



NOVEMBER 2012 FLOODS AT GLASDIR, RUTHIN FROM THE RIVER CLWYD

EXECUTIVE SUMMARY OF THE REPORT ON THE REVIEW by the Independent Panel for the Evaluation of Hydrology, Flood Risk and Causes of Flooding

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Client Issue 2
27 August 2013

Quality Assurance

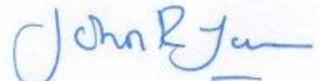
Project Name River Clwyd Ruthin, Independent Evaluation of Hydrology & Flood Risk
Project No Crane 2012-12
Version Client Issue 2
Client Denbighshire County Council
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RECORD OF ISSUE

Document File Name	Rev	Date
Ruthin-Glasdir Flooding Review Report - Client Issue 1 - 2013-08-23.docx	1	23 August 2013
Ruthin-Glasdir Flooding Review Report - Client Issue 2 - 2013-08-27.docx	1	27 August 2013

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Executive Summary

On 27th November 2012 heavy rain on a wet catchment caused high flows in the River Clwyd, which flows through Ruthin. Although the Glasdir residential development has a flood defence system comprising flood relief culverts and flood defence bund, 122 houses suffered internal flooding. Serious flooding also occurred in St Asaph and in many rural areas, indicating that it was an extreme event within the general area. However, the houses at Glasdir had recently been constructed, the development was still being built by Taylor Wimpey, and it was understood that the houses were protected to withstand a 1 in 1000 year flood event.

Denbighshire County Council (DCC) and Natural Resources Wales (NRW) (formerly Environment Agency Wales) carried out an initial investigation into the cause and DCC appointed this Independent Panel to assist with the investigation.

The Terms of Reference (see Appendix 1) explain that the Council wanted to understand:

- Why the flooding occurred
- What the likelihood of recurrence may be
- What can/should be done to by all relevant flood risk management authorities to minimise flood risk to properties in future events

And that the investigation should address the following;

- a) The weather conditions during and preceding the flood events.
- b) The degree to which flood defences and other alleviation/management measures operated as intended, including specifically any factors that may have prevented their full operation.
- c) The overall flood risk assessments for the affected areas and the continued adequacy of these in the light of the flood events. This should include assessment of whether changes to river patterns and/or flood management measures have changed flood risks since the last assessment was concluded.
- d) Whether, in the light of the flooding experienced on 26th/27th November 2012, relevant flood risk management authorities should implement modifications or additions to their flood defence, alleviation and management measures to minimise risk of future flooding to an acceptable level.

The background to the Glasdir development is that the Welsh Development Agency constructed the Ruthin North Link Road (A525) with a roundabout to the north of Ruthin, to give access to land which had been allocated for development. The Link Road crosses the natural flood plain of the River Clwyd on an embankment, and so the planning application included a bridge and culverts to convey river and flood flows. The project also included a flood bund to protect the land allocated for residential uses, and the Flood Consequences Assessment explains that the flood management system would protect the land beyond a 1 in 1000 year event.

A Developer subsequently acquired the residential land and obtained outline planning consent, which was followed up by reserved matters applications, for the residential

development. At the time of the flood approximately half had been completed, and there is an expectation that the development will be completed in due course.

The independent Panel has visited the site, to understand the local conditions and researched the background to the development and flooding event. The Panel has also met with Officers of DCC and NRW, and met with representatives of the residents to hear about their concerns and to understand what analysis of the event had been undertaken.

NRW was developing the computer flood model for the River Clwyd, and the Panel waited for this to be completed before undertaking its own assessment of the model, and then using the model to test scenarios.

The Panel's analysis began with assessing the records of the maximum flood extent in the Ruthin area, and matching these with the terrain model to determine the river flow in the November event. The extent of flooding in the Glasdir area was then considered in more detail to determine the role that the screens on the culverts under the Link Road had, and particularly the level of blockage.

The flow results were compared with recognised guidance to determine the approximate return period of the flooding, which is judged to be between a 1 in 100 year and 1 in 200 year event, but biased towards 1 in 100 years (i.e. between 1% and 0.5% chance of happening in any one year).

The model also showed that the culverts play a vital role in reducing the risk of flooding at Glasdir. The screens were blocked by between 66% and 95% due mainly to vegetation. If the screens had not been partially blocked, the property flooding would probably not have occurred. The screens were also of poor design, not complying with any recognised standard and were not capable of being safely cleared in an emergency. The screens have since been removed, and the Panel has recommended that the screens are not replaced, since they fulfil no real purpose in terms of health and safety (see CIRIA Culvert Guidance, 2010).

