North Uttlesford Garden Community
DFD Technical Report – Flood Risk and Surface Water Drainage

On behalf of Grosvenor

On behalf of Grosvenor

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1 Introduction

1.1.1 This report has been prepared by Peter Brett Associates (PBA) to support emerging proposals for a strategic development site to the north of Great Chesterford. PBA is acting on behalf of Grosvenor Britain & Ireland (Grosvenor) who have been appointed by the land owners to promote the site through the Local Plan process. This report serves as a technical appendix to the Vision Statement prepared by John Thompson & Partners (JTP).

1.1.2 Currently the site, referred to as the North Uttlesford Garden Community (NUGC) from this point forward, is identified in the Regulation 18 Uttlesford Local Plan where it is described as follows:

North Uttlesford – The whole garden community will comprise 5,000 new dwellings, of which a minimum of 1,900 homes will be built by 2033 and a range of local employment opportunities and services and facilities including schools, health, retail and leisure. This garden community will maximise opportunities for economic linkages with the Wellcome Genome Campus and Chesterford Research Park.

1.1.3 The purpose of this document is to provide baseline information on the existing surface water regime and to briefly evaluate the level of flood risk from all sources of flooding.

1.1.4 The vision for the proposed Sustainable Drainage Systems (SuDS) and potential betterment to the wider community has also been assessed.

1.1.5 PBA have liaised with both Essex County Council and the Environment Agency during the production of this document.
2 Existing Baseline Information

2.1 Site Location

2.1.1 The site comprises a 466 hectare (ha) area of primarily agricultural land to the north of Great Chesterford, Uttlesford, Essex. The site is centred on OS grid reference 552454mE 245271mN.

2.1.2 The site lies within the administrative boundary of Uttlesford District Council (UDC). The district boundary forms the northern and western boundaries of the site.

2.1.3 The site is bound by the A11 to the west and the B184 to the south-west. Park Road branches from the B184 and bisects the centre of the site. Cow Lane borders a small section of the south-east site boundary.

2.1.4 The site is predominantly surrounded by agricultural land to the west, north and east. The village of Great Chesterford is situated just south of the site.

2.1.5 A site location plan, site topographical details and flood risk mapping information in relation to the site are contained in Appendix A of this report.

2.2 Site Topography

2.2.1 LiDAR data has been obtained to provide an assessment of the topography.

2.2.2 The LiDAR data shows a variation in ground levels across the site. Northern, eastern and southern areas of the site fall in a southerly and easterly direction towards the watercourse at the south-eastern site boundary.

2.2.3 The high point of the site lies at the north-eastern corner of the site at approximately 105mAOD. From this point the land falls generally in a south-westerly direction through the site. The lowest area at the south-east corner of the site is approximately 40mAOD.

2.2.4 There is a ridge that protrudes southwards centrally through the site from the northern boundary. The high point of this ridge is approximately 98mAOD. To the east of the ridge land falls in a south-easterly and southerly direction towards the watercourse at the south-east site boundary. To the west of the ridge, land falls in a westerly and north-westerly direction towards the A11.

2.2.5 An overview of the site topography is contained in Appendix A.

2.3 Hydrological Context

2.3.1 There are no main rivers located within the site extents. The nearest Environment Agency (EA) designated main river is the River Cam which flows in a north-easterly direction approximately 1km south-west of the site.

2.3.2 A tributary of the River Cam bisects the south-east corner of the site and flows in a south westerly direction along the south-eastern site boundary. This watercourse ultimately confluences with the River Cam to the west of Great Chesterford. This tributary is designated as an ordinary watercourse and is fed by numerous field drains located within the site.

2.3.3 The western part of the site falls in a westerly direction towards the A11. OS mapping suggests there is a drainage connection beneath the A11 and that this would continue to drain in a westerly direction beyond the A11 towards the River Cam.

2.3.4 It is understood that there is potential for some springs to be located within the site and therefore will need to be considered within the future proposals.
2.4 Geological Context

2.4.1 The British Geological Survey (BGS) online geology viewer provides the following information on the geology of the site:

- The bedrock underlying the site is chalk, comprising the ‘Lewes Nodular Chalk Formation and Seaford Chalk Formation (undifferentiated) in the centre and north-east, and the New Pit Chalk Formation across the south and west.’
- Across western and southern parts of the site there are no superficial deposits and the chalk bedrock is present at ground level.
- Central and northern parts of the site are underlain by superficial deposits of the ‘Lowestoft Formation – Diamicton’ comprising chalky till with sands, gravel, silts and clay characterised by its flint and chalk content.

2.4.2 The Cranfield University online ‘Soilscapes’ website provides an overview of the drainage potential of land across Britain. This indicates a number of different soils underlay the site:

- Central and northern areas of the site are underlain by ‘loamy and clayey soils with impeded drainage’
- Western and southern areas of the site are underlain by ‘freely draining lime-rich loamy soils’ and ‘freely draining slightly acid but base-rich soils’

2.4.3 Online EA groundwater maps indicate the chalk bedrock is designated a principal aquifer across the whole site. The superficial deposits are indicated as a secondary (undifferentiated) aquifer.

2.4.4 The online EA maps also confirm that central, northern and western areas of the site are located in a groundwater Source Protection Zone (SPZ) Outer Zone (Zone 2). The remainder of the site is located within the total catchment of the SPZ (Zone 3). Zone 1 of the SPZ is recorded approximately 200m north-west of the site. Groundwater vulnerability is classed as intermediate to high.

2.4.5 Ground investigations will be undertaken to inform the future technical studies to support the planning application, subject to the onward planning and development strategy for the site. These will inform the proposed surface water drainage strategy (i.e. suitability of infiltration drainage), and inform the emerging green infrastructure plan.
3 Assessment of Flooding

3.1 Existing Flood Risk

3.1.1 The online Flood Map for Planning (Rivers and Sea) indicates the site is located almost entirely within Flood Zone 1. This is land assessed as having a lower than 1 in 1,000 (0.1%) annual probability of river flooding.

3.1.2 A small area associated with the watercourse corridor at the south-east of the site is shown to be located in Flood Zones 2 and 3. Flood Zone 2 is land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding and Flood Zone 3 is land assessed as having a 1 in 100 or greater annual probability of river flooding.

3.1.3 An extract of the online flood map is provided in Appendix A.

3.1.4 Immediately downstream of the site is an area of land between the B184 and B1383 that is potentially at high risk of flooding from rivers (Flood Zone 3), possibly affecting the roads, properties, the recreation ground and Community Centre.

3.2 Reservoir Flooding

3.2.1 The online EA Flood Map for Risk of Flooding from Reservoirs indicates that the site is not at risk from a reservoir breach.

3.3 Surface Water Flooding

3.3.1 The online EA Flood Map for Risk of Flooding from Surface Water indicates that the site predominantly lies in an area at ‘Very Low’ risk of flooding from surface water. The map does show isolated areas across the site are classified as ‘High Risk.’

3.3.2 ‘High Risk’ areas generally coincide with existing field drains and watercourses across the site and are associated with the natural overland flow routes and drainage channels.

3.3.3 An extract of the online surface water flood map is provided in Appendix A.

3.4 Groundwater Flooding

3.4.1 The Uttlesford SFRA states that ‘the north of Uttlesford is underlain by a chalk aquifer; however, due to the actual depth (20 to 50m) of the water table compared to the ground surface and the clay till that overlays the underlying chalk, the risk from groundwater flooding is low.’

3.4.2 The baseline ground conditions assessment (PBA, May 2016), confirms that BGS borehole records at the site indicate resting groundwater levels at 31.7-41.5mAOD.

3.4.3 Map 9 of the SFRA indicates the western area of site has lower than 25% susceptibility to groundwater flooding. The remainder of the site remains unaffected. Refer to Appendix A for a copy of this Map.

3.5 Sewer Flooding

3.5.1 Map 10 of the SFRA confirms there have been no recorded incidents of flooding attributable to surcharging sewers within the vicinity of the site.
3.6 **Historical Flooding**

3.6.1 Historic flooding incidents adjacent to the site are listed in the Uttlesford District Council Strategic Flood Risk Assessment (SFRA, 2016) and were confirmed following consultation with local residents as part of the public exhibition undertaken on 10 November 2017. There were no recorded flood events within the site extent.

3.6.2 In October 2001 flooding occurred within the highway and grounds of several properties along Walden Road and the recreation ground to the south of the site, resulting in significant flood damage to the Community Centre. The analysis indicated that flooding was the result of exceptional catchment rainfall (estimated 1 in 92 years rainfall return period), wet antecedent conditions, poor channel conditions and alleviation measures undertaken by the emergency services (embankment breached by the fire brigade to relieve flood risk to properties in Hyll Close).
4 Surface Water Management

4.1 Existing Planning Policy

4.1.1 In addition to the Garden Communities principles for design, other regional and national planning policy will be taken into account going forward within the emerging drainage strategy for the site.

