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19 Februrary 2024

Ian Sandiford
Persimmon Homes & Charles Church Lancashire
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Lancaster Business Park
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Dear Ian,

Re: Development at Hawthorne Farm, Clitheroe - Addendum to Flood Risk Assessment.

EXECUTIVE SUMMARY

EDGE consulting engineers have provided this addendum document alongside the sites proposed drainage design and flood risk assessment report 19310- EDGE-XX-XX-RP-C-0001. The drainage design, flood risk assessment and this addendum document has been produced to demonstrate the following:

- How the detailed design proposals deliver the principles set out in the Flood Risk Assessment report (19310-Edge-XX-XX-RP-C-0001) and proposed Drainage Strategy as set out in Condition 8 of planning permission 3/2019/1104.

- How the detailed drainage designs deliver satisfactory solution(s) to the requirements of Condition 9 of planning permission 3/2019/1104.

- Calculations from pre-development areas (17,300m^2) which drained to the eastern boundary compared to future post development areas (1,100m^2) show the following reduction in flow rate and (6 hour) runoff volumes directed toward the eastern boundary:

    - Pre-development run off flow rates and volumes.
        - 1/1 year = 10.2 l/s and 192.6m^3
        - 1/30 year = 19.8 l/s and 440.92m^3
        - 1/100 year = 24.3l/s and 591.97 m^3

- Post-development run off flow rates and volumes.
    - 1/1 year = 0.7 l/s and 1.22m³
      A 93.04% reduction in flow rate and 99.37% reduction in runoff volume.
    - 1/30 year = 1.3 l/s and 2.80m³
      A 93.43% reduction in flow rate and 99.36% reduction in runoff volume.
    - 1/100 year = 1.6 l/s and 3.76m³
      A 94.16% reduction in flow rate and 99.36% reduction in runoff volume.

- Calculations confirm that areas receiving rainfall, served by positive drainage i.e. areas of highway, shared drives, driveways, roofs and gardens, direct 16,200m² worth of surface water away from predevelopment flood risk boundaries. This represents a 93.64% reduction of areas draining to the eastern boundary when compared to the pre-development condition.

- The calculations include an allowance of an additional 40% (up from 30%) rainfall for climate change and further allowance of 10% additional rainfall for urban creep.

- The proposed pond is designed to an effective volume (560m³) that is required to contain the relevant design storms with top water levels identified in the calculations.

  However, the full extents, volume and capacity of the pond is larger than the effective volume as the ponds sides/ embankments are built significantly higher than top water levels, to tie in to surrounding roads/ drives POS etc. As a consequence the designed pond has a larger capacity of 615m³. This provides an additional 10% volume within the pond, which offers additional capacity before surface water backs into the system of highway gullies, and flows along the roads off-site to Hawthorn Place.

INTRODUCTION

With regards to EDGE Consulting Engineers flood risk assessment report 19310- EDGE-XX-XX-RP-C-0001 (FRA) for the above-named site we issue this letter as addendum specifically concerning post development flood risk, to clarify the extent to which the submitted detailed designs deliver the principles of the FRA, and in fact improves on a number of those principles.

It is stated the FRA and the associated Schematic Drainage Design sets the following principles (now approved within the full planning permission 3/2019/1104:

- Both the new surface water and foul drainage proposals are gravity led.
- In order to mimic greenfield run off rate (at 11.7 Litres per second), on site attenuation is required. This attenuation will store all surface water volumes up to and including the 1 in 100 year plus climate change storm event.
- Surface water will discharge to the existing watercourse running through the site.
- Foul water will discharge to the existing combined public sewer running through the site.
- All sewers will be offered to United Utilities for adoption.

The EDGE FRA states the following flood mechanisms are all low risk in pre and post development conditions:

- Fluvial
- Tidal
- Ground Water
- Reservoirs and canals
- Existing adjacent sewers
- Proposed sewers.

However pluvial / overland surface water flooding is a medium risk to the pre developed site in the location of the eastern/ south eastern boundary. This addendum will detail the origin of the flood risk and how the development proposals mitigate this risk to an acceptable level.

