Water Resource Associates

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Proposed Residential Development, North of Appleford Road, Sutton Courtenay, Oxfordshire, OX14 4NF

Review of the Flood Risk Assessment produced by Peter Brett Associates on Behalf of O & H Properties Ltd

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Version 4: Final report including groundwater monitoring

Background

WRA has been engaged by the residents in Sutton Courtenay in January 2016 to undertake a review of a flood risk assessment (FRA) written by Peter Brett Associates (PBA) and submitted as part of the planning application by O & H Properties Ltd to build 93 houses on the site.

Document Contents

The FRA and associated documents were completed by PBA on 25th November 2015 and submitted in December 2015. The full submission consisted of five files including the main reports and appendices as follows:
FRA1.pdf - Main report of 48 pages including appendices A-C;
FRA2.pdf - Appendix D, 7 pages of maps;
FRA3.pdf - Appendix E, 2 pages of maps;
FRA4.pdf - Proposed drainage plan (2 pages);
FRA5.pdf - Appendix G, 5 pages of computer software output.

The main report has the following breakdown of contents:

Pages 1-4 (numbered i to iv): Cover page, update record and contents;
Page 5 (numbered as page 1): Executive summary;
Pages 6-21 (as numbered 2-17): Report main text;
Pages 22-23 (not numbered): Appendix A Topographic survey map;
Pages 24-26 (not numbered): Appendix B Proposed development layout plan
Pages 27-38 (not numbered): Appendix C Environment Agency information including 10 pages of maps and predicted flood levels and a further 10 pages of e-mail correspondence;

Overview

A FRA is a detailed report which is submitted as part of a planning application. This is required where development sites are shown to be within areas of medium to high risk of flooding as shown on the Environment Agency's (EA) flood zone maps, or required for any areas in excess of 1 ha in area. The aim of the FRA is to consider the flood risk to the development site from all sources and to ensure the flood risk to neighbouring properties is not increased by the development. The level of detail associated with a FRA should be in proportion to the size of the development, therefore a greater level of detail would be expected for a significant housing development such as in Sutton Courtenay as opposed to a proposed single dwelling development. The 64 pages of the report and associated documents submitted by PBA would appear to be of reasonable detail given its length. However only 16 pages are actual written text and the majority of the report is made up of appendices with information either copied from 3rd parties or printouts from computer software.

FRA Review

The review undertaken for this study has shown that details are missing in terms of the description of the site itself, the geology, soils and hydrology of the area, the calculation of the greenfield and developed site surface runoff and the design of the sustainable drainage system (SuDS). These are covered in more detail in the following sections.

Site Description, Topography and Geology

The description of the site is rather brief and in particular there are no ground-level or aerial photographs showing the development site in its current state. The description misses the fact that the site is a former area of gravel extraction which has now been filled with inert landfill such as building waste and spoil. This is referred to in the description of the geology but the history of the site land use should have been made clear in the site description.

The topographic survey as presented in Appendix A is poorly presented and illegible at the normal A4 page size. Generating a digital terrain model from the topographic survey and displaying this as a shade colour-ramp image would give a better presentation of the topography. The description of the topography only considers the levels at the site itself and does not assess whether the neighbouring areas are higher or lower than the site. This aspect is important to determine whether neighbouring areas would potentially be affected by surface runoff from the impermeable surfaces of the new development.

The description of the site in terms of the geology is poor and it is unclear where the information about the sub-surface material has been obtained. Section 2.5.1 stated that an intrusive investigation has been undertaken. This would be either one or more trial pits or boreholes over the site but no details are given as to the type and source of the investigation. Usually such information is either referenced (e.g. British Geological Survey data) or included in an appendix from the results of fieldwork. It appears that the information is from a Ground Investigation Report also undertaken by PBA as part of the application but submitted as a separate document. The FRA should confirm the source of this data, otherwise it should not be accepted by the EA and local authority. Maps from the British Geological Survey and the Environment Agency are shown in Appendix E. These maps are included to show the geology and aquifer designations at the site. The maps are at a low resolution so it is impossible to identify the geological units at the site, furthermore there are no keys indicating the different shadings on the maps which makes them meaningless.

