HORIZON
NUCLEAR POWER

WYLFA NEWYDD

ENERGY WORKING FOR BRITAIN

Wylfa Newydd Project

Dalar Hir FCA Addendum

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1 Introduction

1.1 Overview

1.1.1 Horizon Nuclear Power Ltd (Horizon) produced a flood consequence assessment (FCA) in November 2017 to describe the assessment of flood risk from all local sources resulting from the construction, operation and decommissioning of the Park and Ride facility at Dalar Hir (Park and Ride). The FCA (hereafter known as the 'Original FCA') was submitted as appendix F8-1 (Application Reference Number: 6.6.16) of chapter F8 (surface water and groundwater) (Application Reference Number: 6.6.8) of the Environmental Statement as part of the DCO application.

1.1.2 The Nant Dalar Hir watercourse flows across the Park and Ride site from the north-eastern corner in a south-westerly direction prior to being culverted beneath the A5 and A55. Baseline hydraulic modelling as part of the Original FCA assessed a high risk of flooding to the Park and Ride site, the A5 and the A55 from both fluvial and pluvial sources. It was concluded that construction of the Park and Ride will not exacerbate the baseline flood risk.

1.1.3 The Environmental Statement submitted in support of the DCO application indicated that the flood risk would be addressed through updated flood mitigation and layout of the Park and Ride. The purpose of this addendum is to describe the updates to flood mitigation that have been made, which are within the parameters presented and assessed within the DCO application as submitted, to mitigate the fluvial flood risk to the Park and Ride and to assess the implications on fluvial flood risk to the Park and Ride site and to areas elsewhere.

1.2 DCO application

1.2.1 Original FCA Modelling showed that fluvial flooding occurs at all modelled events from the 5% Annual Exceedance Probability (AEP) event upwards. The modelled flood extents indicated that the land adjacent to the Nant Dalar Hir would be affected but that water would also flow westwards along the site's southern boundary, adjacent to the A5, and pond in the centre of the Park and Ride. There is another small culvert draining this central area, however, it is insufficient to avoid a flood risk impact in this area.

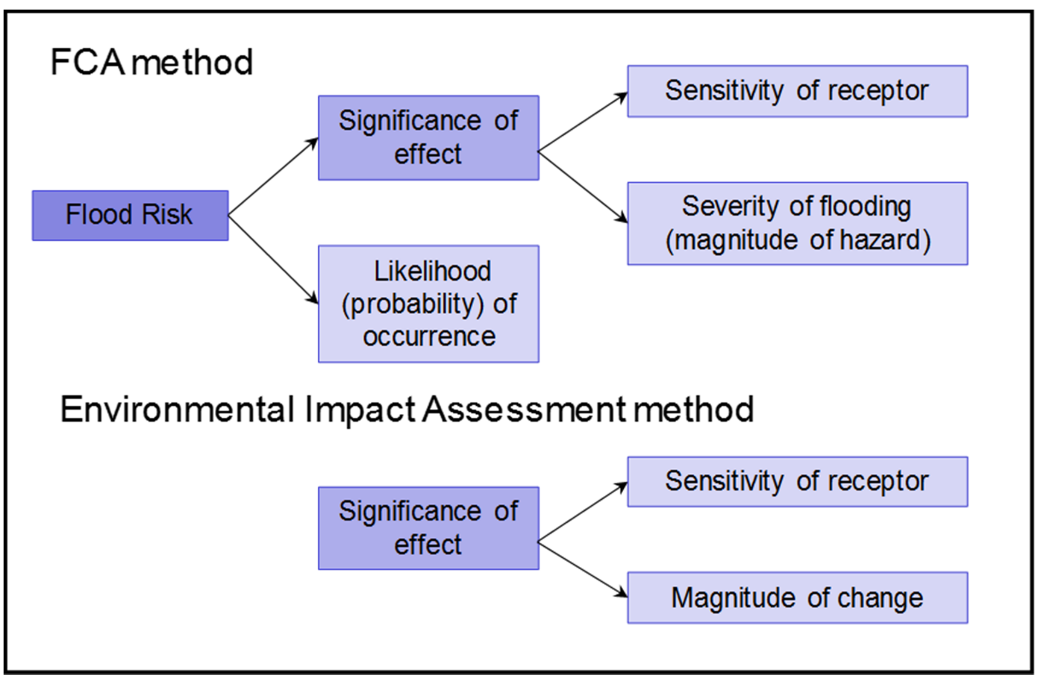
1.2.2 At the 5% AEP event the model indicated that the maximum depth reached would be between 1m and 1.5m. The maximum depth increased with return period to reach depths greater than 2m at the 0.1% AEP event in the south-central area of the Park and Ride. The areas at risk of the deepest flood inundation correspond to the bus drop-off/pick-up point, the building for the bus transport facility, the car park area south of the access road and the package treatment plant to treat the sewage from the Park and Ride. The model indicated that the maximum water velocity that would be reached under fluvial conditions during the 1% AEP event plus 30% climate change allowance would be 0.50m/s.

1.2.3 Based on the FCA methodology (reproduced in appendix 5-1 of this report), the FCA concluded that the magnitude of hazard is high, the significance of effect is moderate and the overall fluvial flood risk is high. The Environmental Statement concluded that the magnitude of change in fluvial flooding to the Park and Ride and the A5 is high adverse, which would result in a moderate and high significance of effect, respectively. Without additional mitigation, this was highlighted as a significant adverse effect. The Park and Ride was identified as a high value receptor in the ES so the significance of effect should in fact be major rather than moderate. Either rating results in a significant effect.

1.3 Approach in this addendum

1.3.1 The study area, planning context, assessment method and baseline site context remain as described in the Original FCA (Application Reference Number: 6.6.16). The method applied within the FCA is informed by Technical Advice Note (TAN) 15 [RD1] and the method is outlined in appendix 5-1 to this addendum. The FCA method differs from the methodology used for the Environmental Impact Assessment (EIA) (see chapter B8 (suface water and groundwater) (Application Reference Number: 6.2.8) of the Environmental Statement). In summary, the different methods are shown schematically in figure 1-1 below. This addendum will acknowledge how the updated flood mitigation affects flood risk in relation to both methods.

Figure 1-1 Outline methods for writing FCAs and EIA



1.3.2 Wood has produced a report to describe the Updated Hydraulic Modelling. This is contained in this addendum as appendix 5-2 and the rationale for the updates are summarised in section 2 below.

1.3.3 This assessment is focussed solely on the fluvial flood risk during operation of the Park and Ride, as this was the most significant source of flooding identified within the original FCA. The DCO application did not consider in detail any fluvial flood risk during construction or decommissioning. Management of these risks are covered in the over-arching Wylfa Newydd Code of Construction Plan (CoCP) (APP-414).

1.3.4 The surface water flood risk was identified as slightly lower in both extent and flood depth to that of fluvial flooding, though the mechanisms of flooding are essentially the same. The risk of flooding from groundwater and services was considered to be low. There are no updates to the flood mitigation and layout of the Park and Ride that would warrant re-assessment of other sources of flooding.

1.4 Report objectives

1.4.1 The objectives of this FCA addendum are to:

- set out the rationale for amendments to the hydraulic modelling approach;
- review the updated hydraulic modelling results;
- assess the impacts on fluvial flooding at the Park and Ride site and effects to other receptors;
- confirm that the Park and Ride would not exacerbate flooding elsewhere;
- consider the level and acceptability of any residual flood risk; and
- confirm compliance with TAN 15 [RD1] and Planning Policy Wales (PPW) [RD2].

2 Updated Hydraulic Modelling

2.1.1 The Original FCA presented a significant flood risk at the site, however, there were elements to the approach which were considered to be overly conservative and which partly prevented the development of mitigation at the site. These elements are summarised below, providing the context for the updates made to the hydraulic modelling.

2.1.2 The Original FCA Modelling utilised a 'lumped inflow' approach, whereby hydrological analysis for Nant Dalar Hir was calculated at a point a few hundred metres south of the site and all of this flow was then applied to the upstream node of the hydraulic model. Whilst conservative, this effectively meant that the flows being modelled were approximately 14% higher than they should have been. This approach was discussed and agreed with NRW on 14th September 2018.

2.1.3 To address this issue, the Updated Hydraulic Modelling amended the application of hydrological inputs to the model, utilising a 'distributed inflow' approach to better represent the way flow would enter the watercourse and therefore the flows along the watercourse. For the updated model, the inflow hydrograph was proportioned to the contributing upstream catchment area. It was split at five locations based on the contributing area.

2.1.4 In addition to the above, a smaller climate change allowance of 15% was applied to the Updated Hydraulic Model, which reflects the 10-year lifetime of the Park and Ride site. The Original FCA modelling applied a climate change allowance of 30% for fluvial events, which is more typical of the allowance applied to developments with a lifetime approaching 100 years. The short lifetime of the Park and Ride, after which the site will be decommissioned and returned to its original use, justifies the lower levels of climate change allowance applied in this study. This approach was also discussed and agreed with NRW on 14th September 2018.

2.1.5 The Updated Hydraulic Modelling still considers the 5%, 1% and 0.1% AEP flood events. The model was updated to re-define the baseline flood risk under fluvial circumstances and two options, which are considered updated flood mitigation relative to the design presented in the DCO, have also been assessed. The two options considered are detailed in appendix 5-2 and repeated in table 2-1 below.

2.1.6 Details of the model data and methodology are contained in the hydraulic modelling report produced by Wood (appendix 5-2).

Table 2-1 Flood risk management options

Option name	Option detail
Option 1A	• Northern fields lowered to a level of 15.03m above Ordnance Datum (AOD)*. • Construction levels of car park 1 and car park 5 refined*. • Spine road incorporated. • Stream crossing under the spine road, which was originally modelled as an orifice unit, replaced with an open span flat bridge unit (span 10m and soffit level 15.8mAOD)*. • Assuming a cover of 0.5m above the soffit, spill level set at 16.3mAOD*.
Option 1B	• Car park 1 and car park 5 construction levels lowered by 210mm (30% void storage in 700mm depth = 210mm) to represent storage allowance underneath*. • Northern fields lowered to a level of 15.03m AOD*. • Spine road incorporated. • Stream crossing under the spine road, which was originally modelled as an orifice unit, replaced with an open span flat bridge unit (span 10m and soffit level 15.8mAOD)*. • Assuming a cover of 0.5m above the soffit, spill level set at 16.3mAOD*.
* represents updated flood mitigation relative to that presented in the DCO.	

2.1.7 It should be noted that the revised baseline scenario excluded blockage of the structure. No blockage was applied on the basis that the Park and Ride site will be managed and maintained throughout its lifetime, as secured via the over-arching Wylfa Newydd Code of Construction Plan (CoCP) (APP-414).

3 Fluvial Flood Risk

3.1.1 Details of the model results are contained in the Updated Hydraulic Modelling report produced by Wood (appendix 5-2).

3.1.2 There is negligible difference between Option 1A and Option 1B as both show almost identical differences in flood depths and velocities compared to the baseline scenario. Considering the ease of construction, lower cost and more realistic representation, Option 1A has been considered as the preferred option.

3.1.3 All relevant model result points for Option 1A show no change or a reduction in flood depth and velocity on the Park and Ride site during the 1% AEP flood event plus 15% allowance for climate change. In addition, there are reductions in flood depths both upstream and downstream of the Park and Ride, with no flood risk to the A5 or the A55.

3.1.4 Result points 'DALA16' and 'DALA37' show an increase in flood depth of 1.23m and an increase in velocity of up to 0.52m/s. This is becasuse the land is dry in the baseline scenario as it is high ground, whereas in the Updated Hydraulic Model both result points are located in the northern fields, i.e. the area of proposed ground lowering that will form part of the updated flood mitigation. The results therefore show a large change in flood depth; however, the area will be designed to hold water during flood events. It is therefore not an area of true flood risk. This is illustrated in figure 6.52 in appendix 5-2.

3.1.5 Result line 'DALA5' on the southern boundary of the site shows an increase in flood depth of 0.17m and increase in veolocity of 0.12m/s. A result 'line', as opposed to a result 'point', takes an average of flood depth along the line and an average of flood flow across the line in both directions. The result line is formed of segments, each with differing ground levels. Where no flow is identified across a segment, the model interprets the flood level as the maximum ground level of the segment. Therefore, the average flood depth recorded at DALA5 includes 'dry' ground levels. As regards flow, recording flow in both directions across the same segment results in over-estimating the flow. For these reasons, result lines are not an appropriate indicator of flood risk. Based on the FCA methodology (appendix 5-1), the magnitude of hazard to the Park and Ride and the A5 is assessed as negligible as there is no potential for flooding. Even in the area of proposed ground lowering, the magnitude of hazard would be very low as it would be planned flooding that does not adversely impact the built development (see chapter B8 (Application Reference Number: 6.2.8) of the Environmental Statement for further details on risk definition). The significance of effect is therefore negligible.

3.1.6 Given the negligible magnitude of hazard during the 1% AEP plus 15% climate change event and the 10-year lifetime of the Park and Ride, there is still a likelihood that a lower probability flood event (>1% AEP) could occur during the lifetime of the development, albeit this likelihood is considered to be low. The flood risk therefore remains negligible. Even a medium likelihood of occurrence would result in a negligible flood risk due to the negligible magnitude of hazard.

3.1.7 Based on the Environmental Statement methodology in chapter B8 (Application Reference Number: 6.2.8), the magnitude of change is considered to be medium and beneficial. This is because over the lifetime of the development there is a medium-term reduction in overall volume of flood water within the Park and Ride and to areas upstream and downstream. There are also changes to flood flow paths as floodwater is contained within the lower areas of ground on the Park and Ride and prevented from flowing onto the A5 and A55. This would result in a moderate beneficial significance of effect to the Park and Ride and the A5 and A55.

3.1.8 Overall, the updated flood mitigation, introducing flood storage basins to act as storage, raising car park levels to avoid impacts and incorporating structural changes at the crossing of the Nant Dalar Hir on the Park and Ride site reduces the flood risk to the development and to the A5 downstream. This has a beneficial effect on flood risk as it there is a high flood risk in the baseline scenario.

3.1.9 The proposed updated flood mitigation is compliant with TAN 15 [RD1] and PPW [RD2] as it meets the key objectives of not causing flooding on the site or increasing the risk of flooding elsewhere.

4 Conclusions

4.1.1 The design for the Park and Ride that was presented in the DCO application was shown to be at fluvial and pluvial flood risk and there was also a risk shown to the A5 and A55. This FCA addendum has assessed the implications of updated flood mitigation (Option 1A) on the fluvial flood risk, as this produced the worst-case flood impacts. The addendum has also assessed the updated flood mitigation in the context of an updated modelling approach. An updated approach was deemed necessary as the Original FCA Modelling over-estimated flows due to the method used, combined with an overly conservative climate change allowance.

4.1.2 The results of an Updated Hydraulic Modelling assessment, which incorporated amendments to flow distribution and climate change allowances, as well as updated flood mitigation have been used to inform this addendum. Table 4-1 summarise the findings of this addendum against those of the original FCA.

Table 4-1 Summary of fluvial flood risk to the Park and Ride, A5 and A55

Criteria		Receptor	Original FCA/ES	FCA addendum (and implications for ES)
FCA criteria	Sensitivity	Park and Ride	Medium	Medium
		A5 and A55	Very high	Very high
	Magnitude of potential hazard	Park and Ride	High	Negligible
		A5 and A55	High	Negligible
	Significance of potential effect	Park and Ride	Moderate	Negligible
		A5 and A55	High	Negligible
	Likelihood of occurrence	Park and Ride	High	Low
		A5 and A55	Medium	Low
	Post-development flood risk	Park and Ride	High	Negligible
		A5 and A55	High	Negligible
Environmental Statement criteria	Sensitivity	Park and Ride	High	High
		A5 and A55	High	High
	Magnitude of change	Park and Ride	High	Medium
		A5 and A55	High	Medium
	Significance of effect	Park and Ride	Moderate adverse*	Moderate beneficial
		A5 and A55	High adverse	Moderate beneficial

*The Park and Ride was identified as a high value receptor in the ES so the significance of effect should in fact be high rather than moderate. Either rating results in a significant effect.

4.1.3 Overall, the updated flood mitigation and mitigation reduces the flood risk to the development and to the A5 and A55 downstream. This has a beneficial effect on flood risk, as it there is a high flood risk in the baseline scenario.

4.1.4 The updated flood mitigation and mitigation is compliant with TAN 15 [RD1] and PPW [RD2] as it meets the key objective of not increasing the risk of flooding to new development or elsewhere.

5 References

Table 5-1 Schedule of references

ID	Reference
RD1	Welsh Government. 2017. *Technical Advice Note TAN 15 Development Advice Map*. [Online]. [Accessed: May 2017]. Available from: https://maps.cyfoethnaturiolcymru.gov.uk/Html5Viewer/Index.html?configBase=https://maps.cyfoethnaturiolcymru.gov.uk/Geocortex/Essentials/REST/sites/Flood_Risk/viewers/Flood_Risk/virtualdirectory/Resources/Config/Default.
RD2	NRW, 2015. Good Practice Guide: Producing flood risk hydraulic models and flood consequence assessments for development planning purposes (GPG 101). Cardiff: NRW.
RD3	Lancaster, J. W., Preene, M. and Marshall. C. T.. 2004. *Development and flood risk: guidance for the construction industry*. Report C624. CIRIA, London.

Appendix 5-1 Assessment methodology

5-1.1.1 In order to allow for the wider assessment of flood risk, a generalised assessment methodology has been developed.

Assessment methodology

5-1.1.2 In line with the risk-based approach detailed by the Welsh Government and recommended elsewhere in industry guidance [RD3], the key to the classification is that the designation of risk is based upon consideration of:

- the sensitivity of the receptor – takes into account the nature of the proposals or receptor and its likely response to increased risk;
- the severity of flooding (i.e. the potential magnitude of the hazard) – takes into account the potential nature of the flooding; and
- the probability of occurrence (i.e. likelihood) – takes into account both the presence of the hazard and receptor, and the integrity of the pathway.

Classification of sensitivity of the receptor

5-1.1.3 When considering new developments, the classification of sensitivity is based (where possible) directly on the technical guidance set out within TAN 15 [RD1]. When considering off-site impacts, there is a general assumption that all developments are highly sensitive. This assumption can, however, typically be relaxed when considering a water-compatible development or undeveloped land. Given this, the sensitivity of the receptor is ranked as shown in table F5-1.1.

Table 5-1.1 Classification of sensitivity of receptor

nsitivity of receptor	New development	Off-site
Very high	Emergency services* developments	All built developments unless mitigating circumstances exist Key access routes
High	Highly vulnerable* developments	Other access routes
Medium	Less-vulnerable* developments	Undeveloped land
Low	Water-compatible[1] developments	-
Very low	Flood attenuation features	-

[1] Category not outlined within TAN 15, but would include any types of development that clearly by their nature often need to be in a floodplain, such as buildings associated with water-sports or pumping stations for low-lying areas.

Classification of the magnitude of hazard

5-1.1.4 To classify the severity of the potential flooding, it is necessary to look at the nature and scale of the individual impacts. These include, but are not confined to, the extent, depth and duration of flooding, and the velocity of flood waters. For new developments, the assessment is based on the likely post-development situation; for off-site receptors, it is based solely on the likely deterioration.

5-1.1.5 Given this, the severity of the potential flooding (hazard) is then ranked in terms of its magnitude as shown below in table 5-1.2.

Table 5-1.2 Classification of magnitude of hazard

gnitude of hazard	New development	Off-site
High	Any one of the following criteria achieved: • flood depths greater than 1m; • flood flow velocities greater than 0.45m/s; or • likely flood duration in excess of 24 hours.	Any marked (>10%) increase in flood depth, flood flow velocity or flood duration Any change in flood extent that impacts additional properties, including access to those properties
Medium	Any one of the following criteria achieved: • flood depths between 0.3m and 1m; • flood flow velocity greater than 0.15m/s; • likely flood duration in excess of one hour; or • any restrictions to access and egress.	Any other measurable increase of flood depths, durations, flow velocities or extent
Low	All of the following criteria achieved: • flood depths below 0.3m; • likely flood duration below one hour; and • flood-proofing measures planned.	Likely but unquantifiable small increases of flood depths, durations, flow velocities or extent
Very low	Planned or permitted flooding that does not adversely impact the built development	-
Negligible	No potential for flooding, or no identifiable impact of flooding	No likely increase in flood severity at any off-site location

Significance of potential effect

5-1.1.6 The magnitude of the hazard and the sensitivity of the receptor are combined using a matrix (shown below in table 5-1.3) to determine the significance of the potential effect, if realised.

