HORIZON NUCLEAR POWER

WYLFA NEWYDD

ENERGY WORKING FOR BRITAIN

Wylfa Newydd Project

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7 Soils and geology

7.1 Introduction

7.1.1 This chapter describes the assessment of potential soils and geology effects resulting from the construction, operation and decommissioning of the WNDA Development, other on-site development, Marine Works and the Site Campus. Further details are presented in chapter D1 (proposed development, Application Reference Number: 6.4.1).

7.1.2 Please refer to chapter B7 (soils and geology, Application Reference Number: 6.2.7) for the technical basis for the assessment including a summary of legislation, policy and guidance; key points arising in consultation that have guided the soils and geology assessment; and assessment methodologies and criteria.

7.2 Study area

7.2.1 This section describes the study area relevant to the soils and geology assessment for the Wylfa Newydd Development Area.

7.2.2 The initial soils and geology study area was defined to incorporate potential environmental receptors located within 2km ('upstream') of the southern side of the Power Station Site, and within 1km of its eastern and western boundaries, with the northern boundary defined by the Irish Sea coastline. These boundaries were designed to include the adjacent surface water catchments, as identified in chapter D8 (surface water and groundwater, Application Reference Number: 6.4.8), in order to cover the maximum possible lateral extents of any potential effects associated with the proposed activities.

7.2.3 As additional baseline information was obtained, the study area boundary was refined and altered to reflect key features of importance to soils and geology, while at the same time acknowledging the inter-relationship between the geological, hydrogeological and hydrological settings. A revised study area was agreed with Natural Resources Wales (NRW) and the Isle of Anglesey County Council in 2015.

7.2.4 However, the majority of potential effects on soils and geological receptors are likely to be associated with the direct disturbance of ground conditions. As the designs have progressed, it has become apparent that the potential effects would be limited to the Wylfa Newydd Development Area and a 250m buffer. Therefore, the study area has been refined to this area, shown as a blue dashed line on figure D7-1 (Application Reference Number: 6.4.101). This change was introduced in the May 2017 addendum to the Wylfa Newydd Project Environmental Impact Assessment Scoping Report (chapter A6 EIA scoping report and addendum, Application Reference Number: 6.1.6) and no comments were received from consultees in this regard.

7.3 Baseline environment

7.3.1 This section provides a summary of the baseline conditions for soils and geology within the study area described in section 7.2.

Baseline surveys

7.3.2 Data sources of relevance to soils and geology chapters across this Environmental Statement are introduced in chapter B7 (Application Reference Number: 6.2.7). However, table D7-1 provides a summary of the site works and baseline reporting of primary relevance to the Wylfa Newydd Development Area. Ground investigation data are only available for the Wylfa Newydd Development Area, therefore discussions in the encountered geology and land contamination conditions sections are limited to this area only.

Table D7-1 Summary of baseline surveys

Title	Company	Year	Description of work undertaken
Wylfa 'B' Geological and Geomorphological Studies	Allott and Lomax	1987–1988	Geological mapping and fault study
Wylfa 'B' Landscape Studies On Site Feasibility Preliminary Report Volume 3: Appendices 1–9	Travers Morgan Planning	1987	Included soil survey at 1:2,500 scale to enable detailed landscape design
Central Electricity Generating Board Wylfa 'B' – Pre-Application Studies Site Investigation Contract WYB/C2.3 Draft Report on Site Investigation	Wimpey Laboratories	1987	21 vertical rotary boreholes, 16 inclined rotary boreholes, 17 cable percussive boreholes and eight trial trenches
Combined Cycle Gas Turbine Power Station Ground Investigation (Onshore and Offshore)	Soil Mechanics	1997–1998	Onshore: 24 rotary boreholes, 10 trial pits and 37 probe holes Offshore: four rotary boreholes and hydrographic survey
Wylfa Power Station. Preliminary Investigation (Desk Study) of Land Potentially Affected by Contamination	British Nuclear Fuels Limited	2005	Desk study of the Existing Power Station site and surrounding land
Wylfa 'B' Power Station Stage 2 Geotechnical Desk Study	Enviros Consulting Limited	2008	Geotechnical desk study written for RWE npower

Title	Company	Year	Description of work undertaken
Nuclear Decommissioning Authority Phase 1 Land Quality Assessment: Non-Operational Landholding at Wylfa Power Station	Enviros Consulting Limited	2008	Desk study of the land surrounding the Existing Power Station for the Nuclear Decommissioning Authority
Investigation of Chlorinated Solvent Contamination of Water in Sump Adjacent to Wylfa Site	Enviros Consulting Limited	2009	Report on investigations into a sump containing chlorinated solvents
Unexploded Ordnance Survey	Explosive Ordnance Disposal Contracts Limited	2009–2010	Unexploded Ordnance risk assessment
New Wylfa Power Station. Ground conditions, hydrology and hydrogeology. Environmental Baseline Conditions Report	Halcrow Group Limited	2010	Summary of available information on ground conditions
Report on Preliminary Ground Investigation at Wylfa (Preliminary Site Investigation (PSI))	Structural Soils Limited	2010	11 rotary boreholes, 10 cable percussive boreholes and nine trial pits
Geophysical Survey	Fugro Aperio Limited	2010–2011	52 shallow, hand-dug trial pits and geophysical data collection (using methods such as vertical magnetic gradiometry)
Factual Report on Wylfa New Build Intermediate Onshore Ground Investigation (IOnGI)	Structural Soils Limited	2011	57 rotary cored boreholes, 23 cable percussive boreholes, 10 trial pits, 28 trial trenches and five hand-augered boreholes and surface geophysical testing

Title	Company	Year	Description of work undertaken
Wylfa Newydd Intermediate Offshore Ground Investigation – Phase 3 (IOffGI)	Fugro Seacore Limited	2011	11 cable percussive and rotary cored boreholes
Wylfa New Build: IOnGI Geotechnical Interpretative Report	Halcrow Group Limited	2012	Presentation and interpretation of the results of the IOnGI
Wylfa New Build: IOffGI Geotechnical Interpretative Report	Halcrow Group Limited	2012	Presentation and interpretation of the results of the IOffGI
Wylfa New Build Power Station. Contaminated Land Desk Study and Initial Risk Assessment	Halcrow Group Limited	2012	Desk study concerned with land contamination within the Wylfa Newydd Development Area
Environmental Baseline Conditions Report. Wylfa Newydd Ground Conditions, Hydrology and Hydrogeology	CH2M Hill	2014	Updated summary of available information on ground conditions
Factual Report on Wylfa Newydd Detailed Onshore Ground Investigation: Volume 1 & Volume 2 (DOnGI)	Structural Soils Limited	2015	96 cable percussive boreholes, 282 vertical rotary boreholes, 32 inclined rotary cored boreholes and 85 trial pits
Agricultural Land Classification and Soil Resources June 2015	Reading Agricultural Consultants Limited	2015	75 soil auger holes and six observation pits, at a density of one observation per four hectares, to provide profiles for assessment and classification
Factual Report for Task Order 002 – SPC1 (2015 GI)	Structural Soils Limited	2015	Investigation primarily targeted to areas of known/suspected ground contamination. Comprised

Title	Company	Year	Description of work undertaken
			53 trial pits, nine hand-dug pits and five boreholes
Wylfa Newydd Nuclear Power Station. DOnGI Final Interpretative Ground Investigation Report	Atkins Limited	2016	Presentation and interpretation of the results of the DOnGI
Agricultural Land Classification and Soil Resources March 2016	Reading Agricultural Consultants Limited	2016	28 soil auger points, two observation pits and one exposed trench were examined across approximately 28ha of suspected Best and Most Versatile (BMV) land
Detailed Offshore Ground Investigation (DOffGI) Factual Report	Fugro Geoservices Limited	2017	Seven rotary cored onshore boreholes, 26 offshore cable percussive and rotary cored boreholes and six cable percussive offshore boreholes[1]
Land Contamination Risk Assessment and Remediation Strategy	Jacobs	2017	Collation of available land contamination information for the Wylfa Newydd Development Area, risk assessment, remediation options appraisal and remediation strategy

7.3.3 The ground investigations of most relevance to the baseline for soils and geology are the PSI, IOnGI, DOnGI and 2015 GI, whilst the IOffGI and DOffGI provide offshore geology data.

7.3.4 Exploratory hole location plans from these ground investigations, as well as from the Wylfa 'B' Ground Investigation and Combined Cycle Gas Turbine Power Station Ground Investigation, are presented in appendix D7-1 (Soils and Geology Baseline Conditions Report, Application Reference Number: 6.4.24).

[1] One of these cable percussive boreholes was terminated at 0.95m because it was sited incorrectly.

Soil quality

Soil type

7.3.5 The National Soil Resources Institute soils report [RD1] (included within appendix D7-1, Application Reference Number: 6.4.24) identifies East Keswick 1 soils as the main soil association (type) present. However, a narrow band of Brickfield 2 soils with a west to east orientation is present in the southeast of the Wylfa Newydd Development Area. Brickfield 2 soils are also present within eastern and southwestern extents of the study area. The characteristics of these soil associations are summarised in table D7-2.

Table D7-2 Characteristics of the soil associations present

	Soil association	
Characteristic	**East Keswick 1**	**Brickfield 2**
Source	Drift material derived from Palaeozoic[2] sandstone and shale.	Drift from Palaeozoic and Mesozoic[3] sandstone and shale.
Composition	Deep, well-drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging. Low/negligible storage capacity and low natural soil fertility.	Slowly permeable, seasonally waterlogged fine loamy soil with low natural soil fertility.
Hydrology of soil type	Free-draining permeable soils in unconsolidated loams or clays with low permeability and storage capacity. Minor risk of flooding.	Slowly permeable, seasonally waterlogged soils over slowly permeable substrates with negligible storage capacity; minor risk of flooding.
Pollutant leaching potential	Soils of intermediate leaching potential which have a moderate ability to attenuate a wide range of diffuse source pollutants, but in which it is possible that some non-absorbed diffuse source pollutants and liquid discharges could penetrate the soil layer.	Soils in which pollutants are unlikely to penetrate the soil layer either because water movement is largely horizontal or because they have a large ability to attenuate diffuse source pollutants.

[2] A geological era extending from approximately 541 to 252 million years ago (Mya).

[3] A geological era extending from approximately 252 to 66 Mya.

	Soil association	
Characteristic	**East Keswick 1**	**Brickfield 2**
Land use	Neutral and acid pastures, deciduous woodlands and acid communities such as bracken and gorse in the uplands supporting stock rearing on permanent grassland.	Seasonally wet pastures and woodlands. Dairying and stock rearing on permanent or short-term grassland; some cereals in drier areas.

7.3.6 In addition to these soil associations, peaty soils are known to be present within the Tre'r Gof Site of Special Scientific Interest (SSSI) and within the area proposed for the realignment of the Nant Porth-y-pistyll to the north of Caerdegog Isaf (see chapter D1, Application Reference Number: 6.4.1 for details), based on the results of the IOnGI; see appendix D7-1 (Application Reference Number: 6.4.24) for more details.

Agricultural Land Classification (ALC)

7.3.7 The ALC system set out within *Agricultural Land Classification of England and Wales. Revised Guidelines and Criteria for Grading the Quality of Agricultural Land* [RD2] defines six grades of soils:

- Grade 1 (excellent quality);
- Grade 2 (very good quality);
- Subgrade 3a (good quality);
- Subgrade 3b (moderate quality);
- Grade 4 (poor quality); and
- Grade 5 (very poor quality).

7.3.8 Grades 1 and 2 and Subgrade 3a are determined as BMV land. BMV agricultural land is the most flexible in terms of the range of crops that can be grown, the level and consistency of yield and the cost of obtaining it, and offers the best prospect for both food and non-food crop production. ALC grades are determined by the most limiting factor present, based on physical or chemical characteristics which pose long-term limitations to agricultural use.