Information on the geology is particularly important to assess the risk of groundwater flooding at the site and also for the design of surface water management. The proposed drainage strategy for the site includes 2 storage ponds and a swale. The depth to the water table (i.e. groundwater depth) will be critical in determining how these measures will perform. During the winter for example high groundwater could significantly reduce the storage capacity. The FRA refers to groundwater levels in August and September 2015 being 2-3m below ground level, again no source for this information is given. However, this is the

part of the year when levels are likely to be at their lowest. Investigations on site should be made to determine typical winter groundwater depths.

Catchment Hydrology and Flood Risk

Apart from acknowledging that the River Thames lies approximately 200m to the north of the site there is no description about the hydrology which is a basic requirement for any flood risk assessment. In this case as the Thames is the one of the largest and intensively monitored rivers in the UK, with quality data going back to the late 19th century there is plenty of accessible data which can be used in the FRA. Information relating to flood risk simply reproduces data provided by the Environment Agency without any further details about how this data has been generated or any accounts of historical flooding. The EA maps show 6 separate historical flood extents from 1947 – 2007, other flood events have since been observed in Sutton Courtenay in 2008, 2012 and 2014. This high frequency of flooding in close proximity to the site should warrant some discussion within the FRA on the causes and nature of flooding, and those areas of Sutton Courtenay which are particularly susceptible.

In addition to the proximity of the site to the River Thames, the drainage ditch forming the eastern boundary of the site is also a notable feature of the site hydrology. The OS 1:50,000 map for the area shows the ditch extending approximately 2km to the south, therefore receiving water from a reasonable area. No further information has been provided about the catchment of this ditch nor has any assessment made of the potential flood flows in the ditch and possible impacts on the site.

A number of maps are presented in Appendix D from the Oxfordshire Council Preliminary Risk assessment and Vale of White Horse Strategic Risk Assessment. The maps are all taken directly from the reports and are at low resolution so it is barely possible to identify the location of the site. One map (Map 7) indicates that most of Sutton Courtenay is susceptible to groundwater emergence. Many of the soils are described as loamey and clayey floodplain soils with naturally high groundwater (Cranfield University, 2016). Significant areas of groundwater flooding were observed in the fields around Sutton Courtenay in 2014 (Figure 1). The EA and local authority should demand more detail on the groundwater levels of the site in order to address this potential risk.

