

6 Ground conditions

6.1 Introduction

- 6.1.1 This chapter considers the baseline conditions present in the area of the proposed Global Centre of Rail Excellence (GCRE, the ‘proposed development’) and identifies the potential effects that construction and operation use may have on ground conditions focusing on geology, hydrogeology and impact of land contamination on soils and controlled waters.
- 6.1.2 The potential effects on hydrology from other aspects of the development including drainage are covered in Chapter 5: Hydrology and Flooding.
- 6.1.3 The Ground Conditions chapter sets out the legislative context specific to the assessment of ground conditions. It then presents baseline conditions within the proposed development. This includes the presentation of geological and hydrogeological setting, underlying ground conditions, site history including details on legacy of opencast and deep mine workings, and the conceptual site model for the assessment of impacts of land contamination. This is followed by assessment of potential effects on ground conditions resulting from construction activities and operation.
- 6.1.4 The chapter includes the following appendix:
- Appendix 6A – Global Centre of Railway Excellence Desk Study

6.2 Review of proposed development

- 6.2.1 The proposed development, as detailed in Section 3, would include construction of train testing infrastructure including railway tracks on a landform (embankments and cutting forming the testing loops) which is to be constructed as part of the Nant Helen earthworks planning consent. Therefore, no significant earthworks are proposed as part of this application. The landform design and construction also include undertaking mineworking risk assessment, hydrogeological impact assessment prior to treatment, if required. These also form part of the Nant Helen earthworks consented works and are excluded from this application.
- 6.2.2 However, some materials movement is anticipated particularly associated with the construction of foundations for the proposed structures and infrastructure. Therefore, a materials handling strategy will be developed which will include the reuse and storage of soils and overburden from within the redline boundary of the development. Detailed requirements with respect to management of materials during earthworks will be set out in the Earthworks Specification, which will

be derived for the proposed development. This will determine suitability for reuse criteria.

- 6.2.3** The proposed development also includes construction of platforms, station building, maintenance facilities, staff overnight accommodation and offices, and numerous sidings. The majority of these structures are likely to be founded on ground bearing shallow foundations e.g. rafts. In some cases, where loads are greater, or structures are sensitive to ground movement, deep piled foundations may be required. Foundation proposals will be developed as design progresses and additional information on ground conditions is obtained through intrusive investigations. Construction of the tracks and sidings will require track bedding comprising granular subbase.
- 6.2.4** Buildings and infrastructure associated with the existing open cast mine operations, including the area of the existing washery, will be demolished. All stockpiled materials including the washery by-products such as coal fines, etc, will be removed as part of the washery decommissioning works. Existing ponds/lagoons within the washery area will also be decommissioned and backfilled to allow for the proposed development.
- 6.2.5** The landscaping of the embankment and cut surfaces will be undertaken in accordance with landscaping proposals provided as part of the Nant Helen earthworks consent. These will include grass seeding to vegetate the restored areas. Some landscaping may be introduced in the area of proposed storage and maintenance facilities. These will be developed as the masterplanning design progresses.

6.3 Legislation, policy context and guidance

- 6.3.1** Legislation and policies specifically related to the assessment of ground conditions focusing on geology, hydrogeology and land contamination are described below.

Legislation

- 6.3.2** Geological sites of national importance are principally afforded protection under the Wildlife and Countryside Act 1981 (as amended) or the National Parks and Access to the Countryside Act 1949 by designation as a Site of Special Scientific Interest (SSSI) or National Nature Reserve (NNR).
- 6.3.3** Environmental legislation implemented as either Acts or Regulations provide separate legislative drivers to manage contamination. The main legislative drivers for managing risks to human health and the environment from land contamination are:
- Part IIA of the Environmental Protection Act 1990;
 - Contaminated Land (Wales) Regulations 2006 (as amended in 2012);

- Environment Act 1995; and
- Environmental Permitting Regulations 2016 (as amended in 2018 and 2019).

6.3.4 In Wales, Part IIA of the Environmental Protection Act 1990, as introduced by Section 57 of the Environment Act 1995, came into effect in September 2001 with the implementation of the Contaminated Land Regulations 2000 (now superseded by The Contaminated Land Regulations 2006/2012). Under Part IIA of the Environmental Protection Act, sites are identified as 'contaminated land' if they are causing, or if there is a significant possibility of causing significant harm to human health or significant pollution of controlled waters (as defined by Section 104 of the Water Resources Act 1991).

6.3.5 The Environment (Wales) Act 2016 sets out a framework for the sustainable management of natural resources. An accompanying Natural Resources Policy was published in 2017 is to drive the delivery of the Well-being Goals aimed at improving the environment as set out by the Well-being of Future Generation Act 2015, at the same time delivering economic objectives.

6.3.6 In general terms the legislation advocates the use of a risk assessment approach to the assessment of contamination and any remedial requirements.

6.3.7 A list of additional legislation considered within this assessment and relating to contamination and water environment includes:

- Water Resources Act 1991 as amended in Wales by the Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009;
- EU Water Framework Directive (WFD) 2000/60/EC (as amended by supplementary directives and decisions);
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 which implement Water Framework Directive (2000/60/EC), and transpose aspects of the Groundwater Directive (2006/118/EEC) and the Priority Substances Directive (2008/105/EC).
- The Environmental Permitting Regulations 2016 (as amended), which amend the Environmental Permitting (England and Wales) Regulations 2010. The 2010 Regulations revoked the Groundwater Regulations (England and Wales) 2009, which originally implemented in the Groundwater Directive;
- Groundwater Daughter Directive (GWDD) (2006/118/EC);
- The Water Framework Directive (Standards & Classification) Directions (England and Wales) 2015;

- The Environmental Damage (Prevention and Remediation) (Wales) Regulations 2009; and
- Flood and Water Management Act 2010.

Policy context

National and Regional Policy

6.3.8 Planning Policy Wales Edition 11 (2021) (PPW11), Section 6.3 highlights the importance that geological features have in the natural environment. Specific reference is made to the protection, conservation and enhancement of:

- UNESCO Global Geoparks;
- Regionally Important Geological and Geomorphological Sites (RIGS); and
- Sites of Special Scientific Interest (SSSIs).

6.3.9 In addition, PPW11 encourages planning authorities to promote opportunities for the incorporation of geological features within the design of development.

6.3.10 PPW11, Section 6.9 covers both development on contaminated land and developments which may pose risks to health and the environment. Physical ground conditions and land instability are also considered within this section.

Local Planning Policy

6.3.11 The Powys Local Development Plan (LDP, 2011 – 2026) was adopted in April 2018. The Strategic Policy SP7 – Safeguarding of Strategic Resources and Assets identifies land designated for environmental protection at international or national level and conservation areas (including locally important site designations) as strategic assets. These assets are to be safeguarded from unacceptable development. The LDP provides a range of detailed Development Management Policies focusing on Natural Environment (DM2) and Contaminated and Unstable Land (DM10). These policies require:

- A demonstration of how geodiversity is protected and enhanced.
- That the Water Framework Directive objectives are met including achievement of Water Quality Standards.
- A demonstration that the proposed development will not result in any additional problems of ground instability or contamination, on or off site.
- remediation of any instability and land contamination.
‘Development proposals within areas of coal mining legacy will be required to give full consideration to coal mining information and,

where necessary, implement mitigation measures to the satisfaction of the Local Planning Authority'

- that protection of public health and safety is assured.

6.3.12 The Neath Port Talbot County Borough Council Local Development Plan (LDP, 2011-2026) was adopted in January 2016. The LDP provides a series of strategic policies, which are underpinned by policies. Two strategic policies SP15 Biodiversity and Geodiversity and SP16 Environmental Protection, are considered relevant to the proposed development. These policies state:

- Policy EN6 Important Biodiversity and Geodiversity Sites: Conservation will be required and, where possible, enhancement of natural heritage.
- Air, water and ground quality and the environment generally will be protected and where feasible improved.
- Policy EN8 Pollution and Land Stability: Proposals resulting in unacceptable adverse effect on health, biodiversity, or which would expose people to unacceptable risk due to contamination, water (including groundwater) pollution and/or instability, will not be permitted. Where contamination is likely to be present, the proposals for remediation and mitigation to show that no adverse effects will be caused at any stage of development, will be required. Development will need to minimise impact on water quality.

Relevant guidance

6.3.13 The assessment will be undertaken with due consideration of the following topic specific guidance:

- Model Procedures for the Management of Land Contamination (CLR11)¹. The guidance is currently under review and will be withdrawn during 2020 and replaced by the updated online guidance called 'Land contamination: risk management'²;
- Construction Industry Research and Information Association (CIRIA) R132: A Guide for Safe Working on Contaminated Sites³;
- CIRIA SP73: Roles and Responsibility in Site Investigations⁴;
- BS5930: 2015: Code of Practice for Site Investigations including Amendment 2⁵;

¹ Model Procedures for the Management of Land Contamination (CLR11), Environment Agency and Defra, 2004.

² Environment Agency, Land contamination: risk management, <https://www.gov.uk/guidance/land-contamination-how-to-manage-the-risks>

³ A Guide for Safe Working on Contaminated Sites (R132), Construction Industry Research and Information Association (CIRIA), 1996.

⁴ Roles and Responsibility in Site Investigations (SP73), Construction Industry Research and Information Association (CIRIA), 1991.

⁵ BS5930:2015 Code of Practice for Site Investigations including Amendment 2, British Standards Institution, 2015.

- BS10175:2011 + A2 2017: Code of Practice for Investigation of Potentially Contaminated Sites⁶;
- Groundwater protection technical guidance⁷, including the Environment Agency’s approach to groundwater protection⁸ (adopted by NRW);
- Underground storage tanks: groundwater protection code, February 2017⁹
- CIRIA 552: Contaminated Land Risk Assessment, A guide to good practice¹⁰;
- CIRIA 681: Unexploded ordnance (UXO) A guide for the construction industry¹¹;
- CIRIA 733: Asbestos in soil and made ground: a guide to understanding and managing risks¹²;
- CIRIA 765: Asbestos in soil and made ground: good practice site guide¹³;
- Definition of Waste: Development Industry Code of Practice¹⁴ sets out a framework for management of materials during construction. This is currently not obligatory for use in Wales, and therefore has not been referenced as a requirement that will be followed.
- Eurocode 7 (BS EN 1997-115 & EN 1997-216) and all relevant normatives;
- NRW Guidance for Pollution Prevention (these replace the withdrawn Pollution Prevention Guidance (PPG)) of relevance in relation to protection of soils and waters.

⁶ BS10175:2011+A2 2017 Code of Practice for Investigation of Potentially Contaminated Sites British Standards Institution, 2011.

⁷ Department for Environment and Rural Affairs, “Groundwater Protection,” 14 March 2017. [Online]. Available: <https://www.gov.uk/government/collections/groundwater-protection>. [Accessed May 2020].

⁸ Environment Agency, “The Environment Agency’s approach to groundwater protection,” February 2018. [Online]. Available: <https://www.gov.uk/government/publications/groundwater-protection-position-statements>. [Accessed May 2020].