4.1.2 The Uttlesford SFRA considers the development site as a potential new settlement and appraises the suitability of SuDS at the site. The SFRA states

‘Most SuDS techniques should be suitable here as an integrated part of a large new settlement. Slope and soil permeability will vary locally across the area, with more freely draining soils located in the west of the area.’

4.1.3 The Uttlesford District Water Cycle Study (Arcadis January 2017) states

‘A drainage strategy must be submitted at an early stage to show how the impact of the development will be reduced through the use of SuDS. All major developments must carry out an FRA including and assessment of flood risk from all sources, and hydraulic modelling of the watercourses to better define the Flood Zones, water levels and the impact of climate change.’

‘…. with surface water run-off rates attenuated according to Essex County Council’s SuDS Guidance and local design standards. The drainage strategy should demonstrate that existing surface water flow paths will be preserved.’

4.1.4 As Lead Local Flood Authority (LLFA), Essex County Council has developed their own Sustainable Drainage Systems Design Guide (April 2016) that sets out the design criteria for SuDS in new development sites within the county. The guide sets out 12 local principles for SuDS:

- Plan for SuDS;
- Integrate with public spaces;
- Manage rainfall at the source;
- Manage rainfall at the surface;
- Mimic natural drainage;
- Design for water scarcity;
- Enhance biodiversity;
- Link to wider landscape;
- Design to be maintainable;
- Use a precautionary approach;
- Have regard to the historic environment; and
- Show attention to detail.

4.1.5 The Essex SuDS Design Guide also sets out stringent local design standards for water quantity and water quality that must be followed within the emerging drainage design for the site. Key elements from the local standards are as follows:
SuDS should be designed so that runoff does not occur for the first 5mm of any rainfall event for 80% of summer events and 50% of winter events.

In all cases, including on brownfield sites, runoff should where possible be restricted to the greenfield 1 in 1 year runoff rate during all events up to and including the 1 in 100 year rainfall event with climate change. An alternative approach would be for discharge rates to be limited to a range of greenfield rates, based on the 1 in 1, 1 in 30 and 1 in 100 year storm events. However, the use of this method to restrict discharge rates would also require the inclusion of online long-term storage, sized to take account of the increased post development volumes, discharging at no greater than 2l/s/ha.

The runoff rate should be calculated based on the area that will be draining via the proposed SuDS and will subsequently be the same area that is used to calculate the required storage (before an allowance for urban creep is applied). Unrestricted rates will only be allowed where the outfall is to a tidal estuary. If a Surface Water Management Plan has been produced for the area, it may set out further advice on allowable runoff rates.

Greenfield runoff rates should be calculated using the ICP SuDS method contained in Micro Drainage, or else the IH124 method should be used for a site of 50ha and reduced down proportionately in accordance with the site size.

Our preference would be for all rainfall events up to the 1 in 100 plus climate change to be stored within SuDS. However, should this be considered unfeasible, storage should be provided for the 1 in 30 year event with flows above this managed in suitable exceedance areas. An additional 10% of impermeable area should be accounted for to mitigate against urban creep, unless this is not appropriate for the proposed development use.

Safe conveyance routes and overflow flood storage areas must be established and agreed with the SuDS Team for the 1 in 100 year rainfall event with an allowance for climate change before adoption.

On 19 February 2016 the government published ‘Flood risk assessments: climate change allowances’ which provides updated climate change figures that should be used for flood risk assessments and drainage strategies.

An appropriate ‘train’ of SuDS components must be installed to reduce the risk of pollutants entering watercourses via runoff from developed sites. Interception storage should be used as part of the treatment train to ensure that pollutants are managed at source, which will reduce the risk of them contaminating water bodies. Following the SuDS Management Train hierarchy, a series of drainage techniques should be designed into the development layout. The design should achieve a system where pollution is incrementally reduced at each stage.

4.1.6 Consultation has been undertaken with ECC to discuss their requirements as LLFA and with the EA.

4.1.7 A meeting was held with ECC on 19 February 2018 and correspondence from both the EA and ECC is contained in Appendix B.

4.2 Existing Site Drainage

4.2.1 An assessment of the likely overland flow routes and outfall locations has been reviewed. This assessment has been undertaken based on freely available LiDAR data made available by the EA. The data has a 2m resolution.

4.2.2 The site is predominantly greenfield with a series of land drains running throughout the site area. From utilising the aforementioned data, onsite observations and discussions with one of the land owners, the current land drainage regime associated with the site could be reasonably determined. During a site walkover existing land drains were observed draining to
the watercourse to the east of the site, and the western part of the site was understood to a
discharge to a land drain which is piped under the A11. Other parts of the site are likely to
infiltrate due to the presence of outcropping chalk, which can be seen from the ground, as
confirmed by the land owner and based on data available for the recent construction of the
crematorium. A series of ponds were also noted at the site, some of which currently accept
runoff from the site.

4.2.3 At this stage of the technical studies the following can be assumed:

4.2.4 The site is split into three broad catchments as follows:

- The majority of the site drains to the watercourse at the south-eastern site boundary
  which flows under the B184 towards Great Chesterford.

- An area to the north west of the site drains towards the A11. It is believed there is a
culvert beneath the A11 that takes flows in a westerly direction towards the River Cam.
This assumption needs to be confirmed through further investigatory surveys which will
be undertaken as part of the planning process.

- A small area at the north-western corner drains in a north-westerly direction towards the
A11. At this stage it is believed to discharge via infiltration or via a culverted land
drainage feature. This assumption needs to be confirmed through further investigatory
surveys which will be undertaken as part of the planning process.

4.3 Infiltration Potential

4.3.1 BGS mapping and Soilscape mapping indicates that the northern and central parts of the site
are underlain by loamy, clayey soils with impeded drainage. Western and southern areas of
the site are underlain by freely draining soils.

4.3.2 The PBA Baseline Ground Conditions Assessment (May 2016) contained within Appendix C
confirms:

i. There is potential for shallow infiltration drainage across parts of the Site directly underlain
by the Chalk bedrock. However, New Pit Chalk Formation is recorded as containing
numerous seams of marl, which may be unsuitable for infiltration drainage. Further
assessment would be required to verify the Site’s suitability, both in respect of infiltration
rates and risk posed by potential dissolution feature occurrence.

ii. The feasibility of soakage infiltration (notwithstanding ground stability considerations/
controls) should be investigated through both BRE 365 tests in trial pits and through
deeper borehole tests.

4.3.3 The lack of drainage features in the north-western part of the site suggests the small
catchment to the north-west may be draining directly into the ground. However, the surface
water flood map in (Appendix A) suggests medium risk of flooding in this area, although this is
likely to be more associated with the topography within this locality, therefore in the absence
of an intrusive ground investigation, we cannot discount that infiltration potential may be
limited in some parts.

4.3.4 The recently constructed crematorium along the western boundary of the site, located just
south of the north-western part of the site, utilises infiltration as a viable method to discharge
the development generated surface water runoff. Further to this the land owner confirmed part
of the land was draining via infiltration. It is therefore likely the western area of the site could
make use of infiltration as a viable means to discharge surface water runoff.

4.3.5 Should infiltration prove to be feasible, the EA and local authorities will likely have additional
requirements for the surface water management strategy to incorporate additional water
quality measures due to the sites location on a principal aquifer. As a precaution at this stage,
we have taken a conservative approach for the surface water management strategy and assumed there is no infiltration at the site.

4.3.6 Intrusive ground investigations will be undertaken at the site in support of the future planning application.

4.4 Existing Surface Water Runoff Rates

4.4.1 For the purposes of this assessment the site has been considered as 100% greenfield. Greenfield runoff rates were estimated for the site using the HR Wallingford Greenfield Runoff calculator (a copy of the calculations is provided in Appendix D) as follows:

- QBAR = 2.27 l/s/ha (mean annual flow rate)
- Q1 = 1.97 l/s/ha (1 in 1 year event flow rate)
- Q100 = 8.07 l/s/ha (1 in 100 year event flow rate)
5 Flood Risk Strategy

5.1 Flood Risk Mitigation Scoping Strategy

5.1.1 Local planning policy emphasises the need to consider opportunities that new major development can offer to reduce flood risk to existing communities downstream. A scoping assessment for flood mitigation opportunities was subsequently undertaken, the aims of which was to:

- Collate available information on flood risk downstream of the site in Great Chesterford
- Undertake preliminary modelling of existing flood risk and potentially viable mitigation measures, using readily available data
- Make recommendations for further work to satisfy planning requirements.

5.1.2 Whilst the site does not suffer from flooding within its own boundary, betterment to downstream communities could potentially be provided as part of the development proposals by way of construction of a flood storage reservoir on site. This would benefit the recreation ground and properties on Walden Road which are currently at risk of flooding, even with the existing flood embankments alongside the drain.

5.1.3 The scoping study was therefore undertaken to assess the viability of providing flood storage within the site extent. Refer to Appendix E for a copy of the Flood Mitigation Scoping Study Report.

