HORIZON NUCLEAR POWER

WYLFA NEWYDD

ENERGY WORKING FOR BRITAIN

Wylfa Newydd Project

6.7.8 ES Volume G - A5025 Off-line Highway Improvements G8 - Surface water and groundwater

PINS Reference Number: EN010007

Application Reference Number: 6.7.8

June 2018

Revision 1.0

Regulation Number: 5(2)(a)

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Horizon Internal DCRM Number: WN0902-JAC-PAC-CHT-00080

[This page is intentionally blank]

Contents

[This page is intentionally blank]

8 Surface water and groundwater

8.1 Introduction

8.1.1 This chapter describes the assessment of potential surface water, groundwater and fluvial geomorphology effects resulting from the construction and operation of the A5025 Off-line Highway Improvements.

8.1.2 Please refer to chapter B8 (surface water and groundwater) (Application Reference Number: 6.2.8) for the technical basis for the assessment including a summary of legislation, policy and guidance; key points arising in consultation that have guided the surface water and groundwater assessment; and assessment methodologies and criteria.

8.2 Study area

8.2.1 This section describes the study areas relevant to the surface water, fluvial geomorphology and groundwater assessment for the A5025 Off-line Highway Improvements.

All road sections

8.2.2 All road sections and main water features are shown in figure G8-1 (Application Reference Number: 6.7.48). The study areas defined for surface water, fluvial geomorphology and groundwater are different. The following paragraphs explain the extent of each study area, with the respective study areas shown on figures G8-2 to G8-6 (Application Reference Number: 6.7.48).

8.2.3 The surface water study area for each section of road is based upon the indicative areas of land that could potentially be affected by the A5025 Off-line Highway Improvements. In general, the surface water study area covers the extent of the A5025 Off-line Highway Improvements and out to a distance of 500m around the site in all directions. The watercourses in each road section are listed below and shown on figure G8-1 (Application Reference Number: 6.7.48).

8.2.4 Where there is negligible effect on receptors within 500m, there will be no affect further downstream. Where there is a minor effect on receptors within 500m, the assessment considers environmental designated sites (such as a Site of Special Scientific Interest (SSSI), Special Area of Conservation or Special Protection Area) further downstream beyond 500m. This includes drainage outfalls within 1km of an environmental designated site, important drinking water supplies or other important abstractions that need to be identified for the purpose of the Highways Agency Water Risk Assessment Tool (HAWRAT) assessment.

8.2.5 Specific exceptions to the 500m distance are associated with flood risk assessment and the assessment using the HAWRAT.

8.2.6 The assessment of flood risk takes a catchment approach. The surface water study area with respect to flood risk is therefore based on the stream

catchments in and around the extent of the A5025 Off-line Highway Improvements, which in some cases extend beyond the 500m study area.

8.2.7 The fluvial geomorphology study area encompasses all drainage features within 250m of the A5025 Off-line Highway Improvements (figure G8-1, Application Reference Number: 6.7.48). However, where a watercourse crosses beneath the carriageway, the assessment could extend for a distance of 1km both upstream and downstream. This extended length encompasses a sufficient distance along the watercourses to assess potential impacts to flow and sediment processes. In addition, where specific flow pathways to sensitive receptors exist (such as ecologically designated sites), a study area wider than 250m may be considered to capture any potential changes to geomorphology arising from the A5025 Off-line Highway Improvements.

8.2.8 The study area for the groundwater assessment includes all groundwater associated receptors that could be physically affected by the A5025 Off-line Highway Improvements. In general, the groundwater study area covers the development site and a distance of 500m around the site in all directions (see figure G8-1, Application Reference Number: 6.7.48).

8.2.9 Vertically, the groundwater assessment has considered the possible effects on the groundwater environment in both the shallow drift aquifers (where present) and the underlying bedrock aquifer (to a depth of approximately 30m below ground level) and associated receptors. This has included consideration of the likely impacts associated with any new sections of cutting.

Section 1: Valley

8.2.10 Section 1 is located within the Cleifiog (Valley) catchment. The main watercourses within the 500m study area are the Afon Cleifiog and its two tributaries: Cleifiog Isaf and Cleifiog Fawr. There are also multiple smaller tributaries and drainage channels within the 500m study area.

Section 3: Llanfachraeth

8.2.11 Section 3 is located within the Alaw and the Tan R'Allt catchments. The main watercourses within the 500m study area are the Afon Alaw, the estuarine length of the Afon Alaw, the Afon Llywenan and the Tan R'Allt. There are also multiple tributaries, drainage channels and small ponds within the 500m study area.

Section 5: Llanfaethlu

8.2.12 Section 5 is located within the Tan R'Allt catchment and the coastal catchment that drains to Holyhead Bay. The main watercourses within the 500m study area are the Afon Garreglwyd, the Afon Llanrhyddlad and Tan-y-bryn. There is also a tributary of the Tan R'Allt, two small ponds and a number of small, drainage channels within the 500m study area.

Section 7: Cefn Coch

8.2.13 Section 7 is located within the coastal catchment that drains to The Skerries. The main watercourses within the 500m study area are the Afon Cafnan and Nant Llygeirian. There is also the Bod-hedd Drain, the Afon Cefn-coch, a number of small drainage channels and a lake (Lyn Llygeirian) within the 500m study area.

Power Station Access Road Junction

8.2.14 The Power Station Access Road Junction is located within the Afon Cafnan catchment to the west of the A5025 and the Cemaes catchment to the east of the A5025. The main watercourses within the 500m study area are Nant Caerdegog Isaf and Nant Cemaes.

8.3 Baseline environment

8.3.1 This section provides a summary of the baseline conditions for surface water and groundwater within the study areas described in section 8.2.

8.3.2 The values ascribed to the receptors in the following section are detailed in the surface water and groundwater methodology in chapter B8 (table B8-11) (Application Reference Number: 6.2.8). The exception is for flood risk, with the value of flood risk receptors based on Welsh Government guidance as detailed in the Flood Consequence Assessment (FCA) in appendix G8-1 (Application Reference Number: 6.7.20).

Section 1: Valley

Surface water

Catchment and water features

8.3.3 Section 1 is located within the Cleifiog (Valley) catchment. The main watercourse within this catchment is the Afon Cleifiog, which is designated as a main river. The Afon Cleifiog flows in a south-westerly direction and is culverted beneath the A5 at the south-eastern extent of section 1, before flowing into Holyhead Strait.

8.3.4 The Afon Cleifiog has two tributaries, both of which are designated as main rivers. The Cleifiog Isaf flows in a south-westerly direction parallel to the existing A5025. The Cleifiog Fawr rises to the north-west of section 1 and flows in a south-easterly direction towards the existing A5025. Cleifiog Fawr is culverted beneath the existing A5025 and flows onwards in a south-westerly direction towards the Afon Cleifiog. The Cleifiog Isaf and Cleifiog Fawr join the Afon Cleifiog to the north and south of the A5, respectively.

8.3.5 There are also multiple smaller tributaries and land drainage ditches within the 500m study area. None of these will be culverted or subjected to direct change by the section 1 proposals; therefore, the majority have been scoped out of this assessment and are not considered further. The exception is an unnamed tributary of Cleifiog Fawr that is culverted beneath the A5025 at

the northern extent of section 1. It continues as open channel adjacent to the southbound carriageway and joins Cleifiog Fawr upstream of the A5.

Surface water dependent terrestrial ecosystems

8.3.6 There are no designated water dependent terrestrial ecosystems located within 1km of section 1 of the proposed route of the A5025 Off-line Highway Improvements.

Flood risk

8.3.7 The current flood risk to the land along the proposed route of the A5025 Off-line Highway Improvements is detailed in the FCA included in appendix G8-1 (Application Reference Number: 6.7.20). This also includes details of the flood modelling undertaken.

8.3.8 Land to the west and south of section 1, including the proposed A5025 Off-line Highways Improvement roundabout junction with the A5, is located within Flood Zone C2, as defined in Technical Advice Note (TAN) 15 [RD1]. This indicates a high risk of tidal and fluvial flooding.

8.3.9 Baseline modelling (see appendix G8-1, Application Reference Number: 6.7.20) to further determine the flood risk indicates that the flood risk to section 1 is primarily from fluvial sources. Flooding of the section 1 route is expected to start at the 1/20 year event and reach peak flood depths of between 0.5m and 1.5m during the 1/100 year event plus climate change (30%).

8.3.10 There are a number of flood risk receptors within the study area. The A5025 and the A5 are very high value flood risk receptors based on transport infrastructure being classed as essential infrastructure [RD1]. Multiple buildings to the west of section 1, a cemetery to the east and a freight yard to the south have been assigned high value flood risk receptors, in line with the TAN 15 advice, which states that all developments are highly sensitive. Agricultural land has been assigned a medium value.

8.3.11 Buildings to the west include a service station and a number of residential properties, approximately 150m to the west of section 1 (and 230m west of Cleifiog Fawr). Approximately 200m to the south-west of section 1 (and 280m west of Cleifiog Fawr) are a number of commercial buildings. The peak flood depth at these buildings ranges between 0.2m and 0.7m during the 1/100 year event plus climate change (30%).

8.3.12 Natural Resources Wales (NRW) surface water flood mapping [RD2] indicates a largely low risk of surface water flooding in the vicinity of Cleifiog Fawr, with areas of medium and high risk generally confined to the channels. No buildings are shown to be at risk of surface water flooding based on NRW mapping.

8.3.13 The nearby town, Valley, has experienced historical flooding. Historical flood records from the Isle of Anglesey County Council (IACC) indicate that the latest recorded flood incident occurred in October 2014, when heavy rainfall overwhelmed sewers resulting in pluvial flooding. Operation of the tidal barrier downstream of Valley town could exacerbate pluvial flooding in

Valley. The closure of the barrier could raise the river level upstream of the barrier, which could restrict discharge of surface water into the river during times of high water levels and affect localised areas in Valley. There are no known historical records of flooding to areas upstream including section 1. There is also a residual risk from tidal flooding in events greater than the standard of protection afforded by the tidal gate. Baseline modelling presented in appendix G8-1 (Application Reference Number: 6.7.20) indicates that the tidal gate provides protection up to and including the 1/1000 year tidal flood level, therefore there is a low residual risk of tidal flooding to Valley and section 1.

8.3.14 As detailed in the FCA (appendix G8-1, Application Reference Number: 6.7.20), the risk of flooding from groundwater, services and reservoirs is low.

Surface water quality

8.3.15 Surface water samples were taken from 10 locations on Cleifiog Fawr and its tributary drains across three rounds of sampling (19 samples in total) between March and April 2016 [RD3]. The majority of the determinands screened were below the respective Environmental Quality Standards (EQSs); however, exceedances were identified in all samples for fluoranthene, chromium (III), copper, lead, nickel and zinc [RD3]. The greater concentrations were found in the central drainage network due to the collection of runoff from agricultural fields and marshland, and the low flow in the drainage system [RD4].

8.3.16 Determinands which exceeded the EQSs did not show elevated concentrations consistently in each of the three sampling rounds. This indicates that the elevated concentrations related more to sporadic sources in the surrounding area rather than migration of contaminants from a single source [RD4]. It could also be that runoff from the A5025 and the A5 shows variable concentrations of determinands depending on antecedent rainfall, with short, intense duration rainfall events potentially causing a sudden flush of pollutants into local watercourses.

Surface water abstractions and discharges

8.3.17 Surface water from watercourses can be abstracted for a variety of uses including potable supply, agriculture (for watering crops or as a water supply for animals) or for industrial uses. The Isle of Anglesey was, until January 2018, a license exempt area and therefore NRW does not (at the time of writing) hold details of any licensed abstractions. There are no known surface water abstractions in the study area, but there could be unrecorded abstractions in the area, although the potential for potable abstraction is extremely low. The channels are used to provide water for cattle across the study area.

8.3.18 There are no known industrial water discharges within the study area, but there could be unrecorded agricultural water discharges.

Summary

8.3.19 In summary, the Afon Cleifiog has been assigned a high value based on this watercourse being the main cause of the flood risk to the A5025, the A5 and multiple properties. The Cleifiog Isaf and Cleifiog Fawr have been assigned a medium value based on their main river designations. The unnamed tributary of Cleifiog Fawr has been assigned a low value based on its ordinary watercourse designation.

Fluvial geomorphology

8.3.20 The Afon Cleifiog flows in a south-westerly direction before flowing through a large culvert (approximately 100m in length) under the A55. The watercourse then flows into a large wetland and eventually to the sand flats located between Holy Island and the Isle of Anglesey. Within the study area, the channel is likely to have been historically realigned for agricultural purposes and delineates a number of field boundaries.

8.3.21 During the site survey in January 2016, the downstream section of the Afon Cleifiog channel at the A55 was observed to be uniform, with an artificially straight planform forming a field boundary. The channel was approximately 3m wide at this location, with the exception of some lengths where livestock poaching had locally widened the channel. The depth of the channel was noted to be approximately 0.3m within the study area. Several sediment sources were recorded within the study area, leading to the delivery of suspended sediment to the channel, primarily through field drains. The Afon Cleifiog is considered to have a low value due to the conditions observed during the site visit.

8.3.22 The Cleifiog Isaf, Cleifiog Fawr and other channels in the study area were predominantly artificially straightened arterial drainage ditches with very few geomorphological features. The flow was noted to be ephemeral in nature. Typically, a vegetated riparian corridor was absent, but in some localised instances a thick line of shrubs was observed to be present. Shrubs were growing parallel to the drains and typically demarcated field boundaries. These watercourses are considered to have a low value.

Water Framework Directive (WFD) water bodies

8.3.23 NRW's Water Watch Wales website [RD5] shows that the proposed site for the A5025 Off-line Highway Improvement sections lies within the Ynys Môn Secondary WFD water body (GB41002G204400) and groundwater drinking water protected area which covers most of Anglesey. The Ynys Môn Secondary WFD water body is currently classified as achieving good quantitative status (that is, there are no significant pressures on groundwater resources with sufficient water to support stream flows and groundwater inputs to terrestrial ecosystems) and poor quality status. The poor status in relation to quality relates to substances in groundwater which are associated with historical mining activities [RD5].

8.3.24 As the groundwater WFD water body covers most of Anglesey, the chemical water quality will vary and is likely to be better in some areas than the classification for the whole WFD water body would indicate. As NRW does

not have any groundwater monitoring boreholes in the vicinity of the proposed route of the A5025 Off-line Highway Improvements, the quality is not known.

8.3.25 The Cleifiog (Valley) WFD water body (GB110102058930) (referred to as Afon Cleifiog in this report) lies within the area covered by the Western Wales River Basin Management Plan (RBMP) [RD6] and measures approximately 3.7km in length with a catchment area of 21.7km^2. The WFD water body is currently achieving moderate ecological status and has no protected areas associated with it.

8.3.26 A WFD Compliance Assessment (Application Reference Number: 8.26) has been completed for the Wylfa Newydd Project (including the A5025 Highway Off-line Highway Improvements) and is included as a standalone report in the Development Consent Order application submission. The potential effects of the Wylfa Newydd Project on the WFD waterbodies are detailed in that report and are not discussed within this chapter.

Groundwater

8.3.27 The following section describes the characteristics of the groundwater regime. This is largely applicable to all of the A5025 Off-line Highway Improvements and so is not repeated for each road section, but any elements specific to each road section are discussed in the relevant part of the chapter.

Geology and aquifer characteristics

8.3.28 A detailed description of the soils and geology within the A5025 Off-line Highway Improvements area is provided in chapter G7 (Soils and geology) (Application Reference Number: 6.7.7) with much information drawn from a ground investigation undertaken by Structural Soils [RD3] and an analytical report by AECOM [RD4] in 2016. Only information pertinent to the groundwater assessment has been included in this chapter.

8.3.29 The majority of section 1 is underlain by tidal flat deposits, with an area to the north and east underlain by glacial till. The tidal flat deposits tend to be low permeability strata that have limited supply potential, and therefore have neutral significance for water supply. The value of tidal flat deposits for water supply has been assessed as neutral, and they have been scoped out of the groundwater assessment as a sensitive receptor.

8.3.30 The glacial till is defined by NRW as a Secondary (undifferentiated) aquifer, but where the matrix is dominated by clay, as it is at section 1, it will be of low permeability with limited significance for water supply. NRW identifies the solid bedrock as a Secondary B aquifer. The deposits comprise predominantly lower permeability layers that could store and yield limited amounts of groundwater due to localised water-bearing features such as fissures, thin permeable horizons and weathering.

8.3.31 There are no groundwater source protection zones in the study area at section 1, but NRW datasets identify groundwater vulnerable zones in the Secondary aquifer beneath the route of the proposed A5025 Off-line Highway Improvements. In line with the assessment criteria in table B8-12

in chapter B8 (Application Reference Number: 6.2.8), the value of the Secondary aquifers is assessed as low.

Groundwater quality

8.3.32 Groundwater samples were taken from boreholes in the study area on two occasions in May 2016 [RD3]. The analyses were predominantly focused on identifying whether there was any contamination present and did not fully characterise the groundwater quality for environmental quality or drinking water determinands.

8.3.33 There is a possibility that some wells in the vicinity of the A5025 are used as private water supplies (PWSs) (as discussed below). Therefore, the water quality data from the samples collected in May 2016 have been compared to UK Drinking Water Standards (DWSs). The groundwater can also support surface water flows and so the data have also been compared to EQS.

8.3.34 Along the whole route of the proposed A5025 Off-line Highway Improvements, the pH of the groundwater varied from mildly acidic to mildly alkaline (pH 6 to 8). Alkalinity and hardness varied across the samples, as did chloride, sulphate and nitrate.

