

TECHNICAL NOTE

JBA Project Code
Contract

Client
Date / Version
Author
Reviewer / Sign-off
Subject

2020s1712
Review of Drainage Strategy for Thames Farm,
Shiplake
Shiplake Parish Council
21/07/2021 S3-P02
Paul Eccleston / Brendon McFadden
Paul Eccleston / Brendon McFadden
Review of revised Flood Risk Appraisal and
Drainage Strategy, July 2021

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1 Introduction

This technical note documents a review of a revised Flood Risk Appraisal and Drainage Strategy for Thames Farm, Shiplake, submitted by developers Taylor Wimpey in June 2021. This review has been prepared for Shiplake Parish Council, Henley Town Council and Harpsden Parish Council. The documents reviewed herein are:

Document	File name	Notes
Thames Farm Drainage Statement March 2021	A253-R001 Drainage Statement v11.pdf	Previous version dated Oct 2020 already reviewed.
FRA and drainage study March 2021 Final ()	FRA and Drainage Study.pdf	Previous version dated Feb 2021 already reviewed
FRA Appendix 1 Hydraulic modelling report March 2021	FRA Appendix 1 - Hydraulic Modelling.pdf	
FRA Appendix 2 Highway Drainage Plans	FRA Appendix 2 - Highway Drainage Plans.pdf	
FRA Appendix 3 Soft Bed assessment	FRA Appendix 3 - Soft Bed Assessment.pdf	
SuDS Maintenance Plan	Sustainable Drainage Systems Maintenance Plan A253-R003 v8.pdf	

In addition, we reference the review of the drainage statement and flood risk appraisal prepared for Henley Town Council by HR Wallingford.

Sections 0 and 0 of this document comment on the revised drainage strategy and flood risk appraisal. We have focussed these sections on what has changed since our previous reviews, which are attached in annexes A and B. Finally, in section □ we provide direct responses to the specific questions raised by Shiplake Parish Council.

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2 Review of revised drainage statement

2.1 Drainage proposals

- The drainage strategy is stated as being designed to achieve the requirements of the NPPF as well as Oxfordshire County Council's Local Standards and Guidance document for Surface Water Drainage on Major Development in Oxfordshire (section 5.2 to 5.3). We have assessed against these requirements.
- Peak runoff (sections 5.6 to 5.10) – with the proposal to discharge, via a pumping station and with no losses through source control and/or infiltration, the site is proposed to discharge at 2/s/ha. (8.5l/s). So, this is the flow rate that the pump will discharge at for all events. This has reduced from the 30l/s discharge considered in the previous (February 2021) version of the Flood Risk Appraisal.
- There is no mention of the drainage volume design taking any account of the reduce impermeability of the site due to the proposed grouting and compaction. This could be expected to have a significant impact on the site's runoff characteristics, allowing less water to permeate into the ground (in gardens and estate green spaces) and therefore generating more surface water runoff. The gardens and other green spaces do not appear to be accounted for in the drainage calculations, and therefore extra runoff due to compaction and grouting would either prematurely fill the site's drainage system, or lead to increased surface water runoff coming off the site onto Reading Road.
- Section 5.17 states that site-wide offset of soakaways by 10m from all structures (to prevent solution features forming close to buildings) was not feasible as it would not have been possible with the approved layout. This may be true, but no mention is made of considerations to change the layout to account for the findings of the ground investigations.
- A pumped discharge solution is selected "Due to the A4155 Reading Road being topographically higher than the Site some 800m north of the site access road." (s5.38). No long section of this option has been provided (although a long section of the rejected Option 2 to the Lash Brook is included). We have made an approximate check of the long-section using the layout shown on page 35 and Environment Agency LiDAR terrain model (Figure 2-1). This shows that whilst there are some small "lumps" in the profile along Reading Road, they wouldn't preclude a gravity sewer, although this would need to be laid deeper beneath these sections. It is likely that the design has prioritised the lower capital costs of building a rising main when compared to a gravity sewer. The high operating costs of pumping all surface water for the lifetime of the development will be passed to Thames Water and its bill payers once the sewer has been adopted. There is no evidence of whole-life costing or hydraulic calculations to justify the selection of a pumped system.

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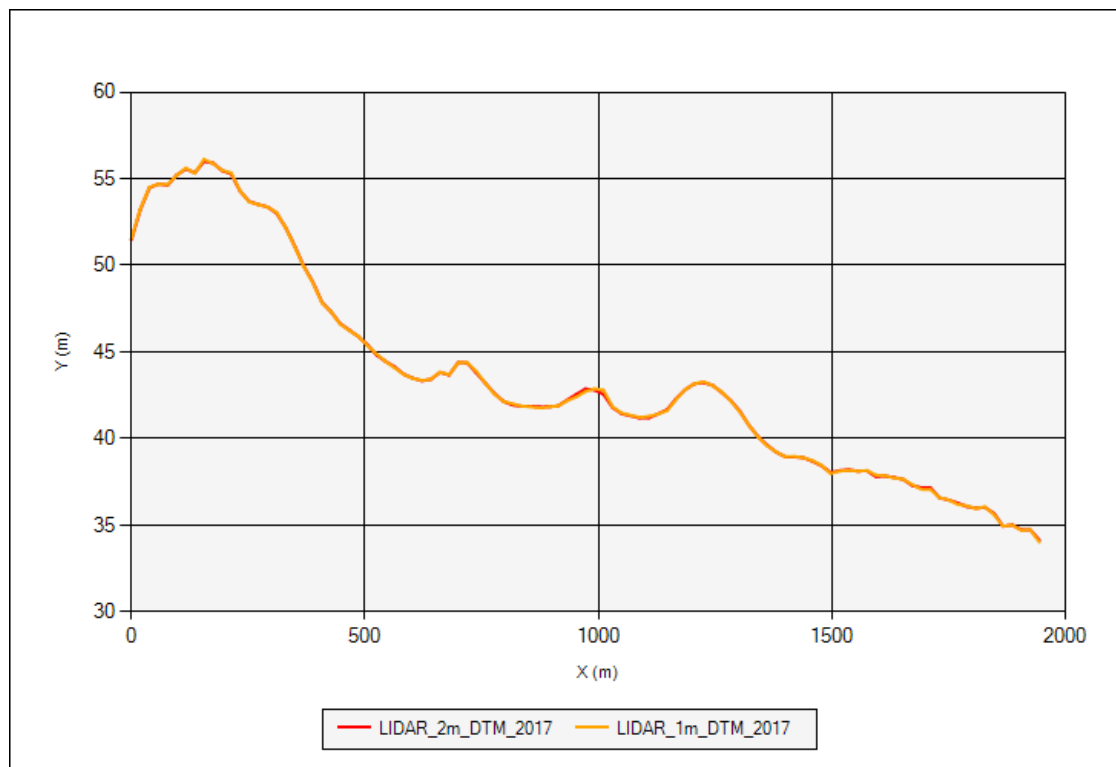


Figure 2-1: Ground elevations from proposed pumping station to outfall

- The statement makes only brief mention of designing for water quality, and does not present any calculations on how water quality objectives should be met, for example the stated aim within the Oxfordshire guidance (in line with other UK guidance) that the first 5mm of the majority of rainfall events should be intercepted and not cause runoff. It proposes to address water quality using granular filter strips, localised permeable paving and a wetland basin in the form of a reed bed system (s5.73). The plans do show the basin and areas of permeable paving serving units 9, 10, 11, 12, 13, 14, 15, 53, 54, 55, 56, 57, 67, 68, 69, 70, 71, i.e. only 17 of the 90 units. It is not explained how these will operate i.e. will they infiltrate into the ground or will they be separated from the ground by an impermeable membrane. No filter strips are shown in the drainage layout drawings. During an “every-day” rainfall event, the runoff from the majority of the estate roads and all roofs will flow straight to the pumping station and thence to the River Harp. This does not demonstrate adequate design for water quality, and will lead to surface water discharges from the site even during minor rainfall events. Given that the pre-development nature of the site is one of largely permeable soils and bedrock, this is a significant change to the site hydrology and therefore not in keeping with the principles of SuDS, which seek achieve drainage systems which as closely as possible reproduce the natural hydrology of the site.