ALC within the Wylfa Newydd Development Area

7.3.9 The 2015 ALC survey [RD3] (provided in appendix D7-1, Application Reference Number: 6.4.24) was completed at a density of one observation per four hectares and is thus considered a semi-detailed survey rather than a detailed survey [RD4]. This approach was adopted because, based on a review of desk-based information (including provisional ALC data), the survey was expected to find land predominantly not classed as BMV, i.e. Grade 3b or below.

7.3.10 Five areas were identified as potential BMV land during the semi-detailed survey. Therefore, a detailed survey was undertaken in these areas in

February 2016 [RD5] (provided in appendix D7-1, Application Reference Number: 6.4.24) to determine the extent of BMV land with greater confidence and further characterise the soil resources.

7.3.11 The ALC surveys were limited in extent to the Wylfa Newydd Development Area, as no effects are expected to occur on soils within the 250m buffer as part of the construction, operation or decommissioning of the WNDA Development. The only way in which soils could be affected within the 250m buffer would be as a result of the migration of contamination, but this is very unlikely based on the nature and spatial distribution of existing contamination, and the nature of the proposed activities for the WNDA Development.

7.3.12 The surveys identified that most of the soils within the Wylfa Newydd Development Area are Subgrade 3b, with large areas of Grade 5, and smaller areas of Grade 2 and Subgrade 3a land. A very small area of Grade 4 land was identified northeast of Tregele. Non-agricultural land was mapped for several areas of the site, including the former Wylfa Sports and Social Club, woodland, roads and buildings. It should be noted that, although some of these areas likely contain soil that could be returned to agricultural use, soil in these locations is not considered within the assessment of effects; it is considered likely that the soils would be non-BMV, based on the mapped grades in their vicinity. The locations and extents of ALC grades are shown on figure D7-2 (Application Reference Number: 6.4.101).

7.3.13 Table D7-3 presents a summary of ALC grade, area and relative percentage of the encountered grades across the Wylfa Newydd Development Area from the two ALC surveys. The total area surveyed does not add up to the total area of the Wylfa Newydd Development Area (approximately 410ha) for two reasons:

- the Wylfa Newydd Development Area has extended since the survey was conducted; and
- the Wylfa Newydd Development Area includes several areas which were not assigned ALC grades, including the sea, shoreline and Tre'r Gof SSSI.

7.3.14 However, it is considered that these areas would likely be Subgrade 3b or non-agricultural based on the classifications adjacent to them or their current/past land use.

7.3.15 For comparison purposes, table D7-3 also presents a summary of the provisional ALC grades across the entire Isle of Anglesey, where the total area of Anglesey has been taken as 71,361 hectares. The provisional ALC data for Wales [RD6] provide no differentiation between Subgrades 3a and 3b.

Table D7-3 ALC grades – spatial coverage (adapted from [RD5])

Grade/ Subgrade	Description	Wylfa Newydd Development Area		Anglesey	
		Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
1	Excellent quality	0	0	0	0

Grade/ Subgrade	Description	Wylfa Newydd Development Area		Anglesey	
		Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
2	Very good quality	6.5	2.0	1,116.9	1.6
3a	Good quality	18.0	5.6	27,559.3	38.6
3b	Moderate quality	224.3	69.5		
4	Poor quality	0.1	<0.1	27,213.8	38.1
5	Very poor quality	38.0	11.8	10,398.4	14.6
-	Non-agricultural	35.8	11.1	5,072.6	7.1

ALC within the 250m buffer of the study area

7.3.16 The provisional ALC data [RD6] indicate that the 250m buffer of the Wylfa Newydd Development Area comprises mainly Grade 3 and Grade 4 soils, although an area of Grade 5 soils is also mapped to the east of Tregele. See figure D7-2 (Application Reference Number: 6.4.101) for the locations of these provisional ALC grades.

Identification of soil quality receptors

7.3.17 The value of soil as a receptor in this assessment relates to its ALC grade, with each grade classified as a receptor. Particular focus is given to BMV land (Grade 1 to Subgrade 3a) which has been allocated the highest sensitivity.

7.3.18 The assessment of potential effects on soil receptors has been limited to the Wylfa Newydd Development Area, as any potential effects on soil would be restricted to this area, rather than affecting the land within the 250m buffer (as previously discussed).

7.3.19 The extent of Grade 4 soils is very limited within the Wylfa Newydd Development Area, and the location in which they occur is unlikely to be affected significantly by the proposed activities; therefore, they have not been identified as a receptor. As such, ALC Grades/Subgrades 2, 3a, 3b and 5 comprise the receptors within the Wylfa Newydd Development Area.

7.3.20 Potential effects upon soil receptors from land contamination are discussed under the 'land contamination receptors' headings within section 7.5.

7.3.21 Effects related to the loss of ALC land in relation to land use and the economy are discussed within chapter D3 (socio-economics, Application Reference Number: 6.4.3).

Artificial geology

Published artificial geology

7.3.22 British Geological Survey (BGS) geological mapping [RD7] [RD8] suggests that artificial geology is absent across the study area.

Encountered artificial geology

7.3.23 The majority of the Wylfa Newydd Development Area is relatively undeveloped, and therefore artificial geology is largely absent. However, made ground has been encountered within the area surrounding the Existing Power Station, associated with the construction laydown area used during the development of that site. Other areas of made ground have been found associated with road construction, agricultural development, former developed sites along the Cemlyn Road and isolated residential properties.

7.3.24 Made ground has typically been found to comprise re-worked natural material, in some areas also containing anthropogenic materials such as brick and concrete. In some parts of the Wylfa Newydd Development Area, made ground has been found to comprise 'waste' or 'fill' materials that contained plastic, pipe, wire and glass. Asbestos and asbestos-containing materials have also been identified within made ground in a number of locations.

7.3.25 During interpretation of the DOnGI, made ground encountered within trial pits dug specifically for contamination purposes was separated into four distinct categories. Table D7-4 presents the classification of these made ground types. This classification was subsequently used in the interpretation of ground conditions encountered during the 2015 GI, and retrospectively applied to the made ground encountered during the PSI and IOnGI within the Land Contamination Risk Assessment and Remediation Strategy (appendix D7-2, Application Reference Number: 6.4.25), in order to provide a consistent interpretation of made ground across the various phases of ground investigation.

Table D7-4 Made ground units as identified during the DOnGI

Type	Unit	Description
1	Waste material	Dark brown mottled dark grey sandy gravel with cobbles, containing a mixture of metal, wire, plastic sheeting, fibreglass, whole bricks, asphalt, slag, old oil filter, ash, plastic pipe, plastic tape, glass, wood, masonry, corrugated board/metal and possible asbestos board/cement.
2	Re-worked natural ground intermixed with made ground/waste	Brown clayey sandy gravel with medium cobble and boulder content, containing inclusions of waste material.

Type	Unit	Description
3	Re-worked natural/possible made ground	Brown to dark brown or grey slightly clayey sandy gravel with rare quantities of brick or ceramics.
4	Topsoil	Brown, firm, friable, gravelly, sandy clay with abundant rootlets and occasional anthropogenic material.

7.3.26 Figures showing the locations of the made ground types identified during the PSI, IOnGI, DOnGI and 2015 GI are presented in appendix D7-1 (Application Reference Number: 6.4.24). Figure D7-3 (Application Reference Number: 6.4.101) presents a plan showing the 'worst case' made ground found in each hole (ascending from type 1 to 4), with interpolation between and beyond exploratory locations to show the potential made ground coverage within the Wylfa Newydd Development Area. Full details regarding the nature and extent of made ground, and locations where asbestos have been identified, are presented in appendix D7-2 (Application Reference Number: 6.4.25).

Superficial geology

Published superficial geology

7.3.27 Figure D7-4 (Application Reference Number: 6.4.101) presents the published superficial geology for the study area, provided by the BGS [RD9].

7.3.28 According to BGS geological mapping [RD7]; [RD8], the superficial geology underlying the study area predominantly comprises glacial till[4] deposited during the last major glaciation phase approximately 14,000 to 24,000 years ago (the Late Devensian glaciation). The Tre'r Gof SSSI, which is located in a buried valley feature in the north of the Wylfa Newydd Development Area, comprises layers of peat and alluvium overlying glacial till. Coastal zone deposits of sand, silt and clay are mapped along some stretches of the coast, particularly to the west and northwest of the Existing Power Station. Superficial deposits are absent in several small and isolated areas of the study area, including at Wylfa Head.

Encountered superficial geology

7.3.29 Ground investigations within the Wylfa Newydd Development Area have confirmed that the superficial deposits mainly comprise glacial till, although a total of nine superficial deposit units have been identified on-site [RD10] including wind-blown silts and sands (loess), alluvium, lacustrine and glacio-lacustrine deposits.

7.3.30 Forty-two boreholes were located within the study area across the IOffGI and DOffGI. Granular deposits (including gravelly sand, gravel, cobbles and

[4] Unsorted glacial material typically comprising clay with bands of sand and gravel and larger rock fragments up to boulder size (formerly referred to in the UK as 'boulder clay').

boulders) were widely encountered offshore, overlying glacial till in a number of locations.

7.3.31 A detailed discussion of the superficial geology and figures presenting the thickness and extent of the superficial deposits onshore can be found in appendix D7-1 (Application Reference Number: 6.4.24).

Bedrock geology

Published bedrock geology

7.3.32 Figure D7-5 (Application Reference Number: 6.4.101) presents the bedrock geology of the study area provided by the BGS [RD9].

7.3.33 The BGS geological map [RD7]; [RD8] indicates that the geology underlying the majority of the study area comprises metamorphic[5] rocks of the New Harbour Group, deposited approximately 635 to 542 Mya (the late Precambrian[6] geological period). The bedrock geology underlying the area northeast of the Existing Power Station comprises the Gwna Group which dates from approximately 635 to 508 Mya (the late Precambrian to mid-Cambrian[7] geological period). However, there has been some debate over the ages of the New Harbour and Gwna Groups – refer to appendix D7-1 (Application Reference Number: 6.4.24) for more details. The southern and southwestern extents of the study area are underlain by the Skerries Group. The age of the Skerries Group is also under debate, but it has recently been classified as part of the New Harbour Group.

7.3.34 Other rock types are mapped for the study area, including igneous intrusions of various compositions and the Central Anglesey Shear Zone and Berw Shear (undifferentiated). However, the occurrence of the Central Anglesey Shear Zone within this area may be misleading, as Leslie *et al.* [RD11] assert that this group contains a very different range of lithologies in northern Anglesey compared to southeast Anglesey. Furthermore, the Gwna Group (a chaotic deposit comprising rock fragments of widely varying size) is known to be present where the Central Anglesey Shear Zone and Berw Shear (undifferentiated) is mapped in Cemaes Bay [RD12]; [RD13]; thus, it is more likely that the Gwna Group occurs there.

7.3.35 The New Harbour Group was derived from sand and mud deposits, eroded from a volcanic arc (a chain of volcanoes), which were subjected to weak metamorphism. This metamorphism occurred as a result of plate tectonic activity, as the New Harbour Group was pushed under the Gwna Group [RD14]. The New Harbour Group is characterised by fissile green mica schist,

[5] Rock that has been subjected to varying degrees of heat and/or pressure, which have led to physical and chemical changes.

[6] The Precambrian period extends from approximately 4,600 Mya (formation of the Earth) to 541 Mya.

[7] The Cambrian period extends from approximately 541 to 485 Mya.

gritty green mica schist with bedded jasper, jaspery phyllite[8], psammite and alternating with pelites[9].

