Visual Impact Provision (VIP) – Snowdonia Project

Flood Consequences Assessment

Date:

03/12/2019

Prepared for:

National Grid

Prepared by:

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Project Name:

Visual Impact Provision (VIP): Snowdonia Project

Project No:

41523996

Report Ref:

RPT_41523996_*FCA*

Sign-off Sheet

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Project No	41523996
Report Reference	RPT_*41523996_FCA*

Revision	Date	Description	Author	Check	Review
Draft	16 September 2019	First Draft	Kelvin Limbrick	Janet Langsford	Pauline Barry
Updated to incorporate comments from NG and RSK	03 December 2019	Second Draft	Kelvin Limbrick	Janet Langsford	Pauline Barry

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Executive Summary

This document presents the findings of a Flood Consequences Assessment (FCA) for National Grid's Visual Impact Provision (VIP) Snowdonia Project (the Proposed Project). This FCA has been produced in accordance with Planning Policy Wales and Technical Advice Note (TAN) 15: Development and Flood Risk. This FCA demonstrates that:

- the consequences of flooding from all sources to the Proposed Project are fully understood;
- appropriate mitigation measures have been put in place to ensure that the Proposed Project will remain safe and operational during times of flooding over its intended lifetime, whilst taking climate change into account;
- the consequences (i.e. the overall impacts) of the Proposed Project on flood risk elsewhere are understood;
- the Proposed Project meets the requirements of the TAN 15 Justification Test; and
- the flood consequences of the Proposed Project are considered to be acceptable.

As such, this FCA demonstrates that the Proposed Project will be safe, will not increase flood risk elsewhere and is acceptable in principle for its location.

Abbreviations

AEP	Annual Exceedance Probability (%) of a flood event.
AONB	Area of Outstanding Natural Beauty
BGS	British Geological Survey
CEMP	Construction Environmental Management Plan
FCA	Flood Consequences Assessment
ha	Hectares
km	Kilometers
m/s	Meters per second
NRW	Natural Resources Wales
OHL	Overhead Line
PPW	Planning Policy Wales
QBAR	Greenfield runoff rate
SAB	SuDS Approval Body
SEC	Sealing End Compound
SuDS	Sustainable Drainage Systems
TAN	Technical Advice Note
VIP	Visual Impact Provision
WFD	Water Framework Directive

Glossary

Term	Definition
Alluvium	Material transported by rivers and deposited along its course
Aquifer	A body of permeable rock that is capable of storing significant quantities of water and through which groundwater moves
Attenuation Storage	Surface water storage required to reduce the peak flow rate
Base flow	Sustained or dry-weather flows not directly generated by rainfall. It commonly constitutes flows generated by domestic and industrial discharges and also infiltration or groundwater-fed river flows
Bedrock aquifer	Solid geological formations e.g. sandstone, chalk and limestone.
Catchment	A defined area, often determined by topographic features or land use, within which rain will contribute to runoff to a particular point under consideration
Construction Environmental Management Plan	A document outlining how a construction project will avoid, minimise or mitigate effects on the environment and surrounding area. They often implement environmental commitments outlined in an Environmental Statement, an environmental policy or environmental plan, requirements of planning conditions, Section 106 agreements or other legislative requirements. They are 'live' documents that are reviewed and updated at regular intervals throughout the project life cycle.
Development Advice Map (DAM) Zone A	Considered to be at little or no risk of fluvial or tidal/coastal flooding. Does not require any further assessment of flood risk.
Development Advice Map (DAM) Zone B	Areas known to have been flooded in the past evidenced by sedimentary deposits. Flood risk should usually be considered further.
Development Advice Map (DAM) Zone C1	Based on the extreme flood outline, equal to or greater than 0.1% (river, tidal or coastal) (i.e. greater than 1 in 1,000 chance of flooding in any one year). Areas of the

	floodplain which are developed and served by significant infrastructure, including flood defences. A Flood Consequences Assessment (FCA) is required.
Development Advice Map (DAM) Zone C2	Based on the extreme flood outline, equal to or greater than 0.1% (river, tidal or coastal) (i.e. greater than 1 in 1,000 chance of flooding in any one year). Areas of the floodplain without significant flood defence infrastructure. A Flood Consequences Assessment (FCA) is required.
Event (rainfall)	Single occurrence of rainfall before and after which there is a dry period.
Flood Consequences Assessment	Technical review of the flood risks to and as a result of a proposed development. Often includes flood risk mitigation measures as appropriate.
Floodplain	An area that would naturally be affected by flooding if a river rises above its banks, or high tides and stormy seas cause flooding in coastal areas.
Greenfield runoff rate	Usually calculated as the peak rate of runoff for a specific return period due to rainfall falling on a given area of vegetated (i.e. undeveloped) land.
Groundwater	Water flowing through or contained beneath the ground surface. Sub-surface water occupying the saturated zone from which wells and springs are fed. Strictly the term applies only to water below the water table.
High Risk	Of flooding from rivers, the sea and from surface water. Each year, the area has a chance of flooding of greater than 1 in 30 (3.3%).
Impermeable surface	Surface which resists the infiltration of water.
Infiltration	The introduction of rainwater runoff into the ground.
Low Risk	Of flooding from rivers, the sea and from surface water. Each year, the area has a chance of flooding of between 1 in 1000 (0.1%) and 1 in 100 (1%).
Overland flow	The flow of water over the ground, or paved surface before it enters a defined channel or inlet.
Permeability	The property or capacity of a rock, sediment or soil for transmitting a fluid.

Pollution	The addition to a natural body of water of any material which diminishes the optimal use of the water body by the population which it serves and has an adverse effect on the environment.
Principal aquifer	These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.
QBAR	The Mean Annual Flood flow rate for an area of vegetated (i.e. undeveloped) land. This approximates to a return period of 2.3 years and is often used to calculate the rate of Greenfield runoff.
Runoff	The water derived from snow or rain falling on a surface which does not permeate into the soil but which flows off the surface to reach a drain, sewer or receiving water.
Secondary A Aquifer	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.
Secondary B Aquifer	Predominantly lower permeability layers, which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.
Secondary Undifferentiated Aquifer	Aquifer that has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.
Superficial aquifer	Permeable unconsolidated (loose) deposits. For example, sands and gravels.
Surface Runoff	See also Runoff. The flow of water over a land surface when rainfall can no longer soak into the ground below.
Water quality	A measure of the chemical, physical and biological characteristics of a water body or sample.

Watercourse	A natural or artificial channel which conveys water.
Flood Zone 3	The extent of a flood from rivers with a 1% (1 in 100) chance or greater of happening in any given year. The extent of a flood from the sea with a 0.5% (1 in 200) chance or greater of happening in any given year.
Flood Zone 2	The extent of a flood from rivers or from the sea with up to a 0.1% (1 in 1000) chance of happening in any given year. Contains areas recorded to have flooded in the past. Flood Zone 2 is important from a planning context as it forms the basis of Zone C in the Welsh Government Development Advice Map.
Flood Zone 1	Land with less than a 0.1% (1 in 1000) chance of flooding from rivers and the sea in any given year. Flood Zone 1 is important from a planning context as it is similar to Zone A in the Welsh Government Development Advice Map.

1.0 INTRODUCTION

1.1 PURPOSE

National Grid is currently undertaking the Visual Impact Provision (VIP) Snowdonia Project, (here on referred to as the Proposed Project), which aims to mitigate the visual impact of existing electricity infrastructure within the Snowdonia National Park near Minffordd and to conserve and enhance the natural beauty, wildlife and environmental heritage of the area.

The Proposed Project comprises undergrounding a 3.5km section of existing overhead line (OHL) (here on referred to as the VIP subsection) using a tunnel from a location close to National Grid's existing Garth Sealing End Compound (SEC) on the western side of the Dwyryd Estuary to Cilfor on the eastern side of the Dwyryd Estuary, and to remove the existing VIP subsection (pylons and conductors).

This document presents the findings of a Flood Consequences Assessment (FCA) for the Proposed Project. An FCA is required for the Proposed Project because its planning application area a) is greater than 1ha in area; and b) is located within areas of flood risk. An FCA is also required to accompany the application to the SuDS Approval Board (SAB) for Sustainable Drainage Systems (SuDS) approval for the Proposed Project.

This FCA has been produced in accordance with Planning Policy Wales (edition 10, December 2018) and Technical Advice Note (TAN) 15: Development and Flood Risk (July 2004)[1]. As set out in Planning Policy Wales and TAN 15, the objectives of an FCA are to establish:

- That the consequences of flooding to the Proposed Project are fully understood;
- That the consequences (i.e. the overall impacts) of the Proposed Project on flood risk elsewhere within the catchment are understood for a range of potential flooding scenarios up to the flood with a probability of 0.1%; and
- Whether appropriate mitigation measures can be incorporated within the design of the Proposed Project to ensure that development minimises risk to life, damage to property and disruption to people living and working on the site or elsewhere in the floodplain.

This FCA seeks to demonstrate that flood risk from all sources has been considered as part of the Proposed Project and that the requirements of the tests set out in TAN 15: Section 6 (Justifying the Location of the Development), and Section 7 (Assessing Flooding Consequences) are met.

1.2 OVERVIEW OF THE PROPOSED PROJECT

The Proposed Project aims to mitigate the visual impact of existing electricity infrastructure within the Snowdonia National Park, near Minffordd, and to conserve and enhance the natural beauty, wildlife and environmental heritage of the area. The Proposed Project comprises undergrounding a 3.5km section of existing VIP subsection using a tunnel from a location close to National Grid's existing Garth SEC on the western side of the Dwyryd Estuary to Cilfor on the eastern side of the Dwyryd Estuary, and to remove the existing VIP subsection (pylons and conductors). National Grid is seeking to secure full planning permission for the Proposed Project by way of a planning application under the Town and Country Planning Act 1990.

[1] TAN15 is currently being updated although, at the time of writing, it is not known when the updated document will be made publicly available.

The Proposed Project comprises the following main elements:

- Western Side of the Dwyryd Estuary Diversion of third-party assets, including the undergrounding of an OHL supported on wooden poles away from the construction area in accordance with operator requirements;
  - Reconfiguration of equipment at the existing Garth SEC (including removal of the gantry, there will therefore be no equipment greater than 10m high);
  - A tunnel head house (containing a tunnel shaft), with a permanent access road close to National Grid's existing Garth SEC. The ground will need to be raised out of the flood zone level. A permanent power supply and site drainage will be required;
  - Underground buried cable to connect into the SEC from the tunnel head house;
  - Removal of six lattice pylons and associated foundation to 1.5m below ground level;
  - Temporary access routes (with potential highways improvements or passing places) and laydown areas to facilitate construction activities;
  - A section of cable tunnel (total length across the Proposed Project 3.4km long, with an internal diameter of up to 4.4m, at varying depths below the ground); and
  - Landscape and visual mitigation mounding and planting.
- Eastern Side of the Dwyryd Estuary
  - Diversion of third-party assets including the diversion of a water pipeline and OHL supported on wooden poles away from the construction area in accordance with operator requirements;
  - A new SEC near Cilfor (required to connect the new underground cable to the remaining existing OHL);
  - A tunnel head house (containing a tunnel shaft), with a permanent access road. The ground will be raised to create a working platform and will be regraded/ contoured. A permanent power supply and site drainage will be required;
  - A section of cable tunnel (approximately 100m);
  - Removal and reinstallation of one pylon (Pylon 4ZC027) adjacent to the new Cilfor SEC;
  - Removal of two lattice pylons and associated foundation to 1.5m below ground level;
  - Temporary access routes and laydown areas to facilitate construction activities; and
  - Landscape and visual mitigation mounding and planting.
- Dwyryd Estuary
  - A section of cable tunnel;
  - Removal of Pylon 4ZC030R, National Grid will also aim to remove all pylon structures including the foundation piles and cofferdam sheet piles; alternatively, foundations will be removed to the maximum depth possible by an excavator located on the working area;
  - Partial removal of the foundations of the previously dismantled pylon 4ZC030;
  - Removal of Pylon 4ZC031 and full or partial removal (3.75m) of its foundations; and
  - Temporary accesses associated with the removals noted above, as well as temporary access to enable the dismantling of Pylon 4ZC032 (although the pylon itself is within the terrestrial environment).

The Proposed Project layout is presented in Appendix A.

1.3 REPORT OBJECTIVES AND STRUCTURE

This report has been prepared in accordance with the requirements of Planning Policy Wales (edition 10, December 2018) and TAN 15: Development and Flood Risk (July 2004). The objectives of this report are to a) quantify the flood risk to the site, b) demonstrate that the Proposed Project will remain operational during flood conditions over its intended lifetime taking climate change into consideration, and c) demonstrate that the Proposed Project will not increase flood risk elsewhere and reduce flood risk overall where possible.

This FCA covers the flood risk issues associated with the construction, operational and decommissioning phases of the Proposed Project.

The report is structured as follows:

- Section 2 covers the relevant planning policies related to the preparation of FCAs including the requirements of Planning Policy Wales (edition 10) and TAN 15, and relevant local flood risk policies;
- Section 3 describes the operational phase components of the Proposed Project in more detail;
- Section 4 presents the Baseline Conditions in terms of physical characteristics such as topography, hydrology, hydrogeology, soils and land use;
- Section 5 assesses the risk of flooding to the Proposed Project from all potential sources;
- Section 6 considers TAN 15 Land Use Acceptability;
- Section 7 addresses the TAN 15 Justification Test;
- Section 8 details the flood risk considerations during the construction and decommissioning phases, and presents mitigation measures as appropriate;
- Section 9 details the flood risk considerations during the operational phase and presents mitigation measures as appropriate. This section also considers climate change;
- Section 10 provides the TAN 15 Consequences Assessment; and
- Section 11 presents the conclusions of this FCA.

1.4 AVAILABLE INFORMATION

This FCA is based on the following information:

- National Strategy for Flood and Coastal Erosion Risk Management in Wales, November 2011;
- Gwynedd Council Local Flood Risk Management Strategy, February 2013;
- TAN 15: Development and Flood Risk (July 2004);
- Planning Policy Wales (edition 10, December 2018);
- North Wales Tidal Water Level Information (NRW, 2018);
- Afon Glaslyn & Tributaries at Porthmadog Flood Risk Study. Final Modelling Report. (JBA, January 2014);
- LiDAR Digital Terrain Model (DTM) ground level data; and
- Minutes from a telephone conference with NRW on the 12th June 2019.

2.0 FLOOD RISK AND PLANNING POLICY OVERVIEW

2.1 NATIONAL PLANNING POLICY

2.1.1 Planning Policy Wales (Edition 10, December 2018)

Section 6.6 of Planning Policy Wales specifically addresses water and flood risk highlighting aims to minimise adverse impacts on the environment, amenity, and health and communities, particularly in light of the consequences of climate change. Paragraphs 6.6.22 to 6.6.29 inclusive specifically address development and flood risk, emphasising that climate change is likely to increase the risk of flooding through sea-level rise, storm events and intense rainfall, and that consideration is required in terms of both consequences and likelihood.

The document recognises that surface water flooding can affect the location, layout and design of schemes and that these factors should be considered at an early stage when formulating development proposals.

The document also encourages the use of the NRW Development Advice Maps to inform decisions on the location of new development and the supporting information for new applications, such as FCAs, to provide a greater understanding of the potential effects.

The document states that development should reduce, not increase, flood risk arising from river and/or coastal flooding on and from the development site itself. The priority should be to protect the undeveloped or unobstructed floodplain from development and to prevent the cumulative effects of incremental development. Only in wholly exceptional circumstances or where the Proposed Projectcomprises essential utilities infrastructure should this be allowed. The Proposed Projectshould be designed and constructed to remain operational even at times of flood, to result in no net loss of floodplain storage, to not impede water flows and to not increase flood risk elsewhere. The ability of emergency services to respond to flood events should be taken into account.

The Proposed Projectshould not cause additional run-off and this should be achieved by the use of SuDS. Consultation with drainage bodies and NRW should be undertaken, with relevant evidence and information drawn from Area Statements.

TAN 15: Development and Flood Risk is referred to for the provision of further policy advice.

2.1.2 The Wales Spatial Plan 2008 Update

Chapter 12 (Valuing our Environment) recognises the importance of climate change and the impact that this will have on communities, working environments, way of life, and health and wellbeing. Climate change will impact these receptors through increased flood risk, with further consequences for land use, water resources, biodiversity and wildlife. It recognises that these adaptation issues need to be addressed.