2.2 Hydrogeology and impacts on the aquifer

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The updated drainage strategy (ALP, March 2021) has been reviewed in relation to the Hydrogeological Review (JBA, Jan 2021). It is understood that the primary update to the strategy regards an alteration to the outfall position from Lash Brook to the south, to a northern watercourse following a study of optimal surface water discharge locations. In general, the updated strategy does not change the outcomes of the Hydrogeological Review, with the impact considerations and conclusions still standing. However, it is noted that the proposal is for a pumped discharge to the River Harp, and therefore a new surface water pumping station will be required. Should the pumping station require additional and more extensive foundation construction beyond the proposed grouting (i.e. deeper piled foundations drilled into the Chalk aquifer), then additional risk assessments may be required by the EA to ensure that it does not adversely impact the Principal Aquifer/SPZ 1. It is understood that no update to the Hydrogeological Impact Assessment (H Fraser Consulting, April 2020) for the development proposals has been made following subsequent updates of the drainage strategy, and therefore our original conclusions remain, that:

- A revised hydrological impact assessment (HIA) should include a hydrogeological conceptual model of the site, which needs to confirm that the PWS borehole doesn't take its water from a part of the aquifer which may be grouted up.
- This should be informed by at least 12 months of groundwater monitoring on the site.
- Monitoring should continue during and after construction to assess any ongoing impacts of the grouting on local groundwater levels and chemical quality.
- A Construction Environmental Management Plan (CEMP) should be developed to set out measures to avoid creating potential pollution pathways into the aquifer during construction works, including the grouting.
- Regardless of mitigations, the proposal cannot mitigate against the loss of recharge to the aquifer.

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3 Review of the revised Flood Risk Appraisal

- Section 3.2 identifies the two surface water flow pathways running west to east along the site's northern edge and approximately through the centre of the site. However, as our previous review noted, neither the site layout nor the drainage arrangements are designed around these pathways. This brings into question the standard of protection offered by the drainage design, particularly when considering failure of drainage systems (say due to blockage or pump station failure) and runoff onto the site from upstream. It is long-standing principle of SuDS drainage that the site's natural flow pathways should be maintained when setting out the site layout, rather than building houses across them as is the case here.
- The modelling report (section 2.5.5) notes that the proposed discharge of 8.5l/s represents an increase of 0.17% to the 1 in 20 year flows and 0.07% to the 1 in 1,000 year flows. We note that the HR Wallingford report goes into the hydrology of the River Harp in some detail, and includes independent calculations. We would concur with HR Wallingford's point that the selection by Enzygo of the method giving the highest fluvial flows as being a conservative assessment is not helpful in this case, since the impact of the discharge flows would be greater when added to the lower fluvial flow estimates.
- The flood risk appraisal and modelling are focussed on impacts in high flow situations. There has been no separate assessment of the impacts of introducing a new discharge, every time it rains, into an ephemeral stream with little or no flow for much of the time at the point of discharge. Again, the HR Wallingford work goes into this in detail and we would concur with their points that the water quality impacts have not been assessed.
- Our previous review did not have sight of the full modelling report, which has now been included in the material submitted by Taylor Wimpey. This does, on the whole, provide reassurance of how the flood risk was modelled. Notably the model has been run at "hard-bed" conditions, assuming that the channel and structures have been cleared. An 80% blockage scenario has been run on the railway crossing, but in reality this blocked state is closer to being the norm at several structures. Whilst we agree with the overall conclusions that there is negligible increase in flood risk at the higher order events (1 in 20, 100, 1,000), the more frequent impacts of increased flow, particularly into the part of the River Harp which is normally dry, is not fully addressed.

In short, the key conclusions raised in our March 2021 review remain, namely:

- The surface water flow pathways across the site have not been accounted for in the site layout or drainage.
- The option of a lower-density development, which would enable discharge via shallow infiltration features, has not been explored.
- A pumped discharge is an energy-intensive solution in contrary to SODC and Thames Water objectives on addressing carbon emissions.
- The calculation of surface runoff has not considered the impacts of the grouting and compaction on runoff from gardens and green spaces.

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4 Responses to specific questions raised by Shiplake Parish Council

1. Does the information received cover ALL of the areas that a formal FRA (Flood Risk Assessment as opposed to Flood Risk Appraisal which the document is submitted as). They were asked for the former of course so important to know and if necessary to ask SODC to reiterate what is required.

No, the flood risk appraisal seems to have deliberately set itself to not cover all the requirements of a formal FRA. In fact, in section 4.1 it states that "The development would only be compatible with NPPF and PPG ID: 7 after the completion of a satisfactory Flood Risk Assessment, inclusive of mitigation measures and a Drainage Strategy." It is, therefore, surprising that an FRA has not been submitted.

2. Can the RM Application be determined without knowledge of what the Grouting Proposals are, which are not part of this application? In particular what level of outflows will be driven by those works if known/estimable? What levels of onsite attenuation will be needed and what that physically comprises/could be achieved in principle - are these material changes or non-material ones to any application process.

Considering the situation during the grouting works, the drainage statement (section 7.4 to 7.5) does provide some guidance for the Construction Management Plan (CMP), however this is generic guidance for a housing development – the CMP should also consider the grouting and compaction works.

Considering the post-development situation, the drainage design does not account for a reduction in impermeability, and hence an increase in runoff, as a result of the compaction and grouting. Consequently, it is likely that the storage design, for the 1 in 100 year event plus climate change, will not be sufficiently sized to meet this standard of protection. Since the reserved matters application is the stage at which the drainage design will be approved, this matter must be considered now.

There is documented evidence of the often very significant impacts of compaction from "normal" construction activities^{1,2}, regrettably this type of compaction isn't routinely accounted for in drainage designs in the UK. However, in this case the ground compaction will be more widespread and deliberate, and the grouting will also fill voids which would previously have assisted drainage. It would, therefore, be recommended that the drainage design makes allowance for this reduction in permeability within green spaces, and provides additional storage capacity to prevent runoff onto Reading Road or premature filling of the site's surface water storage tanks and basin.

3. How the grouting is affected and what are the water quantity implications of the water table being at 10m in part rather than 16m which is the depth of some of the voids and of course the aquifers.

¹ <https://abe.ufl.edu/faculty/mdukes/pdf/stormwater/Gregor-et-%20al-JSWC-compaction-article.pdf>

² <https://sustainablecitycode.org/brief/reduce-soil-compaction-during-construction-2/>

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In regard to groundwater quantity implications the impact is discussed within the Hydrogeological Review technical note, mainly under section '4.2 Loss of aquifer storage'. In summary, where grouting extends below the maximum water table level there will be a loss of groundwater storage, due to the infilling of voids and fissures within the Chalk normally containing groundwater with impermeable grouting concrete. As limited groundwater monitoring data has been available (i.e. no long-term monitoring for at least a year) the true seasonal variability (which can be significant within Chalk) has not been established, and therefore the maximum groundwater level may be higher than seen previously.

As previously commented, the Hydrogeological Impact Assessment lacks a conceptual model of the site which, with groundwater monitoring, is required to demonstrate that there would be no significant impacts on water levels, flow and chemistry.

4. Ditto re Water Quality implications if identifiable?

The impact of proposed grouting within the Chalk aquifer was discussed in the Hydrogeological Review technical note, under section '4.3 Potential contamination of groundwater'. As discussed, the grouting mixture may contain a proportion of fly ash (power station ash) which may have a detrimental impact on the water environment due to very high pH. However, grouting operations are generally not seen as a polluting activity, and unlikely to require an environmental permit. Liaison with the regulator (EA) regarding the proposed methodology and grouting mixture will ensure that the work is acceptable and does not require a permit.

5. Implications physically on land stability of only grouting down to 8/10 metres

There is limited comment we can make on the practicality and resulting stability of grouting to a maximum depth of 8-10m when some voids extend to 16m deep. It is our understanding that this may be technically possible, but that the practicality and stability would need a separate assessment by a geotechnical engineer. Given the material changes brought about as a result of the discovery of the voids, it would seem reasonable to expect reasonable for planning permission to be conditioned on the basis of a geotechnical report confirming the approach to the grouting, as a minimum addressing the recommendations of the Terramech Geotechnical Investigation contained within the Drainage Statement.

6. The implications of this not being a good 'sustainable' option bearing in mind SODC Ecological Emergency and Thames Water's drive for 'carbon neutral'.

- The argument for a pumped rather than gravity discharge is not fully evidenced. Whilst a gravity solution is likely to have higher capital costs, financial and carbon (due to the increased depth of excavation to construct a gravity sewer), the operational costs in money and carbon will be much higher in the pumped option. The pumped option therefore appears to favour the developer and to put higher ongoing costs onto Thames Water and consequently their bill payers.

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A whole-life costing exercise and hydraulic calculations should be provided to evidence why the pumped solution has been selected.

- The drainage design does not design for water quality. Runoff from the majority of the roads and all of the roofs will, in minor rainfall events, be discharged without any attenuation or any form of treatment, to the River Harp. A true SuDS scheme should:
 - “where possible, provide multifunctional benefits” (NPPF)
 - “reduce pollutants in the water, such as hydrocarbons, nutrients and heavy metals, by filtering and treating runoff” (OCC guidance), and
 - “seek to enhance water quality and biodiversity in line with the Water Framework Directive” (SODC Local Plan Policy EP4).

The design presented does none of these things.