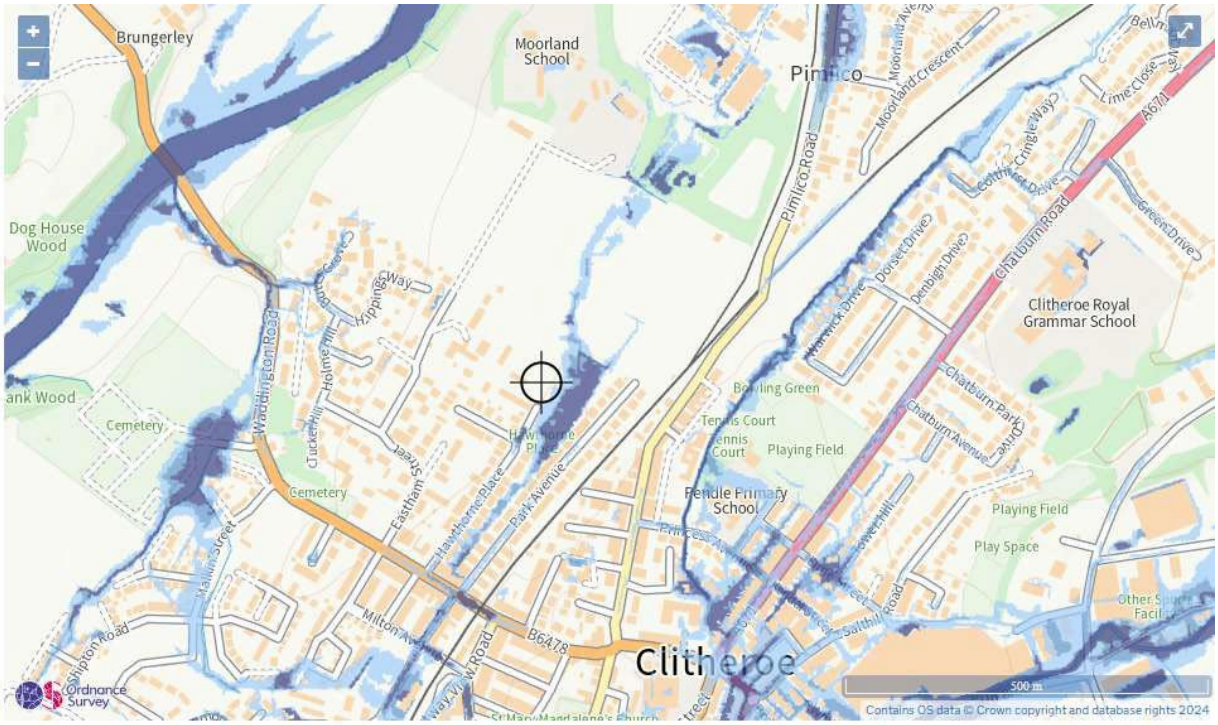
ORIGIN OF FLOOD RISK

Pluvial flooding is noted to occur when intense rainfall causes the ground to be saturated and its capacity is exceeded.

The flood risk assessment highlights excess surface water drains naturally to the low point in the south and to the watercourse itself by overland flow. The location and route of this flood risk follows the line of an existing surface water culvert. This culvert is 600 x 600mm concrete slab in construction, crudely assembled and located close to existing ground levels at the surface.

Pluvial flood risk is highlighted on the surface water flood map available on the flood risk service section of the Government website. An extract is included below which shows that the site is predominantly at low risk of flooding from pluvial sources. The south/ south eastern border of the site, adjacent to the rear boundary of the existing Park Avenue properties does show a medium to high risk of pluvial flooding.

This extends through the neighbouring northern field but at a lower extent of risk.