2.1.3 TAN 15: Development and Flood Risk 2004

This document provides technical guidance which supplements the policy set out in Planning Policy Wales (Section 2.1.1) in relation to development and flooding. It advises on development and flood risk in relation to sustainability principles and provides a framework where, risks arising from both river and coastal flooding, as well as additional runoff from development, can be assessed.

TAN 15 classifies utilities infrastructure as Less Vulnerable Development. At the time of writing, TAN 15 is currently being revised however no date for publication is currently

available. A review of TAN 15 was completed in December 2017 which put forward 14 recommendations and included the following:

- Moving to a fully risk-based approach which should encompass all sources of flood risk and capture the awareness of surface water flooding.
- A strong presumption against highly vulnerable development in areas of greatest flood risk.
- A recommendation that there should be a complete review of the Development Advice Maps (DAMs) incorporating mapping prepared by NRW.

2.2 LOCAL FLOOD RISK POLICY

2.2.1 Anglesey and Gwynedd Joint Local Development Plan

The Anglesey and Gwynedd Joint Local Development Plan was adopted on 31 July 2017.

Strategic Policy PS 5: Sustainable Development – the policy relates to reducing the amount of water used and wasted; reducing the effect on water resources and quality; managing flood risk and maximizing use of sustainable drainage schemes; and progressing the objectives of the Western Wales River Basin Water Management Plan.

Strategic Policy PS 6: Alleviating and adapting to the effects of climate change relates to:

- Locating development away from flood risk areas and aiming to reduce the overall risk of flooding within the Plan area and its surrounding area; and
- Being able to withstand the effects of climate change by implementing high standards of sustainable building design, location, layout and methods (in line with Policy PCYFF 3).

Policy PCYFF 3: Design and Place Shaping – the policy states that, for new development, drainage systems are to be designed to limit surface water runoff, flood risk and pollution.

The Anglesey and Gwynedd Council Joint Local Development Plan is supported by the Strategic Flood Consequences Assessment Stage 1 (March 2016). This document forms a key part of the evidence base, helping to:

- Determine appropriate development policies and land allocations that avoid or minimise flood risk from all sources; and
- Assess any future development proposals in line with the precautionary framework in PPW and TAN15.

2.2.2 Local Flood Risk Management Strategy

The Local Flood Risk Management Strategy was published by Gwynedd Council in February 2013. This document advocates a risk management approach to flood risk, working with natural processes to contribute to a more sustainable ecosystem management approach. This includes deploying the SuDS approach for surface water management for both new and existing developments.

Gwynedd Council (covering the Snowdonia National Park Authority) is identified as being the SuDS Approval Body (SAB) to which applications from developers for SuDS drainage approval should be submitted. Gwynedd Council advises Snowdonia National Park Authority on the likely impact of new development on flood risk.

2.2.3 Eryri Local Development Plan 2016-2031

The revised Eryri Local Development Plan (2016-2031) was adopted by Snowdonia National Park Authority on the 06 February 2019.

Strategic Policy A: National Park Purposes and Sustainable Development – The policy seeks to ensure that new development promotes the principles of sustainable development in ways which further the National Park's purposes and duty whilst conserving and enhancing the National Park's 'Special Qualities'. This includes conserving the quality and quantity of natural resources, such as water, and preventing inappropriate development in areas which are at risk from flooding or which contribute to the risk of flooding.

Development Policy 6: Sustainable Design and Materials – The policy requires all forms of new built development to attain the minimum level of national sustainable building requirements. Developments must also take into consideration biodiversity protection and enhancement and environmental sustainability.

Strategic Policy Dd: Climate Change – The policy relates to ensuring that any flood protection works have no adverse environmental impacts or that they can be satisfactorily mitigated. The policy states that flood protection works should conserve and enhance areas of peatland to assist in carbon retention, water storage and flood prevention, where possible.

2.3 TAN 15 TESTS

2.3.1 Justifying the Location of the Development

Section 6 of TAN 15 concerns 'Justifying the Location of the Development'. It states that new development should be directed away from Zone C and towards suitable land in Zone A (refer to the Glossary for a definition of the TAN 15 Flood Zones). If this is not possible, new development should be directed to Zone B, where river or coastal flooding is less of an issue.

Highly vulnerable development and emergency services in Zone C2 should not be permitted, and all other new development should only be permitted within Zones C1 and C2 if determined by the planning authority to be justified in that location. TAN 15 classifies utilities infrastructure as Less Vulnerable Development.

Development may be justified if it can be demonstrated that the potential consequences of a flooding event for the particular type of development have been considered. This must be completed in accordance with criteria contained in TAN 15 Section 5 (Nature of development or land use) and Section 7 (Assessing Flooding Consequences).

2.3.2 Assessing Flooding Consequences

Section 7 (and Appendix 1) of TAN 15 concerns 'Assessing Flooding Consequences'. It applies to proposed development located in Zone C, and those parts of Zone B where flooding has been identified as a material consideration to allow for localised problems. The assessment should be appropriate to the size and scale of the proposed development. It emphasises that development should only proceed if the consequences of flooding can be managed to a level which is acceptable for the nature/type of development being proposed.

Mitigation measures incorporated into the design should ensure minimal:

- Risk to life;
- Disruption to people living and working in the area;
- Potential damage to property;
- Impact of the Proposed Project on flood risk generally; and

- Disruption to natural heritage.

These measures must be put in place and implemented at the appropriate stage. Where necessary, provision for their long-term maintenance should be stated.

3.0 THE VIP SNOWDONIA PROJECT

3.1 SITE LOCATIONS

The Proposed Project represents a major opportunity to mitigate the visual impact of existing electricity infrastructure within the Snowdonia National Park near Minffordd and to conserve and enhance the natural beauty, wildlife and environmental heritage of the area. The Proposed Project comprises undergrounding a 3.5km section of existing OHL using a tunnel from a location close to National Grid's existing Garth SEC on the western side of the Dwyryd Estuary to Cilfor on the eastern side of the Dwyryd Estuary, and to remove the existing VIP subsection (pylons and conductors). A site location plan is included in Appendix A.

3.2 DEVELOPMENT PROPOSALS

3.2.1 Permanent Operational Phase Components (western side of the Dwyryd Estuary)

On the western side of the Dwyryd Estuary the Proposed Project will comprise elements as listed in Section 1.2 above. These elements will introduce the following new areas of permanent impermeable hardstanding:

- Reconfiguration of equipment at the existing Garth SEC;
- A tunnel head house close to National Grid's existing Garth SEC; and
- A short access road to the tunnel head house.

The total area of this new impermeable hardstanding (i.e. roof area, road/parking areas and reconfigured equipment concrete slab areas) is shown in Table 1 below.

Table 1. New impermeable areas associated with the permanent operational phase components of the Proposed Project (western side of the Dwyryd Estuary).

Operational Phase Component	Total Impermeable Area (m^2)
Reconfiguration of equipment at the existing Garth SEC	0[2]
Western tunnel head house and car parking	329
Access road to western tunnel head house	198

[2] Whilst the reconfiguration of the existing Garth SEC is a component of the operational phase of the Proposed Project, it is not expected to result in the creation of additional impermeable area.

3.2.2 Permanent Operational Phase Components (eastern side of the Dwyryd Estuary)

On the eastern side of the Dwyryd Estuary the Proposed Project will comprise elements as listed in Section 1.2 above. These elements will introduce the following new areas of permanent impermeable hardstanding:

- A new SEC near Cilfor (required to connect the new underground conductor to the remaining existing OHL);
- A tunnel head house located in the same compound as the new SEC; and
- An access road to the new SEC and tunnel head house.

The total area of this new impermeable hardstanding (i.e. roof area, road/parking areas and new SEC equipment concrete slab areas) is shown in Table 2 below.

Table 2. New impermeable areas associated with the permanent operational phase components of the Proposed Project (eastern side of the Dwyryd Estuary).

Operational Phase Component	Total Impermeable Area (m^2)
New SEC near Cilfor, Eastern tunnel head house, and SEC pads	982
Access road to the new SEC and eastern tunnel head house	1369

3.2.3 Removal of Existing Infrastructure (VIP subsection)

On the western side of the Dwyryd Estuary, the Proposed Project will comprise the removal and dismantling of six pylons. On the eastern side of the Dwyryd Estuary, the Proposed Project will comprise the removal and reinstallation of one pylon at the new Cilfor SEC and the removal and dismantling of two pylons. Temporary access routes and laydown areas will be constructed to facilitate these activities.

Within the Dwyryd Estuary, the Proposed Project will comprise the following:

- Removal of Pylon 4ZC030R, National Grid will also aim to remove all pylon structures including the foundation piles and cofferdam sheet piles; alternatively, foundations will be removed to the maximum depth possible by an excavator located on the working area;
- Partial removal of the foundations of the previously dismantled pylon 4ZC030;
- Removal of Pylon 4ZC031 and partial removal of its foundations; and
- Temporary accesses associated with the removals noted above, as well as temporary access to enable the dismantling of Pylon 4ZC032 (although the pylon itself is within the terrestrial environment).

4.0 BASELINE CONDITIONS

4.1 TOPOGRAPHY

4.1.1 Permanent Operational Phase Components (western side of the Dwyryd Estuary)

Existing ground levels in the area of the western tunnel head house and access road are at ca. 1.89m AOD. Ground levels throughout the existing Garth SEC are at ca. 2.5m AOD.

4.1.2 Permanent Operational Phase Components (eastern side of the Dwyryd Estuary)

Existing ground levels in the area of the new SEC near Cilfor (including the eastern tunnel head house) are at ca. 4.2m AOD. Ground levels along the route of the new access road range between ca. 2.8m to ca. 3.6m AOD.

4.1.3 Works within the Dwyryd Estuary

The topography of the OHL to be removed is undulating, rising from the Glaslyn Estuary over the headland at Minffordd to the Dwyryd Estuary and crossing the estuary to Cilfor. Approximate levels at each pylon are:

- 4ZC037 - approx. 3.0mAOD;
- 4ZC036 - approx. 15.75mAOD;
- 4ZC035 - approx. 27.0mAOD;
- 4ZC034 - approx. 34.0m - 35.0mAOD;
- 4ZC033 - approx. 32.0mAOD;
- 4ZC032 - approx. 3.0m-4.0mAOD;
- 4ZC031 - approx. 2.0mAOD – within saltmarsh area of Dwyryd Estuary;
- 4ZC030 - approx. 2.0mAOD – within saltmarsh area of Dwyryd Estuary;
- 4ZC029 - approx. 2.75mAOD;
- 4ZC028 - approx. 2.7mAOD; and
- 4ZC027 - approx. 7.0mAOD.

4.2 GROUND CONDITIONS

4.2.1 Permanent Operational Phase Components (western side of the Dwyryd Estuary)

Cranfield University's Soilscapes website[3] provides high-level information on soil characteristics across the UK and classifies the soil types for these operational phase components as: *"Freely draining acid loamy soils over rock, and Saltmarsh soils (naturally wet)".*

[3] http://www.landis.org.uk/soilscapes/

The British Geological Survey's Geology Viewer website[4] describes the bedrock geology and superficial deposits beneath these locations as:

- Bedrock geology: Maentwrog Formation - Mudstone, siltstone and sandstone. Sedimentary bedrock formed between 508 and 485.4 million years ago during the Cambrian period; and
- Superficial deposits: Tidal Flat Deposits - Clay, silt and sand. Sedimentary superficial deposit formed between 11.8 thousand years ago and the present during the Quaternary period.

4.2.2 Permanent Operational Phase Components (eastern side of the Dwyryd Estuary)

Cranfield University's Soilscapes website[5] classifies the for these operational phase components as: *"Freely draining acid loamy soils over rock".*

The British Geological Survey's Geology Viewer website[6] describes the bedrock geology and superficial deposits beneath these locations as:

- Bedrock geology: Dol-cyn-afon Formation - Mudstone and siltstone. Sedimentary bedrock formed between 485.4 and 477.7 million years ago during the Ordovician period; and
- Superficial deposits: Alluvium - Clay, silt, sand and gravel. Sedimentary superficial deposit formed between 11.8 thousand years ago and the present during the Quaternary period.

The eastern operational components of the Proposed Project will be constructed in an area where there are widespread active peat deposits. A Peat Management Plan is provided in the Outline Construction Environment Management Plan which forms Appendix 2A of the accompanying Environmental Appraisal.

4.3 EXISTING DRAINAGE

Ordinary watercourses are located to the north of the existing Garth SEC and to the south of the proposed location of the western tunnel head house and access road. These watercourses flow east to west into the Afon Glaslyn estuary. The Nant Yr Efail stream flows from northeast to southwest from the Llyn Tecwyn Uchaf reservoir across the proposed location of the new Cilfor SEC and eastern tunnel head house. Numerous drains connect into the stream from across the area. These are also ordinary watercourses that join the Dwyryd estuary further west.

No sewers are present in the vicinity of the existing Garth SEC and western tunnel head house with the nearest sewer located at Syenite Terrace (foul) and at Osmond (surface water and combined). No sewers are present in the vicinity of the proposed SEC near Cilfor and eastern tunnel head house.

The alignment of the OHL to be removed crosses a small number of unnamed field drains/ditches, as well as crossing the Nant Yr Efail stream twice on the eastern side of the Dwyryd Estuary.

[4] https://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html
[5] http://www.landis.org.uk/soilscapes/
[6] http://mapapps.bgs.ac.uk/geologyofbritain/home.html

4.3.1 Existing Land Use

Land use at the location of the western tunnel head house is currently improved grassland, used for livestock grazing, surrounded by managed hedgerows, stone walls or tree belts.

Land use at the location of the eastern SEC and tunnel head house is currently unimproved grassland/heathland with scattered trees and scrub.

The alignment of the OHL to be removed crosses a mix of rural and urban land uses, including farmland fields, woodland, saltmarsh and river, as well as roads, railway lines, business park and residential development.

5.0 FLOOD RISKS TO THE PROPOSED PROJECT

5.1 POTENTIAL SOURCES OF FLOODING

5.1.1 Development Advice Maps

Proposed Project – Western side of the Dwyryd Estuary

The components of the Proposed Project on the western side of the Dwyryd Estuary will be located within TAN 15 Flood Zone C1. Zone C is based on the Environment Agency's extreme flood outline and indicates land with an annual probability of flooding from rivers or the sea of up to 0.1%. TAN 15 defines Zone C1 as: "*Areas of the floodplain which are developed and served by significant infrastructure, including flood defences*." The Development Advice Map (DAM) designation applies to the construction, operational and decommissioning phases of the Proposed Project. The DAM for the Proposed Project is shown in Appendix B.

Proposed Project – Eastern side of the Dwyryd Estuary

The components of the Proposed Project on the eastern side of the Dwyryd Estuary will also be largely located within TAN 15 Flood Zone C1, with the new pylon located in Zone B. These DAM designations also apply to all three phases of the Proposed Project (Appendix B).

Proposed Project – VIP Subsection

From west to east, the alignment of the pylons to be removed crosses Zones C1, Zone A, Zone C2, and Zone C1 (Appendix B). By its nature, the 3.4km long cable tunnel will need to cross Zone C2 (i.e. it will cross beneath the Dwyryd Estuary).

5.1.2 Flooding from Rivers and the Sea

Proposed Project – Western side of the Dwyryd Estuary

The components of the Proposed Project on the western side of the Dwyryd Estuary will be located within Flood Zones 2 and 3 (i.e. Medium and High Probability, respectively). Flood Zone 2 indicates land with an annual probability of flooding from rivers or the sea of up to 0.1%. Flood Zone 3 indicates land with an annual probability of flooding from rivers or the sea of between 1 to 0.1%. The western components of the Proposed Project are also shown to be located in an area that benefits from the presence of flood defences. These Flood Zone designations apply to the construction, operational and decommissioning phases of the Proposed Project. The Flood Zones for the Proposed Project are shown in Appendix C.

Proposed Project – Eastern side of the Dwyryd Estuary

The components of the Proposed Project on the eastern side of the Dwyryd Estuary will also be located within Flood Zones 2 and 3, with these designations also applying to all three phases of the Proposed Project (Appendix C). The eastern components of the Proposed Project are also shown to be located in an area that benefits from the presence of flood defences (Appendix C).