- The grouting works will have a carbon cost to it, and again the extent of this will depend on the final method of working and the type of grout mixture used.

7. Maintenance issues and implications particularly of the water course and river bed down from Harpsden and also the blockages and route down from Reading Road.

Maintenance of the River Harp lies, and will continue to lie following the proposed works, with the riparian owners. These are the land owners either side of the channel, with the centre-line of the channel normally forming the land ownership boundary. This may also be true of the culverts beneath Reading Road. Some culverts beneath highways are the responsibility of the Highways Authority, but many are not, and there is no duty on Highways Authorities to adopt culverts³.

Culverts under railways are normally adopted and maintained by Network Rail.

More frequent flows in the channel of the River Harp may help to keep it a clearer, better defined channel, although where the channel and structures are currently blocked or overgrown, the new flows are likely to lead to some minor, localised ponding. Furthermore, as the site's drainage design does not provide adequate water treatment flowing SuDS principles, it is likely to introduce sediment generated from urban runoff into the River Harp.

8. Check if Thames Water have more up to date (than 2017) water table figures.

Thames Water have proved a groundwater level graph for water levels at the Engbers Farm Borehole (north of the site). The water levels for the period 2009-2017 are between approximately 15 to 18mbgl (33-36mAOD). From 2017 groundwater levels have remained within a similar range, of approximately 16 to 18 mbgl. The observation borehole is a similar distance and elevation to the Thames Farm site from the PWS pumping boreholes, and the two groundwater levels provided from ground investigation on the Thames Farm site of 32 to 33.3 mAOD are in a similar range. The

³ <https://www.floodtoolkit.com/wp-content/uploads/2017/11/9.Roles-and-responsibilities-for-highways-1.pdf>

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higher maximum groundwater levels within the observation borehole could be an indication that water levels may also have been higher within the Thames Farm site historically, although this would need to be confirmed through on-going monitoring within the site itself.

9. Comment on the issue of tying together this Application and the outstanding issue of the further Groundworks Application.

Planning advice would need to be sought, but the grouting and compaction may not be a major consideration of the groundworks application, which is normally focussed on the site topography and planting etc. Furthermore, the grouting is not normally an activity requiring a permit. The proposed works do, however, appear to go against the EA's Approach to Groundwater Protection" which states "N8 - Within SPZ1, the Environment Agency will normally object in principle to any planning application for a development that may physically disturb an aquifer."

Now is absolutely the time to consider the grouting and compaction impacts, because:

- The impact of these works hasn't been accounted for in the drainage design, and
- They may not be considered in detail as part of the Groundworks Application.

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Annex A: Hydrogeological review of drainage proposal (January 2021)

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1 Introduction

1.1 Background

JBA consulting have been commissioned by Shiplake Parish Council to complete a hydrogeological review of the proposed planning application Ref P20/S2808/DIS under consultation for a housing development at Thames Farm, Shiplake (see Figure 1-1), focusing on elements of the scheme that could affect groundwater and groundwater dependent receptors.

The Thames Farm site at Reading Road, Lower Shiplake, obtained planning permission (P16/SO970/O) in 2017 for up to 95 homes on a 5.6Ha site. The developer had originally proposed to drain the site to soakaways, however subsequent ground investigations have identified that the site has a large number of sub-surface voids formed by dissolution of the underlying Chalk bedrock. Consequently, the developer is now proposing to grout and vibro-compact the site in order to stabilise it for construction. Concerned that shallow soakaways will wash material from the voids and increase the risk of collapse and prevented from using deep borehole soakaways as the site is in Source Protection Zone 1 (SPZ 1), the surface water strategy has been amended to exclude any infiltration methods.

Approval was given on planning ref P16/SO970/O with various conditions, including condition 11 which states; No development shall commence until a drainage strategy, detailing all on and off-site surface and foul drainage works, has been submitted to and approved in writing by the local planning authority. No discharge of foul or surface water from the site shall occur before the drainage strategy has been completed and brought into use.

As part of the discharge condition 11 (P20/S0715/DIS) which required a drainage strategy to be submitted, a Hydrogeological Impact Assessment was completed by H Fraser Consulting (April, 2020). This assessment refers to the use of deep soakaway boreholes from a previous drainage plan (ALP, April 2020), and no update to this HIA has been made available for the new drainage plan (ALP, Oct 2020). This report therefore considers the original HIA, and whether it is sufficient, detailing the site constraints, findings of the HIA and potential hydrogeological impacts to consider. The original discharge of condition 11 (P20/S0715/DIS) was withdrawn, due objections from Thames Water and the Environment Agency regarding the use of deep soakaways within an SPZ 1 an unacceptable risk. This review therefore considers the current information on the site, including the existing HIA (HFC, 2020), in regard to the updated drainage scheme proposal, and any further considerations that should be made.

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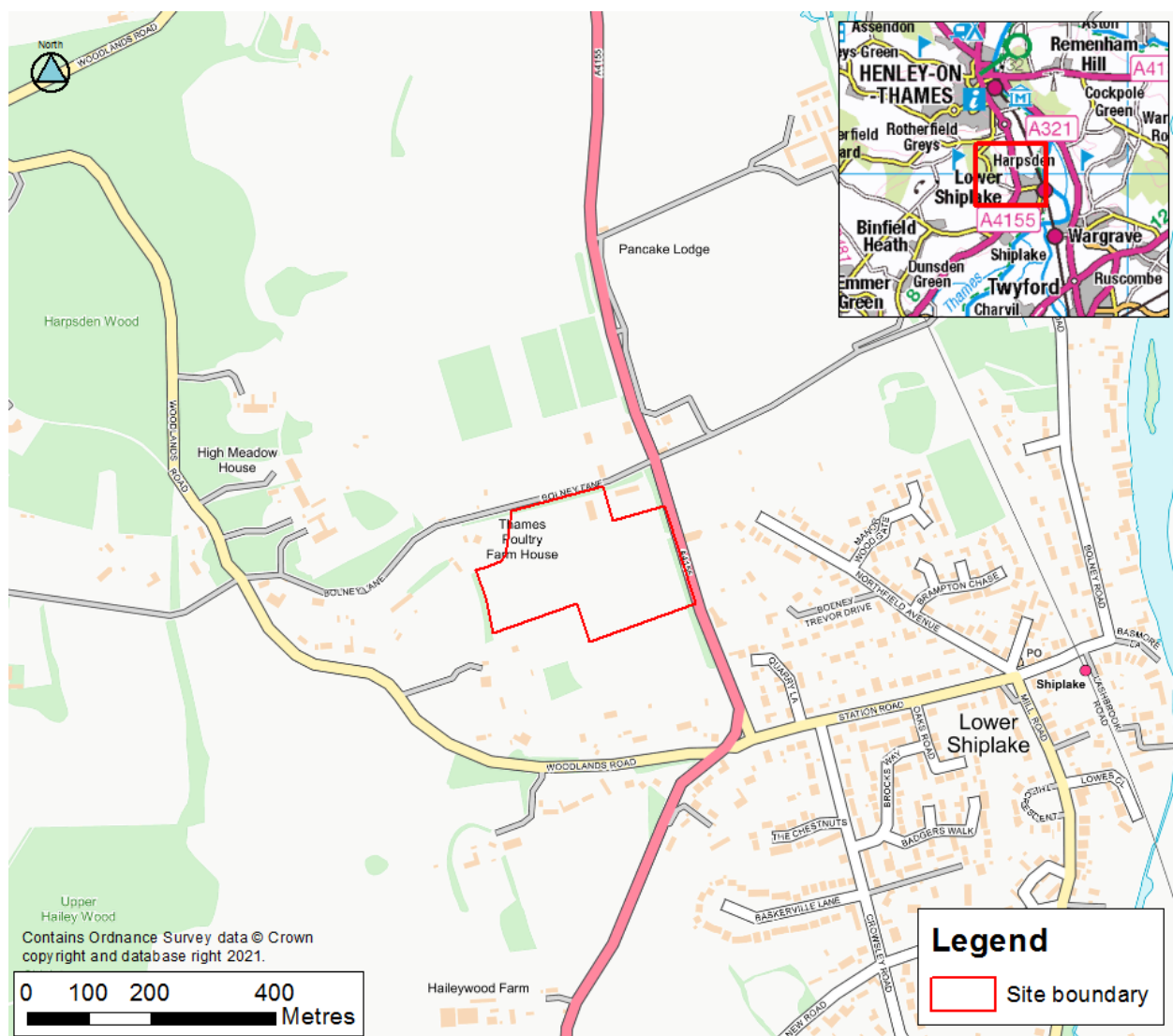
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1.1.1 Current drainage scheme proposal

The current drainage scheme proposal is detailed in Thames Farm, Shiplake Drainage Statement (ALP, Oct 2020) under consultation (P20/S2808/DIS). Due to the identified constraints relating to ground conditions and location within an SPZ 1 (discussed further in Section 1.2), shallow and deep soakaway drainage strategies are excluded, with no infiltration features proposed.

