pipelines, cables and service conduit (or ducts) through trenchless methods to avoid obstacles and sensitive features (e.g. roads, watercourses, woodlands, etc.). The term HDD is used here interchangeably with other similar trenchless techniques but excluding micro tunnelling or direct pipe methods.
Onshore HVDC Cable Corridor	The proposed corridor within which the onshore High Voltage Direct Current cables would be located.
Onshore Infrastructure Area	The proposed infrastructure area within the Order Limits landward of Mean High Water Springs. The Onshore Infrastructure Area comprises the transition joint bays, onshore HVDC Cables, converter stations, HVAC Cables, highways improvements, utility diversions and associated temporary and permanent infrastructure including temporary compound areas and permanent accesses.
Proposed Development	The element of Xlinks' Morocco-UK Power Project within the UK. The Proposed Development covers all works required to construct and operate the offshore cables (from the UK Exclusive Economic Zone to Landfall), Landfall, onshore Direct Current and Alternating Current cables, converter stations, and highways improvements.
Secondary Aquifer	A locally important aquifer unit.
Study area	This is an area which is defined for each environmental topic which includes the Order Limits as well as potential spatial and temporal considerations of the impacts on relevant receptors. The study area for each topic is intended to cover the area within which an impact can be reasonably expected.
Xlinks' Morocco UK Power Project	The overall scheme from Morocco to the national grid, including all onshore and offshore elements of the transmission network and the generation site in Morocco (referred to as the 'Project').

Acronyms

Acronym	Meaning
BGS	British Geological Survey
Defra	Department for Environment, Food and Rural Affairs
EA	Environment Agency
ES	Environmental Statement
PWS	Private Water Supply
UK	United Kingdom

Units

Units	Meaning
m^3	Cubic metre
km	Kilometre
m	Metre
m bgl	Metres below ground level

1 PRIVATE WATER SUPPLY DESK BASED ASSESSMENT

1.1 Introduction

1.1.1 This document forms Volume 2, Appendix 4.2: Private Water Supply Desk Based Assessment of the Environmental Statement (ES) prepared for the United Kingdom (UK) elements of Xlinks' Morocco-UK Power Project (the 'Project'). For ease of reference, the UK elements of the Project are referred to as the 'Proposed Development, which is the focus of the Environmental Statement (ES). The ES presents the findings of the Environmental Impact Assessment process for the Proposed Development.

1.1.2 This document provides the methodology and qualitative risk assessment of identified private water supplies (PWS) which have the potential to be impacted by the Proposed Development.

1.2 Methodology

Data Sources

1.2.1 The data presented in this technical report has been taken from the following publicly available data sources from the following organisations:

- British Geological Survey (BGS);
- Department for Environment, Food and Rural Affairs (Defra); and
- Environment Agency (EA).