Proposed Project – VIP Subsection

From west to east, the alignment of the pylons to be removed crosses Flood Zones 2 and 3, Flood Zone 1 (i.e. Low Probability), and then Flood Zones 2 and 3 again (Appendix C). The works to remove pylons within the Dwyryd Estuary, specifically Pylons 4ZC028 to 4ZC032, are also within Flood Zone 3 with only Pylons 4ZC028 and 4ZC029 benefitting from flood defences. By its nature, the 3.4km long cable tunnel will need to cross Flood Zone 3 (i.e. it will cross beneath the Dwyryd Estuary).

5.1.3 Flooding from Surface Water

Proposed Project – Western side of the Dwyryd Estuary

NRW's Long Term Flood Maps also indicate the potential flood risk from surface water (i.e. overland flow and surface water accumulations/ponding). These maps indicate that the surface water flood risk to the components of the Proposed Project on the western side of the Dwyryd Estuary is neither widespread in extent nor significant in depth under the 1 in 100-year scenario (Appendix Di). The surface water flood risk is shown to be largely contained within the field drains to the south of the western tunnel head house and to the east of the existing Garth SEC (Appendix Di).

Proposed Project – Eastern side of the Dwyryd Estuary

The surface water flood risk to the components of the Proposed Project on the eastern side of the Dwyryd Estuary is associated with local field drains and ponding within the areas of peatland located to the east of the A496 (Appendix Dii). Under the 1 in 100-year scenario, a surface water flood outline is indicated for the local field drain that runs through the site of the eastern tunnel head house compound (Appendix Dii), although this field drain will be diverted and reinstated as part of the Proposed Project.

Proposed Project – VIP Subsection

The proposed works to remove and/or reinstall Pylons 4ZC027 to 4ZC029 are located in an area of low to high risk of surface water flooding. In general, the remaining pylon removal works are not at significant risk of surface water flooding, although temporary access tracks would cross a small number of field drains/ditches where there would be an increased risk.

5.1.4 Flooding from Reservoirs, Canals and Other Artificial Sources

Proposed Project – Western side of the Dwyryd Estuary

NRW's Long Term Flood Maps also show the potential flood risk from reservoir failure. These maps indicate that the components of the Proposed Project on the western side of the Dwyryd Estuary are not expected to be at risk of flooding due to reservoir failure (Appendix E). There are no canals or other artificial sources of flood risk that could impact these components of the Proposed Project.

Proposed Project – Eastern side of the Dwyryd Estuary

The eastern components of the Proposed Project are, however, shown to be at potential flood risk from reservoir failure (Appendix E). This would primarily be a result of failure of the reservoir that feeds the Nant Yr Efail. Reservoir flooding is, however, extremely unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in Wales, NRW ensures that reservoirs are inspected regularly, and essential safety work is carried out. There are no canals or other artificial sources of flood risk that could impact these components of the Proposed Project.

Proposed Project – VIP Subsection

The proposed works to remove and/or reinstall pylons will mostly be located in areas not at risk of flooding due to reservoir failure (i.e. the removal of the six pylons on the western side of the estuary). The removal of the pylons in the estuary itself and on the eastern side would, however, be at risk, although this risk is considered extremely low as outlined above. There are no canals or other artificial sources of flood risk that could impact these components of the Proposed Project.

5.1.5 Flooding from Groundwater

Proposed Project – All Components

Jeremy Benn Associates' groundwater flooding data for areas at risk of flooding from groundwater under a 1 in 100-year event were obtained in May 2018. The data shows only a small portion of land in the vicinity of Pylon 4ZC035 to be at risk of groundwater flooding, where groundwater levels are between 0.025 and 0.5m below ground level (Appendix F).

5.1.6 Flooding from Sewers

Proposed Project – All Components

NRWs Long Term Flood Risk Maps for surface water provide a useful indication of where water will flow and accumulate in the event that sewer capacity is exceeded (Appendix D). However, as no sewers (foul, surface water or combined) are present at the location of the proposed western tunnel head house or eastern SEC and head house, the Proposed Project at these locations is not considered to be at risk of flooding from sewers.

Along the line of the pylons to be removed a combined sewer is present along the A497, and surface water sewers and combined sewers are present to the south of the A497/A487 roundabout. No other sewers are, however, present along the route.

5.2 SUMMARY OF FLOOD RISKS

Table 3 below provides a summary of the risk of flooding from all sources.

Table 3. Risk of flooding from all sources (refer to Appendices B to F).

Source	Western Components	Eastern Components	VIP Subsection
Development Advice Maps (DAMs)	Zone C1 (served by significant infrastructure, including flood defences).	Mainly Zone C1 (served by significant infrastructure, including flood defences), with the new pylon located in Zone B.	Present in all DAM zones.
Flooding from Rivers and the Sea	Flood Zones 2 and 3 but benefitting from flood defences.	Flood Zones 2 and 3 but benefitting from flood defences.	Flood Zones 1, 2 and 3 with only Pylons 4ZC028 and 4ZC029 benefitting from flood defences.
Surface Water Flooding	Extent of flooding mainly contained within local field drains.	Flood risk from local field drain, although this will be diverted and reinstated as part of the Proposed Project.	No risk, except Pylons 4ZC027 to 4ZC029 (low to high risk).
Flooding from reservoirs, canals and other artificial sources	No risk.	At risk, but extremely unlikely.	At risk, but extremely unlikely (eastern pylons only).

Source	Western Components	Eastern Components	VIP Subsection
Flooding from Groundwater	No risk.	No risk.	No risk, except Pylon 4ZC035 (groundwater 0.025m and 0.5m below ground level).
Flooding from Sewers	No risk.	No risk.	No risk.

6.0 TAN 15 LAND USE ACCEPTABILITY

6.1.1 TAN 15 Development Category for the Proposed Project

TAN 15 describes utilities infrastructure as 'Less Vulnerable Development'. TAN 15 states that Less Vulnerable Development is appropriate for DAM Zones C1 and C2, subject to the application of the TAN 15 Justification Test and an assessment of the acceptability of flood consequences. The TAN 15 Justification Test is considered in Section 7 and the consequences assessment is presented in Section 10.

7.0 TAN 15 JUSTIFICATION TEST

7.1.1 Justification Test for the Proposed Project

TAN 15 states that new development should be directed away from Zone C and towards suitable land in Zone A, otherwise to Zone B, where river or coastal flooding is less of an issue. New development should only be permitted within Zones C1 and C2 if determined by the planning authority to be justified in that location. Development will only be justified if it can be demonstrated that:

(i) its location in Zone C is necessary to assist, or be part of, a local authority regeneration initiative or a local authority strategy required to sustain an existing settlement; or,

(ii) its location in Zone C is necessary to contribute to key employment objectives supported by the local authority, and other key partners, to sustain an existing settlement or region;

and,

(iii) it concurs with the aims of Planning Policy Wales (PPW) and meets the definition of previously developed land; and,

(iv) the potential consequences of a flooding event for the particular type of development have been considered and found to be acceptable.

The revised Eryri Local Development Plan (2016-2031) was adopted by Snowdonia National Park Authority on the 06 February 2019. Strategic Policy A of this plan: National Park Purposes and Sustainable Development, seeks to ensure that new development promotes the principles of sustainable development in ways which further National Park purposes and duty whilst conserving and enhancing the National Park's 'Special Qualities'.

The Proposed Project will provide visual amenity enhancements through the removal of existing overhead lines and pylons in a popular tourist area that lies within Snowdonia National Park and its immediate landscape setting.

The compounds have been designed so that their footprints are as small as possible. Both compounds incorporate measures such as the inclusion of grasscrete surfacing to minimise the requirement for hard/impermeable surfacing and welded mesh security fencing to minimise visual impact. The landscape around the perimeters of the compounds has been designed to integrate the compounds into the landscape as much as possible and will include new landscaping around their respective perimeters. These landscaped areas will be planted with a mix of native tree, shrub and hedgerow species that will complement the existing environment and provide opportunities for increased biodiversity.

As such, the Proposed Project clearly aligns with Strategic Policy A of the Eryri Local Development Plan and, consequently, is considered to meet item i) above of the TAN 15 Justification Test.

PPW aims to ensure that planning decisions taken in Wales will improve the lives of both current and future generations and will build a better environment to accommodate current and future needs. The primary objective of the Proposed Project clearly aligns with these aims. The Proposed Project will also use previously developed land wherever possible, for example, by reconfiguring the existing Garth SEC and using existing access roads where available. Consequently, the Proposed Project is considered to meet item iii) above of the TAN 15 Justification Test.

The potential consequences of flooding for the Proposed Project are considered in Section 10 of this FCA and are found to be acceptable. As such, the Proposed Project is deemed to meet the requirements of the TAN 15 Justification Test.

8.0 FLOOD RISK CONSIDERATIONS – CONSTRUCTION AND DECOMMISSIONING PHASES

8.1.1 Construction and Decommissioning Phase Flood Risk Considerations

This section outlines the anticipated flood risk considerations associated with the Proposed Project during the construction and decommissioning phases[7]. Mitigation measures are outlined as appropriate.

Construction Phase Flood Risk

As per Table 3 in Section 5.2, some construction phase elements of the Proposed Project will be located within DAM Flood Zone C1. This FCA will be made available to the appointed contractor to ensure that all construction staff are made fully aware of the existing flood risks. The appointed contractor should monitor flood warnings as issued by NRW, regional and national weather forecasts, and antecedent conditions (i.e water levels in watercourses) in order to ensure that the construction phase activities are carried out safely at all times.

Construction activities within the floodplain (DAM Zone C1)

To facilitate the construction of the Proposed Project, temporary working areas (i.e. construction compounds) will be required in the vicinity of the western tunnel head house, and the eastern SEC and tunnel head house. As per Table 3 in Section 5.2, these working areas will be located within DAM Flood Zone C1. The temporary compounds will need to house welfare facilities, construction plant and equipment, and will also need to temporarily store spoil arising from the construction of the tunnel itself. Due to the temporary nature of these working areas measures to mitigate any attendant (and likely minor) impacts on the floodplain are not considered necessary, appropriate or sustainable. This was confirmed during a meeting with NRW on the 12th June 2019.

Temporary Watercourse Crossings

Temporary access routes (comprising Trackway) will be required in order to construct the Proposed Project. Where these need to cross existing watercourses, there is a risk that they could lead to localised increases in flood risk if they are undersized, become blocked, or are otherwise inappropriately designed.

To mitigate this potential risk, all temporary bridges or culverts would be appropriately designed from a hydraulic perspective to convey the range of peak flows likely to occur on each respective watercourse over the duration of the construction period. This would prevent each temporary structure from acting as a 'pinch point' and would also minimise the risk of blockage.

Where appropriate, and if required, watercourses or drains will be crossed by temporary hydraulic structures at right angles to the watercourse using as short a distance as possible while avoiding flow obstruction. This will minimise land surface disturbance and reduce the cross-sectional area of the crossing. Temporary hydraulic structures (e.g. culverts/ flumes for crossings) would be appropriately sized, and construction timed, where possible, to coincide with periods of low flow. Land Drainage Consent applications for all temporary crossings

[7] Note: At the time of writing, the decommissioning phase scope of work has yet to be determined although the flood risk considerations are anticipated to be similar to those for the construction phase, albeit on a significantly reduced scale. As such, the assessment of flood risk considerations for the decommissioning phase are assumed to be the same as for the construction phase.

would be made to Gwynedd Council, and these would be constructed in accordance with their approval.

All watercourse/ditch crossing points would be visually inspected on a regular basis to ensure that construction (or otherwise) debris does not block the crossing point. Permanent surface water drains would be reinstated to their pre-construction condition.

These mitigation measures will ensure that local flood risk is not increased as a result of temporary watercourse crossings.

Construction Phase Surface Water Runoff Management

The construction phase activities will involve the introduction of temporary impermeable areas (e.g. crane pad foundations, temporary access roads, and working area surfaces). Inappropriate management of the surface water runoff generated from these areas could lead to temporary increases in local flood risk.

As such, the appointed contractor will develop a strategy for the sustainable management of construction phase surface water based on the Outline Construction Environmental Management Plan (CEMP), in line with construction industry best practice. This mitigation measure will ensure that local flood risk is not increased as a result of temporary impermeable areas.

Silt and Sediment Management

Construction activities inherently have the potential to generate additional quantities of silt and sediment as a result of soil stripping, foundation excavations and the creation of trenches to house buried infrastructure. Improperly managed, this additional material can cause blockages of watercourses and hydraulic structures, leading to temporary increases in flood risk.

Soil management will form part of the CEMP to ensure that silt and sediment is sustainably managed throughout the construction phase, in line with construction industry best practice.

Where possible, spoil arisings would be stored at least 10m away from watercourses, and outside areas of floodplain. Where this is not possible, gaps would be provided in stored material to prevent the impoundment of flood waters. Industry best practice measures would be applied where required to ensure that stockpiled material would not be eroded/transported by overland flow and would not enter any water bodies (e.g. berms, vegetated strips and silt traps will be included as appropriate). The location of stockpiled material should also avoid overland flow paths.

Buffer strips would be created adjacent to watercourse banks to prevent sediment entering watercourses in addition to industry best practice silt and sediment control and trapping measures. Also, construction activities would not be undertaken during extreme wet weather where it may lead to erosion of sediments or could increase the risk of flooding.

These mitigation measures will ensure that local flood risk is not increased as a result of inappropriate silt and sediment management during the construction phase.

Impacts on Groundwater Flow Pathways

The construction of the shafts, tunnel and underground cable trench to connect the western tunnel head house to the reconfigured Garth SEC has the potential to create preferential linear flow pathways for groundwater.

Groundwater inflow into the tunnel during construction through the water table will be minimised by a groundwater exclusion method (secant piles) in soil and ground treatment in

rock prior to excavation. This will likely include pre-grouting of rock fissures and joints to reduce its permeability thereby reducing water flows into the excavations.

Clay bungs or other vertical barriers would be constructed within the underground cable trench excavation where deemed necessary to prevent the creation of preferential drainage pathways or to prevent the creation of preferential migration pathways for contaminants (where suspected).

These mitigation measures will ensure that local flood risk is not increased as a result of the creation of preferential groundwater flow pathways.

Disposal of Pumped Groundwater (Tunnel Construction)

There is the potential that groundwater will be encountered whilst constructing the tunnel shafts, necessitating the requirement to remove (via pumping) ground water from within the shafts during their construction and transfer to a surface water course (it should be noted that dewatering is only anticipated for a number of months and not for the full duration of construction activities).

It is currently unknown whether the water to be discharged will be fresh or saline due to proximity to the Glaslyn and Dwyryd Estuaries. Groundwater monitoring undertaken to date does not indicate saline waters, however this cannot be ruled out at this stage. Water quality testing of the pumped groundwater will, therefore, be required prior to its discharge.

Should the pumped groundwater prove to be fresh, it will be discharged to a) the existing field drain located to the south of the western tunnel head house (i.e. for the western shaft); and b) the Nant Yr Efail stream downstream of the eastern tunnel head house (i.e. for the eastern shaft).

Should the pumped groundwater prove to be saline, there is the potential to use pipes to discharge the pumped groundwater at a point on these watercourses where brackish waters are encountered (i.e. at a suitable location closer to the tidal estuaries).

Water removed from the excavation via pumps which is too turbid for discharge will be diverted to settlement ponds to remove any silt or contaminants before being discharged into the local surface water system. A water storage pond system will likely be required at both sites depending on the shaft construction method. These could be up to 85m x 65m, consisting of three linked ponds with varying degrees of water filtration to ensure water discharged to surface water is of sufficient quality.

Pumped volumes are likely to be variable but anticipated to be between 0.001 and 4.67m^3/day during tunnel construction over a period of 280 days (increasing as the tunnel lengthens), not including occasional large water flows from fissures at the face.

Water inflows into the shafts will be variable depending on the depth of the shaft but average water inflows are estimated to be:

- Western shaft: 137 m^3/day over 34 days; and
- Eastern shaft: 268 m^3/day over 74 days.

These numbers translate into average pumped rates of ca.1.6l/s and ca.3.1l/s into the existing field drain located to the south of the western tunnel head house (i.e. for the western shaft) and the Nant Yr Efail stream downstream of the eastern tunnel head house (i.e. for the eastern shaft), respectively. These average pumped discharge rates are below 5l/s, which is often used as the minimum discharge rate for single points of discharge from new developments in order to prevent blockage of the discharge outfall point[8]. As such, these temporary pumped

[8] For example, see G2.21 in the Sustainable Drainage Systems Standards for Wales.

discharges are not likely to result in an increase in flood risk or morphological damage to the respective receiving watercourses.