In summary it is proposed that surface water will be collected in on-site attenuation features, and directed through to an off-site main/sewer connection that will travel along approximately 2km of pipework to Lash Brook (a tributary of the River Thames) 1km south-east of the site. Further details and drawings are given in the Drainage Statement.

Figure 1-1 - Site location



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1.2 The Scheme and Constraints

The sections below outline the main elements of the scheme and constraints that are the subject of this review.

1.2.1 Ground condition constraints

A ground investigation and Ground Stability Assessment was carried out by Peter Brett Associates (Nov, 2019). They identified deep seated disturbed ground across the site associated with karstic solution voids within the underlying Chalk, and shallow weak/disturbed ground.

It was therefore recommended that ground stabilisation works are carried out across the site prior to the construction of foundations, using a technique such as compaction grouting to stabilise deep seated disturbance (Chalk voids) and a potential secondary phase of dynamic grouting or replacement of shallow disturbed ground. The grouting treatment process compacts the ground by injecting a viscous sand, cement, PFA and bentonite grout mixture under high pressure to locally consolidate the ground surrounding the point of injection.

1.2.2 Groundwater abstraction and Source Protection Zones (SPZs)

The proposed development site is located over a Chalk aquifer, within SPZ 1 of a Thames Water public water supply (Harpsden PWS). The abstraction is licenced for around 13 MI/d average and 18 MI/d peak, with peak daily output of 14.8MI/d in 2018/19.

The Environment Agency defines Source Protection Zones (SPZs) around groundwater sources - such as wells, boreholes and springs - that are used for public drinking water supply. Within these zones, potentially polluting activities are strictly controlled. Three zones are defined around each source (Environment Agency 2013; Environment Agency website):

- Zone 1: Inner protection zone: The area from which pollution could reach the source within 50 days (minimum 50 m radius).
- Zone 2: Outer protection zone: The area from which pollution could reach the source within 400 days. This zone now has a minimum radius of 250m or 500m around the source, depending upon the size of the abstraction.
- Zone 3: Total catchment: The total area from which groundwater flows to the well, borehole or spring.

Moving from Zone 3 (outermost) to Zone 1 (innermost), the degree of restriction placed on potentially polluting activities increases. The development site is located within SPZ1.

The policies associated with SPZs are set out in 'The Environment Agency's approach to groundwater protection' (EA, 2018). Within the context of the proposed development the following EA Position Statements are considered relevant:

- G4 - Inside SPZ1 we will object to any new trade effluent, storm overflow from sewer system or other significantly contaminated discharges to ground where the

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risk is high and cannot be adequately mitigated. If necessary, we will use a prohibition notice to stop any such existing discharge.

- G12 - The discharge of clean roof water to ground is acceptable both within and outside SPZ1 provided that all roof water down-pipes are sealed against pollutants entering the system from surface run-off, effluent disposal or other forms of discharge. The method of discharge must not create new pathways for pollutants to groundwater or mobilise contaminants already in the ground.
- G13 - Where infiltration SuDS are proposed for anything other than clean roof drainage (see G12) in a SPZ1, a hydrogeological impact assessment should be undertaken, to ensure that the system does not pose an unacceptable risk to the source of supply.
- N8 - Within SPZ1, the Environment Agency will normally object in principle to any planning application for a development that may physically disturb an aquifer.

Due to the site location within a Thames Water abstraction borehole SPZ1 area the use of deep bore soakaways was rejected by Thames Water and the Environment Agency, who stated that the close proximity to the nearby groundwater abstraction station and underlying aquifer introduced an unacceptable risk which could not be overcome within the constraints of the approved Site Layout or within the overall scheme viability.

1.2.3 Proposed drainage scheme

The latest proposed drainage scheme is detailed in Thames Farm, Shiplake Drainage Statement (ALP, Oct 2020). Due to the identified constraints relating to ground conditions and location within an SPZ1, shallow and deep soakaway drainage strategies have now been excluded, with no infiltration features proposed.

The current proposal is that surface water will be collected in on-site attenuation features and directed through to off-site main/sewer connection to Lash Brook (a tributary of the River Thames) 1km south-east of the site. Further details and drawings are given in the Drainage Statement.

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2 Site ground conditions

A summary of the ground conditions at the site is described below, based on the following investigation reports;

- Geotechnical Investigation - Terramech (2018-2019)
- Phase 1 Ground Stability Assessment - Peter Brett Associates LLP (2019)

2.1 Geology

With reference to online resources (www.bgs.ac.uk), and the British Geological Survey (2000) Reading, Solid and Drift, 1:50,000 (Sheet 268), the published geology suggests that much of the eastern section of the site comprises Quaternary age Taplow Gravel Member (sand and gravel), overlying Cretaceous Chalk Group strata of the Seaford and Newhaven Chalk Formations (undifferentiated). Towards the west of the site, the Taplow Gravels appear to feather out; exposing the chalk. Within the south western corner of the site, a wedge of Head Deposits (gravel, sand, silt and clay) are identified.

With reference to the previous ground investigations undertaken by Terramech, boreholes have confirmed a ground model comprising a thin mantle of topsoil across the site ranging from 0.2 to 0.35 m in thickness, above the Taplow Gravel Member and Head Deposits, all overlying the Chalk Group. The chalk surface was encountered at about 6.2 mbgl (metres below ground level) on the western side of the site, and 4.2 mbgl at the eastern side of the site. Made Ground was not encountered at any of the exploratory hole locations across the site.

2.1.1 Cavity assessment (PBA, 2019)

Approximately 550 dynamic probe locations were completed across the site, with 87 locations recording slightly disturbed/disturbed ground profiles. These profiles tend to display reduced levels of strength in the ground from surface level, with significant depths of weak ground and possible voiding to varying depths up to 16mbgl.

Where disturbed ground has been identified, many of the locations are peripherally surrounded by profiles that exhibit relaxed or slightly relaxed ground that has been affected by the karstic processes.

2.2 Hydrogeology

The Chalk bedrock underlying the site is a Principal Aquifer, in an area with medium to high groundwater vulnerability. The gravels underlying the site have a Secondary A or minor aquifer status. Groundwater flow in the Chalk aquifer is primarily by secondary permeability, such as fractures or fissures, rather than through primary matrix porosity.

Groundwater levels within the underlying Chalk aquifer were 12-22mbgl in two Terramech boreholes drilled on site (March, 2019). The groundwater level has implications for the hazards posed by natural and mining cavities (PBA, 2019).

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3 Review of Available Information

3.1 Hydrogeological impact assessment for proposed development works near Harpsden Water Treatment Works (H Fraser Consulting, April 2020)

A hydrogeological impact assessment was completed for the site in April 2020 under an application to discharge condition 11 (P20/S0715/DIS). This HIA is written for a previous drainage proposal (ALP, April 2020), which included deep soakaway boreholes.

In this HIA (HFC, 2020), the effects of the grouting operation on the PWS are thought to be low as:

- The grouting will be above the water table.
- The grout is a stiff grout that does not flow horizontally under its own weight.
- The depth of grouting is largely above the base of the solid casing of the PWS boreholes.
- There will be operational controls to monitor grout takes and pressure, hence unexpected loss of grout will result in cessation of operations and assessment.

The effects on the PWS due to changing recharge across the developed site are thought to be negligible because:

- Recharge across the site is less than 0.5% of the abstraction at the PWS.
- If recharge were to be removed from the site, the maximum impact on drawdown is thought to be 0.03 m. This is not considered to be a significant impact.
- Recharge is in fact thought likely to increase due to reduction in volumes lost to run-off, evapotranspiration and soil moisture deficit.
- Recharge under the developed scenario may be quicker, although it will be attenuated through the storm water collection and attenuation system, however the recharge volumes are not sufficiently large for a change in timing to have a deleterious effect on the PWS abstraction.
- Given the relatively low volumes of recharge, the effect of changing the spatial distribution of recharge over the site is not thought to be significant.
- The quality of the surface water collected is anticipated to be good. It is understood that there are proposals to further govern the quality of the injection water via reedbeds/attenuation infrastructure, and that water quality is not a concern. This aspect has not been further assessed.

It is noted that the report does not use the most up to date SPZ mapping (see latest SPZ outlines in Figure 4-1).

The hydrogeological considerations for an updated HIA are discussed in Section 4.

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3.2 Risk Assessment for Drilling & Grouting Works near Thames Water Main Supply (Vertase, March 2020)

Vertase produced a risk assessment for Drilling & Grouting Works near Thames Water Main Supply (submitted in March 2020 for P20/SO715/DIS) which state that "where groundwater conditions allow the ground treatment will be undertaken to a typical maximum depth of 15m below ground level. Where the water table is confirmed at a shallower depth, then treatment will be restricted to finish in the ground immediately above the water table".