7.3.36 The Gwna Group is the main unit of the Monian Supergroup and contains some of the oldest exposed Precambrian strata in Wales. The Gwna Group comprises rocks of various ages and origins. The main types are pillow lava[10] (originally formed at a volcanic mid-ocean ridge), green schist (once muddy seafloor sediment, now metamorphosed) and mélange – including large blocks of quartzite, limestone, pillow lava and other rocks set in a matrix of schist. The mélange was formed at a destructive tectonic plate margin, where descending ocean crust was broken up and plastered onto the underside of the opposing tectonic plate.

7.3.37 The Skerries Group was derived from a sub-volcanic granite/felsic[11] source which was potentially an island arc. The Skerries Group is characterised by widely deformed and metamorphosed sandstones, conglomerates and basalts [RD15].

7.3.38 Refer to appendix D7-1 (Application Reference Number: 6.4.24) for further discussion of the published bedrock geology, including the complex boundary between the New Harbour and Gwna Groups and debate over the ages of these groups.

Encountered bedrock geology

7.3.39 The majority of the Wylfa Newydd Development Area has been confirmed by the ground investigations undertaken to date to be underlain by the New Harbour Group. The New Harbour Group has been found to comprise phyllite, psammite and metaconglomerates.

7.3.40 During the DOnGI, the Gwna Group was encountered towards the north of the Wylfa Newydd Development Area. The Gwna Group was found to comprise chaotic, randomly orientated clasts[12] of breccias[13], quartzite, phyllite, psammite, granites, basalt, limestone and schist in a fine-grained, locally schistose, matrix.

7.3.41 Intrusions were found to be steeply dipping and trending northwest to southeast, predominantly consisting of dolerite[14], with a typical thickness of between 0.1m and 5.0m (refer to appendix D7-1, Application Reference Number: 6.4.24, for a detailed plan of intrusions and faults).

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[8] Metamorphosed slate.

[9] Metamorphic rock derived from fine-grained sediments which typically consist of green silty or muddy layers.

[10] Lava deposits formed underwater.

[11] Igneous rocks, typically rich in feldspar and quartz.

[12] Fragments of rock broken off by weathering and other (e.g. tectonic) processes.

[13] Rocks composed of fragments of other rocks or minerals held together by fine-grained sediment.

[14] Medium-grained igneous rock, typically rich in iron and magnesium.

7.3.42 The IOffGI and DOffGI boreholes generally encountered phyllite and psammite of the New Harbour Group. Boreholes located to the north of Wylfa Head during the IOffGI encountered rocks of the Gwna Group, comprising phyllite, pelite, psammite, quartzite and metabreccia.

Seismicity

Background

7.3.43 An assessment of the potential risks posed by seismic activity has been undertaken to characterise the seismic hazards at the Wylfa Newydd Development Area [RD16]. The main aim of the assessment was to consider the impact of potential seismic events on the Power Station Site. The assessment also included an assessment of the potential for ground rupture (where a ground movement along a geological fault breaks through the ground surface) and an assessment of the maximum probable height of a tsunami wave which could credibly reach the Power Station Site.

7.3.44 The assessment was undertaken conservatively, and included the compilation of background data on seismic events and geology, followed by the calculation of the probable intensity of any events using established methods. The 1 in 10,000-year seismic event was calculated to have a peak ground acceleration of less than 2.5m/s^2.

7.3.45 The assessment of potential for ground rupture included consideration of the various stages of ground investigation undertaken on site to identify whether any faults could pose a risk during a seismic event. None of the faults on site were identified as likely to pose a risk.

7.3.46 The study also indicated that the potential impact of tsunami waves at the Wylfa Newydd Development Area is negligible, both in terms of likelihood and amplitude.

7.3.47 For a detailed discussion on seismic hazard, refer to appendix D7-1 (Application Reference Number: 6.4.24).

Generic Design Assessment

7.3.48 Seismic hazard has also been considered in the Generic Design Assessment pre-construction safety case, alongside other external hazards such as extreme meteorological conditions, in order to demonstrate that the radiological dose risk to on-site workers and members of the public is acceptable and as low as reasonably practicable. Various systems and structures have been designed to ensure that they will function as required during and following the characteristic earthquake to ensure that nuclear safety is maintained. Design is in progress, adopting appropriate international standards, and the required functionality of equipment will be demonstrated.

7.3.49 The design of the Advanced Boiling Water Reactors for the Wylfa Newydd Development Area will be based upon that presented during the Generic Design Assessment and will incorporate the location-specific aspects of seismic hazard. A site-specific seismic hazard assessment is in progress for the Wylfa Newydd Development Area to characterise the hazard at that

location. The assessment includes the effects of ground shaking, the potential for ground rupture and consequential effects such as tsunami. The design to protect on-site workers and members of the public against radiological dose will also ensure that there is no potential for unacceptable radiological dose or contamination to the environment.

7.3.50 As a result of the above, seismicity will not be considered further within this chapter.

Land contamination

Former uses of the study area

7.3.51 A review of available desk-based information has identified that the majority of the study area has either remained undeveloped since the earliest available historical mapping, or has been used for grazing or cultivation. Outside the areas immediately surrounding the Existing Power Station, there are few locations which have been used for activities that may have caused contamination of the underlying soils. Figure D7-6 (Application Reference Number: 6.4.101) shows the locations and nature of the historical activities that may have had the potential to cause land contamination, as identified by the desk-based review.

7.3.52 A review of aerial photographs [RD17] indicated that, during construction (1960s–1970s), the area immediately surrounding the Existing Power Station was used for construction laydown and car parking. These activities have the potential to have caused land contamination, associated with made ground and waste materials. In addition, anecdotal evidence provided by Magnox indicated that asbestos fibres or asbestos-containing materials may be present in made ground associated with the former construction areas (refer to appendix D7-2, Application Reference Number: 6.4.25, for details).

7.3.53 Desk study reporting undertaken between 2005 and 2012 (refer to table D7-1 for a list of baseline surveys), identified a number of Areas of Potential Concern (APCs) that primarily relate to the former construction areas around the Existing Power Station site. As more information has been obtained and reviewed, primarily from the DOnGI and 2015 GI, further delineation of the APCs has resulted in identification of the relevant APCs shown in table D7-5.

Table D7-5 Summary of APCs

APC	Description
APC6	Non-radiological contaminants may be present within fill material (which includes railway ballast) used to landscape area to the north of the gas turbine fuel oil tanks, in the north of the Existing Power Station site. Ballast may contain some hydrocarbon contamination relating to leaks of fuel and hydraulic liquid from rolling stock.
APC7	Located to the south of the Existing Power Station site and included a contractor's laydown area, car park and workshop during site construction; there was evidence of abandoned cars in the area. Chlorinated solvents were observed within water

APC	Description
	samples obtained from a sump and a surface watercourse during ground investigations.
APC7a	Located adjacent to the north of APC7 and currently occupied by a car park associated with the Existing Power Station. Aerial photography dated from 1968 to 1972 shows the construction compound and storage area identified within APC7 to have extended across into the area; thus, similar ground conditions may persist.
APC9	Located to the north of the 400kV switch house at the Existing Power Station and included offices, parking, site plant, stores, workshops and a cement mixing plant during the construction of the Existing Power Station. APC9 also includes part of a contractor's site disposal area, and tanks were present from approximately 1975 to 1991 according to historical mapping.
APC10	Former topsoil storage area.
APC11	Construction works spoil heap (later removed to APC9) and contractor's site disposal area.
APC12	Spoil heap area (Dame Sylvia Crowe's Mound). Anecdotal evidence that the heap contains buried heavy machinery and site vehicles. The mound covers the areas of two old quarries identified during the review of historical mapping.
APC15	Area identified from historical map review to potentially contain made ground relating to the Existing Power Station construction works.
APC16	Tregele petrol station located within the Wylfa Newydd Development Area, on the south-eastern boundary.
APC17	A localised area of made ground containing general waste (plastic/rubber etc.) located to the east of the Tai Hirion farmstead.
APC18	Made ground associated with former properties along Cemlyn Road (identified following the DOnGI).
APC19	Made ground associated with the former Wylfa Sports and Social Club (identified following 2015 GI, refer to appendix D7-2 (Application Reference Number: 6.4.25) for details).
APC20	Area of the Existing Power Station located within the Wylfa Newydd Development Area, including car parks, offices and access roads, as well as electricity transformers for the 400kV switch house. APC20 incorporates two former APCs: APC4 and APC13 [RD18]. APC4 was identified due to evidence of a transformer oil spill, thought to have originated from a waste oil trailer in 2002. APC13 was defined due to the presence of two 1,000 gallon underground storage tanks, although there have been no known releases from these. Aerial imagery from 1968

APC	Description
	to 1972 also shows an area to the south of the 400kV switch house to have potentially been excavated and later infilled during construction of the Existing Power Station.

7.3.54 Figure D7-6 (Application Reference Number: 6.4.101) shows the location and extent of the APCs listed above. For a detailed description of the identification of the APCs over time, refer to appendix D7-2 (Application Reference Number: 6.4.25).

Land contamination conditions

7.3.55 As outlined within table D7-1, there have been a number of previous ground investigations undertaken within the Wylfa Newydd Development Area. Investigations to date have provided information on the ground conditions and determinand concentrations, principally within the APCs. Full details of the assessments undertaken and the screening criteria used are presented in appendix D7-2 (Application Reference Number: 6.4.25).

7.3.56 Soil chemical testing data obtained during the PSI, IOnGI, DOnGI and 2015 GI were compared to publicly available Generic Assessment Criteria (GAC) used to assess the potential risks to human health, whilst soil leachate data were compared to the relevant Water Quality Standards (WQSs) to assess potential risks to controlled waters. Refer to appendix D7-2 (Application Reference Number: 6.4.25) for further details and identification of the locations at which analytical testing results exceeded the screening criteria.

7.3.57 The land contamination conditions are linked to the presence and nature of made ground, as described in the artificial geology section above and illustrated on figure D7-3 (Application Reference Number: 6.4.101). Asbestos fibres and fragments of asbestos-containing materials have also been recorded in made ground, and the locations at which these were positively detected (and tested for but not detected) are shown on figure D7-7 (Application Reference Number: 6.4.101).

7.3.58 A brief summary of the key findings is presented in table D7-6 for each APC. Made ground types have not been classified for APC6, APC7a, APC16 or APC20, as the PSI, IOnGI, DOnGI and 2015 GI did not include exploratory hole locations in these APCs. Made ground types 2–4 have been encountered in all the other APCs and thus, for brevity, only type 1 made ground is noted in table D7-6 where it has been encountered.

Table D7-6 Key land contamination findings across the Wylfa Newydd Development Area

Area	Key findings
APC6	Nine soil samples were collected between 2004 and 2006 [RD18]. Low concentrations of Polycyclic Aromatic Hydrocarbons (PAHs) were detected in one sample taken in

Area	Key findings
	2004[15]. Low concentrations of polychlorinated biphenyls (up to 1.1µg/kg) and metals were also recorded but were below the relevant GAC.
APC7	A sump and valve chamber has been identified in which chlorinated solvents (in particular trichloroethene) were recorded to a maximum concentration of 1,100µg/l (the Environmental Quality Standard for trichloroethene is 10µg/l). A localised area of hydrocarbon-contaminated soil was also identified, with a total petroleum hydrocarbon concentration of 1,130mg/kg and low concentrations of PAHs; GAC were not exceeded. Type 1 made ground (waste material) was encountered at a number of boreholes and trial pits within APC7 to the southwest of the Existing Power Station. Eight positive detections of asbestos were recorded in this area, with a further four elsewhere within the APC. Lead and dibenz(a,h)anthracene concentrations were recorded above GAC, whilst exceedances of WQSs were recorded from soil leachate for metals and organics.
APC7a	Ground investigation data are not currently available for this APC, but ground conditions are likely to be similar to APC7 based on similar historical activities in the area.
APC9	Soil leachate exceedances of WQSs were recorded for copper, chromium, lead, manganese and zinc.
APC10	Asbestos was encountered in one trial pit, whilst exceedances of WQSs from soil leachate were recorded for chromium, copper, lead, manganese and zinc.
APC11	Leachable determinands such as zinc, copper, lead, and PAHs were recorded at concentrations in excess of WQSs.
APC12	Asbestos was encountered in one trial pit and dibenz(a,h)anthracene was recorded above the GAC within made ground at one location. Concentrations of chromium, copper, lead, manganese, nickel and zinc were recorded in excess of WQSs in leachate testing.
APC15	Soil leachate testing recorded concentration of copper and zinc in excess of the WQSs.
APC16	Ground investigation data are not currently available for this APC.
APC17	Type 1 made ground was encountered at one trial pit on the border of APC17, and asbestos was recorded at two locations.