In the event that occasional larger flows (i.e. due to fissures at the tunnel face) are encountered, antecedent conditions on the receiving watercourses (i.e. water level and velocity) should be checked by the contractor to determine if the higher flows could be accommodated without causing adverse impacts. The water storage pond systems could be utilised to provide temporary storage in the event that water levels in the receiving watercourses are high prior to discharging these larger flows. Should the pumped water prove to be saline, then the discharge points would be in/closer to the Glaslyn and Dwyryd Estuaries, meaning that receiving capacity would be unlikely to pose an issue.

Other Temporary Construction Discharges

Land Drainage Consent applications for all remaining temporary construction discharges would be made to Gwynedd Council, and these would be constructed and operated in accordance with their approval.

Post-Construction Restoration

Inappropriate restoration following the completion of construction phase activities also has the potential to increase flood risk. Permanent changes to surface roughness and ground elevation could lead to increases in the volume and rate of runoff generated and block existing flow pathways, respectively. Diverted or modified watercourses or land drainage systems could lead to permanent changes in conveyance capacity or alignment of existing drainage systems.

Following the completion of all construction works, the land within the working areas would be fully reinstated as near as practically possible to its former condition, and where possible all reinstated surfaces would have the same runoff properties and elevation as existing or as agreed with landowners and stakeholders in advance (this would include the reinstatement of modified watercourses/drainage ditches).

After re-grading of the working areas to reflect the original profile, a replacement drainage scheme would be installed, where appropriate, following discussions with the landowner/occupier. The design of these drainage schemes would be agreed between National Grid and the landowners/occupiers and would pay particular attention to the need to ensure that reinstated land drains do not act as new pathways to watercourses for sediment/contamination or cause an increase in flood risk.

These mitigation measures will ensure that local flood risk is not increased as a result of inappropriate post-construction restoration.

9.0 FLOOD RISK CONSIDERATIONS – OPERATIONAL PHASE

9.1.1 Operational Phase Flood Risk Considerations

This section outlines the anticipated flood risk considerations associated with the Proposed Project during the operational phase. Mitigation measures are outlined as appropriate. National Grid will sign up to NRW's automated flood warning service and monitor national and regional weather forecasts in order to avoid maintenance staff visiting the site during flood conditions.

Safe Operation of the Proposed Project – Western Components

Detailed flood risk data from the Afon Glaslyn & Tributaries at Porthmadog Flood Risk Study (Final Modelling Report - JBA, January 2014) were used to design the western tunnel head house to ensure that it remains safe and operational during times of flooding over the duration of its design lifetime. This report was provided by NRW and represents the most appropriate source of detailed flood risk data for this purpose.

The JBA modelling report contains a wide range of flood risk scenarios relevant to the western tunnel head house location. Table 4 below provides a summary of the available scenarios contained therein.

Table 4. Flood scenarios for the western tunnel head house taken from the JBA report provided by NRW. Scenario	**Western Tunnel Head House Maximum Flood Level (m AOD)[9]**
Fluvial Defended 1% AEP + Climate Change	2.36
Fluvial Defended 0.1% AEP	2.53
Fluvial Undefended 1% AEP + Climate Change	2.36
Fluvial Undefended 0.1% AEP	2.53
Tidal Defended 0.5% AEP 2112 Climate Change Scenario	1.52
Tidal Defended 0.1% AEP	1.33
Tidal Undefended 0.5% AEP 2112 Climate Change Scenario	3.93
Tidal Undefended 0.1% AEP	4.57
30% Blockage	2.10
67% Blockage	2.44
100% Blockage	2.65
Main Cob Breach 0.5% AEP	2.13
Main Cob Breach 0.5% AEP 2112 Climate Change Scenario	2.84
Main Cob Door Failure 0.5% AEP	2.14
Main Cob Door Failure 0.5% AEP 2112 Climate Change Scenario	2.53
Notes: All levels were taken at their maximum value i.e. 24-hour max flood duration.	

The most appropriate flood level listed in Table 4 to use as a 'design level' is the 'Fluvial Undefended 0.1% AEP' level of 2.53m AOD. This is because the site of the western head house is protected by tidal flood defences (i.e. TAN 15 DAM Zone C1) that provide a high standard of protection (the Tidal Defended 0.1% AEP level is 1.33m AOD, which is lower than the existing ground level for this component of the Proposed Project)[10]. The site is not, however, protected by fluvial defences (note that the fluvial 'defended' and 'undefended' flood levels are the same). Consequently, the 'Fluvial Undefended 0.1% AEP' level of 2.53m AOD was used for design purposes.

The developed level for the western head house and tunnel access shaft has been designed at 3.2m AOD, with the remainder of the head house compound at 3.0m AOD (Appendix G). These levels are above both the design flood level of 2.53m AOD and also the remainder of the flood levels that result from the various tidal defence failure scenarios presented in Table

[9] Note: some of these flood levels were taken from the GIS layers provided by NRW for the various scenarios, as specific flood levels for this location for all scenarios contained in Table 4 were not presented in the JBA report itself.

[10] Whilst Table 4 also presents tidal defence breach, blockage and failure scenarios, these represent 'Joint Probability' events with a combined probability of occurrence lower than the 0.1% AEP event that new developments are required to consider under TAN 15.

4[11]. The developed levels of 3.2m and 3.0m AOD for the western head house compound also provide a significant degree of inherent 'freeboard' within the design. The design of the western head house compound in this way will, therefore, ensure that the western components of the Proposed Project will remain safe and operational during times of flooding over their intended lifetime[12].

Safe Operation of the Proposed Project – Eastern Components

At the time of writing, NRW does not hold detailed flood risk data for the Dwyryd Estuary in the same way as it does for the Glaslyn Estuary described above. However, the existing ground levels at the location of the eastern SEC and tunnel head house are considerably higher than the western components, at ca. 4.2m AOD. This means that the eastern components of the Proposed Project are unlikely to be impacted by an equivalent 'Fluvial Undefended 0.1% AEP' level on the Dwyryd Estuary. Consequently, 'undefended' tidal flood levels were obtained from NRW in order to provide 'worst-case'[13] design levels for the eastern components. These are presented in Table 5 below and account for predicted sea level rise to 2118.

Table 5. Extreme (undefended) tidal levels for the eastern SEC and tunnel head house provided by NRW.		**Extreme Event Sea Level**		
Year	**Sea Level Rise (m)**	**T100**	**T200**	**T1000**
2018	0.035	4.2	4.3	4.6
2068	0.449	4.6	4.7	5.0
2093	0.761	4.9	5.0	5.4
2118	1.123	5.3	5.4	5.7

The developed level for the eastern SEC and tunnel head house has been designed at 6.0m AOD (Appendix H). This level will ensure that the eastern components of the Proposed Project will remain safe and operational during times of flooding (from main rivers and the sea) over their intended lifetime and will also include a significant degree of inherent 'freeboard'.

As described in Section 5.1.3 above, the eastern SEC and tunnel head house are shown to be located in an area of surface water flood risk associated with local field drains. To achieve the developed level of 6.0m AOD, the eastern SEC and tunnel head house would need to be raised by ca. 1.8m above the surrounding ground level. Consequently, these components of the Proposed Project would not be impacted by surface water flooding from these sources.

[11] With the exception of the 'undefended' tidal levels. Designing to 'undefended' tidal levels in this instance would be unnecessary and unsustainable, given the presence of existing tidal flood defences that afford a high level of protection. It would also increase the visual impact of the western head house, which is contrary to the primary objective of the Proposed Project.

[12] The developed levels are also above the 'Fluvial Undefended 1% AEP + Climate Change' level, so can also be considered to account for climate change over the lifetime of the Proposed Project. The ground levels throughout the existing Garth SEC are already at or above 2.5m AOD.

[13] These are considered 'worst-case' given that the eastern components of the Proposed Project are also located in TAN 15 DAM Flood Zone C1, and as such are served by significant flood defence infrastructure. In reality, the tidal levels shown in Table 5 are, therefore, unlikely to occur at the location of the eastern components.

Floodplain Impacts – Western Components

To achieve the developed level of 3.0/3.2m AOD, the western head house compound would need to be raised by between ca. 1.11 to 1.31m above surrounding ground levels. This degree of ground level raising would take place in an area of undefended fluvial floodplain (the 'Fluvial Undefended 0.1% AEP' flood level in this area is 2.53m AOD). Consequently, this will result in the displacement fluvial floodwater. An analysis of the impacts of this floodplain displacement on third party land and property is provided below.

Appendix I presents the fluvial floodplain displacement calculations. The total volume of floodplain displaced by the western head house compound (and access ramp) under the 'Fluvial Undefended 0.1% AEP' scenario would be ca. 1021m^3. This displaced volume would be distributed over a flood 'cell' of ca. 2,200,000m^2 as shown in Appendix J. This would raise the flood level under this event by 0.0005m (or 0.5mm) throughout this flood 'cell'. This impact is not significant and would not result in an increase in flood risk to third party land or property, especially considering that this displacement would occur close to the tidal boundary.

Floodplain Impacts – Eastern Components

The eastern components of the Proposed Project will be located on land that is expected to be significantly above the equivalent 'Fluvial Undefended 0.1% AEP' flood level for the Dwyryd Estuary and will not result in any floodplain impacts as a result[14].

Surface Water Impacts – Eastern Components

As described in Section 5.1.3 above, the eastern SEC and tunnel head house are shown to be located in an area of surface water flood risk associated with local field drains. Under the 1 in 100-year scenario, a surface water flood outline is indicated for the local field drain that runs through the site of the eastern tunnel head house compound (Appendix Dii), although this field drain will be diverted and reinstated as part of the Proposed Project, thus preserving its conveyance capacity and overall destination.

Sustainable Surface Water Management - (Western and Eastern Components)

Appendix 9B of the Environmental Appraisal contains the Sustainable Drainage Systems (SuDS) Strategy for the Proposed Project. This strategy presents the sustainable surface water management solutions for the operational phase of the western and eastern components and demonstrates that the SuDS measures incorporated will ensure that the Proposed Project will not result in an increase in surface water flood risk elsewhere.

Disposal of Pumped Groundwater - (Western and Eastern Components)

There is the potential that groundwater ingress into the tunnel will be encountered during the operational phase of the Proposed Project and that this will need to be pumped out of the respective eastern and western shafts.

It is currently unknown whether the water to be discharged will be fresh or saline due to proximity to the Glaslyn and Dwyryd Estuaries. Groundwater monitoring undertaken to date does not indicate saline waters, however this cannot be ruled out at this stage. Water quality testing of the pumped groundwater throughout the operational phase of the Proposed Project will, therefore, be required prior to its discharge.

Should the pumped groundwater prove to be fresh, it will be discharged to a) the existing field drain located to the south of the western tunnel head house (i.e. for the western shaft); and

[14] Although 'undefended' extreme tidal flood levels have been used in the design of these components, tidal floodplain displacement calculations are not usually undertaken, due to the 'infinite' volume of available storage within the sea. In addition, the tidal flood levels used assume that there are no defences in place. In reality, the tidal levels that would result from defence failure scenarios would be somewhat less than those presented in Table 5. As such, any displacement calculations based on these levels would represent significant overestimates.

b) the Nant Yr Efail stream downstream of the eastern tunnel head house (i.e. for the eastern shaft).

Should the pumped groundwater prove to be saline, there is the potential to use a permanent piped arrangement to discharge the pumped groundwater at a point on these watercourses where brackish waters are encountered (i.e. at a suitable location closer to the tidal estuaries).

The potential permanent water ingress into the tunnel which will need to be pumped out of the shafts is 5340 litres over a 24-hour period (permanently during the operational phase of the Proposed Project). This is broken down into:

- 4800 litres/day from the tunnel;
- 350 litres/day from eastern shaft at Cilfor; and
- 190 litres/day from the western shaft at Garth[15].

These values are based on British Tunnelling Society (BTS) specifications for water ingress to tunnels.

There is likely to be a large sump in the bottom of each shaft to collect water ingress prior to it being pumped to the surface. This means that continuous pumping of collected groundwater is unlikely to be required. Instead, it is anticipated that the sumps will need to be emptied via pumping up to three times each day over the operational phase of the Proposed Project.

Assuming a constant rate of pumped discharge, the above rates translate into:

- 0.056l/s from the tunnel;
- 0.004l/s from eastern shaft at Cilfor; and
- 0.002l/s from the western shaft at Garth.

These assumed constant rates are clearly very minor. Given that constant pumping is unlikely to be required (i.e. the discharges could occur up to three times each day) it is probable that the peak rates of instantaneous pumping would be higher (although the exact peak rates are not known at the time of writing). As such, it is recommended that the peak rates of instantaneous discharges into the respective receiving watercourses do not exceed 5l/s[16], which is often used as the minimum discharge rate for single points of discharge from new developments in order to prevent blockage of the discharge outfall point.

This measure will ensure that the need to pump and discharge groundwater from the tunnel and shafts over the operational phase of the Proposed Project will not lead to an increase in flood risk or morphological damage to the receiving watercourses.

Permanent Watercourse Crossings - (Western and Eastern Components)

Limited permanent access routes will be required in order for National Grid to be able to manage and maintain the Proposed Project. Where these need to cross existing watercourses, there is a risk that they could lead to localised increases in flood risk if they are undersized, become blocked, or are otherwise inappropriately designed.

To mitigate this potential risk, all permanent bridges or culverts would be appropriately designed from a hydraulic perspective to convey the range of peak flows likely to occur on

[15] It is possible that the pumped rates for the eastern and western shafts could be 190 litres/day and 350 litres/day, respectively, depending on which shaft ends up being the deepest.

[16] Given the stipulated 'constant' rates of discharge, however, it is likely that the peak rates of instantaneous discharges will be considerably lower than 5l/s. In this instance, outfall rates of less than 5l/s would not be prone to blockage given that the discharges would be pumped.

each respective watercourse over the duration of the operational phase. This would prevent each structure from acting as a 'pinch point' and would also minimise the risk of blockage over the lifetime of the Proposed Project.

For example, the western tunnel head house compound will require permanent access across the existing field drain located directly to the south (Appendix G). The Revitalised Flood Hydrograph (ReFH) method has been used to estimate the peak flood flows that could occur on this field drain; these are presented in Table 6 below.

Table 6. ReFH flood flow estimates for the existing field drain located to the south of the western head house compound. Return Period	**Peak Flow (m^3s^{-1})**
1 in 100 year	0.71
1 in 100 year + 30% for climate change	0.93
1 in 1000 year	1.46

According to NRW's surface water flood mapping (Appendix Di), these flows ought to be broadly contained within the channel of this field drain. As such, the permanent access crossing at this point should either be clear span, or the hydraulic design of any new culvert should ensure that these flows will be able to pass freely beneath the structure without creating significant afflux/headloss.

Where appropriate, and if required, watercourses or drains will be crossed by permanent hydraulic structures at right angles to the watercourse using as short a distance as possible while avoiding flow obstruction in order to minimise land surface disturbance and to reduce the cross-sectional area of the crossing. Land Drainage Consent applications for all permanent crossings would be made to Gwynedd Council, and these would be constructed and managed in accordance with their approval.

These mitigation measures will ensure that local flood risk is not increased as a result of permanent watercourse crossings.

10.0 TAN 15 CONSEQUENCES ASSESSMENT

10.1.1 Objectives of the Consequences Assessment

Appendix A1.2 of TAN 15 states that the prime objective of a consequences assessment is to develop a full appreciation of:

- The consequences of flooding on the development; and
- The consequences (i.e. the overall impacts) of the development on flood risk elsewhere within the catchment for a range of potential flooding scenarios up to that flood having a probability of 0.1%.

Section 7.3 of TAN 15 also states that where development is justified (as demonstrated in Section 7 of this FCA) the consequences assessment can be used to establish whether suitable mitigation measures can be incorporated within the design to ensure that development is as safe as possible and there is:

- minimal risk to life;
- minimal disruption to people living and working in the area;
- minimal potential damage to property;
- minimal impact of the Proposed Project on flood risk generally; and
- minimal disruption to natural heritage.