5.2 Hydraulic Modelling

5.2.1 A 2D-only model for the site was constructed using TuFLOW software, using the available LiDAR data on a 2m grid size. The model extents and features are shown in Figure 5.1. Refer to the report in Appendix C for the assumptions made, testing scenarios and the refinement which would be undertaken as part of a future planning application.
5.3 Results

5.3.1 Figures 5.2 to 5.4 show maximum flood depths for each of the three scenarios modelled:

- Scenario A replicates the EA Flood Map for Planning (Appendix A), demonstrating consistency between the maps and the flooding observed in 2001.

- When flood embankments are included in Scenario B, flood extents are reduced. However flooding still occurs due to overtopping of the B184 (Walden Road), and due to spill around the embankments on the B1383 (Newmarket Road).

- Scenario C demonstrates that full flood mitigation could be achieved by creation of a flood storage reservoir upstream of the B184 (Walden Road). Downstream peak flows are throttled to approximately 0.8 m$^3$/s by the embankment and culvert. Water levels upstream of the embankment reach approximately 42.2 mAOD with a total 38500 m$^3$ volume of water stored. The crudity of the model meant some of the potential flood storage was shown in areas beyond the redline boundary, this would be refined as part of a future planning application for containment within the redline boundary to ensure no detriment to offsite areas, with avoidance of the existing Scheduled Ancient Monument (SAM) located north of the proposed storage area.

5.3.2 A study has not tested what rate the peak flow downstream should be throttled to. It may be possible to increase discharge downstream from the 0.8 m$^3$/s restriction used, whilst still providing betterment. This would decrease the storage volume required.

![Figure 5.2: Scenario A maximum flood depths, 1% event](image-url)
5.3.3 The results have shown that it is potentially feasible for the development of NUGC to provide betterment downstream, by providing flood storage on site. This would benefit the recreation ground and properties on Walden Road which are currently at risk of flooding, even with the existing flood embankments alongside the drain.
5.3.4 Storage areas shown are likely to be reduced further due to the reduction in runoff rates from the contributing site catchment as a result of a positive SuDS drainage system, provided as part of the development proposals (as detailed in Section 6 of this report), which would result in a reduction in greenfield discharge rates. The area shown within Figure 5.4 is also subject to further hydraulic modelling and therefore to be considered as a worst case assumption, the extent of which would be aligned to fit within the development proposals and boundary.

5.3.5 A residual risks of flooding downstream would remain in the event of overtopping or failure. A planning application was approved for a new preschool building in the community land north-east of the recreation ground (UTT/17/2228/FUL), therefore the, risk to the new preschool facility will be paid particular consideration and will form part of a future detailed modelling strategy to inform the future flood risk assessment to be produced in support of the site.
6 Surface Water Drainage Strategy

6.1 Proposed Strategy

6.1.1 At this stage it is anticipated the attenuation features proposed at the site will be widely dispersed throughout the green infrastructure of the Garden Community.

6.1.2 The design and the integration of the proposed SuDS features within the wider landscape strategy and proposals will be carefully considered as part of the master planning process and will themselves provide an element of Public Open Space (POS) use.

6.1.3 The site already has some established landscaping which is to be retained and enhanced where possible through the appropriate provision of SuDS to be incorporated within the wider landscape strategy for the site. There are existing water courses, land drains and some ponds that could be integrated as part of the site’s surface water drainage system, which will enhance the landscape. The SuDS proposals will therefore be designed to ensure they enhance and support the landscape proposals going forward which are in accordance with the principles of the Garden Community.

6.1.4 Some of the strategic SuDS attenuation features could be designed with flexible parameters for storage associated with the frequent storm events. This is to enable the form of the POS to be further assessed as part of the future design proposals.

6.1.5 The proposed SuDS seek to deliver long term mitigation by attenuating and treating the development generated surface water runoff and where possible provide betterment. SuDS will be designed so they are integrated within the wider landscape proposals and will provide opportunities, where possible, to enhance biodiversity and recreation facilities.

6.1.6 As well as providing a drainage function, the SuDS will also form an important part of the project’s biodiversity strategy. The proposed SuDS features will be designed so that they maximise opportunities for habitat creation.

6.1.7 The prevailing surface water strategy to be adopted is a network of positive drainage consisting of and not limited to:

- Green Roofs
- Open cascading swales / rills;
- Attenuation Basins;
- Ponds;
- Wetlands;
- Infiltration SuDS (such as soakaways, infiltration basins, infiltration drains etc.);
- Porous Paving;
- Bio-retention areas; and
- Rainwater Harvesting.

6.1.8 Upstream on plot drainage solutions such as bio-retention planters, rainwater gardens and permeable paving could also provide pre-treatment for hard standing surfaces such as parking areas. Roof runoff where feasible will either drop directly into a piped drainage network, on plot rills, or rainwater gardens before discharging to the strategic attenuation areas.
6.1.9 Due to the steeply sloping nature of the site, the land take of any strategic attenuation features will need to be carefully considered as part of the emerging design of the site with the phasing of the development informing the emerging SuDS design.

6.1.10 Following consultation with ECC piped networks may still be utilised due to site gradients.

6.1.11 As a minimum requirement, in accordance with Sewers for adoption 7th Edition, no part of the site should flood in a 30-year rainfall event, hence the drainage systems associated with the proposed development should be designed to at least this standard. In addition, any part of a building, utility plant, or any neighbouring sites should not flood in a 100-year event.

6.1.12 Surface water runoff is proposed to be attenuated on-site for events up to and including the critical 1 in 100 year storm rainfall event plus a 40% allowance for climate change. Currently surface water runoff in the extreme events will discharge via overland flow routes towards existing watercourses or discharge locations. The development proposals will therefore provide a betterment downstream by attenuating surface water currently generated within the site and release at a lower and more controlled rate.

6.1.13 The proposed SuDS devices will provide source control, water quality treatment and biodiversity enhancement prior to discharging to the watercourse system or infiltrating at the site.

**Exceedance**

6.1.14 To demonstrate that in an exceedance event any flooding does not negatively affect the development, flows up to the 1 in 100 (1%) annual probability plus climate change rainfall event will be managed onsite. Furthermore, the attenuation will be designed to accommodate surface water runoff with no flooding for all storms up to and including the 1 in 100 (1%) annual probability plus 40% climate change event. Therefore, betterment will be provided during this extreme event.

**Pollution Control**

6.1.15 Appropriate pollution control measures must be included in the surface water drainage system to minimise the risk of contamination or pollution entering the receiving watercourse and aquifer from surface water runoff from the development.

**Adoption and Management**

6.1.16 The long term management of surface water drainage assets, including any SuDS components, is essential to ensure they continue to function to their design standard. As such, a management and maintenance plan will need to be developed in order to ensure the systems continue to work effectively.

6.1.17 It is assumed that the majority of surface water sewers and SuDS features will be adopted either by Anglian Water, a Garden Community Trust, ICOSA or private management company. Further consultation with an adopting authority at a more advanced stage of design is required to confirm which components may be adoptable and to agree specific design criteria.
7 Conclusion

7.1.1 The above information is providing some of the baseline data for informing the emerging Flood Risk Assessment, Geotechnical Studies and Surface Water drainage strategy being produced in support of the proposed development.

7.1.2 The work currently being undertaken has already resulted in several key issues and themes being identified, these are as follows:

- Sustainable Drainage Systems (SuDS) will be proposed throughout the development and will form a key part of the green infrastructure network. These will be designed to enhance the biodiversity opportunities within the development.

- Greenfield runoff from the site will be limited in accordance with the Lead Local Flood Authority (Essex County Council) surface water drainage design requirements.

- There are existing water courses, land drains and some ponds that could be integrated as part of the site’s surface water drainage system, which could enhance the landscape.

- It is potentially feasible for the development of the North Uttlesford Garden Community to provide betterment downstream, by way of constructing a flood storage reservoir on site. This would benefit the existing recreation ground and properties on Walden Road which are currently at risk of flooding, even with the existing flood embankments alongside the drain. Further hydraulic modelling will be undertaken to assess the flood mitigation proposals and associated works.
Appendix A  Site Baseline Mapping and SFRA Map
Flood Zones refer to the probability of river and/or sea flooding, ignoring the presence of defences.
Flood Zones refer to the probability of river and/or sea flooding, ignoring the presence of defences.
Figure 005 Rev A

Contains Environment Agency information © Environment Agency and database right
Contains Ordnance Survey data (c) Crown copyright and database right 2016.

Maps based on UK updated Flood Map for Surface Water (UWSFM) released in 2013 as the latest iteration of a national scale surface water modelling exercise.

Site boundary
Risk of flooding from surface water - Depth

- Below 150mm
- 150 - 300mm
- 300 - 600mm
- 600 - 900mm
- 900 - 1200mm
- Over 1200mm

Risik of flooding from surface water - Depth

- Site boundary
- Below 150mm
- 150 - 300mm
- 300 - 600mm
- 600 - 900mm
- 900 - 1200mm
- Over 1200mm

Client

UTTLESFORD

3.3 Percent Chance

EA Surface Water Flood Risk - Depth

20/04/18

Check: SK
Environmental Agency and database right 2016.