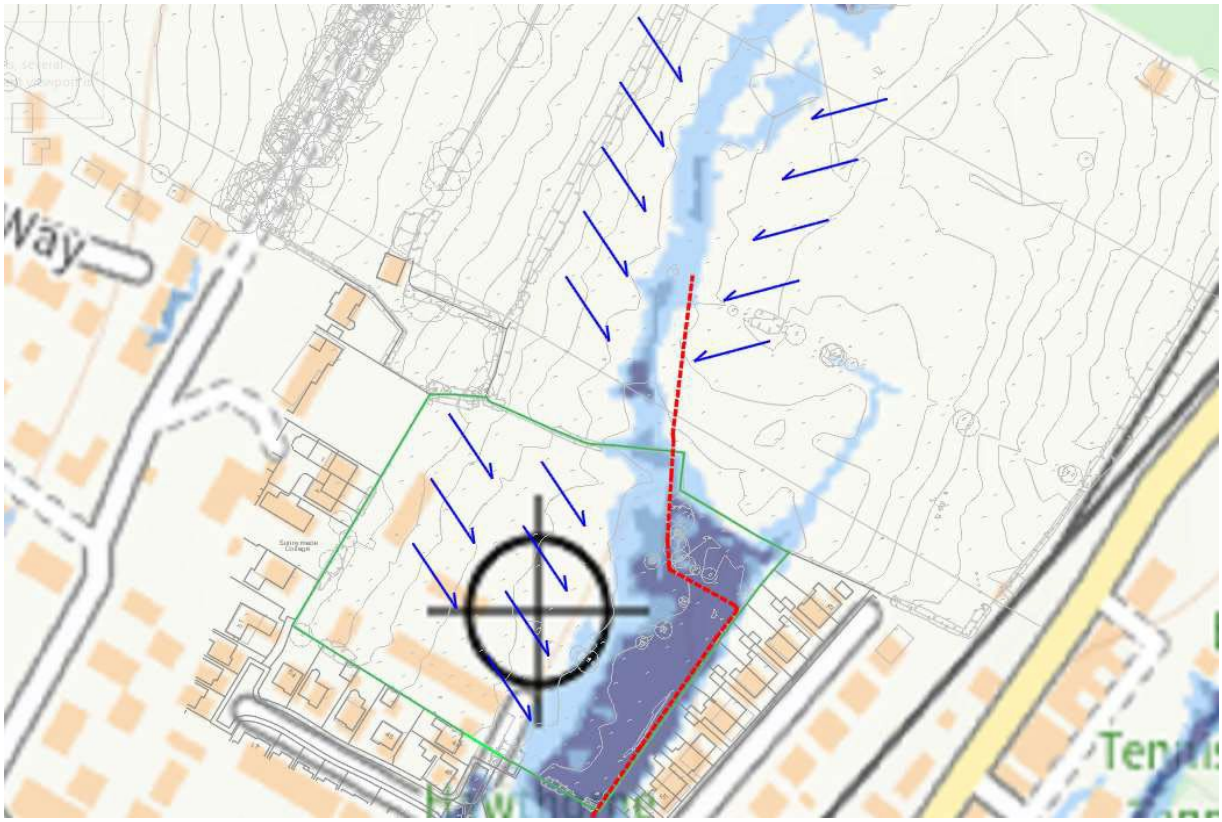


Extent of flooding from surface water

High Medium Low Very low Location you selected

The extent of pluvial flooding follows the line of the existing watercourse/ culvert, which is located along a low point of the northern field and within the site. It is expected that overland flow ponding and surcharging of the culvert in extreme events is the source of the medium to high risk of pluvial flooding indicated in these areas.

The screenshot below notes the line of the culvert/ watercourse against the flood mapping. The red line indicating the surveyed location of the culvert. Blue arrows also show the direction overland surface water flow would take following the land topography.



Investigations into the watercourse show there are collapsed/ broken sections of culvert, this will exacerbate the flooding shown.

MITIGATION

Development proposals include upgrading the culvert to convey flows through the site improving the efficiency and enhancing the watercourses capacity within the development boundary. Collapsed areas and blockages will be removed/ repaired and the culvert will be set at a lower level and a larger diameter pipe is proposed through the development site. It is proposed to replace the 600mm x 600mm Surface Water (SW) damaged makeshift culvert and replaced this with a 750mm diameter concrete drain that offers 22.7% more capacity. The replaced 750mm concrete surface water pipe is on average 1.50m deeper than the original damaged culvert.

Furthermore, the development of the site and introduction of impermeable areas (roofs, drives and roads etc) will intercept and divert pre-existing overland surface water flows that previously followed the lands topography and collected in the south/ south eastern corner of the site. Surface water will be intercepted and directed away from proposed houses into a positive drainage system via gullies and drainage channels.

These in turn connect to the drainage network via adoptable and private roads with flows restricted to greenfield rates and water volumes contained within the designated SUDs attenuation pond feature.

The only source of surface water able to navigate to the low area adjacent to the Park Avenue properties rear garden boundaries will be what may shed off the proposed adjacent rear gardens (of plots 40-46). The area generating the pluvial runoff is therefore significantly reduced meaning a corresponding reduction in the flood risk at the boundary. Moreover, development proposals include a boundary French drain specifically to collect this reduced runoff and direct it to the watercourse.

These measures will reduce the extent of and risk of pluvial flooding within the site.

THE DETAIL

The following plans are submitted in addition to this report in order to discharge condition 9 of Planning Permission 3/2019/1104:

- Detailed Drainage Design Layout – 19310.DR.C.C2008 Rev 21
- A surface Water Displacement plan – 19310.C2004
- Updated Exceedance routes plan – 19310.C2009. Rev 3
- Updated Catchment Analysis Plan – 19310.C2003 Rev 6
- Updated Plot Drainage Plan – 19310.C2008 Rev 12
- Updated Externals Works Plan – 19310.C1001 Rev 11
- Drainage Flow Calculations – 19310-MDX-CULVERT-230303

The following section details directly how these plans demonstrate deliver on the principles of the FRA and the requirements of condition 9 of 3/2019/1104.

Detailed Drainage Design Layout – 19310.DR.C.C2008 Rev 21
This plan depicts the entirety of the separate foul and surface water drainage systems as required by Condition 9. At no point is there opportunity for surface water to enter into the closed foul network which is proposed to out fall into the existing combined sewer crossing the site. The accompanying exceedance route, catchment analysis and surface water displacement plans show the route(s) that all water landing on the site will take (route dependant on where it has landed), in its journey off the site.