Finally, section A1.12 of TAN 15 presents the acceptability criteria for flooding consequences. Any new development on the flood plain will generally result in additional risks. The main criteria for deciding whether such a development is acceptable will depend on whether those factors can be effectively managed. NRW will advise the planning authority on the consequences of flooding for the type and nature of any proposal and this should enable the planning authority to arrive at a judgement on the acceptability of the flooding consequences. To satisfy these criteria a site should only be considered for development if the following conditions can be satisfied:

- Flood defences must be shown by the developer to be structurally adequate particularly under extreme overtopping conditions (i.e. that flood with a probability of occurrence of 0.1%);
- The cost of future maintenance for all new/approved flood mitigation measures, including defences must be accepted by the developer and agreed with NRW;
- The developer must ensure that future occupiers of development are aware of the flooding risks and consequences;
- Effective flood warnings are provided at the site;
- Escape/evacuation routes are shown by the developer to be operational under all conditions;
- Flood emergency plans and procedures produced by the developer must be in place;
- The development is designed by the developer to allow the occupier the facility for rapid movement of goods/possessions to areas away from the floodwaters;

- Development is designed to minimise structural damage during a flooding event and is flood proofed to enable it to be returned to its prime use quickly in the aftermath of the flood; and

- No flooding elsewhere.

As such, this section on the TAN 15 Consequences Assessment addresses each of these points in turn.

The consequences of flooding on the development

The western and eastern components of the Proposed Project will be located in TAN 15 DAM Flood Zone C1, although will be designed to remain operational under the (undefended) 0.1% AEP fluvial and tidal flood events respectively, with climate change taken into account. As such, under these events, the respective western and eastern compounds would remain flood-free with no flooding consequences.

The consequences (i.e. the overall impacts) of the development on flood risk elsewhere

This FCA has demonstrated that the western and eastern compounds would not have a significant impact on the undefended fluvial and surface water floodplains, respectively. The development of these compounds would not, therefore, lead to an increase in fluvial or surface water flood risk to third party land or property. Temporary and permanent watercourse crossings would be designed to avoid increasing local flood risk. The Sustainable Drainage Systems (SuDS) Strategy (Appendix 9B of the Environmental Appraisal), demonstrates how the Proposed Project will avoid causing an increase in surface water flood risk elsewhere through the use of SuDS.

Minimal risk to life

The Proposed Project will not increase flood risk to third party land or property and would be routinely unmanned throughout the operational phase, with the exception of visits by National Grid's operational staff for the purposes of asset management and maintenance. National Grid will sign up to NRW's automated flood warning service and monitor national and regional weather forecasts in order to avoid maintenance staff visiting the sites during flood conditions.

Minimal disruption to people

During its operational phase, the Proposed Project will only incur minimal disruption to the surrounding communities and only as a result of visits by National Grid's operational staff for the purposes of asset management and maintenance. The western and eastern compounds have been designed to minimise their respective visual impact, whilst at the same time visual amenity throughout the Snowdonia National Park will be improved as a result of the removal of the existing OHL.

Minimal damage to property

The Proposed Project will not increase flood risk to third party land or property. The western and eastern compounds will be designed to remain flood-free under the 0.1% AEP fluvial and tidal flood events respectively, with climate change taken into account.

Minimal impact of the Proposed Project on flood risk

This FCA as demonstrated that the Proposed Project would not have a significant impact on flood risk elsewhere.

Minimal disruption to natural heritage

The Environmental Appraisal Report demonstrates that the Proposed Project will incur minimal disruption to natural heritage and visual amenity throughout the Snowdonia National Park will be improved as a result of the removal of the existing OHL.

Flood defences

This FCA has demonstrated that the existing tidal flood defences provide a high standard of protection and would not result in flooding of the Proposed Project under a 0.1% AEP event, whilst taking into account defence failure scenarios and climate change. The Proposed Project has been designed so that it does not rely on the maintenance of existing or the creation of new flood defences in order to remain operational over its intended design lifetime, with climate change taken into consideration.

Cost of future maintenance for all new/approved flood mitigation measures

The main flood mitigation measures associated with the Proposed Project will be a) the design of the western and eastern compounds; and b) the SuDS measures contained therein. The construction and maintenance costs associated with these measures will met by National Grid over the lifetime of the Proposed Project.

Occupier awareness of flooding risks and consequences

The Proposed Project would be routinely unmanned throughout the operational phase, with the exception of visits by National Grid's operational staff for the purposes of asset management and maintenance. National Grid will sign up to NRW's automated flood warning service and monitor national and regional weather forecasts in order to avoid maintenance staff visiting the sites during flood conditions.

Effective flood warnings

As above, effective flood warnings will be provided as part of NRW's flood warning service.

Escape/evacuation routes

The Proposed Project would be routinely unmanned throughout the operational phase, with the exception of visits by National Grid's operational staff for the purposes of asset management and maintenance. As mentioned above, the use of NRW's automated flood warning service and monitoring of national and regional weather forecasts will avoid maintenance staff visiting the sites during flood conditions.

Flood emergency plans and procedures

N/A – see *Escape/evacuation routes* above.

Facility for rapid movement of goods/possessions

N/A – the Proposed Project will be designed to remain flood-free under the 0.1% AEP event over the duration of its intended lifetime.

Designed to minimise structural damage

N/A – the Proposed Project will be designed to remain flood-free under the 0.1% AEP event over the duration of its intended lifetime.

No flooding elsewhere

This FCA has demonstrated that the Proposed Project would not have a significant impact on flood risk elsewhere.

10.1.2 Conclusion of the Consequences Assessment

Based on the above, the conclusion of this assessment is that the flood consequences of the Proposed Project are considered to be acceptable.

11.0 CONCLUSIONS

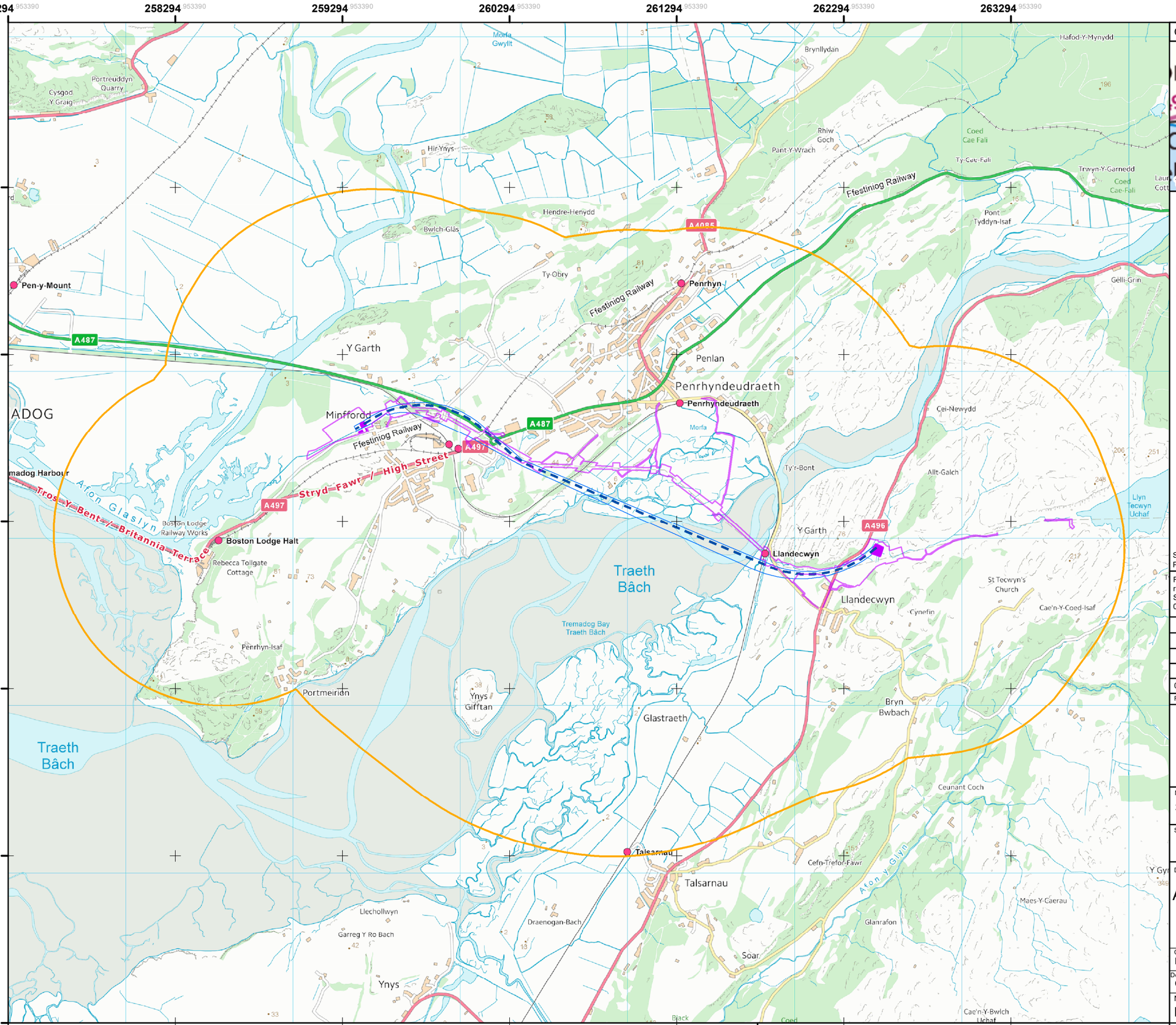
This document presents the findings of a Flood Consequences Assessment (FCA) for National Grid's Visual Impact Provision (VIP) Snowdonia Project (the Proposed Project). This FCA has been produced in accordance with Planning Policy Wales and Technical Advice Note (TAN) 15: Development and Flood Risk. This FCA demonstrates that:

- the consequences of flooding from all sources to the Proposed Project are fully understood;
- appropriate mitigation measures have been put in place to ensure that the Proposed Project will remain safe and operational during times of flooding over its intended lifetime, whilst taking climate change into account;
- the consequences (i.e. the overall impacts) of the Proposed Project on flood risk elsewhere are understood;
- the Proposed Project meets the requirements of the TAN 15 Justification Test; and
- the flood consequences of the Proposed Project are considered to be acceptable.

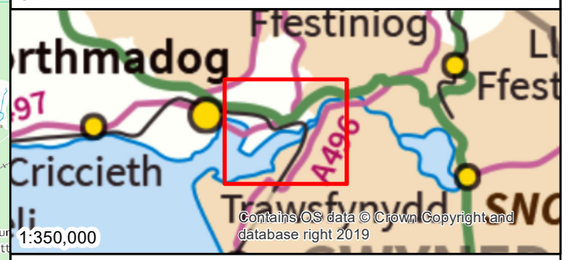
As such, this FCA demonstrates that the Proposed Project will be safe, will not increase flood risk elsewhere and is acceptable in principle for its location.

APPENDICES

Appendix A Site Location Plan



Overview



Proposed Development

- Proposed Tunnel Alignment
- Proposed Tunnel Alignment (inc Limit of Deviation)
- Above Ground Permanent Works
- Site Boundary
- Study Area

Source:
Proposed Development: National Grid November 2019.

Rev	Description	Cre'd	Chk'd	App'd	Date
009	Revised site boundary	LA	JL	KL	03/02/2020

nationalgrid

Master Scheme No:	Sub-Scheme No:	Site:
33495	33495	Snowdonia

Scheme Name:
Visual Impact Provision (VIP) Snowdonia Project

Document Title:

Appendix A: Flood Consequences Assessment Site Location Plan

Created by:	Date:	Checked by:	Date:	Approved by:	Date:
LA	03/02/2020	JL	03/02/2020	KL	03/02/2020
Development Eng:	**Document Type:**	**Scale:**	**Format:**	**Sheet(s):**	**Rev:**
C. Carr	GIS	1:22,500	A3	1 of 1	001

National Grid Document Number:
PDD-33494-GIS-?

FEED Document Number:
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The plan / drawing is for the purpose of the Environmental Impacts Assessment (EIA) and represents the proposed project. The design, scale and layout shown on this plan / drawing are indicative.

0 0.1250.25 0.5 0.75 1 Kilometer

Coordinate System: British National Grid

\\UKRED1S01\Data\Projects\41523774 - National Grid VIP Hydrology\Technical (T)\T5- GIS\Snowdonia\Maps\Flood Consequences Assessment\Appendix A - Site Location Plan Feb 2020.mxd

Appendix B Development Advice Map (DAM)

257294 953390 | 258294 953390 | 259294 953390 | 260294 953390 | 261294 953390 | 262294 953390 | 263294 953390

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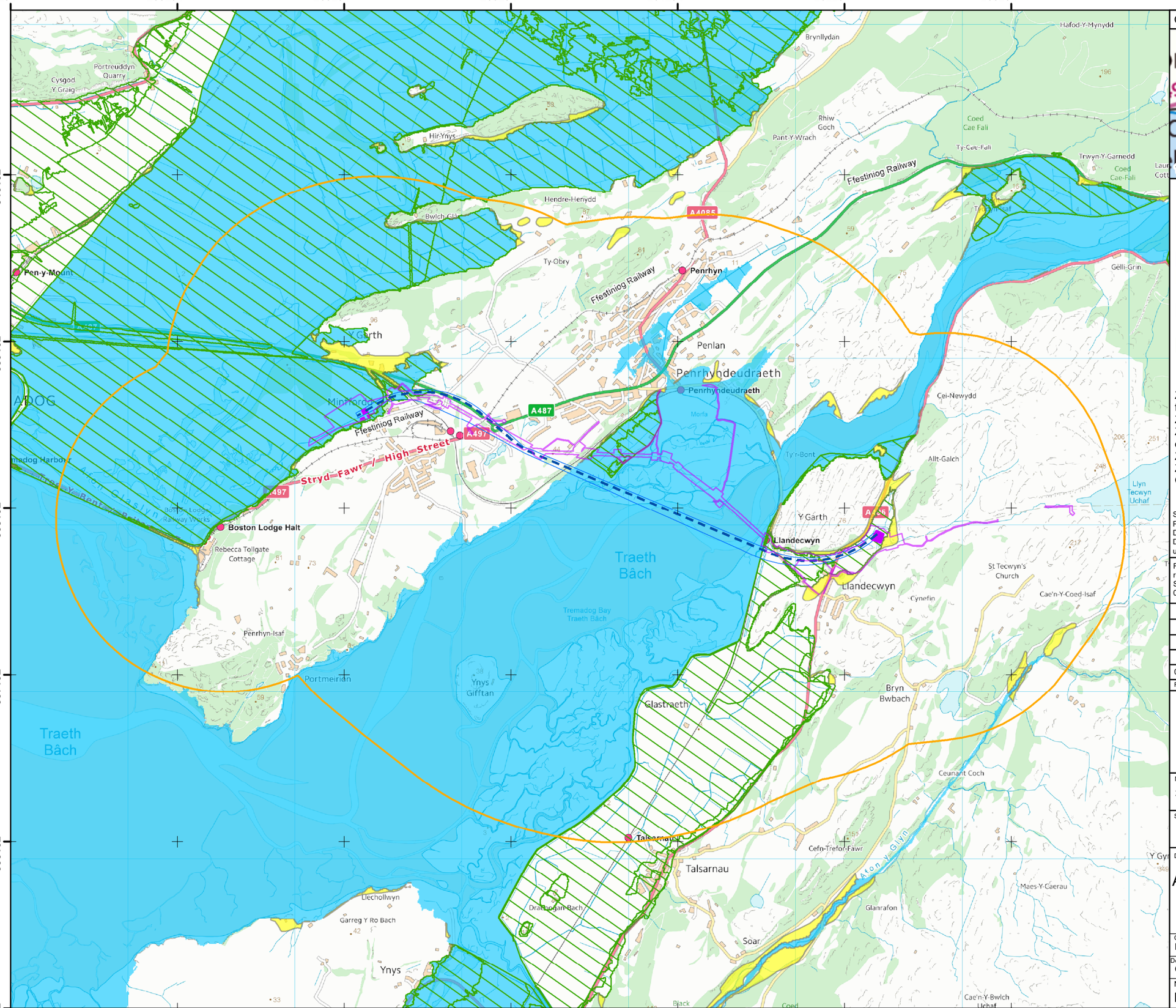
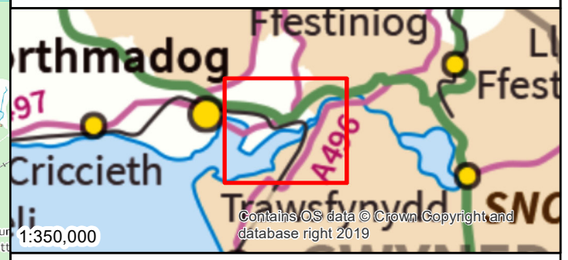


Overview



Proposed Development

- Proposed Tunnel Alignment
- Proposed Tunnel Alignment (inc Limit of Deviation)
- Above Ground Permanent Works
- Site Boundary
- Study Area

Areas at risk of Flooding

- Zone A
- Zone B
- Zone C1
- Zone C2

Zone A - Considered be be at little or no risk of fluvial or coastal flooding.
Zone B - Areas known to have been flooded in the past.
Zone C1 - Served by significant infrastructure, including flood defences.
Zone C2 - Without significant flood defence infrastructure.
Zone C1 & C2 are based on the Environment Agency's Extreme Flood Outline >= 1,000 year flood event (fluvial, tidal or coastal).

