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Proposed Residential Development, Land North of Hobbyhorse Lane, Sutton Courtenay, Oxfordshire

Review of the Sutton Courtenay Flood Risk Assessment produced by JNP Group on Behalf of Redrow Homes

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Version 4: Final Report

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 John Newton and Partners (JNP) and submitted as part of the planning application by Redrow Homes to build 200 houses on the site.

Document Contents

The FRA and associated documents were completed by JNP on 17th September 2015 and submitted in December 2015. The full submission on the Vale of White Horse planning website consisted of 15 files relating to the FRA including the main reports and appendices totalling 169 pages as follows:
Main report of 19 pages;
Appendix A: Topographic Survey (8 pages);
Appendix B: Groundwater Monitoring Results (13 pages);
Appendix C: EA correspondence and SFRA maps (9 pages);
Appendix D: Thames Water Sewer Records and Historical Flooding Records (20 pages);
Appendix E: Greenfield Runoff Rate Calculations (2 pages);
Appendix F: Site Masterplan (2 pages);
Appendix G: Soakage Test Results (3 pages);
Appendix H: OCC Meeting Notes and EA Correspondence (3 pages);
Appendix I: Proposed Attenuation Volume Estimates (6 pages);
Appendix J: Proposed Drainage Strategy Drawings (3 pages);
Appendix K: Runoff Volume Calculations (3 pages);
Appendix L: Drainage Strategy Calculations (73 pages);
Appendix M: Formpave Design Drawings (5 pages);

The main report has the following breakdown of contents:

Pages 1: Cover page;
Pages 2-3: (numbered as 1-2): Document control sheet and contents;
Pages 4-19: (numbered as 3-18): Report main text;

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 169 pages of the report and associated documents submitted by JNP would appear to be of reasonable detail given its length. However only 15 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.

The FRA is of poor quality, lacking in important detail and fails to provide an adequate description of the flood risk at the site and the proposed SuDS design. It is written as a series of numbered points like a checklist rather than a proper technical report. The FRA should be rejected by the EA and local authority. Important points to be notes are as follows:

- The FRA is lacking detail on the location of the site, topography, geology, and hydrology:
- The FRA fails to identify the fall of the ground surface by some 15m from the capped landfill towards the site;
- The FRA fails to identify the presence of a ditch at the foot of the landfill to the eastern edge of the site;
- The proposed site drainage strategy is based on calculations from outdated methods and data from the 1970s and there are errors in the storage volumes tabulated in the text;
- The site has a history of groundwater flooding at is still at risk of this form of flooding;
- The effect of high groundwater has not been properly considered for the site drainage strategy – shallow infiltration systems will not function if they are filled with groundwater.

Any development would therefore be in breach of Suds Guidance and as shallow infiltration systems will not function on the site, it cannot be deemed to be sound. The proposed drainage design is therefore not deliverable in terms of providing a low risk of flooding to the new development and not increasing the risk of flooding to neighbouring properties.

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 topographic survey as presented in Appendix A is poorly presented, with large scale maps showing spot heights plotted over 8 pages and largely illegible at the normal A4 page size. Only one of these pages shows any contours and there is no overview map showing the topography of the site in relation to the surrounding areas. 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 (Figure 1). The description misses the fact that the site is considerably lower than the existing residential land to the west and the capped landfill to the east. The fact that the site is considerably lower than the surrounding areas has implications in terms of the flood risk for the site receiving surface water and being at risk of flooding from high groundwater.

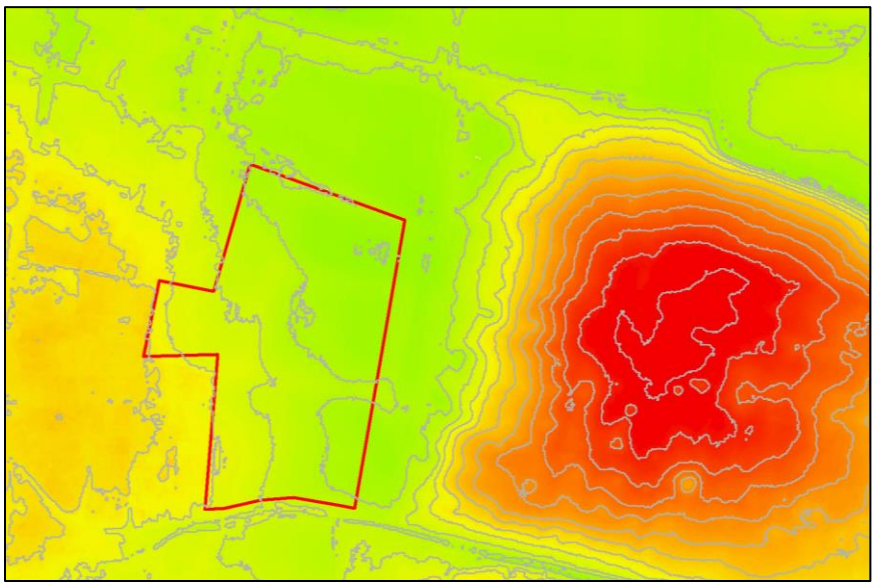

Figure 1. The topography of the area surrounding the development site (red outline) with levels ranging from 47.5m AOD (green) to 62.9m AOD (red), with 1m contours is grey. (Source: EA 1m resolution filtered LiDAR, scale 1:5,000)

The description of the site in terms of the geology is based on fieldwork undertaken by GRM and it documents the results of trial pits. The report would however benefit from including maps from the British Geological Survey, or Cranfield University showing the extent of geology and soils over a wider area. This information is important in relation the assessing the risk of flooding to the site from groundwater.