⁹ Welsh Government, Groundwater protection codes for Wales, Underground storage tanks: groundwater protection code, February 2017

¹⁰ Contaminated Land Risk Assessment, A guide to good practice (C552), Construction Industry Research and Information Association (CIRIA), 2001

¹¹ Unexploded ordnance (UXO) A guide for the construction industry (C681), Construction Industry Research and Information Association (CIRIA), 2009

¹² Asbestos in soil and made ground: a guide to understanding and managing risks (C733), Construction Industry Research and Information Association (CIRIA), 2014

¹³ Asbestos in soil and made ground: good practice site guide (C765), Construction Industry Research and Information Association (CIRIA), 2017

¹⁴ Definition of Waste Development Industry Code of Practice. Version 2. In association with the Homes and Communities Agency, DEC UK and Hydrock. Contaminated Land: Applications in Real Environments (CL:AIRE), 2011.

¹⁵ BS EN 1997-1: 2004 and Amendment 1: 2013: Eurocode 7 Geotechnical Design. General Rules British Standards Institution, 2013.

¹⁶ BS EN 1997-2: 2007 UK National Annex to Eurocode 7 Geotechnical Design. Ground Investigation and Testing, British Standards Institution, 2007.

6.4 Scoping and consultation

Scoping

- 6.4.1 The scoping opinion responses relevant to this chapter have been received from Natural Resources Wales, Coal Authority and Powys County Council as summarised in Table 6-1.
- 6.4.2 The matters considered within the impact assessments relate to key issues identified at the scoping process such as land contamination associated with current and historical coal exploration activities and underlying geology. The assessments will incorporate a Preliminary Risk Assessment as requested by a scoping opinion response provided by NRW.
- 6.4.3 The aspects associated with ground hazards such as mining legacy would be considered as part of the engineering design, however the identification of the constraints such as mine entries or shafts will be included within the baseline conditions. This is to satisfy the scoping opinion response provided by the Coal Authority.

Table 6-1: Response to scoping opinion

Scoping opinion clause	Scoping Opinion	Response
NRW, Land contamination	Agree with the proposed methodology for establishing baseline conditions and advise that a Preliminary Risk Assessment (PRA) is undertaken. CLR11, Guiding Principles for Land Contamination (EA and adopted by NRW) and British Standards to be used for these assessments. If any piling is to be undertaken, the ES should include a piling risk assessment.	Preliminary risk assessments identifying plausible pollution linkages are presented in Sections 6.7, 6.9 and 6.10. Risk assessments will be updated as further ground conditions information is gathered as part of proposed ground investigations.
Coal Authority	Where mine entries are present on a site, they would expect the location of these to be established by intrusive investigations. They would expect that it is demonstrated that adequate separation between these features and their zone of influence and any structures is proposed. Building on top of these features or close proximity should be avoided.	The location of mine entries and other historical shallow mine workings have been reviewed as part of the desk study and will be further assessed through ground investigations. Appropriate mitigation will be put in to avoid or treat the risks posed by mine workings.
Powys County Council	The scope and level of detail of information included in the report would be considered sufficient for any environmental statement required for the proposed development.	Noted.

Consultation

- 6.4.4 No additional consultation was undertaken following receipt of scoping responses.

6.5 Methodology

Overview

- 6.5.1 The methodology for the ground conditions impact assessment includes a review of the existing baseline conditions to assess the potential impacts due to the construction and use of the area of the proposed development.

Methodology for establishing baseline conditions

- 6.5.2 The identification of baseline method included:
- Confirmation of information gathered from the relevant statutory bodies and the local planning authorities;
 - Review of current and historical plans;
 - Review of published geological maps and memoirs;
 - Review of published mineral resources plans and local development plans;
 - Review of Coal Authority data;
 - Site walkover survey; and
 - Discussions with current site owners Celtic Energy Ltd.
- 6.5.3 A desk study review of the above information has been completed to support the design of a testing track as part of the Global Centre of Railway Excellence proposal. This is presented in Appendix 6A of the ES. This desk study has also been submitted to support the consented Nant Helen Earthworks application. The desk study remains valid for the GCRE assessment as it covers the current baseline and discussed future baseline conditions.

Study Area

- 6.5.4 The study area that has been used for this assessment includes an area extending up to 250m away from the boundary of the proposed development area. This distance is considered to be appropriate in order to establish the current baseline for the ground conditions at the site, impact by historical mining activities and includes all those sites that have plausible pollutant linkages. Notwithstanding this, potential pollutant linkages have been considered on a case by case basis, for

example, if sources of contamination are identified outside the study area but there is potential for that contamination to migrate towards the proposed development area, for instance via groundwater then this has been included.

- 6.5.5 A study area of 1km has been used to identify sensitive controlled water receptors. This will cover, for example source protection zones or water abstraction points, that could be impacted by any potential contamination originating within the proposed development area.
- 6.5.6 The geology study area has been determined on the basis of the regional geology of the area, however it is considered that the proposed development would have an impact on geology only within the footprint of the development.

Assessment methodology

- 6.5.7 The assessment of risks associated with contaminated land will be based on the risk management framework provided in the Model Procedures for the Management of Land Contamination (CLR 11) to be replaced by new guidance 'Land contamination: risk management' during 2020. This will involve preparation of a Conceptual Site Model for the baseline conditions, which will form the basis for a Preliminary Risk Assessment followed by a Generic Quantitative Risk Assessment and, if required, a Detailed Quantitative Risk Assessment.
- 6.5.8 The impacts and effects on the geology/geomorphology and land contamination arising from construction of the proposed development will be assessed by review of baseline conditions in the context of the extent, method and programme of the proposed construction activities that will be required.
- 6.5.9 Assessment of the likely impact on the geology/geomorphology and land contamination arising from the operation of the proposed development will be undertaken by review of baseline conditions in the context of the final end use.
- 6.5.10 Potential interrelationships have been identified between the ES chapters concerned with water resources, nuisance (noise), air quality (dust) and climate change. The assessment of effects will take into account these interrelationships.

Significance Criteria

- 6.5.11 The significance of impacts will be assessed by attributing a value or sensitivity to each receptor impacted, in combination with the magnitude of impact that will occur to it. The sensitivity of each receptor will be assessed in line with Table 6.2 and the magnitude of impact in accordance with Table 6.3.

6.5.12 The significance of impact will be then assessed by considering the sensitivity of the receptor in combination with the magnitude of impact in accordance with Table 6.4.

Table 6.2: Criteria and EIA Definitions of Sensitivity or Value

Value (sensitivity)	Typical Descriptors
Very high	<p>Geology: Very rare and of very high national and regional geological/geomorphological importance with no potential for replacement (e.g. designated sites of national importance).</p> <p>Groundwater: Groundwater with a high quality and rarity on a regional or national scale with limited potential for substitution (e.g. principal aquifer/(high productivity) providing potable water to a large population).</p> <p>Surface water: European Community (EC) Designated Salmonid/Cyprinid fishery Water Framework Directive (WFD) Class 'High' Site protected/designated under EC or UK wildlife legislation (SAC, SPA, WPZ, Ramsar Site, salmonid water)/species protected by EC legislation.</p> <p>Land Contamination: Human health (High sensitivity land use scenario e.g. residential with gardens and allotments).</p>
High	<p>Geology: Of medium national and high regional geological/ geomorphological importance with limited potential for replacement (e.g. GCR sites, regionally important site).</p> <p>Groundwater: Groundwater with a high quality and rarity on a local scale with limited potential for substitution, or attribute with a medium quality or rarity on a regional or national scale with limited potential for substitution (e.g. principal aquifer/(high productivity) providing potable water to a small population and/or large resource potential).</p> <p>Surface water: WFD Class 'Good' Major Cyprinid Fishery Species protected under EU or UK habitat legislation</p> <p>Land Contamination: Human health (Lower sensitivity land use scenario e.g. mixed use (residential without gardens), public open space)</p>
Medium	<p>Geology: Of low regional and high local geological/ geomorphological importance with some potential for replacement (e.g. allocated RIGS or recommended RIGS).</p> <p>Groundwater: Groundwater with a medium quality and rarity on a local scale with limited potential for substitution, or attribute with a low quality and rarity on a regional or national scale with limited potential for substitution (e.g. secondary aquifer unit supporting abstraction for agricultural or industrial use and/or moderate resource potential).</p> <p>Surface Water: WFD Class 'Moderate'</p> <p>Contamination:</p>

Value (sensitivity)	Typical Descriptors
	Receptor which is of regional importance. Human health (Low sensitivity land use scenario e.g. commercial, industrial)
Low (or Lower)	<p>Geology: Of local geological/geomorphological importance with potential for replacement (e.g. non-designated exposure).</p> <p>Groundwater: Groundwater with a low quality and rarity on a local scale with limited potential for substitution (e.g. non-aquifer unit that does not afford protection to underlying water bearing units).</p> <p>Surface Water: WFD Class 'Poor'</p> <p>Land Contamination: Human health (Lower sensitivity land use scenario e.g. construction site). Receptor which is of local importance.</p>
Negligible	<p>Geology: Of little local geological/geomorphological interest.</p> <p>Land Contamination: Receptor with low importance and rarity.</p>

Table 6.3: Criteria and EIA Definitions of Impact Magnitude

Magnitude of Impact	Typical Criteria Descriptors
Major	<p>Geology: The proposals are very damaging to the geological environment/soils resource of the area. May result in loss or damage to areas designated as being of regional or national geological interest. Loss of resource and/or quality and integrity of resource. Severe damage to key characteristics, features or elements. Impacts cannot be mitigated for (e.g. destruction of a designated site (RIGS)). (Adverse)</p> <p>Controlled Waters (aquifers/surface water): Reduction of water quality rendering groundwater or surface water unfit to drink and/or substantial adverse impact on groundwater dependent environmental receptors. Discharge of hazardous substances to groundwater. (Adverse)</p> <p>Land Contamination: Major effect upon receptor. Severe or irreversible effect on human health. Temporary severe or irreversible effect on ground/surface water quality. (Adverse).</p>
	Large scale or major improvement of resource quality; extensive restoration or enhancement; major improvement of attribute quality (Beneficial).
Moderate	<p>Geology: The proposals may adversely affect the geological/hydrogeological conditions/soils resource existing at the site but will not result in the loss of, or damage to, areas designated as being of regional or national geological interest. Loss of resource, but not adversely affecting the integrity. Partial loss of/damage to key characteristics, features or elements. Some mitigation may be possible but will not prevent scarring of the geological environment, as some features of interest will be lost or partly destroyed. (Adverse)</p>

Magnitude of Impact	Typical Criteria Descriptors
	<p>Controlled Waters (aquifers/surface water): Reduced reliability of a supply at a groundwater or surface water abstraction source. Discharge of non-hazardous substances to groundwater and surface water resulting in pollution (i.e. contaminants present above the EQS) (Adverse)</p> <p>Land Contamination: Moderate effect upon receptor. Long term or short term moderate effect on human health. Moderate effect on ground/surface water quality, reversible with time. (Adverse)</p> <p>Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality (Beneficial).</p>
Minor	<p>Geology: The proposals will not affect areas with regional or national geological interest/soils resource but may result in the loss of, or damage to, areas of local geological/soils resource interest. Cannot be completely mitigated for but opportunities exist for the replacement of lost or damaged areas which may be of similar local geological/soils interest. (Adverse)</p> <p>Controlled Waters (aquifers/surface water): Marginal reduced reliability of a supply at a groundwater or surface water abstraction source. Discharge of non-hazardous substances to groundwater and surface water not resulting in pollution (i.e. contaminants present below the EQS) (Adverse)</p> <p>Land Contamination: Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc.). Slight effect on ground/surface water quality, reversible with time. (Adverse)</p> <p>Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring (Beneficial).</p>
Negligible	<p>Geology: The proposals will result in very minor loss or damage to local area of geological interest/soils resource such that mitigation is not considered practical. Very minor loss or detrimental alteration to one or more characteristics, features or elements. (Adverse)</p> <p>Controlled Waters (aquifers/surface water): Non-measurable change to quality, level and flow. (Adverse)</p> <p>Land Contamination: Results in no discernible change or an impact on attribute of sufficient magnitude to affect the use/integrity. (Adverse) E.g. Soil contaminants present, but risk assessment suggests negligible/ low risk to human health. (Adverse)</p> <p>Very minor benefit to or positive addition of one or more characteristics, features or elements (Beneficial).</p>
No change	No loss or alteration of characteristics, features or elements; no observable impact in either direction.