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4 Hydrogeological impact considerations

The current application is not supported by a hydrogeological impact assessment that takes into consideration the updated drainage strategy. The section below provides an outline assessment of the potential impacts of proposed grouting and surface drainage schemes that should be considered, and any potential gaps in the current HIA. This is not a comprehensive assessment but outlines areas of concern that should be addressed in an updated HIA.

4.1 General considerations for the HIA

The HIA needs to include a good spatial and 3D understanding of the hydrogeological setting of the site, which would be improved with the following inclusions.

- Mapping:
 - Geology: BGS mapped geology (including any faults or structural features, fracture directions/bedding plane orientation) and also the geology encountered on site with the probing (and any differences).
 - Hydrogeology: including aquifers, depth to water, SPZs, surface water. Actual distance of the boreholes to the site (unless actual location of boreholes is confidential). It would be useful to know how close the grouting is to the actual borehole - is it clearly within fissure / fracture location. Could use observation borehole locations. Consideration of the typical fracture length in the Chalk and proximity to the PWS.
- A conceptual model of the site including:
 - PWS boreholes and key depths - base of casing, screen depths. Depths of known flow.
 - Depth of Chalk rock head, superficial horizons and any bedding plan horizons (may be level of preferential flow).
 - Depth of groundwater levels and degree of seasonality and uncertainty in this.
 - Level of nearby surface waters, e.g., pond, streams, river etc.
 - Depth of unstable/ground improvement ground - i.e., maximum depth of proposed grouting or areas where the grout may migrate to through voids.

This should pull together all the information spatially and demonstrate how this works to protect the PWS and to clearly demonstrate any level of risk to the PWS.

The original HIA (HFC, 2020) report includes location of observation boreholes - if long term data is available from the EA for any of these this should be included in any new HIA update if available (e.g., Shiplake OBH, Engbers OBH, Kilnpits OBH).

4.2 Loss of aquifer storage

The grouting of voids within the Chalk aquifer underlying the site will lead to a potential decrease in the overall potential storage of the aquifer. This is against EA Policy N8, where the EA will normally object in principle to any planning application for a development that may physically disturb an aquifer.

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Groundwater levels were taken at two boreholes drilled at the site, approximately 12 and 22 mbgl. As disturbed ground was found up to 16mbgl there is potential that grouting could be required below the water table, removing this potential storage. It was noted that groundwater levels could vary significantly from those observed during the ground investigation and the range of potential variation has not been defined by ongoing monitoring via installed observation wells (Terramech, 2019).

The current HIA states that the effect of grouting is low risk in part due to grouting being above the water table. However, the ground investigation data suggests that disturbed ground/voids may be located beneath the water table. If this is the case it would suggest that any grouting operation would result in grouting within the aquifer. More detailed monitoring of seasonal groundwater levels relative to the known disturbed ground depths should be established to demonstrate that grouting would not be required to go below the maximum water table depth. If grouting occurs below the water table, there may be additional impacts on water quality (for instance fly ash has a very high pH) and potential for additional migration of the grout.

4.3 Potential contamination of groundwater

The grouting mixture may contain a proportion of fly ash (power station ash) as a cheap filler to reduce the cost of the concrete. This may have a detrimental impact on the water environment due to very high pH. Some confirmation may be required by the Environment Agency to demonstrate that there will be no risk to groundwater (ALP Drainage Statement, Oct 2020).

The SODC emerging Local Plan¹ includes the following policies regarding new developments;

- Policy ENV11: Pollution - Impact from Existing and/ or Previous Land Uses on New Development (Potential Receptors of Pollution)
 - *Development proposals should be appropriate to their location and should be designed to ensure that the occupiers of a new development will not be subject to individual and/or cumulative adverse effect(s) of pollution. Proposals will need to avoid or provide details of proposed mitigation methods to protect occupiers of a new development from the adverse impact(s) of pollution.*
- Policy ENV12: Pollution - Impact of Development on Human Health, the Natural Environment and/or Local Amenity (Potential Sources of Pollution)
 - *Development proposals should be located in sustainable locations and should be designed to ensure that they will not result in significant adverse impacts on human health, the natural environment and/or the amenity of neighbouring uses.*

Due to the removal of any soakaway element within the new drainage strategy it is likely that there will be a reduced risk of groundwater pollution from surface run-off. The current HIA assumes that grouting is low risk due to only effecting the unsaturated zone above the aquifer, however, as discussed above it is not clear from ground investigation data that disturbed ground does not extend below the watertable.

1 <https://www.southoxon.gov.uk/wp-content/uploads/sites/2/2020/12/SODC-LP2035-Non-Track-Change-Version-November-2020.pdf>

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Therefore, an updated HIA should demonstrate that the grouting works will not pose a pollution risk to the Chalk aquifer, including additional monitoring and analysis of groundwater levels to demonstrate that grouting is not required below the water table.

The composition of any leachate from the grout material should be specified within the HIA and whether this could impact upon the aquifer water quality arriving at the PWS. The findings of this assessment should then be adopted into the Construction and Environmental Management Plan for the development.

4.4 Loss of aquifer recharge

The proposed drainage scheme is such that water that would have previously infiltrated to ground is diverted to surface water attenuation storage and then a surface water course (Lash Brook) a significant distance from the area of the site (1km south-east of the site). The site is currently estimated to be 98% permeable (ALP, Oct 2020), with the Chalk aquifer overlain by highly permeable sand and gravel. This permeability would be largely negated across the proposed site, with surface water infiltration reduced significantly with proposed impermeable surfacing, sub-surface grouting and surface water capture and export via mains/sewer.

The grouting of voids within the Chalk, and shallow disturbed ground underlying the site will lead to a decrease in the overall permeability of the ground above and including the aquifer. This will result in a significant decrease in infiltration of water directly from the ground surface (i.e. due to rainfall infiltration) to the underlying groundwater table.

The catchment required to support the borehole will increase due to this loss of infiltration across the site, which is sited in the SPZ 1 for the Thames Water PWS. This will mean a larger area would be within the 50-day travel time covered by the SPZ 1. The SPZ 1 would need to be redrawn, bringing new areas into SPZ 1. This would have two potential impacts:

- Increase the likelihood of the borehole being affected by pollution incidents,
- Put new SPZ 1 restrictions on the uses of parcels of land formally not subject to them, reducing their potential utility. This also relates to Policy ENV12 detailed above, which states that there should not be significant adverse impacts on the amenity of neighbouring uses. The SPZ 1 area is approximately 1,280,000 m² while the site footprint is 57,300 m² (see Figure 4-1), which is approximately 4.5% of the SPZ 1 area.

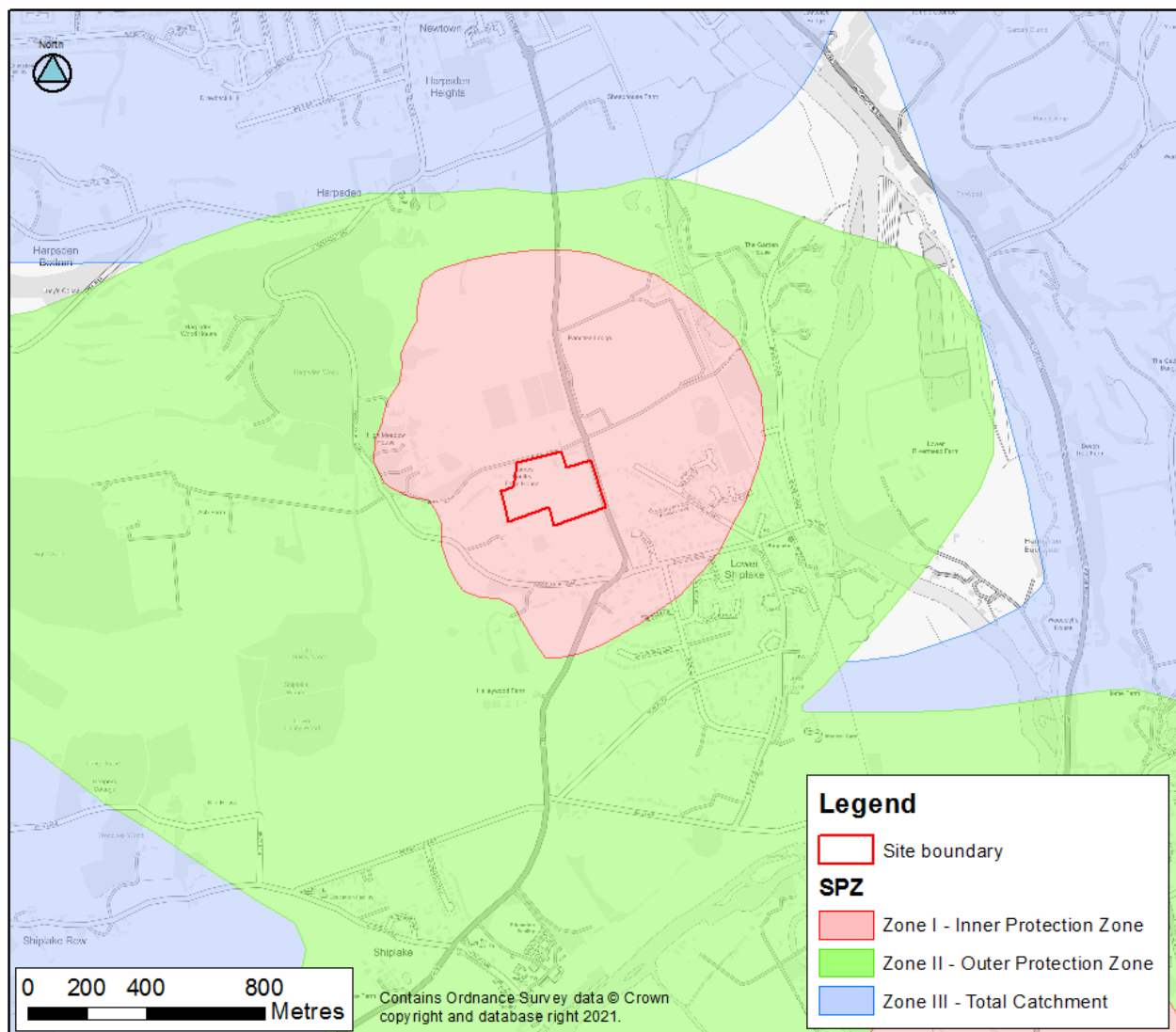
The current HIA (including deep borehole soakaways) assumes that recharge to the PWS would likely increase and be quicker with the proposed development. However, as the newly proposed drainage plan excludes all infiltration mechanisms it would be necessary to reassess the potential effect of removing nearly all recharge across the site, and alteration of the SPZ 1, in an updated HIA.