Table 5-1.3 Matrix for determining the significance of the potential effect

		Sensitivity of receptor				
		Very low	**Low**	**Medium**	**High**	**Very high**
Magnitude of potential hazard	**High**	Low	Moderate	Moderate	High	High
	Medium	Very low	Low	Moderate	Moderate	High
	Low	Very low	Very low	Low	Moderate	Moderate
	Very low	Negligible	Very low	Very low	Low	Low
	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible

Classification of likelihood of occurrence

5-1.1.7 To classify the likelihood or probability of occurrence for a potential effect, it is necessary to understand how regularly a given event or outcome will occur. This can be assessed in a number of ways, including assessments based on historical data, quantitative analysis or experience from other similar sites. Often, this assessment will be based on standard guidance. The classifications used for defining the likelihood of a potential effect occurring are as shown below in table 5-1.4.

Table 5-1.4 Classification of likelihood of occurrence

ikelihood of occurrence	Potential effect
High	Any consequence would likely appear in the medium term and inevitably in the long term (i.e. the lifetime of the proposed development).
	Equivalent to an annual probability of flooding of greater than 1% (0.5% for tidal).
Medium	Circumstances are such that an event is possible in the medium term and likely over the long term, although not necessarily inevitable.
	Equivalent to an annual probability between 0.1% and 1% (0.1% and 0.5% for tidal).
Low	It is unlikely that any consequence would arise within the lifetime of the proposed development.
	Equivalent to an annual probability of less than 0.1%.
Very low	It is unlikely that any consequence would ever arise.

5-1.1.8 It should be noted that in circumstances where sites have flood defences, determining an accurate assessment of probability of flood occurrence is complex, and assumptions that defences will not fail are unlikely to be acceptable. In such cases, assessments cannot be prescriptive and site-specific assessments would be undertaken. Factors that would be considered include construction, age, condition, maintenance, exposure and other external pressures.

Risk assessment

5-1.1.9 Once the significance of the potential effect and likelihood of occurrence have been assessed, these are then combined using a risk matrix (table 5-1.5) to assess the flood risk of each potential effect.

Table 5-1.5 Risk matrix

		Likelihood of occurrence			
		Very low	**Low**	**Medium**	**High**
Significance of potential effect	**High**	Low	Moderate	High	High
	Moderate	Low	Low	Moderate	High
	Low	Very low	Low	Low	Moderate
	Very low	Negligible	Very low	Low	Low
	Negligible	Negligible	Negligible	Negligible	Negligible

5-1.1.10 Typically, flood risks assessed as Low or less are considered acceptable. If the assessment results in moderate or high risk, this is considered significant (i.e. equivalent to a significant effect under the Environmental Impact Assessment regulations as set out in Chapter B8 of the Environmental Statement), and additional mitigation measures would be required to facilitate development.

5-1.1.11 In some situations, the risk assessment procedure will result in an artificially low assessment of risk. This is particularly the case in situations where consequences of very rare flooding (i.e. breach scenarios) are so extreme that any residual risk, however low, would not be allowed. In such instances, the assessed risk would be elevated. Such decisions must always be accompanied by detailed justification.

Appendix 5-2 Dalar Hir – Hydraulic Modelling Update report

Technical note:
Dalar Hir – Distributed Inflow Hydraulic Modelling
Ref 207672-0012-AA40-TLN-001)

1. Introduction

This technical note outlines the hydraulic modelling task carried out for Task Sheet 12 [PO498788 Variation 2], as part of supporting documents for Defensive Brief 16 [Item4]. The previous hydraulic modelling report for Dalar Hir - Park and Ride site (Doc Ref 207017-0000-AA40-RPT-0006-003) presented the fluvial baseline and mitigation options derived using a conservative, 'lumped inflow' approach, as previously agreed with National Resources Wales (NRW). In November 2017, a sensitivity test was performed which tested a 'distributed inflow' approach, in which the inflow hydrograph was distributed in proportion to the contributing upstream area. This technical note presents the data, methodology and results obtained for the hydraulic modelling carried out at Wood (formerly known as AMEC Foster Wheeler) using such distributed inflow approach. The note also presents the results of alternative carpark designs and flood mitigation options, developed by the project design team. This technical note presents the results of the modelling only.

Please note – this technical note references the 2017 baseline modelling and 2017 options modelling work undertaken in support of the DCO. This Note is prepared as an addendum to the original Amec Foster Wheeler modelling report prepared for DCO submission [Doc Ref 207017-0000-AA40-RPT-0006-003]. This note is not suitable for submission to NRW in isolation.

The content of this technical note is organised as below:

2. Purpose

The purpose of this modelling study is to define the fluvial flood risk to the site using a distributed inflow approach. The sensitivity analysis carried out in Rev0.1 report (Doc Ref 207017-0000-AA40-RPT-0006-003) suggested that the representation of flow could be more realistic if applied in area-distributed way which could enable the carpark design to be optimised. In this study, the inflow hydrograph is proportioned to the contributing upstream catchment area. This study presents the results for baseline and four various development option scenarios to recommend a best option to inform the DCO application. A more realistic climate change factor of 15 % was agreed by the project team to consider given the life span of 10 years and use of the proposed park and ride carpark. This was agreed in the project team telephone conference held on 31 January 2018 and subsequent communications with the design and FRA team.

3. Hydrology

Hydrological inputs for this study were derived using industry standard hydrologic software tool ReFH2.2 utilising latest rainfall FEH2013 DDF data obtained from the FEH Web service. For the assessment of the flood risks associated with fluvial events, following three events have been considered for this study:

- 1:20yrs AEP + Climate change (15%);
- 1:100yrs AEP + Climate change (15%); and
- 1:1,000yrs AEP + Climate change (15%).

These events were run through the hydraulic model and results for flood inundation depths and extents were calculated. The results are presented in section 6. For this modelling study, the events were considered with a short-term climate change factors. Following the discussion with the project team, the climate change factor has been considered for 10 years of design life of the proposed carpark. An uplift factor of 15% has been applied considering a period between 2015 and 2039. The detail of the model run event and development options are given in section 5.

The hydrographs for the events listed above were generated at the downstream end of the catchment and proportioned with the contributing upstream area to apply into the model in a distributed manner. To be consistent with the modelling in the DCO submission, a summer rainfall profile with critical storm durations of 6.5 hours, 5.5 hours, and 4.5 hours for 1:20, 1 :100 and 1:1,000 years AEP events respectively, have been taken forward. The justification of these durations is outlined in the DCO modelling report for Dalar Hir(Doc Ref 207017-0000-AA40-RPT-0006-003).

4. Methodology

Following the sensitivity test (see Test 13, Section 8.2; Doc Ref: 207017-0000-AA40-RPT-0006-003) using distributed inflow approach, it was expected that the design could be optimised and the hydraulic modelling could result in a reduced flood levels and a reduction in the area inundated. In this distributed inflow approach, the total inflow to the catchment were split into five inflow hydrographs proportional to their corresponding contributing areas, in contrary to a single inflow hydrograph at the upstream node. The detail of the model configuration has already been reported in aforementioned report. Further to the inflow method, the climate change allowance has also been reduced from 30% to 15% for 1:100 years AEP plus climate change event.

The scope of this hydraulic modelling task covers the model runs for a baseline and four mitigation options model runs.

A number of mitigation options were developed by the project design team, and these were built into the model to test design effectiveness of the optimised design. Table 4.1 Mitigation Options (Iteration 1 2017)

below shows the detail of mitigation options considered for model runs.

Table 4.1 Mitigation Options (Iteration 1 2017)

Option name	Option detail
No-Mitigation (with development)	▶ Both Field Ponds (at northern fields) are at existing ground levels. ▶ Constructions levels for carpark areas as informed by the CAD model supplied (ref to: *60PO8081-JAC-CIV-MOD-00024.dwg*). ▶ Voids and cellular tank storage are not considered for this option.
Mitigation Option 1	▶ Both Field Ponds (at northern fields) are lowered and set at 15.03 mAOD. ▶ Constructions levels for carpark areas as informed by the CAD model supplied (ref to: 60PO8081-JAC-CIV-MOD-00024.dwg). ▶ Voids and cellular tank storage are not considered for this option.
Mitigation Option 2	▶ Both Field Ponds (at northern fields) are lowered and set at 15.03 mAOD. ▶ Carpark 1: formation level picked from the CAD drawing model (cellular storage has not been applied). ▶ Carpark 5: lowered to represent cellular tanks, modelled down to 15.04 mAOD.
Mitigation Option 3	▶ Both Field Ponds (at northern fields) are lowered and set at 15.03 mAOD. ▶ Carpark 1: split into northern and southern sections, and lowered to represent cellular tanks, modelled down to 15.99 mAOD on northern section and 15.04 mAOD on southern section. ▶ Carpark 5: lowered to represent cellular tanks, modelled down to 15.04 mAOD.

Mitigation options Option 2 and Option 3 as listed above were tested, as they were preferred options in previously reported modelling studies (Doc Ref 207017-0000-AA40-RPT-0006-003). However, owing to the fact that the climate change factor is lowered and because the inflows are applied in a distributed manner to the model, these options were not deemed to be relevant for the updated model configuration and design options. To mitigate the identified risk, additional mitigation options were developed, as detailed in Table 4.2. The option modelling detailed in this technical note also benefits from the inclusion of carpark spine road and bridge crossing. The spine road levels were taken from the CAD file supplied by the design team (Doc Ref: 60PO8081-JAC-CIV-MOD-00024.dwg), whereas the bridge levels and sizes were directly supplied by the project design team.

Table 4.2 Mitigation Options (Iteration 2 2018)

Option name	Option detail
Mitigation option-1A	▶ Northern fields are lowered at a level of 15.03mAOD. ▶ Construction levels of carparks (carpark-1 and carpark-5) were picked from the CAD model supplied. ▶ Spine road is incorporated with levels picked from the CAD model. ▶ Stream crossing under the spine road which was originally modelled as an orifice unit is replaced with an open span flat bridge unit (span 10m and soffit level 15.8mAOD).

Option name	Option detail
	▶ Assuming a cover of 0.5m above the soffit, a spill level was set at 16.3mAOD.
Mitigation Option-1B	▶ Northern fields are lowered at a level of 15.03mAOD. ▶ Spine road is incorporated with levels picked from CAD model. ▶ Stream crossing under the spine road which was originally modelled as an orifice unit is replaced with an open span flat bridge unit (span 10m and soffit level 15.8mAOD). ▶ Assuming a cover of 0.5m above the soffit, a spill level was set at 16.3mAOD. ▶ Carpark-1 and Carpark-5 construction levels have been lowered by 210mm (30% void storage in 700mm depth = 210mm) for storage allowance underneath.

5. Model Runs

Hydrological software tool ReFH2.2 had been used with FEH2013 DDF Rainfall data that was obtained from the FEH Web service to generate inflow hydrographs. Additional monitoring points and lines have been added to existing points and lines. Eleven points and five lines were added to the existing PO layer so as to assess the flood risks closely outside (both at upstream and downstream locations) of the development boundary as shown in Figure 6.30 in Appendix A.

The coupled 1D-2D hydraulic model in Flood modeller (1D) and TUFLOW (2D) was deployed in this modelling work with the distributed inflow hydrograph. Only the fluvial event was considered in this modelling task. The detail of model runs for baseline and option runs are outlined in Table 5.1 and Table 5.2 respectively.

Table 5.1 Baseline model runs

Item	Model run events and details of Input files
Fluvial baseline events	▶ F20cc: 1:20 year AEP event plus climate change (15%). ▶ F100cc: 1:100 year AEP event plus climate change (15%). ▶ F1000cc: 1:1000 year AEP event plus climate change (15%).
1D model files	▶ DALA01_031.dat
2D model files	▶ 35589-24_S1_Base_032.tgc ▶ 35589-24_S1_Base_024.tbc ▶ DALA01_Base_051_TS12_F20CC_001.tcf ▶ DALA01_Base_051_TS12_F100CC_001.tcf ▶ DALA01_Base_051_TS12_F1000CC_001.tcf no bcdbase – all inflows and boundary conditions from 1D model.
Model run parameters and settings	Default parameters were used for all settings except those listed below: Automatic Preissmann Slot for River Sections.

Table 5.2 Development Option Runs (Iteration 1)

Option name	Model run events and details of Input files
No-Mitigation (with development)	▶ F20CC: 1:20 year AEP event with climate change (15%). ▶ F100CC: 1:100 year AEP event with climate change (15%). ▶ F1000CC: 1:1000 year AEP event with climate change (15%). ▶ DALA01_031.dat ▶ 35589-24_S1_NOMit_002.tgc ▶ DALA01_1D-031_2D-051-NOMit_F20cc_002.tcf ▶ DALA01_1D-031_2D-051-NOMit_F100cc_002.tcf ▶ DALA01_1D-031_2D-051-NOMit_F1000cc_002.tcf
Mitigation Option 1	▶ F20CC: 1:20 year AEP event with climate change (15%). ▶ F100CC: 1:100 year AEP event with climate change (15%). ▶ F1000CC: 1:1000 year AEP event with climate change (15%). ▶ DALA01_031.dat ▶ 35589-24_S1_MitOPT1_001.tgc ▶ DALA01_1D-031_2D-051-MitOPT-01_F20cc_001.tcf ▶ DALA01_1D-031_2D-051-MitOPT-01_F100cc_001.tcf ▶ DALA01_1D-031_2D-051-MitOPT-01_F1000cc_001.tcf
Mitigation Option 2	▶ F100CC: 1:100 year AEP event with climate change (15%). ▶ DALA01_031.dat ▶ 35589-24_S1_MitOPT2_001.tgc ▶ DALA01_1D-031_2D-051-MitOPT-02_F100cc_001.tcf
Mitigation Option 3	▶ F100CC: 1:100 year AEP event with climate change (15%). ▶ DALA01_031.dat ▶ 35589-24_S1_MitOPT3_001.tgc ▶ DALA01_1D-031_2D-051-MitOPT-03_F100cc_001.tcf

In addition to above four option model runs, it was deemed that the preferred option could be one of the variants of option 1 above, with the inclusion of proposed carpark spine road (Doc Ref: 60PO8081-JAC-CIV-MOD-00024.dwg) and an open flat bridge crossing under the spine road. So, new input layers were created to reflect the changes to the model configurations and two variants named as Option-1A and Option-1B were run as shown in Table 5.3.

Table 5.3 Preferred Mitigation Option Runs (Iteration 2)

Option name	Model run events and details of additional Input files
Mitigation option-1A	▶ F100CC: 1:100 year AEP event with climate change (15%). ▶ DALA01_033.dat[a] ▶ 35589-24_S1_MitOPT1A_001.tgc[b] ▶ DALA01_1D-032_2D-051-MitOPT-01a_F100cc_001.tcf
Mitigation option-1B	▶ F100CC: 1:100 year AEP event with climate change (15%). ▶ DALA01_033.dat[a] ▶ 35589-24_S1_MitOPT1B_001.tgc[c] ▶ DALA01_1D-032_2D-051-MitOPT-01b_F100cc_001.tcf
Changes	[a] 1D model has been updated with the bridge unit under carpark spine road. [b] Spine road layer has been added as polygon GIS-shape file. [c] Carpark-1 and Carpark-5 levels have been lowered by 210mm.

6. Model Run Results

The following sections present results of model runs that were circulated and issued to the project team for evaluation and discussion. These results were produced as Spreadsheets, pdf Maps, GIS-shape files and CAD drawings as required by the project team. Following sub-sections enlist the detail of the deliverables that were issued as part of the task and they are also appended in Appendix A and B of this technical note.

6.1 Baseline model run results

Maps:
Fig 6.30 Dalar Hir 1D-2D Hydraulic Model [Zoom]
Fig 6.31 Dalar Hir distributed inflow baseline peak fluvial flood depth 1:20 year AEP plus climate change (15%)
Fig 6.32 Dalar Hir distributed inflow baseline peak fluvial flood depth 1:100 year AEP plus climate change (15%)
Fig 6.33 Dalar Hir distributed inflow baseline peak fluvial flood depth 1:1,000 year AEP plus climate change (15%)
Fig 6.34 Dalar Hir distributed inflow baseline peak fluvial flood extents

Spreadsheets:
35989-C1444_Base_Task_48_TS12_Fluvial_F20cc.xlsx
35989-C1445_Base_Task_48_TS12_Fluvial_F100cc.xlsx
35989-C1446_Base_Task_48_TS12_Fluvial_F1000cc.xlsx

Shapefiles:
Dist_inflow_baeline_inundatin_extent_f20cc15pc_v1.shp
Dist_inflow_baeline_inundatin_extent_f100cc15pc_v1.shp
Dist_inflow_baeline_inundatin_extent_f1000cc15pc_v1.shp

6.2 Mitigation Option model run results

No Mitigation (with development)

Maps:

Fig 6.35 Dalar Hir distributed inflow No Mitigation peak fluvial flood depth 1:20 year AEP plus climate change (15%)
Fig 6.36 Dalar Hir distributed inflow No Mitigation peak fluvial flood depth 1:100 year AEP plus climate change (15%)
Fig 6.37 Dalar Hir distributed inflow No Mitigation peak fluvial flood depth 1:1000 year AEP plus climate change (15%)
Fig 6.38 Dalar Hir distributed inflow No Mitigation peak fluvial flood extents
Fig 6.39 Dalar Hir distributed inflow No Mitigation peak fluvial flood extent compared with baseline flood extent
Fig 6.40 Dalar Hir distributed inflow peak depth difference fluvial 1:100 year AEP plus Climate change (15%)

Spreadsheets:

35989-C1447_NOMit_Task_48_TS12_Fluvial_F20cc.xlsx
35989-C1448_NOMit_Task_48_TS12_Fluvial_F100cc.xlsx
35989-C1449_NOMit_Task_48_TS12_Fluvial_F1000cc.xlsx

Mitigation Option-1

Maps:

Fig 6.41 Dalar Hir distributed inflow Mitigation Option-1 peak fluvial flood depth 1:20 year AEP plus climate change (15%)
Fig 6.42 Dalar Hir distributed inflow Mitigation Option-1 peak fluvial flood depth 1:20 year AEP plus climate change (15%)
Fig 6.43 Dalar Hir distributed inflow Mitigation Option-1 peak fluvial flood depth 1:1000 year AEP plus climate change (15%)
Fig 6.44 Dalar Hir distributed inflow Mitigation Option-1 peak fluvial flood extents
Fig 6.45 Dalar Hir distributed inflow Mitigation Option-1 peak fluvial flood extent compared with baseline flood extent
Fig 6.46 Dalar Hir distributed inflow peak depth difference fluvial 1:100 year AEP plus Climate change (15%)

Spreadsheets:

35989-C1450_MitOPT-1_Task_48_TS12_Fluvial_F20cc.xlsx
35989-C1451_MitOPT-1_Task_48_TS12_Fluvial_F100cc.xlsx
35989-C1452_MitOPT-1_Task_48_TS12_Fluvial_F1000cc.xlsx

Mitigation Option-2

Maps:

Fig 6.47 Dalar Hir distributed inflow Mitigation Option-2 peak fluvial flood extent compared with baseline flood extent
Fig 6.48 Dalar Hir distributed inflow peak depth difference fluvial 1:100 year AEP plus Climate change (15%)

Spreadsheet

35989-C1453_MitOPT-2_Task_48_TS12_Fluvial_F100cc.xlsx

Mitigation Option-3

Maps:

Fig 6.49 Dalar Hir distributed inflow Mitigation Option-3 peak fluvial flood extent compared with baseline flood extent
Fig 6.50 Dalar Hir distributed inflow peak depth difference fluvial 1:100 year AEP plus Climate change (15%)

Spreadsheet:

35989-C1454_MitOPT-3_Task_48_TS12_Fluvial_F100cc.xlsx

Mitigation Option-1A

Maps:
Fig 6.51 Dalar Hir distributed inflow Mitigation Option-1A peak fluvial flood depth 1:100 year AEP plus climate change (15%)
Fig 6.52 Dalar Hir distributed inflow Mitigation Option-1A peak fluvial flood extent compared with baseline flood extent
Fig 6.53 Dalar Hir distributed inflow peak depth difference fluvial 1:100 year AEP plus Climate change (15%)

Spreadsheet:
35989-C1455_MitOPT-1A_Task_48_TS12_Fluvial_F100cc.xlsx

CAD drawing:
DH_MitOPT1A_CAD.dwg

Mitigation Option-1B

Maps:
Fig 6.54 Dalar Hir distributed inflow Mitigation Option-1B peak fluvial flood depth 1:100 year AEP plus climate change (15%)
Fig 6.55 Dalar Hir distributed inflow Mitigation Option-1B peak fluvial flood extent compared with baseline flood extent
Fig 6.56 Dalar Hir distributed inflow peak depth difference fluvial 1:100 year AEP plus Climate change (15%)

Spreadsheet:
35989-C1456_MitOPT-1B_Task_48_TS12_Fluvial_F100cc.xlsx

6.3 Results Comparison

A comparative analysis of the results for flood depths and flood velocities at some selected monitoring locations has been carried out. Table 6.2 and Table 6.3 show the comparison of the results for 1:100 years AEP plus 15% climate change event at the selected monitoring locations for iteration 1 and iteration 2 respectively. The monitoring points cover proposed carpark area and areas lying on upstream and downstream of the development as indicated. Comparing results for various monitoring points from iteration 1 (see Table 6.2), Option 1 showed some desired flood depth reduction in the carpark areas in comparison to other options considered. So, it was further updated with the inclusion of cellular storage under Carpark-1 and Carpark-5. It was also incorporated with the spine road and bridge unit under the spine road, to reflect latest design at the time. Therefore, two further scenarios were modelled in iteration 2: Option 1A and Option 1B. The model results for these two scenarios have been presented in Table 6.3. It can be seen from the results that both Option 1A and Option 1B behaves similarly and the flood depths values are decreased in the carpark areas except at lowered fields on the northern side. As Option 1B was modelled to represent a flat 30% void for a depth of 700mm. Considering the ease of construction and realistic representation, Option 1A has been considered as the preferred option as it does not increase any flood risk within the site and elsewhere. It should be noted that flood depths and extent has been greatly reduced because of lower factor for climate change allowance and distributed mode of model inflow. Table 6.1 shows a comparison between previous and this distributed modelling study.