6.5.13 The criteria for assessing the significance of the impact takes account of the following factors:

- The value of the resource (international, national, regional and local level importance);

- The magnitude of the impact;
- The duration involved;
- The reversibility of the effect; and
- The number and sensitivity of receptors.

6.5.14 The level of significance that merits further consideration / mitigation are taken as those where the significance of the effect is 'moderate' negative or greater.

Table 6.4: Approach to Evaluating Significance of Effect

		Magnitude of Impact				
		No Change	Negligible	Minor	Moderate	Major
Value/ Sensitivity	Very high	Neutral	Slight	Moderate or large	Large or Very large	Very large
	High	Neutral	Slight	Slight or moderate	Moderate or Large	Large or Very large
	Medium	Neutral	Neutral or slight	Slight	Moderate	Moderate or Large
	Low	Neutral	Neutral or slight	Neutral or slight	Slight	Slight or Moderate
	Negligible	Neutral	Neutral	Neutral	Neutral or slight	Neutral or slight

6.6 Limitations and assumptions

Limitations

6.6.1 Limited intrusive ground investigations have been undertaken within the proposed development area. No chemical testing on soils has been undertaken.

6.6.2 Sufficient published information is however available to create a preliminary ground model and identify the required mitigation measures. This is considered sufficient at the initial design stage and to inform the environmental impact assessments. Ground investigations will be required to support the detailed geotechnical design and to refine mitigation measures for the proposed development.

Assumptions

6.6.3 It is assumed that during construction, or any intrusive maintenance works, good health and safety management and pollution control will be undertaken in accordance with current legislation, and as set out in the outline CEMP presented in Appendix 3A. It is assumed that

measures would include groundwater management during excavations and measures aiming at reduction of dust generation.

- 6.6.4 It is assumed that chemical testing of made ground, and ponds/lagoons sediments and water will be undertaken to inform the identification of adequate health and safety mitigation measures. Alternatively, health and safety risk assessments will consider reasonable worst-case scenarios.
- 6.6.5 It is assumed that only materials confirmed suitable for use within the proposed development will be imported and used within the construction of the proposed development.
- 6.6.6 It is assumed that materials constituting on-going sources of contamination, if encountered, will be removed/remediated as part of the development construction in line with current legislation.
- 6.6.7 It is assumed that any discharge into the ground or controlled water environment during construction will be undertaken in line with regulatory requirements and any relevant consents and permits and will not pose a risk to controlled water quality. Treatment and monitoring prior and during discharge would be undertaken, if required.
- 6.6.8 It is assumed that geotechnical and foundations design of the structures would be undertaken in accordance with appropriate engineering codes and would be informed by results of intrusive investigations.
- 6.6.9 It is assumed that appropriate ground gas protection measures identified through ground gas risk assessments that will be completed based on intrusive ground investigations as part of the design. The protection measures will be designed in accordance with BS8485:2015 or equivalent.
- 6.6.10 It is assumed that where piled foundations are proposed, a foundations works risk assessment would be undertaken in accordance with the published guidance (namely Environment Agency, Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention, National Groundwater & Contaminated Land Centre report NC/99/73, Atkins 2001). This will ensure that the selected piling technique does not pose unacceptable risk to controlled waters and human health.
- 6.6.11 Professional judgement has been applied where necessary in assignment of sensitivity and magnitude of effects in line with definitions provided in Table 6.1 and Table 6.2.
- 6.6.12 Notwithstanding the limitations and assumptions, sufficient information has been available for the completion of the assessment of ground conditions.

6.7 Baseline Environment

- 6.7.1 This section of the chapter presents the baseline conditions with respect to geological setting and resources within the site. It also describes the conceptual site model in relation to potential sources, pathways and receptors of contamination and their linkages.
- 6.7.2 The centre of the site is located at approximate National Grid Reference SN 821 112, approximately 1.5km north west of the village of Onllwyn, South Wales. It is located on top of a hill, known as ‘Mynydd y Drum’ with the valleys of the Dulais and the Tawe Rivers to the south and north of the proposed development area respectively.
- 6.7.3 The site boundary is shown on Figure 1.1. For ease of identification, the proposed development has been split into the “main” and the “washery” portions. The “main” portion refers to the central body of the site which contains the proposed rail test tracks whereas, the “washery” portion refers to the extension of the site to the southeast incorporating the Onllwyn Washery.
- 6.7.4 Earthworks associated with the construction of the embankment and cuttings are to be completed as part of a separate consent – Nant Helen Complementary Restoration Earthworks- and will form baseline to these assessments.

Topography

- 6.7.5 The boundary of the site sits at approximately 250m AOD with the land generally rising inwards towards the centre of the site. The main portion of the site sits at around 295m AOD. The “washery” portion of the site sits lower than the main portion of the site at roughly 230mAOD. Site topography is shown on Figure 6.1.
- 6.7.6 The site has been extensively worked through opencast coal mining operations since c.1946 with opencast activities still ongoing within the Nant Helen Extension site. As a result of these activities, the topography of the site has been constantly altered over the last century. Currently a large ‘overburden storage area’ is located within the south east of the site, formed with excess material that has been excavated during opencast mining activity. The current maximum height of the spoil material within the storage area is approximately 80m above the natural ground surface with the top of the overburden storage area sitting at approximately 335m AOD. This point represents the highest location within the site.
- 6.7.7 The base of the active Nant Helen Extension opencast site is typically 150m lower than the site surface level with the base of the excavation currently sitting at approximately 90m AOD. The lowest projected level of excavation within the Nant Helen Extension site is anticipated to reach ~76mAOD. This point is not located within the site however,

the batter slopes of the excavation are located within the western extremity of the opencast excavation.

- 6.7.8** A series of access tracks are present across the site. These access tracks provide access to the site and connect the current open cast workings in the west with the Onllwyn Washery located in the east of the site. The washery site is accessed from the A4221 via a separate entrance, and comprises several buildings, conveyer belts and material sorting facilities.
- 6.7.9** The opencast mining activity within the Nant Helen Extension will cease operation in 2021 and restoration activities will infill to approved contours and landscape the existing workings. This will be undertaken as part of the Nant Helen Complementary Restoration Earthworks consent. As part of the restoration works, embankments and cuttings accommodating the proposed tracks will also be constructed.

Published Geology

- 6.7.10** The geology beneath the site has been interpreted through a review of published geological sources. These sources include the BGS 1:10,560 geological mapping¹⁷, the BGS 1:50,000 geological mapping¹⁸ and the BGS GeoIndex online viewer¹⁹. The mapped solid geology and superficial geology are shown on Figures 6.2 and 6.3 respectively.
- 6.7.11** In addition to the geological mapping sources reviewed, two editions of the geological memoirs for 1:50,000 Sheet 231 have been reviewed to provide additional detail on the geology beneath the site; the first is memoir was published in 1904²⁰ and the second in 1988²¹.
- 6.7.12** **Made Ground**
- 6.7.13** Made ground deposits are anticipated to be encountered beneath the majority of the proposed track route and within the washery portion of the site. A large region of artificial ground is shown to be present in the north of the main site. Based on review of documents provided by Celtic Energy, this is anticipated to be made ground associated with the backfilling of the Abercrave/Gwaunton opencast coal mine (refer to the Coal Mining section below and Figure 6.5).

¹⁷ British Geological Survey (BGS), Geological Survey of Great Britain (England and Wales), 1:10,560 scale geological map, SN 81 SW, 1979

¹⁸ British Geological Survey (BGS), Geological Survey of Great Britain (England and Wales), 1:50,000 series, Merthyr Tydfil, Sheet 231, Solid edition (online), <http://www.largeimages.bgs.ac.uk/iip/mapsportal.html?id=1001724>, Date accessed 20/11/2019

¹⁹ British Geological Survey (BGS), Geoindex online viewer (online), <http://mapapps2.bgs.ac.uk/geoindex/home.html>, Date accessed May 2020

²⁰ British Geological Survey (BGS), The geology of the South Wales Coalfield: being an account of the region comprised in sheet 231 of the map, Strahan. A. et al., 1904

²¹ British Geological Survey (BGS), Geology of the South Wales Coalfield, Part V, the country around Merthyr Tydfil, Sheet Memoir 231, Barclay. W.J. et al., 1988

- 6.7.14 Although not shown on published geological mapping sources, based on the known extent of other phases of opencast mining located within the site boundary, other areas backfilled with made ground are anticipated to be present beneath much of the proposed development area, refer to Figure 6.5. Based on review of site walkover photos, this material is anticipated to be the non-coal bearing arisings excavated during the opencast mining activity. This material is likely to comprise a mixture of weathered fragmented rock (mudstones, siltstones and sandstones) and superficial deposits.
- 6.7.15 The depth of the made ground fill material is likely to vary between opencast areas and is likely to correspond somewhat to the ultimate depth of excavation that pertains to each individual site.
- 6.7.16 Based on the descriptions provided in the logs reviewed, the made ground material anticipated to be encountered beneath the washery site is likely to comprise a mixture of varied granular backfill material within a cohesive clay matrix. The various gravel inclusions within the made ground were noted to be mudstone, sandstone, coal, clinker and wood. The thickness of this material is anticipated to range between 0.25m and 7m, although locally thicker deposits could be encountered in the locations of any stockpiles/spoil heaps within the washery site.
- 6.7.17 **Drift (Superficial Deposits)**
- 6.7.18 Geological mapping sources show that the majority of the site is void of superficial material. Localised areas of till are shown to be present in the west and south of the site. Deposits of Devensian Till and peat are also shown to be present beneath a small section of the washery portion of the site. Glacial Till typically comprises a heterogenous mixture of clay, sand and gravel with large cobble and boulder inclusions of various size and shape. The 1904 geological memoir for sheet 231 describes the glacial till deposits within the Dulais valley as “...*Old Red (sandstone) in a stiff bluish matrix (clay)*”.
- 6.7.19 In addition to the localised pockets of Glacial Till, a minimal deposit of peat is shown to be present within the centre of the site on the published geological mapping sources. Peat typically comprises a partially decomposed mass of vegetation that has grown under anaerobic conditions, usually found in bogs or swamps.
- 6.7.20 It should be noted that given the known extent of opencast workings, much of the Glacial Till shown to be present in the western portion of the site has likely been removed during the excavation of the opencast void. The same can be said for the localised extent of peat shown to be present within the central portion of the site; this deposit directly coincides with a portion of the Nant Helen (1999) opencast site, shown on Figure 6.5 and the large overburden storage area, shown on Figure 6.1. Although the geotechnical properties of peat are unfavourable, there is a possibility that these may have remained in place beneath the stockpiles.