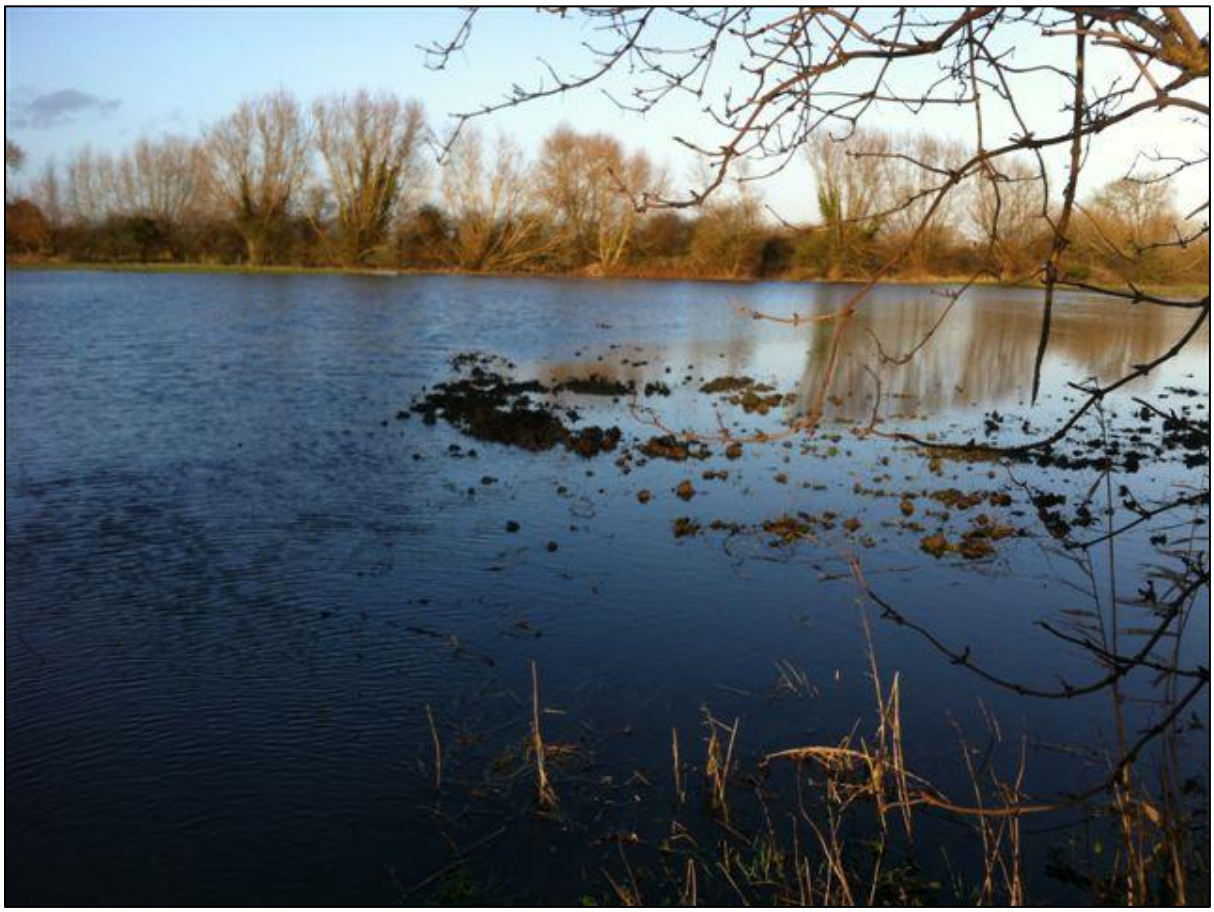

Figure 1. Groundwater flooding observed in Sutton Courtenay in February 2014.

Residents have also observed floodwater from the Appleford Road flowing into properties as shown in Figure 2. This photo is at the entrance to 5 Appleford Road, which borders the south-west corner of the site and has a similar ground level to this part of the site.

The proposed levels for access roads to the new development off the Appleford Road are not listed in the FRA and the proposed drainage layout is at a low resolution so spot heights are illegible. The FRA should discuss the risk of flooding posed by these access roads. Depending on the relative levels floodwater could flow onto the Appleford Road adding to the severity of flooding previously experienced or water from Appleford Road could flow into the site and affect the new houses. The FRA states that the ground floor levels of the houses should be set at a minimum of 300mm above the predicted 100 year plus climate change flood level, but this actual level is never stated in the FRA.

Figure 2 Flooding at 5 Appleford Road in 2007 from surface runoff from the Appleford Road.

A section on safe access to and from the site is included in the FRA where the text states that the access routes onto the adjacent B4016 Appleford Road are all set at or above the predicted 100 year plus climate change flood level. The text fails to mention however that all of the roads leading to and from the site, the B4016 and the minor road leading north over the River Thames to Culham, will be flooded by the 1 in 100 year plus climate change event, as clearly shown in figure 3.4 of the FRA. Therefore access from the site during the design flood event will be affected. The EA and local authority should request that the FRA provides details for safe access during this event.