Table 6.1 Comparison with previously reported lumped method

Parameter	Lumped method (Previous study- (Ref: 207017-0000-AA40-RPT-0006-003)	distributed inflow approach (this study)
Hydrology Approach	Lumped	Distributed
inflow hydrograph	applied at single upstream node	Split at five locations based on contributing area
Climate change (CC) allowance	30%	15%
Peak inflow for 1:100 AEP plus CC	6.0 m3/s	4.6 m3/s

Table 6.2 Summary Results – Peak Flood depth (m), Velocity (m/s) and difference compared to baseline for the 1:100 year AEP+15%cc event (Iteration 1)

Results Point / Lines	Baseline		No Mitigation with development		No mitigation with development minus Baseline		Option 1		Option 1 minus Baseline		Option 2		Option 2 minus Baseline		Option 3		Option 3 minus Baseline	
	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)
DALA5*	0.18	1.18	0.42	1.35	0.24	0.17	0.33	1.35	0.15	0.17	0.33	1.35	0.15	0.17	0	1.31	-0.18	0.13
DALA7*	0	1.54	0	1.63	0	0.09	0	0	0	-1.54	0	0	0	-1.54	0	0	0	-1.54
DALA11	0	0	0.00	0.03	0	0.03	0	0	0	0	0	0	0	0	0	0	0	0
DALA15	0.07	0.06	0.10	0.13	0.03	0.07	0.02	0.04	-0.05	-0.02	0.02	0.04	-0.05	-0.02	0	0	-0.07	-0.06
DALA16	0	0	0.03	0.15	0.03	0.15	0.52	1.23	0.52	1.23	0.52	1.23	0.52	1.23	0.52	1.15	0.52	1.15
DALA17	0	0	0.02	0.07	0.02	0.07	0	0	0	0	0	0	0	0	0	0	0	0
DALA22	0.07	0.88	0.10	0.9	0.03	0.02	0.09	0.64	0.02	-0.24	0.09	0.64	0.02	-0.24	0	0	-0.07	-0.88
DALA25	0.04	0.69	0	0	-0.04	-0.69	0	0	-0.04	-0.69	0	0	-0.04	-0.69	0	0	-0.04	-0.69
DALA26	0.21	1.5	0.28	1.59	0.07	0.09	0	0	-0.21	-1.5	0	0	-0.21	-1.5	0	0	-0.21	-1.5
DALA27	0.14	1.48	0.20	1.58	0.06	0.1	0	0	-0.14	-1.48	0	0	-0.14	-1.48	0	0	-0.14	-1.48
DALA28[d]	0.03	0.12	0.04	0.18	0.01	0.06	0.03	0.07	0	-0.05	0.03	0.07	0	-0.05	0.03	0.05	0	-0.07
DALA29	0.24	0.78	0.24	0.84	0	0.06	0.24	0.73	0	-0.05	0.24	0.73	0	-0.05	0.24	0.71	0	-0.07
DALA34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DALA35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DALA37	0	0	0.02	0.02	0.02	0.02	0.06	1.23	0.06	1.23	0.06	1.23	0.06	1.23	0.06	1.15	0.06	1.15
DALA40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DALA41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DALA42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.16	1.14	0.16	1.14
DALA44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.15	1.14	0.15	1.14
DALA45*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DALA46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DALA47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DALA48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DALA71*[a]	0	0.63	0	0.63	0	0	0	0.63	0	0	0	0.63	0	0	0	0.63	0	0
DALA72*[a]	0	0.53	0	0.53	0	0	0	0.53	0	0	0	0.53	0	0	0	0.53	0	0
DALA75*[d]	0	0.95	0	1.01	0	0.06	0	0.9	0	-0.05	0	0.9	0	-0.05	0	0.88	0	-0.07

Results Point / Lines	Baseline		No Mitigation with development		No mitigation with development minus Baseline		Option 1		Option 1 minus Baseline		Option 2		Option 2 minus Baseline		Option 3		Option 3 minus Baseline	
	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)
DALA81 [a]	0.25	0.09	0.25	0.09	0	0	0.25	0.09	0	0	0.25	0.09	0	0	0.25	0.09	0	0
DALA83 [a]	0.2	0.04	0.20	0.04	0	0	0.2	0.04	0	0	0.2	0.04	0	0	0.2	0.04	0	0
DALA85 [a]	0.21	0.19	0.20	0.21	-0.01	0.02	0.22	0.16	0.01	-0.03	0.22	0.16	0.01	-0.03	0.22	0.16	0.01	-0.03
DALA88 [d]	0.07	0.44	0.07	0.5	0	0.06	0.06	0.39	-0.01	-0.05	0.06	0.39	-0.01	-0.05	0.06	0.37	-0.01	-0.07
DALA90 [d]	0.09	0.37	0.09	0.44	0	0.07	0.09	0.32	0	-0.05	0.09	0.32	0	-0.05	0.09	0.3	0	-0.07
DALA91 [d]	0.19	0.02	0.19	0.03	0	0.01	0.19	0.02	0	0	0.19	0.02	0	0	0.19	0.02	0	0

*: Result monitoring location is a line. [a]: location upstream of proposed development. [b]: location downstream of proposed development.

Table 6.3 Summary Results – Peak Flood depth (m), Velocity (m/s) and difference compared to baseline for the 1:100 year AEP+15%cc event (iteration 2)

Results Point / Lines	Baseline		Option-1A		Option-1A minus Baseline		Option-1B		Option-1B minus Baseline	
	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)
DALA5*	0.18	1.18	0.30	1.35	0.12	0.17	0.3	1.35	0.12	0.17
DALA7*	0	1.54	0	0	0	-1.54	0	0	0	-1.54
DALA11	0	0	0	0	0	0	0	0	0	0
DALA15	0.07	0.06	0.02	0.05	-0.05	-0.01	0.02	0.05	-0.05	-0.01
DALA16	0	0	0.52	1.23	0.52	1.23	0.51	1.23	0.51	1.23
DALA17	0	0	0	0	0	0	0	0	0	0
DALA22	0.07	0.88	0.08	0.6	0.01	-0.28	0.08	0.59	0.01	-0.29
DALA25	0.04	0.69	0	0	-0.04	-0.69	0	0	-0.04	-0.69
DALA26	0.21	1.5	0	0	-0.21	-1.5	0	0	-0.21	-1.5
DALA27	0.14	1.48	0	0	-0.14	-1.48	0	0	-0.14	-1.48
DALA28[d]	0.03	0.12	0.03	0.07	0	-0.05	0.03	0.07	0	-0.05
DALA29	0.24	0.78	0.24	0.73	0	-0.05	0.24	0.73	0	-0.05
DALA34	0	0	0	0	0	0	0	0	0	0
DALA35	0	0	0	0	0	0	0	0	0	0
DALA37	0	0	0.06	1.23	0.06	1.23	0.06	1.23	0.06	1.23
DALA40	0	0	0	0	0	0	0	0	0	0

Results Point / Lines	Baseline		Option-1A		Option-1A minus Baseline		Option-1B		Option-1B minus Baseline	
	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)
DALA41	0	0	0	0	0	0	0	0	0	0
DALA42	0	0	0	0	0	0	0	0	0	0
DALA44	0	0	0	0	0	0	0	0	0	0
DALA45*	0	0	0	0	0	0	0	0	0	0
DALA46	0	0	0	0	0	0	0	0	0	0
DALA47	0	0	0	0	0	0	0	0	0	0
DALA48	0	0	0	0	0	0	0	0	0	0
DALA71*[a]	0	0.63	0	0.63	0	0	0	0.63	0	0
DALA72*[a]	0	0.53	0	0.53	0	0	0	0.53	0	0
DALA75*[d]	0	0.95	0	0.91	0	-0.04	0	0.91	0	-0.04
DALA81 [a]	0.25	0.09	0.25	0.09	0	0	0.25	0.09	0	0
DALA83 [a]	0.2	0.04	0.20	0.04	0	0	0.2	0.04	0	0
DALA85 [a]	0.21	0.19	0.22	0.16	0.01	-0.03	0.22	0.16	0.01	-0.03
DALA88 [d]	0.07	0.44	0.07	0.4	0	-0.04	0.08	0.4	0.01	-0.04
DALA90 [d]	0.09	0.37	0.09	0.33	0	-0.04	0.09	0.33	0	-0.04
DALA91 [d]	0.19	0.02	0.19	0.02	0	0	0.19	0.02	0	0

*: Result monitoring location is a line. [a]: location upstream of proposed development. [b]: location downstream of proposed development.

wood.

Issued by

[redacted]

Bidur Ghimire

[redacted]

John Rampley-Clarke

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Management systems

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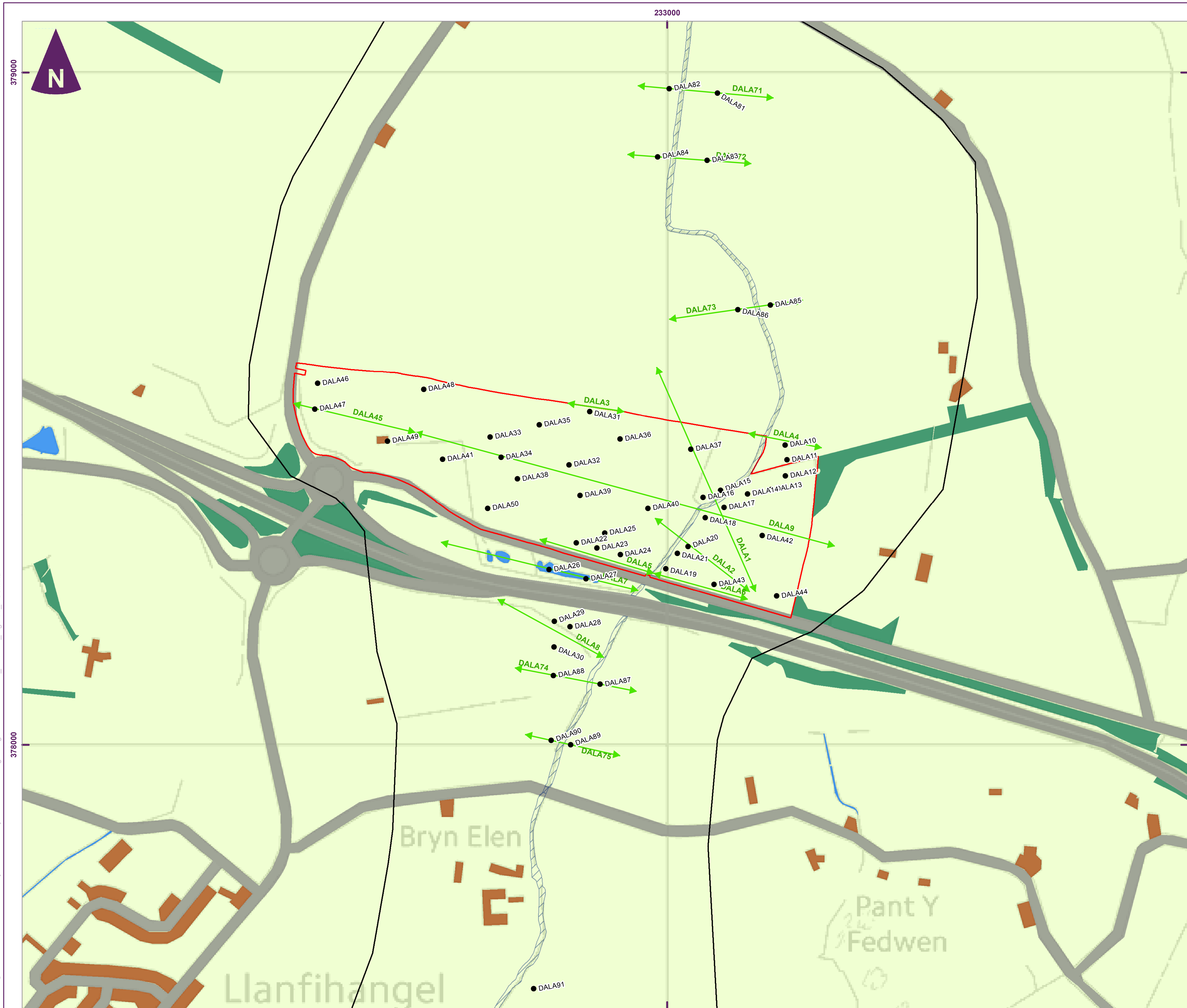
Appendix A
Figure 6.30 to Figure 6.50



Key

Roughness Zones (Mannings n coefficient)

- 0.015 - Road
- 0.025 - Path, Roadside
- 0.035 - Inland Water
- 0.08 - Rough Grassland, Scrub, Trees
- 0.3 - Buildings, Glasshouse
- 0.04 - Grass, General surface

- Model boundary
- 1D Model Domain
- Site Boundary
- Results Point
- **Results Line**
- OS Mapping

FOR INFORMATION ONLY

0 50 100 150 200 250 m

Scale at A3

Wylfa Newydd Associated Developments Hydraulic Modelling

amec foster wheeler

Figure 6.30
Dalar Hir 1D-2D Hydraulic Model [Zoom]

June 2018 35989_Lon603i2 ghimb

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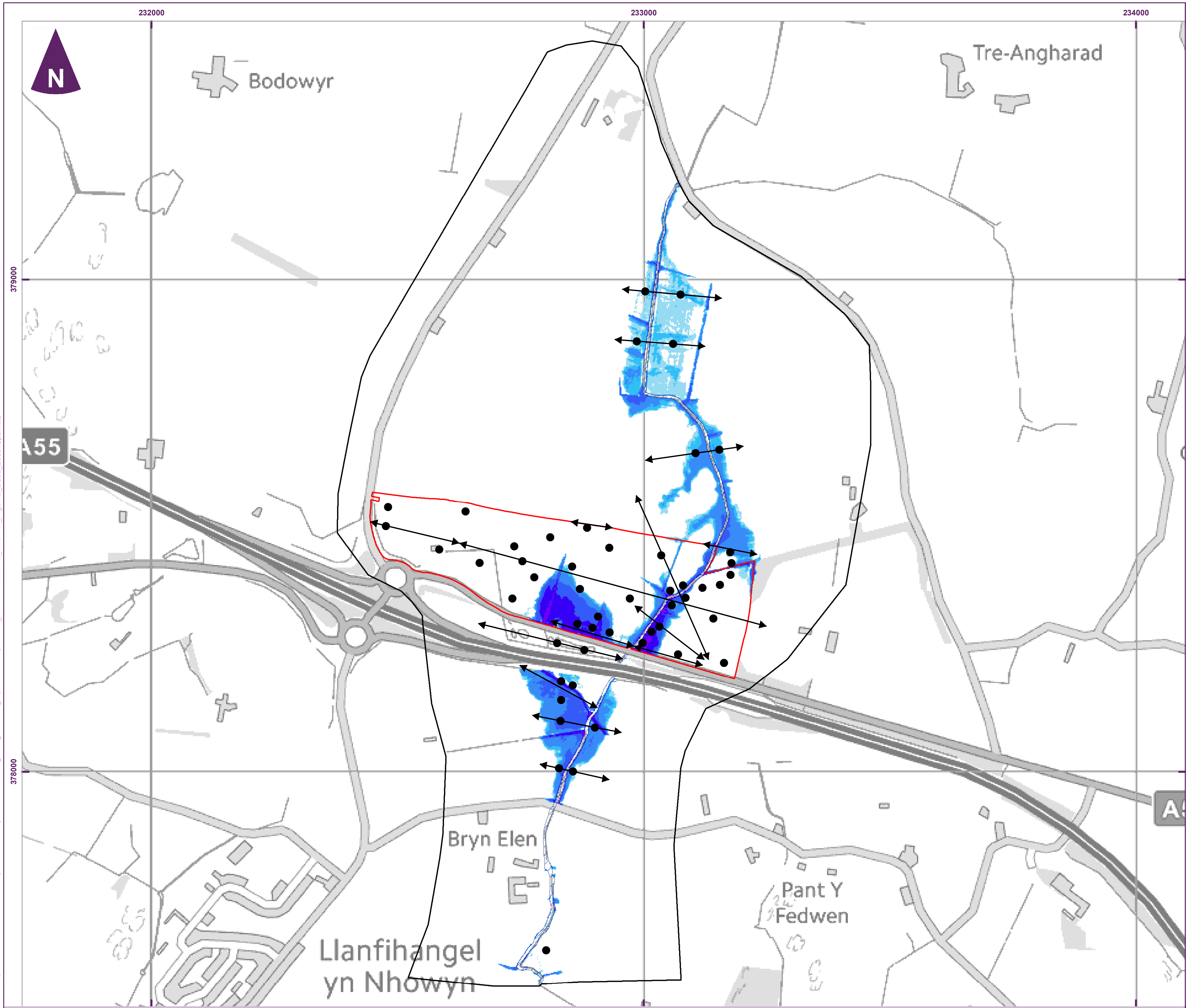


Key

Peak flood depth (m)
Baseline
1:20 year AEP fluvial
Climate change (15%)

- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00
- Model boundary
- 1D Model Domain
- Site Boundary
- Results Point
- Results Line
- OS Mapping

Notes:
The depths represent the maximum depth achieved. The flood prediction does not represent a moment in time as maximum depths can be achieved at different times.

