NOTE TO FILE

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1 Flintshire SFCA Breach Modelling Method Statement

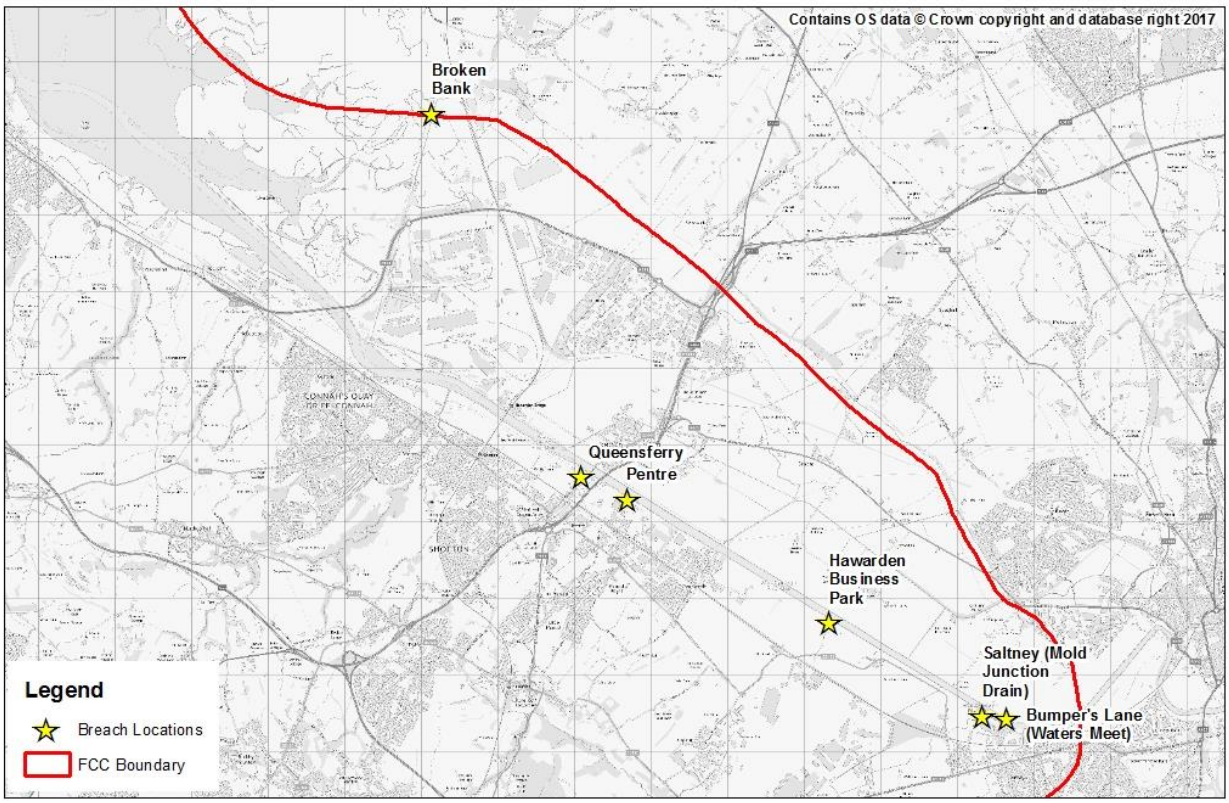
1.1 Objectives

As part of the Flintshire SFCA, some hydraulic modelling is required to assess the risk to development sites from breaching of the River Dee embankments. Flintshire County Council have specified six locations where they require breaches to be modelled:

- Saltney (Mold Junction Drain)
- Bumper's Lane (Waters Meet)
- Hawarden Business Park
- Pentre
- Queensferry
- Broken Bank.

The six proposed locations for breaches are shown below in Figure 1-1.

Figure 1-1: Breach Locations for Flintshire SFCA



1.2 Available Data

The Tidal Dee model has been made available under licence by Natural Resources Wales (NRW) for use in this study. This includes a set of breach models that were configured by NRW in 2017, which include all six of the locations requested by Flintshire.

Prior to the breach runs, the Tidal Dee model was last updated by JBA Consulting in 2012 to run the revised extreme sea levels through the original linked 1D-2D model that was produced in 2010 for the Tidal Dee Strategy. Some important aspects of the previous modelling include;

- The Tidal Dee model has a 10m cell size.