Surface Runoff Calculations

The PBA report includes a discussion of Surface Water and SUDS in Section 5 intended to demonstrate that the proposed development will not increase the risk of flooding to neighbouring properties. The purpose of SUDS (sustainable drainage systems) is to ensure that the surface water runoff from the impermeable surfaces of a new development is attenuated so that the rate at which the excess water is conveyed to waterways is no greater than that which would be experienced under greenfield conditions.

The FRA provides little detail on the design and required calculations for the SUDS. The text refers to the use of Microdrainage software to determine the sizes of the storage basins (shown in Table 5.2) but gives no information on how the volumes have been derived. The values listed in this table should be checked since the contributing area given for each basin

is less than the impermeable area. This cannot be correct as the impermeable area has been calculated as being 60% of the contributing area. Appendix G is simply pages of results from the Microdrainage software which are meaningless to anyone without knowledge of the software or flood estimation. The FRA would benefit from a simple summary showing the greenfield peak surface runoff the development site peak surface runoff and the storage required to ensure the discharge from the developed site does not exceed the greenfield rate.

Some further errors in this section highlight the lack of attention to detail within the FRA. The Microdrainage results give the maximum levels in the region of 99m with an invert level of the storage pond outlet as 98.7m. This is impossible as the land is at a maximum of 51.2m AOD. The EA and local authority should request that the Microdrainage simulations are re-run using the correct level values for the site. The text also describes a drainage ditch which drains into the River Windrush (Section 5.3.2).

The text of the FRA does not fully explain how the SUDS design is tested with extreme rainfall over specific durations. The rainfall magnitudes should be listed and compared with actual observed rainfalls from historical events such as July 2007 (Marsh and Hannaford, 2007) when many surface drainage systems failed. This would provide a context to the robustness of the SuDS design.

The design itself has no explanation about some of the features. A swale is proposed but no description of its purpose, its dimensions, nor any design drawings are included. A swale is a broad ditch with a gentle gradient used for the temporary storage of excess surface water. The water will be lost to evaporation and slowly percolate into the soil. However it appears that the swale shown in the proposed drainage (file FRA4.pdf) design will be used to convey water from the storage pond into the existing drainage ditch at the east of the site. This design is describing a ditch rather than a swale. The storage pond volumes are given in Table 5.2 and surface areas are given in the drainage design but the correct outlet levels and depths of the ponds are not given. This aspect is particularly important to ensure that water is able to flow from the basins to the receiving watercourse and that the basins can still provide the required storage during times of high groundwater. In its current form the EA and local authority should question the design of the surface water management system and request further information.

Groundwater Monitoring

A Ground Investigation Report for the development site, also undertaken by PBA, presented groundwater monitoring results over the period 6th August to 15th September 2015. This gave groundwater levels 1.90 and 3.05m below ground. Much higher groundwater levels are generally observed during the winter and spring (as demonstrated in Figure 1). In the absence of any groundwater monitoring undertaken for the development site during the period when the water table is expected to be highest (October – April) a series of shallow boreholes were sunk in the gardens of properties along the western edge of the site shown in Figure 3. An initial groundwater level reading was taken on 28/01/2016 (Table 1) and regular monitoring was commenced by the property owners. The results of the monitoring will be made available to the EA and local authority of the coming months. The initial groundwater monitoring found that there was no water within 1m of the surface at sites 1,2,3 and 5, but at site 4

(ground level 48.94m AOD) water was struck at 0.9m below the surface (48.04m AOD).This is over a metre higher than the highest level given in the Ground Investigation Report. It is valid to assume that groundwater levels will follow the topography of the site, therefore groundwater within 1m of the surface could be expected along the northern part of the site where the ground surface is at or below 49.0m AOD.

Table 1. Groundwater levels at boreholes bordering the development site.