Model run date: 20/02/2018;
Corresponding data:
35989-C1444_Base_Task_48_TS12
_Fluvial_F20cc.xlsx

0 100 200 300 400 m
Scale at A3

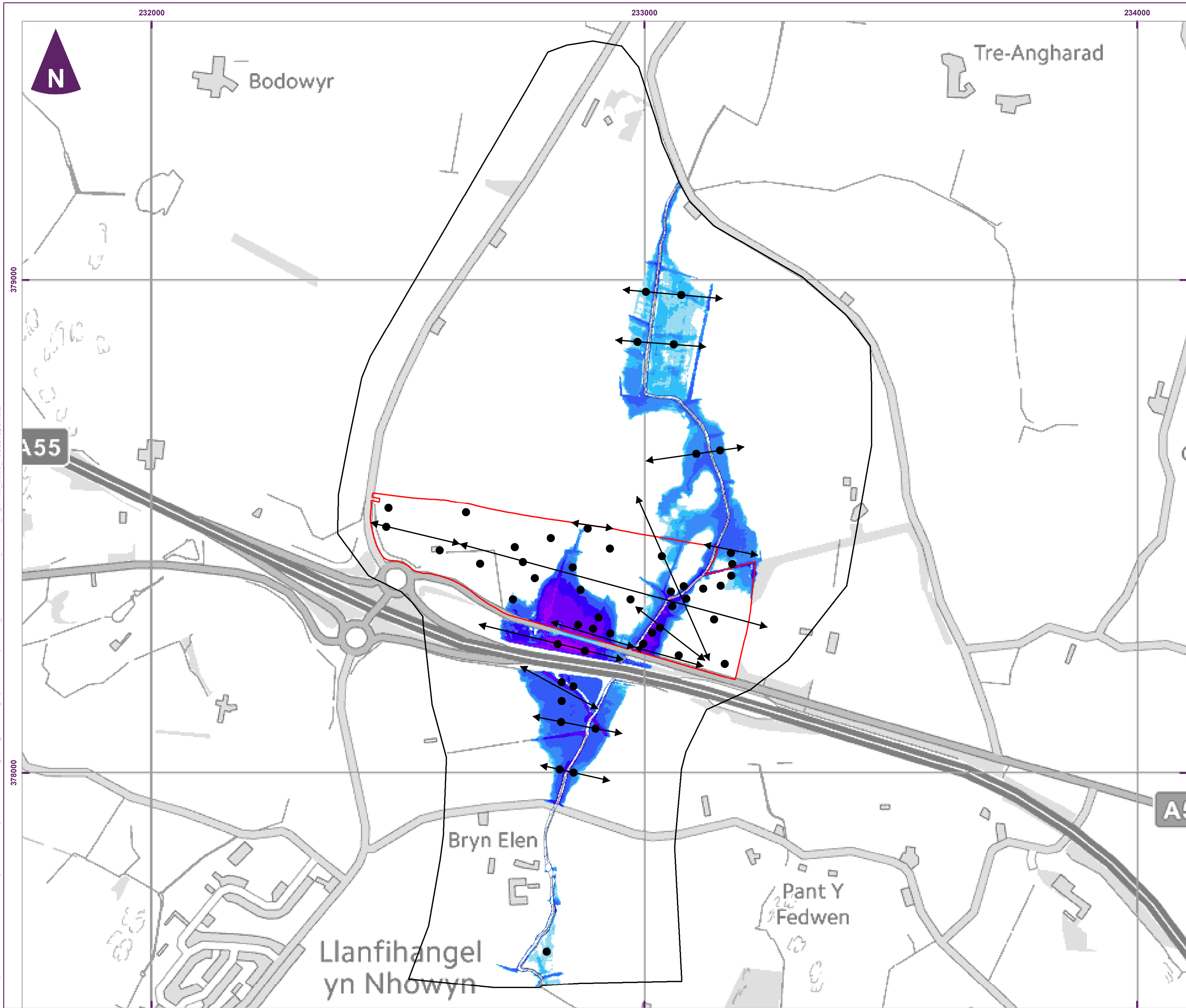
Wylfa Newydd
Associated
Developments
Hydraulic Modelling

amec foster wheeler

Figure 6.31
Dalar Hir distributed inflow baseline peak fluvial flood depth 1:20 year AEP plus climate change (15%)

NOT PROTECTIVELY MARKED

February 2018 35989_Lon600i1 ghimb



Key

Peak flood depth (m)
Baseline
1:100 year AEP fluvial
Climate change (15%)

- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00
- Model boundary
- 1D Model Domain
- Site Boundary
- Results Point
- Results Line
- OS Mapping

Notes:
The depths represent the maximum depth achieved. The flood prediction does not represent a moment in time as maximum depths can be achieved at different times.

Model run date: 20/02/2018
Corresponding data:
35989-C1445_Base_Task_48_TS12_Fluvial_F100cc.xlsx

0 100 200 300 400 m
Scale at A3

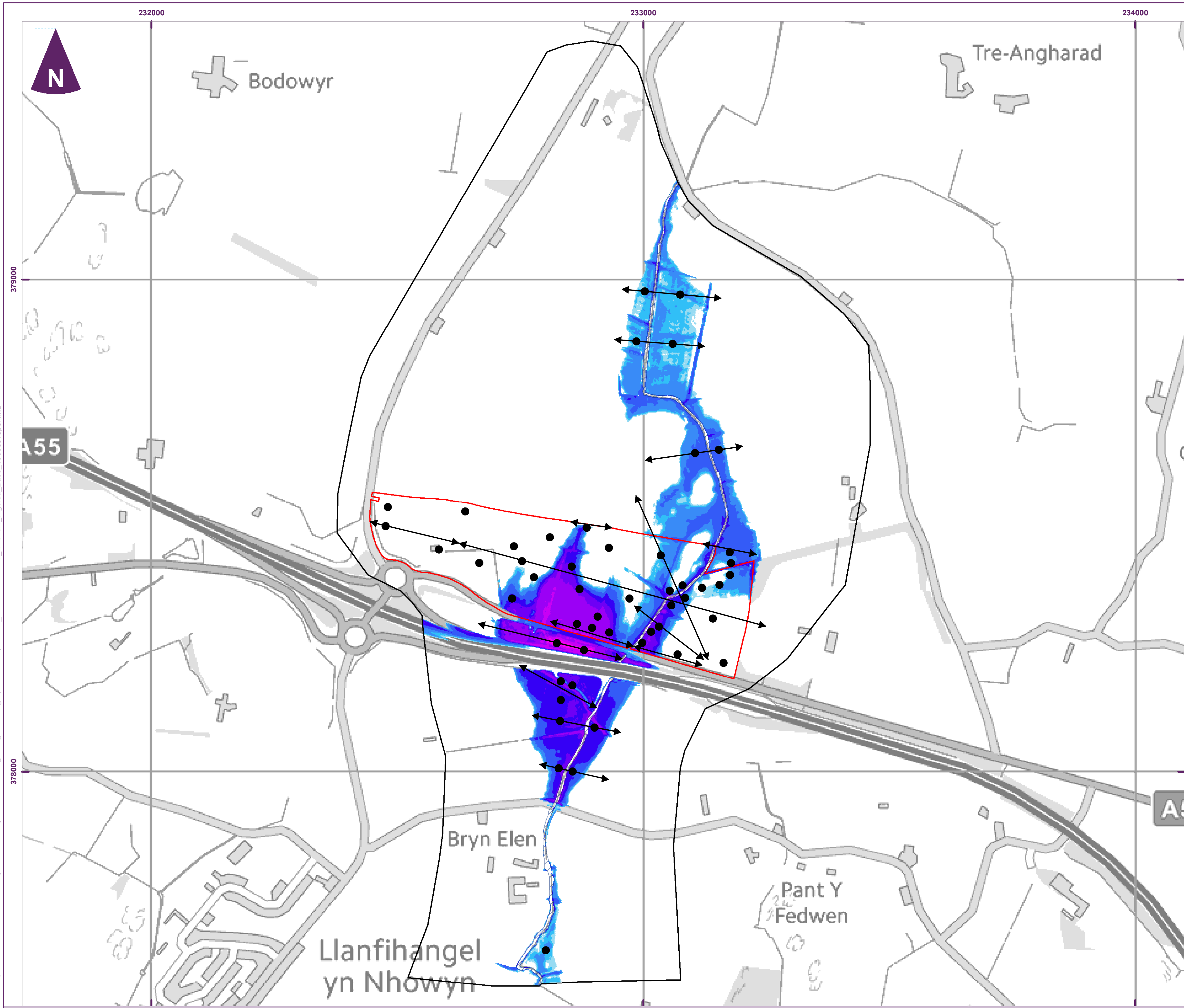
Wylfa Newydd
Associated
Developments
Hydraulic Modelling

amec foster wheeler

Figure 6.32
Dalar Hir distributed inflow baseline peak fluvial flood depth 1:100 year AEP plus climate change (15%)

February 2018 35989_Lon601i1 ghimb

NOT PROTECTIVELY MARKED



Key

Peak flood depth (m)
Baseline
1:1000 year AEP fluvial
Climate change (15%)

- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

- Model boundary
- 1D Model Domain
- Site Boundary
- Results Point
- Results Line
- OS Mapping

Notes:
The depths represent the maximum depth achieved. The flood prediction does not represent a moment in time as maximum depths can be achieved at different times.

Model run date: 22/02/2018
Corresponding data:
35989-C1446_Base_Task_48_TS12
_Fluvial_F1000cc.xlsx

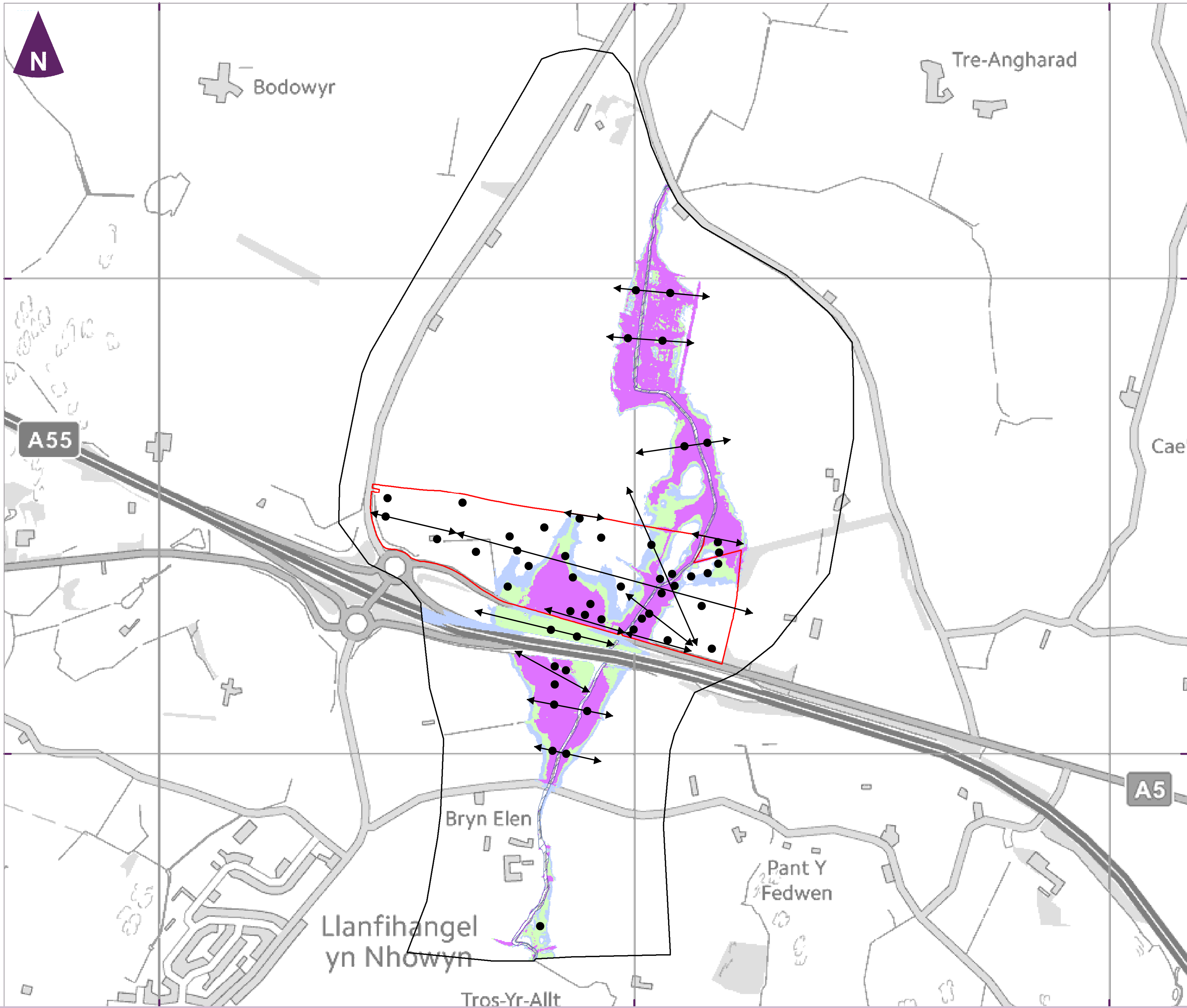
0 100 200 300 400 m
Scale at A3

Wylfa Newydd
Associated
Developments
Hydraulic Modelling

amec foster wheeler

Figure 6.33
Dalar Hir distributed inflow baseline peak fluvial flood depth 1:1000 year AEP plus climate change (15%)

NOT PROTECTIVELY MARKED



Key

Distributed Inflow Baseline fluvial Peak flood extents

- 1:20 Year AEP+15% Climate change
- 1:100 year AEP+15% Climate change
- 1:1000 year AEP+15% Climate change
- Model boundary
- 1D Model Domain
- Site Boundary
- Results Point
- Results Line
- OS Mapping

0 100 200 300 400 m
Scale at A3

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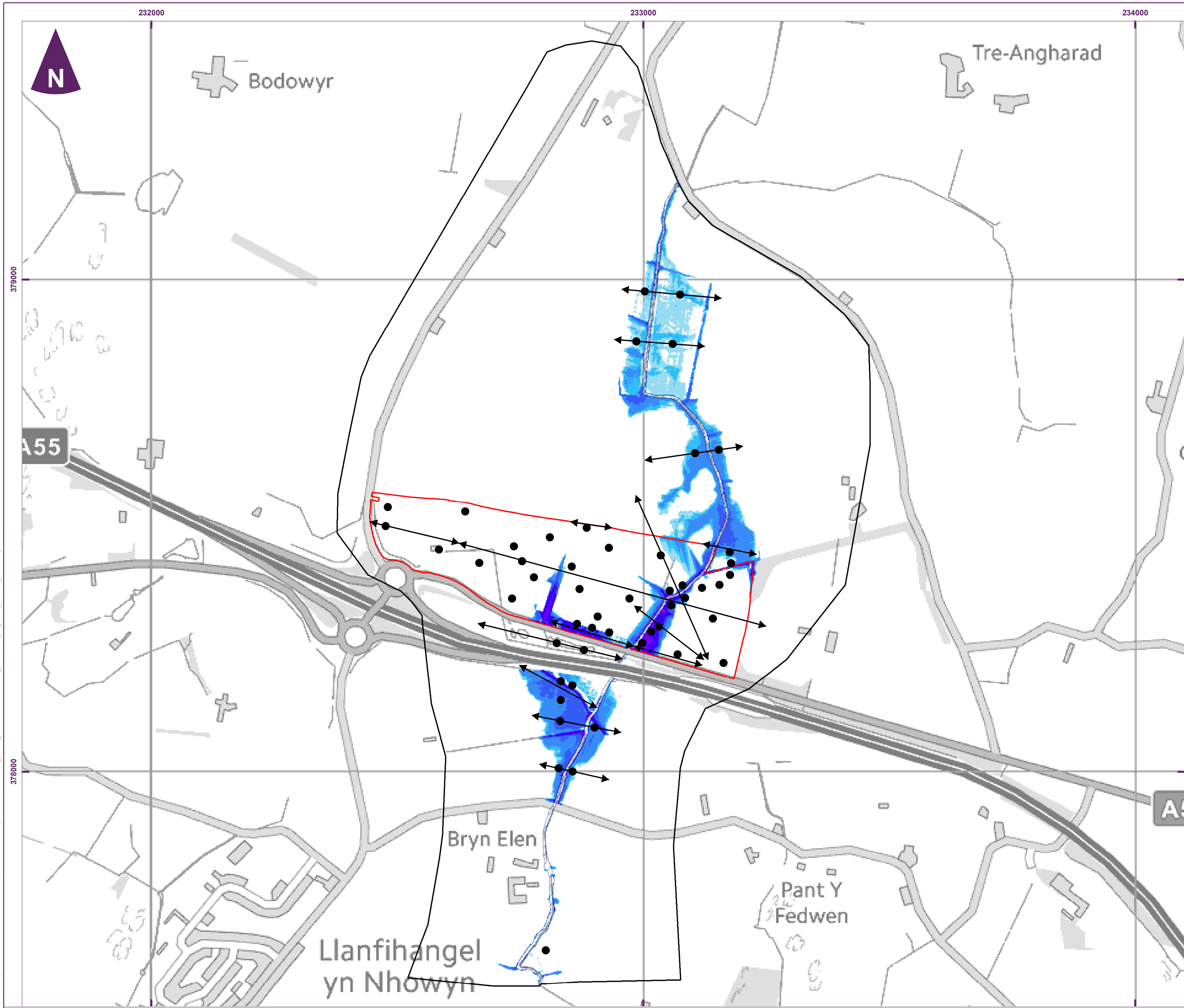
Figure 6.34
Dalar Hir distributed inflow baseline peak fluvial flood extents

February 2018 35989_Lon604i1 ghimb

NOT PROTECTIVELY MARKED



Key

Peak flood depth (m)
With Development No-Mitigation
1:20 year AEP fluvial
Climate change (15%)

- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

- Model boundary
- 1D Model Domain
- Site Boundary
- Results Point
- Results Line
- OS Mapping

Notes:
The depths represent the maximum depth achieved. The flood prediction does not represent a moment in time as maximum depths can be achieved at different times.

Model run date: 05/03/2018;
Corresponding data:
35989-C1447_NOMit_Task_48_TS12_Fluvial_F20cc.xlsx

0 100 200 300 400 m
Scale at A3

Wylfa Newydd Associated Developments Hydraulic Modelling

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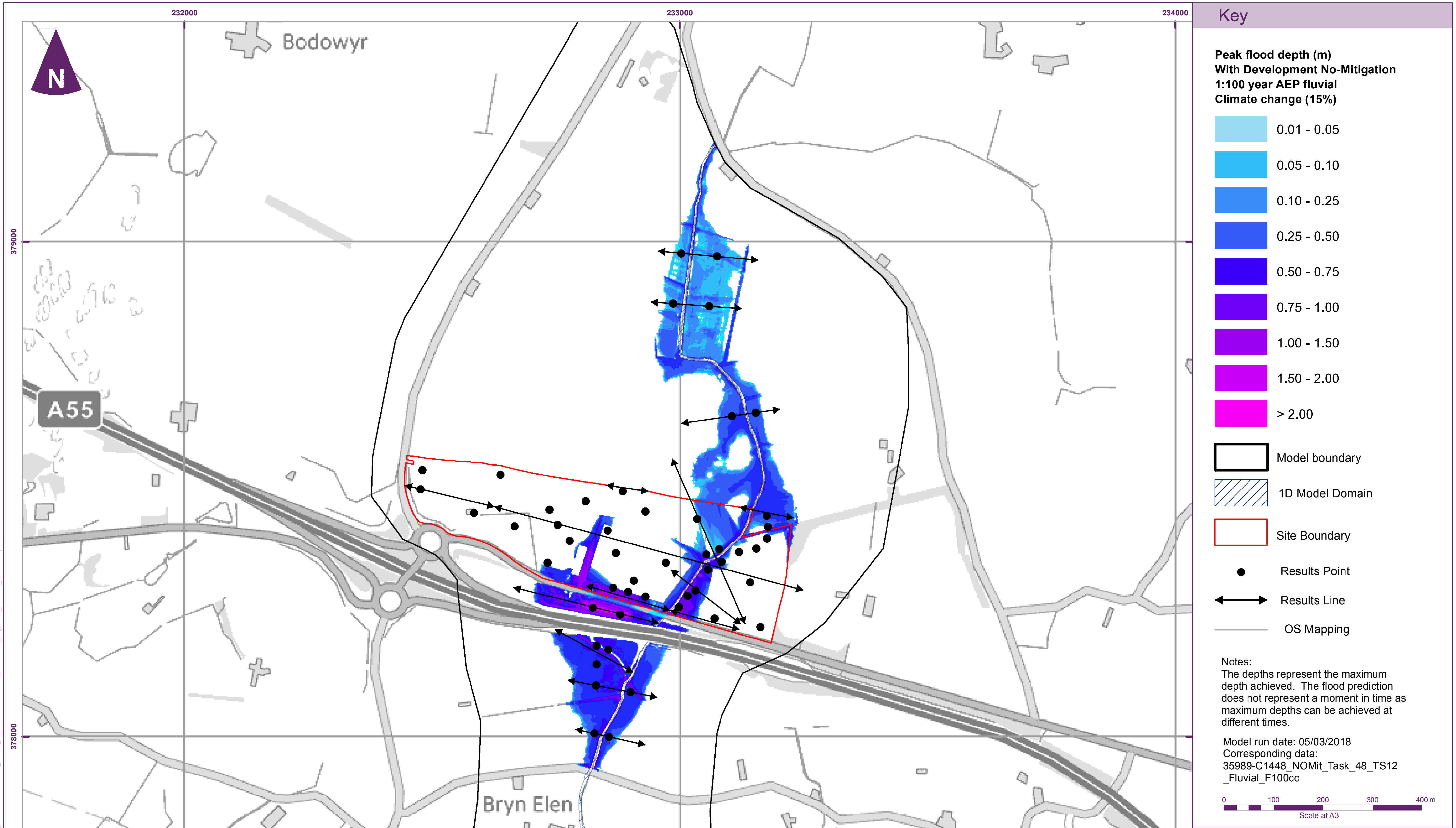
Figure 6.35
Dalar Hir distributed inflow with development No Mitigation peak fluvial flood depth 1:20 year AEP plus climate change (15%)