Reservoir Flood Maps (RFMs) showing the potential extent of flooding in the event of a breach from large reservoirs (over 25,000 cubic metres of water) based on a national scale modelling exercise. Key to read:  "site at risk of flooding in reservoir breachPLETED S FOR D

 visitors reference: Environment Agency and database right 2016. Reservoir Flood Maps (RFMs) showing the potential extent of flooding in the event of a breach from large reservoirs (over 25,000 cubic metres of water) based on a national scale modelling exercise. Key to read:  "site at risk of flooding in reservoir breach.
Historic Flood Map shows the maximum extent of all individual Recorded Flood Outlines from river, the sea and groundwater springs and shows areas of land that have previously been subject to flooding in England.

Recorded Flood Outlines shows all EA records of historic flooding from rivers, the sea, groundwater and surface water.
Historic Flood Map shows the maximum extent of all individual Recorded Flood Outlines from river, the sea and groundwater springs and shows areas of land that have previously been subject to flooding in England.

Recorded Flood Outlines shows all EA records of historic flooding from rivers, the sea, groundwater and surface water

Source Protection Zones

- Zone I - Inner Protection Zone
- Zone II - Outer Protection Zone
- Zone III - Total Catchment
- Zone of Special Interest
Dear Ms Rudge

NORTH UTTLESFORD GARDEN VILLAGE   LAND NW OF B184

Thank you for your e mail of 23 January 2018. I have set out below our preliminary views regarding the environmental constraints within our remit for this proposal. If after consideration you still think a meeting would be useful please complete the attached form and return to planning.ipswich@environment-agency.gov.uk

Please be advised that further work is resource dependent and as Uttlesford DC are currently considering the regulation 18 responses to the local plan document to inform the Pre-submission Plan (Regulation 19) which they will consult on in the winter of 2017/18. Following this consultation the Plan will be submitted to the Secretary of State to be subject to an independent examination by a Planning Inspector. We may therefore consider further work at this time to be premature and not the best use of our resources.

It is also our practice to wish to see technical proposals, such as a draft FRA, prior to any meeting.

Flood risk

There are no in principle issues with the proposed location of the garden village. There is an ordinary watercourse within the red line boundary to the south east of the site. Our flood map for planning shows a Zone 3 high probability fluvial flood risk to this area of the site.

Paragraph 103, footnote 20 of the National Planning Policy Framework (NPPF) requires applicants for planning permission to submit a site-specific flood risk assessment (FRA) when development is proposed in such locations.
We would recommend that the FRA for the garden village undertakes a modelling study for this watercourse and any other watercourse on or near the site. The current flood zones are based on our broad scale, indicative flood mapping and is not appropriate for the assessment of flood risk at a site level. We would recommend that the watercourse is modelled to its confluence with the River Cam. This will allow the developers to assess the impact of the development as the watercourse passes Great Chesterford. The current flood map indicates that the road crossing impedes the flow of the watercourse. The alteration of the flow into the watercourse may have unexpected impacts at those crossing points.

Further advice on the application of climate change allowances is attached at Appendix 1.

Once the risk of flooding has been determined, a sequential approach should be taken the layout of the site, avoiding development within the floodplain and taking steps to integrate the development and SuDS into the wider ecological infrastructure.

**The water environment**

The superficial geology encountered at this site is Lowestoft till formation that acts as a secondary A aquifer. The site is underlain by different chalk formations which is a principal aquifer.

Principal aquifers are geological strata that exhibit high permeability and provide a high level of water storage. They support water supply and river base flow on a strategic scale. The underlying aquifers are considered to have medium vulnerability.

The overlying soils are classified as having between high to low leaching potential (depending on the underlying geology), meaning that it may readily transmit a wide variety of pollutants to the groundwater. The site is located within a groundwater source protection zone 2 (SPZ2). The nearest surface water features are the rivers Granta and Cam.

Our records indicate that there are several domestic groundwater abstractions located in close proximity of the boundaries of the site, the nearest one being approximately 184m north of the boundary of the site. Interpolation on our well archive and monitoring locations indicate that the groundwater beneath the site is relatively deep.

General principles and advice for the protection of the water environment is attached at Appendix 2.

**Water quality and water resources**

For a large development site we expect developers, with the relevant sewerage undertaker, to demonstrate that a long term robust strategy is in place for the discharge of foul water and trade effluent.

That document should demonstrate how the parties intend to work together to anticipate any necessary upgrades to the sewerage infrastructure and recipient Water Recycling Centres (WRCs). The applicant will need to show an agreed phasing plan between the site developers and sewerage undertaker to show that sufficient foul capacity will be available prior to occupation. The strategy should have due consideration for our timescales for permit determination.
The site is close to Anglian Water's Great Chesterford WRC which currently has limited permitted capacity to accommodate additional foul flows. We would advise consulting Anglian Water for their views on hydraulic capacity within the existing foul infrastructure. Thereafter they will be able to discuss appropriate options for dealing with foul water drainage from the site.

We will need to be assured that the development will not adversely impact the receiving water environment. Assessments should be carried out to demonstrate that the objectives of the Water Framework Directive (WFD) will not be compromised. As a minimum, compliance with the WFD will require “No Deterioration” of river status and demonstrate that foul drainage from the site would not prevent a river from achieving “Good” status.

Utteresford District Council are currently undertaking a Water Cycle Study that will make these assessments and advise on the wastewater infrastructure required to serve this development.

For water supply the development lies within the area traditionally supplied by Anglian Water Services Ltd. It is assumed that water will be supplied using existing sources and under existing abstraction licence permissions. You should seek advice from the water company to find out if this is the case or if a new source needs to be established or a new abstraction licence sought.

We may not be able to recommend a new or increased abstraction licence where water resources are fully committed to existing abstraction limits or where there may be risks to the wider environment.

Buildings are responsible for almost half of the UK’s carbon emissions, half of our water consumption, about one third of landfill waste and one quarter of all raw materials used in the economy, therefore the efficient use resources in new development is crucial.

**Review of Documentation and Further Work**

We do offer a voluntary charged-for service where we can provide more detailed pre-application advice. As part of this service we can provide a dedicated project manager to act as a single point of contact to coordinate the review of technical documents. Should you wish us to undertake a detailed review of any supporting technical documents, such as a Flood Risk Assessment, we can do this as part of our charged service.

If you wish us to provide advice under our charged for service we will set up a Project Agreement and send you an offer letter which, among other things, will advise you of our estimated costs and provide a programme of the review work. The Project Agreement will detail the terms and conditions of the review work. If you are happy to go down the charged for service route please advise us and we will make the necessary arrangements. More information can be found on our [website](#).
Please note that this response is based on the information you have provided at this
time and if this changes in the future we would need to consider our position again.

Yours sincerely

[Signature]

Mr GRAHAM STEEL  
Sustainable Places - Planning Advisor

Direct dial 02 03 02 58389
Direct e-mail graham.steel@environment-agency.gov.uk
Appendix 1

Flood Risk Climate Change Guidance

The Planning Practice Guidance provides advice on what is considered to be the lifetime of the development in the context of flood risk and coastal change. Our guidance ‘Flood risk assessments: climate change allowances’ provides allowances for future sea level rise, wave height and wind speed to help planners, developers and their advisors to understand likely impact of climate change on coastal flood risk. It also provides peak river flow and peak rainfall intensity allowances to help planners understand likely impact of climate change on river and surface water flood risk.

For some development types and locations, it is important to assess a range of risk using more than one allowance. The extent, speed and depth of flooding shown in the assessment should be used to determine the flood level for flood risk mitigation measures. Where assessment shows flood risk increases steadily and to shallow depths, it is likely to be more appropriate to choose a flood lower in the range. Where assessment shows flood risk increases sharply due to a ‘cliff edge’ effect caused by, for example, sudden changes in topography or defences failing or overtopping, it is likely to be more appropriate to choose a flood level higher in the range.

Where flood risk data including climate change does not exist it is the responsibility of developers to undertake this assessment using our guidance. Assessment of future flood risk can be undertaken using:

- Freeboard allowances
- Interpolation based on current flood risk models
- New detailed modelling.

Deciding which approach applies depends on the size, vulnerability and location of the development.

It is envisaged that large scale developments (e.g. sustainable urban extensions, retail parks, large commercial developments) will need to adopt the detailed approach. The applicant should consult us to discuss this on a case by case basis. Please note we may charge for this advice.

In some (exceptional) circumstances you may choose to use other evidence to justify use of different allowances to those in our guidance. In these cases you will need to provide an explanation of how these alternative allowances were calculated and what climate change research they are based on for us to check. In some cases it may be necessary to get the views of the Met Office to validate your approach.

Where the argument for an alternative approach is not provided or is not based on robust, peer-reviewed scientific evidence, we will not consider the alternative approach to be robust and we will expect the applicant to use the allowances and approach in our guidance.