Source:
Proposed Development: National Grid November 2019.
DAM: Contains Natural Resources Wales information © Natural Resources Wales and Database Right. All rights Reserved. Derived in part from 1:50,000 scale BGS Digital Data under Licence Number 2013/062. British Geological Society. ©NERC

Rev	Description	Cre'd	Chk'd	App'd	Date
009	Revised site boundary	LA	JL	KL	03/02/2020

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Master Scheme No:	Sub-Scheme No:	Site:
33495	33495	Snowdonia

Scheme Name:
Visual Impact Provision (VIP) Snowdonia Project

Document Title:

Appendix B: Flood Consequences Assessment Development Advice Map

Created by:	Date:	Checked by:	Date:	Approved by:	Date:
LA	03/02/2020	JL	03/02/2020	KL	03/02/2020
Development Eng:	**Document Type:**	**Scale:**	**Format:**	**Sheet(s):**	**Rev:**
C. Carr	GIS	1:22,500	A3	1 of 1	001

National Grid Document Number:
PDD-33494-GIS-?

FEED Document Number:
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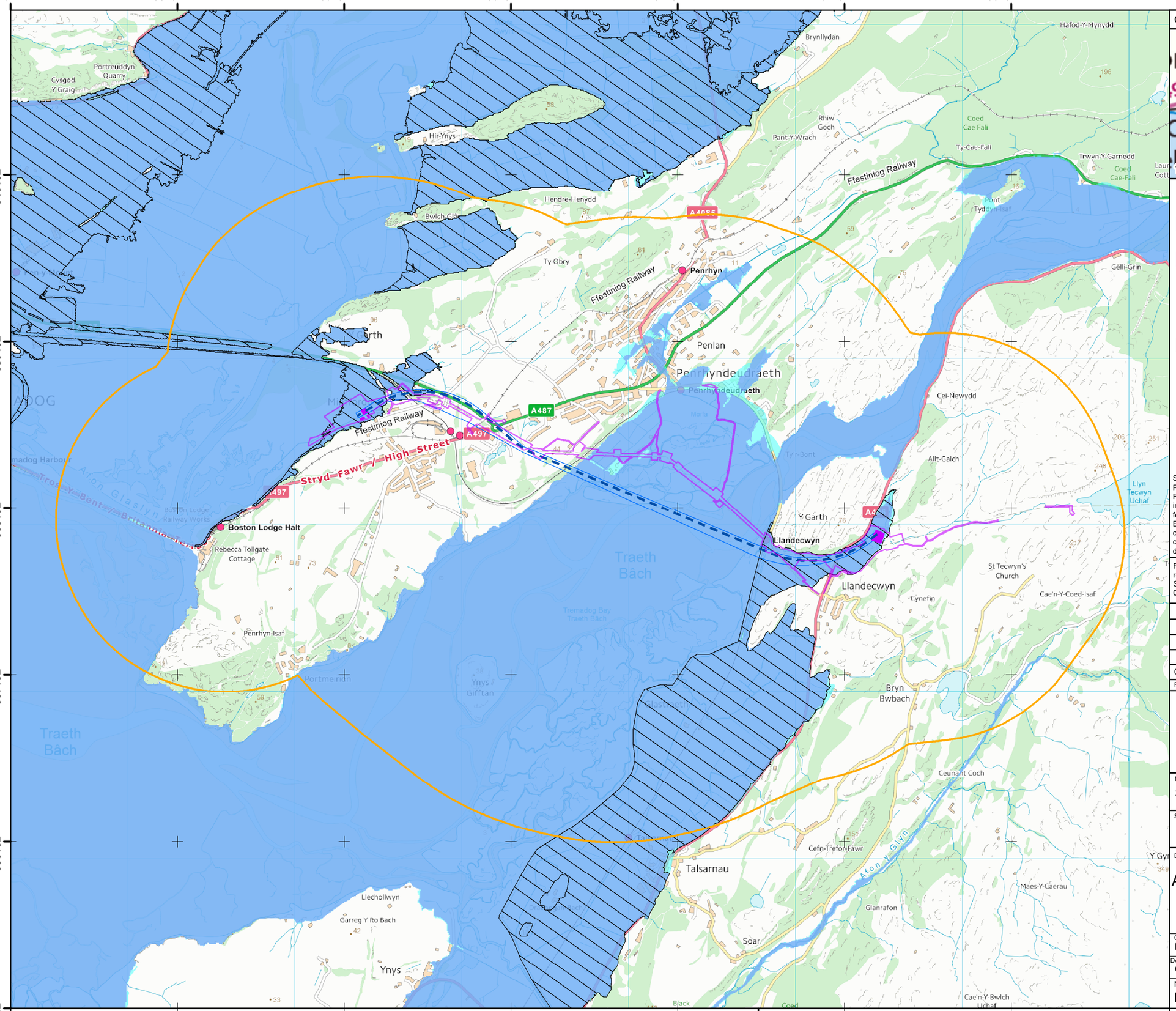
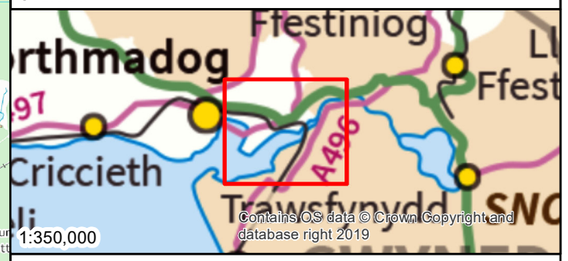
Coordinate System: British National Grid

\\UKRED1S01\Data\Projects\41523774 - National Grid VIP Hydrology\Technical (T)\T5- GIS\Snowdonia\Maps\Flood Consequences Assessment\Appendix B - DAM Feb 2020.mxd

Appendix C Flood Zones 2 and 3



Overview



Proposed Development

- Proposed Tunnel Alignment
- Proposed Tunnel Alignment (inc Limit of Deviation)
- Above Ground Permanent Works
- Site Boundary
- Study Area

Flood Map for Planning

- Flood Zone 3 (high risk)
- Flood Zone 2 (medium risk)
- Areas Benefiting from Flood Defences

Source:
Proposed Development: National Grid November 2019.
Flood Risk Zones & Areas Benefitting from Flood Defences: Contains Natural Resources Wales information © Natural Resources Wales and Database Right. All rights Reserved. Some features of this information are based on digital spatial data licensed from the Centre for Ecology & Hydrology © NERC (CEH). Defra, Met Office and DARD Rivers Agency © Crown copyright. © Cranfield University. © James Hutton Institute. Contains OS data © Crown copyright and database right 2015. Land & Property Services © Crown copyright and database right.

Rev	Description	Cre'd	Chk'd	App'd	Date
009	Revised site boundary	LA	JL	KL	03/02/2020

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Master Scheme No:	Sub-Scheme No:	Site:
33495	33495	Snowdonia

Scheme Name:
Visual Impact Provision (VIP) Snowdonia Project

Document Title:
Appendix C: Flood Consequences Assessment Flood Map for Planning

Created by:	Date:	Checked by:	Date:	Approved by:	Date:
LA	03/02/2020	JL	03/02/2020	KL	03/02/2020

Development Eng:	Document Type:	Scale:	Format:	Sheet(s):	Rev:
C. Carr	-	1:22,500	A3	1 of 1	001

National Grid Document Number:
PDD-33494-GIS-?

FEED Document Number:
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Coordinate System: British National Grid

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Appendix D Surface Water Flood Risk Maps

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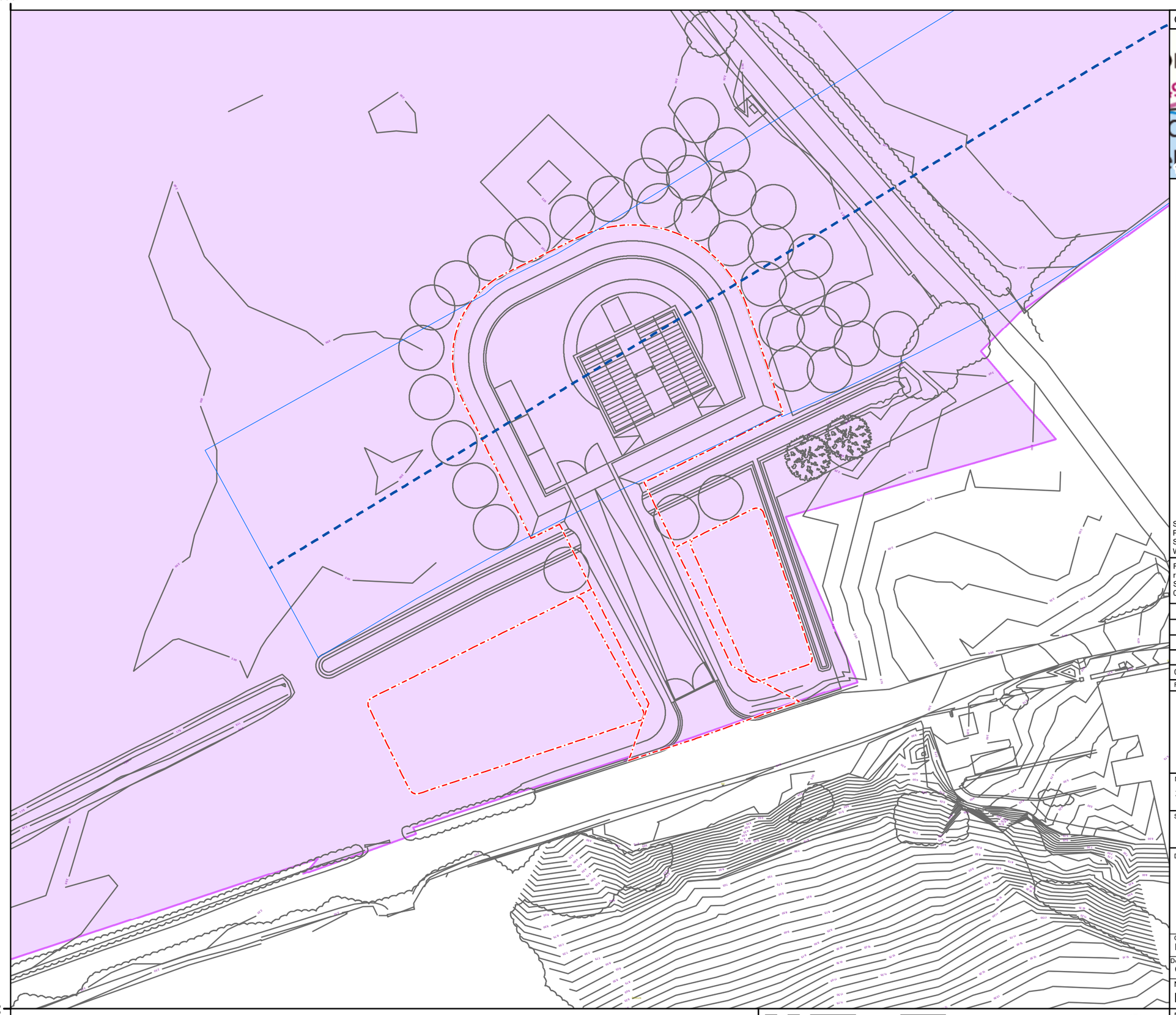

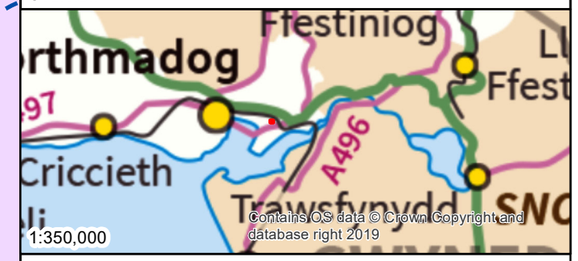

Proposed Development

- Proposed Tunnel Alignment
- Proposed Tunnel Alignment (inc Limit of Deviation)
- Site Boundary
- National Grid Ownership Boundary
- West Proposed Site Plan - taken from PDD-33494-ARC-206

Risk of Flooding from Surface Water - Depth

1 in 100 year depth (m)

- 0.00 - 0.15
- 0.15 - 0.30
- 0.30 - 0.60
- 0.60 - 0.90
- 0.90 - 1.20
- > 1.20

Source:
Proposed Development: National Grid November 2019.
Surface Water Flood Risk:Contains Natural Resources
Wales information © Natural Resources Wales and Database Right. All rights reserved.

Rev	Description	Cre'd	Chk'd	App'd	Date
009	December 2019 Updates	PH	JL	KL	03/02/2020

nationalgrid

Master Scheme No:	Sub-Scheme No:	Site:
33495	33495	Snowdonia

Scheme Name:
Visual Impact Provision (VIP) Snowdonia Project

Document Title:
Appendix Di: Flood Consequences Assessment
Surface Water Flood Map
Western Head House

Created by:	Date:	Checked by:	Date:	Approved by:	Date:
LA	03/02/2020	JL	03/02/2020	KL	03/02/2020

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National Grid Document Number:
PDD-33494-GIS-?

FEED Document Number:
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0 3 6 12 18 24 Meters

Coordinate System:
British National Grid

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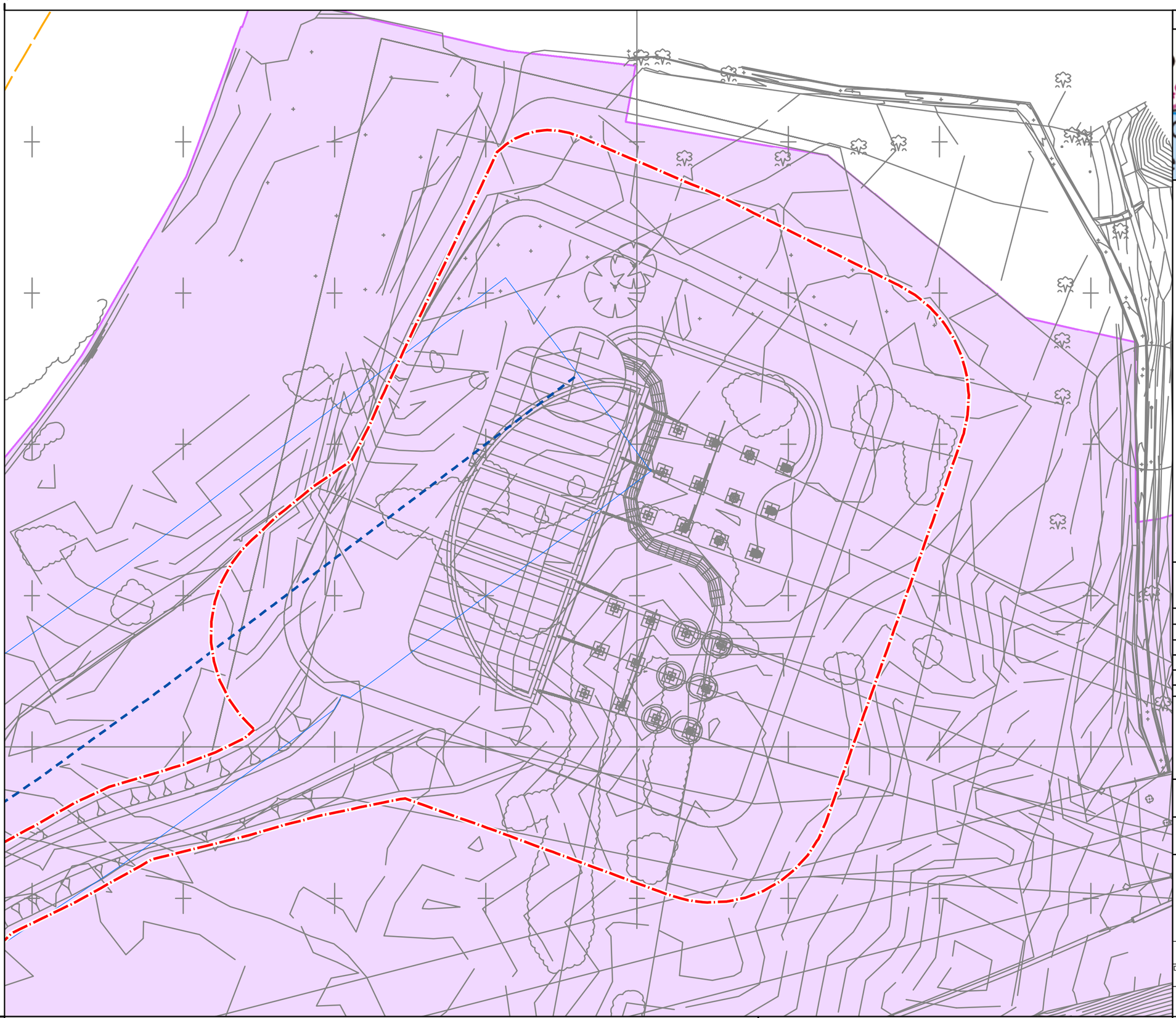

337864 372800

Overview

Proposed Development

- Proposed Tunnel Alignment
- Proposed Tunnel Alignment (inc Limit of Deviation)
- Site Boundary
- National Grid Ownership Boundary
- East Proposed Site Plan - taken from PDD-33494-TUN-004E

Risk of Flooding from Surface Water - Depth

1 in 100 year depth (m)

- 0.00 - 0.15
- 0.15 - 0.30
- 0.30 - 0.60
- 0.60 - 0.90
- 0.90 - 1.20
- > 1.20

Source:
Proposed Development: National Grid Novermber 2019.
Surface Water Flood Risk:Contains Natural Resources
Wales information © Natural Resources Wales and Database Right. All rights reserved.