8.3.35 Water samples were taken from five boreholes in the broad vicinity of section 1. The analytical results in the AECOM report [RD4] have been compared against the DWSs for those parameters analysed, and only chloride exceeded the DWS of 250mg/l with values of 448mg/l and 450mg/l being measured on 20 May 2016 and 26 May 2016 respectively in borehole A11, which is located close to the existing A5/A5025 Junction. The elevated chloride may be from road salt runoff from the winter, or naturally derived from the tidal flat deposits into which the borehole was drilled (although other boreholes also drilled into tidal flat deposits did not have elevated chloride).

8.3.36 The analytical results in the AECOM report [RD4] compared the groundwater analyses against freshwater EQS as a means of assessing the significance of the results in relation to impact of groundwater on surface water (especially nearby watercourses). In section 1, a small number of substances exceeded EQS but not consistently during both monitoring rounds. The only exception is chloride in borehole A11 as discussed above.

Groundwater recharge

8.3.37 Groundwater recharge refers to the flux of water that moves from the ground surface or a surface water body into an underlying aquifer. Rainfall is normally the most significant source of recharge, although only a relatively small proportion of total annual rainfall actually enters the groundwater system. Runoff, shallow unsaturated baseflow to surface water, and evaporation and transpiration from plants, all reduce the total annual downward flux of rainfall. Where the ground has a low permeability, groundwater recharge will be only a small percentage of the incident rainfall.

8.3.38 The wet and loamy soils present in the study area [RD7] typically limit the downward movement of porewater into the underlying bedrock, and offer some form of natural protection to underlying aquifers. As a result, such soils are typically also characterised by; high rates of surface water runoff,

seasonal waterlogging and very wet ground conditions following periods of intense rainfall.

8.3.39 The presence of the widespread glacial till and loamy soils will significantly limit any vertical recharge of the Secondary B bedrock aquifer along the proposed route of the A5025 Off-line Highway Improvements.

Groundwater flow and levels

8.3.40 The AECOM 2016 groundwater monitoring investigation [RD4] recorded very variable groundwater levels. Where present, groundwater was struck at between 0.13m and 1.37m below ground level between 11 May 2016 and 1 June 2016. Rates of inflow to the ground investigation boreholes varied from nil through slow seepage to fast inflow. There were often several separate layers of water bearing strata as identified by the regular occurrence of several water strike levels in the same borehole. These different water bearing units comprised thin granular layers in the superficial deposits, discontinuities at the base of the glacial features on weathered bedrock and within the bedrock itself. In some cases, seepage into the boreholes commenced from ground level in soils.

8.3.41 In many locations, the groundwater in these thin units was confined below clays and rose when penetrated by the borehole. In other cases, there was a degree of hydraulic continuity between the superficial deposits and the weathered top of the bedrock. Generally, monitoring of piezometer water levels over longer periods indicated that the rate of flow reduced and water levels fell significantly below the water struck level, in many cases to below the base of the piezometer. This suggests discontinuous thin aquifer horizons and low storage.

8.3.42 Groundwater levels varied greatly between locations, and did not give the impression of a consistent continuous saturated aquifer. It is clear from the shallow and discontinuous nature of the water bearing horizons and the widespread surface water flow channels crossing the route, that groundwater flow direction will vary at local and regional scales and that shallow groundwater flow paths will not be of significant length.

8.3.43 The dominant groundwater flow direction in the bedrock at the regional scale is likely to be towards the coast in section 1.

Groundwater abstractions

8.3.44 The proposed A5025 Off-line Highway Improvements are in an area that until January 2018 was exempt from groundwater abstraction licensing, and NRW does not (at the time of writing) therefore hold any records of groundwater abstractions in the area.

8.3.45 Although NRW does not hold details of groundwater abstractions, the IACC does maintain a list of PWSs that it is aware of under the Private Water Supplies (Wales) Regulations 2010. Under these Regulations, the local authority has a duty to monitor private supplies and to make and maintain records for every water supply in its area used for potable purposes. Data provided by the IACC indicates that there are no known PWS within 500m of section 1.

8.3.46 The IACC also hold a list of public wells of which it is aware. This data was obtained and combined with Ordnance Survey (OS) mapping to indicate public and mapped wells within 500m of section 1 (see figure G8-2, Application Reference Number: 6.7.48). Some wells could have been used for potable water supply in the past but are now redundant as houses have been supplied from the water main. Others may have been used (and potentially are still used) for irrigation or livestock watering. None of the wells have been visited as part of this assessment.

8.3.47 Utilising a precautionary approach, it is assumed that some of these abstractions will be actively used for potable or other purposes. These are considered potentially sensitive receptors depending upon the nature of the wells and their use and assessed as having medium value.

8.3.48 There is one well located 500m to the north of section 1. Given its distance from the development, the likely nature of the low permeability tidal flat deposits and the typical recharge area/zone of influence for such a small residential abstraction, the well is unlikely to be affected by the A5025 Off-line Highway Improvements and has been scoped out of the assessment.

Groundwater supported waterbodies

8.3.49 There are numerous small watercourses, drainage ditches and ephemeral watercourses adjacent to, and in a number of instances traversing, the route of the proposed A5025 Off-line Highway Improvements. During the course of the 2016 ground investigation cited above, the water levels within these features varied from dry to almost completely full.

8.3.50 It is possible that groundwater flows will support some of these local surface water systems as baseflow. In particular, it is likely that the permeable layers of the Secondary A alluvial aquifer, which follows the course of the main rivers, will form a local source of baseflow to rivers.

8.3.51 However, subject to the exceptions above, given that these waterbodies are numerous and located on clayey glacial till and the characterisation of the shallow groundwater as discontinuous and seasonal, it is likely that there may be only limited connectivity between the groundwater and these surface waterbodies.

8.3.52 Given the extensive network of surface watercourses and the low permeability nature of the superficial deposits and underlying aquifers across most of the area, only limited groundwater baseflow to surface waterbodies is expected.

Groundwater dependent terrestrial ecosystems

8.3.53 There are no SSSIs that could be regarded as groundwater dependent terrestrial ecosystems located within 500m of section 1 of the route of the proposed A5025 Off-line Highway Improvements.

Buildings

8.3.54 Buildings are potential receptors if they could be affected by an increase or decrease in groundwater levels as a result of the A5025 Off-line Highway

Improvements. In some cases, embankments could reduce flow on down gradient sides and perhaps increase groundwater flooding on the up gradient side. Cuttings could locally depress groundwater levels on both sides of the road and also reduce groundwater flow on the down gradient side.

8.3.55 Detail of the risk factors for stability and groundwater flooding arising from shallow groundwater levels is unknown for the buildings in proximity to section 1. There are no known significant groundwater flow paths or instances of groundwater flooding.

8.3.56 An assessment has been undertaken to identify buildings that could be affected by changes in groundwater levels and flows as a result of cuttings and embankments. For those buildings which could be affected, the value of these receptors is assessed as high for the groundwater assessment.

8.3.57 In section 1, a service station and a number of buildings are located within 200m of the western end of the scheme. The embankment proposed in this area would reach a maximum height of 1m and would be unlikely to affect these receptors, which have as a result, been scoped out of the assessment.

Section 3: Llanfachraeth

Surface water

Catchment and water features

8.3.58 Section 3 falls within two catchments: the Alaw and the Tan R'Allt. Both of these catchments drain into the Alaw estuary downstream of section 3 on the western side of the existing A5025.

8.3.59 The Alaw catchment drains an area downstream of Llyn Alaw, approximately 6km to the north-east of Llanfachraeth. The main watercourse within the catchment is the Afon Alaw. This watercourse is fed directly from Llyn Alaw and flows in a south-westerly direction. Section 3 crosses the Afon Alaw at Llanfachraeth.

8.3.60 The Afon Llywenan flows in a north-westerly direction in the southern extent of the study area. It joins the Afon Alaw immediately upstream of the A5025 at Llanfachraeth. The Afon Llywenan is designated a main river by NRW.

8.3.61 The Tan R'Allt catchment drains an area predominately to the north of section 3. The main watercourse within the catchment is the Tan R'Allt. This watercourse flows in a south-westerly direction and beneath the existing A5025 to the north of section 3, after which the watercourse flows in a southerly direction parallel to the A5025. The Tan R'Allt discharges to the Alaw estuary to the east of Llanfachraeth downstream of the A5025.

8.3.62 The most notable ponds (less than 100m^2 in area) are located approximately 300m to the east of the northern extent of section 3. However, given their size and distance from section 3, these ponds have been scoped out of this assessment.

Surface water dependent terrestrial ecosystems

8.3.63 The Alaw estuary is designated a SSSI, known as the Beddmanarch-Cymyran SSSI. The Beddmanarch-Cymyran SSSI is located 250m downstream of section 1. It is a coastal site consisting of sandbanks and mudflats and is primarily a surface water supported feature. In line with the assessment criteria in table B8-12 of chapter B8 (Application Reference Number: 6.2.8), the value of this receptor is assessed as high.

Flood risk

8.3.64 The flood risk to the proposed A5025 Off-line Highway Improvements is detailed in the FCA included in appendix G8-1 (Application Reference Number: 6.7.20). This also includes details of the flood modelling undertaken.

8.3.65 Section 3 is largely located in Flood Zone A, as defined in TAN 15 [RD1]. Zone A comprises land considered to be at little or no risk of fluvial or coastal/tidal flooding. The exception is land adjacent to the Afon Alaw, the Afon Llywenan and the Tan R'Allt, all of which is located in a narrow band of Flood Zone C2 and at high risk of flooding.

8.3.66 Baseline modelling in appendix G8-1 (Application Reference Number: 6.7.20) indicates that the main source of flooding at section 3 is fluvial flooding from the Afon Alaw and the Afon Llywenan. However, there is also a tidal influence from the Alaw Estuary. Fluvial flooding of section 3 is expected to start at the 1/20 year event on the Afon Alaw and the Afon Llywenan immediately upstream of the A5025. The baseline peak flood depth is shown to reach up to 2m in both the Afon Alaw and the Afon Llywenan during the 1/100 year event plus climate change (30%). The combined tidal (1/200 year event plus climate change (40%)) and fluvial (1/100 year event plus climate change (30%)) event is shown to increase the flood depth to over 2m; however, the extent of flooding is similar.

8.3.67 There are a number of flood risk receptors within the study area. The A5025 is a high value flood risk receptor based on transport infrastructure being classed as essential infrastructure [RD1]. Beddmanarch-Cymyran SSSI immediately downstream of the A5025 road crossing is also a very high flood risk receptor based on its SSSI designation [RD1]. Multiple buildings in Llanfachraeth have been assigned high value flood risk receptors, in line with the TAN 15 advice, which states that all developments are highly sensitive. Agricultural land has been assigned a medium value.

8.3.68 Within the section 3 study area, there are two building receptors at risk of fluvial flooding and combined tidal/fluvial flooding. Immediately to the north of the Afon Alaw is a residential property. Baseline modelling indicates that the peak flood depth during the 1/100 year event plus climate change (30%) is up to 2m at this property. Approximately 220m to the north-east of the section 3 viaduct is a farm building, which baseline modelling indicates to be at flood risk up to a depth of 0.25m.

8.3.69 NRW surface water flood mapping [RD2] indicates a largely low risk of surface water flooding in the vicinity of Afon Alaw, the Afon Llywenan and the Tan R'Allt, with areas of medium and high risk generally confined to the

channels. There are no buildings shown to be at risk of surface water flooding based on NRW mapping.

8.3.70 As detailed in the FCA (appendix G8-1, Application Reference Number: 6.7.20), the risk of flooding from groundwater, services and reservoirs is low.

Surface water quality

8.3.71 Surface water samples were taken from 11 locations on the Afon Alaw main channel and multiple tributaries across three rounds of sampling (26 samples in total) between February and April 2016 [RD8]. The majority of the determinands screened were below the respective EQS; however, exceedances were identified in all samples for fluoranthene, benzo(a)pyrene, cadmium, chromium (III), copper, lead, nickel, zinc and cyanide (total) [RD9]. The greater exceedances were found in a field drain at the southern extent of section 3 due to the collection of runoff from agricultural fields and the low flows [RD9]. Concentrations of determinands which did exceed the EQS were not found consistently in each of the three sampling rounds, which indicates that there is no consistent contaminant source [RD9].

Surface water abstractions and discharges

8.3.72 There are no surface water abstractions or discharges recorded in the study area for section 3.

Summary

8.3.73 The Afon Alaw, the Afon Llywenan and Tan R'Allt have been assigned high values based on their regionally important functions draining directly into the Beddmanarch-Cymyran SSSI, which itself is assigned a high value. There is also a risk of fluvial flooding and combined tidal/fluvial flooding to residential buildings from the Afon Alaw and the Afon Llywenan. The smaller tributaries are designated as ordinary watercourses, and these have been assigned low values.

Fluvial geomorphology

8.3.74 Within the study area, the Afon Alaw flows through fields grazed by animals and with very little vegetated riparian/buffer zone present. There are some signs of natural adjustment in the form of erosion, particularly downstream of the A5025 crossing.

8.3.75 During a site survey in January 2016, the Afon Alaw was observed to have a relatively artificial uniform channel, particularly immediately upstream and downstream of the current A5025 bridge. At the location of the A5025 bridge, the channel appeared to have been straightened and modified for the road crossing and as a former water supply to a mill. The channel exhibited some signs of lateral adjustment further upstream with lengths of erosion and deposition visible, creating some variability in flow types. The channel had a pool-riffle sequence and several areas of poaching were visible along the channel, particularly where fencing (that would otherwise control

animals) was absent. A small weir was present immediately upstream of the A5025 bridge. The Afon Alaw is considered to have a medium value.

8.3.76 Within the study area, the Tan R'Allt had a sinuous planform with some lengths over which the channel appears to have been artificially straightened. During the site survey, the watercourse was found to be predominantly bordered by fields, containing semi-improved grassland or tilled arable land. There appeared to be very little vegetated riparian corridor present along either bank.

8.3.77 During the site survey in January 2016, the Tan R'Allt was noted to be laterally adjusting, with evidence of adjustment due to historical modifications such as artificial realignment. In the river channel, several lengths of erosion and deposition were observed to be creating variability in flow types, particularly downstream of the A5025 bridge crossing. The channel was approximately 2m to 2.5m wide within the study area, with the exception of areas where poaching by animals had locally widened the channel. Evidence of undercutting, slumping and vertical eroding banks within the study area indicated an active channel. Some depositional features were also observed to be present, with layers of old alluvium observed within the right bank of the channel. This suggests that the channel historically migrated across the floodplain, creating natural depositional features composed of gravels and cobbles. The Tan R'Allt is considered to have a medium value.

8.3.78 The Afon Llywenan was noted to have a laterally adjusting planform and measured approximately 0.5m to 1m wide within the study area. The channel had a continuous vegetated riparian corridor comprising shrubs and grasses. The bed substrate consisted of silt and fine gravel. The Afon Llywenan is considered to have a low value.

8.3.79 All other watercourses in the study area were noted to be artificially straightened arterial drainage channels, with very little geomorphological value and ephemeral flows. The other watercourses are considered to have a low value.

Water Framework Directive water bodies

8.3.80 The Alaw – downstream Llyn Alaw water body (GB110102058981) lies within the area covered by the Western Wales RBMP [RD6] and the river measures approximately 8.6km in length. The WFD water body is classed as a heavily modified water body and is assessed as achieving moderate ecological potential (see the Water Framework Directive Compliance Assessment, Application Reference Number: 8.26).

8.3.81 The Tan R'Allt water body (GB110102059100) lies within the area covered by the Western Wales RBMP and the river measures approximately 9.57km in length. The Tan R'Allt is assessed to be achieving moderate ecological status, and has no protected areas associated with it.

8.3.82 The Alaw transitional WFD water body (GB521010207600) also lies at the downstream extent of the study area. This is an estuarine area that is currently classified as achieving moderate ecological status.

8.3.83 Details of the WFD groundwater body (which is the same for the whole of the A5025 Off-line Highway Improvements) are provided in section 1 (Valley) of this chapter.

8.3.84 Further information on the WFD water bodies and the assessment of impact on these is reported in the WFD Compliance Assessment (Application Reference Number: 8.26).

Groundwater

8.3.85 The groundwater characteristics along section 3 are as described for section 1, with the exceptions outlined below.

Soils, geology and aquifer characteristics

8.3.86 A thin strip of alluvium comprising clay, silt, sand, gravels and organic soils is present in section 3 along the watercourses associated with the Afon Alaw and extends to the east and west. The deposits are from 0.3m to 3m thick. There are also glaciofluvial sand and gravel deposits to the west of the route. There is a small area in the middle of section 3 where superficial deposits are absent and bedrock crops out at the surface.

8.3.87 The alluvium extending east to west along the Afon Alaw is classed as a Secondary A aquifer having high vulnerability by NRW [RD6]. This is because the alluvium contains permeable layers capable of supporting water supplies at a local rather than strategic scale and form an important source of baseflow to rivers. However, AECOM 2016 [RD9] concluded that, although classified as a Secondary A aquifer, the non-extensive nature of the alluvium as thin shallow deposits means that it is not a potential potable water receptor, but it is considered as a potential pathway to surface water receptors. The Secondary A aquifer is assigned a medium value in this assessment.

Groundwater quality

8.3.88 Fifteen boreholes were sampled in the vicinity of section 3 on two occasions (one hole was sampled only once) towards the end of May 2016, and the results are provided in the Structural Soils ground investigation report [RD8]. The results have been compared to DWS for those parameters analysed, and the exceedances identified in table G8-1. In all cases, the mean concentration of each parameter was significantly below the limit value. The nitrate is likely to be of agricultural origin, but the source of the nickel is not known, although as it is less than twice the DWS it is not particularly high.