[15] The *Summary of Land Quality Information for the NDA Land-Holding at Wylfa Site* [RD18] report does not confirm that the concentrations were below GAC.

Area	Key findings
	Leachable determinand concentrations including of copper, lead, manganese and zinc were in excess of the WQSs.
APC18	Type 1 made ground was recorded at three locations and copper, lead and zinc concentrations were recorded in excess of WQSs in the leachate analysis.
APC19	Type 1 made ground was recorded in one trial pit, as well as asbestos in three locations. Concentrations of ammoniacal nitrogen, antimony, copper, chromium, lead, manganese, nickel, zinc and PAHs in leachate were all in exceedance of the WQSs.
APC20	Possible made ground was identified from 0.2m to 3.2m below ground level in one borehole dated to 1986 to the south of the 400kV switch house [RD19], but no other ground investigation data are available for this APC.
Other areas	Outside of the APCs, ground investigation has been limited and the material encountered has mainly comprised reworked natural material with no anthropogenic inclusions. Soil leachate testing has identified concentrations of chromium, copper, lead, manganese, mercury, nickel and zinc in excess of the WQSs. However, elevated concentrations of chromium may be derived from natural geology (see appendix D7-2, Application Reference Number: 6.4.25), whilst other WQS exceedances were recorded in very few samples outside the APCs. Based on the ground conditions and chemical testing results, it was not deemed necessary to identify any further APCs.

7.3.59 A ‘very low risk’ from ground gases has been identified based on the results of ground gas monitoring undertaken on boreholes within the Wylfa Newydd Development Area, although a ‘low’ risk from carbon dioxide was assessed in one location along Cemlyn Road. Risks from ground gases are based on the potential for the accumulation of ground gases in enclosed spaces, leading to asphyxiation or explosion (see appendix D7-2, Application Reference Number: 6.4.25 for more details).

Identification of land contamination receptors

7.3.60 Relevant receptor groups of contamination within the study area include human health, controlled waters and property. These align with the key receptor groups set out within the *Contaminated Land Statutory Guidance – 2012* [RD20], with further details of the individual receptors comprising these groups provided below. Impacts to ecological receptors are assessed within chapter D9 (terrestrial and freshwater ecology) (Application Reference Number: 6.4.9).

7.3.61 Human health receptors have been subdivided into key groups, with different characteristics. These groups are set out below.

- Construction workers: workers with significant exposure to soils over the short-term (acute exposure).

- Future site users: workers on the Power Station Site (with low likelihood of exposure to soils) and workers on the associated landscaped areas (assumed in this case to be farmers tending to grazing livestock, with likely exposure to soils).
- Maintenance workers: workers undertaking in-ground maintenance work, whereby exposure to the soil is high and could potentially take place over a longer timeframe (for routine maintenance activities).
- Adjacent land users: residents within the study area, farmers, users of Public Rights of Way and workers on the Existing Power Station site who may be exposed to contamination via airborne dispersion of contaminants. Nearby residents would potentially be exposed to airborne contaminants for a longer period of time than other adjacent land users, and therefore these are taken to be the most relevant receptor for this group.

7.3.62 Water contained within aquifers beneath the site, or within surface water bodies, are defined as controlled water receptors. The assessment of groundwater and surface water receptors in this section relates to the potential for contaminants within the soil (above groundwater) to become mobile and migrate into the water. Assessment of contamination once it has entered groundwater and surface water is included within chapter D8 (Application Reference Number: 6.4.8).

7.3.63 Property receptors are defined as buildings or services (which could be damaged as a result of soil contamination), and crops or livestock which could be affected by contaminants within the soil.

Sites of geological importance

7.3.64 The Isle of Anglesey was designated as a European Geopark (the GeoMôn Geopark) in 2009 as a result of its outstanding geodiversity and geological heritage. Furthermore, in November 2015, the GeoMôn Geopark was designated as a UNESCO Global Geopark [RD21]. The new designation is intended to raise awareness and promote respect for the environment and integrity of the landscape. The status also expresses governmental recognition of the importance of holistic management of the Geoparks. The designation is not legislative but the key heritage sites within the Geoparks should be protected under local, regional or national legislation as appropriate.

7.3.65 Regionally Important Geodiversity Sites (RIGS) are non-statutory listed sites of local, regional or national importance. They are conserved and protected from development by local authorities and are designated for their scientific/research, educational, historical and/or aesthetic importance.

7.3.66 There are four RIGS located within the study area, presented in table D7-7 and illustrated on figure D7-8; full descriptions are included within appendix D7-1 (Application Reference Number: 6.4.24).

Table D7-7 Listed sites of geological importance (adapted from [RD12])

Site name	Reasons for designation	Further details
Porth Wnal Dolerite	Tertiary mafic[16] dyke important for enhancing knowledge of plate tectonics and modern-day earthquakes.	The tertiary mafic dyke displays well-defined cooling columns, multiple splays and clear contact relations with the Precambrian Gwna mélange. The dyke appears to have intruded the quartzite of the mélange. The outcrop and geophysically mapped relationships of the dyke provide evidence that none of the local faults in this part of the Carmel Head Thrust complex have moved since the dyke was intruded in the Tertiary Period. The dyke has been radiometrically dated and mapped by following the strong iron-rich magnetic signature. The Isle of Anglesey is the only part of the UK outside Scotland which shows multiple young Tertiary dyke intrusions in close proximity to older Palaeozoic dykes.
Porth Wnal Granite	Important for demonstrating relationships and relevant timing of igneous, tectonic and sedimentary events in Anglesey.	The outcrops provide important information on the granite inclusions within the Gwna mélange, the formation and deformation of the mélange, and fault movements within the Carmel Head Thrust complex. The outcrop consists of muscovite granite with quartzite and carbonate blocks. The granite was subjected to strong shearing before being incorporated into the mélange. The granite was also cut by several small felsic intrusions, which were subjected to shearing associated with the Carmel Head Thrust Complex. Ongoing research at the site aims to understand present controversy on the stratigraphical correlation of Precambrian units. The Precambrian basement rocks were juxtaposed along a series of steep, brittle and/or ductile faults and shear zones.
Cemaes Bay	International significance as the type section (best example)	Cemaes Bay is the best place in the UK to observe the type section of the Gwna mélange and understand its various interpretations.

[16] Igneous rocks, typically rich in magnesium and iron.

Site name	Reasons for designation	Further details
	for the Gwna mélange.	The age of the mélange and its relationship to the adjacent deformed Ordovician[17] rocks are, however, still uncertain. The latest research has demonstrated that the limestone clasts within the mélange are the oldest rocks in Wales. The site also includes an educational trail along two sections of the Isle of Anglesey Coastal Path, the westernmost section running congruent with the northern site boundary.
Trwyn y Penrhyn (Cemaes Bay)	Important for understanding the igneous dykes injected into the Gwna mélange and Precambrian stromatolitic[18] limestones.	The dyke swarm and its relationship with the carbonate country rock (within the Gwna Group) are clearly exposed in both plan and section. The site provides easy access to view these features. Post-intrusion carbonate veins and tectonic slickensides provide further scientific value. Rare Precambrian stromatolitic limestones form part of the Gwna Group, and examples are located to the southeast of Trwyn y Penrhyn. A narrow band of black limestone occurs within the limestone and is currently a topic of significant scientific research. The condensed limestone/stromatolitic sequence has provided new chronological, palaeogeographic, palaeontological and palaeoclimatic data important for understanding Precambrian ocean-floor environments.

7.3.67 A number of consultations have been undertaken with GeoMôn (the organisation that oversees the GeoMôn Geopark) to clarify the location and extent of the RIGS that are located in close proximity to the Wylfa Newydd Development Area. In particular, consultations included the clarification that the Wylfa Head RIGS (referred to within the Preliminary Environmental Information Report [RD22]) actually forms part of the Cemaes Bay RIGS, rather than forming a RIGS in its own right.

7.3.68 NRW is planning to review currently protected geological sites between the cooling water outfall of the Existing Power Station in the west to Llanbadrig-Dinas Gynfor SSSI in the east (see figure D7-8, Application Reference

[17] The Ordovician Period extends from c. 485 to 443 Mya (forms part of the Palaeozoic Era).

[18] Stromatolites are the oldest fossils found on Earth, which were formed by trapping and binding together sedimentary grains and microorganisms in shallow water.

Number: 6.4.101), to determine if a larger Geological Conservation Review site should be created.

7.3.69 The Geological Conservation Review is currently at a very early stage. Only those sites considered to be of national (Great Britain) or international importance merit Geological Conservation Review status. When a locality has been approved and registered as a Geological Conservation Review site, it will then be considered for notification as a SSSI. Further details are provided in appendix D7-1 (Application Reference Number: 6.4.24).

Identification of sites of geological importance receptors

7.3.70 While it is acknowledged that, as a UNESCO Geopark, Anglesey as a whole possesses features of geological interest, for the purposes of this assessment, the sites of geological importance identified within the study area (presented in table D7-7) have been identified as the key receptors. This is considered a more conservative approach, as in the context of the GeoMôn Geopark as a whole, any potential effects are likely to be of less magnitude based on its size.

7.3.71 Although the coastline extending from the Porth Wnal Dolerite RIGS to Llanbadrig-Dinas Gynfor SSSI (see figure D7-8, Application Reference Number: 6.4.101) is currently under review and may potentially be designated as a single geological SSSI in the future, the RIGS located within the study area will continue to be assessed as RIGS, rather than a potential SSSI. This is considered to be a more conservative approach, as despite the higher sensitivity of SSSI, changes would likely have a greater magnitude of effect on the much smaller RIGS, given the large size of the proposed SSSI in comparison.

7.3.72 Potential geomorphology effects on Hen Borth (a geological SSSI located approximately 1500m west of the Wylfa Newydd Power Station) from coastal processes are addressed in chapter D12 (coastal processes and coastal geomorphology, Application Reference Number: 6.4.12).

Geological resources

7.3.73 Geological resources are defined as geological deposits which have a potentially viable economic value by virtue of the resource type, or the amount of a specific deposit present.

7.3.74 The *North West Wales Aggregates Safeguarding Map* [RD23] identifies two categories of safeguarding areas, as per the below.

- Category 1 Aggregates Safeguarding Areas, which contain resources considered to be of national importance.
- Category 2 Aggregates Safeguarding Areas, which contain resources considered to be of local or regional importance.

7.3.75 Six areas of Category 2 Aggregates Safeguarding Area resources are present within the study area; these are listed in table D7-8 and their locations are shown on figure D7-9 (Application Reference Number: 6.4.101).

Table D7-8 Aggregates Safeguarding Areas

Resource	Category	Location
Igneous	2	Porth-y-pistyll Wylfa Head South of Cemlyn Bay (extending across the south/southwest of the study area)
Quartzitic sandstone (with potential for silica sand and silica rock)	2	Wylfa Head
Sand and gravel	2	Tre'r Gof Cemlyn Bay

7.3.76 The Aggregates Safeguarding Areas are based on the aggregate resources identified in the *North West Wales Mineral Resource Map* [RD24], with 'safeguarding margins' created around these resources to protect them from development [RD25]. Therefore, the spatial extents of the geological resources identified above are more limited than the Category 2 Aggregates Safeguarding Areas identified in figure D7-9 (Application Reference Number: 6.4.101) suggest.