Climate change data we can provide our customers

We can provide the following datasets, where it is available, to help customers assess future flood risk:

- Existing 1% annual probability event with an additional 20% increase in peak flood flows to account for climate change impacts flood levels
- Modelled flood levels from existing EA hydraulic models
- Existing climate change freeboard allowances where derived by area teams
- Modelled flood extents where applicable

Customers can use this information to assist in generating their climate change estimate (level and extent) for the flood level for their flood risk management strategy.

Product 4 data requests to inform them of the climate change allowances changes

Flood risk data requests including an allowance for climate change will be based on the 1% annual probability flood including an additional 20% increase on peak flows to account for climate change impacts, unless otherwise stated. You should refer to ‘Flood risk assessments: climate change allowances’ to check if this allowance is still appropriate for the type of development you are proposing and its location. You may need to undertake further assessment of future flood risk using different allowances to ensure your assessment of future flood risk is based on best available evidence.
Appendix 2

Environmental Permit treated sewage effluent discharge

The discharge of trade effluent associated with this development may require an Environmental Permit under the Environmental Permitting (England & Wales) Regulations 2010 (EPR 2010) from the Environment Agency. You can find more information online at [https://www.gov.uk/environmental-permit-check-if-you-need-one](https://www.gov.uk/environmental-permit-check-if-you-need-one) or contact us on 03708 506506 for further advice. You should be aware that the permit may not be granted. A permit will only be granted where the risk to the environment is acceptable.

Groundwater Protection: Principles and Practice

We would like to refer the applicant/enquirer to our groundwater position statements in Groundwater Protection: Principles and Practice (November 2017), available from gov.uk. This publication sets out our position for a wide range of activities and developments, including:
- Discharge of liquid effluents
- Land contamination
- Drainage

**SuDS**
We consider any infiltration Sustainable Drainage System (SuDS) greater than 2.0 m below ground level to be a deep system and are generally not acceptable. All infiltration SuDS require a minimum of 1.2 m clearance between the base of infiltration SuDS and peak seasonal groundwater levels. All need to meet the criteria in our Groundwater Protection: Principles and Practice (GP3) position statements G1 to G13. In addition, they must not be constructed in ground affected by contamination.

We recommend that developers should:

The Local Authority can advise on risk to other receptors, for example human health);
http://www.claire.co.uk/component/phocadownload/category/8-initiatives?download=212:definition-of-waste-development-industry-code-of-practice and


6. Our “Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination” National Groundwater & Contaminated Land Centre Project NC/99/73:

7. Our “Good Practice for Decommissioning Boreholes and Wells”:


- Prior to being discharged into any watercourse, surface water sewer or soakaway system, all surface water drainage from lorry parks and/or parking areas for fifty car park spaces or more and hardstandings should be passed through an oil interceptor designed compatible with the site being drained. Roof water shall not pass through the interceptor.

- Foul and surface water manhole covers should be marked to enable easy recognition, convention is red for foul and blue for surface water. This is to enable water pollution incidents to be more readily traced.

- The Environmental Permitting Regulations make it an offence to cause or knowingly permit any discharge that will result in the input of pollutants to surface waters or groundwater.
Dear Ms Rudge,

**Pre-application Response – Great Chesterford, Uttlesford, CB10 1SA**

Thank you for contacting us for pre-application advice on the above site. In providing advice this Council looks to ensure sustainable drainage proposals comply with the required standards as set out in the following documents:

- The CIRIA SuDS Manual (C753)
- Defra’s SuDS National Standards
- Essex County Council’s (ECC’s) Sustainable Drainage Systems Design Guide.

After reviewing your application and the associated documents and meeting with you on the 19 February 2018 please see a summary of our comments below:

**Flood Risk Assessment**

The discussion was in relation to high level site design so at this stage no detailed information was available. We discussed a range of principles including managing run off from the site based on a number of existing catchments. This approach was generally agreed upon. There are a number of flooding issues related to this area. In particular we discussed issues relating to existing flooding to the west of Gt Chesterford. It is understood that as part of the development of the garden community that additional attenuation will be provided to help mitigate flooding issues in this area. In addition to flooding here Hinxton Parish Council have also raised concerns about flooding along the Cam. While this is not an area that we would directly consider it is thought likely that any upstream mitigation would also help to reducing flooding along the length of the main river.

**Run off Destinations**

Where possible, surface water should be reused for toilet flushing and clothes washing to help reduce surface water runoff and minimise the need for water to be brought into an area that is already considered water scarce. Failing that infiltration should be used to dispose of surface water unless ground conditions are proved not suitable. It is understood that some areas of the site have shown potential for infiltration. Further testing should take place to determine how viable this will be. Testing should take into
account potential ground stability issues as the underlying geology shows potential for chalk deposits across the site. Where infiltration is not possible surface water should be discharged to existing watercourses, in line with current catchments. Where possible conveyance to these locations should take place above ground.

**Peak Flow**

Flows from the site should be limited to the greenfield 1 in 1 year rates for all events up to and including the 1 in 100 year event with an allowance for climate change.

**Volume Control**

Since it is likely that the site will be delivered over two local plan periods it is important to consider the potential future climate change considerations. Current climate change figures cover developments with a design life up until 2115. Housing delivered now is already likely to be in existence beyond the consideration of current climate change allowances. If a significant proportion of the development will come forward as planning applications after 2033 then it will be necessary to give some consideration to rainfall levels beyond 2115.

**Water Quality**

Water quality should be enhanced wherever possible. Our minimum requirement is that water treatment should be in line with the CIRIA SuDS Manual pollution mitigation index. Design should be based on not only managing water quality and quantity but should also promote biodiversity and amenity.

**Residual Flood Risk**

The 300mm freeboard above flood levels is accepted, as is the proposal to route exceedance flows to the ponds for events greater than the 1 in 30 year. However, further information is required to confirm the system functions during the potential joint probability of a fluvial flood and 100 year storm. This can be provided electronically through a .mxd file demonstrating no flooding with a surcharged outfall.

The future ownership and maintenance of watercourses on the development need to be established to ensure that riparian responsibilities are attributed correctly.

**Please note:**

The advice provided by the Council’s Officers is informal opinion only and is made without prejudice to any formal decision that may be given in the event of an application being submitted.

In particular, any advice given will not constitute a formal response or recommendation of the County Council. Any views of opinions expressed are in good faith and to the best of ability, without prejudice to the formal consideration of any application, which will ultimately be decided by the Local Planning Authority. The County Council cannot
guarantee that new issues will not be raised following submission of a planning application and consultation upon it.

Officers cannot give guarantees about the final formal decision that will be made on planning or related applications. However the advice contained within the written response will be considered by officers when considering any future planning application. This is subject to the proviso that circumstances and information may change or come to light that could alter the position. It should be noted that the weight given to pre-application advice will change if new material considerations arise.

Whilst we have no further comments at this stage, we strongly recommend you engage in pre-application consultation with any other organisations that maybe relevant to the proposed drainage strategy to avoid potential delays at the application stage. If you have any queries about any advice we have given please do not hesitate to contact us.

Yours sincerely

Tim Simpson
Development and Flood Risk Manager
Team: Flood and Water Management
Service: Waste and Environment
Essex County Council

Telephone: 03330136812
Internet: www.essex.gov.uk
Email: suds@essex.gov.uk
Appendix C  PBA Baseline Ground Conditions Assessment
Job Name: North Uttlesford, New Settlement
Job No: 36997
Note No: GEO1
Date: May 2016
Prepared By: G.Bates
Subject: Ground Conditions - Baseline Opportunities & Constraints

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| 1.   | **Introduction**  
Peter Brett Associates (PBA) have been commissioned by the Client to undertake a high level baseline assessment of the Site located to the east of the A11, north of Great Chesterford, Essex. The Site centre is located at approximate grid reference TL515449 within the administrative district of Uttlesford District Council, and covers an area of 466.06ha. The following information has been provided in order to determine potential constraints and opportunities to future development related to ground conditions (presented on Appendix A enclosed). Archaeological and considerations have not been included as part of this assessment. The Site location is shown on Figure 1. |

![Figure 1 Site Plan](image1.png)

**DOCUMENT ISSUE RECORD**

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<th>Approved (Project Director)</th>
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<td>May 2016</td>
<td>G.Bates</td>
<td>D. Bissell</td>
<td>M.Brenton R.Henry</td>
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Peter Brett Associates LLP disclaims any responsibility to the Client and others in respect of any matters outside the scope of this report. This report has been prepared with reasonable skill, care and diligence within the terms of the Contract with the Client and generally in accordance with the appropriate ACE Agreement and taking account of the manpower, resources, investigations and testing devoted to it by agreement with the Client. This report is confidential to the Client and Peter Brett Associates LLP accepts no responsibility of whatsoever nature to third parties to whom this report or any part thereof is made known. Any such party relies upon the report at their own risk.

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## TECHNICAL NOTE

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<td>2.</td>
<td><strong>Current Land Use</strong></td>
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The following information has been obtained using the M.A.G.I.C web hosted database[^1] and the Google Earth portal. A site walkover has not been completed as part of this exercise.