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Figure 4-1 - Site footprint in relation to groundwater abstraction borehole SPZ



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5 Conclusion

Based on this review of the current drainage proposal, existing site data and Hydrogeological Impact Assessment the following points are made;

- An updated Hydrogeological Impact Assessment would be needed for the proposed grouting and updated drainage scheme, with approval from EA and Thames Water. The impact assessment should show that there is no significant impact on the underlying aquifer and nearby abstraction borehole, both in terms of water levels, flows and water quality. The HIA should include a hydrogeological conceptual model of the site, which needs to confirm that the PWS borehole doesn't take its water from a part of the aquifer which may be grouted up (such as enhanced permeability of the near surface Chalk).
- It is recommended that borehole groundwater monitoring is carried out across the site for at least 12-months prior to development to assess the groundwater table variability across the area. Additionally, any long-term local observation borehole data available (e.g. from the Environment Agency) should also be included in the assessment and any surface water levels (such as the nearby pond). Current risk assessments assume that grouting will be entirely above the water table of the aquifer, however, it is unclear from current ground investigation data whether this is the case across the site. Detailed groundwater levels should then be compared to the existing extensive ground stability depth mapping across the site to establish relative depths to groundwater ranges. The data should be presented in a comprehensive hydrogeological conceptual model including maps and cross sections to demonstrate the spatial location and potential interaction (or reasons for no interaction) of the proposed grouting and the PWS boreholes.
- Groundwater monitoring should be carried out before, during and after construction to assess any on-going impacts to local groundwater following grouting works. Monitoring would include measurement of long-term groundwater levels and chemical quality. Chemical analysis suite would be appropriate to demonstrate that the grouting mixture has not had a detrimental impact on aquifer quality (water quality records may be available for the PWS).
- A Construction Environmental Management Plan (CEMP) should be developed detailing measures to avoid creation of potential migration pathways into the underlying aquifer or increasing pollution risk. This should include measures to prevent creation of new contamination pathways by piling or excavating through the full thickness of superficial deposits to the Chalk; a detailed grouting scheme that ensures grouting does not extend below the water table, and measures to prevent accidental fuel spillages during construction; and measures to control generation of silt laden run-off during site works. Proposals for wet working or not working during periods of high rainfall (and hence high infiltration to the ground) should be considered and the risk of associated contamination assessed.

Regardless of mitigations measure put in place, the scheme cannot mitigate against the increase in the catchment of the borehole due to loss of recharge to the aquifer across the site. This will increase the vulnerability to pollution of the aquifer/PWS and could put additional restrictions on nearby land that is then captured in the extended SPZ 1.

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The changes to the top of the Chalk and superficial aquifers in terms of reduction in voids and associated reduction in storage and permeability are also inherent in the grouting scheme. These cannot be mitigated. Although if the grouting scheme is never below the water table these impacts may be minimal. However, if the water table ever rises to the elevation of the grouted aquifer then the aquifer will respond in a very different manner to as at present. Once the water table is within the lower permeability, lower storage, grouted material then this ground may become saturated fairly rapidly and not allow rapid flow of groundwater as at present.

6 References

H Fraser Consulting (HFC, 2020) Hydrogeological impact assessment for proposed development works near Harpsden Water Treatment Works.

Abley Letchford Partnership (ALP, April 2020) Thames Farm, Shiplake - Drainage Statement.

Abley Letchford Partnership (ALP, Oct 2020) Thames Farm, Shiplake - Drainage Statement.

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Review of revised Flood Risk Appraisal and
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Annex B: Review of Flood Risk Appraisal and Drainage Study (March 2021)



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Review of Flood Risk Appraisal and
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1 Introduction

JBA Consulting (JBA) were commissioned by Shiplake Parish Council (SPC) to undertake a review of the Flood Risk Appraisal and Drainage Study for Thames Farm, Shiplake.

The Thames Farm site at Reading Road, Lower Shiplake, obtained outline planning permission in 2017, following an appeal, for up to 95 homes on a 5.6Ha site¹. The appeal decision included the following drainage related condition:

11. No development shall commence until a drainage strategy, detailing all on and off site surface and foul drainage works, has been submitted to and approved in writing by the local planning authority. No discharge of foul or surface water from the site shall occur before the drainage strategy has been completed and brought into use.

Reason: to safeguard the water environment and to prevent flooding of the area.

The developer had originally proposed to drain the site to infiltration basins, permeable paving and trench soakaways², however subsequent ground investigations have identified that the site has a large number of sub-surface voids formed by dissolution of the underlying chalk bedrock. Consequently, the developer is now proposing to grout and vibro-compact the site in order to stabilise it for construction. Concerned that shallow soakaways will wash material from the voids and increase the risk of collapse, and prevented from using deep borehole soakaways as the site is in Source Protection Zone 1, the surface water strategy was amended in 2020 to propose a pumped discharge of attenuated surface water to the Lash Brook³. The Parish Council and a large number of residents were concerned about this, principally:

- The potential for increased flood risk from the Lash Brook.
- The risks to the water supply aquifer from the proposed grouting operation.
- Disruption and nuisance caused by the need to construct a rising main through the village.

Following representations from SPC and the Thames Farm Action Group (TFAG) to Taylor Wimpey, South Oxfordshire District Council (SODC), the Environment Agency (EA) and Thames Water Utilities Limited (TWUL), a revised proposal has been supplied to TFAG by developers Taylor Wimpey. This note is a review of that revised Flood Risk

1 The Planning Inspectorate (2017) Appeal Decision: Appeal Ref: APP/Q3115/W/16/3161733 Accessed online at https://data.southoxon.gov.uk/ccm/support/dynamic_serve.jsp?ID=1418241337&CODE=2311F630D11AD5E4C421D65F994A4BF8 on 11/03/2021

2 CEC (2016) Flood Risk Assessment for Proposed Residential Development Thames Farm, Shiplake. Accessed online at https://data.southoxon.gov.uk/ccm/support/dynamic_serve.jsp?ID=1418241303&CODE=2311F630D11AD5E4E995AC1DFEBAD6C5 on 11/03/2021

3 Abley Letchford Partnership Limited (2020) Thames Farm Shiplake, Drainage Statement

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Appraisal and Drainage Study.⁴ The study references back to the work undertaken in 2016 and 2020; relevant sections of these documents have also been reviewed. A review of the hydrogeological implications of the proposed grouting scheme has been prepared separately⁵.