7.3.77 With regards to the igneous resources, these are considered to correspond to dolerite intrusions mapped by Halcrow [RD26] during interpretation of the IOnGI, and are also shown on figure D7-9 (Application Reference Number: 6.4.101). This shows more accurately the extents of the igneous resources within the study area.

7.3.78 Refer to appendix D7-1 (Application Reference Number: 6.4.24) for further discussion of the Aggregates Safeguarding Areas, including the safeguarding margins designated around resources.

7.3.79 None of the mineral resources identified within the study area were recommended for safeguarding by Capita Symonds [RD27].

Identification of geological resources receptors

7.3.80 The sand and gravel resources presented in table D7-8 are not considered receptors in this chapter due to the ecological designations in those locations. Tre'r Gof and Cemlyn Bay are both designated as SSSIs, whilst Cemlyn Bay also has a number of international statutory designations. Therefore, it is considered highly unlikely that mineral resources would be excavated in these areas as part of other projects, regardless of whether the WNDA Development would restrict access to them. Refer to chapter D9 (Application Reference Number: 6.4.9) for details of the ecological designations.

7.3.81 The Category 2 Aggregates Safeguarding Areas for igneous resources and quartzitic sandstone presented in table D7-8 have therefore been identified as the relevant geological resources receptor for this assessment.

Evolution of the baseline

7.3.82 Soil quality is the only aspect of the baseline environment likely to evolve naturally and significantly in the foreseeable future.

7.3.83 The UK Climate Projections published in 2009 indicate that increases in annual, summer and winter temperatures are likely for Wales through to at least 2100 [RD28], whilst mean precipitation levels would likely decrease for summers and increase for winters according to most modelling scenarios.

7.3.84 Taken in isolation, climate is not currently a limiting factor to ALC within the Wylfa Newydd Development Area and is unlikely to become one in the future based on projections [RD28]; [RD29].

7.3.85 The predominant limiting factor for ALC within the Wylfa Newydd Development Area is currently wetness, and hence workability. A general subtle trend towards drier soils across England and Wales is predicted [RD28]; [RD29], which could result in soil wetness becoming less of a limitation within the site.

7.3.86 In contrast, droughtiness is predicted to become a greater limiting factor across Wales due to warmer and drier summers [RD28]; [RD29]. Soils currently limited to Subgrade 3b due to droughtiness in the northeast and southwest of the Wylfa Newydd Development Area may be particularly affected by this trend.

7.3.87 One area in the southwest of the Wylfa Newydd Development Area is currently limited to Subgrade 3b by flooding; with flooding predicted to increase in Wales [RD28], the proportion of the site limited by flooding in the future may increase. The risk of erosion is also likely to increase, which could present a limiting factor in the future [RD28]; [RD29].

7.3.88 Limiting factors for soil quality across the wider study area are not known but would likely be similar; thus, the potential effects of climate change are anticipated to be similar.

7.3.89 Overall, potential changes in ALC grades may be localised and variable, such that there may be both improvements and deteriorations in ALC grade across the study area.

7.3.90 For further discussion of the effects of climate change on the Wylfa Newydd Project, refer to chapter B1 (introduction to the assessment process, Application Reference Number: 6.2.1).

7.4 Design basis and activities

7.4.1 This section sets out the design basis for the assessment of effects. It sets out where any assumptions have been made to enable the assessment to be carried out at this stage in the evolution of the design. This section also identifies the embedded and good practice mitigation that would be adopted to reduce adverse effects as inherent design features or by implementation of standard industry good working practice.

7.4.2 As described in chapter D1 (Application Reference Number: 6.4.1), the application for development consent is based on a parameter approach. The assessment described within this chapter has taken into consideration the

flexibility afforded by the parameters. A worst case scenario has therefore been assessed from a soils and geology perspective within the parameters described in chapter D1 (Application Reference Number: 6.4.1).

Construction

Basis of assessment and assumptions

7.4.3 The activities of relevance to soils and geology are set out below; full details of the proposed activities are provided in chapter D1 (Application Reference Number: 6.4.1).

Site Preparation and Clearance (SPC)

7.4.4 The SPC Works comprise the following activities of relevance to this topic.

- Establishment of Main Site Compound, comprising:
  - provision of fencing and site security facilities, an area for material handling and storage and a secure parking area for plant and machinery; and
  - offices and welfare facilities in temporary buildings, as well as the provision of a fuel store and parking for office-based staff and the site workforce.
- Establishment of Remediation Processing Compound and access track, and treatment of contaminated material.
- Remediation of contaminated soils and treatment of invasive non-native species.
- Establishment of satellite and material storage compounds.
- Erection of perimeter fencing, comprising:
  - temporary construction fencing measuring 2m in height, capable of being moved to accommodate the temporary road closure of Cemlyn Road.
- Watercourse realignment and associated landscaping.
- Clearance of buildings and other existing above-ground structures.
- Vegetation clearance.

Main construction

7.4.5 Following SPC, the following activities are of relevance:

- bulk earthworks including site levelling and grading to form required building platform levels for Unit 1 and Unit 2, including building platforms and construction and laydown areas;
- deep excavation (of Unit 1 and Unit 2);
- progressive mound creation;
- construction of haul roads and bridges;

- construction of internal roads, car parking, security fencing and permanent lighting;
- construction and commissioning of concrete batching plant;
- installation (and removal) of cofferdams for cooling water intake and outfall construction;
- excavation and construction of cooling water intake and outfall, including tunnelling;
- construction of other buildings, structures and features;
- construction, operation and decommissioning of Site Campus; and
- installation of drainage.

Sites of geological importance assumptions

7.4.6 As part of the assessment of effects, it has been assumed that, if any new foul water outfalls are required during construction or operation, they would be located to the west/southwest of the Existing Power Station and thus would not affect any sites of geological importance.

7.4.7 As per chapter D1 (Application Reference Number: 6.4.1), one new surface water drainage discharge point would be created approximately 400m east of Porth y Wylfa within the Cemaes Bay RIGS; this would run via a pipe into the sea. There is an existing pipe enclosed in a concrete channel located at this point. It is assumed that the new discharge pipe would utilise this concrete channel as far as practicable such that any excavations into the local geology would be limited.

7.4.8 It is understood that small-scale blasting may be required around Porth Wnal should hard obstructions be encountered during the construction of the cooling water outfall and tunnels.

Embedded mitigation

Cooling water outfall

7.4.9 The cooling water outfall and its associated temporary cofferdam have been designed to avoid the dolerite dyke intrusion which forms the key feature of the Porth Wnal Dolerite RIGS.

Good practice mitigation

7.4.10 The good practice mitigation measures identified for construction are set out below.

Land contamination

7.4.11 Section 9 of the Wylfa Newydd Code of Construction Practice (CoCP) (Application Reference Number: 8.6) sets out the overarching management strategies for dealing with land contamination. Section 9 of the Main Power Station Site sub-CoCP (Application Reference Number: 8.7) sets out the measures proposed to address contamination identified within the Wylfa Newydd Development Area.

7.4.12 Good practice mitigation during construction would include a number of measures during construction to reduce risks to human health and the environment, including the below.

- A contamination watching brief would be maintained by suitably qualified personnel during excavation works in areas where made ground has previously been encountered, so that any areas of unexpected contamination would be identified as soon as practicable (refer to the Waste and materials management strategy in the Main Power Station Site sub-CoCP for further details, Application Reference Number: 8.7).
- An unexpected contamination scheme of measures would be prepared prior to the commencement of any activities that involve ground disturbance, as set out within section 9 of the Wylfa Newydd CoCP (Application Reference Number: 8.6). These procedures would clearly define methods for dealing with any areas of unexpected contamination in order to manage immediate risks and prevent any contamination, airborne contaminants or odour spreading from the affected area. The scheme of measures would contain protocols for dealing with areas of potential asbestos-containing materials, should they be encountered.

7.4.13 Refer to the appendix D7-2 (Application Reference Number: 6.4.25) and chapter D1 (Application Reference Number: 6.4.1) for further details of the proposed remediation.

Pollution prevention

7.4.14 The water management strategies in section 10 of both the Wylfa Newydd CoCP (Application Reference Number: 8.6) and Main Power Station Site sub-CoCP (Application Reference Number: 8.7) set out the overarching pollution management principles to be applied throughout the construction period. Good practice mitigation during construction would include measures such as good equipment maintenance and repair and containment systems for all fuel storage/filling areas to reduce leaks and spills.

Materials management

7.4.15 Good practice mitigation would include the implementation of materials management measures in accordance with the materials management strategy set out in section 9 of the Wylfa Newydd CoCP (Application Reference Number: 8.6).

7.4.16 The reuse of materials would be managed in accordance with the *Definition of Waste: Development Industry Code of Practice* [RD30]. This would allow the reuse of excavated materials as far as possible without them being defined as waste.

Waste management

7.4.17 Section 9 of the Wylfa Newydd CoCP (Application Reference Number: 8.6) includes a site waste management strategy which sets out a framework for the management of wastes to reduce the amount of waste disposed to landfill.

Further details on waste management are also provided in chapter C6 (waste and materials management, Application Reference Number: 6.3.6).

Soil management

7.4.18 The stripping of topsoil and subsoil during construction, followed by their sustainable reuse in landscape mounds, forms a good practice mitigation measure. As noted in chapter D1 (Application Reference Number: 6.4.1), topsoil and subsoil would be stripped from all areas required for development, including the footprints of the:

- Wylfa Newydd Power Station;
- haul roads;
- compounds and material storage areas;
- landscape mounds;
- proposed new channel of the watercourse realignment; and
- Site Campus – including the temporary car parking, pedestrian areas, buildings, bus pick-up/drop-off area and construction-phase haul/access roads around the site.

7.4.19 This would prevent the loss of soil resources in areas where they would otherwise be covered with hardstanding or lost as a resource through mixing with other general excavation arisings or heavy disturbance.

7.4.20 In accordance with the guidance presented in *Construction Code of Practice for the Sustainable Use of Soils on Construction Sites* [RD31], a soil resource survey would be undertaken by the contractor prior to soil stripping and earthworks commencing (refer to section 9 of the Wylfa Newydd CoCP (Application Reference Number: 8.6) for further details). This information would be used to better understand the nature of soils on-site so that they can be managed appropriately and potential adverse effects upon them can be mitigated.

7.4.21 Additional good practice mitigation measures would be implemented during construction, following guidance on soil management such as the *Construction Code of Practice for the Sustainable Use of Soils on Construction Sites* [RD31]. These measures would include:

- appropriate procedures for soil handling works, such as stopping works when soil moisture exceeds certain limits;
- appropriate segregation of soils, including the segregation of topsoils and subsoils, as well as soils of distinctly different qualities, types or composition;
- soils would be stockpiled using methods appropriate to the soil moisture conditions;
- soil storage mounds would have slopes of 1 in 2 (approximately 25°) or less wherever practicable;
- where soils would be stored for longer than 60 days, stockpiles would be seeded with an appropriate low-maintenance seed mix;

- topsoils would be reinstated to depths recommended by guidance, i.e. 150–300mm for grassland and 150–400mm for woodland, and subsoil would be placed beneath topsoil; and
- appropriate decompaction measures would be undertaken during reinstatement for topsoils, subsoils and their receiving substrates, including loosening with ripping equipment.

7.4.22 Implementation of the soil management measures set out within section 9 of the Wylfa Newydd CoCP (Application Reference Number: 8.6) and Main Power Station Site sub-CoCP (Application Reference Number: 8.7) would reduce effects on soil resulting from the stripping, handling, storage and reuse of soil during construction works.