Rev	Description	Cre'd	Chk'd	App'd	Date
009	Revised site boundary	LA	JL	KL	03/02/2020

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Master Scheme No:	Sub-Scheme No:	Site:
33495	33495	Snowdonia

Scheme Name:
Visual Impact Provision (VIP) Snowdonia Project

Document Title:
Appendix Dii: Flood Consequences Assessment
Surface Water Flood Map
Eastern Head House - Depth - 1 in 100 year

Created by:	Date:	Checked by:	Date:	Approved by:	Date:
LA	03/02/2020	JL	03/02/2020	KL	03/02/2020
Development Eng:	**Document Type:**	**Scale:**	**Format:**	**Sheet(s):**	**Rev:**
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National Grid Document Number:
PDD-33494-GIS-?

FEED Document Number:
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0 3.75 7.5 15 22.5 30 Meters

Coordinate System: British National Grid

\\UKRED1S01\Data\Projects\41523774 - National Grid VIP Hydrology\Technical (T)\T5- GIS\Snowdonia\Maps\Flood Consequences Assessment\Appendix Dii - Surface Water Flood Map - Eastern Head House Compound Feb 2020.mxd

Appendix E Flood Risk from Reservoir Failure

257492.674471 258492.674471 259492.674471 260492.674471 261492.674471 262492.674471 263492.674471

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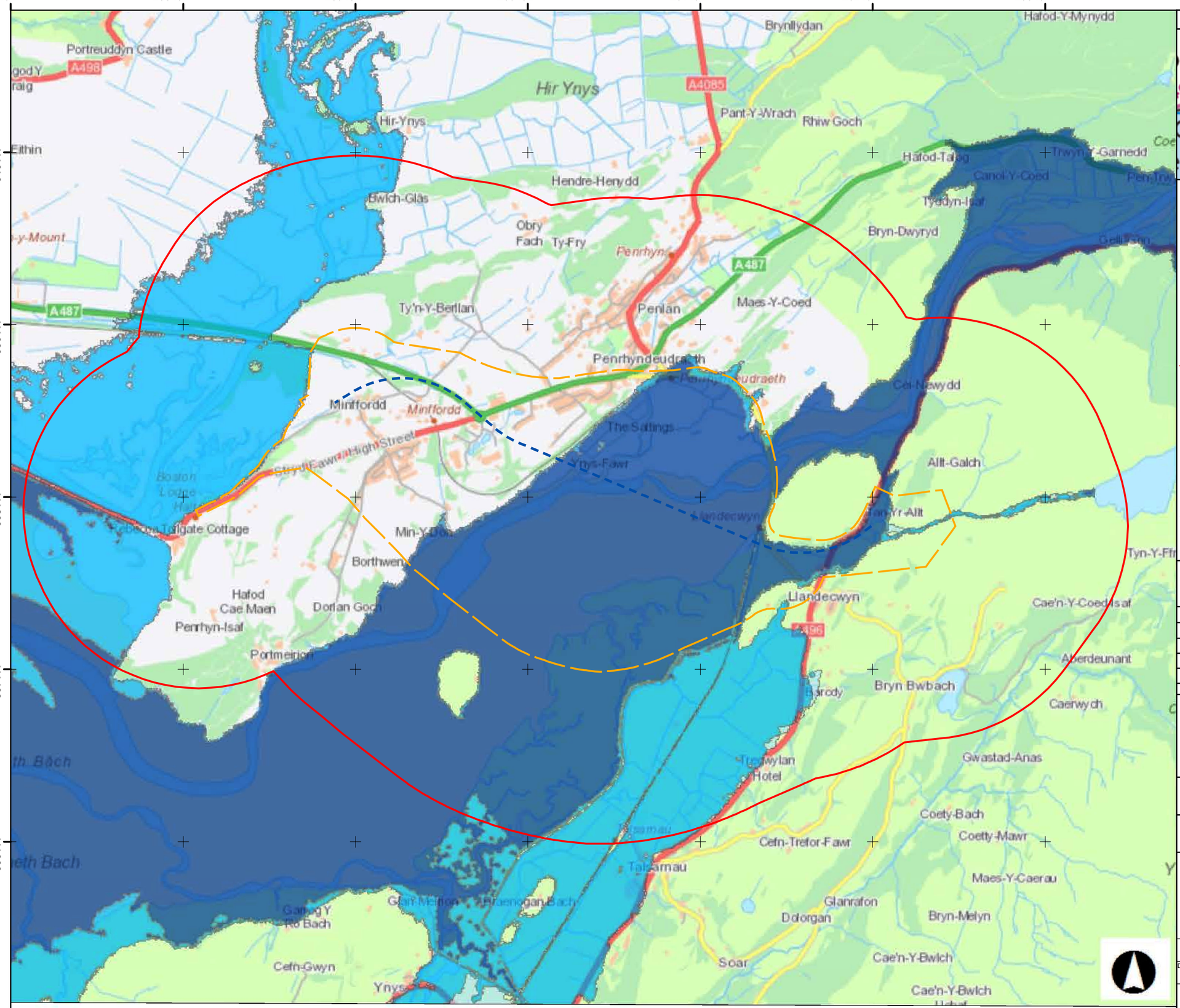
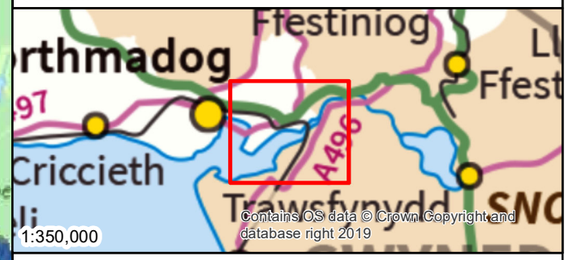


Overview



Proposed Development

- Proposed Tunnel Alignment
- Above Ground Permanent Works
- Proposed Tunnel Alignment (inc Limit of Deviation)
- Area of search for permanent and temporary works
- Study Area

Reservoir Failure Flood Depths

- 0 - 0.3m
- 0.3 - 2.0m
- Greater than 2.0m

Source:
Proposed Development: Mott MacDonald for National Grid August 2019.
Flood Risk Zones & Areas Benefitting from Flood Defences: Contains Natural Resources Wales information © Natural Resources Wales and Database Right. All rights Reserved. Some features of this information are based on digital spatial data licensed from the Centre for Ecology & Hydrology © NERC (CEH). Defra, Met Office and DARD Rivers Agency © Crown copyright. © Cranfield University. © James Hutton Institute. Contains OS data © Crown copyright and database right 2015. Land & Property Services © Crown copyright and database right.

Rev	Description	Cre'd	Chk'd	App'd	Date
007	December Updates	PH	JL	KL	3/12/19

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Master Scheme No:	Sub-Scheme No:	Site:
33495	33495	Snowdonia

Scheme Name:
Visual Impact Provision Snowdonia Project

Document Title:

Appendix E: Flood Consequences Assessment
Reservoir Failure Flood Depth Map

Created by:	Date:	Checked by:	Date:	Approved by:	Date:
PH	3/12/19	JL	3/12/19	KL	3/12/19
Development Eng:	**Document Type:**	**Scale:**	**Format:**	**Sheet(s):**	**Rev:**
C. Carr	-	1:21,894	A3	1 of 1	001

National Grid Document Number:
PDD--LAY-012

FEED Document Number:
MMD-362981-E-GIS--XX-0012

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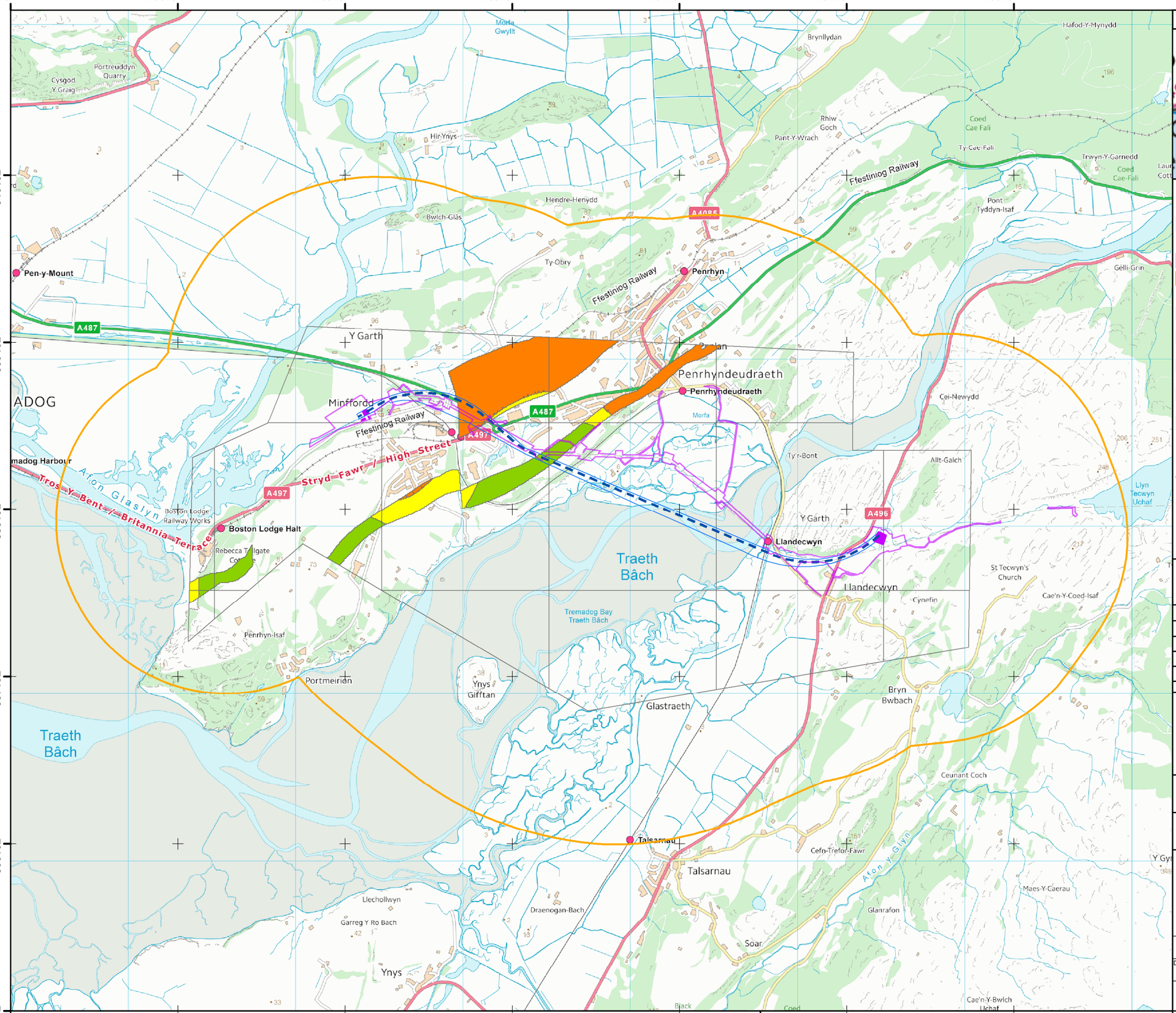
The plan / drawing is for the purpose of the Environmental Impacts Assessment (EIA) and represents the proposed project. The design, scale and layout shown on this plan / drawing are indicative.

0 0.125 0.25 0.5 0.75 1 Kilometer

Coordinate System:
British National Grid

\\ukred1s01\data\Projects\41523774 - National Grid VIP Hydrology\Technical (T)\T5- GIS\Snowdonia\Maps\Flood Consequences Assessment\Appendix E - Reservoir Failure Map.mxd

Appendix F Groundwater Flood Risk



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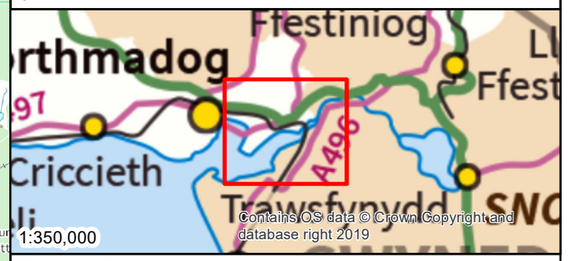

Proposed Development

- Proposed Tunnel Alignment
- Proposed Tunnel Alignment (inc Limit of
- Above Ground Permanent Works
- Site Boundary
- Study Area

Groundwater Flood Risk Zones

- 0; No risk
- 1; Groundwater levels are at least 5m below the ground suface
- 2; Groundwater levels are between 0.5m and 5m below the ground surface.
- 3; Groundwater levels are between 0.025m and 0.5m below the ground surface.
- 4; Groundwater levels are either at very near (within 0.025m of) the ground surface.

Source:
Proposed Development: National Grid November 2019.
Risk of Flooding:

Rev	Description	Cre'd	Chk'd	App'd	Date
009	Revised site boundary	LA	JL	KL	03/02/2020

nationalgrid

Master Scheme No:	Sub-Scheme No:	Site:
33495	33495	Snowdonia

Scheme Name:
Visual Impact Provision (VIP) Snowdonia Project

Document Title:
Appendix F - Flood Consequences Assessment
Risk of Flooding from Groundwater

Created by:	Date:	Checked by:	Date:	Approved by:	Date:
LA	03/02/2020	JL	03/02/2020	KL	03/02/2020

Development Eng:	Document Type:	Scale:	Format:	Sheet(s):	Rev:
-	GIS	1:22,500	A3	1 of 1	001

National Grid Document Number:
PDD-33494-GIS-?