Borehole Number (Fig 3)	Borehole Depth (m)	Ground level (m AOD)	Water on 28/01/2015	Water level (m AOD)
1	0.97	50.88	N	
2	0.97	50.74	N	
3	0.72	49.51	N	
4	1.09	48.94	Y	48.04
5	0.97	50.80	N	

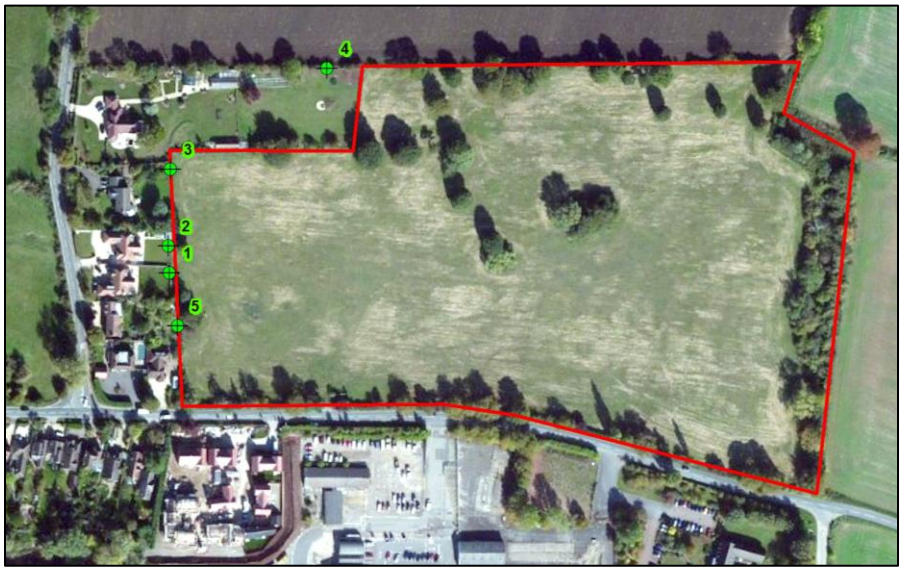

Figure 3. The location of boreholes along the boundary of the development site (red outline).

Conclusions

The PBA flood risk assessment for the housing development North of Appleford Road, Sutton Courtenay is generally lacking in important detail and punctuated by a number of errors. The report fails to provide an adequate description of the flood risk at the site and the proposed SUDS design. The FRA should be rejected by the EA and local authority. Information is missing from the following key areas:

- The site description lacks detail on historical landuse and there are no photos of the site;
- The report does not have any topographic information for neighbouring areas outside of the site;

- A description of the geology is given based on an intrusive survey, but no details are provided about this survey and the source of the data;
- The description mentions groundwater levels in August and September when they would be lowest. Groundwater levels should be taken at the site during the winter as Sutton Courtenay is known to be vulnerable to high groundwater;
- Basic hydrological information is missing about the River Thames its catchment area, and the ditch along the eastern edge of the site;
- No details on historical flooding are included apart from maps provided by the EA;
- All roads leading to the site are flooded by the design flood event, and there is no description in the FRA on how safe emergency access can be achieved to and from the site;
- An explanation of the Microdrainage results as part of the SUDS design is required;
- There are errors in the values listed in Table 5.2 and in the water/pond levels given in the Microdrainage results;
- No depths are provided for the storage ponds and the outlet levels given are incorrect, it is not clear whether the system will provide adequate conveyance to receiving waterways or have adequate capacity during times of high groundwater;
- There are concerns of potential surface water flooding from the site affecting properties on the Appleford Road.
- The risk of groundwater flooding has not been properly assed in the FRA;
- Monitoring of groundwater levels in gardens bordering the development site was started in January 2016;
- Groundwater was found within 0.9m of the surface, at least 1m higher than levels measured in August and September and listed in the Ground Investigation Report.

References

Cranfield University 2016. Soil Scapes http://www.landis.org.uk/soilscapes/

Marsh, T.J. and Hannaford, J., (2007) The summer 2007 floods in England and Wales – a hydrological appraisal. Centre for Ecology and Hydrology, 32pp, ISBN: 978-0-95576772-4-1.