8.3.89 The Structural Soils report [RD8] indicates that there are a small number of exceedances of EQS, although the degree of exceedance is limited.

Table G8-1 Water quality exceedance against DWS

DWS parameter	Limit value	Llanfachraeth	Location
Nitrate (mg/l)	50	73	BHB6 – one occasion
Nickel (µg/l)	20	33	BHB6 – two occasions

Groundwater flow and levels

8.3.90 The AECOM 2016 groundwater monitoring investigation [RD9] recorded very variable groundwater levels. Where present, groundwater was struck at between 0.37m to 5.71m below ground level between 11 May 2016 and 2 June 2016.

8.3.91 The dominant groundwater flow direction in the bedrock at the regional scale is likely to be towards the coast in section 3. However, at the shallow, local-scale, groundwater will flow towards the many tributaries, streams and rivers in the area.

Groundwater abstractions

8.3.92 Data provided by the IACC indicates that there are two PWS within 500m of section 3 (see table G8-2 and figure G8-3, Application Reference Number: 6.7.48).

Table G8-2 PWS within 500m radius of section 3

Name	Address	Usage	Easting	Northing	Distance from scheme (m)	Direction from scheme
Mushroom Cottage	LL65 4UU	Resi-dential	231062	382878	500m	East
Erw Fawr	LL65 3HQ	Farm properties	231352	381994	450m	East

8.3.93 There are thirteen wells (including PWSs and wells shown on OS maps) within 500m of section 3: two within 50m, six between 50m and 250m and five between 250m and 500m. The wells are located in a variety of hydrogeological settings, mostly alluvial floodplain but also in bedrock with no superficial cover, or in glacial till. As detailed in section 1, as a precautionary measure, it is assumed that these wells are used for potable abstractions and are assessed as having medium value for the groundwater assessment.

8.3.94 The two PWSs known to the IACC are likely to be small supplies and the wells are likely to be relatively shallow and will have a limited zone of influence (in the region of 50-150m). Both are close to the limit of the study area and are in relatively close proximity to major watercourses which could potentially be influencing groundwater movement (depending upon well depth and construction). Given the absence of any dewatering associated with the scheme and the distance of the wells from any cuttings, these PWS

are unlikely to be affected by the route of the proposed A5025 Off-line Highway Improvements at section 3 and have been scoped out of the groundwater assessment.

8.3.95 Erw Goch well is located 45m west of section 3, downgradient, of the embankment and therefore is within a potential impact zone. Therefore, this well has been scoped in for assessment.

8.3.96 Bryn well is located 50m east of section 3 and is close to a junction, although it is not likely to be down hydraulic gradient of the main road improvements. Due to its proximity to the junction, Bryn well is scoped in. Bedo well is further from the road junction than Bryn well and is likely to be up hydraulic gradient of section 3 and is therefore scoped out of the assessment.

8.3.97 Pont yr Arw well is adjacent to the north of the Afon Alaw and 250m west of section 3. It is likely to be a shallow well with a local area of influence (of the order of 50-150m) and given its proximity to the Afon Alaw could be influenced by that river (depending upon well depth and construction). Furthermore, it is not in the vicinity of the proposed earthworks along the A5025 Off-line Highways Improvements. Therefore, it is scoped out of further assessment.

8.3.98 Moel Haul well is located 150m east of a proposed attenuation pond and 200m east of an embankment and could potentially be affected. However, it is likely to be up hydraulic gradient of the A5025 Off-line Highways Improvements and so this well is scoped out for assessment.

8.3.99 Ty'n Ffynnon well is located 138m south of section 3, up gradient of section 3 and is therefore scoped out of further assessment.

8.3.100 Roebuck well is 200m west of section 3. It is likely to be a shallow well with a limited radius of influence. As there is no dewatering planned as part of construction and no deep cuttings in the vicinity, it will not be affected by the A5025 Off-line Highway Improvements. It is therefore scoped out of further assessment.

8.3.101 Penyrorsedd well is adjacent to the eastern side of the Tan R'Allt and is located 250m from section 3 where section 3 ties into the A5025 at the northern extent. It is likely to be a shallow well with a limited radius of influence and the local groundwater is likely to be influenced by the adjacent river and not affected by the A5025 Off-line Highway Improvements. It is unlikely to be affected and has been scoped out of further assessment.

8.3.102 The remaining wells are located over 250m from section 3. Given the small size of these wells and limited radius of influence, along with the presence of hills, valleys, field drains, tracks and roads separating the wells from the scheme, these wells are unlikely to be affected by the A5025 Off-line Highway Improvements at section 3 and have been scoped out of the groundwater assessment.

Groundwater dependent terrestrial ecosystems

8.3.103 The Beddmanarch-Cymyran SSSI is down groundwater gradient of the scheme, so there is a potential groundwater flow path from the scheme to the SSSI. It is, however, primarily a surface water supported feature,

although there may be some limited groundwater dependency at the edges of the SSSI. In line with the assessment criteria in table B8-12 in chapter B8 (Application Reference Number: 6.2.8), the value of this receptor is assessed as high.

8.3.104 In addition to the SSSI, the riparian zone of the Afon Alaw may be groundwater dependent, as there is likely to be shallow groundwater baseflow from alluvium supporting the wetland. The value of this receptor is assessed as medium.

Buildings

8.3.105 There are buildings on the southern outskirts of Llanfachraeth on the immediate north and south sides of the Afon Alaw close to the embankment leading up to the Afon Alaw crossing. There is potential for reduction in groundwater levels due to the embankment, with decreasing risk with increasing distance. Buildings at over 50m from the embankment are considered unlikely to be at risk from it considering the low permeability nature of the local deposits and are therefore scoped out of this assessment.

8.3.106 There are a number of buildings along Parc Llynnon on the eastern outskirts of Llanfachraeth that are located less than 50m away from a proposed cutting, as well as several Grade II Listed Buildings in Llanfachraeth located 230m away from a cutting. The buildings less than 50m from the cutting are scoped in for assessment. The Listed Buildings are considered too distant from section 3 to experience effects and are therefore scoped out of the groundwater assessment. Although the well at Erw Goch is less than 50m from Section3, the buildings are over 70m from the road and so have been scoped out of the assessment.

Section 5: Llanfaethlu

Surface water

Catchment and water features

8.3.107 Section 5 falls primarily within the Tan R'Allt catchment, which drains an area largely to the east of the existing A5025, though does comprise a small area of land to the west, which includes Western Pond. Approximately 140m to the east of the existing A5025 is the East Drain. A review of historical mapping shows that a spring and watercourse (most probably the East Drain) was located to the west of the A5025. The associated watercourse, the East Drain, has since been culverted under the garage to the east of the existing A5025 and becomes visible at the eastern boundary of the Off-Site Power Station Facilities site, see chapter E8 (Surface water and groundwater, Application Reference Number: 6.5.8). It then flows as open channel to the east and discharges into a small watercourse, the Afon Llanrhyddlad, approximately 80m to the east. At this point, the catchment of the East Drain is approximately 0.2km^2. The Afon Llanrhyddlad flows in a southerly direction parallel to, and to the east of, the A5025 for around 6km prior to its confluence with the Tan R'Allt.

8.3.108 There are also a number of field drains and small ponds (less than 100m^2 in area) within the study area; however, none of these will be culverted or subjected to direct change by the section 5 proposals. Therefore, these have been scoped out of this assessment.

8.3.109 A small area of section 5 falls within the west of the coastal catchment draining to Holyhead Bay. The main watercourses within the 500m study area are the Afon Garreglwyd and Tan-y-bryn. Tan-y-bryn flows from Tan-y-bryn farm to the south of the A5025. The Afon Garreglwyd flows in a south-westerly direction and lies 750m from the northern extent of the section 5 at its nearest point. The Afon Garreglwyd flows into Llyn Garreglwyd, a SSSI, approximately 750m to the north-west of section 5.

Surface water dependent terrestrial ecosystems

8.3.110 Given its distance upstream of section 5, the Llyn Garreglwyd SSSI has been scoped out for further assessment.

Flood risk

8.3.111 The flood risk to the proposed A5025 Off-line Highway Improvements is detailed in the FCA included in appendix G8-1 (Application Reference Number: 6.7.20). This also includes details of the flood modelling undertaken.

8.3.112 Section 5 is wholly located in Flood Zone A, as defined in TAN 15 [RD1], and lies outside of all main river floodplains, as indicated by NRW river and sea flood mapping [RD2]. Therefore, section 5 is considered to be at low risk of fluvial and tidal flooding.

8.3.113 NRW surface water flood mapping [RD2] indicates a number of flow paths across the site, the most notable of which flows from the Western Pond in an easterly direction across the A5025 to the East Drain. The NRW mapping indicates a medium risk of flooding to the A5025. There are also flow paths associated with Tan-y-bryn ditch; however, the surface water flood risk is largely low and confined to the channels.

8.3.114 Pluvial modelling to determine the baseline surface water flood risk to the garage to the east of the A5025, see appendix E8-1 (Flood Consequences Assessment) (Application Reference Number: 6.5.16). Whilst this does not indicate the extent of pluvial flood risk throughout section 5, it provides an indicative flood depth in the area in which the main water features of section 5 are located. Peak flood depths during both the 1/30 year event and the 1/100 year event plus climate change (40%) are generally up to 0.1m at the garage.

8.3.115 There are a number of flood risk receptors within the study area. The A5025 is a high value flood risk receptor based on transport infrastructure being classed as essential infrastructure [RD1]. Multiple buildings in the vicinity of Llanfaethlu have been assigned high value flood risk receptors, in line with the TAN 15 advice, which states that all developments are highly sensitive. Agricultural land has been assigned a medium value.

8.3.116 The buildings considered flood risk receptors in section 5 include the church, post office and a new school opening in autumn 2017. These were not originally considered as flood risk receptors as they are located at a higher elevation than the proposed A5025 Highway Improvements. However, if there is alteration in the river regime then the flood risk to these receptors may increase, and so they have been included in the assessment.

8.3.117 As detailed in the FCA, appendix G8-1 (Application Reference Number: 6.7.20), the risk of flooding from groundwater, services and reservoirs is low.

Surface water quality

8.3.118 The Structural Soils ground investigation [RD10] excluded surface water sampling in section 5 given that this section does not cross a significant surface water feature.

Surface water abstractions and discharges

8.3.119 As per the information given in section 1, there are no recorded surface water abstractions or discharges within the study area.

Summary

8.3.120 Tan R'Allt has been assigned a high value, based on its regionally important function draining directly into the Beddmanarch-Cymyran SSSI. The Afon Llanrhyddlad, the East Drain, the Western Pond and Tan-y-bryn have been assigned a low value based on their ordinary watercourse designation and low fluvial flood risk. The Afon Garreglwyd feeds directly into the Llyn Garreglwyd SSSI, and therefore the Afon Garreglwyd has been assigned a high value.

Fluvial geomorphology

8.3.121 The Afon Llanrhyddlad, at the time of the site visit (in January 2016), was noted to be approximately 1m wide and 0.35m deep and banks measured approximately 1m high. Flow types were recorded as a mixture of run and glide and the substrate consisted of silt, gravel and cobbles. The Afon Llanrhyddlad is considered to have a medium value.

8.3.122 The Tan-y-bryn and other watercourses within the study area were recorded as predominantly small, artificially maintained drainage channels denoting field boundaries and with little fluvial geomorphological value. The Tan-y-bryn and other watercourses are considered to have a low value.

Water Framework Directive water bodies

8.3.123 All of the watercourses within the study area at section 5, Llanfaethlu form part of the Tan R'Allt WFD water body (GB110102059100). Information on the Tan R'Allt WFD water body has been detailed above under section 3 (Llanfachraeth). Information on the groundwater WFD water body is detailed above under section 1 (Valley).

Groundwater

8.3.124 The groundwater characteristics along section 5 are as described for section 1, with the exceptions outlined below.

Soils, geology and aquifer characteristics

8.3.125 Along the majority of section 5 superficial deposits are absent and bedrock crops out at the surface.

Groundwater quality

8.3.126 Samples were taken from three boreholes in the vicinity of section 5 on two occasions, at the end of April 2016 and at the end of May 2016 [RD10]. There were no exceedances of DWSs in any samples whilst a small number of samples exceeded EQS.

Groundwater flow and levels

8.3.127 The AECOM 2016 groundwater monitoring investigation [RD11] recorded very variable groundwater levels. Where present, groundwater was struck at between 0.59m and 5.5m below ground level between 14 April 2016 and 27 May 2016.

8.3.128 The dominant groundwater flow direction in the bedrock at the regional scale in section 5 is likely to be towards the coast. However, at the shallow, local scale, groundwater will flow towards the watercourses in the area.

Groundwater abstractions

8.3.129 Data provided by the IACC indicates that there is one PWS within 500m of section 5 (see table G8-3 and figure G8-4, Application Reference Number: 6.7.48).

Table G8-3 PWS within 500m radius of section 5

Name	Address	Usage	Easting	Northing	Distance from scheme (m)	Direction from scheme
Ty'n-y-Buarth	LL65 4NW	Residential	231615	387175	<50m	East

8.3.130 In section 5 there are ten wells within 500m of highway improvements; two within 50m, four between 50m and 250m and four between 250m and 500m. This section is mostly situated on bedrock with no superficial cover or on the interface between bedrock and till.

8.3.131 Ty'n-y-Buarth is located immediately adjacent to the northern tie in of section 3 into the A5025. There is potential that the PWS could be affected by the A5025 Off-line Highway Improvements at section 5, therefore it is scoped in for further assessment. The PWS has been assessed as having medium value.

8.3.132 At Mountain View there is a well located within 50m of the southern end of section 5, which although at the limit of the proposed works is close to them.

As it is potentially down groundwater gradient and there could be a flow path towards the well. Therefore, due to its proximity, it is scoped in for further assessment, although there are no significant works at this end of the section of road.

8.3.133 Four wells to the east of the section, at Sisial y Nant, Cae'r-brynlau, Berth and Hen-shop, are located up gradient of the A5025 Off-line Highway Improvements and in some instances, separated from the scheme by watercourses and/or drainage ditches. The closest of these wells is located 130m east of the scheme at Hen-shop, at the head of a tributary of an unnamed ordinary watercourse, which flows south-west away from the scheme. Given their small sizes, distances from the scheme, and the limited flow paths in the aquifer, these wells are unlikely to be affected by the development and are scoped out of the groundwater assessment.

8.3.134 Tan-y-bryn well is about 350m west of the A5025 Off-line Highways Improvements and is close to the Tan-y-bryn watercourse, which may influence groundwater movement to the well depending upon its depth and construction. It is therefore scoped out of further assessment.

8.3.135 The well north of Plas Uchaf and just south of Llanfaethlu is at a distance of 250m from the scheme. The well is likely to be small and shallow with a limited radius of influence, and although it is potentially down gradient from section 5, it is scoped in for further assessment.

8.3.136 The well 290m to the north of section 5 is down gradient of the scheme but there is substantial infrastructure separating it from the scheme and consequently shallow groundwater continuity is unlikely. It is therefore not scoped in for further assessment.

8.3.137 A well to the south of the section is 450m distant and separated from the scheme by ditches. It is therefore not scoped in for further assessment.

Groundwater dependent terrestrial ecosystems

8.3.138 There are no SSSIs or other sensitive ecological areas that could be regarded as groundwater-dependent terrestrial ecosystems within 500m of section 5 of the A5025 Off-line Highway Improvements.

Buildings

8.3.139 Buildings at Rhos-ty-mawr (18m from a new road cutting) and Ty'n-y-buarth (10m from a new road cutting) have the potential for a reduction in groundwater levels due to the new road cutting, albeit that Ty'n-y-buath is at the end of the cutting with limited potential for an effect. These buildings are therefore scoped in for assessment. The value of these receptors is assessed as high for the groundwater assessment.

8.3.140 A Grade II Listed Building is located approximately 200m from the northern end of section 5, but there are no significant embankments or cuttings nearby. This is therefore scoped out of the assessment as being too distant from the section for any effects.

Section 7: Cefn Coch

Surface water

Catchment and water features

8.3.141 The Afon Cafnan issues to the north-west of Llanrhyddlad on the western side of the existing A5025. The watercourse flows in a northerly direction in parallel to section 7 and ultimately outfalls into Porth-y-pistyll on the northern coastline. The Afon Cafnan is designated a main river.

8.3.142 Nant Llygeirian outfalls from Llyn Llygeirian (SSSI) and joins the Afon Cafnan to the west of the A5025. Nant Llygeirian is designated as an ordinary watercourse.

8.3.143 There are a number of small drainage channels located within the study area, including the Bod-hedd Drain and the Afon Cefn-coch. These are not culverted or subjected to direct change by the section 7 proposals; however, they are located within 100m of the proposed section 7 route.

Surface water dependent terrestrial ecosystems

8.3.144 The Llyn Llygeirian SSSI is located approximately 500m east of the proposed route of section 7 of the A5025 Off-line Highway Improvements, and 430m from the cutting at the north end of this section of the proposed road. However, given that it is some 300m upstream of section 7, Llyn Llygeirian SSSI has been scoped out of further assessment.

8.3.145 The Cae Gwyn SSSI is located approximately 900m north-west of the proposed route of section 7 of the A5025 Off-line Highway Improvements and is largely surface water fed. There are several hills and valleys between the SSSI and section 7, and none of the watercourses within the section 7 study area discharge into the SSSI. Therefore, the SSSI has been scoped out for further assessment in relation to section 7.