- 6.7.21 The geological map shows glacial till deposits to be present in the eastern end of the washery portion of the site. Peat deposits are shown to encroach into the north of the washery site, but it is considered likely that these materials would have been removed from beneath developed areas.
- 6.7.22 **Solid (Bedrock)**
- 6.7.23 The western half of the site is underlain by solid geology denoted as South Wales Middle Coal Measures Formation and the eastern half of the site is shown to be underlain by South Wales Lower Coal Measures Formation. Refer to Figure 6.2.
- 6.7.24 The South Wales Coal Measures generally comprise rhythmic sequences of mudstones (commonly containing pyrite), siltstones, sandstones, grits, fireclays and coal. The coals found in these measures tend to be the thickest and most economically significant in South Wales. Nodular masses of pyrite, up to 0.15m thick, are often present within the Middle and Lower Coal Measures formations.
- 6.7.25 From review of dip angles presented on the 1:10,560 geological mapping, the solid geology is anticipated to dip in a west south-west direction and angles ranging between 5° and 15°. Various localised syncline and anticline features are shown to be present beneath the site and as a result dip angles vary accordingly in these locations.
- 6.7.26 **Linear Features**
- 6.7.27 Five faults, three of which are named, are shown to cross through or close to the site along a NNW to SSE alignment, as presented on Figure 6.3. The easternmost fault, the Glyncorrwg Fault, is shown to pass through the washery portion of the site. The geological memoir from 1904 suggests that the fault has a downthrow of “forty yards” (~36.6m) to the west.
- 6.7.28 Moving westwards, there is an unnamed fault (potentially associated with the Glyncorrwg Fault), which crosses into the eastern half of the site and also downthrows to the west. The Chapel Fault is situated beneath the eastern half of the site and is recorded to downthrow by “sixteen yards” (~14.6m) to the east.
- 6.7.29 The Pwllau Bach Fault is located centrally and is roughly orientated along a NNW to SSE alignment. The downthrow of the Pwllau Bach Fault is considerable and is suggested to be “eighty yards” (~73.2m) to the west within the 1904 geological memoir.
- 6.7.30 The Glyncorrwg, Chapel and Pwllau Bach Faults form part of a horst and graben formation which is shown to be located beneath the eastern half of the site. The final fault, which is shown to cross into the north-western corner of the site, is unnamed. The fault is shown to downthrow to the east.

6.7.31 In addition to the extensive faulting, which is shown to be present beneath the site, numerous coal seams are shown to outcrop within the boundary of the site. Refer to Figure 6.3. A review of the coal resource shown to be present beneath the site and the associated mining activities, both surface and sub-surface, is detailed within a latter section of this chapter (refer to the Coal Mining section below for details).

Geological Designated Sites

6.7.32 There are no statutory designated areas specifically of geological interest present within the proposed site boundary. However, as identified from review of Lle Welsh Government Sites of Special Scientific Interest (SSSI) data sets²², the Nant Llech SSSI is located approximately 110m to the north of the site as shown on Figure 6.4.

6.7.33 The Nant Llech SSSI covers a mountain stream that flows through a steep-sided valley of which is of special interest on account of its rich variety of woodland species, cliff plant communities and Westphalian rock exposure. The site has been deemed critical for understanding the stratigraphy of the South Wales Coalfield due to the exposed sequence of over 120m of rock strata.

6.7.34 As highlighted on the Joint Nature Conservation Committee (JNCC) website²³, the Nant Llech has also been identified as a ‘Geological Conservation Review’ (GCR) site. GCR sites are sites that have been identified to be of national and international importance and show key scientific elements of the earth heritage of Britain.

6.7.35 There are no ‘Regionally Important Geological and Geomorphological Sites’ (RIGS) within a 1km radius of the site.

Geomorphology

6.7.36 Three Geological Landscape Areas are present within the study area, as shown on Figure 6.4. These have been identified through review of Natural Resources Wales LANDMAP²⁴. The three Geological Landscape Areas include:

- Ystradgynlais – Upland valley slope (Outstanding)
- Seven Sisters – Upland plateau (Moderate)

²² Welsh Government, Natural Resources Wales (NRW), Lle – A Geo-Portal for Wales, Sites of Special Scientific Interest (SSSi), <http://lle.gov.wales/catalogue/item/ProtectedSitesSitesOfSpecialScientificInterest/?lang=en> , Date accessed 20/11/2019

²³ Joint Nature Conservation Committee (JNCC), UK, UK Geoconservation, Geological Conservation Review, GCR Database, Nant Llech (Westphalian) (online), <http://archive.jncc.gov.uk/default.aspx?page=4174&gcr=1417> , Date accessed 20/11/2019

²⁴ Natural Resources Wales (NRW), Interactive Maps, LANDMAP (online), <https://landmap-maps.naturalresources.wales/> , Date accessed 20/11/2019

- Banwen – Mountain and Upland Valley (High)

- 6.7.37 The Ysradgynllias area has been evaluated to be of ‘Outstanding’ value on account of the Upper Carboniferous stratigraphy within the Nant Llech SSSI being located within the area covered. Principal management recommendations state that the upper carboniferous measure exposures must be conserved.
- 6.7.38 The Seven Sisters area has been evaluated to be of ‘Moderate’ value on account of the glacial drift deposits which cover extensively worked productive coal measures. The moderate valuation concerns the areas research value, historical value and rarity/uniqueness.
- 6.7.39 The Banwen area has been evaluated to be of ‘High’ value on account of the glacial drift deposits which extensively cover the coal measures. The high valuation is based on both the research value and the educational value of the area.

Ground Conditions

- 6.7.40 The anticipated ground conditions beneath the site have been interpreted through review of published geological information and borehole and trial pit logs from previously undertaken ground investigations. The majority of these logs do not pertain to exploratory holes carried out within the site. A total of 8No. boreholes were undertaken within the main body of the site prior to the construction of the large overburden storage area. The logs for these boreholes do not provide detailed material descriptions but provide indicative stratigraphy, highlighting the likely thicknesses of material anticipated to be encountered beneath the site.
- 6.7.41 The likely material composition has been assumed through review of more detailed logs pertaining to boreholes progressed within the Onllwyn washery site and through interpretation of published geological sources.
- 6.7.42 The locations of the boreholes which have been reviewed are shown on Figure 6.2. The logs have been sourced from information provided by Celtic Energy and are presented within Appendix 6A.
- 6.7.43 Natural superficial deposits of peat and glacial till were encountered beneath the southern portion of the site. Peat deposits up to 1.6m thick were encountered. The glacial till material encountered had a thickness range between 1.0m and 3.1m.
- 6.7.44 The depth to rockhead varies greatly depending on location. The borehole logs reviewed noted between 1.8m and 3.6m of superficial material before encountering the head of bedrock. However, the depth to bedrock in the locations that have been previously opencast and subsequently backfilled is likely to be far greater and is likely to depend on the depth of opencast mining activity pertaining to each site. Refer to section on Coal Mining below.

- 6.7.45 Firm to stiff grey/brown clay with various mudstone, siltstone and sandstone gravel inclusions was encountered beneath the made ground deposits within the washery portion of the site. Based on the description and the published geological mapping, these materials are anticipated to be glacial till. Where encountered, the glacial till material beneath the washery portion of the site ranged between 0.2m and 2.4m thick. In some locations within the washery portion of the site, no natural superficial materials were encountered; in these locations the made ground material was encountered directly overlying the weathered bedrock.
- 6.7.46 Detailed descriptions from boreholes progressed within an adjoining site suggests that the mudstones and siltstones are slightly to moderately weathered and are moderately weak to strong. The materials are generally grey to dark grey in colour and occasionally micaceous. Where encountered close to surface, the bedrock was recovered as highly weathered fragments of mudstone and sandstone within a clay matrix.

Site History

- 6.7.47 Historical Ordnance Survey (OS) mapping sets (1876 - 2019)²⁵, acquired from Groundsure, and historical aerial photography (1945 – 2019), acquired from the Welsh Government, have been reviewed to identify particularly relevant features and constraints that pertain to the study area. The source material reviewed is presented within Appendix 6A.
- 6.7.48 In general, the site has been subject to extensive surface and sub-surface coal mining activities over the past century and therefore, the majority of features identified are related to coal mining. Refer to Figure 6.5 for locations.
- 6.7.49 Several historical collieries have been identified along the northern and southern boundaries of the site. The majority of the collieries were located on the lower slopes of Mynydd Drum and extracted coal via numerous drift and shaft mines. The Abercrave and Gwaunclawdd Collieries were present on the earliest historical mapping from 1876/77 and the last evidence of the collieries disappeared following the absence of the Onllwyn Colliery on the mapping from 1977.
- 6.7.50 The first evidence of opencast workings was identified on the 1951 aerial photography which appears to show the partial backfilled workings believed to be associated with the first Onllwyn opencast site. This site is believed to have been licenced between 1946 and 1949. The subsequent aerial photographs show evidence of the second Onllwyn, the Abercrave/Gwaunton, the Nant Helen and the Nant Helen Extension opencast sites.