March 2018 35989_Lon616i1 ghimb

NOT PROTECTIVELY MARKED



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Developments
Hydraulic Modelling

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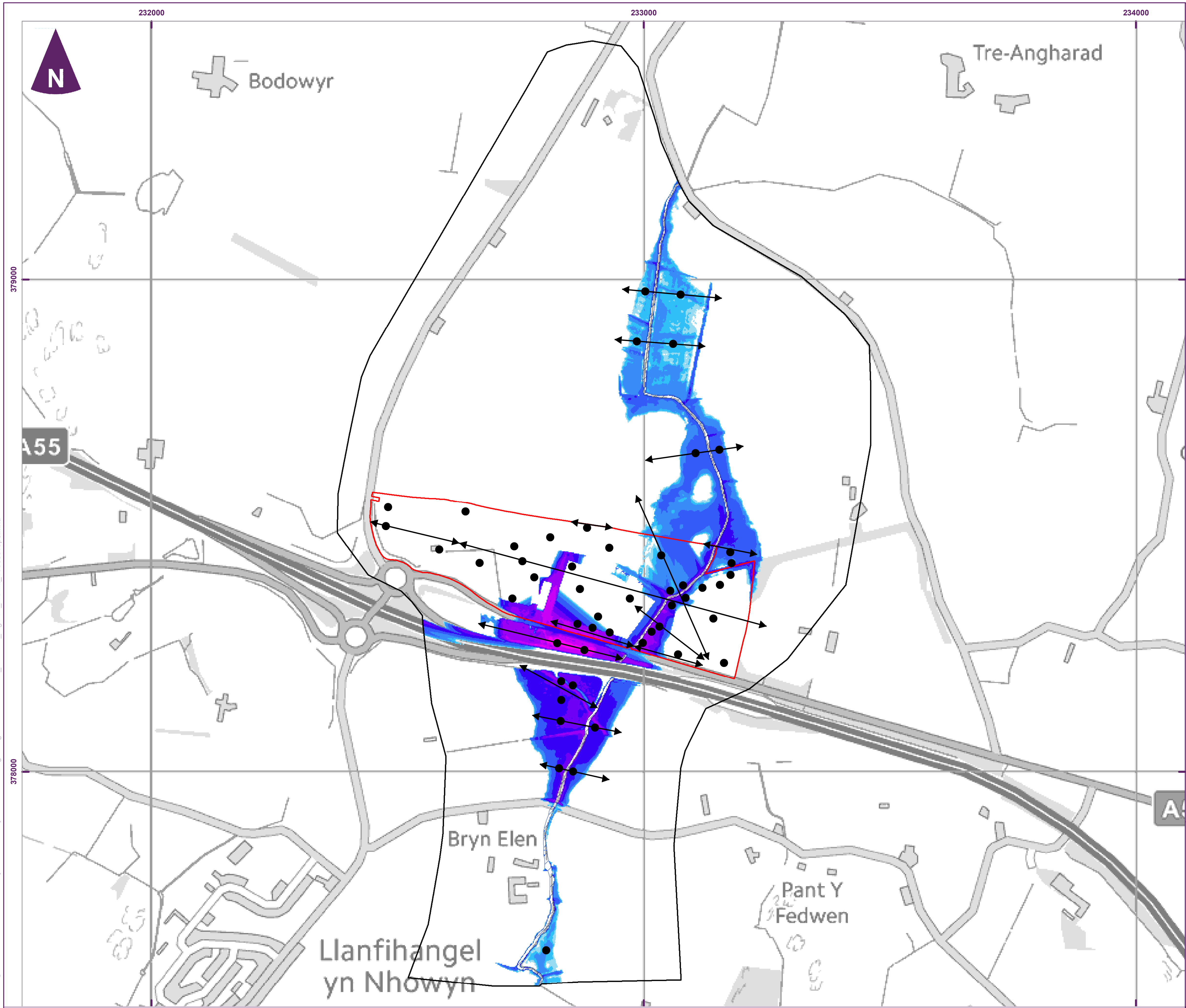
Figure 6.36
Dalar Hir distributed inflow With development No Mitigation peak fluvial flood depth 1:100 year AEP plus climate change (15%)

NOT PROTECTIVELY MARKED

March 2018 35989_Lon617i1 ghimb



Key

Peak flood depth (m)
With Development No-Mitigation
1:1000 year AEP fluvial
Climate change (15%)

- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00
- Model boundary
- 1D Model Domain
- Site Boundary
- Results Point
- Results Line
- OS Mapping

Notes:
The depths represent the maximum depth achieved. The flood prediction does not represent a moment in time as maximum depths can be achieved at different times.

Model run date: 05/03/2018
Corresponding data:
35989-C1449_NOMit_Task_48_TS12_Fluvial_F1000cc.xlsx

0 100 200 300 400 m
Scale at A3

Wylfa Newydd
Associated
Developments
Hydraulic Modelling

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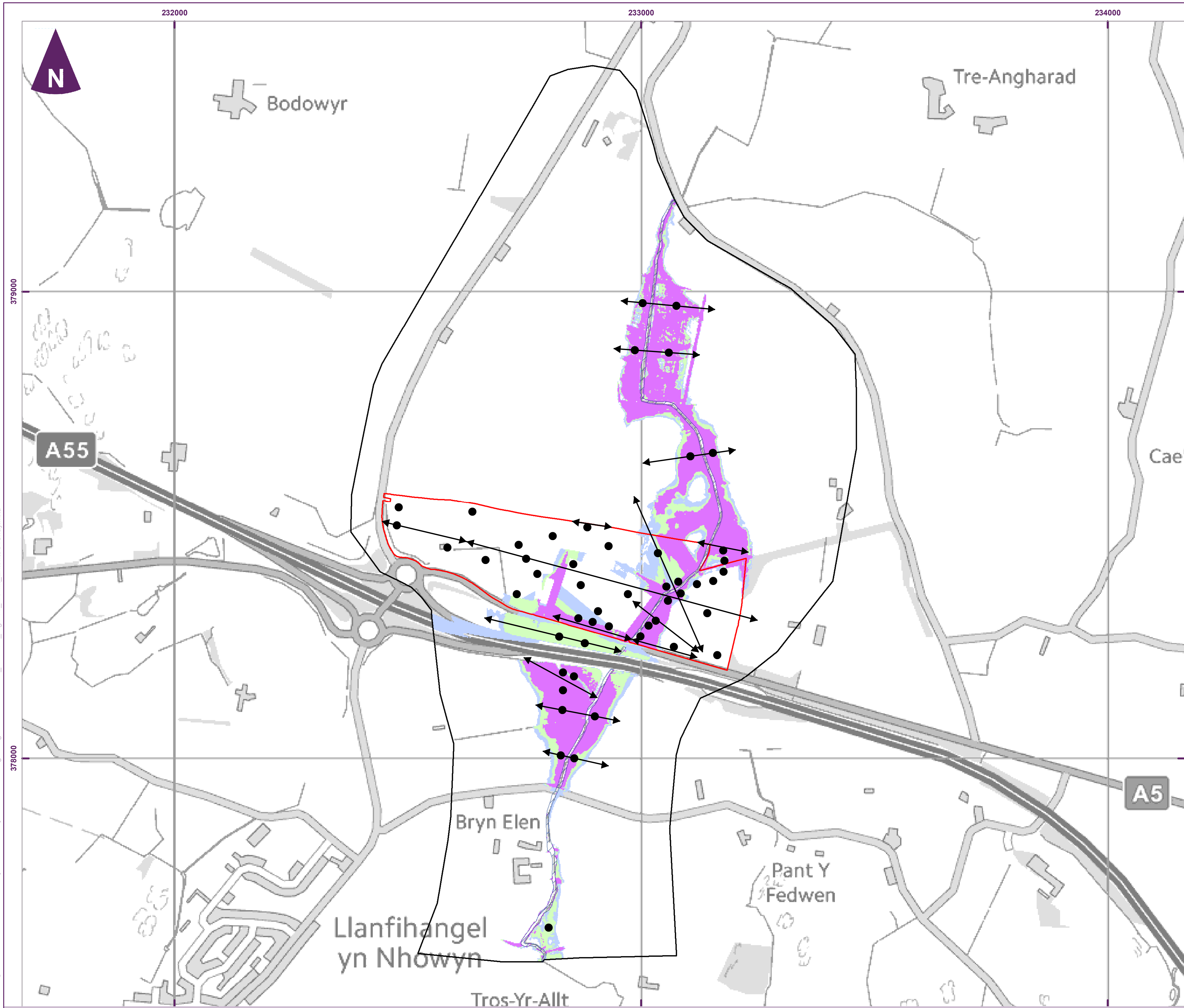
Figure 6.37
Dalar Hir distributed inflow with development No Mitigation peak fluvial flood depth 1:1000 year AEP plus climate change (15%)

NOT PROTECTIVELY MARKED

March 2018 35989_Lon618i1 ghimb



Key

Distributed Inflow With Development No-Mitigation fluvial Peak flood extents

- 1:20 Year AEP+15% Climate change
- 1:100 year AEP+15% Climate change
- 1:1000 year AEP+15% Climate change
- Model boundary
- 1D Model Domain
- Site Boundary
- Results Point
- Results Line
- OS Mapping

0 100 200 300 400 m
Scale at A3

Wylfa Newydd
Associated
Developments
Hydraulic Modelling

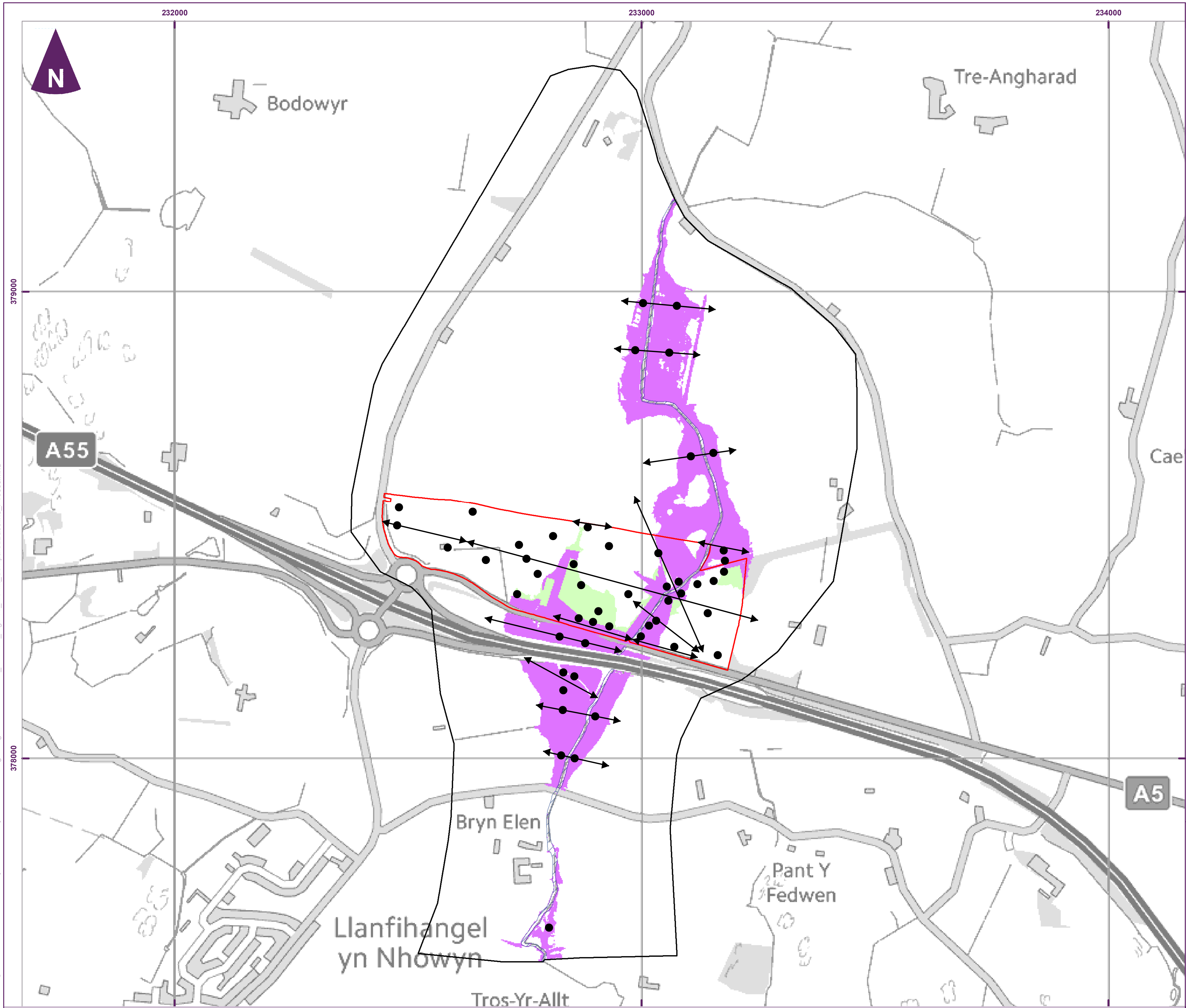
amec foster wheeler

Figure 6.38
Dalar Hir distributed inflow with development No Mitigation peak fluvial flood extents

March 2018 35989_Lon619i1 ghimb

NOT PROTECTIVELY MARKED

file: \\atth-fs7.global.amec.com\shared2\Projects\35989 Wylfa NNB Modelling\Design\TEMP\35989-48_lon619i1_Fig6.38_NOMit_ExtentsOverlay.mxd



Key

Distributed Inflow fluvial Peak flood extents

1:100 Year AEP+15% Climate change (No-Mitigation)

1:100 year AEP+15% Climate change (Baseline)

Model boundary

1D Model Domain

Site Boundary

Results Point

Results Line

OS Mapping

0 100 200 300 400 m

Scale at A3

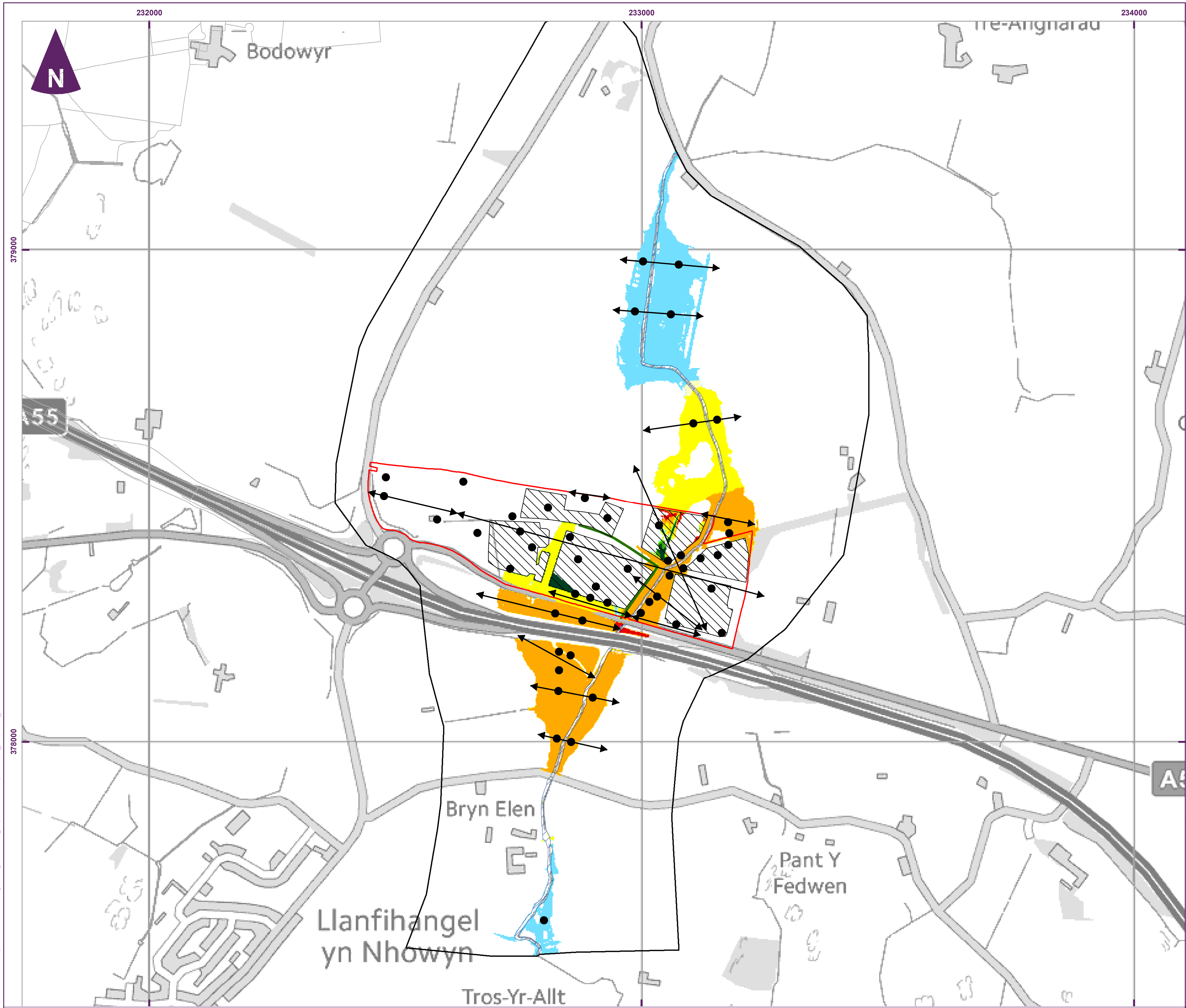
Wylfa Newydd Associated Developments Hydraulic Modelling

amec foster wheeler

Figure 6.39
Dalar Hir distributed inflow with development No Mitigation peak fluvial flood extent compared with baseline flood extent

NOT PROTECTIVELY MARKED

March 2018 35989_Lon620i1 ghimb



Key

Peak flood depth difference (m) between With Development No-Mitigation and Baseline for 1:100 year AEP fluvial Climate change (15%)

- > 0.1
- 0.05 to 0.1
- 0.01 to 0.05
- 0.005 to 0.01
- No Change
- -0.005 to -0.01
- -0.01 to -0.05
- -0.05 to -0.1
- < -0.1
- Model boundary
- 1D Model Domain
- Results Point
- OS Mapping
- Area of proposed ground level change

Notes:
The depths compared use the maximum depth achieved. The flood prediction does not represent a moment in time as maximum depths can be achieved at different times.

Where positive values represent an increase in peak flood depth, and negative values represent a decrease in peak flood depth, as a consequence of the proposed development.

