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CONNAH'S QUAY POWER STATION

SOUTHERN SITE

FLOOD CONSEQUENCES ASSESSMENT

Prepared for

Uniper Technologies Limited

March 2021
Ref:031/34/cq/fca/0321

S M Foster Associates Limited
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1. Introduction

1.1 This report has been prepared in response to instruction dated 4th December 2020 from Uniper Technologies Limited. The report presents the results of a Flood Consequences Assessment (FCA) for land to the south east of Connah's Quay Power Station, Flintshire, North Wales. The power station site is located on the left bank of the River Dee. The area of interest is referred to as the Southern Site.

1.2 The Southern Site is now available for redevelopment but is currently not included in the Flintshire Local Development Plan (LDP) Policy PE1: General Employment Land Allocations. Flintshire Council has indicated that non-inclusion of the site in Policy PE1 is partly related to a requirement for further information on any development constraints associated with the partial location of the site in Flood Zone C1. This FCA has been prepared to provide a robust understanding of local flood risks and the flood consequences of any future development at the site.

1.3 The primary objective of this FCA is to evaluate potential risk of flooding from all sources and the consequent implications for future development of the site. Assessments have been undertaken of potential flood risk related to:

(i) Flooding from rivers and sea;
(ii) Flooding from surface water;
(iii) Flooding from groundwater; and
(iv) Flooding from sewers and drainage infrastructure.

1.4 Flood risk and flood consequence assessments have been based on analysis of published data sources, additional hydrological references, site review and consultation, ground level data and independent hydrological analysis. Natural Resources Wales (NRW) has been consulted with regard to provision of site-specific flood data sets.

1.5 Where information is available or can be derived, an assessment has been made of the potential implications of climate change effects on flood risk at the site. Reference has been made to current Welsh Government climate change allowances[1] for river flow, sea level and rainfall intensity.

1.6 Critical flood defence or drainage control structures have been identified and an assessment has been made of site vulnerability in relation to a failure of such features to meet design performance standards or provide the design standard of protection.

[1] Welsh Government (2016) Flood Consequence Assessments: Climate change allowances

1.7 Whilst this FCA does not address any specific development proposal for the site it is based on the assumption that the site would be considered for energy-related employment uses. Technical Advice Note 15: Development and Flood Risk (TAN15) states that, with regard to flood vulnerability, general industrial, employment, commercial and retail development, transport and utilities infrastructure would be considered to be 'less vulnerable development'. However, power stations are considered to be 'highly vulnerable development'.

1.8 NRW requirements for determining development acceptability in Flood Zone C1 is the same for both less vulnerable and highly vulnerable development although the consequences of flooding may vary in relation to development vulnerability.

1.9 The report is structured to provide a clear understanding of potential flood risk from all sources prior to discussion of the potential approach to flood risk management. The report concludes with recommendations related to any measures considered necessary to improve flood risk management at the site.

2. Approach and scope

2.1 Flood risk assessment has been undertaken through a combination of site assessment, review of published data sets, consultation and new hydrological analysis. The approach to flood risk assessment has been informed by the defined flood status of the site, flood risk from all sources and the potential vulnerability of future development at the site. As the River Dee is tidal adjacent to the site, the dominant source of flood risk is tidal flooding from the Dee Estuary.

2.2 Although this FCA has not been prepared in relation to any specific development proposal at the site, the scope of the assessment incorporates all relevant flood related information as set out in TAN15, Section 7 and Appendix 1.

2.3 Flood hazard analysis has been informed by reference to a number of published data sources that include the following:

- NRW Development Advice Map;
- NRW Flood Risk Assessment Wales Map;
- North West England & North Wales Shoreline Management Plan;
- Local Authority records;
- British Geological Survey;
- Ordnance Survey; and
- Online records search.

2.4 NRW has been contacted to establish the availability of detailed flood data for the site. Flood data sets, including historic flood records, flood model data and flood defence details have been provided by NRW and relevant extracts are included in full at Appendix A of this FCA.

2.5 New hydrological analysis has been undertaken to support evaluation of potential climate change effects on flood risk at the site and surrounding area. In accordance with guidance at Section A1.14 of TAN, there is a requirement to demonstrate that any future development at the site could remain 'flood free' during a 1% (1:100yr) fluvial flood event or a 0.5% (1:200yr) tidal flood event.

2.6 This FCA has been referenced to flood management policy, practice and standards defined in current national and local guidance for flood risk assessment. In accordance with current NRW guidance, the FCA covers the following general area.

- Flood risk to the site;
- The potential flood consequences of development;
- Potential effects on flood risk elsewhere;
- Flood risk management and mitigation options; and
- The effects of future climate change

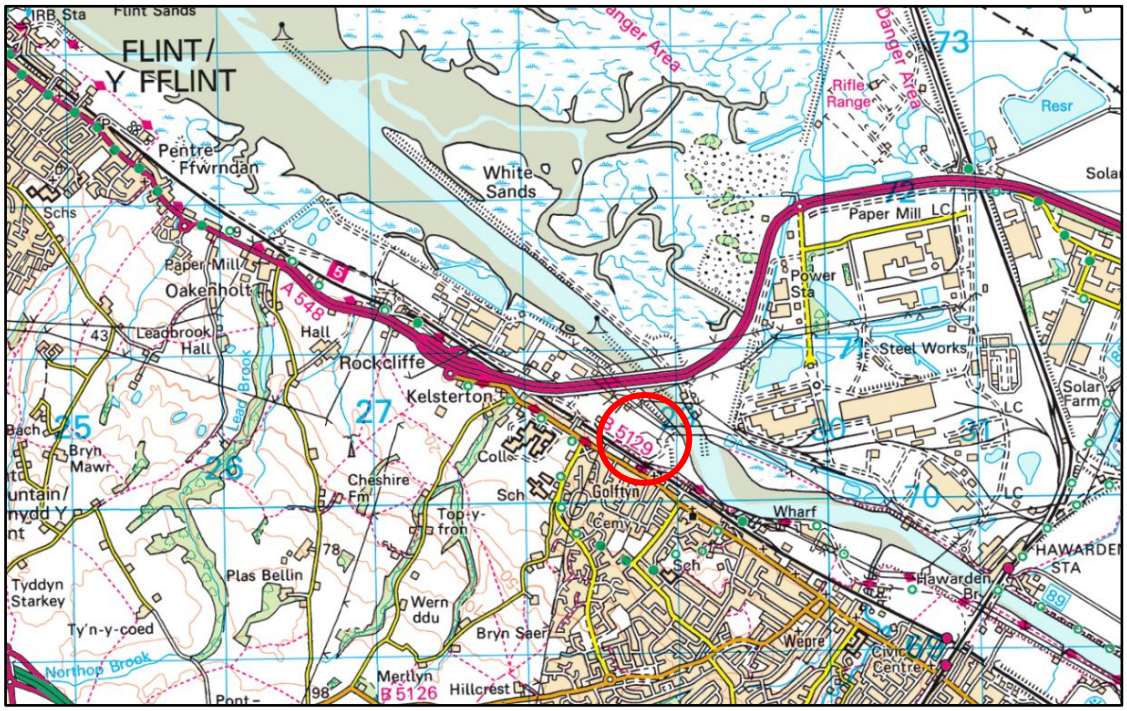
2.7 In February 2016 the Welsh Government published new climate change allowances for flood risk assessment[2]. Allowances relate to river flow, sea level rise and rainfall intensity changes for a range of future timescales. For the purpose of this FCA, climate change allowances have been estimated for both less vulnerable and highly vulnerable development over development timescales of 75 years and 100 years respectively.

2.8 Where there is potential flood hazard, either current or in response to future climate change effects, consideration has been given to on-site flood risk management policy and any requirement for formalised flood warning and emergency evacuation procedures.

3. Site location and hydrological context

3.1 Connah's Quay Power Station is located on the northern side of Connah's Quay and approximately 4.5km south east of Flint. The Southern Site consists of land within the power station site comprising land that previously accommodated the former Connah's Quay Coal Fired Power Station (A Station). The Southern Site extends to a total area of 12.7ha. Site location is shown in Figure 1.