²⁵ Groundsure, Historical Mapping set, Report ref.: GS-6396071, 14/10/2019

- 6.7.51** Various rail tracks and tramways are shown to have crossed through and run along the boundaries of the site. The earliest of which was marked as an ‘Old Tramway’ on the historical mapping from 1876/77; The ‘Old Tramway’ has been identified to refer to a section of the Brecon Forest Tramroad that passed through the site known as “Claypon’s Extension”²⁶ and is a scheduled ancient monument. The tramroad was constructed circa 1827 and fell into disuse at some point prior to 1876. The location is shown on Figure 6.6.
- 6.7.52** The Neath and Brecon Railway line was shown to pass along a northeast to southwest alignment to the south of the southern site boundary, as show on Figure 6.6. A spur from the Neath and Brecon Railway, the Neath and Brecon Railway Junction Line, ran along the northern boundary of the site. Both lines were shown on the earliest historical mapping set from 1876; the Junction Line is shown up until the 1975 where it is no longer shown on aerial photographs. Whereas, a portion of the main line remains to the current day and links the Onllwyn Washery site to Neath.
- 6.7.53** The Onllwyn Washery (the washery portion of the proposed development) remained largely undeveloped until 1945 when the washery infrastructure and railway sidings were introduced in addition to an existing tramway link between the Onllwyn Colliery to the Neath and Brecon Railway line. The washery grew in size over the 1960s and 1970s, with numerous pond features shown on the 1977 aerial photography. The 2019 aerial photography shows the ‘washery’ portion of the site to contain a varied array of coal processing infrastructure with a limited network of rail lines running along an east to west alignment towards the north of the site.

Coal Mining

- 6.7.54** **Coal outcrops**
- 6.7.55** As identified in the Published Geology section above, the site is primarily underlain by South Wales Middle Coal Measures Formation and South Wales Lower Coal Measures Formation. These formations contain numerous coal seams of varying thickness and have been heavily mined, both sub-surface and opencast, in the past and present.
- 6.7.56** The site is roughly split in half by the Pwllau Bach Fault (PBF) along a north to south centrally located axis. Outcropping coal seams are shown to the west of the PBF on the published geological mapping sources. The outcrop of the seams to the west of the PBF within the Middle Coal Measures (‘Soap’ through to ‘Brass’) are shown on Figure 6.3.

²⁶ Fforest Fawr Geopark, Understanding, Archaeology and industrial heritage, Transport by road, rail and water, The Brecon Forest Tramroad (online), <https://www.fforestfawrgeopark.org.uk/understanding/archaeology-and-industrial-heritage/transport-by-road-rail-and-water/the-brecon-forest-tramroad/>, Date accessed 21/11/2019

- 6.7.57 To the east of the PBF, the partially observed and inferred outcropping pattern of the ‘Nine Feet’ and ‘Brass’ seams are shown to initially follow a north to south alignment the fault and then in the south along the side of the Dulais River valley.
- 6.7.58 To the east of the Chapel Fault the “Nine Feet” and “Brass” seam outcrops are once again shown to be present within the site boundary. The alignments of both are shown as observed and are believed to have been mapped during the opencast mining activity located in the eastern half of the main portion of the site.
- 6.7.59 The outcrops of the “Upper Bluers”, “Middle”, “Lower” and “Bryn” seams are shown in the north-eastern corner of the site. An anticlinal axis is shown to manipulate the alignment of the “Upper Bluers” seam at outcrop. All of these seams are located within the South Wales Lower Coal Measures Formation.
- 6.7.60 To the east of the Glyncorrwg Fault the inferred outcrops of the “Upper Bluers”, “Grey” and “New” coal seams are shown to be present beneath the washery portion of the site. These inferred outcrops are shown to be situated along an approximate southeast to northwest alignment.
- 6.7.61 **Mine Entries**
- 6.7.62 Based on review of the Coal Authority online viewer²⁷ a total of 64No. mine entries have been identified to be present within the “main” site and 31No are shown to be present within the “washery” portion of the site. The approximate locations of the majority of these entries, determined through review of Celtic Energy opencast completion plans, have been marked on Figure 6.5. However, the entry locations within the washery site were not shown on the source material provided by Celtic Energy.
- 6.7.63 Many of these mine entries, especially those located within the north-eastern corner of the site and to the south of the site, have been identified to have shallow depths (~4m) and are located within close proximity of each other along coal outcrops. Aerial photographs from 1944 show surface depressions roughly along the location of coal outcrops in the south east of the site. These are indicative of ‘bell pitting’ coal extraction methods.
- 6.7.64 The mine entries within the washery portion of the site include eight recorded shafts and twenty-three recorded adits. No depths were provided for the shafts identified on the Coal Authority viewer.
- 6.7.65 **Underground mine workings**

²⁷ The Coal Authority, Interactive viewer, Coal mining data (online), <https://mapapps2.bgs.ac.uk/coalauthority/home.html> , Date accessed 20/11/2019

- 6.7.66 A total of eight collieries have been identified to have worked the seams beneath study area through various drift and seam entries.
- 6.7.67 The Abercrave, International and Gwaunclawdd collieries were located along the lower northern slopes of Mynydd Drum and through review of the Welsh Coal Mines website²⁸ worked various seams within the Middle and Lower Coal Measures including the “Four Feet”, “Nine Feet” and “Brass” seams within the Middle Coal Measures; these seams are anticipated to contain the shallowest underground workings in this region.
- 6.7.68 The Onllwyn, Dulais and Seven Sisters collieries were located within the Dulais valley to the south of Mynydd Drum and are believed to have worked the “Nine Feet” and “Brass” seams. These seams have been identified to contain workings, believed to be related to the three collieries, within 20m of rockhead beneath the southern half of the site (refer to Figure 6.5).
- 6.7.69 The Glynllech Colliery (also described as the Cwm Tawe Colliery) was shown to be located within the site on the historical mapping between 1914 and 1948. A collection of mine entries, identified through review of Celtic Energy’s opencast completion plans, have been identified to be present in the approximate location of the Glynllech Colliery. Based on the outcrops shown in this portion of the site, the Glynllech Colliery is anticipated to have worked the “Bluers”, “Middle” and potentially “Lower” seams within the Lower Coal Measures Formation.
- 6.7.70 The Hendre Ladis Colliery (later absorbed by the Ynyscedwyn Colliery) was located approximately 1km to the west of the site boundary. Both these collieries are anticipated to have worked the “Nine Feet” and “Brass” seams. However, given the extent of opencast working undertaken in this region in the 21st century, much of these workings are likely to have been worked out where previously located beneath the site.
- 6.7.71 **Opencast mine working**
- 6.7.72 The site has been subject to extensive opencast coal mining activity from as early as 1946. A total of six opencast sites have been identified to be present within the site. The depth of opencast working appears to have increased from the earliest Onllwyn site (1946-49) which reached a maximum depth of ~15m to the ~150m excavations present within the current day Nant Helen Extension opencast site.
- 6.7.73 The depths of excavation provide indicative figures for the depth of fill material which is now present within the opencast sites that have been backfilled post completion of opencast activity. The backfill

²⁸ Welsh Coal Mines, Collieries, Brecon (online), <http://welshcoalmines.co.uk/Photo.htm> , Date accessed 20/11/2019

material is likely to comprise the non-coal bearing site won rock arisings which have been excavated during opencast working.

Hydrology

- 6.7.74 The site overlaps with three principal river catchments: the Tawe catchment, the Dulais catchment and the Pyrddin catchment. Refer to the Water Environment Chapter 5 for details.
- 6.7.75 The northern half the site sits within the Tawe catchment and contains several small unnamed streams which drain in a northerly direction towards the River Tawe. The River Tawe is the largest watercourse within the vicinity of the site and flows roughly from east to west approximately 500m to the north of the site boundary.
- 6.7.76 The Nant Llech, located to the north east of the site, a tributary of the River Tawe, flows from east to northwest where it feeds into the Tawe and passes within 300m of the north-eastern site boundary. A collection of small unnamed stream features to the northeast of the main portion of the site are shown to drain in a north-easterly direction towards the Nant Llech.
- 6.7.77 The southern half of the site sits within the Dulais catchment. The River Dulais flows roughly from east northeast to west southwest and runs through the washery portion of the site and along a portion of the south-eastern boundary of the main site. The Dulais is fed by several tributaries most of which are unnamed. One of the tributaries, the Nant Ystalwyn, originates in the southwestern corner of the site and flows in a south-westerly direction towards its convergence with the Dulais. A collection of other unnamed tributary streams, which originate within the southern and central portions of the site, flow in a southerly direction to their respective convergences with the River Dulais.
- 6.7.78 The Nant Ystalwyn, another tributary of the Dulais, is shown to be fed by a selection of ponds which are located at the base of the large overburden storage area which is centrally located within the body of the main site. These ponds have been identified as water treatment areas and are fed by the drainage features present on the southern face of the large overburden storage area.
- 6.7.79 A small portion of the eastern half of the main portion of the site is shown to sit within the Pyrddin catchment. However, the drainage features within this portion of the site are anticipated to contribute to flows within the Dulais and not the Pyrddin. The drainage features identified appear to be man-made and initially flow in an easterly direction. The alignment of these features then turns to flow south-westwards and feed into a collection of ponds located within the washery portion of the site. These ponds are located at the apparent source of the Dulais and based on the contours of the area are likely to feed into the Dulais.

- 6.7.80 One unnamed stream is shown to be located to the south of the washery portion of the site. From review of information presented within the Groundsure EnvoInsight report, this stream flows in an easterly direction before being culverted beneath the A4109 that borders the washery site to the south. The stream is then shown to re-emerge within the washery site before passing through another culvert beneath a section of the washery site. The stream eventually converges with the Camnant which in turn is a tributary of the Pyrddin.
- 6.7.81 In addition to the numerous watercourses, several small pond/lake features are shown to be located within the boundary of the site. A number of these are 'water treatment ponds' and appear to treat the water from various man-made drainage features which are currently present within the site. A collection of other ponds, which are present in the central southern portion of the site appear to represent an attempt to create marsh/bog type habitat as part of past restoration activity of the original Nant Helen opencast site.

Hydrogeology

- 6.7.82 The information presented below has been based on review of the BGS 1:125,000 Hydrogeological Map of South Wales²⁹.
- 6.7.83 Glacial till, which is likely to be present locally beneath the site where mining activities have not taken place, is typically described as a variable deposit of boulder clay and morainic drift. The principal lithology is unsorted stones of gravel, cobble and boulder within a silty clay matrix (also known as diamicton). However, in places lenses of stratified sand and gravel are present. These predominantly granular lenses can act as aquifers however the predominant hydrogeological importance of glacial till material is in limiting recharge to underlying formations and confining water within. Rainwater tends to drain through surface run-off that form collects and issues that feed streams. These are present to the south and north of the proposed development, as detailed in sections above.
- 6.7.84 The Middle and Lower Coal Measures that are present beneath the site tend to have lower porosities than the overlying Upper Measures with the highest values of porosity occurring in areas of intensive folding and faulting. The groundwater that is contained within the Middle and Lower Measures tends to contribute towards baseflow of rivers and usually emerges as springs at the bases of the subordinate sandstones.
- 6.7.85 Two springs have been identified within the study area. One spring is located approximately 430m to the north (at approximately 135mOD) and the second one, approximately 420m to the south-west (at approximately 250mOD). The first spring is likely to emerge from the

²⁹ British Geological Survey (BGS), Hydrogeological Map of South Wales, 1:125,000 scale (online), <http://www.largeimages.bgs.ac.uk/iip/hydromaps.html?id=south-wales.jp2> , Date accessed 20/11/2019

sandstone or marine band outcropping in that area. Considering the dip of the rock of approximately 5 degrees to the south-south-east, these bands are likely to be under a considerably depth beneath the proposed development area. The second spring is likely to emerge from an outcrop of a band of sandstone present at a relatively shallow depth within the proposed development.