The plan shows and labels (for both the foul and surface water network proposals), all adoptable pipes – location, materials, sizes, depth and gradient, manholes, including sizes, invert and cover levels, outfall structures (headwalls), pond, including depth, water levels at agreed storm events; valve and hydrobrake locations, abandoned watercourses (including confirmation of the lengths of reprovision).

The plan also shows, in two locations (as is then further detailed in with **Surface Water Displacement plan19310.C2004**) where French drain / soakaways are proposed. These drains provide for formal channeled routes on the two boundaries that previously relied on only ground levels to direct any surface water away from existing properties.

This plan (**Detailed Drainage Design Layout)** along with **Externals Works Plan** give the proposed Finished Floor levels of the site, with the adjacent proposed land levels. In order for the outfall of the site (set at the level of the existing outfall culvert at 78.030m AOD) to be fed by gravity, the outfall from the pond is set at 78.3m AOD. This allows for a gradient of 1:501 for the intervening piped connection. Working within the remit of the approved layout, and the required storage volumes (as set and agreed in the FRA), the pond is designed to hold all volumes up to and including the 1 in 100 year plus 40% climate change events. The **Detailed Drainage Design Layout** states the proposed water levels in the ponds for these events. The **Detailed Drainage Design Layout** and **Externals Works Plan** show the proposed level on the site, as well as the drainage network. All proposed plots on the site sit above the 1:100 year (plus climate change) water level event so that should over flowing or over topping occur due to an extreme event over that modelled, a localised blockage, or another reason, water is directed away from proposed properties. This is known as an exceedance event (event that exceeds the proposed positive drainage system) and this is depicted in the **Exceedance routes plan.** This is fully inline (and in fact given the system allows for some additional storage volume it goes beyond) the Defra Technical Standards for Sustainable Drainage Systems.

The **Plot Drainage Plan** shows the locations of the proposed private surface water and foul water network, including invert levels, rodding eyes and backdrop locations, pipe diameters and type.

The **Catchment Analysis Plan** shows the areas of hard standing of the site. All of these areas are positively drained (that is to say are served by the proposed adoptable drainage system). These areas represent 60.8% of the site. A further 30.2% of the site is made up of permeable surfaces – public open space, gardens and the proposed pond that are also drained directly by the proposed adoptable drainage system. This leaves 9% of the site where water is proposed to be directed towards the positive drainage system via surface ground levels, aided by a French drain on the eastern boundary, and a soakaway on the south. The **Surface Water Displacement plan** as already mentioned, pictorially demonstrates how the proposals mitigate, interrupt and direct surface water runoff (originating from water landing on the soft landscaped areas) from the boundaries of the development. To be clear, the **Catchment Analysis Plan & Exceedance routes plan** does this for the positively drained areas of the site.

Drainage Flow Calculations show how the full proposed network, shown on the submitted plans, operate in the 1 in 1year, 1 in 30year and 1in 100year plus climate change event return periods. They allow for a 10% increase in urban creep.

The proposal of the pond on site acts to slow water in its path through to the existing surrounding network. This reduces the transport of pollution to the wider network. It acts to trap silt and sediments that have made their way via run off into the surface water system. They naturally also provide an opportunity for biological breakdown of contaminants over traditional piped / tanked storage. This is a considerable improvement over the former culvert which had no attenuation measures and was built (not designed) to pass water forwards as quickly as possible. Drainage gullies & pots are also designed act as the first line of 'defence' as silt traps.

SUMMARY

- The FRA addendum confirms (not exclusively):
    - That the Surface water outfall pipe is installed at the lowest possible level, and therefore the properties that it serves are also as low as can be in order to ensure they are drained by gravity and not at additional risk of flooding. The only alternative to this would be to permanently pump surface water. This is not considered a sustainable solution
    - 91% of the water that lands on the site is dealt with by positive drainage, only 9% by the land drainage connections now proposed. This is c. 1.4% less than the pre-development level.
    - In 1:1year up to 1:100year events, there is a reduction in flow rates and run off volume following the development.
    - The pond is now 10% larger than the originally proposed volume. This is over the required level of storage.

Pluvial flooding is present due to the following factors:

- Extent and route of overland flow to the site's low points.
- Poor culvert condition.
- Low culvert capacity.
- Surface level location of the existing culvert.

Mitigation is provided within the development proposals by:

- Reducing the extent of area draining to the low points.
- Protecting the boundary low point with a dedicated French drain.
- Improving the culvert condition.
- Increasing the culverts capacity.

- Increasing the culvert depth.
- Reduction of flow rates to mimic greenfield situation.
- Introduction of dedicated SUDs Pond sized to accommodate extreme storm events + climate change + urban creep.

I trust this provides an adequate explanation and evidence of appropriate mitigation measures for the flood mechanism identified with the EDGE flood risk assessment.

Yours sincerely,

Ryan Atherton
Team Leader – Civil