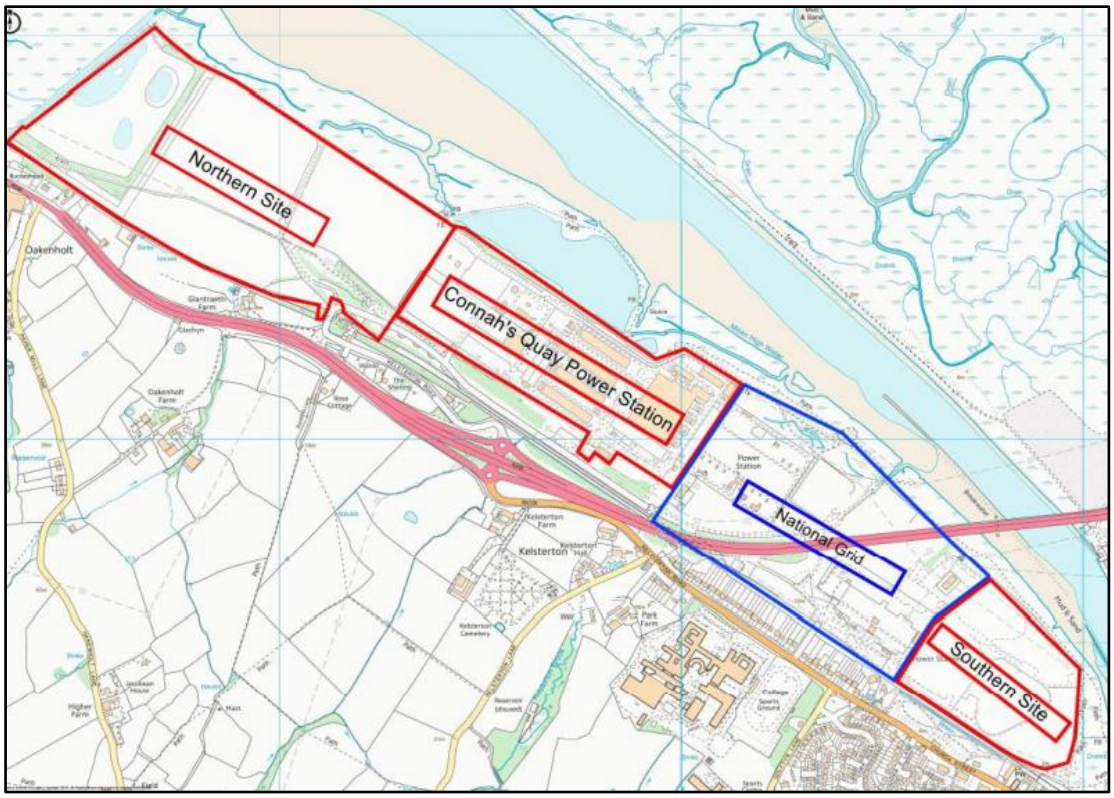
Figure 1: Site location © Ordnance Survey



[2] Welsh Government (2016) Flood Consequence Assessments: Climate change allowances

3.2 The site is bounded to the south west by a mainline railway and to the east north-east by the River Dee and associated floodplain. The north western site boundary is formed by a National Grid site. The respective location of adjacent sites is shown on Figure 2 below. The A584 passes over the River Dee close to the northern site boundary. The nearest residential properties are located adjacent to the south western site boundary. Access to the site is achieved via the A548 and the B5129.

Figure 2: Southern Site location in relation to adacent land use



3.3 The site has been cleared of former power station infrastructure and currently consists of a combination of rough scrubland and extensive areas of concrete hardstanding. An aerial view of the site is presented as Figure 3. Existing ground level at the site has been obtained from reference to high resolution LiDar data which is shown on Drawing 031/34/02. Topographic variation across the site is relatively low with maximum ground level of 7.8mAOD at the western boundary and minimum ground level of 6.0mAOD in the base of the former cooling tower area towards the centre of the site.

3.4 As shown on Figures 1 and 3, the site is located adjacent to the River Dee which flows south east to north west along the north eastern site boundary. The river is defined as part of the Dee Estuary at this location. Flood Estimation Handbook (FEH) catchment models indicate that, on entry to the estuary, the River Dee drains a catchment area of approximately 1,800km^2. As shown on Drawing 031/34/01, there is a continuous area of low lying marshland and tidal mudflats between the site boundary and the main river channel.

Figure 3: aerial view of the site and surrounding area © Ordnance Survey

3.5 Whilst the River Dee is the dominant surface water feature in the vicinity of the site, Ordnance Survey mapping indicates the presence an additional surface water feature orientated parallel to the railway line that forms the southern boundary of the site. Available evidence indicates that this feature may originate as Kelsterton Brook, an open drainage channel that serves a small catchment area to the west of Kelsterton College. Surface water drainage features are also mapped on floodplain areas around the northern and eastern boundary of the site. Land in these areas are established at significantly lower elevation than the site, and support drainage directly to the River Dee.

4. Flood hazard assessment

4.1 Flooding can originate from a number of sources. In accordance with the TAN15, flood consequence assessments should include consideration of flood hazard from all sources including the following:

- Flooding from rivers and sea;
- Flooding from surface water;
- Flooding from groundwater; and
- Flooding from drainage infrastructure.

4.2 This FCA includes review of flood hazard from each source and, where appropriate, evaluation of flood hazard related to a combination of flooding sources. At the Southern Site, the only potential combined flood hazard would arise from a combination of fluvial and tidal flooding or in relation to surface water systems during periods of tide-locking. Flood hazard assessment is based on published flood mapping in combination with existing ground level data and hydrological analysis.

Flood history

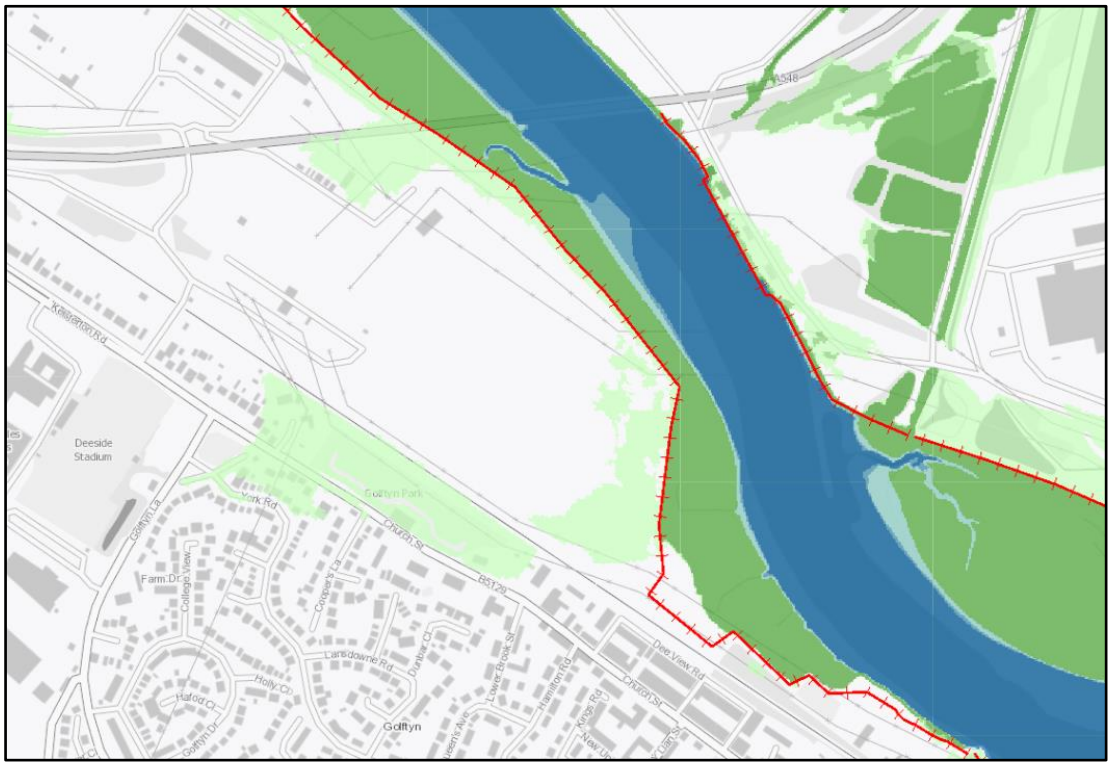
4.3 The Flood Risk Assessment Wales Map (FRAWM) indicates that there are no recorded incidents of historical flooding at the site. The only recorded flood incidents in the area relate to localised flooding of small surface watercourses. The downstream end of Kelsterton Brook, approximately 1km north west of the Southern Site is known to have flooded locally in 2000 resulting in localised inundation of Kelsterton Lane upstream of the B5129 bridge. Historic flooding has also occurred on the Wepre Brook in 1964, upstream of the culvert beneath the railway, approximately 1.5km south east of the Southern Site. There is no recorded history of flooding of the site or the surrounding area from the River Dee.

Flooding from river and sea

4.4 The Southern Site is situated on the left (south) bank of the River Dee, at the entry to the Dee Estuary. Whilst the site is potentially at risk of both fluvial and tidal flooding, tidal flooding is considered to be the dominant flood hazard in the area. Flood modelling used to provide long term flood level data in the Dee Estuary incorporates both fluvial flow and downstream tidal water levels.

4.5 The FRAWM incorporates existing flood defences. For the Southern Site the FRAWM indicates that the site is not at risk of fluvial flooding from the River Dee for flood events with a statistical frequency of 1:1000yr (0.1%AEP). The majority of the site is protected from tidal flooding by existing flood defences that are present along the northern and eastern site boundary with the River Dee. A small area of the site, towards the south eastern boundary is considered to be at low risk of tidal flooding. Reference to topographic data on Drawing 031/34/02, confirms that this area is the lowest part of the site. The low tidal flood risk zone is shown in light green on the FRAWM extract at Figure 4.

Figure 4: Flood Risk Assessment Wales Map extract © Crown copyright



4.6 The appropriate reference for consideration of flood risk and development potential is the NRW Development Advice Map (DAM). It is noted that the DAM is due to be replaced by a new Flood Map for Planning in Spring 2021. The DAM presents undefended flood risk information i.e. assuming that there are no existing flood defences. This approach allows for consideration of flood hazard related to failure or breach of defences.