6.7.86 **Aquifer Designations**

6.7.87 The aquifer designations have been determined through review of the Groundsure EnviroInsight³⁰ report purchased for the site.

6.7.88 The glacial till deposits shown to be present in the southern and western portion of the site are designated as ‘Secondary Aquifer Undifferentiated’. A ‘Secondary Aquifer’ designation is attributed to a stratum where it has not been possible to differentiate between a ‘Secondary (A)’ or ‘Secondary (B)’ designation.

6.7.89 The deposits of peat shown to be present within the site are designated as ‘unproductive strata’.

6.7.90 The South Wales Coal Measures Formations (both Middle and Lower) shown to be present beneath the entirety of the site are both designated as ‘Secondary (A) Aquifers’. Secondary (A) Aquifers are defined as permeable layers capable of supporting water supplies at a local rather than strategic scale.

6.7.91 From review of the Groundsure EnviroInsight report purchased for the proposed development area, there are no active groundwater abstraction licenses that pertain to boreholes located within 1km of the site boundary. However, dewatering operations of the current Nant Helen Extension opencast site is known to be being undertaken through consultation with Celtic Energy.

6.7.92 There is one known Private Water Supply in Caehopkin located approximately 250m to the north of the proposed development.

6.7.93 **Groundwater Levels**

6.7.94 The hydrogeological regime beneath the site is anticipated to be complex and highly varied across the site. Significant underdraining through abandoned workings is likely to dictate the groundwater levels within the areas that have been previously opencast.

6.7.95 The groundwater levels beneath the site have been interpreted through ground investigation logs held by the BGS and review of documents provided by Celtic Energy. It should be noted that the groundwater data presented on the logs held by the BGS is limited in nature and only pertains to the washery portion of the site.

³⁰ Groundsure, EnviroInsight report, Report ref.: GS-6396069, 14/10/2019

6.7.96 Extensive exploratory drilling was undertaken by British Coal in the late 1990s in the location of the Nant Helen Extension opencast³¹, overlapping with the western end of the proposed development. Only a small proportion of these boreholes is located within or close to the proposed development and majority pertains to the land immediately to the west of the proposed development. The boreholes were progressed to known workings within the “Nine Feet” and “Brass” seams and the water levels within each were recorded. The groundwater level within these workings sat approximately at between 119m OAD and 126m AOD (and typically at 124-125mAOD) beneath the proposed development area, which coincides with the eastern part of the International Colliery. The groundwater levels varied depending on the colliery area, as summarised in Table 6.4 below, with groundwater within the western part of the International Colliery measured at between 99mAOD and 104mOAD (typical 99-100 mOAD), which are similar to those measured in Ynyscedwyn Colliery to the west. Groundwater levels in Gwaun Clawdd Colliery were measured at between 107 and 109mOD. This may indicate that the workings and drainage associated with these collieries significantly influence the groundwater levels. There are three known drainage adits associated with the abovementioned collieries, as summarised in Table 6.5 below. The location is marked on Figure 6.5.

Table 6.5: Historical collieries -adits and groundwater levels

Colliery	1990s groundwater levels (pre-Nant Helen extension), mAOD	British Coal piezometers monitoring 2003 – 2016, mOAD	Adit Outfall	Adit outfall elevation, mAOD
International (eastern part)	119 – 127 (typical 124-125)	-	Yard	122.5
International (western part)	99 - -104 (typical 99 – 100)	-	Unknown; possibly connected with Ynyscedwyn Collier adit – Cwm Du	-
Ynyscedwyn	95 – 104 (typical 98- 100)	98.3 - 103.6 (average 100.7)	Cwm Du	93.6
Gwaun Clawdd	107 - 109	97 - 110.1 (average 106.3)	Gwaun Clawdd	106.1

6.7.97 These levels are corroborated by long term monitoring of two piezometers, which were installed within two of the boreholes progressed as part of the investigation by British Coal, one in the area of former Gwaun Clawdd Colliery and another in the area of former Ynyscedwyn Colliery area. Monitoring of these piezometers between

³¹ Nant Helen Remainder – Environmental Statement, Volumes 1 to 3, Celtic energy Ltd, 2011

2003 and 2016 (with an additional measurement taken in 2020) indicate that the groundwater level sits between 97m AOD and 110.1 mAOD with an average of 106.3m AOD; and between 98.3m AOD and 103.6m AOD with an average of 100.7m AOD, respectively.

- 6.7.98 Significant reductions of flow from the Yard and Gwaun Clawdd Addits were measured since 2010 and 2007, respectively, corresponding with the Nant Helen pumping operations. No change was noted in flows from the Cwm Du Adit.
- 6.7.99 Based on current LiDAR elevation data, the levels above put groundwater at significant depth of between 130-200m bgl within the site area. It is however anticipated that groundwater will be present at shallower depth within isolated bands of sandstone, where bedrock has not been disturbed by historical deep or opencast mining.
- 6.7.100 The British Geological Survey, pertaining to the washery portion of the proposed development indicate shallower groundwater levels within the superficial and artificial material present in this region. Where recorded, groundwater strikes were predominantly minimal in nature and potentially indicate areas of perched groundwater sat above the relatively impermeable bedrock. There is the potential that similar conditions may exist beneath the main site where no open cast exploration took place.

Unexploded Ordnance

- 6.7.101 A preliminary risk assessment for the presence of buried unexploded ordnance (UXO) beneath the site has been undertaken in accordance with CIRIA C681 during the preparation of the desk study for the Global Centre of Rail Excellence.
- 6.7.102 No previous military land use was identified within a 10km radius of the site. The collieries and rail infrastructure present surrounding the site at the time of WWII do represent a potential target for WWII Luftwaffe bombing raids. However, given the localised nature of Luftwaffe bombing raids in Wales (primarily concentrated on Swansea, Cardiff and Milford Haven), it is unlikely that the collieries surrounding the site would have been targeted.
- 6.7.103 The firm nature of the superficial geology and reported lack of superficial geology in some areas of the site, means that had any aerially delivered ordnance been dropped it is highly likely to have detonated upon impact. Also, given the general absence of soft superficial deposits it is likely that any UXO would have been discovered on the ground surface and dealt with.
- 6.7.104 The extensive nature of post WWII development to the site, primarily regarding opencast mining activity, further reduces the risk of UXO encounter. This is particularly relevant when considering that the majority of cuttings currently proposed pass through areas of previously backfilled opencast sites, all completed after the WWII.

The remaining cuttings are proposed through areas where superficial deposits are anticipated to be minimal to absent.

- 6.7.105 Based on the preliminary UXO risk assessment detailed above, the risk of UXO encounter beneath the site is considered negligible.

Land Contamination

- 6.7.106 The following sections set out a baseline Conceptual Site Model, which considers potential sources of contamination and pathways via which this contamination may impact the identified receptors. For the risk to exist all three components, source – pathway – receptor, need to be in place.

Sources (Baseline)

- 6.7.107 The following potential sources of contamination have been identified within the Study Area. Refer to Figure 6.6 for location.

Made Ground

- 6.7.108 Made ground deposits are anticipated to be encountered beneath the majority of the proposed track route. The made ground materials are anticipated to be composed of colliery spoil - the non-coal bearing rock arisings used to backfill the areas of opencast working, see Figure 6.5 for the opencast working area extent. This material is likely to comprise gravels, cobbles and occasional boulders of mudstone, siltstone and sandstone mixed with superficial deposits.
- 6.7.109 In the area of the washery, based on the available ground investigation information the made ground materials comprise a mixture of varied granular backfill material within a cohesive clay matrix. The various gravel inclusions within the made ground were noted to be mudstone, sandstone, coal, clinker and wood. Coal and clinker are potential sources of contamination with metals and PAHs. The thickness of this material is anticipated to range between 0.25m and 7m, although locally thicker deposits could be encountered in the locations of any stockpiles/spoil heaps within the washery site.
- 6.7.110 No chemical testing on the made ground materials has been undertaken. However, this material is unlikely to be impacted by significant contamination. Leachable metals and sulphates may be present within possibly acidic leachates generated from the colliery spoil fill materials, although this has not been reported as an issue in the past site operation. In addition, given the extensive usage of motorised plant in opencast mining activities over the past 75 years there is the potential to encounter localised pockets of contamination as a result of fuel spillages and arising from demolition of mining infrastructure.

Coal mining

- 6.7.111 As previously highlighted, the site has been impacted by both sub-surface and surface coal mining activities. The Abercrave/Gwaunton opencast mine excavated the area previously occupied by the Abercrave, International and Gwaunclawdd Collieries. There is the potential that contaminants associated with coal mining activities could be encountered within the backfill in these locations. Contaminants arising from the coal mining infrastructure and activity in the area may be present; typical contaminants may include various metals, metalloids, sulphates, PAHs, TPHs and asbestos.

Settlement ponds/lagoons

- 6.7.112 Water used as part of the washery activities is collected and treated in water treatment areas within the washery area comprising ponds and settlement lagoons. The sediments may be impacted by contaminants such as metals, metalloids, sulphates, PAHs and TPHs.

Rail/tram Lines

- 6.7.113 The Neath and Brecon Railway (main and junction lines) have been identified to have run adjacent to the northern (junction line) and southern (main line) site boundaries through review of historical mapping and historical aerial photographs. In addition, three tramways (including the Brecon Forest Tramroad) have been identified to have run adjacent to the northern (junction line) and southern (main line) site boundaries through review of historical mapping and historical aerial photographs. In addition, three tramways (including the Brecon Forest Tramroad) have been identified to have crossed into the site through review of historical mapping and historical aerial photographs. Potential contaminants associated with rail/tram lines typically include various metals, TPHs, PCBs, PAHs, herbicides, ferrous residues, metal fines, ash, sulphates and asbestos. Given the age of the historical features, the levels of residual contamination are unlikely to be significant.

Fuel Tanks

- 6.7.114 A group of four large cylindrical tanks are currently present close to the site compound and offices centrally located within the site. The tanks are above ground however, there is the potential that spillages and leakages may have occurred and as a result the soils and groundwater present in this location could potentially be impacted by hydrocarbon contamination.

Pollution Incidents

- 6.7.115 From review of the Groundsure EnviroInsight report, four pollution incidents have been recorded by the NRW within the site or <5m away from the site boundary. All were located within or within the direct vicinity of the washery portion of the site. The pollution incidents are detailed below in order of distance from site:

- In 2013 a pollution incident was recorded within the washery portion of the site (E: 283823, N: 210346). The pollutant was identified as ‘Coal’ and the impact to water was categorised as Category 2 (significant impact). No impact to land or air was recorded (both Category 4).
- In 2001 a pollution incident was recorded within the washery portion of the site (E: 285452, N: 210250). The pollutant was identified as ‘Sewage Materials’ and the impact to water was categorised as Category 3 (minor impact). No impact to land or air was recorded (both Category 4).
- In 2014 a pollution incident was recorded 1m to the south of the washery portion of the site (E: 285288, N: 210222). The pollutant was identified as ‘Construction and Demolition Materials and Wastes’ and the impact to both land and air was categorised as Category 3 (minor impact). The impact to water was not categorised.
- In 2001 a pollution incident was recorded 4m to the northeast of the washery portion of the site (E: 285503, N: 210298). The pollutant was identified as ‘Sewage Materials’ and the impact to water was categorised as Category 3 (minor impact). No impact to land or air was recorded (both Category 4).

