GREAT GROVEHURST FARM

FLOOD RISK ASSESSMENT

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1. EXECUTIVE SUMMARY

1.1. This Flood Risk Assessment has been prepared to support a planning application for a residential development of 110 units at Great Grovehurst Farm, Kemsley, Sittingbourne.

1.2. The site area is around 4.8 hectares, and is located to the east of Grovehurst Road and to the south of Swale Way, and lies in the borough of Swale.

1.3. With reference to the Environment Agency's Flood Map for Planning, the site falls within Flood Zone 1, which has the lowest probability of flooding.

1.4. This Flood Risk Assessment has considered the potential consequences of flooding from all potential sources of flooding, which including from watercourses, directly from rainfall on the ground surface, rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

1.5. Based on the publically available information reviewed, no historic flood incidents have been recorded on the Application Site. The pre-development potential flood risk to the site from all sources of flooding has been assessed as between 'Very Low' and 'Low'. The post development potential flood risk to the site from all source of flooding has been assessed as between 'Very Low' and 'Low'.

1.6. A surface water drainage strategy, involving the implementation of Sustainable Drainage Systems (SuDS), is proposed for managing the disposal of surface water runoff from the proposed development on the site. Flow balancing methods in the form of a detention basin is proposed in order to store and attenuate surface water runoff with discharge at greenfield runoff rates to the local Land Drainage System, which drains to a watercourse 50m to the north of the Application Site.

1.7. The proposed drainage strategy will ensure that surface water arising from the developed site would be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while avoiding the flood risk to the site itself and minimising flood risk elsewhere, taking climate change into account.

1.8. The overall conclusions drawn from this Flood Risk Assessment are that the development would be appropriately safe for its lifetime taking account of the vulnerability of its users, the development would not increase flood risk elsewhere, and would reduce flood risk overall.

2. INTRODUCTION

General

2.1. This Flood Risk Assessment has been prepared by PFA Consulting on behalf of G H Dean & Co in support of a hybrid planning application for residential development and open space on land at Great Grovehurst Farm, Sittingbourne, Kent. The application is in outline but seeks the removal of brickearth prior to housing development. The overall area of the site is approximately 4.8 hectares.

2.2. The location of the site is shown on **Figure 1.1**. It lies to the north of Sittingbourne, bounded by Swale Way to the north, the railway line to the east, and Grovehurst Road to the west, with residential development adjoining the south of the site. The village of Iwade is located to the north west, on the opposite side of the A249 trunk road, and the village of Kemsley is located to the south east. The site itself is predominantly made up of arable land and old farm buildings.