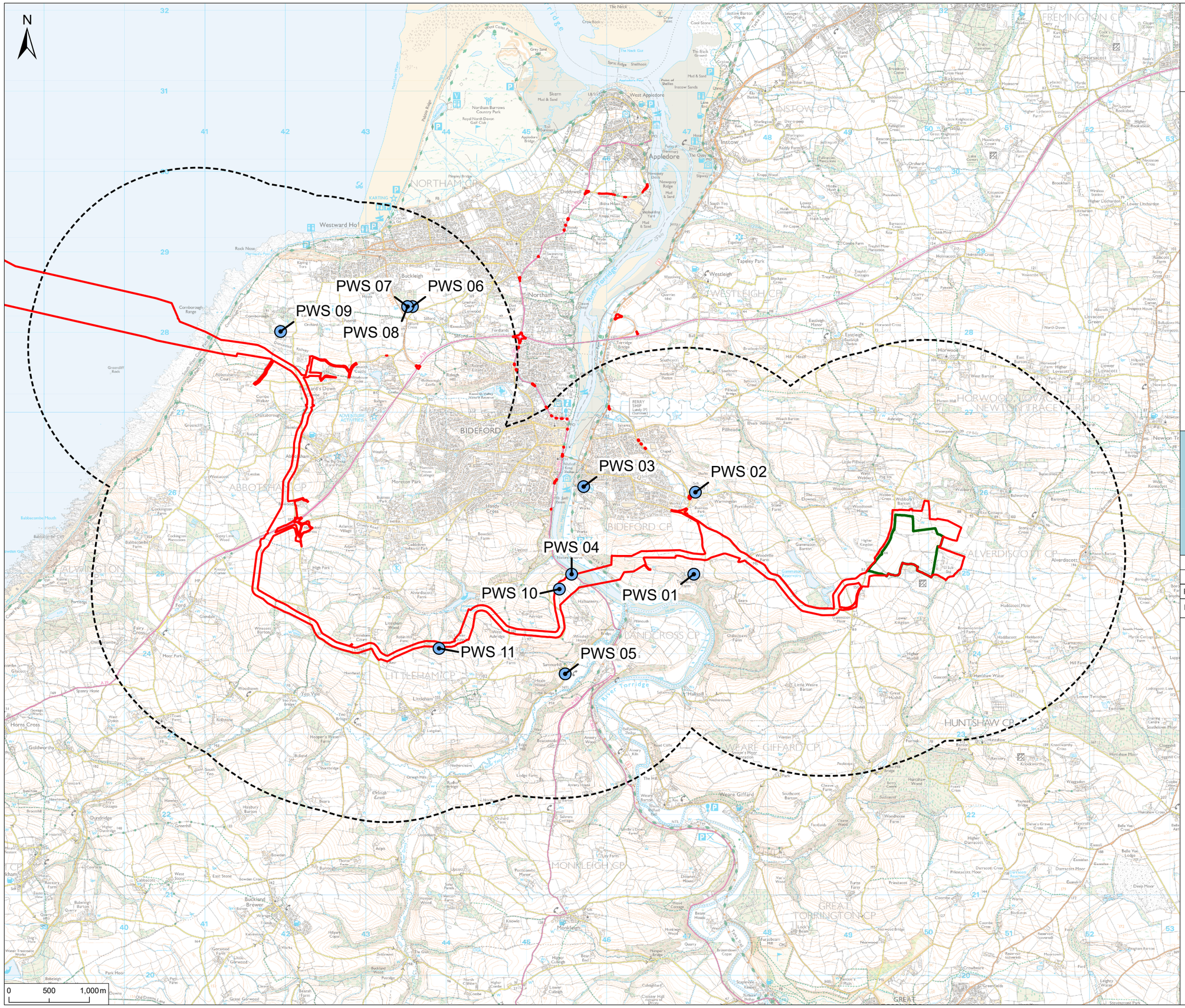
Study Area

1.2.2 The study area applicable to PWS is a 2 km buffer around the Onshore Infrastructure Area, presented in **Figure 1.1**.

Baseline Methodology

Desktop study

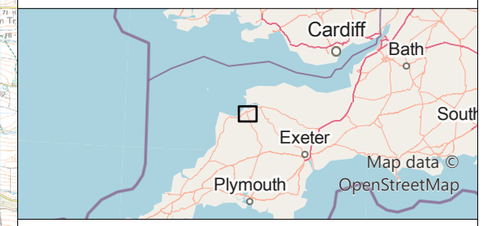
1.2.3 Information relevant to PWS within the study area was collected through a detailed desktop review of existing studies and datasets. These sources are summarised at **Table 1.1**.



Notes
1. This plan is scaled at paper size A3. If received electronically it is the recipients responsibility to print to the correct scale. Only written dimensions should be used.