Meters
0 100 200 300 400
Scale at A3

Wylfa Newydd Associated Developments Hydraulic Modelling

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Figure 6.40
Dalar Hir distributed inflow peak depth difference fluvial 1:100 year AEP plus Climate change (15%)

March 2018 35989-Lon621i1-ghimb

NOT PROTECTIVELY MARKED

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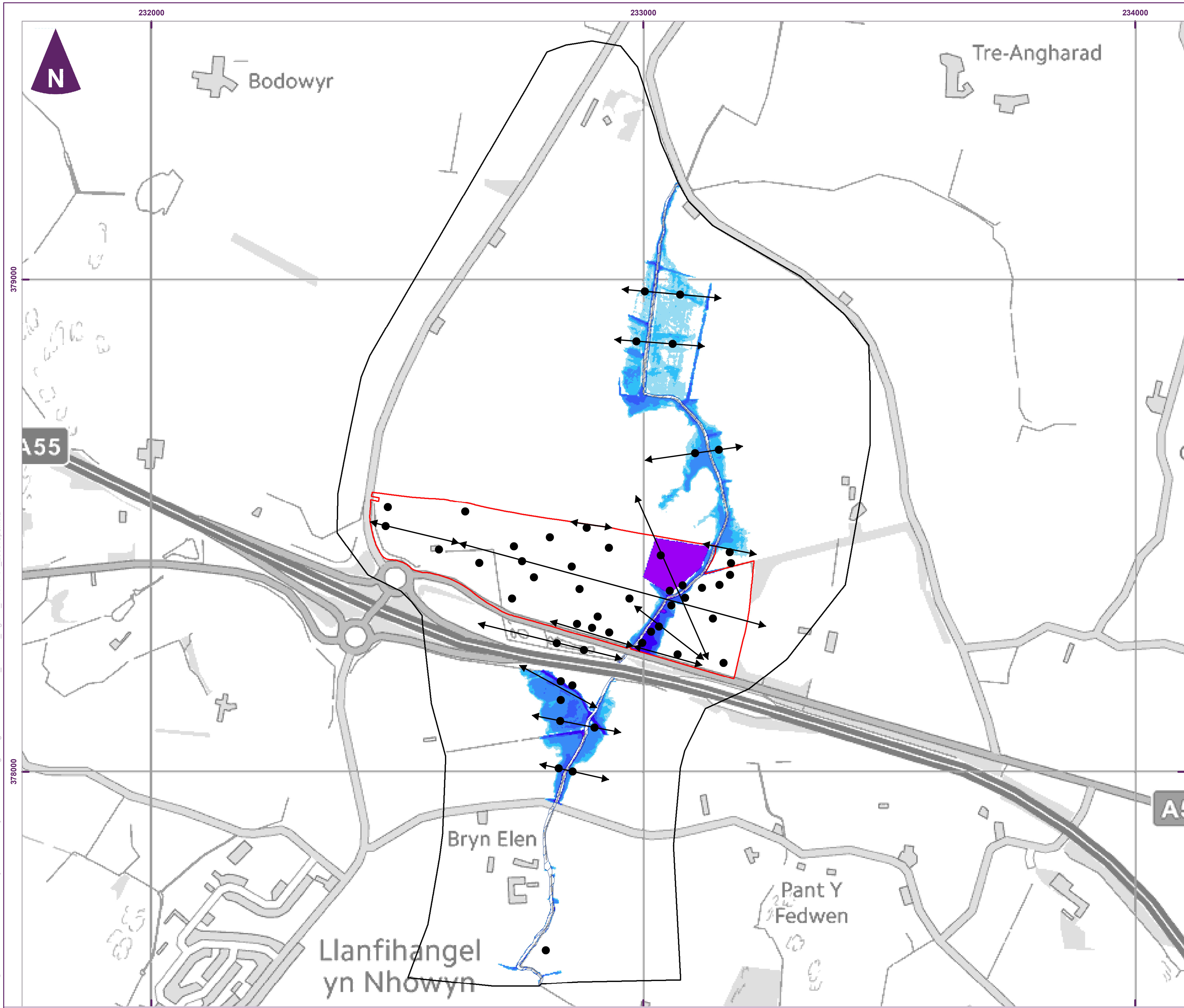

Key

Peak flood depth (m)
With Development Mitigation Option-1
1:20 year AEP fluvial Climate change (15%)

- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00
- Model boundary
- 1D Model Domain
- Site Boundary
- Results Point
- Results Line
- OS Mapping

Notes:
The depths represent the maximum depth achieved. The flood prediction does not represent a moment in time as maximum depths can be achieved at different times.

Model run date: 05/03/2018;
Corresponding data:
35989-C1450_MitOPT-1_Task_48_TS12_Fluvial_F20cc

0 100 200 300 400 m
Scale at A3

Wylfa Newydd Associated Developments Hydraulic Modelling

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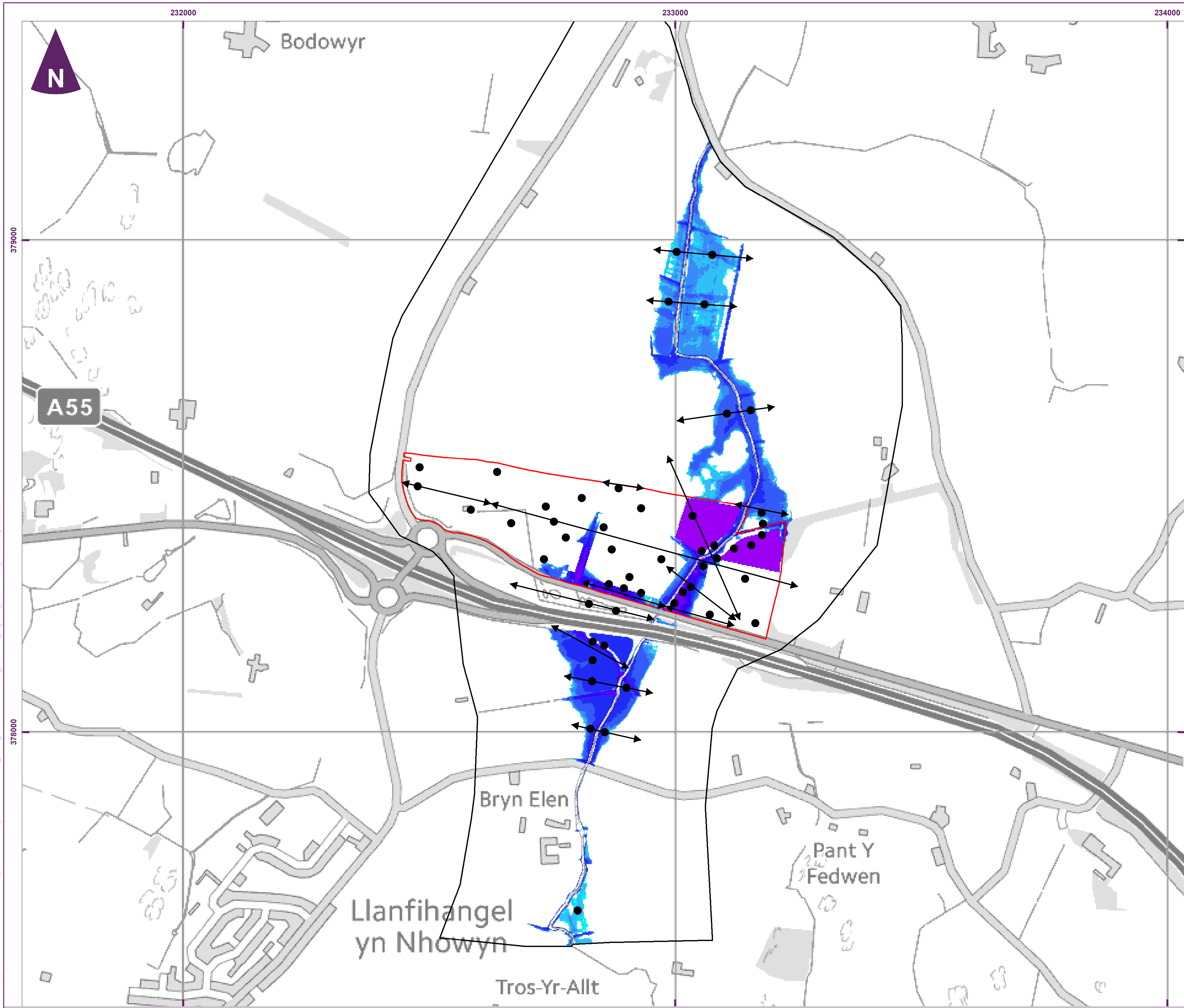
Figure 6.41
Dalar Hir distributed inflow with development Mitigation Option-1 peak fluvial flood depth 1:20 year AEP plus climate change (15%)

NOT PROTECTIVELY MARKED

March 2018 35989_Lon622i1 ghimb



NOT PROTECTIVELY MARKED

Key

Peak flood depth (m)
With Development Mitigation Option-1
1:100 year AEP fluvial
Climate change (15%)

- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00
- Model boundary
- 1D Model Domain
- Site Boundary
- Results Point
- Results Line
- OS Mapping

Notes:
The depths represent the maximum depth achieved. The flood prediction does not represent a moment in time as maximum depths can be achieved at different times.

Model run date: 06/03/2018
Corresponding data:
35989-C1451_MitOPT-1_Task_48_TS12_Fluvial_F100cc.xlsx

0 100 200 300 400 m
Scale at A3

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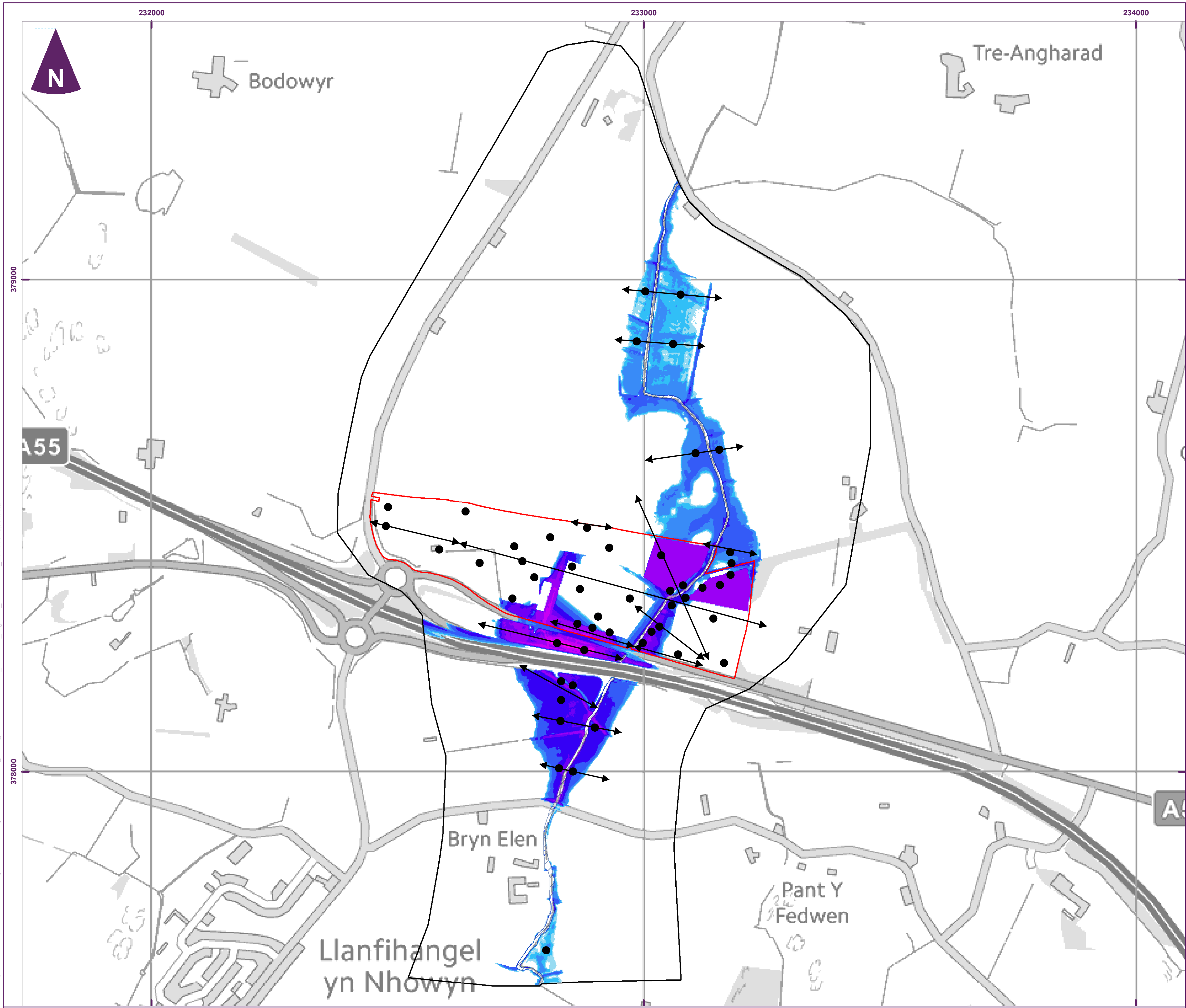
Figure 6.42
Dalar Hir distributed inflow Mitigation Option-1 peak fluvial flood depth 1:100 year AEP plus climate change (15%)

March 2018 35989_Lon623i1 ghimb



Key

Peak flood depth (m)
With Development Mitigation Option-1
1:1000 year AEP fluvial
Climate change (15%)

- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00
- Model boundary
- 1D Model Domain
- Site Boundary
- Results Point
- Results Line
- OS Mapping

Notes:
The depths represent the maximum depth achieved. The flood prediction does not represent a moment in time as maximum depths can be achieved at different times.

Model run date: 05/03/2018
Corresponding data:
35989-C1452_MitOPT-1_Task_48_TS12_Fluvial_F1000cc.xlsx

0 100 200 300 400 m
Scale at A3

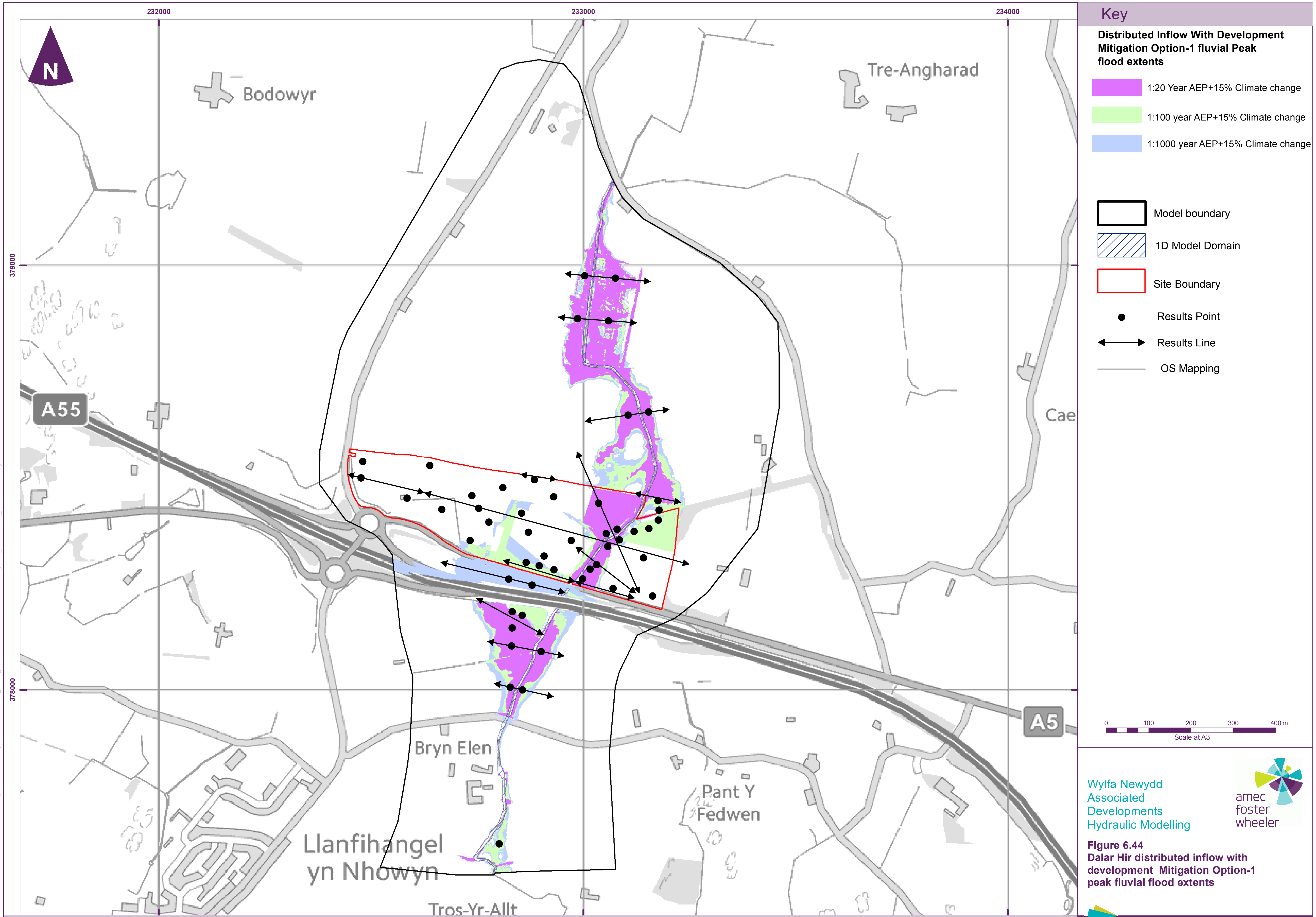
Wylfa Newydd Associated Developments Hydraulic Modelling

amec foster wheeler

Figure 6.43
Dalar Hir distributed inflow Mitigation Option-1 peak fluvial flood depth 1:1000 year AEP plus climate change (15%)

NOT PROTECTIVELY MARKED

March 2018 35989_Lon624i1 ghimb



Wylfa Newydd
Associated
Developments
Hydraulic Modelling

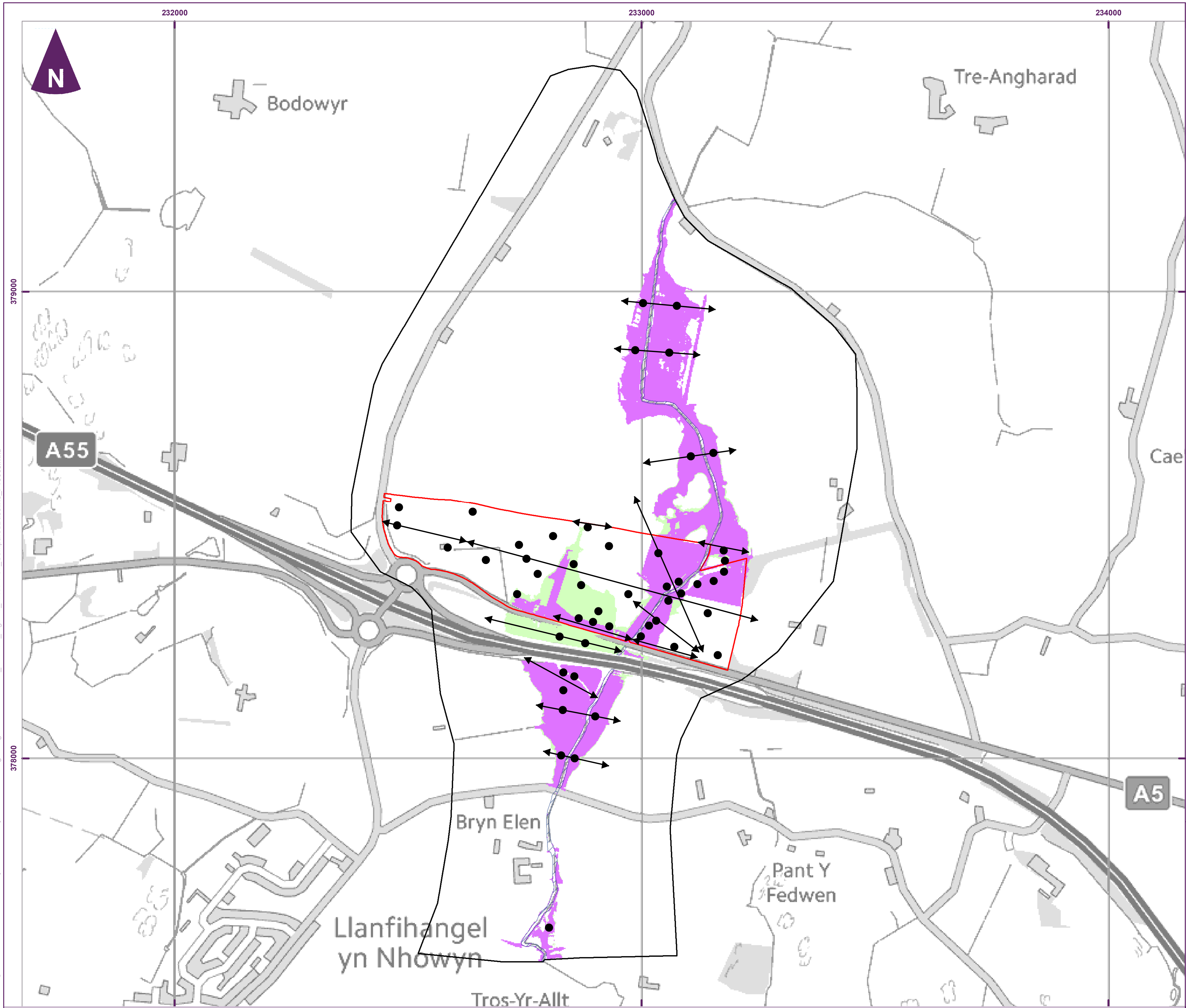
amec
foster
wheeler

Figure 6.44
Dalar Hir distributed inflow with development Mitigation Option-1 peak fluvial flood extents