4.7 The DAM indicates that, without the benefit of existing flood defences, the Southern Site is partly within Flood Zone C1 and partly within Flood Zone B. Flood Zone C1 indicates the extent of flooding up to a 1:1000yr (0.1%AEP) event. Flood Zone B is not hydrologically defined but relates to areas that are underlain by sedimentary deposits that may indicate that the area has been subject to flooding in the past.

Figure 5: Development Advice Map extract © Crown copyright

4.8 Figure 5 shows an extract from the DAM indicating that northern, eastern and south eastern areas of the site are designated Flood Zone C1, shown green, and hence considered to be at risk of tidal flooding during flood events of up to 1:1000yr frequency. The remainder of the site is designated Flood Zone B which is shown as yellow. As indicated on Figure 5, land on the adjacent National Grid site, to the north west, is also designated Flood Zones C1 and B.

4.9 As shown on Figure 4, the Southern Site benefits from flood defences around the northern and eastern boundaries with the River Dee. Reference to NRW spatial flood defence data indicates that, around the periphery of the site, the existing defences are designed to provide a standard of protection (SOP) of 200yrs. The defences are reported to be privately maintained and consist of a natural raised embankment. Defence crest elevation is designed to achieve 6.85mAOD.

4.10 Flood hazard at the site, and potential flood constraints on future development potential is related to both potential flood extent and potential flood water depth. The most recent flood water level data has been derived from the NRW/EA 2018 Coastal Flood Boundary Conditions for the UK. Data is available digitally for GIS application. The data set provides Extreme Water Levels (EWL's) for the UK coastline and extends into estuaries through incorporation of existing

estuary flood modelling outputs. The EWL's represent still water conditions, incorporating an astronomical high tide and storm surge but excluding the effects of any wave action.

4.11 EWL's are available for locations at the downstream boundary of the Southern Site and approximately 1km upstream of the eastern site boundary. Tidal flood levels at both locations for a range of flood frequencies are presented in Table 1.

Table 1: EWL's adjacent to the site

NGR	Location	EWL (mAOD)	97.5% Conf. EWL (mAOD
328871,370804	Downstream		
1:1		5.83	5.87
1:200		6.40	6.57
1:1000		6.60	6.89
330367,369836	Upstream		
1:1		5.84	5.88
1:200		6.41	6.58
1:1000		6.62	6.91

4.12 Adopting the EWL values at the 97.5% confidence level, it is apparent that with a design crest elevation of 6.85mAOD, the existing flood defences would protect against a 1:200yr tidal flood event but would not provide full protection against a 1:1000yr tidal flood event. This is consistent with the design SOP of 200yrs.

4.13 An assessment of potential flood water depth at the site, during undefended conditions, can be made by comparison of existing ground level with predicted EWL's. Reference to Drawing 031/34/02 indicates that existing ground level reaches a minimum of approximately 6.00mAOD in the former cooling tower basin with land to the south east at around 6.60mAOD and land to the north and west, higher at around 7.00mAOD to 7.80mAOD.

4.14 During a present day 1:200yr (0.5%AEP) tidal flood event, without the presence of defences, the site would not be at risk of tidal flooding as the central cooling tower area is entirely surrounded by higher ground with a minimum elevation in excess of the 1:200yr flood level. During a present day 1:1000yr tidal flood event, the south eastern area of the site would be at risk of tidal flooding to a depth of approximately 0.30m. The northern and western areas of the site would be free from flooding. This interpretation is broadly consistent with the extent of Flood Zone C1 shown on the DAM.

4.15 EWL's derived from the 2018 Coastal Flood Boundary Conditions model are referenced to a base date of 2017. Future climate change is expected to result in a rise in sea level around the UK coast and therefore future flood levels may be higher than present day levels. The Welsh Government has set out climate change allowances[3] for use in Flood Consequences Assessments, including allowances for sea level rise. Applying the relevant allowances for a period to 2120 from a base date of 2017 results in a still water level increase of 1,190.5mm.

[3] Welsh Government (2016) Flood Consequence Assessments: Climate change allowances

4.16 The present day peak tidal flood levels presented in Table 1 are therefore predicted to increase by 1.19m by 2120. With the addition of climate change allowance, the 1:200yr and 1:1,000yr peak tidal flood levels would become 7.76mAOD and 8.08mAOD respectively.

4.17 In the absence of flood defences, LiDar ground level data, as shown on Drawing 031/34/02, indicates that a tidal flood level of 7.76mAOD would result in flooding of the majority of the site. Maximum flood water depth would range from approximately 1.16m in the eastern part of the site to 0.46 in the western part of the site.

4.18 The site is protected by existing tidal defences along the left bank of the River Dee. Existing defences have a design SOP of 200 years. Long term policy regarding the status and management of tidal flood defences is set out in the North West England & North Wales Shoreline Management Plan[4] (SMP). The section of defences adjacent to the site is within the Flint Marsh to Chester Weir section of Policy Unit 11a5 of the SMP. Over a duration of up to 100 years, the policy regarding these defences is to 'hold-the-line' which essentially means retaining the current SOP in response to future climate change. The definition of 'hold-the-line' in the SMP is as follows.

***Hold the Line**: By maintaining or changing the current standard of protection. This policy includes those situations where work is carried out in front of the existing defences (such as beach recharge, rebuilding the toe of a structure, building offshore breakwaters and so on) to improve or maintain the standard of protection provided by the existing defence line. It also includes work behind existing defences (such as building secondary flood defences) where this work would form an essential part of maintaining the current coastal defence system.*

4.19 It is therefore reasonable to assume that, over the lifetime of potential development at the Southern Site, the site would continue to benefit from tidal flood defences with a SOP of 1:200yrs. This will mean progressively increasing defence crest level to achieve a minimum of 7.76mAOD by 2120.

4.20 Whilst the site benefits from 1:200yr SOP from tidal defences, both present day and over the lifetime of potential future development, it is necessary to consider the potential flood hazard associated with a breach of flood defences. Flood hazard analysis has demonstrated that, if undefended, the site is not currently at risk of flooding during a 1:200yr tidal flood event but, taking account of climate change to 2120, would be at risk of inundation with inundation depths of up to 1.16m.

4.21 The flood consequences of a defence breach depend on the location and duration of the breach and the timing of a breach in relation to the tidal flood cycle. In most cases, a breach acts as restricted outflow from a flooded river and flood risk is related to the volume of water discharged onto surrounding land rather than direct translation of river flood levels across a site, as is the case for a fully undefended situation. The consequences of a breach are therefore usually less significant than an absence of the entire defence as assumed in the undefended analysis above.

4.22 NRW have undertaken several flood studies of the River Dee in the vicinity of the Southern Site. Following defended flood modelling studies undertaken in 2015[5], further modelling was

[4] North West & North Wales Coastal Group (2011). North West England and North Wales Shoreline Management Plan SMP2.
[5] NRW (2015) Tidal Dee Flood Mapping. Hydraulic Model File Note

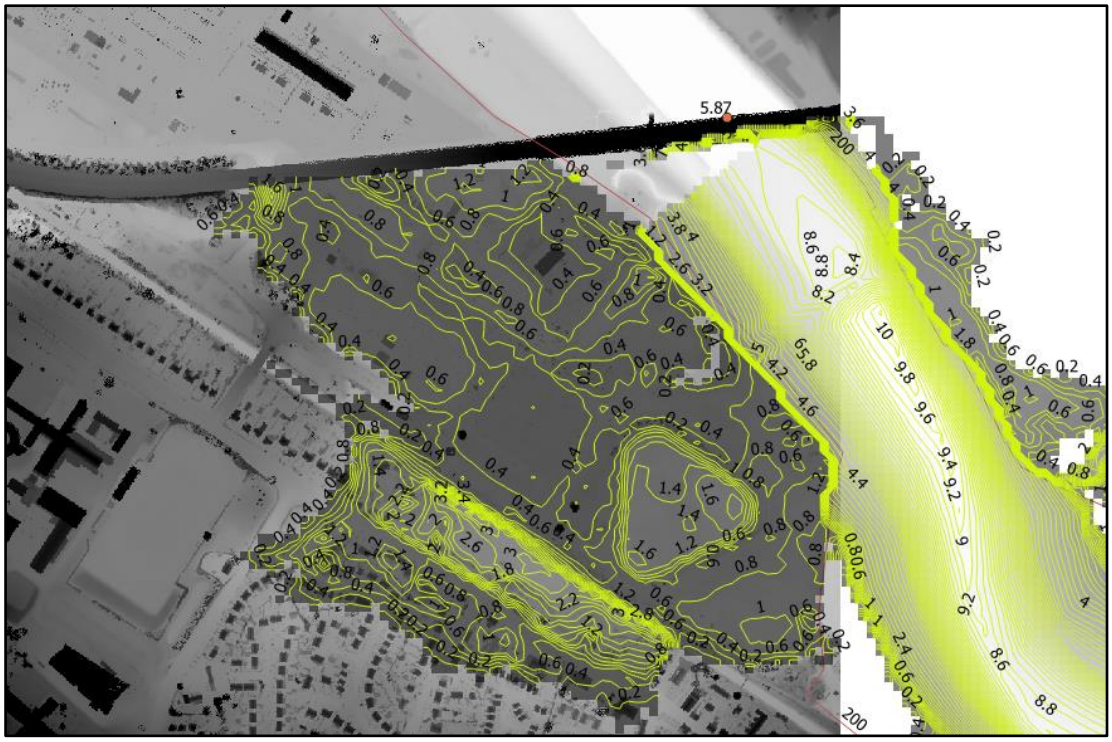
undertaken in 2016[6] to investigate the potential impact of defence breach on local flood risk. NRW has provided full modelling reports and outputs for both modelling studies.