Legend

- Order Limits
- Converter Site
- 2km Cable Route Buffer
- Private Water Supply



Rev	Description	By	CB	Date
P01	FINAL	SHB	ET	16.10.24

Xlinks

Client: Xlinks 1 Limited

Project: Xlinks' Morocco-UK Power Project

Title: Private water supply locations and study area

Status: FINAL

Scale @ A3: 1:45,000

Date Created: Nov 2024

Figure Number: **1.1**

Rev: **P01**

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Table 1.1: Summary of key desktop sources

Title	Source	Year	Author
GeoIndex Onshore	BGS Map Viewers	Accessed October 2024	BGS
GeoIndex Onshore	Borehole records	Accessed October 2024	BGS
Aquifer designation – Bedrock and Superficial Deposits; Groundwater vulnerability; Groundwater safeguard zones Source Protection Zones.	Magic Maps	Accessed October 2024	Defra
Lexicon of Named Rock Units	BGS Lexicon	Accessed October 2024	BGS
LIDAR Composite Digital Surface Model	National LIDAR Programme	Accessed October 2024	Defra Data Services

Site-specific surveys

1.2.4 A targeted site walkover was undertaken in March 2023 by an RPS hydrological consultant. The purpose of the walkover was to collect information from landowners within the Onshore Infrastructure Area regarding PWS.

Risk Assessment Methodology

1.2.5 A qualitative risk assessment methodology has been devised which considers the probability that a hydrogeological pathway exists and the severity of the consequences. The risk matrix which utilises these parameters is provided in **Table 1.2**.

Table 1.2: PWS quantitative risk matrix

		Severity of Consequence if Pathway Exists			
		Severe	Medium	Mid	Negligible
Probability that the hydrogeological pathway exists	Highly Likely	Very High Risk	High Risk	Moderate Risk	Low to Moderate Risk
	Likely	High Risk	Moderate Risk	Low to Moderate Risk	Low Risk
	Low Likelihood	Moderate Risk	Low to Moderate Risk	Low Risk	No Risk
	Unlikely	Low to Moderate Risk	Low Risk	No Risk	No Risk
	No Pathway	No Risk	No Risk	No Risk	No Risk

1.2.6 The probability and severity descriptors are provided in **Table 1.3** and **Table 1.4**.

Table 1.3: Probability that the hydrogeological pathway exists

Probability	
Highly Likely	PWS is expected to be in same groundwater catchment and down-gradient to the construction activity; short groundwater flow path; Simple geological system (e.g. shallow, sand and gravel aquifer in valley bottom); or proven pathway in more complex system.
Likely	PWS expected to be in same groundwater catchment and down-gradient to the construction activity; or relatively simple geological / hydrogeological system / pathway; or complex fractured system with known spring flows, given position of PWS; medium or short flow path.
Low Likelihood	PWS likely to be situated in same groundwater catchment but up-gradient or lateral to the construction activity; or complex geological / hydrogeological system / pathway (e.g. multilayered; thick; low and high permeability; fracture pathways etc); Simple geological system but lateral position; Long flow path.
Unlikely	PWS situated in different groundwater catchment or upgradient from construction activity; pathway dominated by low permeability geology (mudstones / clays etc); very long flow path.

Note: Also records confidence in the assessment (Low, Medium, High)

Table 1.4: Severity of consequence if pathway exists

Severity	
Severe	A significant impact on groundwater quality or quantity that could represent a risk to human health and the long-term viability of the supply source.
Medium	A measurable impact on groundwater quality or quantity, that may that could temporarily render the source usable or result in a long-term change in groundwater status although not its viability as source of supply.
Mild	A measurable change to groundwater quality or quantity expected but no material change in status of the groundwater body or its viability as a source of supply.
Negligible	No measurable effect on groundwater quality or quantity predicted expected at the source of supply.

Note: Also records confidence in the assessment (Low, Medium, High)

1.2.7 The risk matrix defines the measure that must be taken to protect any groundwater supply source and the respective water users, from adverse effects during construction and operation.

1.2.8 Therefore, as uncertainty in the assessment increases, a higher risk ranking is assigned.

1.2.9 This is of most significance for those groundwater supply sources for which a lower risk ranking has been assigned but there is low confidence.

Assumptions and Limitations

1.2.10 Key assumptions relevant to this risk assessment are as follows.

- Prevalent unconfined, fractured bedrock aquifer exists.
- Bedrock sufficiently fractured to support small abstractions but aquifer relatively shallow (<50 m^3).
- Typical capture zone for boreholes, with background water levels / flow directions, reflect topography to some extent (hence topography can be used to understand capture zone).
- Boreholes situated near major rivers will be located at the regional discharge point from the aquifer system (i.e. upward flow) and will be less susceptible to shallow impacts.