Flood risk

8.3.146 The flood risk to the proposed A5025 Off-line Highway Improvements is detailed in the FCA included in appendix G8-1 (Application Reference Number: 6.7.20). This also includes details of the flood modelling undertaken.

8.3.147 Section 7 is partially located in Flood Zone C2, as defined in TAN 15 [RD1], and at high risk of fluvial flooding from the Afon Cafnan. This flood zone largely comprises lower land to the west of the Afon Cafnan.

8.3.148 Baseline modelling (see appendix G8-1, Application Reference Number: 6.7.20) indicates that the 1/100 year event plus climate change (30%) extends only slightly to the east of the Afon Cafnan to a peak flood depth of 0.5m. During the 1/20 year event, the flood extent is much smaller and the peak flood depth is up to 0.25m.

8.3.149 There are a number of flood risk receptors within the study area. The A5025 is a high value flood risk receptor as transport infrastructure is classed as essential infrastructure [RD1]. Multiple buildings along the section 7 route

have been assigned high value flood risk receptors, in line with the TAN 15 advice, which states that all developments are highly sensitive. Agricultural land has been assigned a medium value.

8.3.150 Within the section 7 study area, one residential property is shown to be at risk of fluvial flooding. A terrace of properties is located very close to the Afon Cafnan at the northern extent of section 7, the furthest west of which falls within the floodplain. The peak flood depth during the 1/100 year event plus climate change (30%) is 0.5m.

8.3.151 NRW surface water flood mapping [RD2] indicates that the surface water flood risk is largely low and correlates with the fluvial risk. This includes a low risk of surface water flooding across the A5025 to the north-west of Cefn Coch village. Areas of high surface water flood risk are evident from the mapping on the lower (agricultural) land to the west of the A5025.

8.3.152 As detailed in the FCA, appendix G8-1, (Application Reference Number: 6.7.20), the risk of flooding from groundwater, services and reservoirs is low.

Surface water quality

8.3.153 Surface water samples were taken from four locations on the Afon Cafnan and Nant Llygeirian across three rounds of sampling (12 samples in total) between March and April 2016 [RD12]. The majority of the determinands screened were below the respective EQS; however, exceedances were identified in all samples for fluoranthene, benzo(g,h,i)pyrene, chromium (III), copper and zinc [RD13].

8.3.154 Concentrations of determinands which did exceed the EQS were not found consistently in each of the three sampling rounds, which indicates that concentrations are fluctuating and there is not a consistent contaminant source [RD12].

Surface water abstractions and discharges

8.3.155 There are no recorded surface water abstractions or discharges in the study area.

Summary

8.3.156 In summary, the Afon Cafnan has been assigned a high value based on its fluvial flood risk to a residential property. Nant Llygeirian, Bod-hedd Drain and the Afon Cefn-coch have been assigned a low value based on their ordinary watercourse designation.

Fluvial geomorphology

8.3.157 Two water sources feed the Afon Cafnan: one from Llyn Llygeirian and one from Llanrhyddlad. The Afnon Cafnan flows northwards for approximately 5km, where it then reaches the Irish Sea at Porth-y-pistyll. Much of the channel has been realigned and now has an artificially straightened planform. It is likely that this is a result of the channel being realigned to form field boundaries and to facilitate field drainage in the past. There are, however, lengths (e.g. downstream of Mynydd-Ithel) with signs of natural

adjustment where the channel is more sinuous. This adjustment occurs within the confines of a relatively narrow river corridor.

8.3.158 The Afon Cafnan within the study area was noted to have a small channel with signs of natural processes and adjustment, with some meandering. Areas of deposition and erosion were also observed. A natural bedrock cascade was noted to be present within the study area immediately downstream of the small road crossing to Pen-yr-orsedd. This is of high sensitivity as it provides geomorphological diversity within the catchment and is a unique feature within the watercourse.

8.3.159 During the site visit in January 2016, the channel was on average approximately 0.8m to 1m wide with areas of animal poaching and enhanced erosion causing it to be locally wider in some reaches. The average water depth ranged from 0.1m to 0.3m. The longitudinal connectivity of the watercourse was impacted by culverts and bridges throughout its length. Some areas of good flow diversity were noted and the bed substrate typically consisted of gravels. A vegetated riparian corridor was observed. The Afon Cafnan is considered to have a medium value.

8.3.160 To the east of the A5025 at Cefn-coch village a small watercourse, known as the Afon Cefn-coch, was noted to flow north around the village and then west to its confluence with the Afon Cafnan. The watercourse was observed to be approximately 0.5m wide with a silt bed. A semi-continuous line of shrubs was noted along the left bank, with improved grassland along the right bank. Limited geomorphological features were observed. The Afon Cefn-coch is considered to have a low value.

Water Framework Directive water bodies

8.3.161 All watercourses within the section 7 study area form part of The Skerries WFD coastal water body (GB611010390000). The Skerries is approximately 47km^2 and is currently achieving good ecological status. Further information on the WFD is reported in the WFD Compliance Assessment (Application Reference Number: 8.26).

8.3.162 The Llyn Llygeirian, which feeds into the Afon Cafnan, is also classified as a WFD water body (GB31032435) and is located 500m to the east of the A5025. The WFD water body has been scoped out of detailed assessment due to its distance from the proposed route of the A5025 Off-line Highway Improvements and location upstream of the works.

8.3.163 Details of the WFD groundwater body can be found in section 1 (Valley).

Groundwater

8.3.164 The groundwater characteristics along section 7 are as described for section 1, with the exceptions outlined below.

Soils, geology and aquifer characteristics

8.3.165 The main area where superficial deposits are absent and bedrock outcrops at the surface is a small area at the southern end of section 7.

Groundwater quality

8.3.166 Eight ground investigation boreholes [RD13] were sampled on two occasions in May 2016 and the analytical results, which are provided in the AECOM report [RD12], have been compared against the DWS. The only exceedances are a very slight exceedance of the nickel DWS in BHD14 on both occasions and Benzo(ghi)perylene which has a concentration of 0.17µg/l compared to a DWS of 0.1µg/l on one occasion (the second occasion it was less than limit of detection).

Groundwater flow and levels

8.3.167 The AECOM 2016 groundwater monitoring investigation [RD12] recorded very variable groundwater levels. Where present, groundwater was struck at between 0.95m and 5.86m below ground level, between 27 April 2016 and 26 May 2016.

8.3.168 The dominant groundwater flow direction in the bedrock at the regional scale is likely to be northerly in section 7, following the general trend of surface water. However, at the shallow, local scale, groundwater will flow towards watercourses in the area.

Groundwater abstractions

8.3.169 Data provided by the IACC indicates that there is one PWS within 500m of section 7 (as detailed on table G8-4 and shown on figure G8-5) (Application Reference Number: 6.7.48). Wells shown on OS maps are also shown on figure G8-5 (Application Reference Number: 6.7.48).

Table G8-4 PWS within 500m radius of section 7

Name	Address	Usage	Easting	Northing	Distance from scheme (m)	Direction from scheme
Cefn Coch	LL68 0SW	Residential/ agricultural	234245	390719	100m	East

8.3.170 In section 7, there are six wells within 500m of the scheme; three within 250m and three between 250m and 500m. These wells are mostly located in glacial till, although a few in the south could be in bedrock.

8.3.171 The PWS at Cefn Coch is located to the east of the section 7 and it is likely to be located up groundwater gradient of the development, at the northern end close to the connection between the existing A5025 and the proposed new road. Although the PWS is likely to be up gradient, it is only located 60m from the road improvements and on a precautionary basis has therefore been scoped in. The wells shown on OS mapping located 360m and 280m west of, and at the northern end of section 7, are potentially down gradient from it, although they are to the north of section 7. The most distant of the two wells is immediately adjacent to a small watercourse which is likely to have a significant influence on it. The closer well does not appear to be associated with a surface water feature, nor is it located in close proximity to any properties. Given the location of the wells with respect to the proposed

A5025 Off-line Highways Improvements, and their nature, they are both scoped out of the assessment.

Groundwater dependent terrestrial ecosystems

8.3.172 The Llyn Llygeirian SSSI is approximately 500m east of the proposed route of section 7 of the A5025 Off-line Highway Improvements, and 430m from the cutting at the north end. The SSSI citation for Llyn Llygeirian does not identify groundwater as being a significant source of water in the maintenance of the lake, and the dominant inflow into the SSSI is a watercourse. The SSSI is up groundwater gradient from section 7 and therefore it is scoped out of further assessment.

8.3.173 The Cae Gwyn SSSI is approximately 900m north-west of the proposed route of section 7 of the A5025 Off-line Highway Improvements and is largely surface water fed. There are several hills and valleys between Cae Gwyn SSSI and section 7, as well as a series of igneous dykes which could possibly further create a groundwater flow barrier to the SSSI. The SSSI has therefore been scoped out for further assessment.

Buildings

8.3.174 Tyn Felin is located 50m east and up gradient of an embankment in the south of the scheme. An isolated building to the south of Cefn-coch and buildings on the western edge of Cefn-coch (including a Grade II Listed Building) are located 50m and 60m up gradient from a cutting. In addition, buildings around the mid-section are 35m from a cutting. With all of these, there is a potential for reduction in groundwater levels on the up gradient side of the scheme. However, all buildings, with the exception of Tyn Felin, are on low permeability deposits and located the other side of the existing road from the works. In addition to this, maximum groundwater levels recorded by monitoring installations in boreholes in April 2016 were below the base of the proposed cuttings. Consequently, all are scoped out of further assessment.

Power Station Access Road Junction

Surface water

Catchment and water features

8.3.175 Nant Caerdegog Isaf issues from the Cae Gwyn SSSI approximately 300m to the south-west of the Power Station Access Road Junction. The Cae Gwyn SSSI is a system of basin mires separated by dry heathland habitat. Nant Caerdegog Isaf flows northwards within 200m of the western boundary of the Power Station Access Road Junction.

8.3.176 Nant Cemaes flows from south to north approximately 200m to the east of the A5025 and onwards into Cemaes Bay. Both Nant Caerdegog Isaf and Nant Cemaes are designated as main rivers.

Surface water dependent terrestrial ecosystems

8.3.177 The Cae Gwyn SSSI is largely surface water fed and is located 300m from the Power Station Access Road Junction. In line with the assessment criteria in table B8-12 in chapter B8 (Application Reference Number: 6.2.8), the value of this receptor is assessed as high.

Flood risk

8.3.178 The Power Station Access Road Junction is wholly located in Flood Zone A, as defined in TAN 15 [RD1]. This correlates with fluvial modelling for the Wylfa Newydd Development Area (see appendix D8-4, Flood Consequences Assessment, Application Reference Number: 6.4.29). Therefore, the Power Station Access Road Junction is considered to be at low risk of fluvial and tidal flooding. No high value receptors are shown to be at risk of flooding.

8.3.179 NRW surface water flood mapping [RD2] indicates no surface water flood risk areas within the Power Station Access Road Junction area. This correlates with pluvial modelling of the Power Station Site. Therefore, the Power Station Access Road Junction is considered to be at low risk of pluvial flooding.

8.3.180 There are a number of flood risk receptors within the study area. The A5025 is a high value flood risk receptor based on transport infrastructure being classed as essential infrastructure [RD1]. Cae Gwyn SSSI to the west of the proposed Power Station Access Road Junction is also a very high flood risk receptor based on its SSSI designation [RD1]. Two residential properties at Groes-fechan have been assigned high value flood risk receptors, in line with the TAN 15 advice, which states that all developments are highly sensitive. Agricultural land has been assigned a medium value.

8.3.181 Small pockets of agricultural land close to the Cae Gwyn SSSI and a very small area of the Cae Gwyn SSSI are shown to be at high risk of surface water flooding, based on NRW mapping. No building receptors are shown to be at risk of flooding.

8.3.182 As detailed in the FCA (appendix G8-1, Application Reference Number: 6.7.20), the risk of flooding from groundwater, services and reservoirs is low.

Surface water quality

8.3.183 No ground investigation was undertaken specifically at the Power Station Access Road Junction. Details on the water quality of Nant Caerdegog Isaf and Nant Cemaes are detailed in appendix D8-1 (Surface Water Baseline Report) (Application Reference Number: 6.4.26).

Surface water abstractions and discharges

8.3.184 There are no recorded surface water abstractions or discharges in the study area.

Summary

8.3.185 In summary, Nant Caerdegog Isaf and Nant Cemaes have been assigned a medium value based on their main river designation. The origin of the

watercourse from the Cae Gwyn SSSI does not have an impact on the value as Nant Caerdegog Isaf is a downstream feature. The risk of flooding to the Cae Gwyn SSSI from Nant Caerdegog Isaf is minimal and largely low.

Fluvial geomorphology

8.3.186 The Nant Caerdegog Isaf is located to the west of Tregele and the A5025. During the site survey in January 2016, the watercourse was observed to have an artificially straight planform with a uniform and modified channel cross-section. The substrate was mainly silt with some fine gravel. The watercourse overall was a sediment sink, i.e. it was locally narrowing as a result of areas of sediment deposition in an over-wide channel. The Nant Caerdegog Isaf is considered to have a low value.

8.3.187 Within the study area, the Nant Cemaes is a small watercourse with an artificially straightened planform. During the site survey in January 2016, limited significant vegetated riparian zone was observed; however, the channel had some trees on the banks providing intermittent shade to the channel. The Nant Cemaes is considered to have a low value.

Water Framework Directive water bodies

8.3.188 The Nant Caerdegog Isaf lies to the north of the study area and forms part of The Skerries WFD coastal water body. The WFD water body is currently achieving high status. The Nant Cemaes is to the south of the study area which lies within the Anglesey North WFD coastal catchment area which is currently achieving moderate status. Details of the WFD groundwater body are provided in section 1 (Valley).

Groundwater

8.3.189 The groundwater characteristics for the Power Station Access Road Junction are as described for section 1, with the exceptions outlined below.

Groundwater quality

8.3.190 There have not been any boreholes drilled at this junction associated with the proposed A5025 Offline Highway Improvements. However, there are two boreholes (boreholes RGMBH7 and RGMBH13) within the access road junction study area, installed as part of the Wylfa Newydd Development Area ground investigation, that have been sampled on an approximately quarterly basis, between December 2014 and August 2017.

8.3.191 The results have been compared to DWS and EQS for all parameters analysed, with the DWS exceedances identified in table G8-5. In all cases, the mean concentration of each parameter was significantly below the DWS, with the only exception being concentrations of manganese, which is considered a natural exceedance derived from the bedrock geology and not the result of contamination. The ammonia, nitrate and nitrite are likely to be of agricultural origin, but the source of nickel, aluminium and iron is not known, although these exceedances occur only once or twice over the two-year monitoring period.

Table G8-5 Water quality exceedances in monitoring boreholes

DWS parameter	Limit	Exceedance value	Borehole No. / occasion
Ammoniacal Nitrogen (mg/l)	0.5	5.2/0.6	RGMBH7 – one occasion RGMBH13 – one occasion
Nitrite (mg/l)	0.15	0.2	RGMBH13 – one occasion
Nitrate (mg/l)	11	21	RGMBH13 – one occasion
Nickel (µg/l)	20	39	RGMBH13 – one occasion
Manganese (µg/l)	50	75-1243	RGMBH7 – ten occasions RGMBH13 – six occasions
Aluminium (µg/l)	200	897/280	RGMBH7 – one occasion RGMBH13 – one occasion
Iron (mg/l)	0.2	0.4-1.8	RGMBH7 – one occasion RGMBH13 – three occasions

Groundwater flow and levels

8.3.192 Recorded bedrock groundwater levels show a maximum fluctuation of 1.1m at RGMBH7 and 4.0m at RGMBH13 between March 2015 and August 2017. Groundwater levels range from between 2.0m to 3.2m below ground level at RGMBH7 and 1.0m and 5.0m below ground level at RGMBH13, throughout the monitoring period.

8.3.193 The dominant groundwater flow direction in the bedrock at the regional scale is likely to be northerly, following the general trend of surface water. However, at the shallow, local scale, groundwater will flow towards watercourses in the area.

Groundwater abstractions

8.3.194 Data provided by the IACC indicates that there is a single residential PWS that lies 460m east of the Power Station Access Road Junction (see table G8-6 and figure G8-6 in Application Reference Number: 6.7.48).

Table G8-6 PWS within 500m of the Power Station Access Road Junction

Name	Address	Usage	Easting	Northing	Distance from scheme (m)	Direction from scheme
Foel Fawr	LL67 0DP	Residential	235776	391990	460m	East

8.3.195 In addition to the well at Foel Fawr, OS mapping shows the presence of two other wells within 500m of the Power Station Access Road Junction; one well within 250m and the second well approximately 400m to the south-west.

8.3.196 Abstractions from Secondary B aquifers are small as, due to the inherent nature of the aquifers, they cannot support large abstractions. The typical recharge area/zone of influence for a small abstraction in a Secondary B

aquifer is likely to be of the order of 50 to 150 metres. Given the distance of the wells from the scheme, the absence of any dewatering or deep cuttings and their location, these wells are unlikely to be affected and are therefore scoped out of the assessment.

Buildings

8.3.197 Buildings at Groes-fechan are within 200m south of the junction. The scheme and the buildings are located on glacial till and there is very limited cut and only a small section of embankment. The buildings could be down groundwater gradient from the works but only a small part of the groundwater flow to the area could be affected. They are therefore scoped out for further assessment.

Summary of receptors

8.3.198 All of the receptors that potentially could be impacted by the A5025 Off-line Highway Improvements are listed in table G8-7 along with the value of each receptor.