4.23 Breach modelling studies have incorporated analysis of a defence breach at multiple locations, including two breach scenarios (i) breach occurring in advance of a flood event, and (ii) breach occurring during a flood event. The effects of a defence breach are additional to the defended flood modelling undertaken in 2015. Breach modelling has been undertaken for flood frequencies of 200yrs (0.5%AEP) and 1,000yrs (0.1%AEP) including climate change effects over a 100yr period to 2115.

4.24 The nearest modelled breach location to the Southern Site is the Dock Road breach location (329816,369826) located approximately 1km upstream (east) of the site. Breach modelling results demonstrate that a breach of defences at Dock Road would have negligible impact on flood water extents or depth when compared to the defended model. Defence breaches at other modelled locations, further from the site, similarly have negligible effect on flood extents and depth at the site.

4.25 Breach modelling has been undertaken with flood defences at their current crest level. Flood overtopping analysis above, concluded that the 1:200yr tidal peak flood level adjacent to the Southern Site, including 100yr climate change allowance would be 7.76mAOD compared to a defence crest elevation of 6.85mAOD. Under such conditions the site would be subject to inundation by overtopping regardless of the presence of a local defence breach.

Figure 6: Modelled flood water depth during 1:200yr + 100yr climate change event with defence breach at Dock Road 1km upstream of the Southern Site.



Source data derived NRW 2016 breach modelling study

[6] NRW (2016). Tidal Dee Breach Simulation. Hydraulic Model File Note

4.26 As shown in Figure 6, breach modelling results for a 1:200yr tidal flood event, including climate change allowance to 2115, indicate inundation of the Southern Site with floodwater to a depth ranging from 0.4m to 1.2m with the majority of the site flooded to a depth of between 0.4m and 0.8m. This can be compared to the estimated undefended peak flood water depth of 1.16m for the same event, as calculated above. It is noted however, that the 2016 breach modelling is based on EWL's that precede the latest 2018 data set and that the climate change timescale extends to 2115 rather than 2120 as assumed in undefended assessment above.

4.27 Analysis of defended and undefended flood risk has resulted in the following conclusions

Present day

Defended: 1:200yr - Existing defences provide 1:200yr SOP
1:1000yr – Site at risk of flooding to average depth of 0.3m

Undefended: 1:200yr - Existing ground level above 1:200yr flood level
1:1000yr – Site at risk of flooding to average depth of 0.3m

Defence breach 1:200yr – Existing ground level above 1:200yr flood level
1:1000yr – Site at risk of flooding to average depth of 0.3m

At 2120

Defended: 1:200yr - Existing defences provide 1:200yr SOP (assumes hold-the-line)
1:1000yr – Site at risk of flooding to depth of up to 1.48m (assumes hold-the-line)

Undefended: 1:200yr – Site at risk of flooding to depth of up to 1.16m
1:1000yr – Site at risk of flooding to depth of up to 1.48m

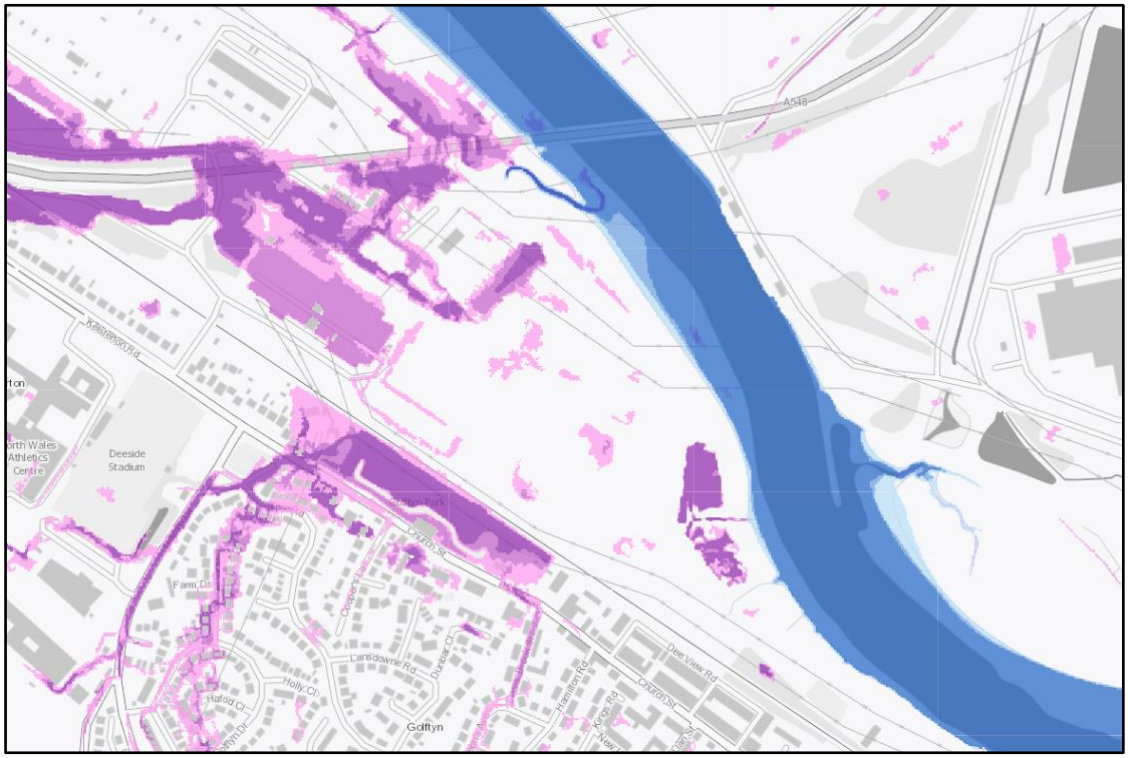
Defence breach 1:200yr – Site at risk of flooding to depth of 0.4 – 1.2m (no defence upgrade)
1:1000yr – Site at risk of flooding to depth of up to 1.48m (no defence upgrade)

4.28 Direct comparison of defended, undefended and defended-breach flood risk data is complicated by the different base data used in the 2016 NRW breach modelling and the undefended analysis detailed above. It is apparent however, that whilst the site is currently protected against tidal flood events with a frequency of 1:200yrs or more, including during a breach of defences, it would be at risk of flooding due to a defence breach in 2115, even if the defence SOP is maintained at 1:200yrs.

Flooding from surface water

4.29 Surface water flood risk is defined in relation to direct rainfall over the site and the capacity of site surfaces and drainage systems to accommodate it. The FRAWM provides information on the extent of potential surface water flooding through definition of three surface water flood risk zones (low, medium and high) related to rainfall accumulation and flooding from small watercourses. An extract from the FRAWM surface water flood risk map is presented as Figure 7 below.

Figure 7: FRAWM surface water flood risk map extract © Crown copyright



4.30 Reference to Figure 7 indicates that the majority of the Southern Site is not considered to be at risk of surface water flooding. Localised areas designated as being at low to high risk of surface water flooding within the site coincide with topographic low points where local accumulation of surface water could occur in response to high intensity rainfall events. It is anticipated that any accumulating surface water would eventually dissipate through a combination of infiltration and evaporative loss.

4.31 More extensive areas at risk of surface water flooding are located on the adjacent National Grid site and in relation to the small surface watercourse to the south west of the site. Within the National Grid site, surface water flood risk is primarily restricted to low lying roadways and areas of hardstanding with low surface permeability. Surface water flooding from the small watercourse to the south west would be constrained by the presence of the railway embankment close to the southern site boundary, preventing surface water migration onto the site.

Flooding from groundwater

4.32 British Geological Survey (BGS) mapping indicates that the Southern Site is underlain by Lower Coal Measures bedrock consisting predominantly of mudstone. The Gwespyr Sandstone is present beneath adjacent land. The mudstone bedrock is overlain by superficial Tidal Flats Deposits consisting of a variable mix of clay, silt and sand. Historic borehole records for the area demonstrate that the superficial deposits, consisting predominantly of clay, extend to a depth of between 4.6mbgl and 7.2mbgl above mudstone or sandstone.

4.33 Groundwater seepage was encountered at various depth within historic exploration boreholes in the vicinity of the site, ranging from 2.5mbgl to 4.6mbgl. A borehole constructed at the Church Street pumping station close to the southern site boundary recorded a rest groundwater elevation of 4.79mAOD in the sandstone beneath superficial clay deposits.

4.34 Coal Measures mudstone typically has low intergranular permeability and limited capacity for storage or transmission of groundwater. Any groundwater presence is usually restricted to secondary porosity related to fracturing within the mudstone. The overlying superficial deposits are predominantly clays, as evidenced from historic borehole records, and therefore also unlikely to have significant permeability or ability for transmission of groundwater. Available records indicate that the local groundwater level in the more permeable sandstone to the south east of the site is approximately 2m below ground level at the Southern Site.