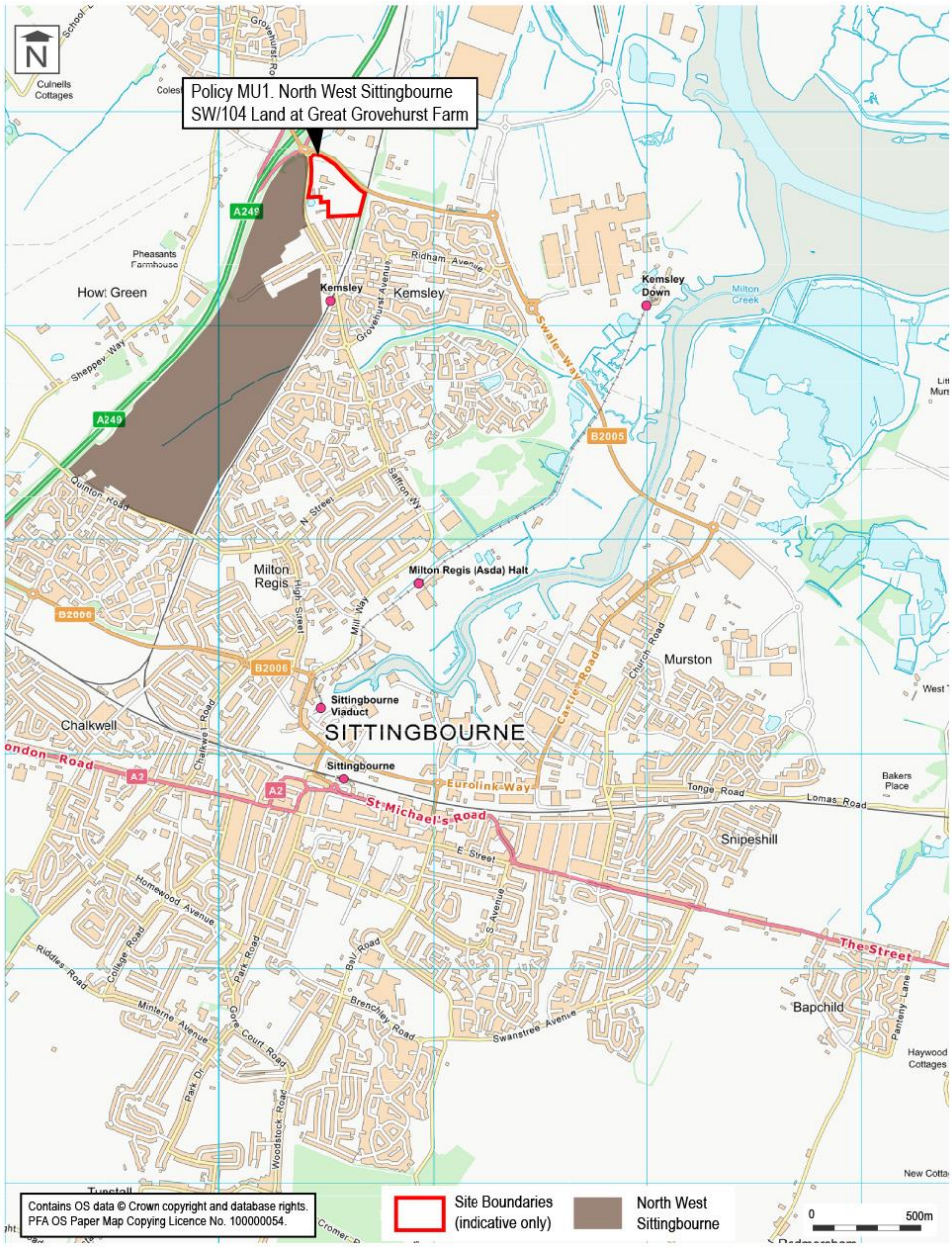

Figure 1.1: Site Location

Background

2.3. The application site forms part of Land at north-west Sittingbourne allocated for mixed use development under Policy MU1 of *Bearing Fruits 2031*: Swale Borough Local Plan, adopted in July 2017. *Bearing Fruits 2031* states that the land at north-west Sittingbourne is suitable for development comprising a new residential community with a minimum of 1,500 dwellings, and supporting community facilities.

2.4. *Bearing Fruits 2031* goes on to explain that there are several landowners involved in the development of this strategic allocation, and that the Council will expect these landowners to come together to ensure the co-ordination of development and the necessary physical and social infrastructure. However, in respect of flood risk and drainage matters the Great Grovehurst Farm site drains to a different land drainage system than the remainder of the allocation and accordingly flood risk matters are considered as a standalone matter.

2.5. *Bearing Fruits 2031* suggest that the land at Great Grovehurst Farm is suitable for up to 120 dwellings. A development of up to 110 units is currently proposed, and the Illustrative Masterplan is reproduced at **Appendix 2**.

Consultations

2.6. A Public Exhibition of the proposals was held jointly with Persimmon Homes and Redrow Homes from 29 – 30 September 2016.

2.7. The main purpose of this site-specific Flood Risk Assessment is to provide sufficient flood risk information to support the planning application and in order to demonstrate that the development would be appropriately safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, would reduce flood risk overall.