6.7.116 The pollution incidents presented above are anticipated to have had a localised impact to the soils and groundwater beneath the washery portion of the site. However, given the categorisation of these incidents the level of contamination is anticipated to be minor.

Landfill and waste management sites

6.7.117 No landfill sites have been identified within the Study Area. Table 6.6 details historical landfills located within 0.5km of the site based on the review of the Groundsure EnviroInsight report.

Table 6.6: Historical landfill and waste management sites – NRW Dataset

Name	Direction and distance from site	Type of Waste Accepted	Year of Closure
Moorside Villas	473m (NW)	Commercial Household	1974
Historical refuse tip 1961 map	Adjacent (S)	Unknown	Unknown
Waste transfer station	211m (NE)	Unknown	Unknown
Historical refuse tip 1961/62 map	290m (S)	Unknown	Unknown
Historical refuse tip 1962 map	350m (S)	Unknown	Unknown
Historical refuse tip 1962-1987 maps	470m (NW)	Unknown	Unknown

6.7.118 As neither of these sites impact the site directly, the risk of encountering potential contamination associated with these locations within the development area is considered to be negligible.

Receptors (Baseline)

6.7.119 Potential receptors to the identified sources of potential contamination within the study area are as follows:

- Human receptors
 - Opencast mine workers who operate plant and occupy the office facilities within the Celtic Energy site;
 - Residents surrounding the site in the towns/villages, particularly residents of Onllwyn, Seven Sisters and Caehopkin;
 - Users of public right of way paths and footpaths in a close vicinity of the opencast site e.g. dog walkers, rambles.
- Environmental receptors
 - Surface watercourses that appear to originate within the site and feed the main watercourses that surround the site
 - Groundwater within the Coal Measures, classified as a Secondary A aquifer
 - Restored artificial marsh/bog pond/lake features located within the site

Pathways (Baseline)

6.7.120 The preliminary pathways between identified sources of contamination and receptors are as follows:

- Human health
 - Ingestion of soils and dust
 - Inhalation of dust, fibres and volatile hydrocarbon contamination
 - Accumulation and inhalation of gases (open cast site offices or other confined spaces within the open cast mine site area)
 - Dermal contact with soils, dust and groundwater
 - Gas migration from made ground (fill) into near surface
- Controlled Waters
 - Vertical and lateral migration of contaminants released to the ground through spillage or leaks; particularly from the opencast workings within the site and the potential for vertical or lateral migration through the underlying strata where permeable material is present.
 - Leaching of contaminants from Made ground (fill) materials into the underlying groundwater, in the non-restored areas, that are currently present on site. Where these materials are exposed at surface and subjected to rainwater infiltration; the groundwater is

likely to flow towards and discharge into surface water features associated with the active dewatering.

Plausible Pollution Linkages (Baseline)

- 6.7.121 Opencast workers have the potential to be directly exposed to soils and dust generated from exposed made ground fill materials within the areas of opencast workings.
- 6.7.122 There may be localised areas of made ground/fill that has been impacted by contamination as a result of the open cast mine operation over the decades.
- 6.7.123 Residents surrounding the site could be impacted by potentially contaminated dusts arising from the workings within the active opencast workings and dusts generated from transport of materials off-site.
- 6.7.124 The risk to residents surrounding the site is likely to be negligible as the materials arising from the site are unlikely to be generally impacted by significant levels of contamination. Dust generation as nuisance and air pollution issue is considered in the Air Quality chapter.
- 6.7.125 Existing made ground (fill) exposed at the surface has the potential to generate leachates which can leach to groundwater via vertical infiltration migration and impact the Secondary (A) Aquifer beneath the site. Once within the groundwater, this leachate could then laterally migrate into the base-flow of the many streams that originate within the site. Contamination impacted soil leachate can also migrate towards the surface water receptors via surface run-off.

6.8 Design mitigation

- 6.8.1 The following section outlines inbuilt mitigations considered within this proposed development, i.e. design mitigation.
- 6.8.2 The geotechnical design of the landform on which the proposed testing tracks would be built (and which will be constructed as part of the Nant Helen earthworks consent) will be undertaken to ensure slope stability of the ground, cuttings and embankments is adequate for the proposed development. That design will also consider ground hazards associated with historical mine workings and subsidence due to potential change in groundwater conditions.
- 6.8.3 Materials reuse would be managed in accordance with an earthwork specification developed at the detailed design stage. This would set out limiting values for materials reuse and import that are protective

of human health in a context of the proposed development and controlled waters.

- 6.8.4 A number of assumptions have been made with respect implementing legislation and good practice during construction as detailed in Section 6.6, which constitute design mitigation. These include appropriate health and safety, materials management and pollution prevention systems applied during the works.

6.9 Assessment of effects - Construction

Assessment of effects from construction - Geology and geomorphology

- 6.9.1 No designated sites are located within the study area. The site is however located within three Geological Landscape Areas, non-statutory designated sites of regional importance due to the geomorphological value considered to be of medium sensitivity due to moderate to outstanding evaluation.
- 6.9.2 Considering the historical exploitation of the open cast area, the features characterising these non-statutory designated sites have been removed and replaced by mine spoil and overburden materials. The geology features of importance are therefore located outside the study area. Consequently, the sensitivity of geological and geomorphological features within the study area is considered to be negligible. The proposed works will result in no change to geological value with a *neutral* significance of effect.

Assessment of effects from construction - Hydrogeology

- 6.9.3 The baseline conditions review indicated that the main groundwater level may be at least 100m below ground level as it is controlled by underground mine workings drainage. Therefore, the proposed development is unlikely to have an impact on either groundwater levels or flows and consequently no impact on groundwater dependent features such as springs or abstractions. Where sandstone bands are intercepted during the excavations, some increased groundwater inflows may occur requiring localised dewatering. The proposed development is to require only shallow excavations for the construction of the buildings and track bed and therefore the impact is likely to be negligible.
- 6.9.4 The sensitivity of hydrogeological features within the study area is considered to be medium on account of aquifer designation of the underlying bedrock. The proposed works will result in a negligible impact on hydrogeological value with a *neutral* significance of effect.
- 6.9.5 Refer to Chapter 11 on Water Environment for the assessment of potential impacts on Groundwater Dependent Terrestrial Ecosystems.

Assessment of effects from construction - Land contamination

- 6.9.6 The construction works would introduce new pollution linkages into the baseline conceptual site model. The revised conceptual site model is detailed below.
- 6.9.7 The review of the identified potential sources, receptors and pathways and plausible pollution linkages, as detailed in sections below, allows for assessment of the likely impacts of construction on land contamination.

Potential Sources (construction)

- 6.9.8 The potential baseline sources of contamination identified in relation to the study area are presented in Section 6.7 Baseline Environment, Land Contamination. The construction works would introduce the following additional sources as a result of construction activities:
- Accidental spillages of fuel or oils while operating or maintaining machinery.
 - Areas of unexpected contamination that would be encountered and excavated as a result of construction works.
 - Dust derived from areas of made ground created during construction.

Potential Receptors (construction)

- 6.9.9 Potential baseline receptors to the identified sources of potential contamination within the study area are presented in relevant sections in Section 6.7 Baseline Environment, Land Contamination. The construction works would introduce the following additional receptors:
- Construction workers: It has been assumed that the construction workers include adults and also apprentices aged 16 and above.

Potential Pathways (construction)

- 6.9.10 The preliminary potential baseline pathways between identified sources of contamination and receptors are presented in Section 6.7 Baseline Environment, Land Contamination. The construction works would introduce the following additional pathways:
- Direct exposure to soils and washery by-products (remaining post decommission), such as ingestion, dermal contact and/or inhalation of vapours, during excavation works.
 - Direct exposure to pond/lagoon water and sediments, such as such as ingestion, dermal contact and/or inhalation of vapours, during ponds/lagoons removal.
 - Surface run-off where made ground is exposed during excavation works.

- Discharge of water removed from the ponds/settlement lagoons within the washery area.
- Vertical migration along piles

6.9.11 The proposed development is likely to require only shallow excavations. Considering the regime beneath the proposed development site (i.e. significant depth to the groundwater and potential for minor isolated perched groundwater at shallower depth or isolated sandstone bands), no significant pumping or removal of groundwater is anticipated.

Plausible Pollution Linkages (construction)

6.9.12 Construction workers have the potential to be directly exposed to soils and dust from exposed made ground materials, and should removal of the ponds and settlement lagoons be required, to water and sediments. Providing that health and safety measures are in place in accordance with current legislation and good practice, as assumed in Section 6.6, is unlikely to pose a risk to construction workers. There is however an increased risk due to encountering unexpected contamination, particularly in the area of the washery site.

6.9.13 Considering the low sensitivity of the construction worker as a receptor, based on exposure scenario, short-term and temporary with a minor magnitude of impact of encountering unexpected contamination prior to implementation of the Action Plan, the significance of effect on construction workers is likely to be *slight adverse*.

6.9.14 The proposed development will result in potentially increased dust generation rate primarily as a result of site clearance and excavation works allowing for the construction of the maintenance facilities and infrastructure, which may migrate towards the residents of nearby settlements. This would be a temporary impact. However, the nearest residential properties in Onllwyn are located at higher ground and are separated from the proposed development by a green belt of woodland, which is likely to significantly reduce the amount of dust migrating off-site. Therefore, the magnitude of impact on the residents from dust and potential contaminants is considered to be negligible adverse. Considering very high sensitivity of the residents as potential receptors to contamination, the significance of effect on the site neighbours is likely to be *slight adverse*.

6.9.15 Breaking the ground, moving materials within the study area, temporary storage, may result in contaminant mobilisation due to increased exposure to rainfall and consequent increased rate of contaminants leaching into the underlying groundwater or surface run-off into watercourses. Encountering unexpected contamination during the works may also pose a risk to controlled water receptors as a result

of mobilisation of contamination due to disturbance or exposure to rainfall.