4.35 The presence of generally low permeability superficial deposits and underlying bedrock restricts the potential for significant infiltration and therefore any laterally continuous groundwater bodies within more permeable horizons in the superficial deposits are unlikely to be responsive to rainfall recharge. Groundwater levels in more permeable horizons within the superficial deposits may vary in relation to water level variation in the River Dee but the low permeability nature of the deposits would tend to preclude significant groundwater level rise during tidal flood cycles. It is therefore concluded, on the basis of available information, that the site is at low risk of groundwater flooding.

Flooding from sewers and drainage infrastructure

4.36 The Southern Site was previously subject to power station development and all the associated infrastructure, including surface water drainage infrastructure. The current existence and status of any residual drainage infrastructure at the site is unknown. However, experience from other former power station sites in the UK suggests that the majority of surface water drainage infrastructure tends to cease to be functional following power station demolition and site clearance. Any residual on-site drainage systems would be contained within the site and would not convey surface water from outside the site. As a consequence, any flooding due to failure of such systems would result in surface water flooding as described above.

4.37 There is no evidence to indicate the presence of external drainage infrastructure crossing the site. Surface water drainage systems to the south of the site appear to be routed parallel to the railway embankment, with downstream discharge to the River Dee to the east of the Southern Site. It is assumed that the adjacent National Grid site will be equipped with surface water drainage infrastructure with adequate capacity to convey design storm runoff without risk of overland flow onto the Southern Site. It is noted that a previous detailed drainage assessment for the existing power station site, adjacent to the National Grid site, demonstrated that the majority of the stormwater drainage system has capacity to convey 1:100yr + climate change storm runoff without flooding at surface.

5. Flood risk management

Flood protection

5.1 Flood hazard assessment has led to the conclusion that the Southern Site is at low risk of flooding from surface water, groundwater and drainage infrastructure related sources. Existing tidal defences provide a design SOP of 1:200yrs against fluvial and tidal flooding in the River Dee. Assuming that defence crest elevations are managed to maintain the existing SOP over a 100yr development design life, as stated in the SMP, the site would retain a 200yr SOP in response to climate change. The site would, however, remain at risk of tidal inundation during

a breach of defences during the period 2020 to 2120, or during more extreme flooding due to overtopping of defences.

5.2 In accordance with the provisions of TAN15, commercial/industrial development at the site would be required to meet the 'flood free' objective for fluvial flood events with a frequency of 1:100yrs (1%AEP) and tidal flood events with a frequency of 1:200yr (0.5%AEP). This condition should be achieved for the lifetime of the proposed development.

5.3 1:200yr risk to the site would arise from a defence breach during timescales at which the peak tidal flood level exceeds existing site ground level. NRW breach modelling incorporates a breach location 1km upstream of the Southern Site. However, a breach of defences at the site boundary could result in greater risk to the site. The appropriate reference levels for flood consequences assessment are therefore,

(i) the 2115 1:200yr breach model peak tidal flood levels at the site, and
(ii) the undefended 2120 1:200yr peak tidal flood level at the site.

5.4 The 2115 1:200yr breach flood level at the Southern Site is defined in NRW breach modelling as 7.40mAOD at the downstream (western) site boundary to 7.50mAOD at the upstream (eastern) site boundary. The 2120 1:200yr undefended peak tidal flood level is 7.76mAOD. It is therefore concluded that the undefended 2120 1:200yr peak tidal flood level of 7.76mAOD is the appropriate design reference for evaluation of flood protection.

5.5 The undefended 2120 1:1000yr peak tidal flood level has been calculated as 8.08mAOD, or 0.32m above the 2120 1:200yr level. An excess flood water depth of 0.32m is well within the 0.60m tolerable depth of flooding specified in TAN15 for commercial/industrial development.

5.6 On the basis of the above analysis, it is concluded that the required standard of flood protection could be achieved by establishing ground level within developed areas of the site at a minimum elevation of 7.80mAOD. Development floor levels above ground level would provide additional freeboard.

5.7 Reference to LiDar ground elevations, as shown on Drawing 031/34/02, indicates that existing ground level in some parts of the site is currently above 7.80mAOD. Average ground level in the western part of the site is approximately 7.40mAOD. The eastern part of the site is lower with average ground level of approximately 6.60mAOD. From a flood hazard perspective it would be preferrable to locate new development as far from flood defences as possible. Taking account of existing ground levels, it would therefore be preferable to locate above ground development in the western part of the site. Minimum ground raising would be required in this area.

5.8 With an average existing ground level of 7.4mAOD, achieving a development platform elevation of 7.80mAOD would require an average of 0.4m increase across the western part of the site. Some of the required height increase may be achieved by regrading areas of higher ground within the site. A 0.40m average increase in ground level is comparable to the level that might be achieved by installation of compacted fill materials necessary to establish a stable platform. Such measures are therefore considered to be entirely achievable.

5.9 A ground level of 7.80mAOD would provide protection against a 1:200yr tidal breach flood event for the duration of potential development at the site. During more extreme flood events i.e. the 1:1000yr tidal flood event, the potential depth of ground inundation due to defence overtopping would be less than the tolerances set out in TAN15. Raising development ground levels to 7.80mAOD would eliminate reliance of flood defences.

6. External effects

6.1 In accordance with the provisions of TAN15, it is necessary to consider the potential consequences of development on flood risk elsewhere. Consideration has therefore been given to the potential impact of site development on tidal flood risk in the surrounding area and any changes to flood risk related to off-site discharge of surface water.

Floodplain storage and flood flow conveyance

6.2 In the context that the floodplain is defined as Flood Zone C in TAN 15, any development in areas of the site currently designated Flood Zone C1 would constitute development within the floodplain. Reference to the DAM extract, included here as Figure 5, indicates that it is predominantly the lower, eastern side of the site that is within Flood Zone C1. Locating the majority of new development in the western part of the site would therefore minimise development in the floodplain.

6.3 Flood consequences assessment has been undertaken on the basis that tidal flooding in the River Dee is the dominant flood hazard in the area. Due to the nature of tidal flooding, in contrast to fluvial flooding, loss of floodplain storage does not usually influence tidal flood depth or extent elsewhere. The exception would be flooding due to a defence breach as such events are defined by the magnitude and duration of flood flow. The NRW 2016 River Dee breach modelling did not include modelling of the 1:1000yr (0.1%AEP) flood event with allowance for climate change. Similarly, there is no simulation of a breach event without simultaneous overtopping and therefore no direct basis to quantify breach flood flows onto the site.

6.4 In principle, it may be feasible to design site ground levels such that there is no net loss of floodplain storage. This could be achieved by levelling the western part of the site and reprofiling some areas in the eastern and northern parts of the site, closest to the flood defences. On this basis it is considered that the site could be developed without adverse effect on tidal or fluvial flood risk elsewhere.

Surface water management

6.5 In its current form, the site is surfaced with rough scrub and large areas of concrete hardstanding that formed part of the former power station infrastructure. If future development of the site resulted in a net increase in the impermeable area of the site there would be potential for increase in the peak rate and volume of surface water runoff from the site. It is noted however, that there would be scope for the use of permeable or semi-permeable surfaces within the site and that no net increase in impermeable area may be achievable.

6.6 TAN15 sets out a presumption in favour of sustainable surface water drainage systems (SuDS) for management of surface water, where conditions are suitable. To ensure that increased off-

site discharge of surface water does not represent an increased flood risk elsewhere, the peak rate and volume of off-site surface water discharge from the site would need to be restricted to the current brownfield rate. If there is a net increase in impermeable surfacing post-development there would be a requirement to incorporate some form of stormwater attenuation or discharge regulation within the development drainage system to achieve SuDS objectives.

6.7 Sustainable drainage systems are generally based on a stormwater management train that assigns priority to local control of surface water. SUDS systems should be designed to optimise control at the earliest stage in this sequence.

- Prevention: Good site management, best practice approaches to minimise the risk of flooding or migration of pollutants to surface water;
- Source control: control of runoff at or close to the source using permeable surfaces, filter trenches or swales etc.;
- Site control: local facilities that receive surface runoff to attenuate off-site discharge i.e. balancing ponds etc.;
- Regional Control: larger ponds and wetlands used to control flow and quality prior to final discharge to receiving water.

6.8 National Standards define the appropriate SUDS approach to final discharge destination as the following in order of preference:

1. Discharge into the ground
2. Discharge to a surface water body
3. Discharge to a surface water sewer
4. Discharge to a combined sewer

6.9 As the site is underlain by low permeability superficial deposits and bedrock it is considered to be unsuitable for use of infiltration devices, including soakaways. It is assumed that surface water from the site would be drained to the River Dee, as when previously developed as a power station, and that off-site discharge would be regulated, as necessary, to ensure no external increase in fluvial or surface water flood risk.

7. Justification for development

7.1 TAN15 confirms that, where possible, new development should be directed to Flood Zones A and B. Where development is proposed in Flood Zone C, TAN15 sets out the basis for justifying development as follows.

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 PPW and meets the definition of previously developed land (PPW fig 2.1); and*

iv *The potential consequences of a flooding event for a particular type of development have been considered, and in terms of the criteria contained in sections 5 and 7 and appendix 1 found to be acceptable.*

7.2 Development at the Southern Site would have the potential to deliver significant employment benefits to the local area and make a significant contribution to the local authority employment objectives. The site is defined as a brownfield site due to former use for power generation.