1.3 Desk Study – Baseline Characterisation

1.3.1 Eleven PWS have been identified as presented in **Table 1.5**. The hydrogeological setting pertaining to each is presented in **Table 1.6**. The locations of the PWS are presented in **Figure 1.1.**

Table 1.5: PWS data

Reference	BGS Reference or Other	Name and Owner	Source Description	Easting	Northing	Approx. Distance from the Onshore Infrastructure Area (m)	Direction relative to the Onshore Infrastructure Area	Depth (m)
PWS 01	SS42SE8	Tennacott Bideford	Borehole (BGS Water Well)	247080	124990	218	West	33.53
PWS 02	SS42NE63	N Devon Isolation Hospital Bideford	Borehole (BGS Water Well)	247100	126010	740	West	5.48
PWS 03	SS42NE62	Gas and Coke co works Bideford	Borehole (BGS Water Well)	245710	126080	898	West	75.28
PWS 04	SS42SE10	Bideford	Borehole (BGS Water Well)	245560	124990	Within the Onshore Infrastructure Area	West	22.56
PWS 05	SS42SE7	Not Known	Borehole (BGS Water Well)	245480	123750	494	South west	24.38
PWS 06	SS42NW24	Buckleigh Laundry	Borehole (BGS Water Well)	243580	128320	1,610	North west	30.48
PWS 07	SS42NW1	Not Known	Borehole (BGS Water Well)	243520	128320	1,563	North west	31
PWS 08	SS42NW23	Buckleigh Laundry	Borehole (BGS Water Well)	243520	128320	1,563	North west	30.48
PWS 09	SS42NW2	Not Known	Borehole (BGS Water Well)	241940	128010	280	Northwest	24
PWS 10	Site Walkover Survey. Borehole.	P Pennington	Borehole along field boundary. Used as source of emergency supply (not used at time of site walkover).	245408	124805	Within the Onshore Infrastructure Area	Within the cable route corridor.	Not Known
PWS 11	Likely to b ethe same as PWS 04 (SS42NE62)	M Rose	Described as a well. Piped to farm house (stock watering).	243911	124067	35	Borehole with no pumping equipment.	High

Table 1.6: Hydrogeological Setting

Reference	Bedrock Geology and Aquifer Status	Superficial Geology and Aquifer Status
PWS 01	Bude Formation (mudstone and siltstone, with sandstones). Secondary (A) aquifer.	None
PWS 02	Bude Formation (mudstone and siltstone). Secondary (A) aquifer.	None
PWS 03	Bude Formation (mudstone and siltstone). Secondary (A) aquifer.	None
PWS 04	Crackington Formation (mudstone and siltstone). Secondary (A) aquifer.	None
PWS 05	Bude Formation (sandstone). Secondary (A) aquifer.	None
PWS 06	Bideford Formation (mudstone and siltstone). Secondary (A) aquifer.	None
PWS 07	Bideford Formation (mudstone and siltstone). Secondary (A) aquifer.	None
PWS 08	Bideford Formation (mudstone and siltstone). Secondary (A) aquifer.	None
PWS 09	Bideford Formation (mudstone and siltstone). Secondary (A) aquifer.	None
PWS 10	Bude Formation (sandstone). Secondary (A) aquifer.	None
PWS 11	Bude Formation (sandstone). Secondary (A) aquifer.	None