Table G8-7 Summary of receptor values

Key receptors	Section	Value[1]
Surface water		
Afon Cleifiog: main river which flows into Holyhead Straight and presents a flood risk to flood risk receptors including the A5025, A5 and multiple properties	1	High
Cleifiog Isaf: tributary to the Afon Cleifiog, flows parallel to the A5025	1	Medium
Cleifiog Fawr: tributary to the Afon Cleifiog, is culverted beneath the A5025	1	Medium
Unnamed tributary: tributary to the Cleifiog Fawr, open channel adjacent to the A5025	1	Low
Service Station and residential buildings 150m west of section 1, at risk of fluvial and tidal flooding	1	High
Commercial buildings 200m south-west of section 1, at risk of fluvial and tidal flooding	1	High
Agricultural land at risk of flooding	1, 3, 5, 7 and Power Station Access Road Junction	Medium
Afon Alaw: main river which outfalls to Holyhead Bay and presents a flood risk to flood risk receptors including the A5025 and residential properties	3	High
Afon Llywenan: main river and main tributary to the Afon Alaw, and presents a flood risk to flood risk receptors including the A5025 and residential properties	3	High

Key receptors	Section	Value[1]
Tan R'Allt: main river which discharges to the Alaw estuary	3 and 5	High
Beddmanarch-Cymyran SSSI: located to the west of section 3, and encompasses the Alaw estuary	3	High
Smaller tributaries and pond: feed the main rivers and provide drainage routes for surface flows	3	Low
Farm 220m north-east of section 3, at risk of fluvial flooding	3	High
Two buildings north of the Afon Alaw, at risk of fluvial flooding	3	High
Afon Llanrhyddlad: tributary of Tan R'Allt, flows in a southerly direction parallel to A5025	5	Low
East Drain: tributary to the Afon Llanrhyddlad	5	Low
Western Pond	5	Low
Afon Garreglwyd: flows in a south-westerly direction and outfalls to Llyn Garreglwyd SSSI	5	High
Tan-y-bryn: located to the south of the A5025	5	Low
Afon Cafnan: main river which flows parallel to section 7 and outfalls to Porth-y-Felin. It presents a flood risk to flood risk receptors including the A5025 and a residential property	7	High
Afon Cefn-Coch	7	Low
Bodd-hed Drain and small drainage channels	7	Low
Residential properties at Cefn Coch and north of A5025: one of these properties is at risk of fluvial flooding	7	High
Nant Caerdegog Isaf: originates from Cae Gwyn SSSI and flows north	Power Station Access Road Junction	Medium
Nant Cemaes: flows south to north on the eastern side of the A5025	Power Station Access Road Junction	Medium
Fluvial geomorphology		
Afon Cleifiog – artificially modified channel with a uniform cross-section and straight planform	1	Low
Cleifiog Isaf – artificially straightened arterial drainage ditches with few geomorphological features	1	Low
Cleifiog Fawr – artificially straightened arterial drainage ditches with few geomorphological features	1	Low

Key receptors	Section	Value[1]
Afon Alaw – historically modified channel with evidence of channel adjustment and geomorphological features (including a pool-riffle sequence and deposits)	3	Medium
Tan R'Allt – laterally adjusting channel with erosion and deposition	3	Medium
Afon Llywenan – laterally adjusting channel, with silt and fine gravel bed	3	Medium
Afon Llanrhyddlad – small watercourse with varied flow and coarser bed substrate	5	Medium
Tan-y-bryn – a small artificially maintained channel	5	Low
Afon Cafnan – a historically modified channel with signs of natural adjustment and geomorphological features (including a bedrock cascade of high sensitivity)	7	Medium
Afon Cefn-coch – a small historically modified channel with limited signs of geomorphological features	7	Low
Nant Caerdegog Isaf – a uniform, modified channel	Power Station Access Road Junction	Low
Nant Cemaes – a small watercourse with artificially straightened planform	Power Station Access Road Junction	Low
Other unnamed watercourses (i.e. drains) – artificially straightened arterial drainage ditches	1, 3, 5	Low
Groundwater		
Secondary B Bedrock aquifer: the aquifer forms part of the Ynys Môn Secondary WFD groundwater body	All	Low
Groundwater supported water bodies: groundwater flows that form a local source of baseflow to rivers	All	Low
Groundwater in the glacial till Secondary (undifferentiated) aquifer	All (except 5)	Low
Groundwater in the alluvium: a Secondary A aquifer with high vulnerability	3	Medium
Beddmanarch-Cymyran SSSI: located within a groundwater flow path	3	High
Riparian zone of the Afon Alaw: possibility for limited groundwater dependency	3	Medium
Wells: shown on OS mapping or from the IACC list of private abstractions: Section 3: at Erw Goch and Bryn well	3, 5, 7, Power Station	Medium

Key receptors	Section	Value[1]
Section 5: Ty'n-y-Buarth and Mountain View wells Section 7: Cefn Coch and unnamed wells All assumed to be for potable abstractions	Access Road	
Buildings: located near to cuttings in the groundwater study area	3	Medium
Buildings: located near to substantial embankments or cuttings within the groundwater study area	5	Medium
PWS: 100m west of the scheme	7	Medium

Note [1]: basis of value is defined in table B8-12 in chapter B8 (Application Reference Number: 6.2.8)

Evolution of the baseline

8.3.199 Over a medium- to long-term time period, climate change could potentially alter the hydrological regime of the watercourses. This is assessed as part of the surface water baseline. Baseline modelling (included within appendix G8-1, Application Reference Number: 6.7.20) includes allowances for climate change. Increased frequency/severity of droughts and floods could potentially lead to the watercourses adjusting to different patterns of erosion and deposition. However, it is likely that the adjustment would remain localised and of relatively minor magnitude given the channel types.

8.3.200 The Afon Cleifiog, Afon Alaw, Tan R'Allt and Afon Cafnan are currently exhibiting evidence of channel adjustment. The channels have been assessed as having a low to moderate energy, with limited competence to actively move the course of the planform. It is anticipated that if left undisturbed, the watercourses would continue to adjust slowly laterally within the defined wider corridor.

8.3.201 The remaining channels exhibit less evidence of adjustment, with lower energies (arising from a combination of low slope/discharge). The channel of the small watercourse at Cefn-coch was observed to exhibit some localised adjustment, and it is anticipated that this could continue to change. The remaining smaller watercourses were observed to be typically artificial field drains and artificial extensions to the drainage network. These could potentially continue to receive fine sediment, which would become deposited and, in the absence of maintenance to remove accumulated deposits, remain on the channel bed.

8.3.202 The Western Wales RBMP [RD6] provides details of the anticipated ecological status for the WFD water bodies within the study area for years 2021 and subsequently 2027. As suitable RBMP mitigation is put in place, it is anticipated that the WFD water body statuses and individual quality elements (including water quality and fluvial geomorphology) would improve, potentially from moderate to good.

8.3.203 It is not anticipated that there would be any significant changes to the groundwater regime, unless there are any new abstractions in the area; this is currently assessed as unlikely.

8.3.204 Changes to the current baseline are therefore likely to be limited in the foreseeable future.

8.4 Design basis and activities

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

8.4.2 As described in chapter G1 (proposed development) (Application Reference Number: 6.7.1), the application for development consent for the A5025 Off-line Highway Improvements is based on the designs shown on the Works Plans (Application Reference Number: 2.3) within the limits of deviation specified. As there is only very limited potential for movement within the limits of deviation, and within these the width of the road and design and operation of the drainage would remain unchanged, there would not be any change to the rainfall / runoff relationship, nor to outfalls to watercourses, nor to effects on groundwater quality or movement. This chapter has therefore assessed a worst case scenario from a surface water and groundwater perspective, taking into account the flexibility afforded by the Works Plans (Application Reference Number: 2.3) and limits of deviation described in chapter G1 (Application Reference Number: 6.7.1) and the basis of assessment and assumptions outlined below.

Construction

Basis of assessment and assumptions

8.4.3 The activities that are relevant to surface water and groundwater associated with the construction of the A5025 Off-line Highway Improvements that have been assessed within this chapter include:

- removal of vegetation and topsoil;
- landscape mounding;
- establishment of site compounds;
- establishment of temporary haul roads;
- construction of the road (assuming a maximum limit of deviation along the centre line of 2m);
- construction of the viaduct and culverts;
- construction of road drainage, attenuation ponds and outfalls;
- earthworks associated with construction of embankments and cuttings; and
- installation of fencing where it crosses drainage channels.

8.4.4 There are four site compounds, one for each section of the road, (excluding the Power Station Access Road Junction), and they each include the

following: material storage area, plant storage area, parking, offices and welfare facilities. The outline design of the compounds is detailed in chapter G1 (Application Reference Number: 6.7.1), with those elements of relevance to the water environment, that are included in this assessment outlined below:

- each compound would have a re-fuelling area that would include a diesel storage and dispensing area;
- the whole compound would be surfaced with permeable hard core except the fuel storage and dispensing areas which would be surfaced with concrete and have integrated drainage;
- the drainage from the fuel storage and dispensing compound would be collected and would pass through an oil/water interceptor prior to discharge to either soakaway or watercourse (if present);
- the volume of fuel stored would be between 10,000 and 20,000 litres and this would be located in a double bunded facility with vehicle damage protection;
-
- there would not be any refuelling outside of the fuel storage area; and
- all foul water would be stored on-site, transferred to a tanker and taken off-site to an appropriately licensed facility.

8.4.5 It has been assumed that all the water supply for construction of the A5025 Off-line Highway Improvements will come from mains water provided by Dŵr Cymru Welsh Water. As the water demand will not be substantial and will only be for the duration of construction the additional requirement will be met from existing mains capacity.

Embedded mitigation

8.4.6 Design of the final A5025 Off-line Highway Improvements layout has been an iterative process. The A5025 Off-line Highway Improvements is set out in the Design and Access Statement, volume 3 (Associated Developments and Off-Site Power Station Facilities) (Application Reference Number: 8.2.3) and has been designed to reduce the potential effects of the development on wetland habitats which may have groundwater dependency by keeping the footprint of the development as far from such wetland habitats as practicable.

8.4.7 Floodplain compensatory storage has been incorporated into the design at section 1 (Valley) (see Design and Access Statement, volume 3, Application Reference Number: 8.2.3). This compensatory storage will not impact on the highway drainage scheme.

Good practice mitigation

8.4.8 Good practice mitigation would comprise the adherence to all relevant legislation, statutory and non-statutory guidance as detailed in section 8.2 of chapter B8 (Application Reference Number: 6.2.8) and as stated in the Wylfa

Newydd Code of Construction Practice (CoCP) (Application Reference Number: 8.6).

8.4.9 The Wylfa Newydd CoCP (Application Reference Number: 8.6) and A5025 Off-line Highway Improvements sub-CoCP (Application Reference Number: 8.12) set out the overarching requirements to protect watercourses, control pollution and manage flood risk, which should be applied across the A5025 Off-line Highway Improvements site through the construction period. The Wylfa Newydd CoCP (Application Reference Number: 8.6) and the A5025 Off-line Highway Improvements sub-CoCP (Application Reference Number: 8.12) detail good practice procedures that Horizon will need to ensure are followed during the construction of the Wylfa Newydd Project. Prior to commencement of works, the Contractor would be required to prepare a Construction and Environmental Management Plan which will be in accordance with the Wylfa Newydd CoCP (Application Reference Number: 8.6) and ensure that the mitigation identified in the Wylfa Newydd CoCP and A5025 Off-line Highway Improvements sub-CoCP (Application Reference Number: 8.12) is delivered. Overarching requirements particularly pertinent to this assessment, and which are detailed in the Wylfa Newydd CoCP (Application Reference Number: 8.6) and A5025 Off-line Highway Improvements sub-CoCP (Application Reference Number: 8.12), include the following:

- Horizon will carry out a risk assessment for all works within 15m of watercourses, including but not limited to, clearance adjacent to watercourses, construction of bridges and drainage outfalls. Furthermore, a risk assessment will be undertaken for use of any cementitious materials within 50m of any active watercourse. Appropriate controls, proportionate to the level of risk identified, will be applied to the works.
- Measures will be taken to prevent the deposition of silt or other material arising from work operations in existing watercourses or catchment areas. The measures will accord with the principles set out in industry guidelines, outlined in the Wylfa Newydd CoCP (Application Reference Number: 8.6).
- No fuel, oil or chemical substances will be stored within 15m of a watercourse.
- Any containers of contaminating substances on-site shall be leak-proof and kept in a safe and secure building or compound from which they cannot leak, spill or be open to vandalism. The containers will be protected by temporary impermeable bunds (or drip trays for small containers) with a capacity of 110% of the maximum stored volume. Areas for transfer of contaminating substances (including refuelling areas) will be similarly protected and have appropriate spill kits.
- Horizon shall employ protective measures to control the risk of pollution to groundwater, which will, in particular, be consistent with the Environmental Permitting (England and Wales) Regulations 2016.

8.4.10 Good practice mitigation during construction would include following guidance on pollution control and relevant Construction Industry Research and Information Association (CIRIA) guidance on good construction practice:

- *Environmental Handbook for Building and Civil Engineering Projects* (3 Parts) (C512, C528, C529) [RD14, RD15, RD16];
- *Control of water pollution from construction sites. Guidance for consultants and contractors* (C532) [RD17];
- *Environmental good practice on site guide* (fourth edition) (C741) [RD18];
- *Land use management effects on flood flows and sediment – guidance on prediction* (C719D) [RD19];
- *The SuDS Manual* (C753) [RD20];
- *Development and flood risk – guidance for the construction industry* (C624) [RD21]; and
- *Culvert Design and Operating Guide* (C689) [RD22].

8.4.11 Specific good practice mitigation would include the following:

- During construction, Horizon will maintain, as far as practicable, 15m vegetated buffer strips either side of main rivers and ordinary watercourses, apart from the Afon Alaw which will have an 8m buffer strip as agreed with NRW. Buffer strips will not be practicable where structures are required, such as culverts, outfalls and the viaduct over the Afon Alaw and Afon Llywenan in section 3. The vegetated buffers will reduce the potential for fine sediment and pollutants to enter the watercourses and mitigate effects on water quality and fluvial geomorphology on-site and downstream.
- Horizon will undertake a pre-construction monitoring survey at the private water supply at Erw Goch and continue to monitor on a monthly basis throughout the duration of construction at section 3. If a change in the availability or quality of the water supply is identified, Horizon will put in place measures to reinstate the private water supply to the quality and availability of pre-construction levels.
- Horizon will undertake pre-construction drainage surveys to identify the existing field drainage and therefore identify any potential for the construction work to impact upon that drainage. In doing so, Horizon will identify possible mitigation measures that could be put in place if required, to reduce the risk of damage or disturbance to these drainage systems.
- Repairing and reinstatement of drains affected by construction will be agreed with the landowner/occupier to ensure that drainage capability is maintained and the risk of flooding is not exacerbated.

Operation

Basis of assessment and assumptions

8.4.12 The activities that have been considered for operation of the A5025 Off-line Highway Improvements that have been assessed within this chapter include:

- operation of the road, including the effects of rainfall runoff into the drainage system;
- the physical presence of new structures (i.e. culverts, viaduct and outfalls);
- discharges from the drainage system (i.e. outfalls); and
- the effects of hardstanding limiting recharge of groundwater.

Good practice mitigation

8.4.13 As outlined in the Wylfa Newydd CoCP (Application Reference Number: 8.6) the following good practice mitigation measures that would be applied during construction to manage water quality would also be applicable during operation:

- *Environmental Handbook for Building and Civil Engineering Projects* (3 Parts) (C512, C528, C529) [RD14, RD15, RD16];
- *The SuDS Manual* (C753) [RD20];
- *Development and flood risk – guidance for the construction industry* (C624) [RD21]; and
- *Culvert Design and Operating Guide* (C689) [RD22].

8.5 Assessment of effects

8.5.1 This section presents the findings of the assessment of effects associated with the construction and operation of the A5025 Off-line Highway Improvements.

Common effects - construction

8.5.2 Potential effects arising from construction activities are typically considered to be short-term. However, in some cases they can have longer-term effects; such as fine sediment smothering the bed of a channel and not being transferred downstream due to low stream energies, leading to a long-term effect.

Surface water

Water quality

8.5.3 The potential common effects to water quality during site clearance and construction activities include:

- degradation of surface water quality due to leaks and spillages of fuels or oils used in plant for construction activities;

- degradation of surface water quality due to spillage of cementitious materials, either via groundwater migration or via surface flow pathways;
- degradation of surface water quality due to sediment entering watercourses from road cleaning; and
- rainfall onto the exposed bare earth surfaces during site clearance, construction of crossing structures in-channel or on watercourse banks, and other earthworks could result in a high sediment loading in runoff affecting the water quality within the watercourses.

8.5.4 Good practice mitigation measures for dealing with any fuel/oil leaks from vehicles, are outlined in the Wylfa Newydd CoCP (Application Reference Number: 8.6) and A5025 Off-line Highway Improvements sub-CoCP (Application Reference Number: 8.12). There would also be engineered containment for fuel storage. With the application of these mitigation measures, the magnitude of change on water quality would be neutral and the potential residual effect would also be neutral.

8.5.5 To reduce the potential effect on water quality from cement and cementitious materials, there would be no concrete pouring within 50m of watercourses without a bespoke risk assessment and appropriate procedures. With the application of these mitigation measures, the magnitude of change on water quality would be neutral and the potential residual effect would also be neutral.

8.5.6 To alleviate the potential effect of high sediment loading, vegetated buffer strips have been incorporated into the design to capture runoff and retain fine sediment and pollutants, preventing them moving downstream in high concentrations. These buffer strips are also areas within which no bulk earthworks would take place, and any minor earthworks (e.g. construction of outfalls) would be subject to bespoke risk assessment. In addition, the Wylfa Newydd CoCP (Application Reference Number: 8.6) outlines actions that could be implemented for control. With the application of these mitigation measures, the magnitude of change on water quality would be minor and the potential residual effect would be slight adverse for all watercourses.