7.3 The analysis documented in this FCA provides evidence to demonstrate that the site could be developed with an acceptable standard of flood protection, in accordance with sections 5 and 7 of TAN15, and that such development could be designed to ensure no adverse effect on flood risk elsewhere. On that basis it is concluded that future development of the site can be fully justified in full compliance with the requirements of TAN15.

8. Summary and conclusions

8.1 This Flood Consequences Assessment (FCA) has been prepared to allow consideration of the potential flood consequences associated with future development of the former Connah's Quay coal-fired power station site (the Southern Site) and to identify any flood-related development constraints. The FCA has been undertaken in accordance with the requirements of TAN15 and NRW guidance. The assessment has been supported by detailed flood data provided by NRW.

8.2 The site is partly located in Flood Zone C1 and partly in Flood Zone B. The site is located adjacent to the River Dee and tidal flooding in the River Dee is the dominant flood hazard in the area. The site benefits from the protection provided by existing tidal flood defences around the northern and eastern site boundaries with the river. The design standard of flood protection is 200yr. The local Shoreline Management Plan policy is to maintain the current standard of flood protection for the lifetime of proposed commercial or industrial development at the site.

8.3 Flood hazard analysis indicates that the site is at low risk of flooding from surface water, groundwater and existing drainage infrastructure. The site would be at risk of tidal flooding due to defence overtopping during a more extreme tidal flood event or in response to a breach of flood defences when climate change effects result in peak tidal flood levels above existing site ground level.

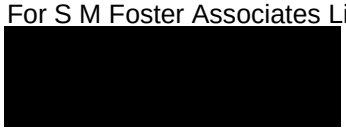
8.4 Preliminary analysis indicates that an adequate standard of flood protection could be achieved at the site by establishing minimum site ground level at 7.80mAOD. It would be beneficial to locate above ground development in the western part of the site, in areas of highest ground and at greatest distance from flood defences. It is considered that achieving minimum design ground level of 7.80mAOD is technically achievable.

8.5 Evaluation of flood consequences has indicated that it should be feasible to design development of the site in a manner that would result in no significant loss of floodplain storage. Surface water

drainage from any new development within the site would be managed by sustainable drainage systems (SuDS) to ensure no net increase in off-site discharge of surface water. As a consequence, the site could be developed without adverse effect on flood risk elsewhere.

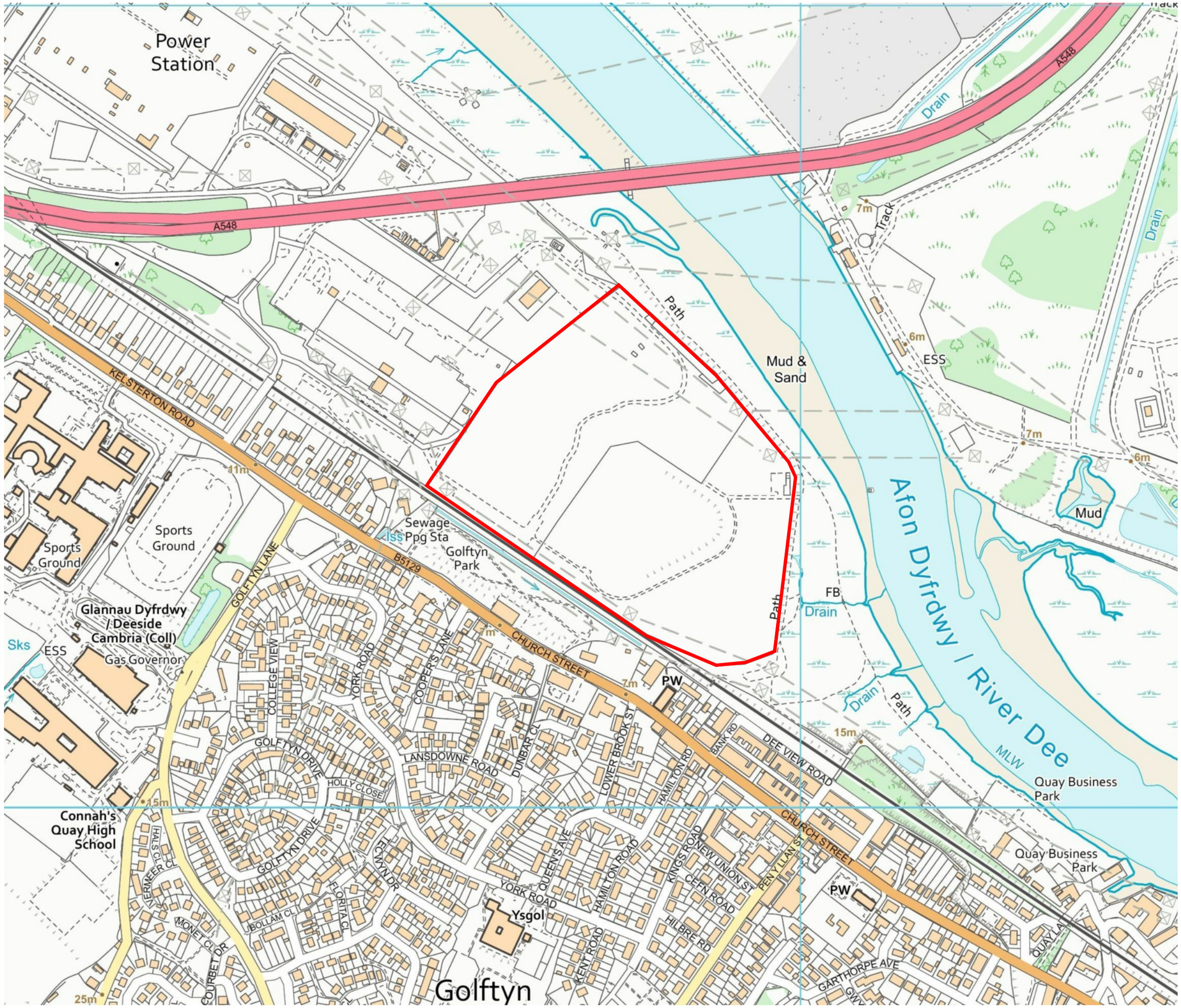
8.6 Location of the site within Flood Zone C1 can be justified, in accordance with the requirements of TAN15, through the contribution to local employment objectives and the potential for mitigation of on-site flood risk with no adverse effect on external flood risk. On that basis it is concluded that there are no significant flood-related development constraints and the site could therefore be developed in accordance with both local and national planning policy objectives.