3. SCOPE OF THE ASSESSMENT

3.1. The Government's National Planning Policy Framework (NPPF), published in March 2012, sets out the Government's policy on development and flood risk. In March 2014 the Department for Communities and Local Government (DCLG) launched the Government's Planning Practice Guidance to the NPPF as a web-based resource. The category dealing with flooding is contained in Flood Risk and Coastal Change[1].

3.2. The NPPF states in paragraph 100 that Local Plans should be supported by a Strategic Flood Risk Assessment (SFRA), and should apply a sequential, risk-based approach to the location of development. As set out in the NPPF, inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere.

3.3. A Level 1 and Level 2 SFRA was prepared by Halcrow Group Limited on behalf of Swale Borough Council, in October 2009, to support the development of their Local Plan. The SFRA provides an overview of flood risk from all sources including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

3.4. As set out in paragraph 101 of the NPPF, the aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. Paragraph 19[2] in the Flood Risk and Coastal Change Planning Practice Guidance states that the flood zones, as refined in the SFRA for the area, provide the basis for applying the Sequential Test.

3.5. A copy of the Environment Agency's Flood Map for Planning, obtained from the GOV.UK website, which shows the Flood Zones in the vicinity of the site, is reproduced as **Figure 2** below.

1 Planning practice guidance reference ID: 7 Updated: 29 December 2016

2 Planning practice guidance reference ID: 7-019-20140306

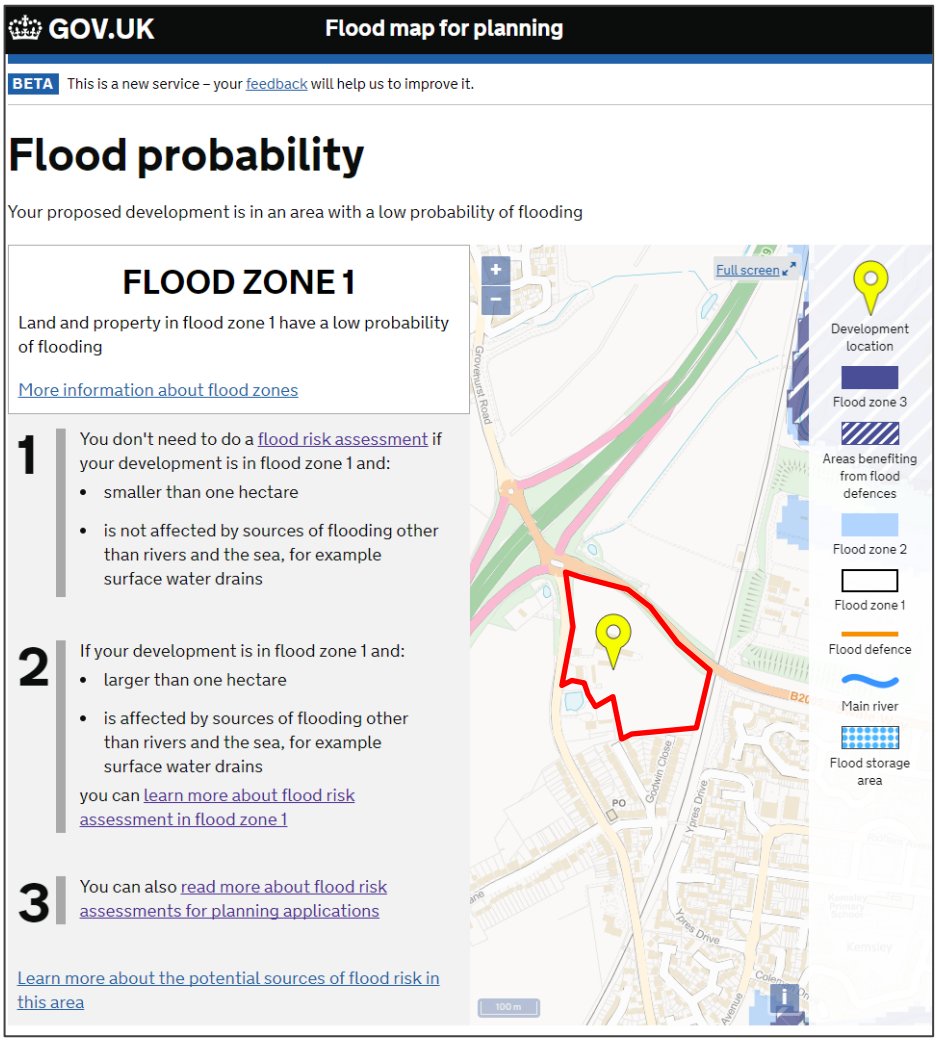

Figure 2: Environment Agency's Flood Map for Planning

3.6. The red line site boundary has been added to the Environment Agency's Flood Map for Planning as shown on **Figure 2**. From inspection of the Flood Map it can be seen that the site falls entirely within Flood Zone 1 where flooding from rivers and the sea is very unlikely. Footnote 20 in the NPPF states that a site-specific flood risk assessment is required for proposals of 1 hectare or greater in Flood Zone 1.

3.7. Paragraph 30 in the Flood Risk and Coastal Change Planning Practice Guidance[3] advises that a site-specific flood risk assessment is carried out to assess the flood risk to and from a development site. The assessment should demonstrate how flood risk will be managed now and over the development's lifetime, taking climate change into account, and with regard to the vulnerability of its users.

3 Planning practice guidance reference ID: 7-030-20140306

Flood Risk Assessment Guidance

3.8. For the purposes of applying the NPPF, paragraph 2 in the guidance[4] advises that "flood risk" is a combination of the probability and the potential consequences of flooding from all sources - including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