Water availability

8.5.7 There is only one notable potential common effect to water availability during site clearance and construction activities.

8.5.8 Temporary mounding of soil and rock during site clearance and construction has the potential to locally increase the steepness of land surfaces and provide a barrier to overland flow. This could locally alter the rainfall/runoff response, potentially increasing runoff rates.

8.5.9 The extent of topsoil removal would be managed in line with the Wylfa Newydd CoCP (Application Reference Number: 8.6) to prevent unnecessary effects on hydrological response. With the application of this mitigation measure, the magnitude of change on water availability would be neutral and the potential residual effect would be neutral for all watercourses.

Flood risk

8.5.10 An FCA has been undertaken for the A5025 Off-line Highway Improvements (appendix G8-1, Application Reference Number: 6.7.20). The assessment follows the requirements of TAN 15 [RD1] which focusses on the flood risks of a development post-construction, but due to the relatively short timescale of construction activities (which would not be affected by climate change), does not consider the risks during construction. These risks are therefore considered below.

8.5.11 During construction the risk of flooding at a site is initially the same as that identified for the baseline condition, but depending upon the nature and timing of the construction activities that risk could change, principally through either an increase in exposure of people and plant or through changes to landforms that might increase the risk of flooding elsewhere. However, the risks are normally managed by the contractor's construction management procedures which may (depending upon site location) include flood risk management procedures that draw on NRW issued flood warnings or Met Office issued weather warnings.

8.5.12 It is normally the case that drainage is one of the first elements of the construction. Where such drainage is an integral part of flood risk management, including attenuation facilities for instance, then this can be assessed in a similar way to the risks during operation, albeit without consideration of climate change.

8.5.13 The potential common effects on flood risk to the flood receptors at each section during site clearance and construction activities are outlined below:

- high sediment loading within watercourses from construction activities reducing conveyance in culverts beneath existing roads and downstream, which could increase the existing flood risk; and
- increase in surface water flood risk as a result of vegetation removal and soil compaction, causing greater rates of surface runoff.

8.5.14 Mitigation highlighted above to prevent effects on water quality by suspended sediment would also serve to prevent an increase in flood risk caused by sediment build-up. The potential magnitude of change in flood risk due to sediment build-up is therefore assessed as neutral.

8.5.15 Localised surface water flooding due to runoff from compacted soil would be managed by several means. As set out in the A5025 Off-line Highways Improvements sub-CoCP (Application Reference Number: 8.12), where possible construction involving bulk earthworks would be undertaken in the summer months when rainfall and saturated soil conditions are least likely. In addition, as set out in the Wylfa Newydd CoCP (Application Reference Number: 8.6), sufficient drainage would be installed prior to topsoil strip, and flood risk would be managed in line with the FCA. The implementation of good practice and embedded mitigation outlined above is considered to result in a minor magnitude of change in flood risk during construction, which would result in a slight adverse effect on flood risk.

Fluvial geomorphology

8.5.16 During the construction period, areas of the construction site would have surfaces of bare earth or imported materials such as crushed rock. There would also be stockpiles of topsoil. Works in and adjacent to the channels (including construction of outfalls and culverts) could result in an increase in fine sediment loading, modifications to the channel banks and increased flow. Any of these could affect channel geomorphology, potentially increasing erosion or deposition, removing features and smothering gravels and associated aquatic habitats. Deposition of silt from the construction of the A5025 Off-line Highway Improvements would cease at the end of construction, but the effects could potentially continue in the longer term within the watercourse systems, potentially causing localised siltation or removal of geomorphological features. With application of the buffers provided around watercourses, and sediment controls, as stated in section 10 of the Wylfa Newydd CoCP (Application Reference Number: 8.6), this would result in a minor magnitude of change. This would result in a slight adverse significance of effect for the Afon Alaw, Tan R'Allt and the Afon Cafnan and a neutral significance of effect on all other watercourses.

8.5.17 Construction of a crossing over a watercourse would remove riparian vegetation and could replace natural bank material with artificial material. Where in-channel works are required (i.e. construction of a culvert) this could affect the morphological features, fluvial processes and sediment transfers in the channels. With the application of pollution prevention measures as set out in the Wylfa Newydd CoCP (Application Reference Number: 8.6), the magnitude of change would be minor. This would result in a neutral significance of effect on all watercourses that have proposed crossings, (with the exception of the Afon Alaw and Afon Cafnan, which are detailed below in section 3 and section 7, respectively).

Groundwater

8.5.18 The key activities with potential to affect groundwater during construction include earthworks for platforms, clearance of vegetation, the stripping of topsoil, formation of the contractor's compounds and vehicle movements. The potential effects on groundwater, common to the whole scheme, are outlined below.

8.5.19 Changes in aquifer recharge rates due to earthworks, vegetation removal, soil compaction and the creation of temporary hardstanding during construction, which could lead to a reduction in groundwater levels and flows. In areas underlain by low permeability tidal flat deposits, and glacial till (where this has a clay matrix) recharge would already be limited and hence the magnitude of change to groundwater receptors would be neutral. In areas of alluvium, granular till or exposed bedrock, the magnitude of change could be more noticeable; however, the volume of recharge lost due to the impermeable areas created during construction would form only a small proportion of the existing recharge reaching the bedrock aquifer. Given the discontinuity of the water-bearing horizons in the bedrock, the magnitude of change to groundwater levels and flows would be neutral and so the potential significance of effects would also be neutral.

8.5.20 Changes to groundwater quality in the Secondary aquifers could occur from any fuel or oil leaks from plant used during the construction works. In the event of a leak or spill, potential contamination could migrate into the drift and / or bedrock and affect groundwater quality, although the glacial till (where it has a clay matrix) and tidal flat deposits, where present and of low permeability, would limit contaminant migration into the underlying bedrock. The effectiveness of this would depend on the clay content, thickness and permeability of the till and the bedrock water level. Even in areas without clayey till, where alluvium or granular till makes up the superficial deposits, or bedrock is exposed, with implementation of the mitigation measures such as the use of spill kits and spill response plans, the magnitude of change to groundwater receptors would be neutral and the residual effect would also be neutral.

8.5.21 It should be noted that the potential effect of cuttings and embankments are only considered in the operational assessment as they have long-term (rather than short-term) potential to effect local groundwater levels and flow directions in the bedrock aquifer. As there will not be any requirement for dewatering during the construction of the proposed cuttings, and general effects from construction (e.g. leaks and spills, ground compaction etc.) are considered separately, the effects of cuttings and embankments on groundwater are not considered as part of the construction phase activities.

Common effects - operation

8.5.22 Operational effects are generally longer-term or permanent effects that would influence the surface water and groundwater environments after the proposed scheme is constructed. The potential common effects to all proposed sections of the A5025 Off-line Highway Improvements are outlined below with effects specific to each section below that.

Surface water

8.5.23 The main potential common effect to surface water receptors during operation is pollutant loading from accidental spillages and potential pollutants in routine runoff. The purpose of the A5025 Off-line Highway Improvements is, however, to improve the road network and to make the road safer, thereby reducing the number of accidents and, consequently, the spillage risk.

8.5.24 The A5025 Off-line Highway Improvements would be designed to current standards, as set out in the *Design Manual for Road and Bridges* (DMRB) [RD23]. The proposed drainage strategy incorporates Sustainable Drainage System (SuDS) features and silt traps, which will allow retention of sediment prior to the drainage outfall into watercourses. This, along with management and maintenance procedures for the SuDS features and drainage outfalls, would mean that the magnitude of change to water quality is likely to be beneficial neutral. Nevertheless, the effectiveness of each outfall (both individually and cumulatively, where necessary) has been assessed below for each section as a requirement of the DMRB [RD23].

Flood risk

8.5.25 The FCA (appendix G8-1, Application Reference Number: 6.7.20) assesses the flood risk associated with the A5025 Off-line Highway Improvements post-construction. The method applied within the FCA to determine the significance of effect (which is informed by TAN 15 [RD1] as outlined in appendix G8-1.4 of the FCA (Application Reference Number: 6.7.20)) differs from the methodology used for this Environmental Impact Assessment (see section 8.4 of chapter B8, Application Reference Number: 6.2.8). The key differences relate to how the value of the receptor and the magnitude are assigned, which therefore drives slightly differing significances of effect.

8.5.26 In order to assess the flood risk consistently with other surface water and groundwater effects within this Environmental Statement, the following assessment of flood risk during operation of the A5025 Off-line Highway Improvements considers changes that would potentially be caused by the development. The assessment therefore assigns a magnitude of change to the risk of flooding to receptors based on the method stated in chapter B8 (Application Reference Number: 6.2.8). The FCA is the key source of information for this assessment; however, given the difference in methods between the FCA and the Environmental Statement, the magnitude of change within this assessment is not directly comparable to the magnitude of hazard or flood risk within the FCA. Nevertheless, whilst the significance of effect may vary between the FCA and the Environmental Statement, the overall conclusions are consistent (i.e. significant or not significant effect).

8.5.27 The potential common effects to flood risk to the A5025 and associated receptors during operation include:

- Introduction of new impermeable areas could potentially increase the volume and peak flow of surface runoff reaching watercourses and could therefore contribute to an increase in flood risk.
- Alteration of the physical flow and water level regimes from earthworks and crossings, including new culverts/bridges or the modifications to existing culverts/bridges could potentially increase or decrease flood risk depending upon the specific location.

8.5.28 To prevent increases in flooding from the introduction of new impermeable areas, drainage has been designed to match greenfield runoff rates with attenuation provided for events up to and including the 1/100 year event (including climate change). Culverts would be sized to ensure attenuation to greenfield runoff rates, whilst maintenance would reduce the chance of an increase in flood risk as a result of a blockage. The design of these structures aims for a neutral effect or reduction in flood risk. Therefore, with the application of this mitigation, the magnitude of change associated with new impermeable areas is considered to be neutral and the residual effect is therefore neutral.

8.5.29 The alteration of physical flow is assessed individually for each section.

Fluvial geomorphology

8.5.30 Each of the potential operational effects resulting from the presence of in-channel structures and new discharges is assessed individually in relation to each fluvial geomorphology receptor in the sections below. The following provides an overview of the potential generic effects of each of the structures, which have then been considered in the detailed assessment.

8.5.31 A permanent crossing in the form of a culvert would remove the natural channel bed and banks and disrupt lateral connectivity with the floodplain. The following are some of the key potential effects that could arise from the installation of a culvert:

- changes in flow velocities, altering the flow patterns and therefore sediment processes within the channel;
- increased potential for blockage with knock-on effects downstream and upstream; and
- changes to patterns of erosion and sedimentation (both upstream and downstream), including disturbance to existing bed forms (e.g. pools and riffles).

8.5.32 Other crossing types not requiring in-channel modifications, such as viaducts, could still impact on the vegetated riparian zone and disrupt lateral connectivity with the floodplain; however, this effect would be localised to the viaduct abutments and piers.

8.5.33 The presence of outfalls within a channel has the potential to alter flow processes by introducing additional flow and a set angle to the channel. The outfall structures also locally alter the natural bed and banks of the channel and locally remove lateral connectivity with the floodplain.

Groundwater

8.5.34 One of the potential effects on groundwater, common to the whole scheme, includes changes in existing groundwater recharge rates caused by permanent new areas of hardstanding, which could result in changes to groundwater levels and flows. The volume of recharge to the aquifer, lost as a result of new impermeable areas created, would likely form only a small proportion of the total recharge volume currently being received by the aquifer from the surrounding local agricultural land. The magnitude of change in groundwater recharge, levels, flows and the contribution of groundwater as baseflow to local watercourses, is therefore assessed as neutral and so the potential significance of effects would also be neutral.

8.5.35 Changes in groundwater levels and flows could occur as a result of cuttings and embankments. Embankments could impede groundwater flows, causing increased groundwater levels upstream of the structure, as well as a decrease in groundwater levels on the downstream side. Cuttings have the potential to depress local groundwater levels in the area surrounding the cutting. However, given the thin and often discontinuous nature of the water-bearing horizons in the bedrock aquifer, and the short groundwater flow paths identified in the ground investigation, the magnitude of change in

groundwater levels is likely to be minor and localised. In areas where there are no groundwater receptors other than the Secondary aquifers, the sensitivity is low and hence the potential significance of effects is considered neutral throughout the scheme, unless specified in the sections below.

Effects specific to each road section

Section 1: Valley

Construction

Surface water

8.5.36 Site clearance works and proposed drainage channel improvement works to Cleifiog Fawr, including ground re-profiling works adjacent to the watercourse, could potentially lead to direct pollution of the watercourse from suspended sediment. This could be exacerbated by high sediment loading within runoff from bare earth surfaces associated with site clearance in the vicinity of Cleifiog Fawr. With implementation of the vegetated buffer strips and SuDS features in parallel to the construction activities, as well as application of measures in the Wylfa Newydd CoCP (Application Reference Number: 8.6) described above, the magnitude of change to water quality would be neutral and the potential residual significance of effect would also be neutral.

Flood risk

8.5.37 There are no potential effects, beyond those that are common to the whole scheme, that would affect section 1 during construction. The common effects on surface water would be mitigated through application of appropriate CIRIA guidance and pollution prevention guidance as set out in the Wylfa Newydd CoCP (Application Reference Number: 8.6). The magnitude of change to flood risk would therefore be neutral, with a neutral significance of effect.

Fluvial geomorphology

8.5.38 The A5025 Off-line Highway Improvements at Valley would require a length of channel realignment and new outfall along a small drainage channel to the north of the existing A5. There would also be need for a new culvert on a small drain immediately east of the existing A5025, at the northern extent of section 1. The construction phase would require in-channel working within the drains and this would have the potential to deliver fine sediment downstream. However, due to the small, ephemeral nature of the watercourses at this location, and the significant pathway distance (approximately 1km) to the Afon Cleifiog, it would be unlikely to cause a significant effect. The two drains are classed as having a low value. The magnitude of change is assessed as minor and therefore the significance of effect is slight adverse.

Groundwater

8.5.39 There are no potential effects, beyond those that are common to the whole scheme, that could affect groundwater during the construction period.

Operation

Surface water

8.5.40 There are five drainage outfalls in section 1, four of which outfall into Cleifiog Fawr and one into Cleifiog Isaf. Four of these outfalls comprise a single SuDS feature (ditch), whilst one outfall into Cleifiog Fawr comprises a treatment train made up of a filter drain and swale. The two longest lengths of ditches include a concrete silt trap prior to the outfall.

8.5.41 The results of the HAWRAT routine runoff assessment on surface water are detailed in appendix G8-2 (HAWRAT and Spillage Risk Assessment) (Application Reference Number: 6.7.21). In summary, all five drainage outfalls into Cleifiog Fawr and Cleifiog Isaf independently passed the routine surface water runoff assessment with respect to dissolved/soluble pollutants and sediment-bound pollutants. There were no exceedances of the EQS for dissolved copper and dissolved zinc for individual outfalls. One cumulative assessment (S1 C1+C2+C3+C4, the outfall numbering system used in appendix G8-2, Application Reference Number: 6.7.21), concerning Cleifiog Fawr, registered an alert for sediment-bound pollutants; the alert being for a culvert less than 100m downstream that could reduce the velocity and therefore dilution of sediment-bound pollutants. However, the magnitude of change would be minor as inclusion of a silt trap, plus cleaning and re-profiling of the section of ditch, would reduce the sediment load therefore the significance of effect has been assessed as slight adverse. EQSs were not exceeded at this cumulative outfall.

8.5.42 Three of the five outfalls were also assessed as soakaways due to the calculated low flow at the outfalls. The results of the routine runoff assessment on groundwater quality are detailed in appendix G8-2 (Application Reference Number: 6.7.21). The assessment of effects on groundwater is discussed below.

8.5.43 The results of the spillage risk assessment are detailed in appendix G8-2 (Application Reference Number: 6.7.21). The annual probability of a serious pollution incident occurring has been estimated to be below the 1/200 year event. Section 1 includes a roundabout, which is road infrastructure with a relatively high spillage risk factor. Whilst the existing A5025 does not include a roundabout, the assessed probability of a spillage in section 1 indicates an acceptable risk (appendix G8-2, Application Reference Number: 6.7.21). The magnitude of change to receiving surface waters is therefore neutral and the significance of effect neutral.

Flood risk

8.5.44 The northern end of section 1 would be located outside of the area at risk from a 1/100 year event plus climate change (30%). However, the southern end of the section, including the roundabout junction with the A5 and a

section of new road off the roundabout, would fall within the floodplain. The roundabout cannot be moved further east outside of the floodplain as its current position affords connectivity to a heavy goods vehicle access road to the south of the A5. The embedded floodplain compensatory storage at section 1 will reduce flood levels sufficiently so that water cannot reach the highway. In all modelled fluvial scenarios, up to and including the 1/1000 year event, the proposed route of section 1 of the A5025 Off-line Highway Improvements remains free from flooding. The modelling shows neutral reductions in fluvial flood depths at built receptors within the section 1 study area. Therefore, the impact of section 1 of the A5025 Off-line Highway Improvements on existing and future fluvial flood risk in section 1 would have a neutral magnitude of effect and a neutral significance.

8.5.45 The tidal influence on fluvial flooding was also investigated by modelling a worst-case combined 1/100 year fluvial event and a 1/200 year tidal event with relevant allowances for fluvial flow increases and sea level rise to 2115. The results indicate a minor increase in flood depth of 0.01m at the A5 and some building receptors, but a neutral decrease at other building receptors. Therefore, the impact of section 1 of the A5025 Off-line Highway Improvements on existing and future combined fluvial and tidal flood risk in section 1 would have a neutral to minor magnitude of effect and a neutral to slight adverse significance.