1.4 Preliminary Qualitative Risk Assessment

1.4.1 A summary risk assessment is presented in **Table 1.7**.

Table 1.7: Qualitative Risk Assessment

Reference	Potential Pathway Discussion	Probability	*Confidence*	Severity	*Confidence*	Preliminary Qualitative Risk Ranking
PWS 01	The borehole reaches a depth of 33.53 m into the Bude Formation. Water has previously been struck at 5 m bgl and 30 m bgl. The rest water level was recorded at 3.6 m bgl. The Bude Formation starts at a depth of 0.3 m. The topography falls to the south, towards the River Torridge. There is a band of Bude Formation (sandstone) between the Onshore Infrastructure Area and the borehole. The area is heavily faulted but the borehole and Onshore HVDC Cable Corridor have a potential hydraulic connection. The mudstone and siltstone of the Bude Formation will not be especially porous or permeable and with groundwater flow restricted principally to fractures. While the geology of the area is complex, groundwater can be assumed to generally follow the topography. The Onshore Infrastructure Area are within the likely catchment area of the borehole. Trench excavation could intercept groundwater, albeit only shallowest fractures (and fracture flow will likely be towards the River Torridge). Therefore, it is not possible to rule out risk for this borehole.	Likely	Low	Medium	Low	Moderate
PWS 02	The borehole reaches a depth of 5.48 m into the Bude Formation. Water has been struck at varying depths previously. The Bude Formation starts close to the surface. The topography falls to the northwest, towards the River Torridge. There are no faults or other features between the Onshore HVDC Cable Corridor and the borehole, although there are nearby bands of sandstone and the surrounding area is heavily faulted. The mudstone and siltstone of the Bude Formation will not be especially porous or permeable and so groundwater movement will be restricted. While the geology of the area of complex, groundwater will generally follow the topography. The borehole is very shallow and at a	Low Likelihood	Low	Medium	Low	Low to Moderate

Reference	Potential Pathway Discussion	Probability	*Confidence*	Severity	*Confidence*	Preliminary Qualitative Risk Ranking
	significant distance from the Onshore HVDC Cable Corridor where shallow cable trenching will occur.					
PWS 03	The borehole reaches a depth of 75.28 m into the Bude Formation. This borehole was recorded as dry, and there is no borehole log. Groundwater will likely flow with topography to the west, towards the River Torridge. The borehole lies directly next to a NW-SE trending fault, and two sandstone bands lie within the fault complex, south of the borehole. The mudstone and siltstone of the Bude Formation will not be especially porous or permeable and so groundwater movement will be restricted. A flow pathway between the Onshore HVDC Cable Corridor and PWS 03 does not seem likely due to the distance between the borehole and the Onshore HVDC Cable Corridor, the lateral position of the borehole to the Onshore HVDC Cable Corridor, the expected westerly groundwater flow pathway and the location of the borehole in a groundwater discharge zone.	Low Likelihood	Low	Mild	Low	Low
PWS 04	The borehole reaches a depth of 22.56 m into the Crackington Formation. Water was previously struck at 14.6 m bgl. The Crackington Formation begins at approximately 1.2 m bgl. The borehole lies within the Onshore Infrastructure Area so there is a definite pathway. The borehole could be very close to drilling. The borehole also lies very close to the catchment discharge point to the River Torridge, this may afford some protection form short term shallow effects.	Highly Likely	Medium	Medium	Medium	High
PWS 05	The borehole reaches a depth of 24.38 m into the Bude Formation. Water was previously struck at 22 m bgl, and the rest water level was noted as 5.4 m bgl. There is a fault between the cable corridor and the borehole, although general migration of groundwater in the area will be southwest, towards the River Torridge and the River Yeo. There is also a band of mudstone and siltstone between the Onshore HVDC Cable Corridor and the borehole. This borehole is also directly next to the superficial alluvium	Low Likelihood	Low	Mild	Low	Low