Operation

Basis of assessment and assumptions

7.4.23 The Power Station would be operated as described in chapter D1 (Application Reference Number: 6.4.1). No further assumptions have been identified.

Embedded mitigation

7.4.24 No embedded mitigation measures have been identified for operation.

Good practice mitigation

7.4.25 Pollution prevention strategies would be implemented during operation in accordance with section 10 (surface water and groundwater strategy) of the Wylfa Newydd Code of Operational Practice (Application Reference Number: 8.13). These aim to reduce the risk of accidental leaks and spills occurring, and to reduce any effects on receptors, should they occur.

Decommissioning

Basis of assessment and assumptions

7.4.26 The decommissioning strategy provides a number of assumptions with regards to decommissioning. However, the assessment of effects is limited by the detail provided therein and is subject to some uncertainty. It is expected that these uncertainties would be addressed within the Environmental Impact Assessment to be completed prior to decommissioning.

7.4.27 To facilitate the assessment, a number of assumptions have been made.

- All plant and equipment would be removed prior to demolition and all structures down to 1m below ground level would be removed.
- Structures greater than 1m depth would be left in place and punctured to allow drainage, whilst voids below 1m would be infilled with inert rubble/aggregate or grouted.
- The cooling water outfall structure would be removed, with a cofferdam required to facilitate its removal.

- Topsoil and subsoil would be imported to restore the Power Station Site to a condition similar to that which existed prior to construction.
- The landscape mounds would remain *in situ*.

7.4.28 The approach to decommissioning is set out in chapter D1 (Application Reference Number: 6.4.1).

Embedded mitigation

7.4.29 No embedded mitigation measures have been identified for decommissioning.

Good practice mitigation

7.4.30 No good practice mitigation measures have been identified for decommissioning at this stage. However, it is expected that the Environmental Impact Assessment to be completed prior to decommissioning would identify similar measures to those for construction to mitigate potential effects on soils and geology.

7.5 Assessment of effects

7.5.1 This section presents the findings of the assessment of effects associated with the construction, operation and decommissioning of the Wylfa Newydd Development Area.

Construction

Soil quality

Site clearance works

7.5.2 Vegetation, walls and other surface features would be removed from the Wylfa Newydd Development Area (as required) during the SPC Works. The SPC Works would be likely to disturb soil resources on-site, both directly through vehicle traffic and excavations (causing compaction and smearing) and indirectly through the removal of vegetation which previously maintained good soil conditions.

7.5.3 All of the ALC grades identified as receptors would likely be affected: Grade 2 (high value), Subgrade 3a (high value), Subgrade 3b (medium value) and Grade 5 (low value). However, the spatial extent of the disturbance would be limited, since the clearance works would mainly occur around field boundaries and haul/access roads would be used as far as possible. In addition, the extent of high-value BMV soil resources is relatively limited within the Wylfa Newydd Development Area in comparison to medium and low value soils. Therefore, the magnitude of change would be small and the effect minor adverse for all of the identified soil receptors.

Soil stripping and storage

7.5.4 As noted in section 7.4, topsoil and subsoil would be stripped from all areas required for development. This would affect all of the identified ALC grades:

Grade 2 (high value), Subgrade 3a (high value), Subgrade 3b (medium value) and Grade 5 (low value).

7.5.5 Soil could be affected in several ways during stripping, handling and its subsequent storage, including those set out below.

- Soil deformation would occur through compaction and smearing as a result of trafficking and handling of the soil.
- Stripping topsoil too deeply, thereby incorporating subsoil, or stripping to too shallow a depth could respectively lead to a degradation of soil quality or result in the loss of topsoil or subsoil.
- If soils of different quality are mixed during soil stripping and subsequent storage, higher quality soils may be degraded.
- During storage, a number of biological, chemical and physical changes may occur as a result of natural compaction and anaerobic conditions in the core of the stockpile, although these would be largely reversible upon reinstatement.

7.5.6 Although there would be reductions in soil quality as a result of these processes, it is considered that the good practice measures set out in section 7.4 would largely mitigate this through careful planning and consideration of soil resources. For instance, stopping works when soil moisture exceeds specific limits would reduce the potential for compaction and smearing, and the appropriate segregation of soils would reduce the potential for mixing. Moreover, the extent of high-value BMV soil resources is relatively limited within the Wylfa Newydd Development Area in comparison to medium and low value soils. Therefore, on the basis of professional judgement, it is considered that the magnitude of change associated with soil stripping and storage would be small, and a minor adverse effect would occur across the range of soil receptors.

7.5.7 For an assessment of effects on the water environment from soil handling and storage, including the potential for sedimentation and (nutrient) pollution of the water environment, refer to chapter D8 (Application Reference Number: 6.4.8).

7.5.8 Effects relating to the potential loss of agricultural land from a socio-economic perspective are covered within chapter D3 (socio-economics) (Application Reference Number: 6.4.3).

Treatment of invasive non-native species

7.5.9 The treatment of invasive non-native species would mitigate the risk of them being spread during construction, such that no effect on soil resources would occur in this regard. Further consideration of invasive species and their clearance is presented in chapter D9 (Application Reference Number: 6.4.9).

Soil reuse on-site

7.5.10 As set out in chapter D1 (Application Reference Number: 6.4.1), the majority of the soil stripped from the Wylfa Newydd Development Area would be reused within landscape mounding on site. The soil would mainly be sourced

from the temporary mounding but some soil would be reused directly on the landscape mounds without temporary storage to avoid effects associated with storage and double-handling (e.g. compaction and smearing).

7.5.11 As set out in section 7.4, topsoils and subsoils would be reinstated to depths consistent with good practice guidance, and decompaction measures would be undertaken. These measures would help to ensure that anaerobic conditions do not arise and poor plant growth does not occur. In addition, as measures would be implemented to reduce adverse effects on soil during stripping, handling and storage (see section7.4), it is expected that soils would be reinstated to qualities consistent with their original conditions. As such, no effect is predicted on soil quality as a result of reinstatement in itself. Compaction and smearing would occur due to soil handling associated with reinstatement, but the effect of this is assessed above in the 'soil stripping and storage' section above.

Soil reuse off-site

7.5.12 As identified in chapter D1 (Application Reference Number: 6.4.1), it is expected that surpluses of topsoil and subsoil would be generated from the Site Campus. As the soil would be reused sustainably, no loss (through wastage) of soil resources is expected and so no effect would occur in this regard.

Importation of soils

7.5.13 As identified in chapter D1 (Application Reference Number: 6.4.1), topsoil and subsoil would need to be imported to restore the Site Campus to agricultural land use. The potential effects of this are considered in conjunction with the degradation of soil quality during soil stripping and handling in the 'soil stripping and storage' section above.

Land contamination receptors

Remediation of contamination

7.5.14 As noted in section 7.4, a risk assessment and remediation strategy has been completed (appendix D7-2, Application Reference Number: 6.4.25) and the remediation would be undertaken as described therein and in chapter D1 (Application Reference Number: 6.4.1). The remediation of the key areas of contamination would have a beneficial effect by severing potential pollutant linkages (through the removal of sources or pathways to receptors), thereby removing short- and long-term risks to:

- high value receptors – construction workers, adjacent land users, future site users and high-sensitivity controlled waters (e.g. Tre'r Gof catchment);
- medium value receptors – Subgrade 3b soils and medium-sensitivity controlled waters (e.g. Afon Cafnan catchment); and
- low value receptors – Grade 5 soils and low-sensitivity controlled waters (e.g. Power Station catchment).

7.5.15 The magnitude of change would be medium across the receptors due to the removal of the majority of identified pollutant linkages so that risks to receptors are reduced. The effects would therefore be major beneficial for high value receptors, moderate beneficial for medium value receptors and minor beneficial for low value receptors.

7.5.16 Only low and very low risks were identified for property receptors within appendix D7-2 (Application Reference Number: 6.4.25) based on current and future site uses; thus, no beneficial effect from remediation is anticipated in this regard. Nor are other construction activities likely to affect property receptors with regard to land contamination; therefore, they are not considered further in the construction phase assessment.

7.5.17 As noted in section 7.4, appropriate measures would be implemented, and suitable health and safety procedures followed, to reduce risks to remediation workers from existing contamination. Therefore, no adverse effects would occur in this regard.

7.5.18 Furthermore, appropriate techniques would be used (e.g. damping down, enclosed processing facility) during the remediation works to prevent the release of asbestos fibres which could affect adjacent land users. Therefore, no effects are anticipated in this regard.

Made ground encountered during soil strip

7.5.19 Made ground is known to be present in central and northern parts of the Wylfa Newydd Development Area, predominantly in the areas surrounding the Existing Power Station. Small pockets of made ground are also present adjacent, and in close proximity to, Cemlyn Road (refer to figure D7-3 Application Reference Number: 6.4.101) for locations of made ground). Remediation activities to remove the most significant areas of contamination would have taken place prior to soil stripping; however, the proposed remediation does not aim to remove all of the made ground identified within the Wylfa Newydd Development Area.

7.5.20 It is proposed that the soil strip would only take place to the interface with the made ground, and where made ground is encountered the soil strip would cease. However, due to the likely difficulties in identifying made ground as works are in progress, there is the potential for topsoil and subsoil to become mixed with made ground.

7.5.21 Based on the location of made ground encountered to date (figure D7-3, Application Reference Number: 6.4.101), it is anticipated that the risk of made ground being accidentally mixed into soil during stripping is highest for Subgrade 3b (medium value) and Grade 5 (low value) soils. There remains the potential, however, for BMV (high value) soils to be affected by unexpected made ground (although if significant anthropogenic inclusions are found to be already present within BMV soil, it is likely that the ALC would be downgraded).

7.5.22 The mixing of soils with made ground would lead to a reduction in quality of the resources, but the potential for this to occur would be mitigated by the contamination watching brief and the processes and procedures for dealing

with unexpected contamination (see section 7.4). The magnitude of change would be medium for high value soils and small for medium and low value soils. However, based on the likely nature of any remaining made ground and the low likelihood of the effect occurring, it is considered that significant reductions in soil quality are unlikely to result. As such, the degree of effect has been moderated through professional judgement to minor adverse across the soil receptors (taking into account the respective extents of the soil quality receptors present).

7.5.23 Potential effects relating to the unexpected exposure of made ground during soil stripping works are considered below.

Exposure of areas of unexpected contamination

7.5.24 The potential exists for areas of unexpected contamination (previously unidentified contamination that has not been remediated) to be exposed during construction, which may pose a risk to receptors if not managed appropriately. The primary effect would be upon construction workers, who may be directly exposed to the contamination. Desk-based assessments and ground investigations indicate that the most likely contaminant of concern is asbestos, which has been found in a number of isolated locations within the Wylfa Newydd Development Area.

7.5.25 There is the potential that construction workers may be exposed to asbestos contamination if it is encountered unexpectedly, although the likelihood of occurrence would be low after remediation. In addition, as per section 7.4, a contamination watching brief would be maintained during works in areas of high risk and procedures would be put in place to reduce risks from any unexpected contamination encountered. These measures would mitigate the potential for unexpected contamination to affect receptors. Accordingly, a medium magnitude of change is predicted on the high value construction workers, with a moderate adverse effect resulting.

7.5.26 The inadvertent exposure of unexpected areas of asbestos-containing made ground could also potentially affect adjacent land users as a result of the liberation of fibres which could then migrate off-site via aerial dispersion. However, the likelihood of this occurring would be very low following remediation and implementation of good practice mitigation measures (see section 7.4). In addition, based on the results of ground investigations to date, the areas in which asbestos might be encountered unexpectedly are limited and likely to be a considerable distance from adjacent land users. Therefore, the potential magnitude of change on adjacent land users (high value) from exposure to wind-blown asbestos fibres would be negligible and the degree of effect would be negligible.