FEED Document Number:
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0 0.1250.25 0.5 0.75 1 Kilometer

Coordinate System:
British National Grid

\\UKRED1S01\Data\Projects\41523774 - National Grid VIP Hydrology\Technical (T)\T5- GIS\Snowdonia\Maps\Flood Consequences Assessment\Appendix F - JBA Groundwater Risk Data Feb 2020.mxd

Appendix G Detailed Layout Drawing – Western Compound

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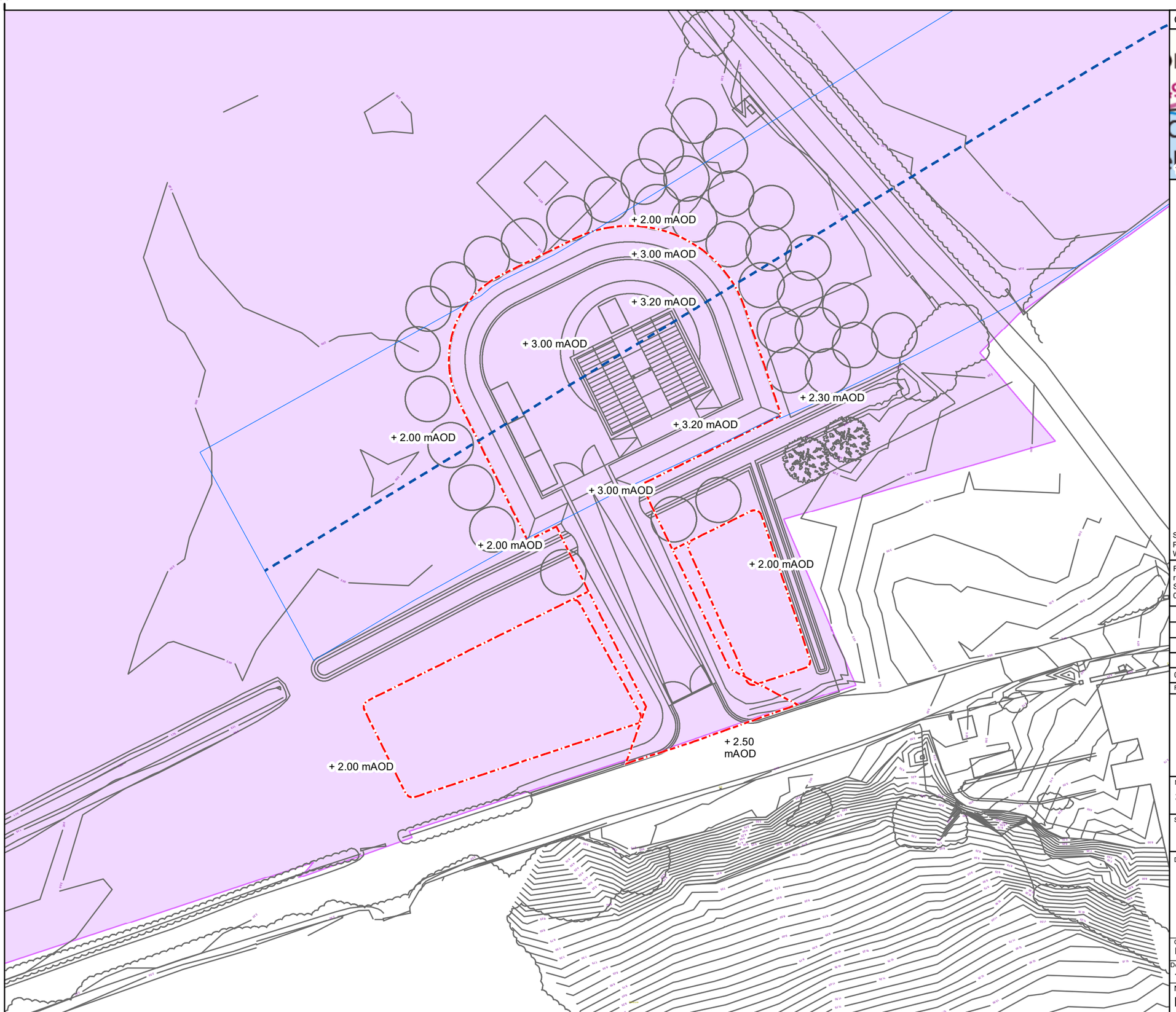

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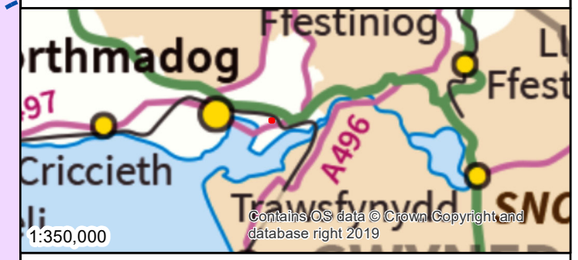

Proposed Development

- Proposed Tunnel Alignment
- Proposed Tunnel Alignment (inc Limit of Deviation)
- Site Boundary
- National Grid Ownership Boundary
- West Proposed Site Plan - taken from PDD-33494-ARC-206

Source:
Proposed Development: National Grid November 2019.
West Proposed Site Plan: Taken from PDD-33494-ARC-206.

Rev	Description	Cre'd	Chk'd	App'd	Date
009	Revised site boundary	LA	JL	KL	03/02/2020

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Master Scheme No:	Sub-Scheme No:	Site:
33495	33495	Snowdonia

Scheme Name:
Visual Impact Provision (VIP) Snowdonia Project

Document Title:
Appendix G: Flood Consequences Assessment Western Head House Showing Design Levels

Created by:	Date:	Checked by:	Date:	Approved by:	Date:
LA	03/02/2020	JL	03/02/2020	KL	03/02/2020

Development Eng:	Document Type:	Scale:	Format:	Sheet(s):	Rev:
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National Grid Document Number:
PDD-33494-GIS-?

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0 5 10 20 Meters

Coordinate System: British National Grid

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Appendix H Detailed Layout Drawing – Eastern Compound

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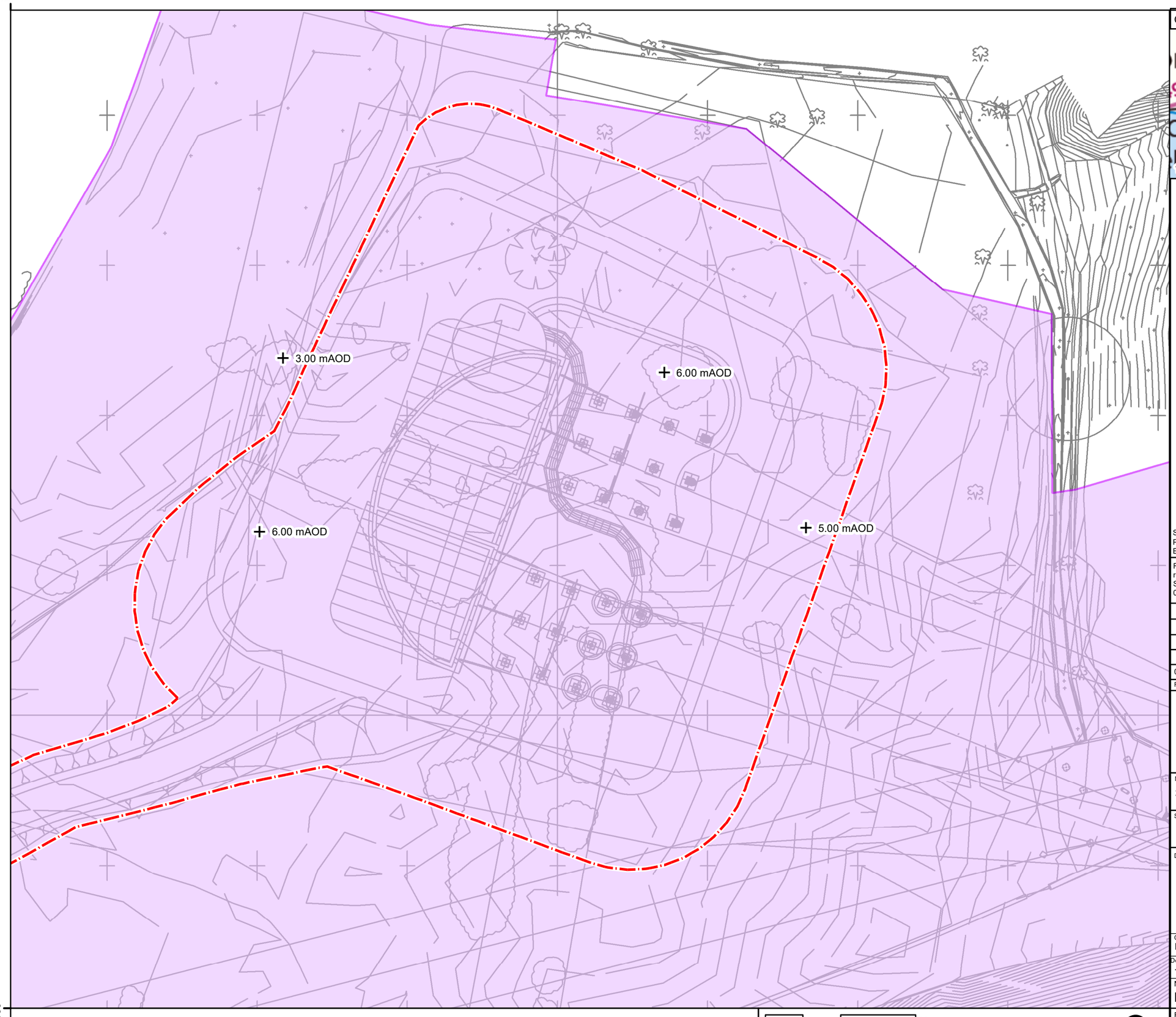

Overview

Proposed Development

- Proposed Tunnel Alignment
- Proposed Tunnel Alignment (inc Limit of Deviation)
- Site Boundary
- National Grid Ownership Boundary
- East Proposed Site Plan - taken from PDD-33494-TUN-004E

Source:
Proposed Development: National Grid November 2019.
East Proposed Site Plan: Taken from PDD-33494-TUN-004E.

Rev	Description	Cre'd	Chk'd	App'd	Date
009	Revised site boundary	LA	JL	KL	03/02/2020

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Master Scheme No:	Sub-Scheme No:	Site:
33495	33495	Snowdonia

Scheme Name:
Visual Impact Provision (VIP) Snowdonia Project

Document Title:
Appendix H: Flood Consequences Assessment
Eastern Head House Showing Design Levels

Created by:	Date:	Checked by:	Date:	Approved by:	Date:
LA	03/02/2020	JL	03/02/2020	KL	03/02/2020

Development Eng:	Document Type:	Scale:	Format:	Sheet(s):	Rev:
-	GIS	1:500	A3	1 of 1	001

National Grid Document Number:
PDD--LAY-012

FEED Document Number:
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0 5 10 20 Meters

Coordinate System:
British National Grid

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Appendix I Floodplain Displacement Calculations – Western Compound

Appendix I - Floodplain displacement calculations for the Western Head House compound

Western Head House Compound Average Existing Ground Level (m AOD)	1.89
Western Head House Developed Level (m AOD)	3.00
Access Ramp Level (m AOD)	2.50
Area of Western Head House Compound (m^2)	1153.73
Area of Access Ramp (m^2)	463.84
'Fluvial Undefended 0.1% AEP' Flood Level (m AOD)	2.53

Floodplain Volume Displaced by Western Head House Compound (m^3)	738.38
Floodplain Volume Displaced by Access Ramp (m^3)	282.94

Total Volume of Floodplain Displaced (m^3)	1021.33

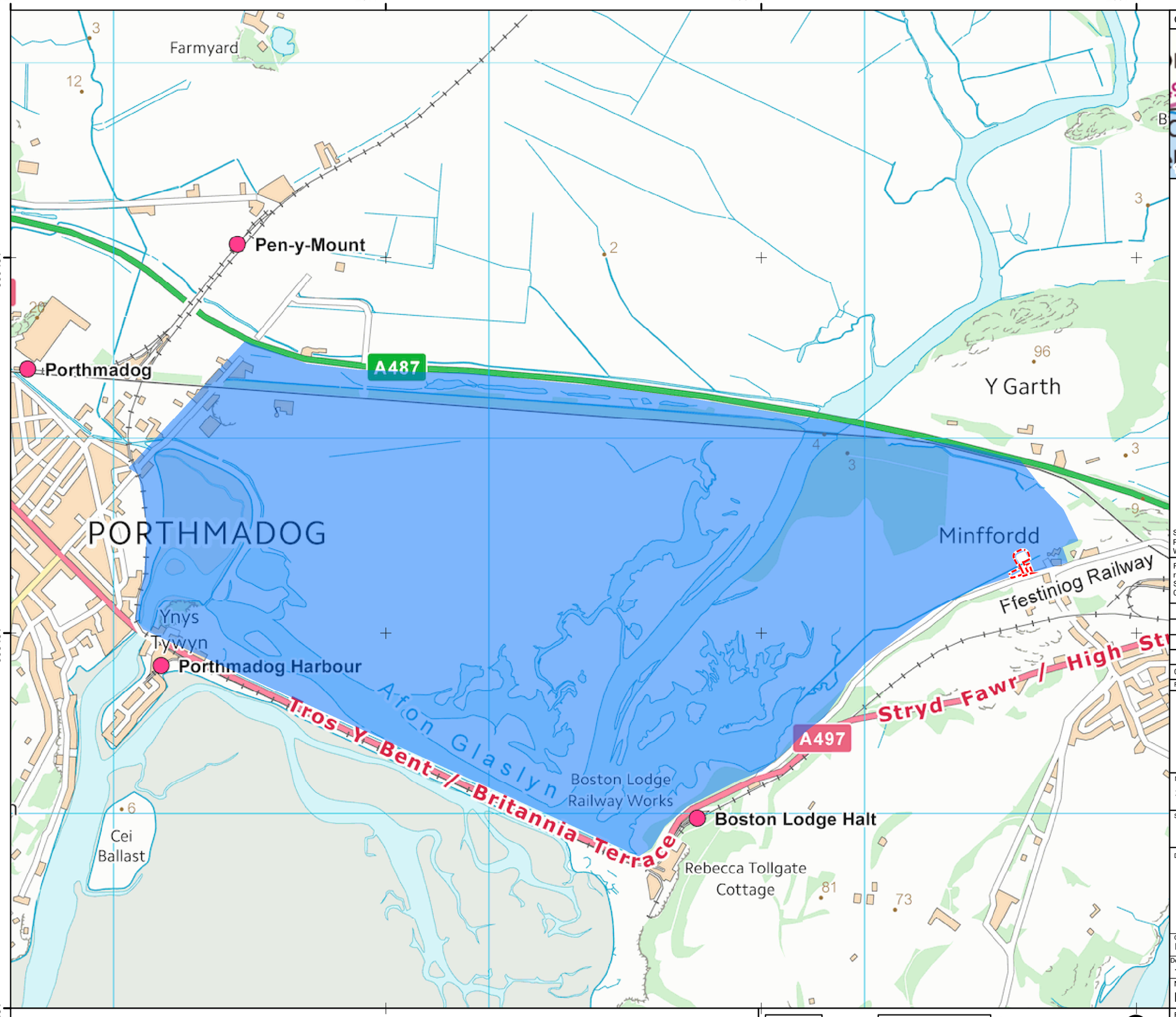
Floodplain 'Cell' Area (m^2)	2,200,000

Increase in Flood Level due to Displaced Floodplain Volume (m)	0.0005

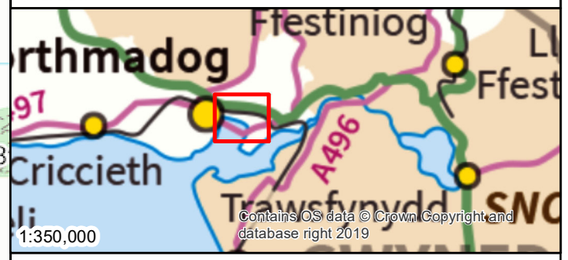
Appendix J Floodplain Displacement Calculations – Western Compound: Flood 'Cell'

256724 988936 | 257724 988936 | 258724 988936 | 259724 988936

339481 958799 | 338481 958799 | 337481 958799



Overview



Proposed Development

National Grid Ownership Boundary

Area of flood cell used for floodplain displacement calculation (Area - 2,200,000m^2)

Source:
Proposed Development: National Grid November 2019.
West Proposed Site Plan: Taken from PDD-33494-ARC-206.

Rev	Description	Cre'd	Chk'd	App'd	Date
009	December 2019 Updates	PH	JL	KL	3/12/19

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Master Scheme No:	Sub-Scheme No:	Site:
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Appendix J: Flood Consequences Assessment
Western Head House 'flood cell' used for Floodplain Displacement Calculation

Created by:	Date:	Checked by:	Date:	Approved by:	Date:
PH	3/12/19	JL	3/12/19	KL	3/12/19

Development Eng:	Document Type:	Scale:	Format:	Sheet(s):	Rev:
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National Grid Document Number:
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0 150 300 600 Meters

Coordinate System: British National Grid

\\ukred1s01\data\Projects\41523774 - National Grid VIP Hydrology\Technical (T)\T5- GIS\Snowdonia\Maps\Flood Consequences Assessment\Appendix J - Western HH Flood Displacement Cell.mxd