8.5.46 The introduction of impermeable surfaces would increase the rate and volume of runoff compared to the natural state, where a proportion of incident rainfall would be able to infiltrate the soils. Any additional runoff may contribute to an increase in flow and therefore increase the flood level in areas that are currently shown to flood from surface water, fluvial and tidal sources. The embedded road drainage would ensure that any increase in flood level is likely to be local, restricted to less than 10mm and only occur in greater than 1/5 year events. The proposed route of section 1 of the A5025 Off-line Highway Improvements is therefore expected to produce no greater than a neutral magnitude of effect, which may be minor on agricultural land close to the bypass. The significance of effect is therefore neutral to slight adverse.

8.5.47 The magnitude of effect on flood risk from groundwater, services and reservoirs is assessed at neutral, with a resulting neutral significance of effect.

Fluvial geomorphology

8.5.48 The outfall, culvert and channel realignment required at section 1 would lead to the permanent removal of a length of the channel bank and bed at these locations. Due to the existing nature of the channels (shallow earth drainage ditches) and ephemeral nature of the flow in the watercourses, these effects would not be significant (i.e. low value watercourses with a minor magnitude of change leading to a slight adverse significance of residual effect).

Groundwater

8.5.49 There is a potential change in groundwater quality of the bedrock aquifer associated with contaminated highway runoff able to discharge to ground via

three outfalls assessed as soakaways for the proposed surface water drainage system. The soakaways were assessed as having a medium risk of effect on groundwater quality in the HAWRAT assessment in appendix G8-2 (Application Reference Number: 6.7.21). However, the ground investigation [RD4] did not identify any significant linkages to groundwater receptors, and given the clayey nature and thickness of superficial deposits in the area they are unlikely to act as a significant aquifer and will provide natural protection to the bedrock aquifer. Therefore, the potential magnitude of change to groundwater quality in the Secondary aquifers is considered to be neutral. The potential significance of effects is therefore also neutral.

Section 3: Llanfachraeth

Construction

Surface water

8.5.50 Construction of the viaduct will take place in the channels of the Afon Alaw and the Afon Llywenan. Any leaks and spillages of fuels and oils from construction plant or mobilisation of sediment from the channel and embankments could directly affect the water quality of these watercourses. These could subsequently affect the water quality of the Beddmanarch-Cymyran SSSI downstream. With the application of the pollution prevention measures as set out in the Wylfa Newydd CoCP (Application Reference Number: 8.6), the magnitude of change on water quality would be neutral and the potential residual significance of effect would also be neutral.

Flood risk

8.5.51 There are no potential effects, beyond those that are common to the whole scheme, that would affect section 3 during construction. The common effects on surface water would be mitigated through application of appropriate CIRIA guidance and pollution prevention guidance as set out in chapter 10 of the Wylfa Newydd CoCP (Application Reference Number: 8.6). The magnitude of change to flood risk would therefore be neutral, with a neutral significance of effect.

Fluvial geomorphology

8.5.52 In-channel works associated with the construction activities for the culverts and outfalls required on the Afon Alaw and other small watercourses would temporarily remove natural vegetation and lead to changes in the in-channel processes and fluvial geomorphology features. This would be of particular importance in the Afon Alaw, where the outfalls are located near a series of depositional features and areas of erosion. For the smaller watercourses, there is likely to be removal of the earth banks and gravel beds.

8.5.53 In addition, on the Afon Alaw, the construction of the viaduct embankment on the right bank would lead to further disturbance of the vegetated banks and lateral connectivity with the floodplain during construction.

8.5.54 With implementation of the measures in the Wylfa Newydd CoCP (Application Reference Number: 8.6), and allowing for buffers around the watercourses (where direct works are not taking place), the potential effects would be reduced. This would limit the length of channel affected and prevent excessive fine sediment input downstream during in-channel construction activities. As a result, the construction activities would result in a minor magnitude of change and therefore a slight adverse significance of effect on the Afon Alaw and all other watercourses.

Groundwater

8.5.55 Changes in groundwater levels and flows could arise in the Secondary A alluvial aquifer as a result of vegetation stripping, ground compaction and the creation of impermeable surfaces through new areas of temporary hardstanding. The volume of recharge lost as a result of these construction activities would form only a small proportion of the existing area contributing to recharge the alluvial aquifer. The magnitude of change to this receptor is therefore assessed as neutral. With the medium value of the aquifer as a receptor, the potential significance of effects is assessed as neutral.

8.5.56 The magnitude of change to groundwater levels in the Secondary B, Secondary (undifferentiated) and the Secondary A alluvial aquifers is assessed as neutral. The resulting groundwater availability for the potential PWSs at Erw Goch and Bryn, and groundwater levels and flows reaching the Beddmanarch-Cymyran SSSI and the riparian zone of the Afon Alaw, are also considered to have neutral magnitude of change. The significance of effects to all of these secondary receptors is therefore neutral.

Operation

Surface water

8.5.57 During operation, there is a risk of scour of the viaduct piers during flood events, which could release cement and cementitious materials into the Afon Alaw and Afon Llywenan. However, the four piers have been aligned with the flow of the water, which will reduce the risk of scour. The potential magnitude of change has been assessed as minor, with the significance of effect being slight adverse.

8.5.58 There are three drainage outfalls in section 3 falling into the Afon Alaw, the Afon Llywenan and the Tan R'Allt. All of these outfalls comprise a SuDS treatment train of made up of a filter drain and retention pond (wet).

8.5.59 The results of the HAWRAT routine runoff assessment on surface water are detailed in appendix G8-2 (Application Reference Number: 6.7.21). In summary, all three drainage outfalls passed the routine surface water runoff assessment with respect to dissolved/soluble pollutants and sediment-bound pollutants both independently and cumulatively. There were no exceedances of the EQS for dissolved copper and dissolved zinc. The magnitude of change on water quality is therefore considered to be neutral, as is the significance of effect.

8.5.60 The results of the spillage risk assessment are detailed in appendix G8-2 (Application Reference Number: 6.7.21). The annual probability of a serious pollution incident occurring has been estimated to be below the 1/200 year event. The magnitude of change on receiving surface waters is therefore neutral, and the potential residual significance of effect would also be neutral.

Flood risk

8.5.61 The viaduct piers and embankments would be located within the floodplain of the Afon Alaw and the Afon Llywenan. The embankments have been moved back to over 8m from the existing banks of the Afon Alaw and the Afon Llywenan so that encroachment is lessened, and the four piers have been aligned with the flow of the water to facilitate flow. Nevertheless, these works could reduce the long-term flood storage capacity due to a reduction in floodplain area, and increase the flood risk locally.

8.5.62 Scheme modelling (included with the FCA in appendix G8-1, Application Reference Number: 6.7.20) indicates that the water level immediately upstream of the bypass increases in the Afon Alaw and Afon Llywenan in all flood events. The increase in the Afon Alaw and Afon Llywenan during the 1/100 year event plus climate change (30%) is 0.09m and 0.02m respectively. The viaduct reduces flood levels immediately downstream of the viaduct structure and local to the structure itself. There is minimal change to the flood extent both upstream and downstream.

8.5.63 Where the difference in flood depth is +/-5mm, this is not sufficient to be deemed significant, based on NRW guidance on flood risk [RD24] and DMRB guidance [RD23] on flood risk. However, given that a residential property is located adjacent to the northern bank of the Afon Alaw close to the confluence of the Afon Alaw and the Afon Llywenan, any increase in flood depth poses additional risk, albeit minor, to a high value flood risk receptor. Without additional mitigation, the magnitude of change to flood risk from both watercourses is considered to be minor, with the resulting significance of effect being moderate adverse.

8.5.64 For the remainder of section 3, once operational there is unlikely to be any measurable increase in flood risk to the road or surrounding land/properties due to the incorporation of attenuation into the road drainage design. The magnitude of change to fluvial flood risk is neutral and the potential effect is therefore assessed as neutral.

8.5.65 There may be a minor beneficial impact on surface water flood risk because of the operation of Section 3. The presence of the highway will reduce the catchment of a field drain, reducing flows and therefore flood risk.

8.5.66 The magnitude of effect on flood risk from tidal, groundwater, services and reservoirs is assessed at neutral, with a resulting neutral significance of effect.

Fluvial geomorphology

8.5.67 Section 3 at Llanfachraeth would require new outfalls that would discharge to the watercourses within the study area, as well as physical modifications to

the watercourses/ditches through realignments, construction of outfall structures and new culverts. This would alter flow and sediment processes within the channels as well as causing changes to lateral connectivity with the floodplain. Vegetated riparian corridors would also be removed. The viaduct embankments would also remove a length of the Afon Alaw floodplain.

8.5.68 The presence of the structures in the watercourses would be mitigated through design, following good practice design guidelines. The viaduct along the Afon Alaw has also been set back from the watercourse edge to limit potential effects on the banks and riparian corridor. As a result, there is anticipated to be a minor magnitude of effect on the Afon Alaw and other watercourses, resulting in a slight adverse residual effect for all fluvial geomorphology receptors.

Groundwater

8.5.69 There are no potential effects on groundwater quality to the Secondary B or Secondary (undifferentiated) aquifers outside of those identified as common effects to the whole scheme. Hence, the change in magnitude of groundwater quality to the wells at Erw Goch and Bryn are assessed as neutral and the potential significance of effects is neutral.

8.5.70 The creation of hardstanding associated with the new highway could result in changes in groundwater levels and flows in the Secondary A alluvial aquifer or any granular glacial till. However, the volume of recharge lost as a result of this new impermeable area would form only a minor proportion of the existing local recharge area. The magnitude of change in groundwater levels is therefore assessed as neutral, and even with the receptor value of medium for the aquifer, the potential significance of effects is assessed as neutral.

8.5.71 With the magnitude of change in groundwater levels in the Secondary aquifers assessed as neutral, the magnitude of change in groundwater availability for the well at Bryn and groundwater levels and flows at the Beddmanarch-Cymyran SSSI and the Afon Alaw riparian zone, are also considered neutral. The receptor value for the SSSI and the PWS is high, while a medium value has been assigned to the riparian zone of the Afon Alaw. The potential significance of effects for all three receptors is considered neutral.

8.5.72 A depression of groundwater levels could occur in the vicinity of the proposed cutting at Llanfachraeth (ch950-1640). Along this cutting is a property (and well) at Bedo, located 50m to 60m east, and a number of residential properties along Parc Llynnon (50m west). The maximum cutting depth at both locations is 1m to 1.6m. The closest boreholes (BHB11 and BHB15) record maximum groundwater levels of more than 2m below ground level in the weathered bedrock and till, respectively. As groundwater levels lie below the base of the cutting adjacent to these buildings, the magnitude of change in groundwater level and building stability is assessed as neutral. With the medium value of the receptors, the significance of effects is also neutral.

8.5.73 Buildings at Plas Ellen and Tan-y-bryn lie adjacent to, and 75m east of, the cutting in the far north of the scheme, respectively. The cutting would reach 0.5m deep, where the maximum recorded groundwater level at the nearest borehole (BHB29), located 200m to the south, was 0.7m below ground level in May 2016. The magnitude of change in groundwater levels in the areas of the existing buildings is therefore assessed as neutral and the potential significance of effects is neutral.

8.5.74 There is potential for changes in groundwater levels and flows due to the embankment to the south of Llanfachraeth (ch100-950). The well at Erw Goch is located 100m west of the scheme, where the embankment would be 2.5m high, reaching up to 7m adjacent to the proposed viaduct. The closest ground investigation borehole (BHB6) recorded a maximum groundwater level in the till of 1.1m below ground level in May 2016. There is potential therefore, for groundwater levels to drop to the west of the scheme as a result of impeded flows caused by the embankment. The potential magnitude of effect to the well at Erw Goch is assessed as moderate adverse. Given its medium value as a receptor, the potential significance of effects is assessed as moderate adverse.

8.5.75 Based on the Beddmanarch-Cymyran SSSI being predominantly surface water fed, the percentage of groundwater to total water inflows into the SSSI will be neutral. There is no mention of groundwater dependency in the SSSI citation and the site is designated as such based on its marine biological interest, independent of groundwater levels. The magnitude of change in groundwater levels and flows to the SSSI as a result of the embankment to the south of Llanfachraeth is assessed as neutral and although the value of the receptor is high, the residual effect is neutral.

8.5.76 The embankment could also result in potential changes in groundwater flow towards the riparian zone of the Afon Alaw. However, the wetland is fed largely by fluvial inflows from the river and groundwater dependency is anticipated to be very low. The magnitude of change in groundwater flows and levels is therefore assessed as neutral and although the value of the receptor is assessed as medium, the significance of effect is neutral.

Section 5: Llanfaethlu

Construction

Surface water

8.5.77 With implementation of measures in the Wylfa Newydd CoCP (Application Reference Number: 8.6), vegetated buffer strips and SuDS features in parallel to the construction activities, there are no anticipated significant effects to surface water receptors during construction activities within section 5.

Flood risk

8.5.78 There are no potential effects, beyond those that are common to the whole scheme, that would affect section 5 during construction. The common effects on surface water would be mitigated through application of

appropriate CIRIA guidance and pollution prevention guidance as set out in the Wylfa Newydd CoCP (Application Reference Number: 8.6). The magnitude of change to flood risk would therefore be neutral, with a neutral significance of effect.

Fluvial geomorphology

8.5.79 In-channel works associated with construction activities relating to outfall structures placed in the Afon Llanrhyddlad and Tan-y-bryn would temporarily remove natural vegetation and lead to alteration of in-channel processes and fluvial geomorphology features. With the implementation of the Wylfa Newydd CoCP (Application Reference Number: 8.6) during construction, this would lead to a minor magnitude of change, resulting in a slight adverse effect on the watercourses.

Groundwater

8.5.80 The significance of effects in recharge rates, groundwater levels and flows in the Secondary aquifers is assessed as neutral as the area of the road is relatively small in comparison to the extent of the aquifer recharge area and the use of SuDS in the design will encourage runoff to recharge groundwater. As a result, the potential change in magnitude in groundwater availability for the wells and abstractions within the section 5 study area, including the two wells located less than 50m downgradient from the section, is assessed as neutral. The significance of the effect to these receptors is therefore also neutral.

Operation

Surface water

8.5.81 There are three proposed drainage outfalls in section 5, two of which would fall into the Afon Llanrhyddlad and one into Tan-y-bryn. All of these outfalls would comprise a SuDS treatment train of made up of a filter drain and retention pond (wet).

8.5.82 The results of the HAWRAT routine runoff assessment on surface water are detailed in appendix G8-2 (Application Reference Number: 6.7.21). In summary, all three drainage outfalls passed the routine surface water runoff assessment with respect to dissolved/soluble pollutants and sediment-bound pollutants both independently and cumulatively. There were no exceedances of the EQSs for dissolved copper and dissolved zinc. The magnitude of change on water quality is therefore considered to be neutral, as is the significance of effect.

8.5.83 The three outfalls were also assessed as soakaways due to the calculated low flow at the outfalls. The potential effect of these on groundwater quality is assessed below.

8.5.84 The results of the spillage risk assessment are detailed in appendix G8-2 (Application Reference Number: 6.7.21). The annual probability of a serious pollution incident occurring has been estimated to be below the 1/200 year

event. The magnitude of change on receiving surface waters is therefore neutral, as is the significance of effect.

Flood risk

8.5.85 Once operational there is unlikely to be any measurable increase in flood risk to section 5 or surrounding agricultural land and properties due to the incorporation of attenuation into the road drainage design. There may be a minor beneficial effect, as the drainage system would provide betterment relative to the baseline runoff events above the discharge rate up to the 1/100 year event plus the climate change allowance. The magnitude of change for all sources of flood risk is neutral and the potential significance of effect is therefore assessed as neutral.

Fluvial geomorphology

8.5.86 There would be new outfalls discharging to the small watercourses and physical modifications as a result of the presence of outfall structures. This would alter flow and sediment processes locally within the channels, as well as altering lateral connectivity with the floodplain. Vegetated riparian corridors would also be removed. Good practice guidance [RD22] as detailed in the Wylfa Newydd CoCP (Application Reference Number: 8.6) would be followed during detailed design of the structures and this would reduce the potential effects of the structures on the fluvial geomorphology. As a result, the magnitude of change on the watercourses would be minor, resulting in a slight adverse effect for each of the watercourses.

Groundwater

8.5.87 The three proposed outfalls in section 5 were assessed as soakaways due to the calculated low flow at the outfalls. There is a potential change in groundwater quality due to the soakaways, which were assessed as having a medium risk of effect on groundwater quality in the HAWRAT assessment in appendix G8-2 (Application Reference Number: 6.7.21). However, the embedded design includes the use of SuDS features, therefore the magnitude of change in groundwater quality is considered to be neutral. The potential significance of effects is therefore also neutral for both the aquifer and the wells and abstractions in the study area for section 5.

8.5.88 A depression of groundwater levels could occur on either side of the proposed cutting (ch850-1200). Two properties lie within close proximity of the cutting; Rhos-ty-mawr (25m west of the cutting centre) and Ty'n-y-buarth (which also has a well), adjacent to the far northwest of the cutting. The borehole log from BHC10 [RD10], located directly between the cutting and Rhos-ty-mawr, indicates that till is present to a depth of 3.75m. A potential impact on the Rhos-ty-mawr as a result of ground compaction, caused by a depression in groundwater levels cannot be ruled out. However, maximum groundwater levels recorded by the two ground investigation boreholes installed within the bedrock (BHC14 and BHC16) were 3.7m below ground level between April 2016 and May 2016, and below the base of the cutting in its deepest section (3m). The magnitude of change in bedrock groundwater levels as a result of the cutting is therefore assessed as neutral. Given the

high value of the buildings and abstractions (including PWS) as receptors, the significance of effects of groundwater level changes is assessed as minor adverse.