- The Site predominately comprises agricultural farmland and small, scattered areas of woodland, with drains and tracks sub-dividing the land.
- Dell’s Farm is located in the south-west of the Site along Park Road. Park Farm is located in the north of the Site and comprises farm buildings with three ponds in the adjacent fields. There is a television mast located in the north of the Site, to the north-east of Park Farm. Field Farm Cottages and The Limes are located in the north-west and centre of the Site respectively. There is a small disused chalk pit located in the east of the Site (see Figure 2).
- Field Farm and The Barn are located in the north-west and centre of the main body of the Site but are not included in the Site area (See Figure 1).
- General topography on-site is high in the north and centre and falls away to the west, south and east. A maximum elevation of 99m aOD is recorded to the south of Park Farm. Four valley features are located across the Site orientated north-east to south-west (see Figure 2).

![Figure 2 Topographical Plan](Disused Chalk Pit)

- Surrounding land uses generally comprise farmland. Adjacent to the west of the Site is the A11 road. The A11 is shown to follow the route of a Roman road. The village of Great Chesterford lies to the south-west of the Site. A dismantled railway is located.

### TECHNICAL NOTE

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<td>approximately 200m to the west of the Site.</td>
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#### 3. Historical Land Use

The following data has been obtained from the Old Maps website².

- **1880**: Dell’s Farm present in the south-west of the Site and Park Road Farm located to the north-east of Dell’s Farm (off-site). Park farm is present in the north of the Site with three separate pool/pond features recorded to the north-west, south and south-east. Well located in the north-west (off-site). Chalk pit located in the east of the Site (see Figure 2). General Site use is agricultural. Surrounding land use is generally agricultural, woodland or park land. Great Chesterford is located to the south-west of the Site. The Mills (corn mills) is located 20m to the south-west of the Site.
- **1891**: No significant changes on-site. Field Hall recorded in the north-west of the Site at the location of the well (off-site).
- **1898-99**: No changes.
- **1904**: No changes.
- **1924**: Wind pump at location of The Mills (off-site).
- **1938-51**: No changes.
- **1960**: Identified Roman Building in the south of the Site.
- **1983-84**: Field Hall (off-site in the north-west) recorded as Field Farm and Field Farm Cottages.

#### 4. Geology

- The 1:50,000 solid and drift geology map of Saffron Walden (sheet 205) records superficial Lowestoft Formation across the centre and north-east of the Site (correlating to topographical highs on-site) overlying the Cretaceous aged Chalk Group bedrock. The Chalk belongs to the White Chalk Subgroup (formerly the Upper and Middle Chalk).
- The Lewes Nodular Chalk Formation and Seaford Chalk Formation (undifferentiated) are present in the centre and north-east, and New Pit Chalk Formation is present across the south and west. Chalk bedrock is present from ground level or underlying Lowestoft Formation where present. There is a thin band of Chalk Rock Member in between the Lewes Nodular Chalk Formation and the New Pit Chalk Formation along the geological boundary (see Figure 3). The following descriptions have been taken directly from the BGS Lexicon of named rock units:
  - **Lowestoft Formation** – 'chalky till with outwash sands and gravel, silts and clay. It is characterised by its flint and chalk content.' The base of the till is characterised in some areas by a bed, less than 1m thick, of irregularly laminated silt and sand with scattered stones and gravel seams.
  - **Lewes Nodular Chalk Formation** – ‘hard to very hard nodular chalk and hardgrounds with interbedded soft to medium hard chalk and marls. Nodular chalk is typically lumpy and iron stained.’ The Formation includes the Top Rock Member and at the base the Chalk Rock Member. The Top Rock Member is a bed of strongly indurated chalk about 0.6m thick with glauconitised pebbles. The Chalk Rock Member in this district is a nodular chalk 4 to 5m thick.
  - **New Pit Chalk Formation** – ‘blocky, white firm to moderately hard chalk with numerous marls or paired marl seams. Flint occurs sporadically in the upper part of the unit.’
  - Whilst not depicted on the published map record, Head deposits may also be present as a thin surface mantle locally within the valley features. The absence of Head deposits on published mapping is noted in the published note of the geology of this district.
  - The 1:50,000 geology map of the district shows the A11/ M11 Grade Separated Junction to comprise an area of ‘Worked Ground’ – this representation of the junction being formed in cutting.
  - In terms of geological structure, no geological faults are depicted on the published map record.

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² https://www.old-maps.co.uk

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<td>5.</td>
<td><strong>Hydrogeology</strong></td>
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<td>The following data has been obtained from the Environment Agency’s ‘what’s in your backyard’ portal.</td>
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<td>• The Site lies within Zone 2 (in the west) and 3 (in the east) of a Source Protection Zone (SPZ). Zone 1 of the SPZ is recorded approximately 200m north-west of the Site.</td>
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<tr>
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<td>• Lowestoft Formation is classified as a Secondary (undifferentiated) Aquifer.</td>
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<td></td>
<td>• The Chalk bedrock is classified as a Principal Aquifer.</td>
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<td></td>
<td>• Groundwater vulnerability is classified as intermediate to high.</td>
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<td>• Rest groundwater levels have been recorded on available BGS borehole records on-site at 31.7 – 41.5m aOD.</td>
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<td>• According to the Environment Agency ‘what’s in your backyard’ portal, there are no groundwater abstractions recorded within the boundaries of the Site. However, available BGS borehole records indicate groundwater wells have historically been drilled into the chalk aquifer at Dell’s Farm, Park Road Farm (now The Barn - off-site) and Field Hall (now Field Farm - off-site). These are recorded as ‘water wells’ on the PBA WMS GeIndex Dataset and are present on Appendix A.</td>
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<td>• The Site does not lie within a drinking water safeguarded area.</td>
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<td>6.</td>
<td><strong>Hydrology</strong></td>
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<td>• There are surface water drains located Site-wide. These are generally orientated north-west to south-east or north-east to south-west. The drain located along the south-eastern boundary of the Site is recorded as flowing in a south-westerly direction towards the River Cam, which is located to the south-west of the Site and flows to the...</td>
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3 http://maps.environment-agency.gov.uk/wiyby
7. **Geo-Environmental Data**
   - There is a historic landfill recorded at the location of a disused Chalk Pit approximately 700m to the south of the Site, south-east of Great Chesterford (Appendix A). Information regarding accepted waste and first/last input date is not available. There are no other recorded landfill sites within 1000m of the Site.
   - There is a Romano-Celtic temple (Scheduled Monument) recorded in the south of the Site, 400m south of Dell's Farm (Appendix A).
   - The chalk bedrock that underlies the Site is classified as Higher Purity Chalk (93-98% CaCO₃) with regards to mineral resourcing by the BGS and the west and south of the Site lie within a Minerals Safeguarding Area.
   - The Lowestoft Formation is not recognised as a mineral resource.
   - There is a Site of Special Scientific Interest (SSSI) located adjacent to the north of the Site at Hildersham Wood (Appendix A). It has been classified as a SSSI due to its main habitat of broadleaved, mixed and yew woodland.
   - The Site lies within a lower probability radon area, as less than 1% of homes are above the action level. No radon protection measures are considered necessary in the construction of new dwellings.

8. **Environmental Assessment**
   - Based on the current and historical land use on the Site, there are not considered to be any significant sources of potential contamination present within the boundaries of the Site. Potential risks are generally considered to be very low. However, there is potential for localised hotspots of contamination located within farmyards associated with agro-chemical stores and fuel tanks and at the location of the disused pit.
   - On review of the most recent Google Earth entry for the area, the disused former chalk pit located in the east of the Site appears to have been backfilled. Potential exists for localised soil and ground gas contamination to be present associated with this feature and the unknown backfill material.
   - Although a historical landfill has been identified to the south of the Site, there is a water course separating the landfill from the Site. As such, there are not considered to be any pathways by which landfill gases or leachate could migrate onto the Site.

   **Opportunities**
   - Any site won soils requiring off-site disposal are likely to be classified as ‘Inert’ waste.

   **Constraints**
   - Any contamination or pollution generated on-site as part of future development has the potential to impact on the quality of off-site surface water features.
   - The Site lies on a Principal Aquifer, and partly in Zone 2 of a SPZ. Any contamination or pollution generated as part of the proposed development has the potential to impact groundwater quality and nearby groundwater wells. However, no specific protection measures are considered necessary during redevelopment.
   - Measures should be taken to ensure there is no adverse impact on the SSSI located adjacent to the north of the Site.

9. **Minerals**
   The Essex Minerals Local Plan adopted July 2014 identifies the Site as lying within a Minerals Safeguarded Area and Minerals Consultation Area for ‘White Chalk’. The Mineral Planning Authority (MPA) will need to be consulted as part of this planning application to ensure the mineral resource will not be sterilised by the development. Due to the size of this Site, it is likely that the MPA will consider extraction of mineral prior to any construction/development of the area.