March 2018 35989_Lon625i1 ghimb

file: \\atl5-fs7.global.amec.com\shared2\Projects\35989 Wylfa NNB Modelling\Design\TEMP\35989-48_lon625i1_Fig6.44_MitOPT-01_ExtentsOverlay.mxd

NOT PROTECTIVELY MARKED



Key

Distributed Inflow fluvial Peak flood extents

1:100 Year AEP+15% Climate change (Mitigation Option-1)

1:100 year AEP+15% Climate change (Baseline)

Model boundary

1D Model Domain

Site Boundary

Results Point

Results Line

OS Mapping

0 100 200 300 400 m

Scale at A3

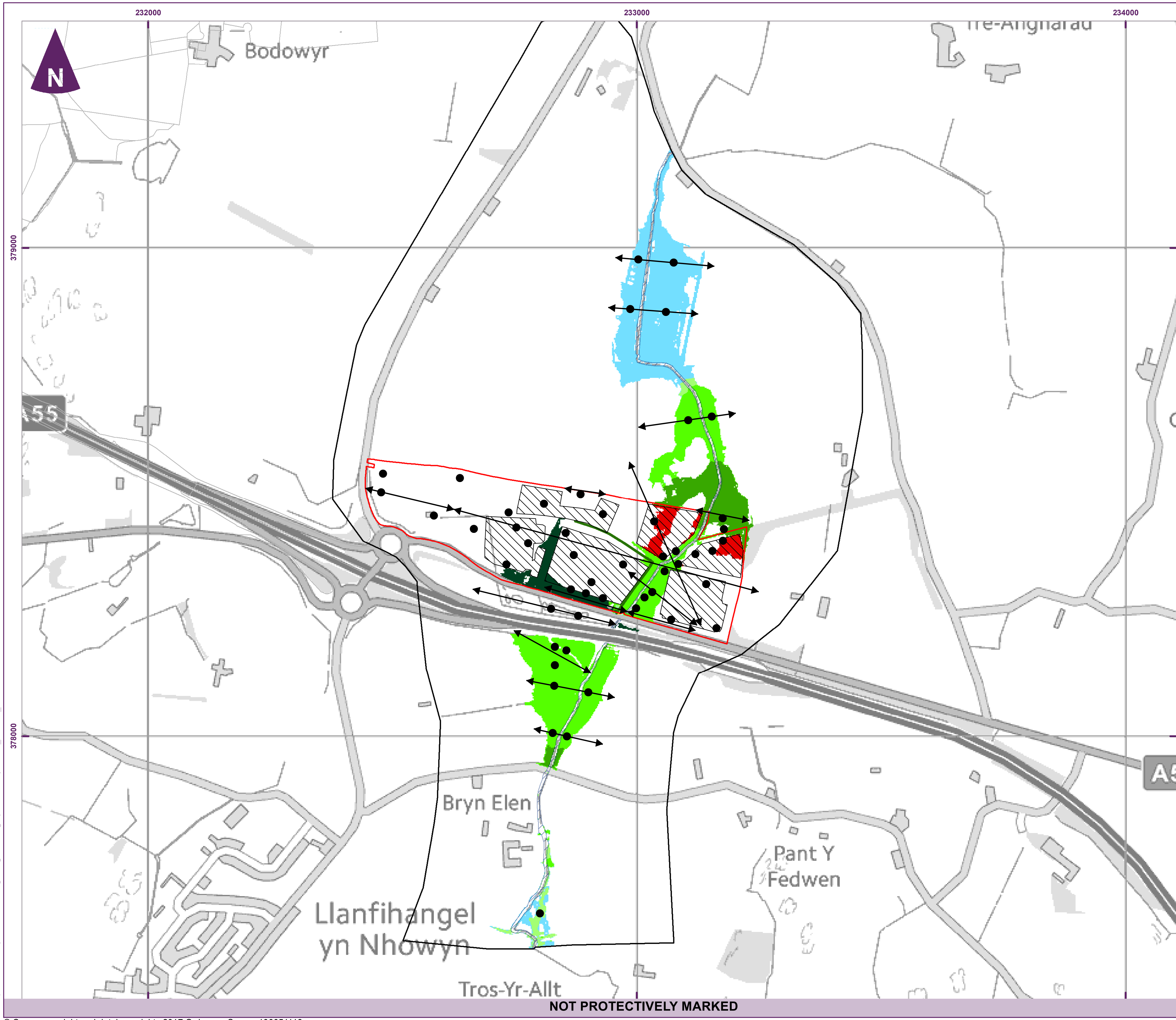
Wylfa Newydd Associated Developments Hydraulic Modelling

amec foster wheeler

Figure 6.45
Dalar Hir distributed inflow with development Mitigation Option-1 peak fluvial flood extent compared with baseline flood extent

NOT PROTECTIVELY MARKED

March 2018 35989_Lon626i1 ghimb



Key

Peak flood depth difference (m) between Mitigation Option-1 and Baseline for 1:100 year AEP fluvial Climate change (15%)

- > 0.1
- 0.05 to 0.1
- 0.01 to 0.05
- 0.005 to 0.01
- No Change
- -0.005 to -0.01
- -0.01 to -0.05
- -0.05 to -0.1
- < -0.1
- Model boundary
- 1D Model Domain
- Results Point
- OS Mapping
- Area of proposed ground level change
- Proposed flood defence wall

Notes:
The depths compared use the maximum depth achieved. The flood prediction does not represent a moment in time as maximum depths can be achieved at different times.

Where positive values represent an increase in peak flood depth, and negative values represent a decrease in peak flood depth, as a consequence of the proposed development.

Meters
0 100 200 300 400
Scale at A3

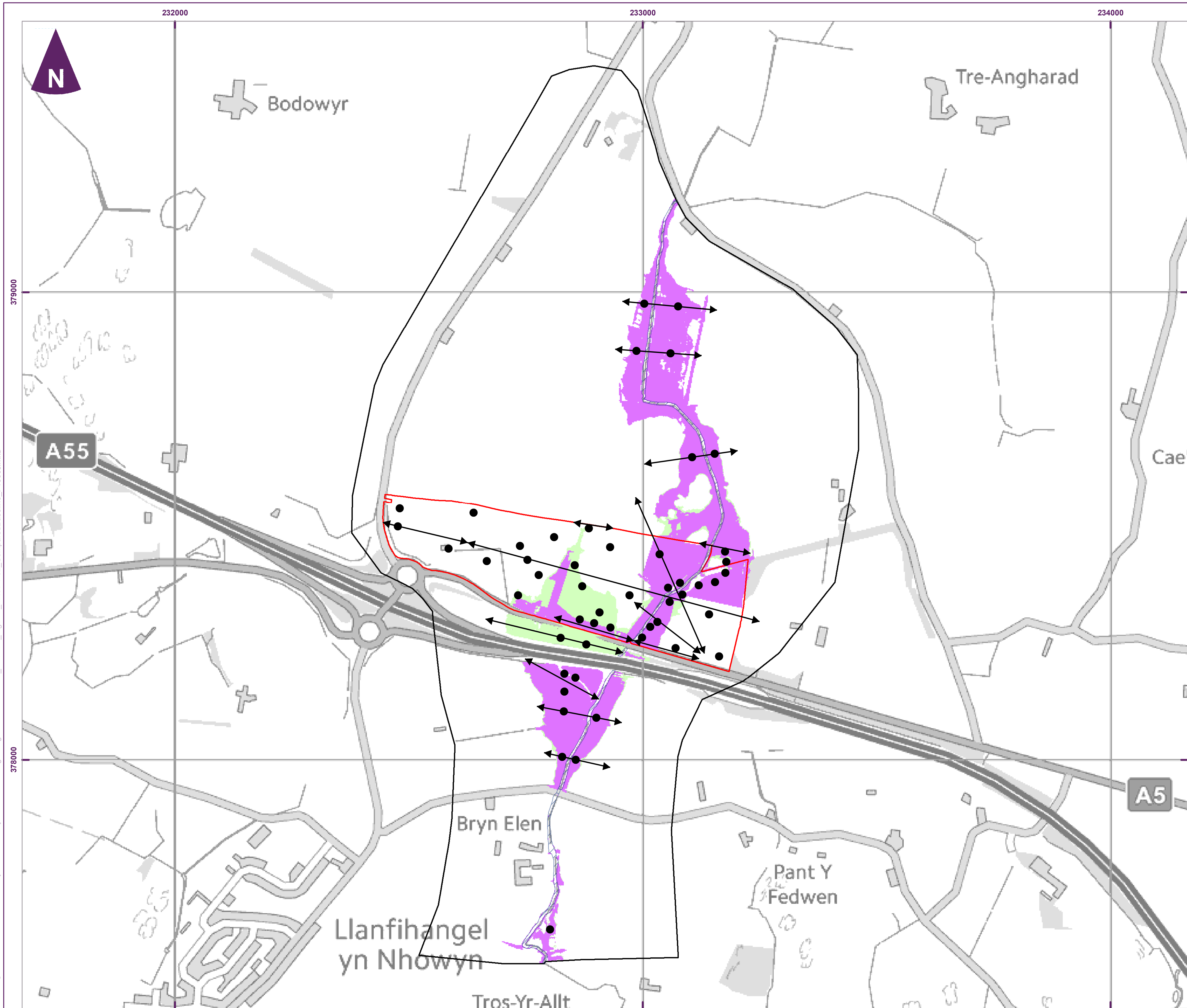
Wylfa Newydd Associated Developments Hydraulic Modelling

amec foster wheeler

Figure 6.46
Dalar Hir distributed inflow peak depth difference fluvial 1:100 year AEP plus Climate change (15%)

March 2018 35989-Lon627i1-ghimb

H:\Projects\35989 Wylfa NNB Modelling\Design\Drawings (E&I created)\Task32_DalarHir_Results



Key

Distributed Inflow fluvial Peak flood extents

- 1:100 Year AEP+15% Climate change (Mitigation Option-2)
- 1:100 year AEP+15% Climate change (Baseline)
- Model boundary
- 1D Model Domain
- Site Boundary
- Results Point
- Results Line
- OS Mapping

0 100 200 300 400 m
Scale at A3

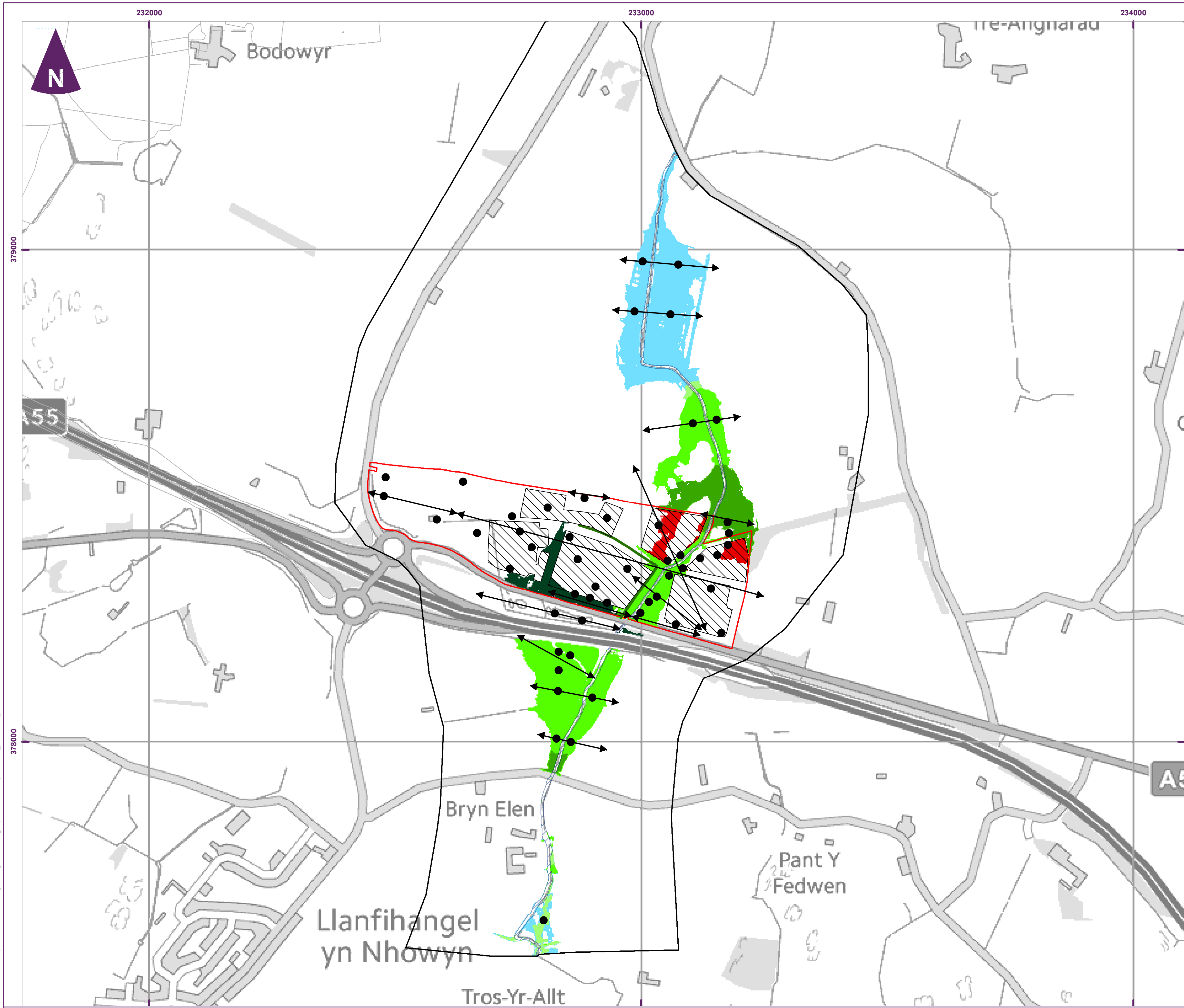
Wylfa Newydd Associated Developments Hydraulic Modelling

amec foster wheeler

Figure 6.47
Dalar Hir distributed inflow with development Mitigation Option-2 peak fluvial flood extent compared with baseline flood extent

March 2018 35989_Lon628i1 ghimb

NOT PROTECTIVELY MARKED



Key

Peak flood depth difference (m) between Mitigation Option-2 and Baseline for 1:100 year AEP fluvial Climate change (15%)

- > 0.1
- 0.05 to 0.1
- 0.01 to 0.05
- 0.005 to 0.01
- No Change
- -0.005 to -0.01
- -0.01 to -0.05
- -0.05 to -0.1
- < -0.1
- Model boundary
- 1D Model Domain
- Results Point
- OS Mapping
- Area of proposed ground level change
- Proposed flood defence wall

Notes:
The depths compared use the maximum depth achieved. The flood prediction does not represent a moment in time as maximum depths can be achieved at different times.

Where positive values represent an increase in peak flood depth, and negative values represent a decrease in peak flood depth, as a consequence of the proposed development.

Meters
0 100 200 300 400
Scale at A3

Wylfa Newydd Associated Developments Hydraulic Modelling

amec foster wheeler

Figure 6.48
Dalar Hir distributed inflow peak depth difference fluvial 1:100 year AEP plus Climate change (15%)

March 2018 35989-Lon629i1-ghimb

NOT PROTECTIVELY MARKED

H:\Projects\35989 Wylfa NNB Modelling\Design\Drawings (E&I created)\Task32_DalarHir_Results

Key

Distributed Inflow fluvial Peak flood extents

1:100 Year AEP+15% Climate change (Mitigation Option-3)

1:100 year AEP+15% Climate change (Baseline)

Model boundary

1D Model Domain

Site Boundary

Results Point

Results Line

OS Mapping

0 100 200 300 400 m

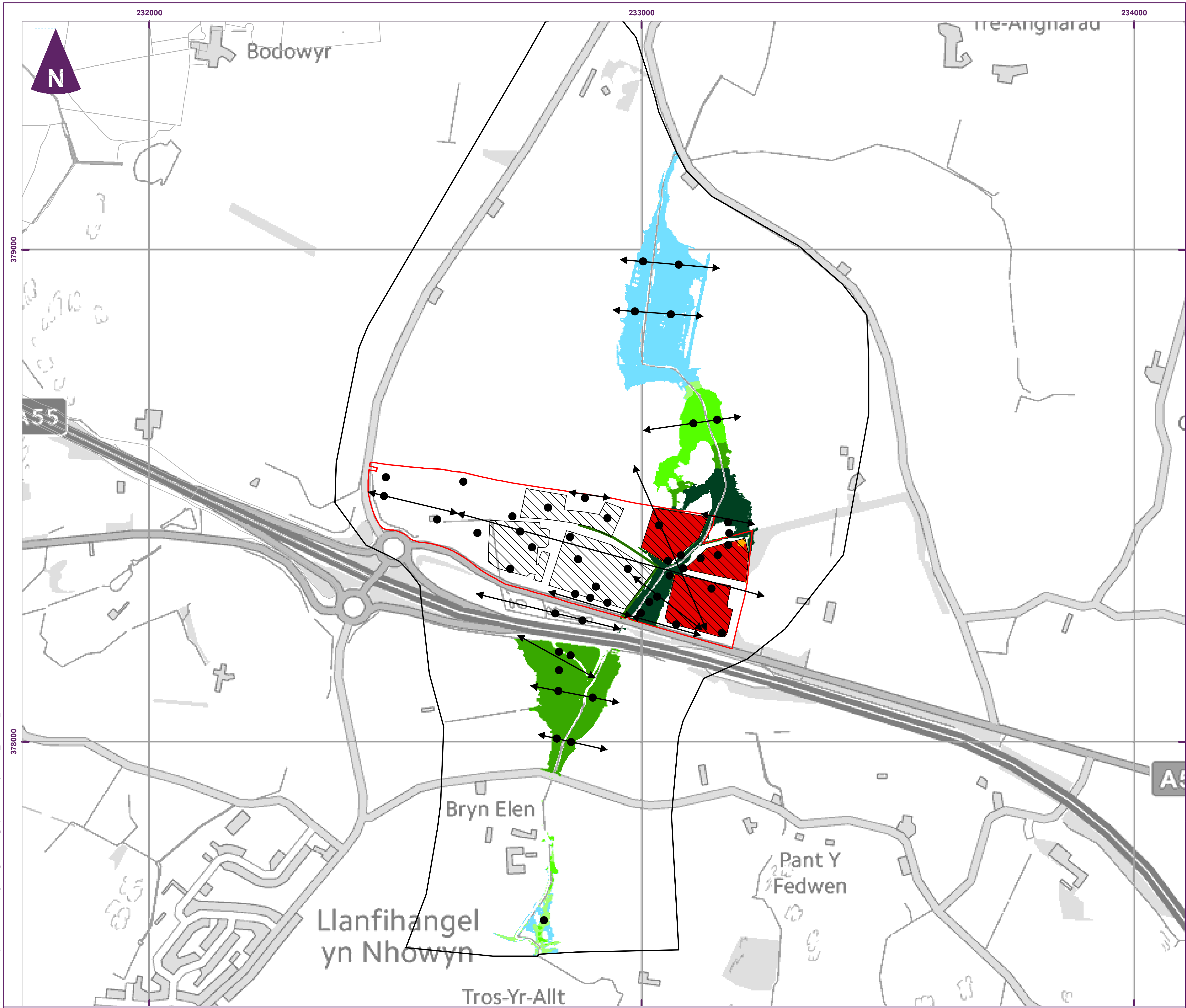
Scale at A3

Wylfa Newydd Associated Developments Hydraulic Modelling

Figure 6.49
Dalar Hir distributed inflow with development Mitigation Option-3 peak fluvial flood extent compared with baseline flood extent

March 2018 35989_Lon630i1 ghimb

NOT PROTECTIVELY MARKED



Key

Peak flood depth difference (m) between Mitigation Option-3 and Baseline for 1:100 year AEP fluvial Climate change (15%)

- > 0.1
- 0.05 to 0.1
- 0.01 to 0.05
- 0.005 to 0.01
- No Change
- -0.005 to -0.01
- -0.01 to -0.05
- -0.05 to -0.1
- < -0.1
- Model boundary
- 1D Model Domain
- Results Point
- OS Mapping
- Area of proposed ground level change
- Proposed flood defence wall

Notes:
The depths compared use the maximum depth achieved. The flood prediction does not represent a moment in time as maximum depths can be achieved at different times.