3.9. Paragraph 31 in the guidance[5] advises that the information provided in the flood risk assessment should be credible and fit for purpose. Site-specific flood risk assessments should always be proportionate to the degree of flood risk and make optimum use of information already available, including information in a SFRA for the area, and the interactive flood risk maps. A flood risk assessment should also be appropriate to the scale, nature and location of the development.

3.10. Paragraph 68 of the guidance[6] provides a model checklist for a site specific flood risk assessment.

3.11. The guidance[7] refers to the Environment Agency Standing Advice on flood risk. Guidance from the Environment Agency and Department for Environment, Food & Rural Affairs (DEFRA), on the Government's GOV.UK website, includes guidance on how to carry out a flood risk assessment entitled: 'Flood risk assessment in flood zone 1 and critical drainage areas'. This guidance provides information on the range of factors that need to be considered when assessing flood risk.

Local Plan Policies

3.12. The Bearing Fruits 2031 The Swale Borough Local Plan Document was formally adopted in 26 July 2017 and provides a planning policy framework for Swale Borough for the period up to 2031. The adopted Local Plan contains development management policies relevant to this assessment.

3.13. Policy ST 1: 'Delivering sustainable development in Swale' is relevant to this assessment and states:

> *"… 10. Meet the challenge of climate change, flooding and coastal change through: …*
>
> *b. the management and expansion of green infrastructure; and*
>
> *c. applying planning policies to manage flood risk and coastal change. …"*

3.14. Policy CP 7 'Conserving and enhancing the natural environment - providing for green infrastructure' states:

> *"… 8. Promote the expansion of Swale's natural assets and green infrastructure, including within new and existing developments, by: …*
>
> *g. taking account of and integrating with natural processes, such as flood risk and utilising sustainable urban drainage. …"*

3.15. Policy DM 21 'Water, flooding and drainage' states:

> ***"**When considering the water-related, flooding and drainage implications of development, development proposals will:*

4 Planning practice guidance reference ID: 7-002-20140306

5 Planning practice guidance reference ID: 7-031-20140306

6 Planning practice guidance reference ID: 7-068-20140306

7 Planning practice guidance reference ID: 7-032-20150415

1. Accord with national planning policy and planning practice guidance;

2. Avoid inappropriate development in areas at risk of flooding and where development would increase flood risk elsewhere;

3. Provide site specific flood risk assessments, as required, carried out to the satisfaction of the Environment Agency and, if relevant, the Internal Drainage Board. These will, where necessary, include details of new flood alleviation and flood defence measures to be installed and maintained by the developer;