Catchment Hydrology and Flood Risk

Apart from acknowledging that the River Thames lies approximately 850m 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. Monitoring data extends back to the late 19th century and there is plenty of accessible data which can be used in the FRA. Information relating to flood risk simply reproduces the flood zone maps from the EA website and maps plotted as part of the Vale of Whitehorse Strategic Flood Risk Assessment. Detailed EA maps of historical flooding 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.

Critically the EA surface water flood risk map is not included as this shows a medium and high risk of surface water flooding over parts of the site (Figure 2). Also recent incidents of flooding of the site were observed in 2012 and again in 2014 (Figure 3). Furthermore the description of the hydrology identifies ditches along the northern and southern boundary of the site but neglects the presence of a ditch along the eastern boundary at the foot of the landfill. This ditch was also observed to be full and overtopping into the site in December 2012 (Figure 4). No further information has been provided about the catchment of these ditches nor have any assessments been made of the potential flood flows in the ditches and possible impacts on the site. In addition the recreation ground immediately to the north of the site is prone to flooding with water emanating from the upslope development site (Figure 5). The FRA does not give any detail on the how water from the development site can affect neighbouring areas.

Figure 2. Surface water flood risk map showing areas within the development site (highlighted).

Figure 3. Flooding of the development site in February 2014, viewed from the northern boundary.

Figure 4. Flooding of the boundary ditch in 2012, looking south.

Figure 5. Flooding of the recreation ground in February 2014, viewed from the northern boundary of the development site.

A number of maps are presented in Appendix C from Vale of White Horse Strategic Flood Risk Assessment (JBA, 2013). The maps are all taken directly from the report and are at low resolution so it is barely possible to identify the location of the site. One map (Map 6.2) 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. Significant areas of groundwater flooding were observed in the fields around Sutton Courtenay in 2012, 2013, and 2014. The report describes a groundwater survey of the site where water levels were monitored from March to May 2015. The highest groundwater level was observed just 0.22m from the surface. Such levels are very high as the monitoring period is when groundwater levels naturally fall due to the uptake of water from plant growth. This indicates that during the winter levels will reach the surface and cause flooding. For a proper assessment of groundwater levels the monitoring should have covered the full winter period from October to April.

Surface Runoff Calculations

The JNP report has some detail on calculations which have been undertaken to estimate the amount surface runoff from the greenfield and developed site as presented in Section 7. Greenfield surface runoff has been calculated using the IH 124 method as outlined in the

DEFRA/EA 2007 SuDS guidelines. This method however is inappropriate for estimating surface runoff from development sites, it uses inaccurate data from the 1970s, and has been demonstrated to produce significant underestimates of greenfield surface runoff. In the latest publication on flood estimation from the EA (2015), they "*advise users to avoid IH 124 for flood or greenfield runoff estimation on small catchments*". The report makes no comment about the lack of accuracy of the IH 124 method and in particular it does not highlight the fact that IH 124 does not include a factor to allow for the slope of the ground surface, when it is stated in section 7 that the site falls by 4m from west to east. An improved method has now been made available in 2015 through the Wallingford Hydro Solutions Ltd ReFH software. Revised estimates of greenfield surface runoff should be made using this method.

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 storage estimates (shown in Table 2) but gives no information on how the volumes have been derived. The table includes the 1 in 1 year flow. This is a meaningless term in hydrology and cannot be obtained from the standard statistical methods used to calculate the return periods, it is simply not mathematically possible (like dividing a number by zero). Design flow estimates will normally start with the median annual flow (1 in 2 year) or the mean annual flow (1 in 2.33 year).

Further storage volumes results are listed in Table 3 showing the pre-development, post development and residual runoff volume for the 1 in 100 year 6 hour rainfall. The volumes however do not equate. The total post development volume is 2,814 m^3, the pre-development volume is 1,120 m^3, the difference between these is the residual volume which is 1,694 m^3, however the value listed in Table 3 is 1,883 m^3. In addition the pre-development volume does not correspond to the flow value given in Table 2. The 1 in 100 year flow +30% is listed as 35.4 l/s, which means the 1 in 100 year flow is 27.2 l/s. For this value to flow over 6 hours the volume would be the product of the flow (27.2) and the total number of seconds in 6 hours (21,600). The answer is 587.5 m^3, which is different from the value given in Table 3. Another table in the report, Table 4, lists different Microdrainage storage estimates where the design flow is listed as 11.1 l/s for both the 1 in 30 year event and the 1 in 100 year plus 30% event. The design flow cannot be the same for different return periods. The EA and local authority should request clarification of the listed values from JNP as they appear incorrect, or are unclear what they represent. This raises doubts over the accuracy of the Microdrainage calculations and the quality of the drainage design.