Further analysis was undertaken to determine the level of the flooding for a range of events, including the following, details of which are contained in the Panel's report;

- 1 in 100 year return period (1% chance of flooding in any one year),
- 1 in 100 year with climate change allowance (additional 20% flow)
- Various levels of culvert blockage (0%, 33%, 66% and 95%, in line with recognised guidance)
- 1 in 1000 year (0.1% chance of happening in any one year)

The Panel has considered what would be a normal level of protection if the development were to be promoted at the present day, and feels that the appropriate standard would be a level of protection provided by:

1 in 100 year + Climate Change allowance, with 95% culvert blockage and 600mm freeboard.

The analysis shows that this level of defence would also defend against the 1 in 1000 year event, with less freeboard. The culvert blockage allowance has been included because the culverts are wide and shallow, have been shown to block previously with serious consequences, and the floodplain contains trees and other vegetation, which pose a risk of blockage.

A freeboard of 600mm is a standard requirement for residential areas adjacent to sensitive flooding. The River Clwyd is a sensitive river because the flow varies depending on the state

of the catchment prior to rainfall, the seasonal growth in the catchment and other criteria such as the tolerances of the flood model.

The levels contained within the report can be related to the floor levels of the houses, based on the topographical survey data obtained by DCC.

A number of potential solutions have been considered to provide the recommended level of protection, including additional culverts below the road, removal of Ruthin weir and forming a high bank adjacent to the river. These all have serious consequences downstream of the Link Road, and cause unacceptable increases in flooding to property downstream.

The recommended solution is to form a bank adjacent and to the east of the existing footway. The additional height will be approx. 1.1m at the north end of the embankment to approx. 200mm at the south end of the existing embankment. The detail design needs to ensure that the bank is robust and is tied into the level on the Link Road.

The Panel recommends that a formal inspection and maintenance regime of all the flood defence structures, culverts and flood plain should be established with clear responsibilities. NRW is installing additional flood warning equipment and will set up a reporting system with the Council and Residents.

It is equally important that, whilst responsibility lies with the Authorities, the residents are alert to the flood risk, and recognise that they need to report immediately potential hazards such as flytipping in the flood plain or fallen trees and branches.

One striking feature of the overall project is that there have been many companies involved in the evolution of the development, with six flood reports by different Consultants. This is common to many projects, and a feature of the commercial world of seeking lowest price at each stage. It is important that the Council seeks to encourage those involved in development to provide continuity on projects in future, to ensure that critical aspects are considered throughout the process **and that improvements are made to keep up with developments in design guidance.**

Conclusions

- a) **Key data on the November event** – We have estimated that the flow in the November 2012 event was between 35.9 and 40.4 m³/s, which we judge to be between a 1 in 100 year and 1 in 200 year event but biased towards 1 in 100 year, and the blockage of the culverts was between 66% and 95%.
- b) **Solutions to restore the level of protection** – Various engineering solutions were explored and these are detailed in Section 4 of this Report. It is the Investigating Team's opinion that the solution that offers the earliest and most cost-effective solution to re-instating the flood defences around the development is to raise the bund height.
- c) **Organisational complexity** – The process of preparing the land at Glasdir for development has involved many organisations over many years (see diagram in Appendix 2). During that period the methods of hydraulic modelling have developed and standards and guidance have changed. Communication between the various parties could have been clearer; assumptions previously made could have been challenged. In addition, it is necessary to have an overall view on the interaction between the road built as an embankment and the operation of the flood plain with

respect to the flood risk of the proposed development land. There does not seem to have been continuity of involvement provided during the development of the area, to avoid important criteria being missed.

- d) **Blockages** – The blockage of the culverts played a significant part in causing the flood water to flow over the bund (which was also too low). Thus the proposed height of the bund is based on an assumption of a 95% blockage to the culverts. (See paragraph 3.6.5).

Although blockage was mentioned in previous reports there is no evidence that work was done to assess its impact. It is only recently that a Welsh Government survey has revealed that 60% of flooding incidents on ordinary watercourses (see paragraph 4.3) were caused by blockages.

- e) **Response to the event** – The belief that this development was protected to an unusually high level of 1 in 1000 meant that it was not on the list of high risk areas to visit in a high rainfall event. The vertical grills are hard to clear during a storm once they had become blocked and certainly not safely. Access to the top of the culvert entrances has been improved since the event in November 2012 but clearing the culvert entrances of debris in a storm will not be easy and could be unsafe in an extreme event.
- f) **Planning** – It is clear from the documentation that the land at Glasdir was expected to be protected to a 1 in 1000 (0.1% annually) standard for flood risk management. The calculated level of this 1 in 1000 standard/level has varied over the years as different models and assumptions have been used consistent with practice at the time.
- g) **Datum** – It is unclear whether ‘site datum’ referred to on some drawings is the same as AOD. In addition there is reference on one of the drawings to the possibility of a peat layer under the 5 culverts. Therefore possible settlement of the peat in the area could have had an impact on datum levels and bund heights.
- h) **Grills** – Vertical grills are known to be prone to blockage and are difficult to clear during a storm once they have become blocked. The current standard for grills would be difficult if not impossible to achieve given the form of the culverts and their location. The Panel does not see the need for grills and recommends that they are not re-installed. Posts to capture large obstructions such as branches are feasible and recommended.
- i) **Wind farms and associated tree felling** – The tree felling proposed in association with the proposed wind farm construction is not considered to have a significant impact on future flooding at Glasdir.