- Model grid elevations are read in from a zpts layer rather directly than a LIDAR ASCII grid. The latter is now a more up-to-date approach.
- The model has previously been run for 40 hours for each breach model, which includes three tidal cycles, with the peak tide occurring in the second tide cycle at around T=27 hours.
- The breach models took ~4 hours to run.
- The breaches have been run for the 0.5% and 0.1% AEP tidal events for present day and the 0.5% AEP event for future climate change (years 2090 and 2115).
- The sea level rise modelled due to climate change is in accordance with the FCDPAG guidance (from 2006) which is consistent with the most recent climate change guidance for planning[1].

1.3 Proposed Approach

Our proposed approach is to use the Tidal Dee model and the same breach locations that were used by NRW in 2017 (Figure 1-1). The breach locations are shown in more detail with the LIDAR data in Figure 1-2. These breaches are close to areas to some of Flintshire CC's main development sites and are already located at areas that are considered to be more prone to risk, such as outfall structures, so are in accord with current NRW guidance relating to breaches[2].

1.3.1 Breach Parameters

Each breach will be configured in accordance with the NRW guidance relating to breaches[2], specifically:

- The breach widths will be 50m, as they are all considered to be breaches to earth embankments in tidal (estuary) river reaches;
- The duration of the model run will extend to 36 hours (i.e. 3 tide cycles) after the initiation of the breach (which is an estimation of time lapse between initial breach and subsequent repair).
- Since overtopping may not occur at the breach location across the range of modelled events, the initiation of breaching will be timed to coincide with the peak water levels in the Dee Estuary. For model stability purposes, the breach will initiate half an hour before the peak of the event, and will gradually be reduced to the base level of the defence over a half hour period so that the breach is fully formed at the tidal peak.

The above represents a small departure from the methodology previously used by NRW, in that the model runs will be extended to include 3 tide cycles (i.e. 36 hours) after the formation of the breach whereas the NRW models modelled only 2 tide cycles following breach formation. The modelled tidal series will not need to be updated for this as they already extend beyond the fourth cycle.

1.3.2 Model Updates

JBA propose the following updates to the model are carried out for this study:

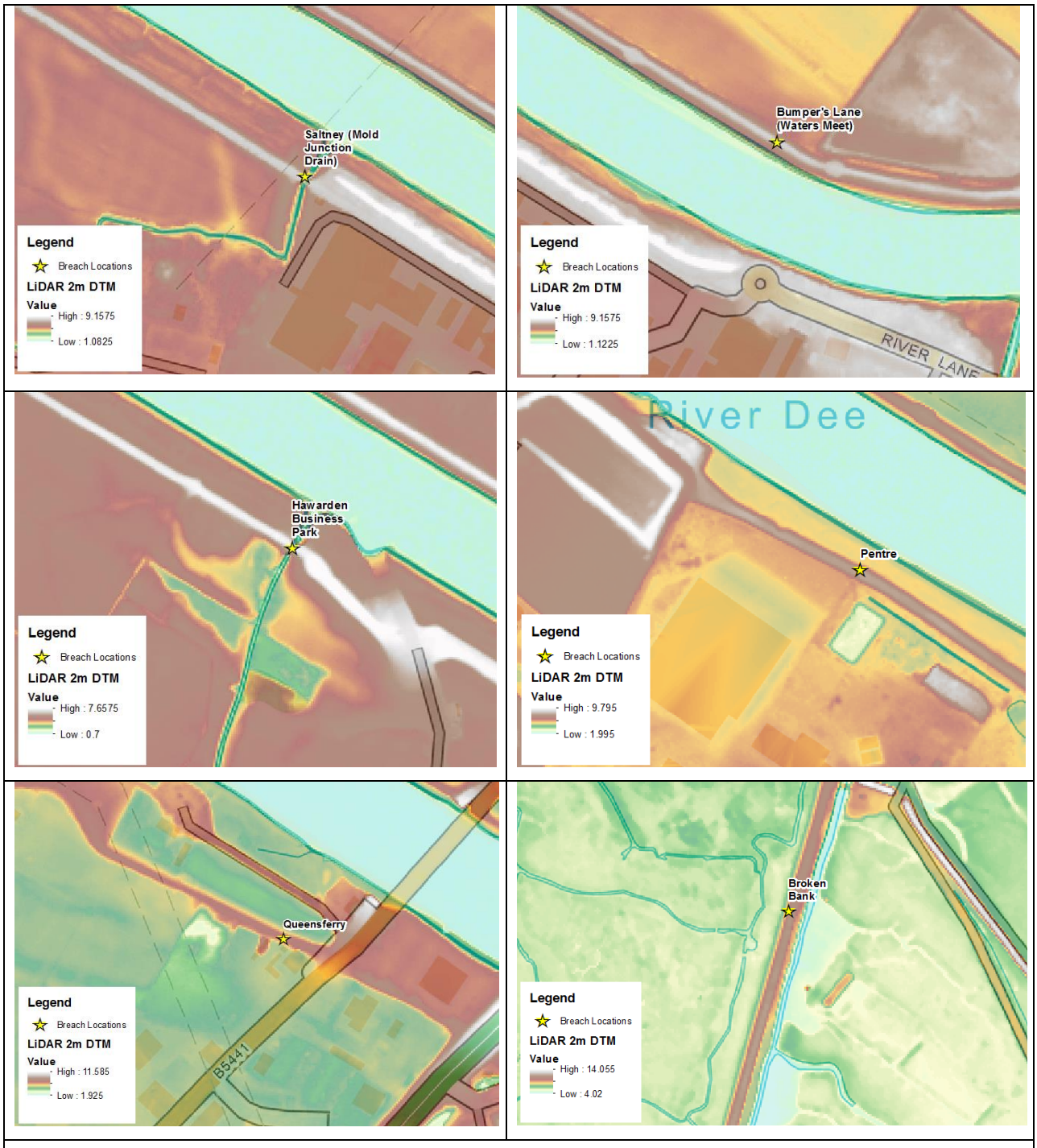
- The representation of the Dee embankments should be updated to include the information captured by the North Wales Tidal Defence Survey (2015). The current configuration of the embankments in the model is from survey carried out largely in 2005-2006 and therefore so does not reflect the most up-to-date assessment of the embankment crest levels. The crest levels will potentially be important when breaching is likely to be accompanied by overtopping of the embankments.
- It is proposed that the 2D model topographic grid is updated by directly reading in the most recent LIDAR. The most recent LIDAR for much of the model extent is from 2008, which would have been used in the original model; however, there is some more recent LIDAR flown in 2013 which would improve the model definition around the Queensferry and Pentre areas. Even in the areas where LIDAR has not been flown since the original model, this will still represent a useful model update, as the resulting model will be much more flexible to varying the model definition (i.e. cell size).
- It is also proposed that the 2D model roughness is updated using the most recent OS MasterMap data, since this will ensure that any recent developments are captured within the model.

[1] Guidance for Flood Consequence Assessments – Climate Change Allowances, Welsh Government, 2016.

[2] Flood Risk Management: Modelling blockage and breach scenarios guidance, OGN100, Natural Resources Wales, February 2015.

- It is likely that the 10m cell size will be retained for the breaches. However, a lower cell size could be beneficial in the event of localised urban flows, in which case there may be benefit in sensitivity testing a lower cell size (e.g. 6m) for critical breaches. However, this would likely lead to a significant increase in model run times, if used for all model runs.

Figure 1-2: Six proposed breach locations compared to LIDAR data



Ideally, the breach models should provide an appropriate representation of any raised embankments (such as roads and railways) and floodplain culverts, which may be critical for defining flow routes once water is on the floodplain. The most accurate way of defining these is through survey data. Therefore, JBA would need to request any available survey available on raised road and railway embankments, and floodplain culverts to incorporate this information into the model. However, if there was no available survey, JBA propose to model the embankment features using Z lines based on interpolating LIDAR levels (potentially necessary because of the large {10m} model cell size) and any floodplain culverts would be modelled by assuming a reasonable size and geometry to allow water to pass through the culvert (e.g. 900mm diameter circular culvert with invert levels based on LIDAR data).

1.3.3 Model Runs

Six model runs will be undertaken for each breach:

- 0.5% and 0.1% AEP events for present day;
- 0.5% and 0.1% AEP events for present day at 95th percentile for Extreme Sea Levels; and
- 0.5% and 0.1% AEP events accounting for future climate change in year 2117 (100 years in future).

There are already tidal curves set up for the 0.5% and 0.1% AEP events for present day. The tidal curves for the future climate change scenarios are currently configured for the Year 2115 so will be updated with two extra years of sea level rise to take the scenarios to 2117. New tidal curves will be derived for the 0.5% and 0.1% AEP events for present day at the 95th percentile, based on the Extreme Sea Levels dataset.