7.5.27 The likelihood of other contaminants being encountered in sufficient concentrations to be able to affect adjacent land users via airborne dispersion is considered to be very low. Therefore, a negligible magnitude of change and negligible effect is predicted in this regard.

7.5.28 Further assessment of the potential effects of the WNDA Development upon human health is presented in the Health Impact Assessment (Application

Reference Number: 8.19) accompanying the application for development consent.

7.5.29 The disturbance of unexpected areas of contamination could also result in the mobilisation of contaminants resulting in the creation of new pollutant pathways, or the inadvertent mixing of contaminated and uncontaminated soils during works. The contamination watching brief and the processes and procedures for dealing with unexpected contamination would reduce the likelihood of this occurring (see section 7.4). It is considered that the effects on soil are likely to be limited to reduction in soil quality, whilst only moderate and low risks would be posed to controlled waters (based on the conceptual site model in appendix D7-2, Application Reference Number: 6.4.25). As such, a small magnitude of change is predicted across the high value (BMV soils and high-sensitivity controlled waters), medium value (Subgrade 3b soils and medium-sensitivity controlled waters) and low value (Grade 4 soils and low-sensitivity controlled waters) receptors. The effect would be minor adverse across these receptors. This conclusion takes into account the respective extents of the soil quality receptors present and the locations of the receptors in relation to the areas of contamination encountered thus far. For instance, high-value controlled waters and soil quality receptors are not located in close proximity to areas of known contamination, thus the risks are lower for these receptors and the degree of effect is correspondingly small.

Pollution incidents causing soil contamination

7.5.30 During construction, there is the potential for activities and pollution incidents to cause new contamination on-site. This could be as a result of leaks or spills from construction plant, or fuel and chemical storage facility leaks. Any contamination resulting from such events has the potential to pose a risk to high value (construction workers, adjacent land users and BMV soils), medium value (Subgrade 3b soils) or low value (Grade 5 soils) receptors.

7.5.31 However, the implementation of pollution prevention measures such as the bunding of any fuel tanks and good maintenance of equipment (refer section 7.4) would reduce this risk, such that the change would be of small magnitude and the potential effect minor adverse across the identified receptors. This conclusion has been reached taking into account the low likelihood of the effect occurring such that a greater degree of effect is not considered appropriate for any receptor.

7.5.32 For effects that occur to surface and groundwater, including leaks and spills, reference should be made to chapter D8 (Application Reference Number: 6.4.8).

Sites of geological importance

Installation (and removal) of cooling water outfall and cofferdam

7.5.33 The cooling water outfall would be located in Porth Wnal within the boundary of the Porth Wnal Dolerite RIGS; refer to figure D7-8 (Application Reference Number: 6.4.101) for the location of the RIGS and figure A2-1 (Application Reference Number: 6.1.10) for the location of the cooling water outfall.

7.5.34 The construction of the outfall through the cliff face would necessitate the removal and destruction of part of the RIGS. The rocks in the vicinity of the outfall are of the Gwna Group and highly variable, varying from weak to medium-strong and highly fractured in places; this renders the rock more vulnerable to damage during construction. It is considered unlikely that blasting would be required in close proximity to the Porth Wnal Dolerite RIGS, based on borehole logs from the DOnGI. However, as noted in section 7.4, localised small-scale blasting may be required in the vicinity of the cooling water outfall if areas of hard rock (e.g. granite) are encountered which cannot be excavated through using other techniques.

7.5.35 The construction of a cofferdam would be necessary to provide a dry working area for construction of the outfall structure, and this would be tied into the cliffs around the outfall; however, as per section 7.4, the key features of the Porth Wnal Dolerite RIGS would be avoided as far as practicable.

7.5.36 Overall, the effect on the medium value Porth Wnal Dolerite RIGS resulting from the construction of the cooling water outfall would be of a medium magnitude and moderate adverse.

7.5.37 As a result of the construction of the cooling water outfall, there would be a loss of accessibility to the RIGS as an educational resource, as access to the site is likely to be strictly controlled for security reasons. The educational value of the RIGS would therefore be reduced, such that a medium magnitude and moderate adverse effect would occur.

7.5.38 Consideration of the loss of public access to sites of geological importance within the GeoMôn Geopark, throughout all phases of the Wylfa Newydd Project, is presented within chapter D4 (public access and recreation, Application Reference Number: 6.4.4).

Installation of new surface water discharge point

7.5.39 As per section 7.4, a new surface water discharge point would be created within the Cemaes Bay RIGS. The installation of the pipe for this discharge has the potential to damage the RIGS through excavations into the local geology. However, as noted in section 7.4, it is expected that any excavations of the geology would be very limited. In addition, the excavations would not be located within any of the key features of the RIGS. Therefore, no noticeable change would occur and a negligible magnitude of change would result for the medium value RIGS, such that the effect would be negligible.

Geological resources

7.5.40 Four medium value Category 2 Aggregates Safeguarding Areas have been identified as receptors within the study area. The loss of these reserves as a result of excavation and non-beneficial reuse e.g. as general fill within landscaped mounds, or a temporary loss of access to/sterilisation of the resources during construction works, would potentially result in adverse effects.

7.5.41 For the igneous rock resources around Porth-y-pistyll, it is likely that some would be extracted during deep excavation works. As it may not be possible to segregate the igneous resources from other rock types during construction,

they are likely to be reused as fill on-site. Where this is the case, they would mostly be reused within the landscape mounds but possibly also in other areas as fill for structures or drainage layers. As a beneficial reuse (e.g. road surfacing) cannot be guaranteed, this would constitute an adverse effect. A proportion of the resources would not be extracted but would be sterilised due to long-term development over/proximal to them. However, as per the discussion in section 7.3, the actual extent of the igneous resources is more limited than the Aggregates Safeguarding Areas shown in figure D7-9 (Application Reference Number: 6.4.101) suggest. In addition, the proportions of the resources affected would likely be less than 50% of the total resources. Therefore, the effect is considered to be of small magnitude and minor adverse.

7.5.42 Access to the igneous resources to the south of Wylfa Head would be temporarily restricted by the Site Campus. Access to the sandstone resources at Wylfa Head would also likely be restricted during construction. The magnitude of change associated with this loss of access would be negligible and the degree of effect negligible, based on the relatively short time period over which the resources would be affected.

Operation

Soil quality receptors

7.5.43 The existing drumlin slopes on the Wylfa Newydd Development Area tend to range from approximately 2.6° to 8.1°, although the majority are from 4.8° to 7.1°. Slopes greater than 7° limit the ALC to Subgrade 3b or below; thus, few areas of the Wylfa Newydd Development Area are limited in this respect.

7.5.44 For the proposed landscaping, mound slopes would generally range from approximately 2.6° to 9.5°, with the majority of slopes less than 7°. Overall, slope angles are likely to increase from the baseline conditions, with a number of areas limited to Subgrade 3b as a result of slope angles and some slopes likely limited to Grade 4 (by exceeding 11°).

7.5.45 However, these possible reductions in ALC grade do not represent reductions in soil quality per se. The gradient limitations [RD2] are designated primarily due to the type of machinery that can be safely and efficiently operated on certain slope angles, without risking soil erosion. This is not particularly relevant to the intended land use on the landscape mounds (grazing).

7.5.46 Notwithstanding the above, there may be implications in terms of soil erosion. Clay loams are the most commonly occurring soil textures across the Wylfa Newydd Development Area, whilst clay has also been encountered in a number of locations [RD3]; [RD5]. Clay loams are medium-textured soils and clays are heavy-textured [RD32]. Medium soils are susceptible to high levels of soil erosion on slopes exceeding 7°, with heavy soils at a lower risk [RD33]. Therefore, increases in soil erosion may occur due to the changed landform, possibly degrading soil quality through aspects such as the removal of soil particles, organic matter and nutrients from upper parts of the slopes.

7.5.47 However, the increases in slope angle would be relatively minor and the proposed land use on the landscape mounds (grazing) would limit the

potential for erosion. As such, it is considered that there would only be limited reductions in soil quality such that the magnitude of the change would be small. Therefore, minor adverse effects are predicted to occur across the range of identified soil receptors (high to low value) on the basis of professional judgement (taking into account the respective extents of the soil quality receptors present).

7.5.48 Surface water runoff tends to be high for all soil textures on slopes exceeding 7° [RD33], but the implications for increases in runoff on the water environment are considered in chapter D8 (Application Reference Number: 6.4.8).

Land contamination receptors

Existing contamination

7.5.49 Material excavated during construction would be retained on the Wylfa Newydd Development Area during operation within landscape mounds or areas of fill, and it is possible that some of this material would contain elevated levels of contamination.

7.5.50 As no soft landscaping is proposed within the operational area, the potential for effects to occur to workers on the Power Station Site from contamination remaining *in situ* is limited. The lack of areas of bare earth and soft landscaping means that there would be no direct contact between site workers and any contamination present beneath the site, and thus no pollutant linkages are likely to exist.

7.5.51 However, maintenance workers (high value) may come into contact with soils as a result of undertaking excavation works, for example when repairing buried services. Buildings and buried services (medium value) located in or near areas of made ground retained on-site may be affected if contaminants capable of attacking concrete or drinking water pipes are present.

7.5.52 It has been assumed that the landscape mounds would be used for grazing. Therefore, there is a potential for farmers (high value) and livestock (medium value) to come into contact with contaminated soil. Adjacent land users (high value) may potentially be exposed to wind-blown contaminants from areas of bare soil on the landscape mounds.

7.5.53 However, the remediation implemented during construction would be designed to break all pollutant linkages present, both current and future, and as such would consider the remediation required to protect receptors during the operation of the Power Station. This would include measures to reuse materials in locations where they are unlikely to pose a risk to receptors, for example by placing them at depth within the landscaped mounds. Although there may be isolated areas where pollutant linkages may be present, the likelihood of this occurring is very low. As such, the magnitude of change and degree of effect have been assessed as negligible across the receptors identified above.

New contamination

7.5.54 There is the potential for pollution incidents to cause contamination during operation. This could be a result of fuel or chemical storage facility leaks or spills. Any contamination caused by such events has the potential to pose a risk to receptors. However, pollution incidents are only likely to occur within the Power Station Site during operation. The majority of the remainder of the Wylfa Newydd Development Area would be used for grazing or as open land; thus, pollution incidents are considered unlikely in these areas.

7.5.55 Given that hardstanding would be present across the Power Station Site, the only receptors for which there may be pathways to new contamination would be maintenance workers (high value) and buildings and buried services (medium value). However, after the implementation of pollution prevention strategies, the likelihood of pollutant linkages being realised is very low. Therefore, no effects are anticipated from pollution incidents on soils and geology receptors during operation.

7.5.56 The potential for water bodies to be affected by leaks and spills is assessed in chapter D8 (Application Reference Number: 6.4.8).

Sites of geological importance

7.5.57 It is expected, based on current design proposals, that the Porth Wnal Dolerite RIGS would retain its key features of interest following construction works and would, therefore, retain its listing and educational value as a RIGS during the operational phase.

7.5.58 The cooling water outfall would be orientated to the northwest, such that the water/effluent would flow directly out to sea without impinging on the rocks comprising the Porth Wnal Dolerite RIGS. The cooling water outfall is therefore unlikely to cause erosion of the RIGS during operation and, as such, no effect is anticipated in this regard.

7.5.59 As a result of the presence of the cooling water outfall in the medium value RIGS, there would be a continued loss of access for educational purposes, as noted for the construction phase. A medium magnitude of change and moderate adverse effect is therefore predicted to occur.

Geological resources

7.5.60 Access to the medium value igneous resources to the south of Wylfa Head and the sandstone resources at Wylfa Head would be restored during operation. However, no effect is predicted as the area would simply be returned to approximately its current condition.