10. **Geotechnical Assessment**
    - According to the PBA natural cavities database, there are no natural cavities or mining cavities recorded within 2000m of the Site.
THE TECHNICAL NOTE

### Item
- **The Chalk is known in the district to have been dug in the past for agricultural lime from numerous small pits.**
- **There are no recorded historical landslides located within 2000m of the Site.**

#### Opportunities
- **It is likely that re-use of Lowestoft Formation as engineering fill will be possible as part of future development.**
- **There is potential for shallow infiltration drainage across parts of the Site directly underlain by the Chalk bedrock. However, New Pit Chalk Formation is recorded as containing numerous seams of marl, which may be unsuitable for infiltration drainage. Further assessment would be required to verify the Site’s suitability, both in respect of infiltration rates and risk posed by potential dissolution feature occurrence.**
- **The Lowestoft Formation is likely to be suitable for traditional shallow foundations. It will be classified as a ‘clay-soil’ and as such foundation design will need to take account of any existing trees or proposed landscape plantings.**
- **The Chalk bedrock is likely to be suitable for traditional shallow foundations. Chalk with a lower carbonate content and higher proportion of clay minerals would be classified as a shrinkable soil. Classification of the chalk grade will be required to confirm shrinkability. Foundation design will also need to take account of any potential for natural cavity occurrence. Further assessment / investigation work is required to understand the suitability.**

#### Constraints
- **The topography of the site will require earthworks to facilitate development.**
- **The shallow valley features present on the site may contain Head deposits; in terms of engineering characteristics, these can be highly variable and contain relict shear surfaces which can give rise to local slope instability if slopes are saturated, loaded or undercut.**
- **The potential exists for unidentified dissolution features to be present in the underlying chalk bedrock. In addition, it is known from the historic map record that the chalk has locally been worked. There is the possibility of further unrecorded small chalk pit workings occurring. Whilst there is no record of chalk mining in the artificial cavities database reviewed, further research is required to confirm the absence of any local risk of chalk mining on this site.**
- **The presence of dissolution features on the site may restrict further those areas where infiltration drainage can be used.**
- **The cohesive Lowestoft Formation and clayey chalk may be classified as shrinkable soils. The degree of volume change is likely to vary across the Site.**

### 11. Recommended Additional Studies

The following work has been recommended for the Site based on the findings of this technical note. Although all these works may not be strictly required for the planning application, it is anticipated that a phase 1 contaminated land desk study will be required as a minimum.

**Chalk dissolution/ natural cavity occurrence**
- Geomorphological mapping should be undertaken across the site to identify topographical features possibly indicative of natural cavity occurrence/ land instability.
- A ground stability desk study will potentially be required for this Site to support the planning application and Environmental Impact Assessment (EIA).

**Contaminated Land**
- A Phase 1 Contaminated land desk study will be required to support the planning application and EIA. The study should include obtaining environmental information from the local planning authority in addition to that from a commercially produced modular report (i.e. a Landmark Environment report).
- Proposed ground investigation works should target the location of the disused chalk pit, as this has been identified as the main potential source of contamination on-site.

**Minerals**
- Consultation with the Mineral Planning Authority should be undertaken to address the Mineral Consultation Area requirement, and identify the scope of work (if any) required for the site.
### TECHNICAL NOTE

<table>
<thead>
<tr>
<th>Item</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>to address the statement in the ‘Minerals Safeguarding Areas for Essex’ publication (Mouchel, 2012) that “The applicant would be expected to provide information to determine what quality and quantity of deposit would be capable of being economically worked” in respect of prior extraction before non-minerals development on the site.</td>
</tr>
<tr>
<td>Geotechnical</td>
<td>An intrusive ground investigation will be required in due course to confirm the general geology of the site and inform the design process.</td>
</tr>
<tr>
<td>Geotechnical</td>
<td>The feasibility of soakage infiltration (notwithstanding ground stability considerations/controls) should be investigated through both BRE 365 tests in trial pits and through deeper borehole tests.</td>
</tr>
<tr>
<td>12. Summary</td>
<td>The Site predominately comprises agricultural farmland, with Park Farm, Dell’s Farm, The Limes, Field Farm Cottages, a disused chalk pit and a television mast all present within the boundaries of the Site.</td>
</tr>
<tr>
<td>Environmental</td>
<td>The Site has remained mostly undeveloped since the late 19th century.</td>
</tr>
<tr>
<td>Environmental</td>
<td>Any site won soils requiring off-site disposal are likely to be classified as ‘Inert’ waste.</td>
</tr>
<tr>
<td>Environmental</td>
<td>Site wide contamination based on current and historical land use is not considered to be an issue.</td>
</tr>
<tr>
<td>Environmental</td>
<td>Localised contamination may exist associated with storage of agro-chemicals and fuel in farmyards, and the disused chalk pit in the east of the Site. Remediation may be required in these areas.</td>
</tr>
<tr>
<td>Environmental</td>
<td>The Site lies in a Minerals Safeguarded Area for Chalk. Consultation with the MPA will be required to discuss potential mineral extraction prior to development.</td>
</tr>
<tr>
<td>Geotechnical</td>
<td>Potential exists for ground stability hazards associated with the shrink / swell potential of the Lowestoft Formation and clayey chalk.</td>
</tr>
<tr>
<td>Geotechnical</td>
<td>The shallow natural soils are generally considered suitable for traditional shallow foundations.</td>
</tr>
<tr>
<td>Geotechnical</td>
<td>Infiltration drainage may be suitable at the Site within the chalk. However, assessment will be required to confirm suitability.</td>
</tr>
<tr>
<td>Geotechnical</td>
<td>Earthworks will be required on-site due to the variable topography.</td>
</tr>
<tr>
<td>Geotechnical</td>
<td>There is potential for unidentified dissolution features to exist in the Chalk underlying the Site.</td>
</tr>
</tbody>
</table>
Appendix D  Existing Greenfield Runoff Rates
This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance “Preliminary rainfall runoff management for developments”, W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

### Site characteristics

- **Total site area (ha)**: 1

### Methodology

- **Qbar estimation method**: Calculate from SPR and SAAR
- **SPR estimation method**: Calculate from SOIL type

### Hydrological characteristics

- **SAAR (mm)**: 572
- **Hydrological region**: 5
- **Growth curve factor: 1 year**: 0.87
- **Growth curve factor: 30 year**: 2.45
- **Growth curve factor: 100 year**: 3.56

### Notes:

1. Is $Q_{BAR} < 2.0$ l/s/ha?
   Normally limiting discharge rates which are less than 2.0 l/s/ha are set at 2.0 l/s/ha.

2. Are flow rates < 5.0 l/s?
   Where flow rates are less than 5.0 l/s consents are usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set in which case blockage work must be addressed by using appropriate drainage elements.

3. Is SPR/SPRHOST ≤ 0.3?
   Where groundwater levels are low enough the use of soakaways to avoid discharge offsite may be a requirement for disposal of surface water runoff.

### Greenfield runoff rates

<table>
<thead>
<tr>
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<th>Default</th>
<th>Edited</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qbar (l/s)</td>
<td>0.13</td>
<td>2.27</td>
</tr>
<tr>
<td>1 in 1 year (l/s)</td>
<td>0.12</td>
<td>1.97</td>
</tr>
<tr>
<td>1 in 30 years (l/s)</td>
<td>0.32</td>
<td>5.56</td>
</tr>
<tr>
<td>1 in 100 years (l/s)</td>
<td>0.47</td>
<td>8.07</td>
</tr>
</tbody>
</table>
Appendix E  Scoping for Flood Mitigation Opportunities Report
North Uttlesford Garden Village
Scoping for Flood Mitigation Opportunities

On behalf of Grosvenor Homes
This report has been prepared by Peter Brett Associates LLP (‘PBA’) on behalf of its client to whom this report is addressed (‘Client’) in connection with the project described in this report and takes into account the Client’s particular instructions and requirements. This report was prepared in accordance with the professional services appointment under which PBA was appointed by its Client. This report is not intended for and should not be relied on by any third party (i.e. parties other than the Client). PBA accepts no duty or responsibility (including in negligence) to any party other than the Client and disclaims all liability of any nature whatsoever to any such party in respect of this report.

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1 Introduction and Flood Risk Context

1.1 Background and Scope of Study

1.1.1 A Garden Village development is proposed for a 466 ha site to the north of Great Chesterford, Uttlesford, Essex. The site is located in the headwaters of a small tributary of the River Cam which flows in a south-westerly direction through Great Chesterford.

1.1.2 Local planning policy emphasises the need to consider opportunities that new major development can offer to reduce flood risk to existing communities downstream. This scoping review aims to:

- Collate available information on the flood risk downstream of the site in Great Chesterford
- Undertake preliminary modelling of the existing flood risk and potentially viable mitigation measures, using readily available data
- Make recommendations for further work to satisfy planning requirements

1.2 Existing Flood Risk

1.2.1 The Environment Agency’s Flood Map for Planning (Figure 2.1) shows that while the site itself has a low overall risk of flooding, immediately downstream of the site there is an area of land between the B184 and B1383 that is potentially at risk of flooding during the 1% (1 in 100 year) event, potentially affecting the roads, properties, the recreation ground and Community Centre. The Environment Agency confirmed that no detailed hydraulic modelling had been undertaken for this drain, and therefore the flood map was generated using simplistic modelling (JFlow).