2 Flood Risk

2.1 Scope

In section 1.4.1 it is stated that *"the Flood Risk Appraisal and Drainage Study is limited to the assessment of fluvial flood risk arising from the proposed surface water drainage outfall to watercourse, and opportunities for betterment to existing surface water flooding issues arising from existing surface water runoff from the Site."*

This is not actually the case, since the report (section 3) goes on to consider baseline flood risk to the site, including an improved assessment of surface water flow pathways across the site (two pathways are identified, whereas the 2016 FRA only identified one). As such, the study is improving the assessment of flood risk to the site but, because it does not seek to replace the FRA, makes no recommendations as to how these flow pathways should be managed. The site layout shown in the 2020 Drainage Strategy shows that properties are designed within the flow paths (see Figure 2-1). This indicates a lack of sequential planning within the site (a requirement of National Planning Policy Guidance) and designing for exceedance (a good-practice approach to drainage design recommended in the SuDS Manual⁶).

4 Enzygo (2021) Flood Risk Appraisal and Drainage Study. Thames Farm, Shiplake.

5 JBA Consulting (2021) Review of Drainage Strategy for Thames Farm, Shiplake: Hydrogeological review of drainage proposal.

6 CIRIA (2015) The SuDS Manual

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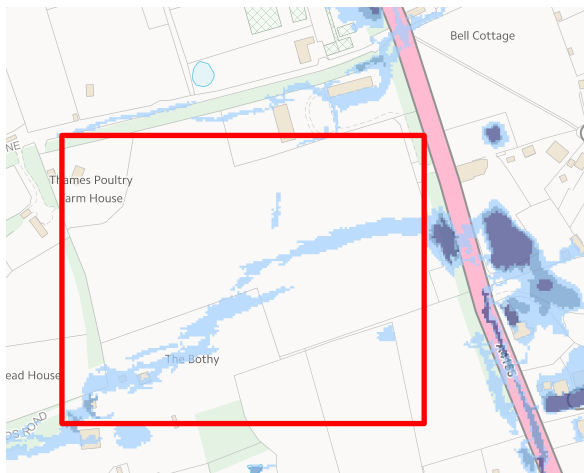
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(a) Risk of flooding from surface water map showing two flow pathways across site - red box shows the approximate area covered in (b).



(b) Detail from the 2020 Drainage Strategy

Figure 2-1: Surface water flow pathways and site layout

Further review of the flood risk appraisal is included below under the review of the drainage scheme.

3 Drainage scheme

3.1 Drainage strategy

3.1.1 The drainage hierarchy

The drainage hierarchy is a well-established principal which defines the order of preference in which surface water discharge routes should be considered, and is usually expressed as:

- Treat at source / reuse
- Soakaway or other infiltration to ground
- Discharge to a watercourse
- Discharge to a surface water sewer
- Discharge to a combined sewer

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The principal is supported by Building Regulations Part H, the lead Local Flood Authority (LLFA) Oxfordshire County Council (OCC)⁷ and by the water industry⁸.

It is acknowledged that deep borehole soakaways would not be permitted as the site is in SPZ1, and that infiltration features close to buildings have the potential to encourage the formation of voids, preventing the use of shallow infiltration features close to buildings. However, this would not necessarily preclude the use of shallow infiltration features set further from buildings. It is probable that the developer has not considered this option because it would mean reducing the number of dwellings on the site in order to make space for adequate infiltration features.

3.1.2 The drainage route and point of discharge

Having rejected discharge to ground on site (Option 1), the study goes on to consider three possible routes for a surface water discharge to watercourse:

- Option 2 - Sewer requisition to the Lash Brook
- Option 3 - Gravity outfall to the North-East Watercourse
- Option 4 - Pumped outfall to the Northern Watercourse (preferred option).

It is welcoming to see that various options have been considered, compared to the 2020 proposal which only considered discharge to the Lash Brook. Each of the three watercourses has been walked and photographed (where accessible).

The consultant summarises the Lash Brook as *"comprised of disconnected reaches along the upstream (southern) and middle reaches, including poorly defined and overgrown dry reaches, as well as reaches of standing water. The watercourse is considered to be a 'relic watercourse', which is likely to have been a former mill race."*

This matches our conclusion reached from our own inspection of the Lash Brook, and we welcome their rejection of the Lash Brook as the preferred discharge location for the Thames Farm development.

The report opts for Option 4, discharge to the Northern Watercourse, as the preferred option. We have reviewed the assessment of the impacts of the discharge below in section 3.3.

3.1.3 Options not considered

We have noted above that the option of changing the development intensity in order to make space for discharge to ground using shallow infiltration features has not been considered. It is worth also noting that discharge to a deep borehole soakaway off the site has also not been considered. In theory water could be discharged to a deep borehole soakaway outside of Source Protection Zone 1 as shown by the red area in Figure 3-2. Such an option could result in a shorter length of pipework, and would be in line with the discharge hierarchy, however we acknowledge that such an option is

7 <https://www.oxfordshirefloodtoolkit.com/wp-content/uploads/2018/12/LOCAL-STANDARDS-AND-GUIDANCE-FOR-SURFACE-WATER-DRAINAGE-ON-MAJOR-DEVELOPMENT-IN-OXFORDSHIRE.pdf>

8 <https://www.water.org.uk/wp-content/uploads/2020/03/SSG-App-C-Des-Con-Guide-v-2-100320-C.pdf>

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not without difficulties, and would likely require a landowner to be willing to sell or long-term lease a suitable plot of land to locate the soakaway.

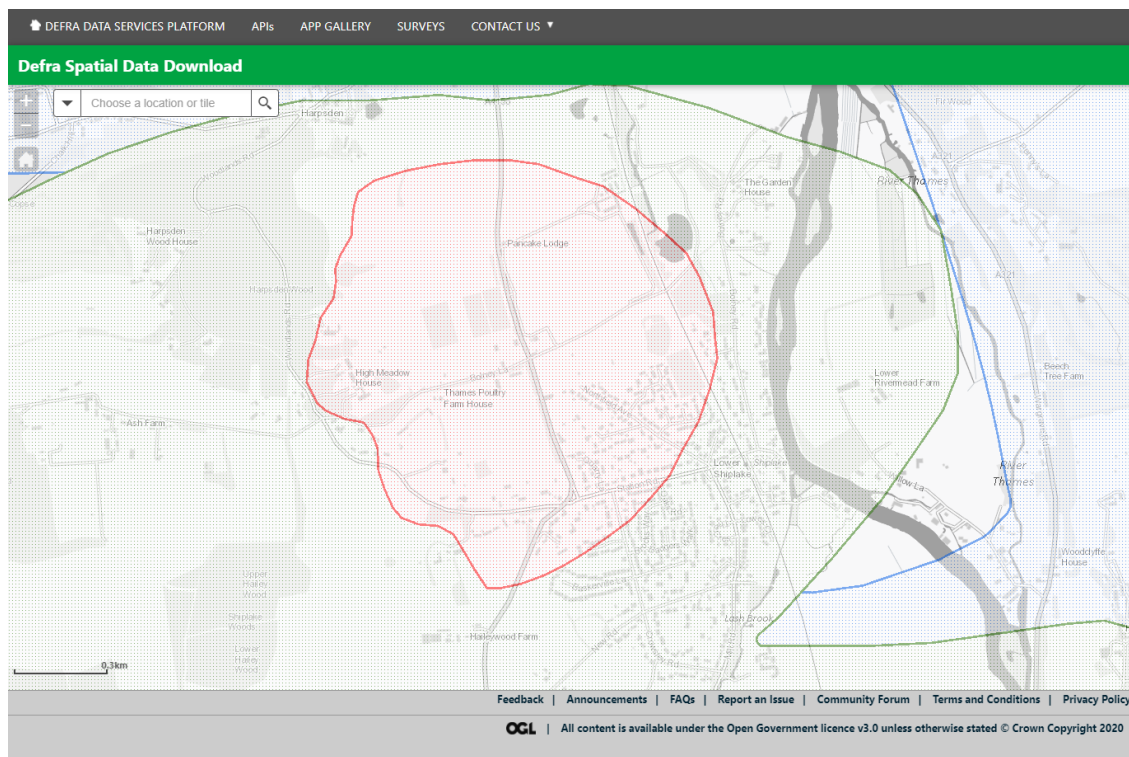


Figure 3-1: Source Protection Zones

3.1.4 Sustainability

It is proposed that the pumped drainage system is adopted by TWUL. Along with the rest of the UK water industry, TWUL have pledged to become operationally net-zero by 2030^{9,10}. The adoption of an energy intensive pumped surface water system, as opposed to an infiltration-based system with no pumping required, is contrary to the aims of this policy.

3.2 Storage calculations

The 2021 Enzygo study has re-used the flow and storage calculations developed for the 2020 study, thus in this section we refer to that 2020 study. Storage calculations have been made following the advice in the Interim Code of Practice for SuDS¹¹, which recommends use of the IH124 method for estimating greenfield runoff rates on sites of less than 50 hectares. This method is still supported by the SuDS Manual and OCC

9 <https://www.thameswater.co.uk/about-us/responsibility/climate-change>

10 <https://www.water.org.uk/routemap2030/>

11 National SuDS Working Group (2004) Interim Code of Practice for SuDS

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guidance, although research for the EA recommends that it is no longer the preferred method and that FEH Statistical should be preferred in permeable catchments¹².