4. Include, where possible, sustainable drainage systems to restrict runoff to an appropriate discharge rate, maintain or improve the quality of the receiving watercourse, to enhance biodiversity and amenity and increase the potential for grey water recycling. Drainage strategies (including surface water management schemes) for major developments should be carried out to the satisfaction of the Lead Local Flood Authority;

5. Integrate drainage measures within the planning and design of the project to ensure that the most sustainable option can be delivered, especially where, exceptionally, development is to be permitted in an area of flood risk;

6. Within areas at risk of flooding, submit a suitable flood warning and emergency plan that has been approved by the relevant emergency planning regime and, where appropriate, the emergency services;

7. Where necessary, demonstrate that adequate water supply and wastewater connection and treatment infrastructure is in place before construction commences and that these details have been approved by the appropriate water company and funded by the development where appropriate;

8. Ensure future unconstrained access to the existing and future sewerage and water supply infrastructure for maintenance and up-sizing purposes;

9. Make efficient use of water resources and protect the yield of local public water supplies. For new residential development, all homes to be designed to achieve a minimum water efficiency of 110 litres per person per day, in line with the Government's Housing Optional Technical Standard for water efficiency; and

10. Protect water quality, including safeguarding ground water source protection zones from pollution, to the satisfaction of the Environment Agency."

3.16. Policy CP 4 'Requiring good design' states:

"All development proposals will be of a high quality design that is appropriate to its surroundings. Development proposals will, as appropriate: …

13. Maximise opportunities for including sustainable design and construction techniques including the use of recycled and recyclable materials, sustainable drainage systems, carbon reduction and minimising waste; …"

Summary of Scope

3.17. The scope of this Flood Risk Assessment is to provide sufficient information to satisfy the relevant requirements of the NPPF, guidance published by DEFRA and Environment Agency, the planning practice guidance checklist, and Local Plan Policies.

4. FLOOD RISK ASSESSMENT

Development Site and Location

4.1. The Site Location Plan and the Environment Agency's Flood Map for Planning are based on the Ordnance Survey map of the area, and show geographical features and identify watercourses and other bodies of water in the vicinity of the site.

4.2. In its present state the Application Site is in agricultural use. The eastern and northern area of the site is in arable use whereas the western area consists of a farm yard, and associated agricultural dwellings and a farm house with access onto Grovehurst Road.

4.3. There are no watercourses present on the Application Site. A pond is present in the vegetated area to the south of the site. The nearest watercourse to the site is an unnamed watercourse approximately 50m to the north of the site, north of Swale Way. This watercourse drains north into the Coldharbour Fleet and then into The Swale. A pond is also present to the north of Swale Way associated with the highway drainage for that stretch of road. Another unnamed watercourse is situated 700m to the south of the site and flows from west to east through Kemsley. Both watercourses in the vicinity of the site are classified as ordinary watercourses.

4.4. No existing formal drainage measures are identified on the Application Site. Runoff from the areas of hard standing and agricultural buildings presently runs off onto the surrounding ground where it eventually infiltrates into the ground. Any runoff that collects in the northern area of the site is intercepted by the Filter Drain Toe Drainage installed as part of the Swale Way Highway scheme which was installed to drain the highway embankment and land to the south (including the Application Site). As the Filter Drain Toe Drainage accepts runoff from the highway embankment and land drainage from the land to the south it is therefore classified as a Land Drainage System. A copy of the "As Constructed Drawing" is attached as **Appendix 1**. Drawing No. K34/101 Rev M shows the Filter Drain Toe Drainage draining north under Swale Way via a 225mm diameter pipe and into the unnamed watercourse, 50m to the north of the Application Site.

Development Proposals

4.5. A copy of the Illustrative Masterplan, prepared by Tibbalds, showing the development proposals, is reproduced in **Appendix 2**.