Section 7: Cefn Coch

Construction

Surface water

8.5.89 There are no anticipated significant effects to surface water receptors during construction activities within section 7.

Flood risk

8.5.90 There are no potential effects, beyond those that are common to the whole scheme, that would affect section 7 during construction. The common effects on surface water would be mitigated through application of appropriate CIRIA guidance and pollution prevention guidance as set out in the Wylfa Newydd CoCP (Application Reference Number: 8.6). The magnitude of change to flood risk would therefore be neutral, with a neutral significance of effect.

Fluvial geomorphology

8.5.91 In-channel works associated with construction activities relating to the culverts and outfalls in the Afon Cafnan and Nant Llygeirian would temporarily remove natural vegetation and lead to changes in the in-channel processes and fluvial geomorphology features. The implementation of measures in the Wylfa Newydd CoCP (Application Reference Number: 8.6), including control of sediment during works and undertaking works in period of low flows, would result in the magnitude of change being assessed as minor. This would result in a slight adverse effect on the Afon Cafnan and a neutral effect for Nant Llygeirian. The construction of this section would also include the removal of a section of bedrock cascade on the Afon Cafnan which is currently providing flow variability and a natural change in bed and bank material. This would be replaced with a concrete culvert. Based on professional judgement, this would result in a minor magnitude of change and therefore a moderate adverse effect on the Afon Cafnan.

Groundwater

8.5.92 The significance of effects in recharge rates, groundwater levels and flows in the Secondary aquifers is assessed as neutral due to the low permeability strata and limited vertical recharge. As a result, the potential change in magnitude in groundwater availability for the abstractions in the section 7 study area, including the identified PWS and wells, is assessed as neutral. The significance of the effect on these receptors is therefore also neutral.

Operation

Surface water

8.5.93 There are three drainage outfalls in section 7, all of which fall into the Afon Cafnan and all of the outfalls comprise a retention pond (wet).

8.5.94 The results of the HAWRAT routine runoff assessment on surface water are detailed in appendix G8-2 (Application Reference Number: 6.7.21). In summary, all three drainage outfalls passed the routine surface water runoff assessment with respect to dissolved/soluble pollutants and sediment-bound pollutants both independently and cumulatively. There were no exceedances of the EQSs for dissolved copper and dissolved zinc. The magnitude of change on water quality is therefore considered to be neutral, as is the significance of effect.

8.5.95 The results of the spillage risk assessment are detailed in appendix G8-2 (Application Reference Number: 6.7.21). The annual probability of a serious pollution incident occurring has been estimated to be below the 1/200 year event. The magnitude of change on receiving surface waters is therefore neutral and the significance of effect neutral.

Flood risk

8.5.96 The proposed highway crossing of the Afon Cafnan is to be a culvert designed to the 1/100 year fluvial event plus allowance for climate change and appropriate freeboard. The culvert has been designed sufficiently large so as not to impact conveyance of flow, as confirmed by flood risk modelling (included with the FCA in appendix G8-1, Application Reference Number: 6.7.20). This will enable flood flows to pass downstream without any backing up from the culvert and increase in flood risk upstream. On this design basis, the culvert represents a sufficient likeness to the baseline and is likely to have neutral effect on flood risk, with a neutral significance of effect.

8.5.97 At the northern extent of section 7, the proposed highway encroaches very slightly into the edge of the fluvial and tidal floodplain. Scheme modelling (appendix G8-1, Application Reference Number: 6.7.20) indicates that the difference in flood depth is +5mm. This is not sufficient to be deemed significant, based on NRW guidance [RD24] and DMRB guidance [RD23] on flood risk, and therefore the magnitude of change to the flood risk from the Afon Cafnan is considered to be negligible, with the resulting significance of effect being negligible.

8.5.98 For the remainder of section 7, once operational there is unlikely to be any measurable increase in flood risk to the road or surrounding agricultural and residential property at the northern extent of the section due to the incorporation of attenuation into the road drainage design. The magnitude of change is neutral and the potential significance of effect is therefore also assessed as neutral.

Fluvial geomorphology

8.5.99 There would be physical modifications to the channels of the watercourses and the Afon Cafnan through diversions of ditches, construction of outfall structures and the new culvert. This would alter flow and sediment processes within the channels as well as altering lateral connectivity with the floodplain. Vegetated riparian corridors would also be removed. The new outfalls would lead to changes in flow processes from new discharges. The construction of this section would also include the removal of a section of bedrock cascade on the Afon Cafnan which is currently providing flow variability and a natural change in bed and bank material. This would be replaced with a concrete culvert. Based on professional judgement, this would result in a minor magnitude of change and therefore a moderate adverse effect on the Afon Cafnan, and a slight adverse effect for small watercourses, drains and ditches.

Groundwater

8.5.100 There are no potential effects on groundwater quality to the Secondary aquifers outside of those identified as common effects to the whole scheme. As a result, the change in magnitude of groundwater quality to the PWS and wells is assessed as neutral and the potential significance of effects is also neutral.

8.5.101 As the magnitude of change in groundwater levels in the Secondary aquifers, caused by the proposed cuttings and embankments, is assessed as neutral, the potential magnitude of change in groundwater availability for the PWS and unnamed well is also neutral and there is neutral significance of effect to these receptors.

Power Station Access Road Junction

Construction

Surface water

8.5.102 There are no anticipated significant effects to surface water receptors during construction of the Power Station Access Road Junction.

Flood risk

8.5.103 Construction works will take place approximately 200m from Nant Caerdegog Isaf and Nant Cemaes, and will not cross any surface water flow paths. Therefore, the magnitude of change to flood risk from Nant Caerdegog Isaf and Nant Cemaes would be neutral, and the significance of effect would also be neutral.

Fluvial geomorphology

8.5.104 There are no proposed in-channel works within the study area for the Power Station Access Road Junction. The construction of the road could potentially result in the delivery of fine sediment (i.e. silt) to the Nant Cemaes and Nant Caerdegog Isaf resulting in smothering of any geomorphological features within the channels. However, due to the sufficient distance from the

proposed road (over 150m), this would have a neutral magnitude of change resulting in a neutral significance of effect on the two watercourses.

Groundwater

8.5.105 There are no potential effects, beyond those that are common to the whole scheme, that could affect groundwater during the construction period.

Operation

Surface water

8.5.106 Neither the HAWRAT routine runoff assessment on surface water, nor the routine runoff assessment on groundwater or the spillage risk assessment have been undertaken at this location as there are no outfalls to watercourses. Drainage from the Power Station Access Road Junction would connect to the Power Station Site access road drainage network.

Flood risk

8.5.107 Once operational there is unlikely to be any measurable increase in flood risk to the road or surrounding agricultural area due to the incorporation of an appropriate road drainage design. The magnitude of change is neutral and the potential significance of effect is therefore also assessed as neutral.

Fluvial geomorphology

8.5.108 There are no proposed in-channel structures or discharges into the Nant Caerdegog Isaf and the Nant Cemaes during operation. Due to the sufficient distance from the proposed road (over 150m), a neutral magnitude of change is expected resulting in a neutral significance of effect on both watercourses.

Groundwater

8.5.109 The HAWRAT routine runoff assessment has not been undertaken for this location as a result of insufficient drainage information. Assuming that no future outfalls are to be assessed as soakaways, there are no potential groundwater quality effects on the Secondary aquifers beyond those identified as common effects to the whole scheme.

8.5.110 The magnitude of change in groundwater levels in the Secondary aquifers is assessed as neutral as there are no proposed cuttings or embankments. The residual effect is therefore neutral.

8.6 Additional mitigation

8.6.1 In accordance with chapter B1 (introduction to the assessment process) (Application Reference Number: 6.2.1), embedded and good practice mitigation measures relevant to surface water, groundwater and fluvial geomorphology were taken into account when determining the ‘pre-mitigation’ significance of effects. These are detailed in the design basis and activities section of this chapter.

8.6.2 Additional mitigation measures would be implemented to address the potential significant effects identified in the assessment of effects section. These additional mitigation measures are summarised in table G8-8.

Construction and Operation

8.6.3 The additional mitigation measures required during construction and operation are detailed in table G8-8. Two of the effects could span both construction and operation and, as the mitigation would be the same, they are combined.

Table G8-8 Additional mitigation measures – operation

Additional mitigation measures	Objective	Achievement criteria and reporting requirements
Surface water - operation		
Further design to address the impact to flood flow paths from the A5025 viaduct and embankments at section 3 would be progressed and mitigation upstream of the viaduct in the form of minor ground re-profiling would be used to manage the flood waters associated with the A5025 Off-line Highway Improvements without increasing flood risk elsewhere.	To avoid any increase in flood risk to off-site receptors.	No significant increase in flood depth at property.
Fluvial geomorphology – construction and operation		
A natural bedrock cascade is present immediately downstream of the road crossing to Pen-yr-orsedd on the Afon Cafnan. There is a risk that construction of a culvert within the riverbed, which will require removal of a section of this cascade, could result in further damage to the in-river cascade features that do not require removal. Horizon will reduce the extent of the area that is likely to be damaged, including establishing an appropriate working corridor. Horizon will also follow the protective measures outlined in the Wylfa Newydd CoCP (Application Reference Number: 8.6). These measures include limiting working in buffer zones and carrying out a risk assessment prior to construction.	Minimise extent of area likely to be damaged by contractor.	No significant damage to channel bed and river morphology.
Groundwater – construction and operation		
As set out in the A5025 Off-line Highway Improvements sub-CoCP (Application Reference Number: 8.12), Horizon will undertake a pre-construction monitoring survey at the private water supply at Erw Goch and continue to monitor on a monthly basis throughout the duration of construction at section 3. If a change in the availability or quality of the water supply is identified, Horizon will put in place measures to	The protection of existing water supplies.	No permanent reduction in availability or quality of water.

Additional mitigation measures	Objective	Achievement criteria and reporting requirements
reinstate the private water supply to the quality and availability of pre-construction levels.		

8.7 Residual effects

8.7.1 This section describes the residual effects for surface water and groundwater having taken into account the embedded, good practice and additional mitigation described above. Tables G8-9, G8-10 and G8-11 below provide a summary of significant effects identified prior to and post application of additional mitigation for the construction and operational phases.

8.7.2 Significant residual adverse effects were identified for the construction and operational phases, although two of three identified significant effects have the same issue for construction and operation.

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

8.7.4 A WFD compliance assessment (Application Reference Number: 8.26) has been undertaken in parallel to the assessment of effects on surface water, groundwater and fluvial geomorphology provided within this chapter. When taking into account good practice and embedded mitigation, the WFD compliance assessment (Application Reference Number: 8.26) identified that for the A5025 Off-line Highway Improvements all construction and operation activities would be compliant with the legislative requirements.

[This page is intentionally blank]

Table G8-9 Summary of residual effects: surface water during operation

Receptor (or group of receptors)	Value of receptors	Description of potential effect	Nature of effect	Potential magnitude of change	Potential significance of effect	Additional mitigation	Post-mitigation magnitude of change	Significance of residual effect
Residential property (unnamed) (section 3)	High	Increase in flood depth of less than 10mm	Long-term Adverse	Minor	Moderate	Further design to address the impact to flood flow paths from the A5025 viaduct and embankments at section 3 would be progressed and mitigation upstream of the viaduct in the form of minor ground re-profiling would be used to manage the flood waters associated with the A5025 Off-line Highway Improvements without increasing flood risk elsewhere.	Minor adverse	Slight

Table G8-10 Summary of residual effects: fluvial geomorphology during construction and operation

Receptor (or group of receptors)	Value of receptor	Description of potential effect	Nature of effect	Potential magnitude of change	Potential significance of effect	Additional mitigation	Post-mitigation magnitude of change	Significance of residual effect
Afon Cafnan (section 7)	Medium	Construction and operation of a new culvert over the bedrock cascade removing a unique feature of the Afon Cafnan	Local Permanent Adverse	Moderate	Moderate	Horizon will follow protective measures to reduce the extent of the area that is likely to be damaged, including an appropriate working corridor (as detailed in table G8-8).	Minor adverse	Slight

Table G8-11 Summary of residual effects: groundwater during construction and operation

Receptor (or group of receptors)	Value of receptor	Description of potential effect	Nature of effect	Potential magnitude of change	Potential significance of effect	Additional mitigation	Post-mitigation magnitude of change	Significance of residual effect
Well at Erw Goch (Potential PWS) (section 3)	Medium	Reduction in water levels and flow that could manifest during construction, or at the start of operation	Adverse Local Long-term	Moderate	Moderate	Horizon will undertake monitoring at the private water supply at Erw Goch as detailed in table G8-8. If a change in the availability or quality of the water supply is identified, Horizon will put in place measures to reinstate the private water supply to the quality and availability of pre-construction levels.	Neutral	Neutral

[This page is intentionally blank]

8.8 References

Table G8-12 Schedule of references

ID	Reference
RD1	Welsh Government. 2004. *Technical Advice Note* (TAN) *15: Development and Flood Risk*. [Online]. [Accessed: April 2017]. Available from: http://wales.gov.uk/docs/desh/publications/040701tan15en.pdf.
RD2	Natural Resources Wales. 2015. *Long term flood risk.* [Online] [Accessed: May 2017]. Available from: https://naturalresources.wales/evidence-and-data/maps/long-term-flood-risk/?lang=en
RD3	Structural Soils. 2016. Factual Report on Ground Investigation, Site 1 – Junction 3 A55 Valley Improvements.
RD4	AECOM. 2016. A5025 Wylfa, Ground Investigation, Section 1, Valley.
RD5	Natural Resources Wales. 2016. *Water Watch Wales Map Gallery.* [Online] [Accessed: October 2016]. Available from: http://waterwatchwales.naturalresourceswales.gov.uk/en.
RD6	Natural Resources Wales. 2015. *Western Wales River Basin Management Plan 2015 – 2021 Summary.* [Online] [Accessed: June 2017]. Available from: https://naturalresources.wales/media/676165/wwrbdsummary.pdf.
RD7	Cranfield Soil and AgriFood Institute. 2017. *Soilscape Viewer.* [Online] [Accessed: October 2016]. Available from: http://www.landis.org.uk/soilscapes/.
RD8	Structural Soils. 2016. Factual Report on Ground Investigation, Site 2 – Llanfachraeth Improvements.
RD9	AECOM. 2016. A5025 Wylfa, Ground Investigation, Section 3, Llanfachraeth.
RD10	Structural Soils. 2016. Factual Report on Ground Investigation, Site 3 – Llanfaethlu Improvements.
RD11	AECOM. 2016. A5025 Wylfa, Ground Investigation, Section 5, Cefn Coch.
RD12	Structural Soils. 2016. Factual Report on Ground Investigation, Site 4 – Cefn Coch Bend Improvements.
RD13	AECOM. 2016. A5025 Wylfa, Ground Investigation, Section 7, Llanfachraeth.
RD14	Venables, R., Newton, J., Westaway, N., Venables, J., Castle, P., Neale, B., Short, D., McKenzie, J., Leach, A., Housego, D., Chapman, J., Peirson-Hills, A. 2000. *Environmental Handbook for Building and Civil Engineering Projects. Part 1: design and specification* (C512). London: CIRIA
RD15	Venables, R., Newton, J., Westaway, N., Venables, J., Castle, P., Neale, B., Short, D., McKenzie, J., Leach, A., Housego, D., Chapman, J., Peirson-Hills, A. 2000. *Environmental Handbook for Building and Civil Engineering Projects. Part 2: construction* (C528). London: CIRIA
RD16	Venables, R., Newton, J., Westaway, N., Venables, J., Castle, P., Neale, B., Short, D., McKenzie, J., Leach, A., Housego, D., Chapman, J., Peirson-Hills, A. 2000. *Environmental Handbook for Building and Civil Engineering Projects. Part 3: demolition and site clearance* (C529). London: CIRIA

ID	Reference
RD17	Masters-Williams, H., Heap, A., Kitts, H., Greenshaw, L., Davis, S., Fisher, P., Hendrie, M. and Owens, D. 2001. *Control of water pollution from construction sites. Guidance for consultants and contractors* (C532). London: CIRIA
RD18	Charles, P. and Edwards, P. (eds.) 2015. *Environmental good practice on site guide* (fourth edition) (C741). London: CIRIA.
RD19	McIntyre, N., Thorne, C. (eds.) 2013. Land use management effects on flood flows and sediment – guidance on prediction (C719D). London: CIRIA
RD20	Woods Ballard, B., Wilson, S., Udale-Clarke, H., Illman, S., Scott, T., Ashley, R. and Kellagher, R. 2015. *The SuDS Manual* (C753). London: CIRIA.
RD21	Lancaster, J. W., Preene, M., Marshall, C, T. 2004. *Development and flood risk – guidance for the construction industry* (C624). London: CIRIA
RD22	Balkham, M., Fosbeary, C., Kitchen, A. and Rickard, C. 2010. *Culvert Design and Operating Guide* (C689). London: CIRIA.
RD23	Highways Agency. 2009. *Design Manual for Roads and Bridges*. Volume 11, Section 3, Part 10: Road Drainage and the Water Environment (HD45/09). London: The Stationery Office.
RD24	Natural Resources Wales. 2015. Good Practice Guide: Producing flood risk hydraulic models and flood consequence assessments for development planning purposes (GPG 101). Cardiff: NRW.