The peak flow and storage calculations are based on 2.42Ha of the 5.60Ha site being made impervious, based on the internal road, roofs, hardstanding areas, and a section of the Reading Road which will also drain into the system. In this calculation, it is assumed that the remaining 3.18Ha remains permeable and will continue to drain in the same manner as prior to development. This is a normal assumption in site drainage design, however in this case there are two reasons why this should be questioned:

- The extensive grouting and compaction works are likely to change the natural hydrology of the ground which will remain as gardens and green spaces, which we know to have been highly permeable prior to development. These are recognised effects of both techniques. Grouting is sometimes used, for example, in the ground around pipelines to reduce water infiltration, whilst vibro-compaction can be used to reduce the risk of solifluction. This proposed work is likely to increase the percentage runoff from the site, with the consequence that the planned drainage may fill up quicker than designed, and/or runoff off the site may increase, although this could be recaptured back onto the system by the highway drainage improvements which have already been installed. The question remains, however, and we consider that an allowance should have been made to account for the reduced permeability of green spaces as a result of ground compaction and grouting.
- The southern surface water flow pathway onto the site (shown in Figure 2-1) has the potential to bring in runoff from outside of the site and subsequently for this water to enter the site's drainage system. No allowance for such runoff has been made, and as discussed in section 2.1, the layout of the site has not been planned to allow for this flow pathway.

The combination of these two effects is considered likely to result in premature filling of the site's drainage storage, and the standard of protection offered by this drainage system is likely to be compromised.

3.3 Assessment of flood risk in the Northern Watercourse

3.3.1 Hydraulic modelling

Enzygo have developed a 1D-2D hydraulic model of the Northern Watercourse in order to assess its capacity and the impact of the discharge from Thames Farm, which is proposed to discharge immediately upstream of the A4155 culvert. Unfortunately, the model, hydrology and modelling reports and channel survey were not provided for review, and very little information is provided in the main report. Consequently, it is not possible to provide a full assessment of this work. We note, however, that:

- The Northern Watercourse has a highly permeable catchment. The photographs in the flood risk appraisal indicate that when Enzygo visited it was dry along most of

12 Faulkner DS et al (2011) Greenfield run off and flood estimation on small catchments Accessed online at <https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1753-318X.2011.01128.x>

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its length, and it should probably be considered to be an ephemeral stream. As such, we would expect to see appropriate application of suitable hydrological methods. FEH Statistical with permeable adjustment is likely to be an appropriate method, but consideration should also be given to correlating any observed flow records with local borehole data. Such a study was carried out by JBA on the neighbouring Assendon Stream¹³.

- The new flood outlines are broadly similar to the existing Flood Zones. The main differences appear to be due to the use of more detailed LiDAR terrain data available to the 2021 study (see Figure 3-2).

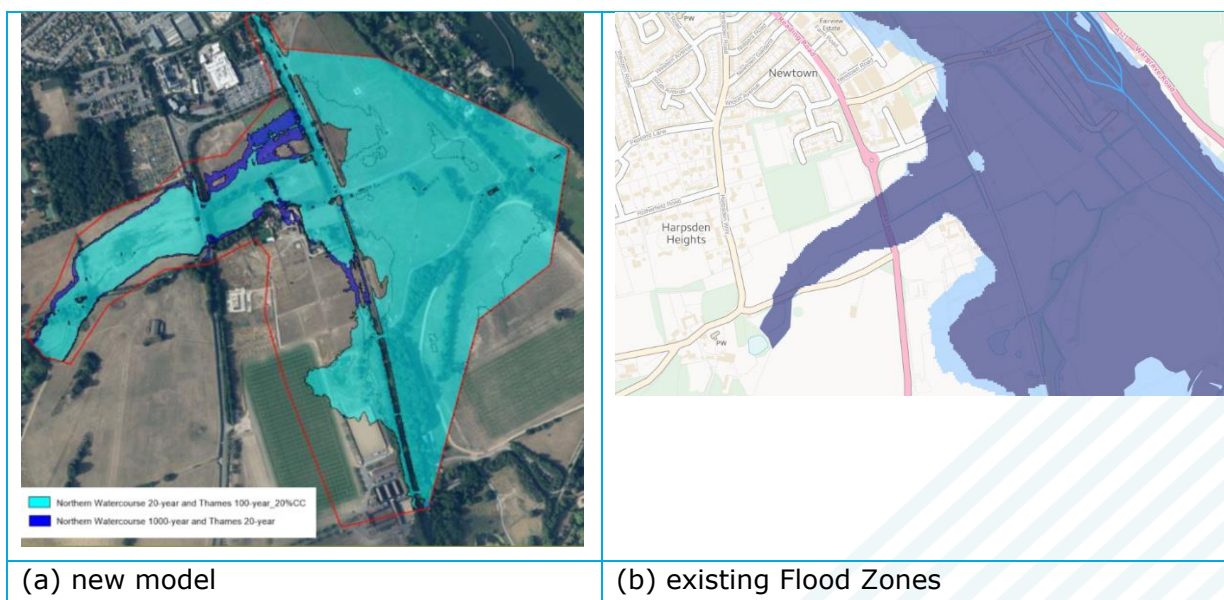


Figure 3-2: Comparison of newly modelled and existing flood outlines

- The Northern Watercourse is an ordinary watercourse and therefore the relevant authority to provide Land Drainage Consent is OCC. The hydrology and modelling reports and the model itself should be submitted to OCC for review.

3.3.2 Impact of the proposed 30l/s discharge

The base model was then used to test the impact of an additional 30l/s discharge from Thames Farm, immediately upstream of the A4155 culvert. It is stated that this resulted in a "very minor" increase in flood extents in a 1 in 20-year event, and a 1mm rise in water levels in a 1 in 1,000-year event. However, no detailed model results are provided either as a map of flood extents, in tabular format or in long section. The consultant should demonstrate the impacts more clearly, in particular:

13 JBA Trust (2016) Emergence of an ephemeral chalk stream at Assendon, Oxfordshire, in 2014 Accessed online at <https://www.jbatrust.org/wp-content/uploads/2017/03/W15-1389-Assendon-Stream-2014-Event-Report-Final-.pdf> on 11/03/2021

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- Is there any increase in flood extents impacting neighbouring properties at Lavender Lodge, Jubilee Park and Mill Lane?
- The consultant's photographs of sections of the Northern Watercourse immediately downstream of the Reading Road, notably NW9 to NW14 show a heavily overgrown channel with some very restrictive culverts. A comparison of base-case and post-development water levels along this reach for various return periods is required to demonstrate the impact of the proposed discharge.

4 Conclusions

The February 2021 Flood Risk Appraisal and Drainage Study recognises that the Lash Brook is a disconnected and poorly defined watercourse, and as such is unsuitable for the 30l/s discharge from Thames Farm. However, the study remains some way from adequately demonstrating that the drainage strategy is appropriate, in line with planning policies and design good practice, and will not increase flood risk. Particular attention is drawn to the following points:

- The flood risk appraisal identifies the two pathways of "low risk" (i.e. low probability) surface water flooding running across the site. These indicate the risks of surface water flows entering from offsite, but these are not taken into account either within the layout of homes on the site, nor in the design of the drainage system. This raises the risk that the site drainage system will not deliver the standard of protection that it has been designed to meet.
- In considering options for discharging surface water, the study has not considered the option of reducing the development intensity on the site to make space for infiltration drainage to be used at a safe distance from buildings. Neither has a deep borehole soakaway outside of SPZ1 been considered.
- A pumped discharge to the Northern Watercourse is selected as the preferred option. Introducing pumping commits Thames Water, as proposed adopters of the system, to an energy intensive solution, which is contrary to both Thames Water's, and SODCs stated objectives on climate change and achieving net-zero greenhouse emissions.
- The calculation of surface water storage on the site has not considered the impacts of the proposed grouting and compaction on the areas of the site which will remain as green surfaces. These measures are likely to reduce the ground's permeability and thus increase runoff from what is currently a highly permeable site, increasing the risk of overloading the site's drainage system or of causing runoff from the site.

The study has modelled the Northern Watercourse to which discharge is proposed. However, the report is very light on the details of the hydrological methods applied, and shows no detailed model results. The consultant's photographs show sections of the Northern Watercourse to be highly overgrown with constricting culverts. The impact of the proposed discharge on water levels in this watercourse has not been adequately demonstrated, so it is not yet possible to conclude that the proposal will have negligible impact on flood risk. The discharge will require a land drainage consent, and the model and modelling and hydrology reports should be submitted to OCC for review.