For S M Foster Associates Limited



Stephen M Foster
BSc MSc CGEOL MCIWEM CSi CEnv FIQ
Principal Consultant

Drawings



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Approximate site boundary

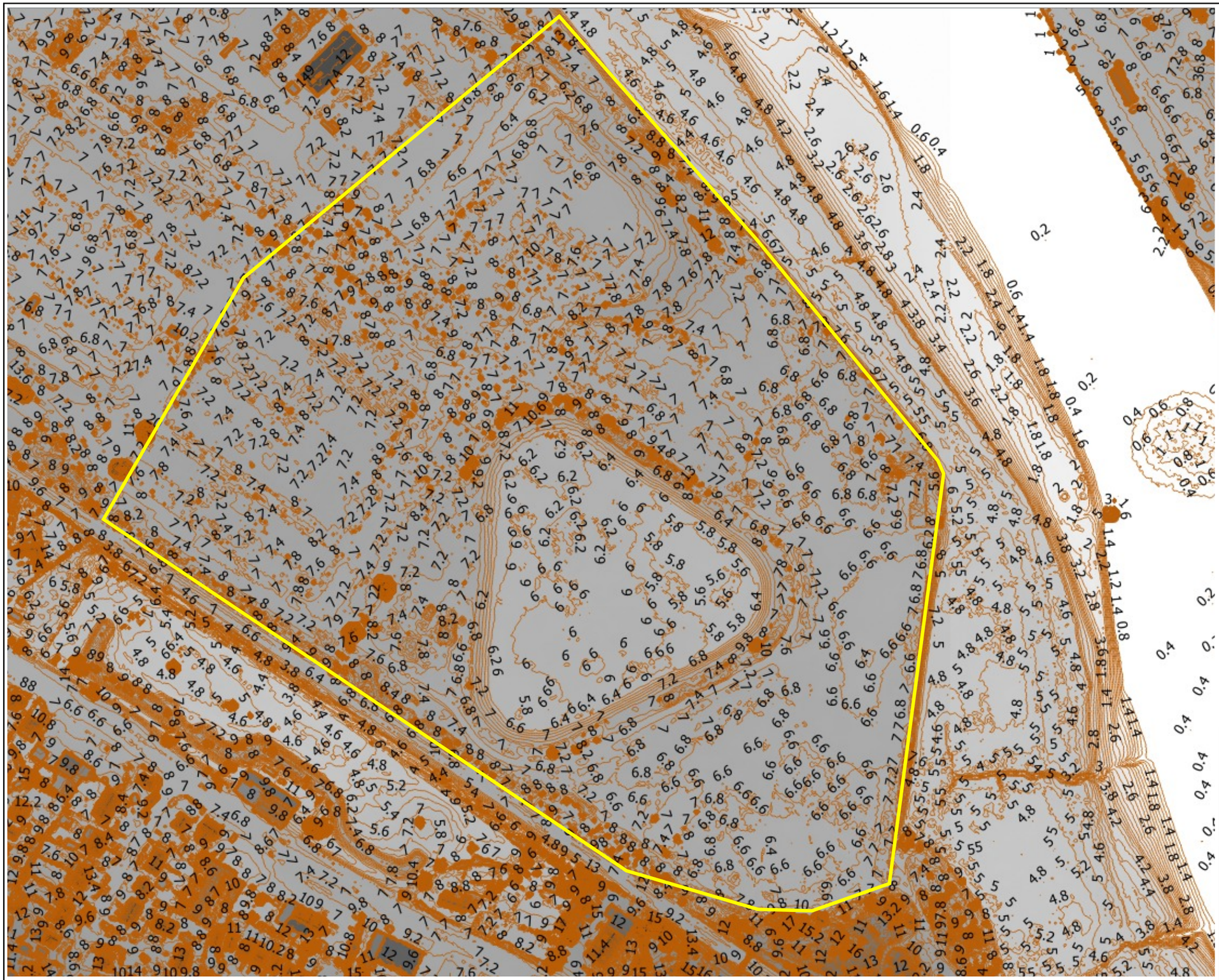
CLIENT:
UNIPER TECHNOLOGIES LIMITED

PROJECT:
CONNAH'S QUAY POWER STATION SOUTHERN SITE

FLOOD CONSEQUENCES ASSESSMENT

Ref:031/34/01/1220	Date: December 2020
Approved: smf	Rev:

DRAWING 031/34/01
SITE LOCATION AND LOCAL HYDROLOGY



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Approximate site boundary

CLIENT:
UNIPER TECHNOLOGIES LIMITED

PROJECT:
CONNAH'S QUAY POWER STATION
SOUTHERN SITE

FLOOD CONSEQUENCES ASSESSMENT

Ref:031/34/02/1220	Date: December 2020
Approved: smf	Rev:

DRAWING 031/34/02
LIDAR GROUND LEVEL DATA (1M RESOLUTION: 2017 DSM)

Appendix A

NRW Flood Data Extracts

1. 2015 Tidal Dee Model flood levels table

2. 2016 Tidal Dee Breach Model – Present day 1:200yr flood extents

3. 2016 Tidal Dee Breach Model – 2115 1:200yr flood extents

							Climate Change Scenarios						Sensitivity Analysis Scenarios	
Node Point ID	Easting	Northing	0.5% AEP (2011)	0.5% AEP (2015)	0.1% AEP (2011)	0.1% AEP (2015)	0.5% AEP (2065)	0.5% AEP (2090)	0.5% AEP (2115)	0.1% AEP (2065)	0.1% AEP (2090)	0.1% AEP (2115)	0.5% AEP (2090) Upper Band	0.5% AEP (2115) Upper Band
10114710	340258	365532	6.31	6.32	6.47	6.48	6.58	6.79	7.02	6.68	6.93	7.09	6.93	7.09
10114210	339782	365578	6.32	6.33	6.46	6.46	6.57	6.76	7.05	6.64	6.93	7.13	6.94	7.12
10113710	339680	366030	6.35	6.35	6.48	6.49	6.57	6.77	7.01	6.64	6.94	7.09	6.94	7.09
00010113210u	339762	366511	6.42	6.42	6.57	6.58	6.68	6.86	7.14	6.81	7.05	7.21	7.06	7.20
10112990	339581	366629	6.42	6.43	6.58	6.58	6.69	6.87	7.14	6.82	7.06	7.21	7.06	7.20
10112710	339413	366420	6.4	6.41	6.55	6.56	6.66	6.82	7.09	6.77	7.02	7.17	7.02	7.17
10112210	339090	366037	6.43	6.44	6.57	6.58	6.71	6.88	7.14	6.83	7.05	7.20	7.06	7.19
10111710	338769	365653	6.45	6.45	6.6	6.61	6.74	6.93	7.18	6.88	7.08	7.24	7.08	7.23
10111450	338602	365454	6.46	6.47	6.63	6.63	6.76	6.97	7.21	6.92	7.11	7.27	7.11	7.27
10111210	338367	365402	6.46	6.46	6.63	6.63	6.75	6.96	7.20	6.91	7.10	7.26	7.10	7.26
10110710	337869	365347	6.48	6.49	6.65	6.66	6.80	7.02	7.25	6.95	7.18	7.31	7.16	7.31
10110210	337413	365514	6.48	6.49	6.65	6.65	6.81	7.01	7.25	6.95	7.17	7.31	7.16	7.31
10109710	336984	365773	6.49	6.49	6.65	6.66	6.82	7.05	7.27	6.97	7.20	7.34	7.18	7.33
10109210	336557	366035	6.49	6.49	6.66	6.67	6.82	7.07	7.29	7.00	7.21	7.35	7.19	7.35
10108710	336129	366296	6.49	6.50	6.67	6.68	6.85	7.09	7.31	7.02	7.23	7.37	7.21	7.37
10108210	335701	366557	6.49	6.50	6.67	6.68	6.87	7.10	7.31	7.02	7.23	7.37	7.22	7.38
10107710	335274	366818	6.49	6.50	6.69	6.70	6.87	7.12	7.32	7.03	7.23	7.39	7.23	7.39
10107210	334845	367078	6.49	6.50	6.69	6.70	6.88	7.14	7.34	7.06	7.26	7.41	7.26	7.41
10106710	334417	367339	6.48	6.49	6.69	6.70	6.88	7.16	7.34	7.07	7.28	7.42	7.28	7.42
10106210	333989	367599	6.47	6.48	6.69	6.70	6.90	7.16	7.35	7.08	7.29	7.42	7.29	7.42
10105710	333561	367859	6.48	6.49	6.71	6.72	6.92	7.18	7.39	7.08	7.32	7.46	7.32	7.46
10105210	333133	368120	6.48	6.49	6.71	6.72	6.92	7.20	7.41	7.11	7.34	7.48	7.34	7.48
10104710	332705	368381	6.48	6.48	6.7	6.71	6.91	7.20	7.42	7.12	7.35	7.49	7.35	7.50
10104210	332277	368641	6.47	6.48	6.68	6.69	6.91	7.20	7.43	7.13	7.35	7.51	7.35	7.51
10103710	331849	368901	6.48	6.49	6.69	6.70	6.93	7.21	7.46	7.13	7.37	7.55	7.37	7.55
10103210	331422	369164	6.48	6.49	6.7	6.71	6.93	7.23	7.47	7.12	7.38	7.58	7.37	7.58
10102710	331002	369438	6.48	6.49	6.69	6.71	6.92	7.24	7.48	7.13	7.38	7.60	7.38	7.60
10102220	330583	369713	6.48	6.49	6.68	6.69	6.90	7.24	7.50	7.14	7.39	7.62	7.39	7.63
10101970	330367	369836	649	6.50	6.7	6.71	6.90	7.23	7.51	7.14	7.40	7.64	7.40	7.65
10101720	330123	369893	6.47	6.48	6.69	6.70	6.90	7.22	7.51	7.13	7.39	7.62	7.39	7.63
10101240	329625	369943	6.49	6.50	6.7	6.71	6.91	7.21	7.52	7.11	7.38	7.66	7.38	7.65
10100740	329192	370149	6.49	6.50	6.71	6.72	6.90	7.22	7.52	7.11	7.38	7.68	7.38	7.68
10100240	329025	370615	6.47	6.48	6.69	6.70	6.87	7.20	7.49	7.11	7.36	7.64	7.35	7.64
10100000	328871	370804	6.47	6.48	6.68	6.69	6.88	7.19	7.47	7.10	7.35	7.62	7.34	7.62
Est_24000	328069	371550	6.54	6.55	6.75	6.76	6.93	7.25	7.56	7.16	7.44	7.76	7.43	7.75
Est_23000	327307	372191	6.52	6.53	6.74	6.75	6.92	7.21	7.54	7.13	7.41	7.73	7.40	7.71
Est_22000	326572	372848	6.52	6.53	6.73	6.74	6.90	7.19	7.51	7.11	7.38	7.70	7.37	7.69
Est_21000	325841	373506	6.5	6.51	6.71	6.72	6.88	7.17	7.51	7.08	7.37	7.70	7.36	7.70
Est_20000	325192	374187	6.5	6.51	6.7	6.71	6.88	7.17	7.51	7.08	7.37	7.71	7.36	7.70
Est_19000	324852	375111	6.49	6.50	6.69	6.70	6.88	7.19	7.53	7.09	7.39	7.72	7.38	7.71
Est_16000	322649	375610	6.47	6.48	6.69	6.70	6.89	7.19	7.53	7.10	7.39	7.72	7.38	7.71
Est_15000	322091	376418	6.47	6.48	6.69	6.70	6.89	7.19	7.52	7.09	7.38	7.71	7.37	7.70
Est_14000	321265	376979	6.45	6.46	6.67	6.68	6.86	7.18	7.50	7.09	7.36	7.68	7.35	7.68
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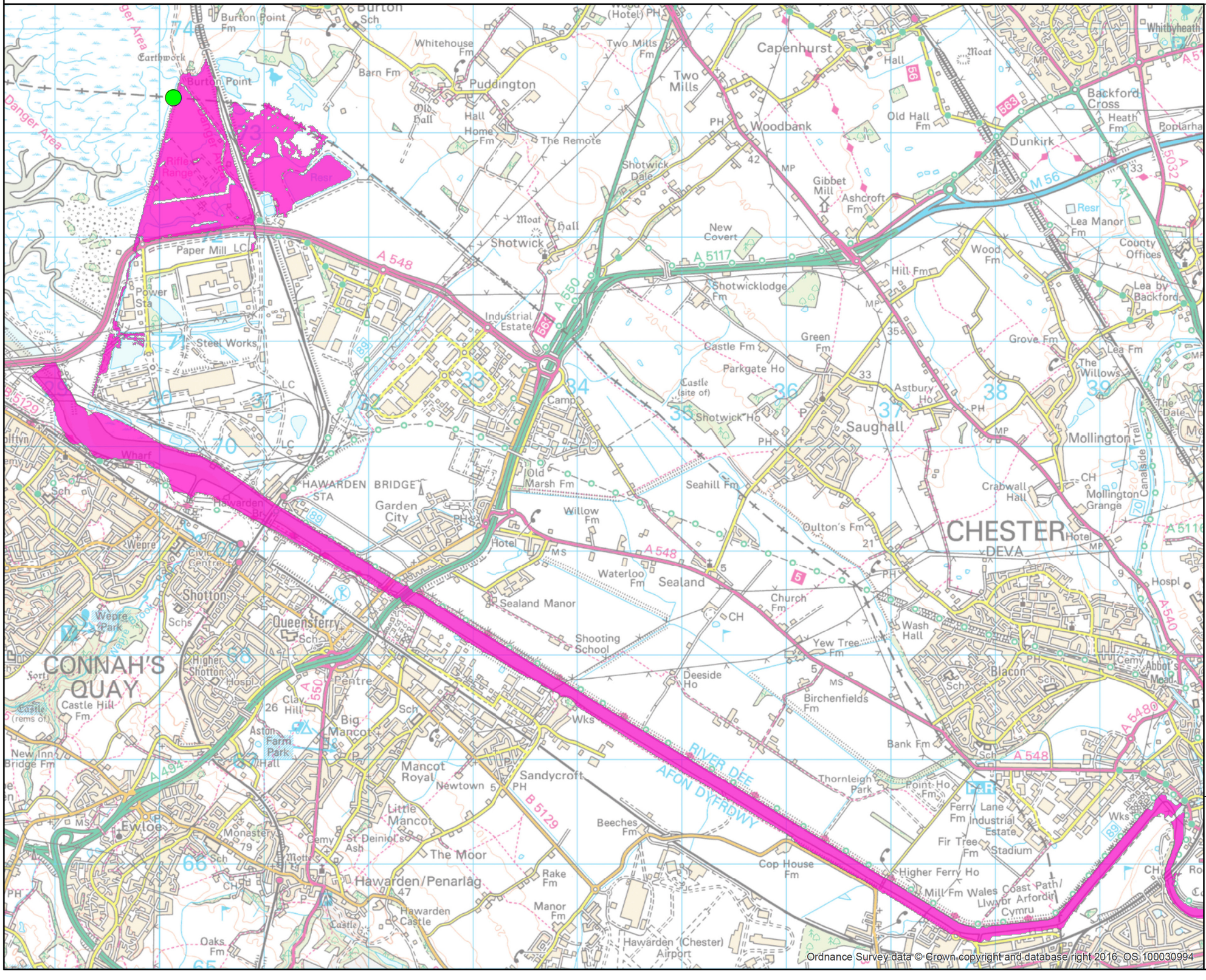
Est_12000	320451	378658	6.41	6.42	6.65	6.66	6.84	7.14	7.47	7.05	7.33	7.65	7.32	7.64
Est_11000	320248	379623	6.36	6.38	6.62	6.63	6.82	7.13	7.44	7.04	7.31	7.62	7.30	7.61
Est_10000	319896	380564	6.34	6.35	6.59	6.61	6.79	7.11	7.41	7.02	7.29	7.59	7.28	7.59
Est_7000	320594	383146	6.25	6.27	6.49	6.50	6.69	7.03	7.34	6.93	7.23	7.52	7.22	7.50
Est_6000	320174	383930	6.21	6.23	6.45	6.46	6.65	6.99	7.30	6.89	7.19	7.47	7.18	7.46
Est_5000	319627	384740	6.17	6.18	6.41	6.42	6.60	6.93	7.26	6.84	7.14	7.44	7.13	7.42
Est_4000	318992	385519	6.13	6.14	6.38	6.39	6.56	6.88	7.22	6.79	7.09	7.42	7.07	7.40
Est_3000	318347	386290	6.08	6.09	6.32	6.33	6.50	6.80	7.15	6.72	7.02	7.36	6.99	7.34
Est_2000	318017	387214	6.02	6.03	6.25	6.26	6.43	6.74	7.08	6.65	6.95	7.28	6.93	7.27
Est_1000	317700	387800	5.98	5.99	6.2	6.21	6.38	6.69	7.05	6.60	6.91	7.27	6.89	7.25