The Microdrainage results are listed in Appendix I but a major concern is that the results of the software list the rainfall as being calculated using the FSR. This is the Flood Studies Report, a UK Government research report produced in 1975 (NERC, 1975), giving a method to calculate design floods and rainfalls for any location in the UK. However this method was replaced by the FEH in 1999, which is now accepted as the standard approved methodology. The FEH included a further 20 years of observed data, improved calculation techniques, and the use of proper computer modelling software to give more accurate estimates. The FEH was also recently updated in 2015 making use of rainfall data up to 2013. Any drainage design should be tested using the latest FEH derived rainfalls, and this should be insisted by the EA and local authority.

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 when many surface drainage systems failed. This would provide a context to the robustness of the SuDS design.

Section 10 includes an assessment of the overland flows from the surrounding land which may affect the site. This section has neglected the effect of the capped landfill site to the east. Figure 4 in the JNP report shows the indicative flow of water from the southwest towards the site. It is clear however from the correct representation of the topography which includes the landfill (Figure 1) that surface runoff would flow from east to west from the landfill onto the site. The section should also acknowledge the natural flow of water across the site in a north-easterly direction to the recreation ground.

Groundwater Monitoring

The surface water management design itself promotes the use of infiltration based measures in the form of permeable paving and infiltration basins. Such measures are considered plausible in the FRA based on the results of infiltration tests at the site. The results are listed in m/s but are fairly meaningless without a standard rate for comparison. A better indication of the infiltration would be to convert them into m/day and assign a class following the ADAS soil drainage classification (ADAS, 1981).

The infiltration of surface water will however not be effective with the presence of a high water table as there will not be enough storage volume for the excess surface water coming off the impermeable surfaces of the development. The FRA states that the EA made no comments on the drainage strategy and that Oxfordshire County Council had no objection to the use of infiltration systems in conjunction with the high water table. This claim is in contrast to the latest SuDS guidance that infiltration should not be allowed where the groundwater is within 1m of the surface (Woods-Ballard et al., 2015). Not only has groundwater been shown to be close to the surface from monitoring but this monitoring was not undertaken during the period when the highest groundwater levels would be expected. The photographic evidence shows flooding resulting from high groundwater in 2012 and 2014. In the absence of any groundwater monitoring undertaken during the period when the water table is expected to be highest (October – April) a shallow borehole was sunk on the recreation ground 20m from the northern edge of the development. An initial groundwater level reading was taken on 28/01/2016 which showed water at 0.85m below ground level. Using the LiDAR the ground level at the borehole was established at 51.06m AOD so the measured water level equates to 50.21m AOD. Regular monitoring of the borehole will be undertaken by local residents and the results will be made available to the EA and local authority over the coming months.

The proposed drainage strategy from Appendix J of the FRA shows infiltration basins with a base 0.5m below ground level. In the north east of the site where the ground level is 51.0m AOD the base would be at 50.5m AOD. Groundwater levels measured as part of the FRA were at a maximum of 0.22m below the surface. This would mean standing water would be at

50.78m, so the detention basin would be partially filled and not provide adequate storage for a design rainfall event.

Conclusions

The JNP flood risk assessment for the housing development North of Hobbyhorse Lane, Sutton Courtenay is generally lacking in important detail and 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. Specifically the use of infiltration to convey excess surface water from the site will not work given the high groundwater and the flood risk at the site and to neighbouring areas is likely to increase. Information is missing from the following key areas:

- The site description lacks detail and there are no photos of the site;
- The report does not have any topographic information for neighbouring areas outside of the site and fails to identify the site at the foot of a capped landfill;
- Basic hydrological information is missing about the River Thames, its catchment area, and the report does not identify the presence of a drainage ditch alongside the site;
- No maps showing the risk of surface water flooding are presented;
- Greenfield surface runoff has been estimated using an outdated technique which is inadequate and gives poor estimates, a revised estimate should be presented using updated techniques;
- An explanation of the Microdrainage results as part of the SuDS design is required;
- Microdrainage calculations use outdated rainfall information from the 1975 Flood Studies Report which was replaced as the standard flood estimation procedure in the UK in 1999. Revised calculations are required using updated information;
- There are errors and inconsistencies in the values listed in Tables 2, 3, and 4 of the FRA showing proposed storage volume output from Microdrainage.

The following points relate in particular to the proposed surface water management at the site:

- Geological investigations at the site have measured groundwater 0.22m below the surface;
- Flooding of the site has been observed in 2012 and 2014 through a combination of surface water and high groundwater;
- The proposed surface water management promotes the use of infiltration measures with infiltration basins excavated 0.5m below the ground surface;
- SuDS guidance recommends infiltration to groundwater should not be used for surface water management when the water table is within 1m of the ground surface;
- The use of infiltration at the site for management of surface water will not function during the winter months when groundwater is high.

References

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