Reference	Potential Pathway Discussion	Probability	*Confidence*	Severity	*Confidence*	Preliminary Qualitative Risk Ranking
	deposits that line the rivers in the area. The borehole lies next to the discharge point for the catchment, at the River Yeo. This means it is unlikely to be affected by works within the Onshore HVDC Cable Corridor, and the red line boundary is not likely to be within the borehole catchment.					
PWS 06	The borehole reaches a depth of 30.48 m into the Bideford Formation. Water was previously struck at 7.6 m bgl. This borehole is at a higher elevation than the Onshore HVDC Cable Corridor in this area, and it also almost 1 km away. Groundwater in this area is likely to flow west towards the coast, and not towards the borehole. The borehole also lies on the opposite side of a valley to the Onshore HVDC Cable Corridor, further restricting the chance of a flow pathway. Therefore, it is unlikely this borehole would be affected.	Low Likelihood	High	Medium	High	Low to Moderate
PWS 07	The borehole reaches a depth of 31 m into the Bideford Formation. Water was previously struck at 7.6 m bgl. This borehole is at a higher elevation than the Onshore HVDC Cable Corridor in this area, and it also almost 1 km away. Groundwater in this area is likely to flow west towards the coast, and not towards the borehole. The borehole also lies on the opposite side of a valley to the Onshore HVDC Cable Corridor, further restricting the chance of a flow pathway. Therefore, it is unlikely this borehole would be affected.	Low Likelihood	High	Medium	High	Low
PWS 08	The borehole reaches a depth of 30.48 m into the Bude Formation. Water was previously struck at 7.6 m bgl. This borehole is at a higher elevation than the Onshore HVDC Cable Corridor in this area, and it also almost 1 km away. Groundwater in this area is likely to flow west towards the coast, and not towards the borehole. The borehole also lies on the opposite side of a valley to the cable corridor, further restricting the chance of a flow pathway. Therefore, it is unlikely this borehole would be affected.	Low Likelihood	High	Medium	High	Low
PWS 09	The borehole reaches a depth of 24 m into the Bude Formation. Water was previously struck at 9.1 m bgl, and the rest water level was shallow noted as 0.9 m bgl. Borehole	Low Likelihood	Medium	Mild	Medium	Low

Reference	Potential Pathway Discussion	Probability	*Confidence*	Severity	*Confidence*	Preliminary Qualitative Risk Ranking
	situated up hydraulic gradient from the Onshore HVDC Cable Corridor which is located in the dry valley below. Shallow excavation in the dry valley below considered unlikely to have a direct impact on groundwater at source in terms of water quality, levels or supply give low groundwater levels at the Onshore Infrastructure Area relative to the borehole and the borehole catchment extending northward beneath high ground. It is unclear which direction groundwater will be flowing; it could be westward to the coast or eastward to the point the river in the valley below begins to flow. Immediately down gradient of the borehole groundwater is likely to be below groundwater level and deeper that than the base of the borehole. Although there may be continuity between the Onshore HVDC Cable Corridor and the borehole (it cannot be entirely discounted), any consequences are mild.					
PWS 10	It seems likely this borehole is the same as PWS04, which is likely the property registered to the borehole. The borehole abstracts from the fractured bedrock (sandstones) of the Bude Formation. Although unused currently, the borehole lies within the Onshore Infrastructure Area so there is a definite pathway with construction activities or even direct damage to the well itself (not just water quality or water supply). Those activities could include shallow trenching and/or trenchless crossing (i.e. Horizontal Directional Drilling) operations below the River Torridge. Location / position of distribution pipework unknown, but as unused likely to be absent.	Highly Likely	Medium	Medium	Medium	High
PWS 11	The well abstracts groundwater from the shallow sandstones of the Bude Formation. The topography falls to the north, towards the Onshore Infrastructure Area, the farm and the tributary of the River Torridge.	Likely	Low	Medium	Low	Moderate for well

Reference	Potential Pathway Discussion	Probability	*Confidence*	Severity	*Confidence*	Preliminary Qualitative Risk Ranking
	While the geology of the area of complex, groundwater levels and flow can be assumed to generally reflect topography. Well situated immediately up-gradient of the Onshore Infrastructure Area (i.e. higher elevation). Distribution pipework for well crosses the cable route corridor. Although situated up gradient of the Onshore HVDC Cable Corridor, cannot discount potential for shallow trenching to affect shall groundwater levels and flow paths in the shallow fractured bedrock aquifer, given their proximity.					Very high risk for water distribution pipework

1.5 References

British Geological Survey (BGS) Natural Environment Research Council (NERC) and Environment Agency (EA) (20" The physical properties of minor aquifers in England and Wales, Hydrogeology Group, Technical Report WD/00/04, Environment Agency R&D Publication 68.

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