Cyfoeth Naturiol Cymru
Natural Resources Wales

T200 2015 - Broken Bank Breach from start



Legend

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Breach Location

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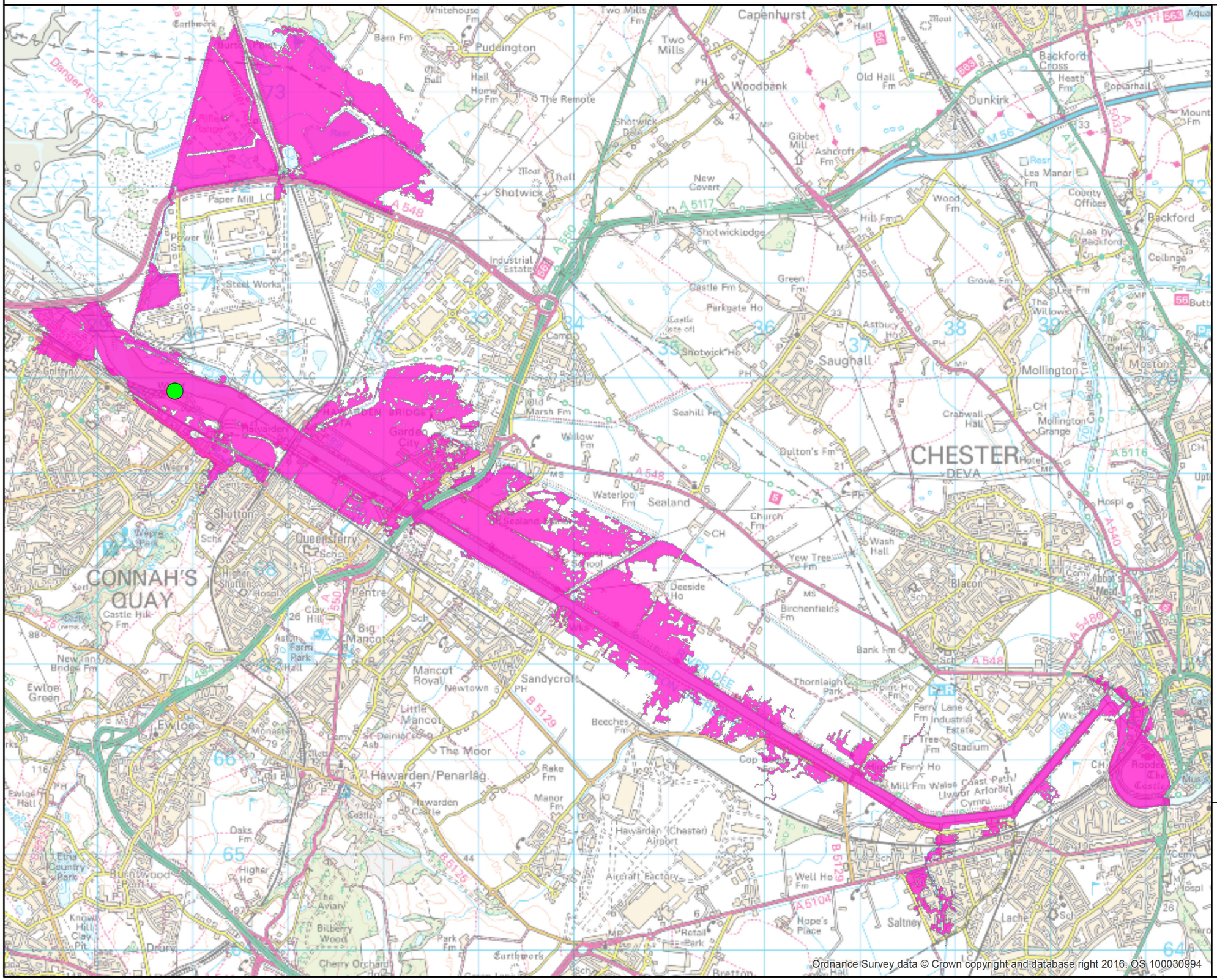
Cyfoeth Naturiol Cymru
Natural Resources Wales

T200 2115 - Dock Road Breach from start



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Legend

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