Recommendations

- a) **The bund** should be raised to the level shown in the Outline Proposal in Appendix 3, which is based on a 1 in 100 year event with climate change and 95% blockage, with a 600mm freeboard.

Once raised it should be checked regularly and after extreme events (wet and dry) for possible settlement and damage, and repaired if necessary. In setting this height, the demonstrated likelihood of blockage, climate change and uncertainties associated with modelling have been taken into consideration.

Whereas the current bund has an allowance of only 200mm of freeboard, we are recommending 600mm be used as this is in line with custom and practice over several years for residential development. It is anticipated that this flood defence will enable flood insurance to be purchased **without significant increases in premium**.

- b) It is to be hoped that the bund will be permanently raised as soon as possible. However, for the interim, a temporary line of sandbags (or equivalent) should be considered to be used to raise the bund height. Careful monitoring during a storm event is recommended to ensure integrity is maintained.
- c) **Long term management of the flood plain and catchment** area should be organised. The maintenance of the area around the culverts' entrance and exit should particularly be cleared of debris, garden waste and the vegetation kept short. The responsibility for doing the maintenance should be clearly identified.

There is currently a belief (*Managing Woody Debris in Rivers, Streams and Floodplains* written by the Wildlife Trusts and Water for Wildlife (2005) that catchment management should encourage natural processes and so woody debris in the catchment and watercourse would be encouraged. However, this catchment has been severely impacted by the construction of a road across the flood plain on an embankment rather than a bridge structure. This acts as a dam and the mitigation of providing the 5 culverts to pass the flood water is nullified if they block with debris (as happened in November 2012).

Thus this catchment should be maintained to avoid debris being carried by flood flows. In addition, the exits from the culverts should be kept clear. A question has been raised about the need for a channel to connect the land immediately to the north of the culverts with the downstream floodplain. Whilst this is unlikely to have a significant impact during a flood, it would allow this land to drain more effectively to the river downstream of the road after the event. This should be the subject of further study.

- d) **A network of flood wardens** should be put in place with tasks that include monitoring the condition of the flood plain and the culverts. There should be a designated DCC officer to respond to wardens. Organising annual river events during dry spells, to inspect and clear potential obstructions, helps to maintain awareness of the flood risk management system, especially during dry spells. This arrangement is becoming commonplace in areas at risk, and is proving to be an important educational opportunity.
- e) **Linking a flood warning system to an upstream gauge** will be useful to the residents, flood wardens, NRW and DCC. It is vital there is a clear means of communication with identified recipients.
- f) **The grills** have been removed from the culvert entrances and exits and should not be put back. Given the shallow height of the culverts and the staggered entrances and exits, designing screens to conform to the CIRIA Guide, with a low risk of blockage, would be a challenge.
- g) **An alternative** that could be explored is a line of posts around the entrances to the culverts that could catch larger debris and vegetation carried in the flow (see Plate 12, Section 4.3 for photo).

- h) **A 300mm diameter sewer** is shown on the drawings running under the culverts and a broken manhole cover was observed just upstream of the culverts on a visit on 7th August 2013. This manhole cover and any others in the area should be inspected, repaired and made safe in this public area.
- i) **The surface water drainage** within the Glasdir site, in our view, had no discernible effect on the consequences of the flooding on 26/27 November 2012. Its ongoing monitoring, inspection and maintenance is vital to ensure it effectively drains rain water within the site.

Explanation of Abbreviations used

AMAX	Annual maximum peak flow (see para 5.1.3 a)
AOD	Above Ordnance Datum
CFMP	Catchment Flood Management Plan
DAM	Development Advice Map
DCC	Denbighshire County Council
EA	Environment Agency
EA (Wales):	Environment Agency Wales, now Natural Resources Wales
FCA	Flood Consequence Assessment
FEH	Flood Estimation Handbook
GIS	Geography Information System
LiDAR	Light Detection and Ranging
NRW	Natural Resources Wales
QMED	Index Flood, Median flood of annual maximum peak flow series (see para 5.1.3)
SEA	Strategic Environment Assessment
SuDS	Sustainable Drainage Systems
WDA	Welsh Development Agency

Acknowledgements

The Investigating Panel gratefully acknowledges the assistance given by DCC, especially Wayne Hope, by the staff at Natural Resources Wales (previously the Environment Agency Wales), and by the Residents Committee of the Glasdir Estate.



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