Figure 2.1. Extract of EA Online Flood Map for Planning (Rivers and Sea). 09/05/2016.
1.2.2 Historic flooding incidents are listed in the Uttlesford District Council Strategic Flood Risk Assessment (SFRA, 2016) as follows, although the lack of specific locations makes it difficult to draw conclusions as to whether the historic flooding incidents were caused by the tributary drain.

- October 2001: Flooding in Great Chesterford from the River Cam, affecting 3 properties and 4 garages
- September 2002: Flooding affecting South Street, Great Chesterford
- June 2009: Flooding affecting Great Chesterford Primary School
- Unspecified: Flooding affecting properties in Cambridge Road, Ickleton Road, Walden Road, sewage pumping station and playing field.
- 2 external flooding incidents due to Thames Water sewer flooding within postcode, specific locations unknown.

1.2.3 During the 2001 event, the highway and grounds of several properties along Walden Road were flooded and the inundation of the recreation ground resulted in significant flood damage to the Community Centre. The analysis indicated that flooding was the result of exceptional catchment rainfall (estimated 1 in 92 years rainfall return period), wet antecedent conditions, poor channel conditions and alleviation measures undertaken by the emergency services (embankment breached by the fire brigade to relieve flood risk to properties in Hyll Close). A number of recommendations were made to reduce the level of flood risk, many of which were already implemented by 2002, including channel enlargement and embankment raising.

1.2.4 The Environment Agency undertook a modelling investigation in 2003 to investigate the effects of the channel modifications on flood risk. A 1D HecRas model was constructed and flows estimated using the FEH Rainfall-Runoff method. The model was not available to PBA at the time of writing this report. The results indicated that while the modified channel had sufficient capacity for a 0.5% (200 year) event, flooding would occur during a 1% (100 year) event due to overtopping of Walden Road and overspill of the left bank at Carmen Street. The report recommended formalising the use of the recreation ground as a floodplain with a new bund to protect the Community Centre. These recommendations have not been implemented.

1.2.5 A planning application is currently under consideration for a new preschool building in the community land north-east of the recreation ground (UTT/17/2228/FUL).

1.3 Site Visit

1.3.1 A site visit was undertaken by PBA staff in August 2017, with the following observations:

- The drain is embanked for its full length between the B184 (Walden Road) and the B1383 (Newmarket Road). The embankments are substantial, of estimated height 1.5 to 2 m above ground levels, and well established with mature vegetation.
- The drain is crossed by footbridges at the raised embankment height.
- The channel bed of the drain is at a similar elevation to neighbouring ground levels in some places. The recreation ground is particularly low-lying. The channel was dry at the time of observation.
- Culverts underneath the B184 and B1383 were of a reasonably large size and did not appear to be a severe obstruction to flow, though two right angle bends downstream of the B184 culvert could be problematic.
2 Preliminary Modelling

2.1 Data Inputs

2.1.1 Preliminary modelling was undertaken to investigate flood risk further. The model was based entirely on available LiDAR data, downloaded from the Environment Agency in July 2017. The 2m LiDAR dataset was used. 1m LiDAR is also available but with a smaller spatial coverage.

2.1.2 A review of the LiDAR (Figure 3.1) indicated that the data did not include the existing flood protection embankment. This was most likely erroneously removed by the automatic filtering methods used to remove vegetation from LiDAR data.

![Figure 3.1: LiDAR data](image)

2.2 Flow Estimates

2.2.1 A basic flow estimation calculation was undertaken as follows:

- Catchment descriptors extracted from the FEH CD-Rom in 2016 were used, with a catchment area of 6.78 km² reflecting the entire catchment draining to Newmarket Road (B1383).

- The ReFH method was applied to estimate a flow hydrograph for the 1% (100 year) event, giving a peak flow of 2.57 m³/s for the critical duration 8.7 hour storm.

2.2.2 The flow estimate was input to the model as a single inflow at the upstream limit of the modelled section.

2.2.3 There is a high uncertainty in the flow estimate due to the small catchment size and high bedrock permeability of the catchment. Further detailed flow estimation should be undertaken.
to support a planning application, including review of catchment areas, geology and soils, testing of a variety of flow estimation methods and storm durations, distribution of flows along the length of the modelled drain, and assessment of the potential impacts of climate change.

2.3 **Hydraulic Modelling**

2.3.1 A 2D-only model for the site was constructed using TuFLOW software, using the available LiDAR data on a 2m grid size. The model extents and features are shown in Figure 3.2. A gully line was used to ensure a connected flow path within the drain.

2.3.2 A uniform spatial roughness of 0.06 was applied to all areas, representing a rough floodplain surface. The downstream boundary was set to a slope of 0.005, assuming free discharge into the River Cam.

2.3.3 There is a high uncertainty in the hydraulic modelling due to the errors in the LiDAR data and the assumptions made regarding the flood embankment dimensions. Improvements to the model should be undertaken to support a planning application, using channel and structure survey, spatially-variable roughness parameters, and testing the backwater impacts of the River Cam under flood conditions.

![Figure 3.2: Model Schematic](image)

2.4 **Scenario Testing**

2.4.1 The following scenarios were tested:

a. Baseline: LiDAR data as above with no further amendments

b. Impact of flood embankments: As (a), with 2m wide, 2m high embankments added to the topography to reflect site observations of the existing flood protection embankment
c. Impact of site storage: As (b), with a further 3m wide 5m high provisional flood storage reservoir embankment added to the north of the B184 (Walden Road), to store water on-site and mitigate flood risk downstream. A 0.5 m diameter culvert was added underneath the embankment to restrict outflows.

2.5 Results

2.5.1 Figures 3.3 to 3.5 show maximum flood depths for each of the three scenarios modelled:

- Scenario (a) replicates the EA Flood Map for Planning (Figure 2.1), demonstrating consistency between the maps and the flooding observed in 2001.

- When the embankments are included in Scenario (b), flood extents are reduced however flooding still occurs due to overtopping of the B184 (Walden Road), and due to spill around the embankments on the B1383 (Newmarket Road).

- Scenario (c) demonstrates that full flood mitigation can be achieved by creation of a flood storage reservoir upstream of the B184 (Walden Road). Downstream peak flows are throttled to approximately 0.8 m$^3$/s by the embankment and culvert. Water levels upstream of the embankment reach approximately 42.2 mAOD with a total 38500 m$^3$ volume of water stored.

2.5.2 This study has not tested what rate the peak flow downstream should be throttled to. It may be possible to increase discharge downstream from the 0.8 m$^3$/s restriction used here, while still providing betterment. This would decrease the storage volume required.

![Figure 3.3: Scenario A maximum flood depths, 1% event](image-url)
Figure 3.4: Scenario B maximum flood depths, 1% event

Figure 3.5: Scenario C maximum flood depths, 1% event
3 Conclusions and Recommendations

3.1 Conclusions

3.1.1 The results have shown that it is potentially feasible for the development of the North Uttlesford Garden Village to provide betterment downstream, by way of construction of a flood storage reservoir on site. This would benefit the recreation ground and properties on Walden Road which are currently at risk of flooding, even with the existing flood embankments alongside the drain.

3.1.2 The storage volume identified in this study, based on throttling flows to 0.8 m³/s, would place the reservoir under the requirements of the Reservoirs Act (1975). This would lead to particular requirements regarding the reservoir construction, future maintenance and emergency overtopping design. There would remain residual risks of flooding downstream in the event of overtopping or failure. If granted planning permission, risks to the new preschool facility will require particular consideration.

3.2 Recommendations

3.2.1 This study is based on readily available data of limited accuracy. In order to progress assessment of the feasibility and design of the flood storage reservoir for planning purposes, the following would be required:

a. Channel survey of the tributary drain and all structures from its headwaters in the site to the confluence with the River Cam and construction of a 1D-2D hydraulic model appropriate for acceptance by the EA to update their flood maps.

b. Detailed hydrological assessment of flows within the drain, improving catchment descriptors where possible, comparing flow estimation methodologies and taking into account the potential impacts of climate change. A range of storm durations should be tested to identify the impacts of volume on the proposed flood storage reservoir.

c. Modelling of baseline and proposed scenarios, including development run-off to test if a hybrid flood storage and surface water storage reservoir is possible, and testing of the backwater impacts of the River Cam; reporting and mapping of flood extents.

3.2.2 The detailed modelling should iteratively identify the flow throttle required to improve flood risk downstream. It may be possible that a greater flow than used in this scoping study can be allowed to pass downstream, which would reduce the reservoir volume required and potentially remove the Reservoirs Act (1975) requirements.