Decommissioning

7.5.61 The effects during decommissioning have been assessed against the current baseline. The works required to decommission the Power Station would be subject to a separate Environmental Impact Assessment that would assess the effects in detail against the baseline conditions at that time.

Soil quality receptors

7.5.62 As per section 7.4, it is assumed that topsoil and subsoil would need to be imported during decommissioning to restore the site to a condition equivalent to that which existed prior to construction. Based on this, it is anticipated that similar soils would be imported, such that BMV (high value), Subgrade 3b (medium value) and Grade 5 (low value) soils would be the receptors. It is assumed that appropriate good practice measures would be implemented to mitigate effects on this soil. Although there may be some damage to soils during handling and placement, it is expected that this would be short-term and reversible if appropriate aftercare is implemented. As such, the magnitude of change and degree of effect upon imported soils would be negligible.

Land contamination receptors

Existing contamination

7.5.63 No contamination arising due to pollution incidents during operation is expected to persist through to decommissioning, as the pollution prevention strategies implemented at that time would ensure that any leaks and spills would be dealt with appropriately. Any unexpected contamination encountered during construction would also have been dealt with during that phase. Therefore, there is not expected to be any existing contamination that could pose risks to soils and geology receptors during decommissioning and no adverse effects would occur.

Pollution incidents causing soil contamination

7.5.64 There is the potential for accidental pollution incidents during the decommissioning works. However, it is expected that appropriate procedures would be implemented to reduce the potential for, and the scale of, any pollution incidents. As such, the magnitude of change and degree of effect would be negligible for construction workers (high value), BMV soils (high value), Subgrade 3b soils (medium value) and Grade 5 soils (low value). This conclusion has been reached taking into account the low likelihood of the effect occurring such that a greater degree of effect is not considered appropriate for any receptor.

7.5.65 For effects that occur to surface and groundwater, including from leaks and spills, reference should be made to chapter D8 (Application Reference Number: 6.4.8).

Sites of geological importance

7.5.66 As per section 7.4, it is assumed that the cooling water outfall would be removed during decommissioning and a cofferdam would be required to enable this.

7.5.67 It is expected that consultation would be undertaken with GeoMôn and NRW (or the appropriate supervising bodies at that time), and measures would be embedded into the design to reduce or eliminate potential damage to the Porth Wnal Dolerite RIGS. Therefore, it is assumed that the potential effect on the

medium value RIGS due to the removal of the cooling water outfall could be mitigated such that the change would be of small magnitude and the degree of effect minor adverse.

7.5.68 Decommissioning could also provide opportunities to enhance the Porth Wnal Dolerite RIGS from an educational resource perspective, e.g. by improving access to particular exposures compared to the current baseline conditions. However, due to uncertainty over whether this effect would be realised (as access arrangements have not yet been defined), no effect has been assessed in this regard at this time.

Geological resources

7.5.69 Access to the Category 2 Aggregates Safeguarding Areas located within the Wylfa Newydd Development Area that are not excavated as part of the construction works may be restored as a result of decommissioning. This may create a beneficial effect, but as the area would simply be restored to a state equivalent to the present baseline conditions, this has not been assessed.

Transboundary effects

7.5.70 As outlined within table D7-11, there is a potential for effects on soils and geology to occur from the proposed activities. However, the geographical extent of these effects is local within the study area, with no possibility of significant transboundary impacts on other European Economic Area Member States.

7.6 Additional mitigation

7.6.1 In accordance with chapter B1 (Application Reference Number: 6.2.1), embedded and good practice mitigation measures relevant to soils and geology were taken into account when determining the 'pre-mitigation' significance of effects. These are detailed in the design basis and activities section of this chapter.

7.6.2 Additional mitigation measures would be implemented to address potential significant effects identified in the assessment of effects section. These additional mitigation measures are summarised in table D7-9 and table D7-10 for construction and operation respectively. No additional mitigation measures have been identified for decommissioning.

Construction

Table D7-9 Additional mitigation measures – construction

Additional mitigation measures	Objective	Achievement criteria and reporting requirements
Installation of bilingual information board(s) at Wylfa Head to highlight the importance of the geology of the area.	To provide an educational resource highlighting the importance of the geology in the area.	The information board(s) would be erected prior to construction and would remain in place for at

		least the duration of construction.
Access to exposed cliff faces at Porth Wnal for geologists to study (subject to works and safety requirements).	To allow geologists to study newly created rock exposures that may provide further insight into the geology in the area.	Access would be granted to Porth Wnal when and where practicable.
Facilitation of a LiDAR survey of existing cliffs within the vicinity of the Porth Wnal Dolerite RIGS prior to construction in that area.	To provide a detailed record of the site, thereby enhancing future study/understanding of the site and the part that would be damaged/lost.	The survey would be sufficiently detailed to provide adequate data for future study of the RIGS.

7.6.3 Refer to the Main Power Station Site sub-CoCP (Application Reference Number: 8.7) for further details of the above mitigation measures.

Operation

Table D7-10 Additional mitigation measures – operation

Additional mitigation measures	Objective	Achievement criteria and reporting requirements
Access to the site (as operations allow) for study by students/geologists.	To retain the educational value of the Porth Wnal Dolerite RIGS as far as practicable.	Access would be granted to Porth Wnal for students/geologists as operations allow.
Continued presence of information board(s) at Wylfa Head highlighting the importance of the geology of the area.	To provide an educational resource highlighting the importance of the geology in the area.	The information board(s) erected prior to construction would be left in place throughout operation.

7.6.4 Refer to the Code of Operational Practice (Application Reference Number: 8.13) for further details on the above mitigation measures.

7.7 Residual effects

7.7.1 This section describes the residual effects for geology and soils having taken into account the embedded, good practice and additional mitigation described above. Table D7-11 provides a summary of significant residual effects identified either prior to or post application of additional mitigation for both construction and operation.

7.7.2 No significant adverse effects were identified for the decommissioning phase.

7.7.3 Additionally, all effects of minor significance or greater identified in the assessment of effects section are summarised in appendix I3-1 (master residual effects table, Application Reference Number: 6.9.8).

Construction

7.7.4 The following significant effects would remain during construction.

- Major and moderate beneficial effects would remain in relation to the remediation of contamination (for construction workers, adjacent land users, future site users, high-sensitivity controlled waters, Subgrade 3b soils and medium-sensitivity controlled waters).
- A moderate adverse effect on construction workers remains due to their potential exposure to unexpected contamination. No practicable measures have been identified to reduce the effect further but it should be noted that the likelihood of occurrence is low following remediation.
- A moderate adverse residual effect would persist on the Porth Wnal Dolerite RIGS due to the construction of the cooling water outfall and reduced accessibility. The proposed additional mitigation measures would mitigate the effects to an extent but, as blasting near the outfall cannot be ruled out, damage to the RIGS would still occur such that the effect cannot be downgraded further.

7.7.5 The following non-significant effects would also remain during construction, as no practicable measures have been identified to reduce the effects further.

- Soil quality:
  - a minor adverse effect on soil quality (ALC Grades/Subgrades 2, 3a, 3b and 5) would remain due to site clearance works, as vehicle trafficking over soil would necessarily occur; and
  - a minor adverse effect would remain due to the degradation of soil quality (ALC Grades/Subgrades 2, 3a, 3b and 5) as a result of stripping, handling and storage.
- Receptors of contamination:
  - a minor beneficial effect would occur in relation to the remediation of contamination (for Grade 5 soils and low-sensitivity controlled waters);
  - a minor adverse effect would remain due to the potential for soil quality (ALC Grades/Subgrades 2, 3a, 3b and 5) to be degraded through mixing with made ground;
  - a minor adverse residual effect would persist in relation to the potential for soils (ALC Grades/Subgrades 2, 3a, 3b and 5) and controlled waters (high- to low-sensitivity) to be affected by the disturbance of unexpected contamination; and
  - a minor adverse effect remains across human (construction workers and adjacent land users) and soil (ALC Grades/Subgrades 2, 3a, 3b

and 5) receptors in relation to pollution incidents, although the likelihood of occurrence remains low.

- Sites of geological importance:
  - an adverse effect would remain due to reduced accessibility and educational value of the Porth Wnal Dolerite RIGS due to the presence of the outfall, although this would be mitigated from moderate to minor adverse through additional mitigation.
- Geological resources:
  - a minor adverse effect would remain on the Category 2 Aggregates Safeguarding Areas due to non-beneficial reuse/sterilisation of the resources.

Operation

7.7.6 A minor adverse effect would remain in relation to potential degradation of soil quality (ALC Grades/Subgrades 2, 3a, 3b and 5) due to increased soil erosion.

7.7.7 An adverse effect would remain due to the continued reduced accessibility to the Porth Wnal Dolerite RIGS, which would be mitigated from moderate to minor adverse through additional mitigation.

Decommissioning

7.7.8 A minor adverse effect would remain in relation to the removal of the cooling water outfall and potential damage to the Porth Wnal Dolerite RIGS, for which no additional mitigation has been identified at this stage.

Table D7-11 Summary of residual effects

Receptor (or group of receptors)	Value of receptor (s)	Description of potential effect	Nature of effect	Potential magnitude of change	Potential significance of effect	Additional mitigation	Post-mitigation magnitude of change	Significance of residual effect
Construction								
Construction workers, adjacent land users and future site users	High	Remediation of contamination	Indirect Beneficial Short-term	Medium	Major beneficial	Not applicable	Medium	Major beneficial
High-sensitivity controlled waters e.g. Tre'r Gof Catchment	High		Indirect Beneficial Long-term	Medium	Major beneficial		Medium	Major beneficial
Subgrade 3b soil	Medium			Medium	Moderate beneficial		Medium	Moderate beneficial
Medium-sensitivity controlled waters e.g. Afon Cafnan Catchment	Medium			Medium	Moderate beneficial		Medium	Moderate beneficial

Receptor (or group of receptors)	Value of receptor (s)	Description of potential effect	Nature of effect	Potential magnitude of change	Potential significance of effect	Additional mitigation	Post-mitigation magnitude of change	Significance of residual effect
Construction workers	High	Potential exposure of construction workers to unexpected contamination	Direct Adverse Short-term	Medium	Moderate adverse	None	Medium	Moderate adverse
Porth Wnal Dolerite RIGS	Medium	Damage to the RIGS due to the excavation of the cooling water outfall and associated cofferdam required for construction	Direct Adverse Long-term	Medium	Moderate adverse	• Geological information board(s) at Wylfa Head. • Access for geologists to study rock exposures. • LiDAR survey of Porth Wnal Dolerite RIGS cliffs.	Medium	Moderate adverse

Receptor (or group of receptors)	Value of receptor (s)	Description of potential effect	Nature of effect	Potential magnitude of change	Potential significance of effect	Additional mitigation	Post-mitigation magnitude of change	Significance of residual effect
Porth Wnal Dolerite RIGS	Medium	Reduced accessibility and value of the RIGS as an educational resource due to the presence of the cooling water outfall	Adverse Medium-term	Medium	Moderate adverse	• Geological information board(s) at Wylfa Head. • Access for geologists to study rock exposures. • LiDAR survey of Porth Wnal Dolerite RIGS cliffs.	Small	Minor adverse

Receptor (or group of receptors)	Value of receptor (s)	Description of potential effect	Nature of effect	Potential magnitude of change	Potential significance of effect	Additional mitigation	Post-mitigation magnitude of change	Significance of residual effect
Operation								
Porth Wnal Dolerite RIGS	Medium	Reduced accessibility to the RIGS as an educational resource due to the presence of the cooling water outfall	Adverse Medium-term	Medium	Moderate adverse	• Access to the site (as operations allow) for study by students/ geologists. • Geological information board(s) at Wylfa Head.	Small	Minor adverse

7.8 References

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