- 6.9.16 Decommissioning of the ponds/lagoons will require draining of the water. If removed water would be discharged to the wider site drainage or ground, this could potentially impact the receiving controlled water receptors. As stated in Section 6.6, it is assumed that such discharge would only be permissible if there is no detrimental impact on the receiving water quality and where required, treatment would be undertaken.
- 6.9.17 Piles may be required to provide a suitable founding solution for some of the proposed structures with large loads or sensitive to ground movement (e.g. a crane). The foundation solution will be confirmed by intrusive investigations. Subject to a selected piling technique, piles may create preferential flow paths allowing for vertical migration of potentially contaminated soil leachate/shallow perched groundwater into the underlying aquifer. This will be assessed on confirmation of the design by a foundation works risk assessment.
- 6.9.18 The proposed development is located within a sensitive setting with respect to controlled waters, with surface water receptors being assigned high value and groundwater medium, as detailed in the ES Water Environment chapter (Chapter 11). The magnitude of impact is considered to be negligible on account of the environmental monitoring being in place, a requirement to set out an Action Plan as per the Outline CEMP and a foundation works risk assessment, with a potential *slight adverse* significance of effect. This is due to the potential mobilisation of contaminants contained within the fill materials during general earthworks and also as a result of disturbing areas of significant unexpected contamination.

6.10 Assessment of effects - Operation

Assessment of effects from operation - Geology and geomorphology

- 6.10.1 It is considered that the proposed development will have negligible impact on geology and geomorphology during operation with a *neutral* significance of effects. This is due to minimal maintenance requirements or need to undertake any works that would disturb ground.

Assessment of effects from operation - Hydrogeology

- 6.10.2 The proposed development would incorporate permanent drainage in the area of the proposed tracks. Where the tracks are located within a cutting that permanent drainage would have a potential to intercept groundwater. Baseline conditions review indicated that the main groundwater level may be at least 100m below ground level as it is

controlled by underground mine workings drainage. Therefore, the proposed permanent drainage is unlikely to be intercepting the main groundwater body and have an impact on either groundwater levels or flows and consequently no impact on groundwater dependent features such as springs or abstractions.

- 6.10.3** Groundwater may however be present within sandstone bands that form part of the bedrock sequence. Where sandstone bands are present at shallow depth and intercepted by the cuttings, groundwater contained within these bands may be intercepted and the groundwater flows and levels within that band impacted consequently impacting features e.g. springs that directly rely on this groundwater. Geology plans identify sandstone bands that outcrop within the proposed scheme area. The cuttings are located within these outcrop areas, as shown on Figure 6.2.
- 6.10.4** The baseline conditions study identified a number of groundwater dependent features, as shown on Figure 6.2. Two springs and a Private Water Supply that are likely to be associated with the sandstone bands have been identified within the study area; the first spring and a private water supply are both located in Caehopkin approximately 250m to the north of the proposed development and the second approximately 440m to the south-west. Considering the geology beneath the study area, sandstone bands outcropping to the north are likely to be at significant depths beneath the site due to the 5-15 degrees dip in a south westerly direction. Also, the proposed development will be positioned on an embankment. Therefore, the proposed development would have no impact on these sandstone bands and associated groundwater. The second spring is however located within the area of the same sandstone outcrop as that within the cutting. The base of the cutting is proposed to be approximately at 250mOD. The spring is located at approximately 255mOD. This indicates that groundwater is likely to be intercepted by the drainage at the base of the cutting and therefore impact groundwater flows and levels within that band. The magnitude of impact is likely to be minor. This is due to the distance between the spring and the proposed development. In addition, the proposed development has a potential to impact only a small proportion of the outcrop and therefore not significantly reducing the catchment of the spring.
- 6.10.5** The sensitivity of hydrogeological features within the study area is considered to be medium on account of aquifer designation of the underlying bedrock and sensitivity of the Dulais River tributaries. The proposed development will result in no change to hydrogeological value of the main groundwater body with a *neutral* significance of

effect. However, the proposed development has a potential to have a *slight adverse* significance of effect on the spring.

Assessment of effects from operation - Land contamination

- 6.10.6 The operation of the proposed development would introduce new pollution linkages into the baseline conceptual site model. The revised conceptual site model is detailed below.
- 6.10.7 The review of the identified potential sources, receptors and pathways and plausible pollution linkages, as detailed in sections below, allows for assessment of the likely impacts of construction on land contamination.

Potential Sources (operation)

- 6.10.8 The potential baseline sources of contamination identified in relation to the study area are presented in Section 6.7 Baseline Environment, Land Contamination. The completion phase would not introduce additional sources. Only materials deemed safe with respect to human health and controlled waters would be reused within the development. Materials impacted by significant contamination would have been removed or remediated.

Potential Receptors (operation)

- 6.10.9 Potential baseline receptors to the identified sources of potential contamination within the study area are presented in Section 6.7 Baseline Environment, Land Contamination. On completion this would introduce the following additional receptors:
- End users of the development such as railway testing facilities workers and visitors, based both on site and in the offices. It has been assumed that the workers and visitors of the railway testing facility would include adults and also apprentices aged 16 and above.

Potential Pathways (operation)

- 6.10.10 The preliminary potential baseline pathways between identified sources of contamination and receptors are presented in Section 6.7 Baseline Environment, Land Contamination. On completion this would remove or change the following pathways:
- Direct exposure to soils and dust would be significantly reduced due to landscaping and introduced vegetation; this will significantly reduce dust generation and off-site migration, albeit some dust generation may occur.
 - The development workers (e.g. where vegetation maintenance is required or intrusive repair works to tracks) may still come to

dermal contact with soils, this will however be likely to be infrequent, short-term and temporary.

- Migration of volatile hydrocarbon vapours and ground gases into confined spaces or structures.
- No exposure to groundwater is likely as part of normal operation or maintenance works.
- Introduction of vegetation in areas of landscaping will reduce rainwater infiltration and therefore the rate of contaminant leaching into the underlying groundwater would be reduced.
- Vertical migration along piles.

Plausible Pollution Linkages (operation)

- 6.10.11 The development workers are unlikely to be exposed to dust from soils via inhalation and to a lesser extent via dermal contact or ingestion of soil. Providing that health and safety measures are in place in accordance with current legislation and good practice, as assumed in Section 6.6, is unlikely to pose a risk to maintenance workers.
- 6.10.12 Significant dust generation and off-site migration is unlikely to be a viable pathway on completion, significantly reducing the exposure of residents from nearby villages. This would present a beneficial impact in relation to baseline conditions.
- 6.10.13 If encountered during the earthworks, significant contamination is likely to have been removed and therefore have a beneficial impact on underlying groundwater. Buildings and vegetation introduced in landscaped areas would reduce rainwater effective infiltration and leachate generation and migration towards the controlled water receptors. This would have a beneficial impact.
- 6.10.14 Piles may be required to provide a suitable founding solution for some of the proposed structures with large loads or sensitive to ground movement (e.g. a crane). The foundation solution will be confirmed by intrusive investigations. Subject to a selected piling technique, piles may create preferential flow paths allowing for vertical migration of ground gas into confined spaces within the structures/buildings. This will be assessed on confirmation of the design by a foundation works risk assessment.
- 6.10.15 Made ground is a potential source of ground gas, which may migrate into the buildings through its foundations (shallow or deep) and accumulate within confined spaces or poorly ventilated areas. This may pose a risk of asphyxiation. The design will consider appropriate ground gas protection measures for the proposed development and therefore eliminate the pathway.
- 6.10.16 Based on the medium sensitivity of the testing track facilities workers, and a negligible magnitude of impact as a result of a short-term and

temporary dermal exposure to made ground, the significance of effect on end users is likely to be *neutral*. On completion there is likely to be a *moderate beneficial* significance of effect on nearby residents (very high value with minor magnitude of impact) due to reduction in soil dust generation in comparison with the baseline scenario. Based on the design incorporating appropriate ground gas mitigation measures, if required, and therefore eliminating the potential impact from ground gas migration, the significance of effect on end users is likely to be *neutral*.

- 6.10.17 The site is located within a sensitive setting with respect to controlled waters, with surface water receptors being assigned high value and groundwater a medium value, as detailed in the Water Environment Chapter 5. The magnitude of impact is considered to be minor, with a potential overall *slight beneficial* significance of effect.

6.11 Mitigation and enhancement

- 6.11.1 This section sets out measures that are to prevent, reduce and where possible offset any significant adverse effects on the environment.

Mitigation of effects from construction

- 6.11.2 The proposed development is likely to have neutral significance of effect on geology and geomorphology and neutral-slight adverse significance of effect as a result of contamination. Therefore, no mitigation measures are required in addition to measures presented within the Outline CEMP.
- 6.11.3 Detailed requirements with respect to management of materials during earthworks will be set out in the Earthworks Specification, which will be derived for the proposed development at the detailed design stage. This will determine suitability for reuse criteria protective of the end site user's health and controlled waters.

Mitigation of effects from operation

- 6.11.4 The proposed development is likely to result in slight adverse to moderate beneficial significance of effect and therefore no mitigation measures are required.

6.12 Residual effects

- 6.12.1 This section identifies the effects of the development on the environment after taking account of mitigation measures.

Residual effects from construction

- 6.12.2 The construction of the proposed development may have temporary moderate negative effect on the water environment and therefore in-

build mitigation measures have been identified, as presented in the Outline CEMP. On implementation of the mitigation measures the residual effect on the water environment is likely to be slight adverse, as the release of pollutants may still occur at levels not causing pollution.

Residual effects from operation

- 6.12.3 The proposed development is likely to result in neutral to moderate beneficial significance of effect and therefore no mitigation measures are required.

6.13 Assessment summary matrix

Potential Effect	Receptor (s)	Sensitivity of Receptor	Magnitude (prior to mitigation)	Significance (prior to mitigation)	Mitigation	Magnitude (following mitigation)	Significance (following mitigation)	Comments
Construction								
Construction of testing tracks, maintenance facilities and infrastructure	Geology and geomorphology	Medium	Negligible	Neutral	n/a	n/a	Neutral	n/a
	Hydrogeology	Medium	Negligible	Neutral	n/a	n/a	Neutral	n/a
Unexpected contamination during construction	Construction workers	Low	Minor	Slight adverse	None in addition to measures presented in Outline CEMP	n/a	Slight adverse	n/a
	Controlled waters	High	Negligible	Slight adverse		n/a	Slight adverse	n/a
Mobilisation of contaminants during earthworks (leaching, dust migration); discharge of water drained from ponds/lagoons	Controlled waters	High (surface water) Medium (groundwater)	Negligible	Slight adverse	None in addition to measures presented in Outline CEMP	n/a	Slight adverse	n/a
	Residents of nearby villages	Very high	Negligible	Slight adverse		n/a	Slight adverse	n/a
Operation								
Operation of testing tracks, maintenance facilities and infrastructure	Geology and geomorphology	Medium	Negligible	Neutral	n/a	n/a	Neutral	n/a
	Hydrogeology	Medium	Negligible	Neutral	n/a	n/a	Neutral	n/a
Exposure to made ground containing contaminants	End users of the development	Medium	Negligible	Neutral	n/a	n/a	Neutral	n/a

Reduction in exposure to dust	Residents of nearby villages	Very high	Minor	Moderate beneficial	n/a	n/a	Moderate beneficial	n/a
Reduction in leachability of contaminants	Controlled waters	High (surface water) Medium (groundwater)	Minor	Slight beneficial	n/a	n/a	Slight beneficial	n/a