Where positive values represent an increase in peak flood depth, and negative values represent a decrease in peak flood depth, as a consequence of the proposed development.

Meters
0 100 200 300 400
Scale at A3

Wylfa Newydd Associated Developments Hydraulic Modelling

amec foster wheeler

Figure 6.50
Dalar Hir distributed inflow peak depth difference fluvial 1:100 year AEP plus Climate change (15%)

March 2018 35989-Lon631i1-ghimb

NOT PROTECTIVELY MARKED

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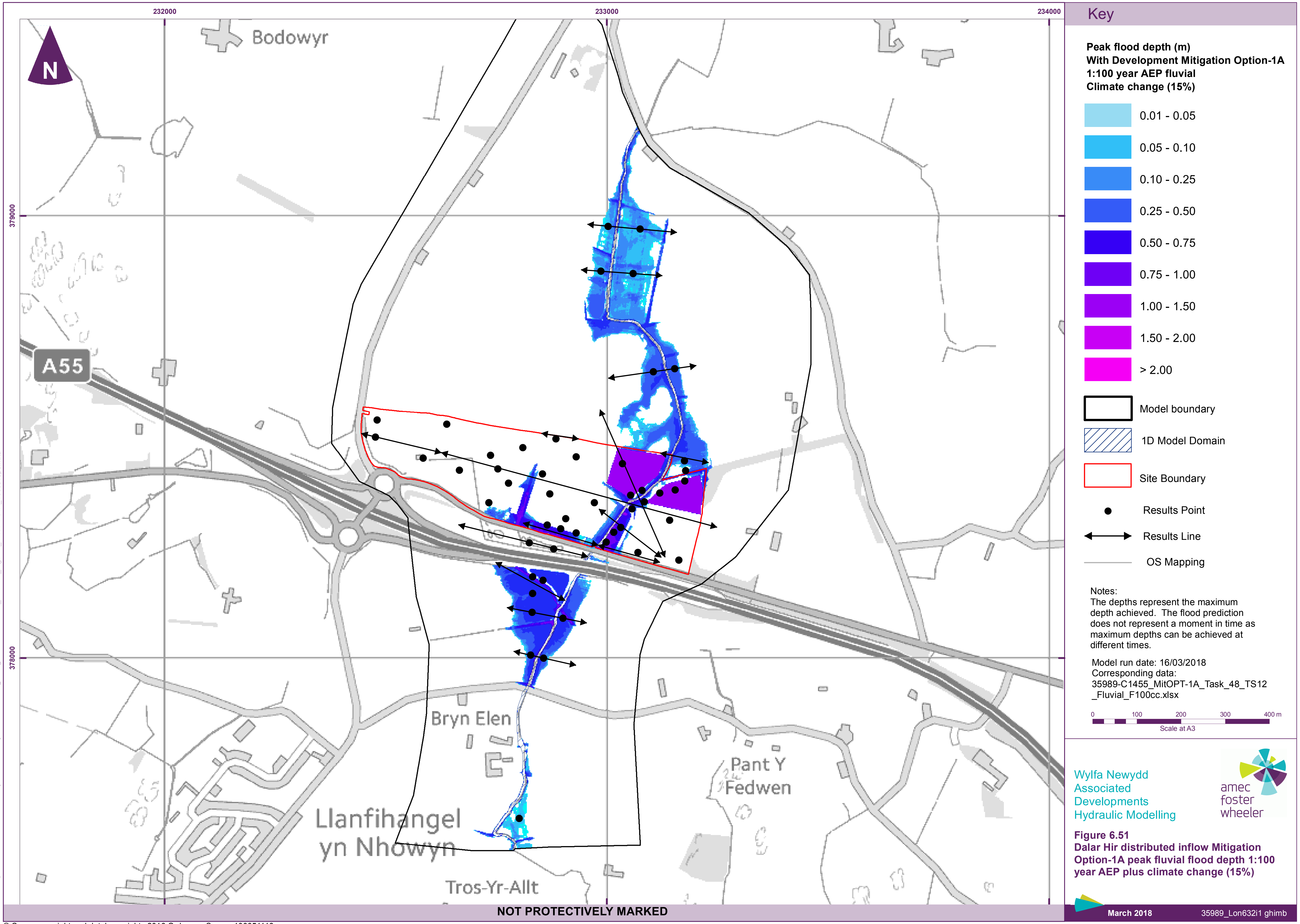
Appendix B
Figure 6.51 to Figure 6.56



Notes:
The depths represent the maximum depth achieved. The flood prediction does not represent a moment in time as maximum depths can be achieved at different times.

Model run date: 16/03/2018
Corresponding data:
35989-C1455_MitOPT-1A_Task_48_TS12_Fluvial_F100cc.xlsx

0 100 200 300 400 m
Scale at A3

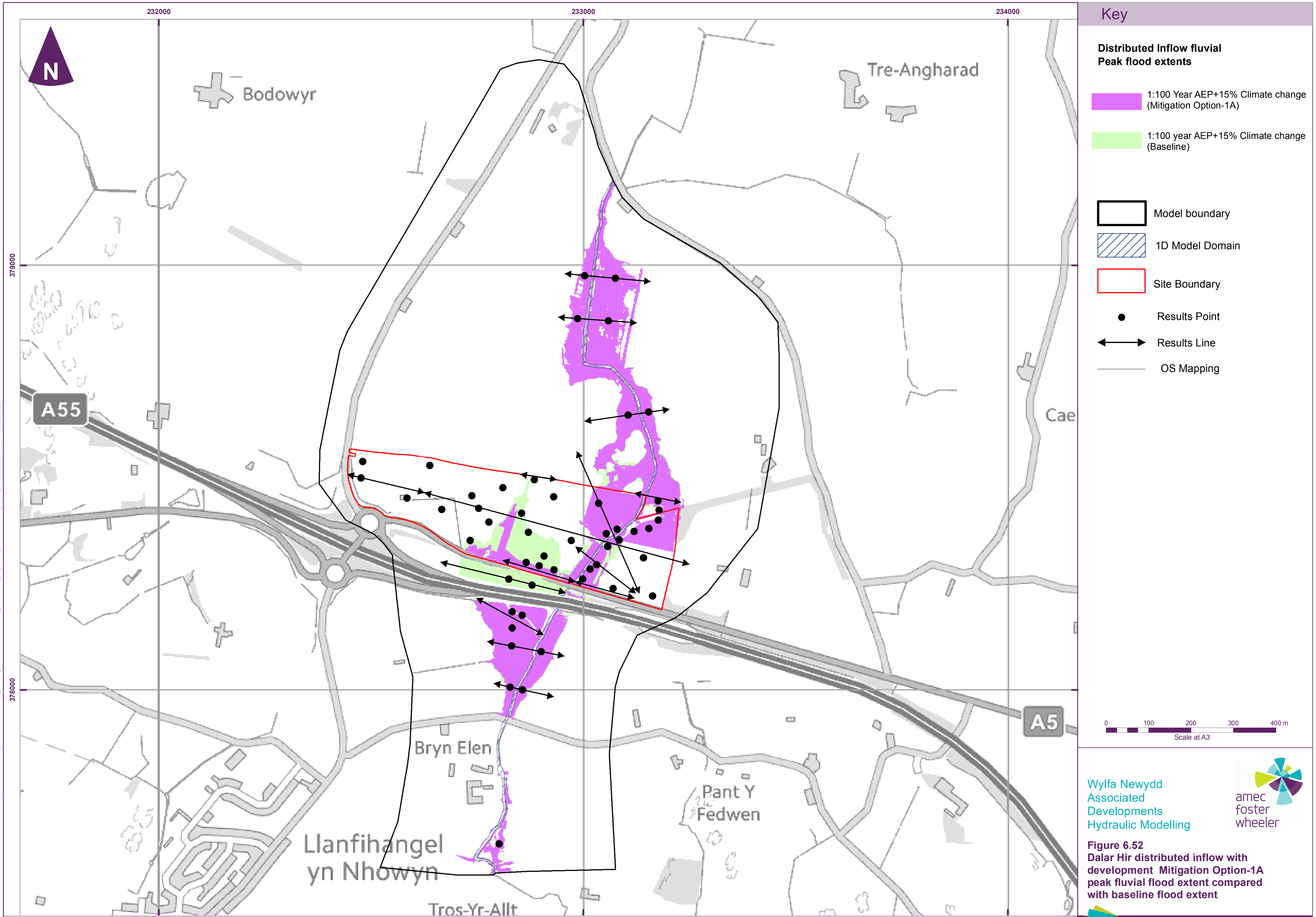
Wylfa Newydd Associated Developments Hydraulic Modelling

amec foster wheeler

Figure 6.51
Dalar Hir distributed inflow Mitigation Option-1A peak fluvial flood depth 1:100 year AEP plus climate change (15%)

March 2018 35989_Lon632i1 ghimb

NOT PROTECTIVELY MARKED



Wylfa Newydd Associated Developments Hydraulic Modelling

amec foster wheeler

Figure 6.52
Dalar Hir distributed inflow with development Mitigation Option-1A peak fluvial flood extent compared with baseline flood extent

March 2018 35989_Lon633i1 ghimb

NOT PROTECTIVELY MARKED

Key

Peak flood depth difference (m) between Mitigation Option-1A and Baseline for 1:100 year AEP fluvial Climate change (15%)

- > 0.1
- 0.05 to 0.1
- 0.01 to 0.05
- 0.005 to 0.01
- No Change
- -0.005 to -0.01
- -0.01 to -0.05
- -0.05 to -0.1
- < -0.1
- Model boundary
- 1D Model Domain
- Results Point
- OS Mapping
- Area of proposed ground level change
- Proposed flood defence wall

Notes:
The depths compared use the maximum depth achieved. The flood prediction does not represent a moment in time as maximum depths can be achieved at different times.

Where positive values represent an increase in peak flood depth, and negative values represent a decrease in peak flood depth, as a consequence of the proposed development.

Meters
0 100 200 300 400
Scale at A3

Wylfa Newydd Associated Developments Hydraulic Modelling

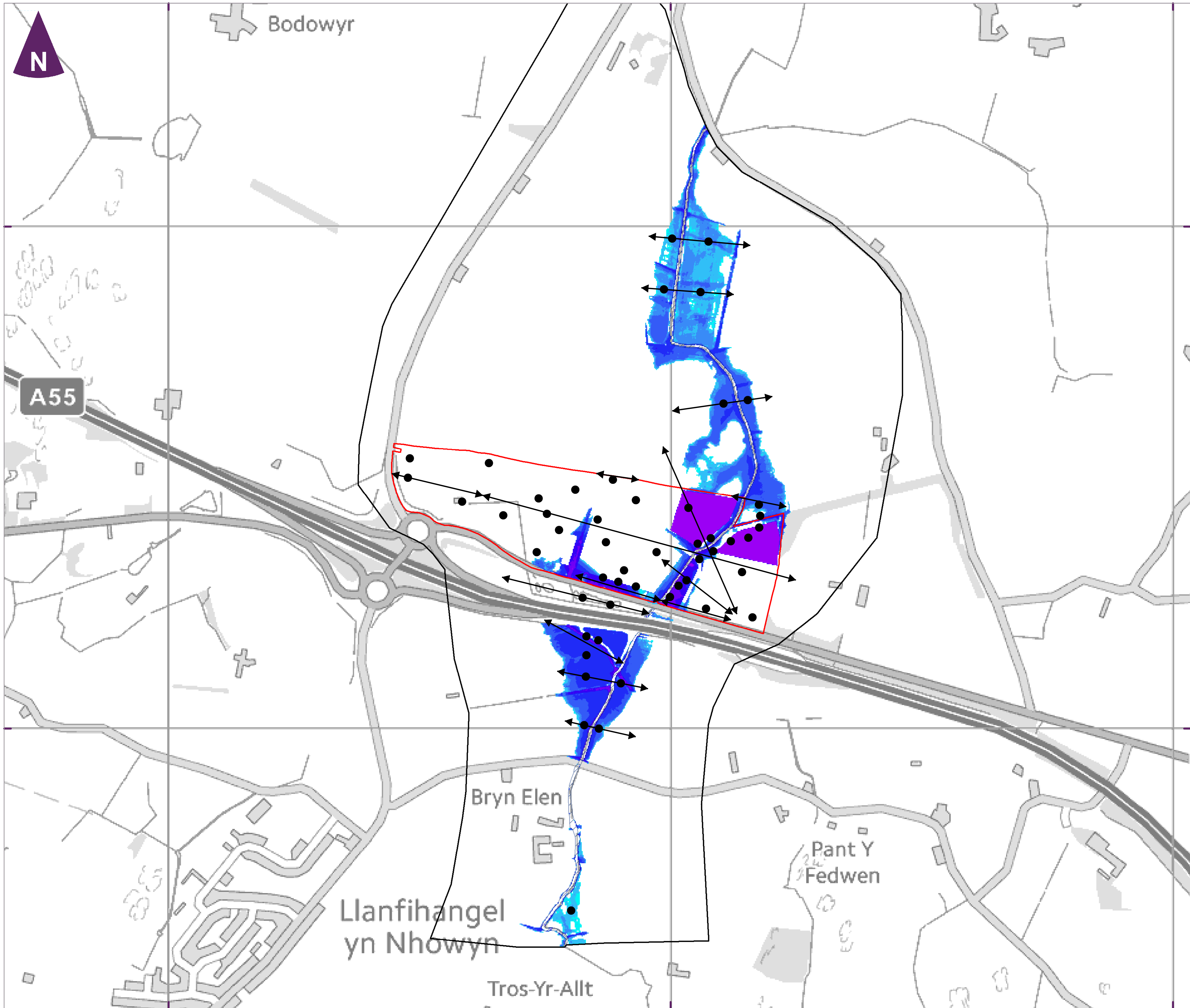
amec foster wheeler

Figure 6.53
Dalar Hir distributed inflow peak depth difference fluvial 1:100 year AEP plus Climate change (15%)

November 2018 35989-Lon634i1-ghimb

H:\Projects\35989 Wylfa NNB Modelling\Design\Drawings (E&I created)\Task32_DalarHir_Results

NOT PROTECTIVELY MARKED



Key

Peak flood depth (m)
With Development Mitigation Option-1B
1:100 year AEP fluvial
Climate change (15%)

- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00
- Model boundary
- 1D Model Domain
- Site Boundary
- Results Point
- Results Line
- OS Mapping

Notes:
The depths represent the maximum depth achieved. The flood prediction does not represent a moment in time as maximum depths can be achieved at different times.

Model run date: 16/03/2018
Corresponding data:
35989-C1456_MitOPT-1B_Task_48_TS12_Fluvial_F100cc.xlsx

0 100 200 300 400 m
Scale at A3

Wylfa Newydd
Associated
Developments
Hydraulic Modelling

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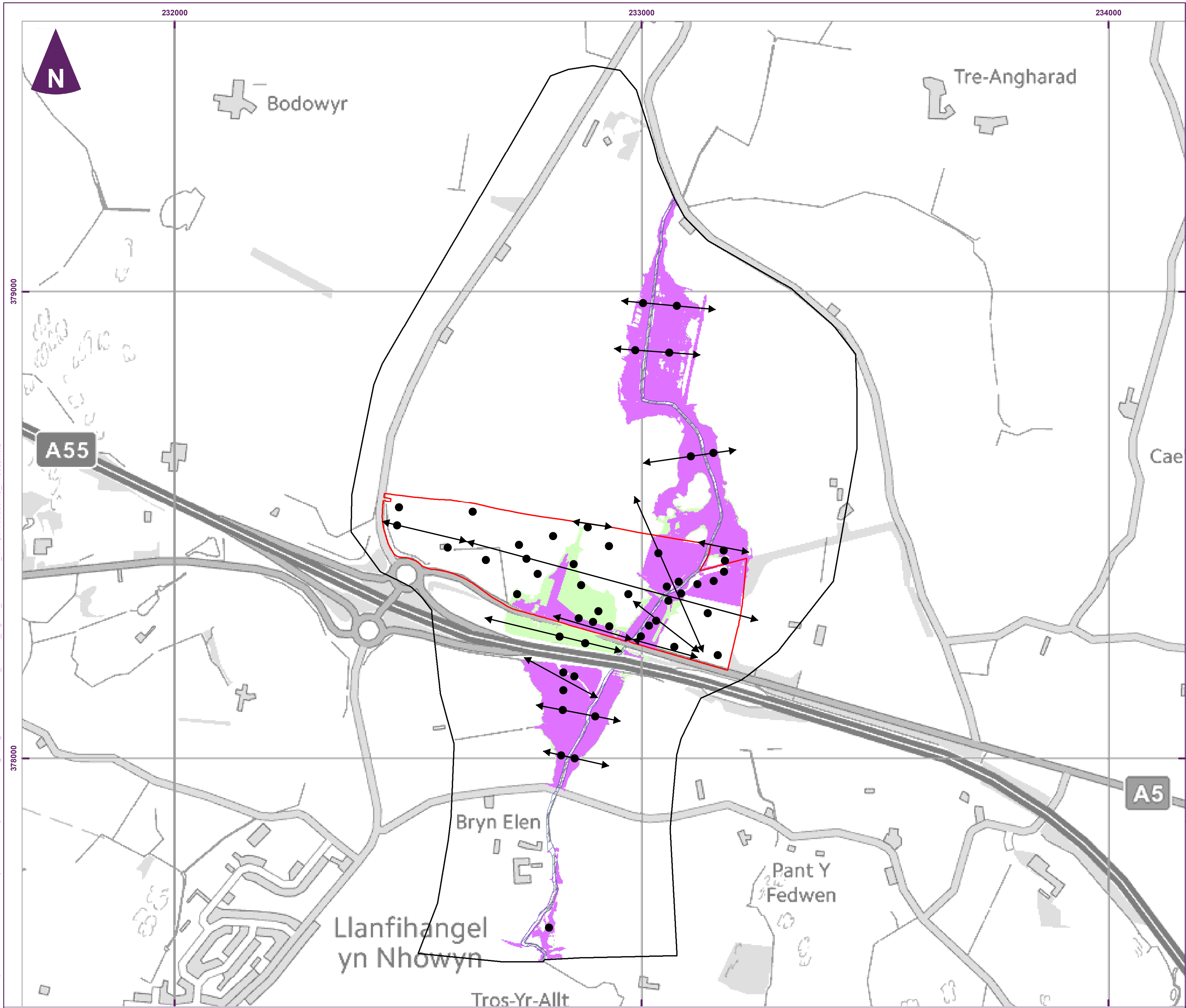
Figure 6.54
Dalar Hir distributed inflow Mitigation Option-1B peak fluvial flood depth 1:100 year AEP plus climate change (15%)

NOT PROTECTIVELY MARKED

March 2018 35989_Lon635i1 ghimb



NOT PROTECTIVELY MARKED

Key

Distributed Inflow fluvial Peak flood extents

- 1:100 Year AEP+15% Climate change (Mitigation Option-1B)
- 1:100 year AEP+15% Climate change (Baseline)
- Model boundary
- 1D Model Domain
- Site Boundary
- Results Point
- Results Line
- OS Mapping

0 100 200 300 400 m
Scale at A3

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Figure 6.55
Dalar Hir distributed inflow with development Mitigation Option-1B peak fluvial flood extent compared with baseline flood extent

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Key

Peak flood depth difference (m) between Mitigation Option-1B and Baseline for 1:100 year AEP fluvial Climate change (15%)

- > 0.1
- 0.05 to 0.1
- 0.01 to 0.05
- 0.005 to 0.01
- No Change
- -0.005 to -0.01
- -0.01 to -0.05
- -0.05 to -0.1
- < -0.1
- Model boundary
- 1D Model Domain
- Results Point
- OS Mapping
- Area of proposed ground level change
- Proposed flood defence wall

Notes:
The depths compared use the maximum depth achieved. The flood prediction does not represent a moment in time as maximum depths can be achieved at different times.

Where positive values represent an increase in peak flood depth, and negative values represent a decrease in peak flood depth, as a consequence of the proposed development.

Meters
0 100 200 300 400
Scale at A3

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Figure 6.56
Dalar Hir distributed inflow peak depth difference fluvial 1:100 year AEP plus Climate change (15%)

November 2018 35989-Lon637i1-ghimb

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Appendix C
Reference Separate file: Digital Results Sheets and Shapefiles

Not provided - electronic data only