4.6. Brick Earth deposits have been identified on the Application Site, and it is proposed that this material is extracted prior to the development of the site. Subsequently, site levels will be lower than presently shown onsite following the extraction of the brickearth.

Site Levels

4.7. A Topographical Survey was undertaken by Multi-Limn in July 2014. A copy of the survey is reproduced in **Appendix 3.**

4.8. The Topographical Survey presently indicates that the Application Site falls downhill south to north from around 17m AOD, in the southern area of the site, to around 11m AOD to the northern corner of the site, adjacent to Grovehurst Road and Swale Way roundabout. The brickearth removal will reduce levels across the site by up to about 1.7m however, in order to drain the development site, the excavated site levels will be raised to create a gently sloping site sloping from a level of above 13m AOD in the south, to a level of about 12m AOD to the north.

Probability, Flood Risk Vulnerability and Flood Zone 'Compatibility'

4.9. Section 25 of the Flood Risk and Coastal Change Planning Practice Guidance[8] sets out 3 Flood Zone and Flood Risk Tables. Table 1: Flood Zones provides a definition of each Flood Zone. Table 2: Flood Risk Vulnerability Classification categorises different types of development according to their vulnerability to flood risk. Table 3: Flood risk vulnerability and flood zone 'compatibility' maps these vulnerability classes against the flood zones to indicate where development is appropriate and where development should not be permitted. With reference to Table 3, all uses of land are appropriate in Flood Zone 1.

4.10. Flood Zone 1 Low Probability is defined as land having a less than a 1 in 1000 (0.1%) annual probability of river or sea flooding.

The Sequential Test

4.11. Paragraph 101 of the NPPF states: *'The aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding.'*

4.12. The site falls within Flood Zone 1 and on this basis the Sequential Test is satisfied.

Climate Change

4.13. The NPPF requires development to take account of the impacts of climate change. The allowances to be made for climate change effects when assessing flood risk are related to the lifetime of the development.

4.14. Guidance on the lifetime of development is provided in the Flood Risk and Coastal Change Planning Practice Guidance[9] and section 4.6 of BS 8533:2011. Residential development should be considered for a minimum of 100 years.

4.15. Under heading 4 in the Site-Specific Flood Risk Assessment Checklist in the Guidance[10], it asks how is flood risk at the site likely to be affected by climate change and states that further information on climate change and development and flood risk is available on the Environment Agency's web site. Guidance published by the Environment Agency on 19 February 2016, and last updated on 3 February 2017, entitled 'Flood risk assessments: climate change allowances', sets out the climate change allowances to be used for peak river flow by river basin district, peak rainfall intensity, sea level rise, offshore wind speed and extreme wave height.

8 Planning practice guidance reference ID: 7-065-20140306

9 Planning practice guidance reference ID: 7-026-20140306

10 Planning practice guidance reference ID: 7-068-20140306

4.16. The peak rainfall intensity allowances to be used when designing urban drainage systems are given in Table 2 of 'Flood risk assessments: climate change allowances'. Both the central and upper end allowances need to be assessed to understand the range of impact. The total potential change anticipated for 2060 to 2115 is 20% for the central category, and 40% for the upper end category.

Standard of Protection

4.17. In terms of providing an acceptable standard of protection against flooding for new development, paragraph 54 in the guidance[11] advises how development can be made safe from flood risk. Reference is made to the ability of residents and users to safely access and exit a building during a 'design flood'. Paragraph 55 in the guidance[12] defines a 'design flood': '*This is a flood event of a given annual probability, which is generally taken as:*

- *a fluvial (river) flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year) or ;*
- *tidal flooding with a 0.5 per cent annual probability (1 in 200 chance each year),*

against which the suitability of a proposed development is assessed and mitigation measures, if any, are designed.'

4.18. Therefore, in terms of providing an acceptable standard of protection against flooding for new development, no flooding of property should occur as a result of the 'design flood' corresponding to a 1 in 100 year fluvial flood event, or a 1 in 200 year tidal flood event, taking account of climate change.

4.19. The Government published its 'Non-statutory technical standards for sustainable drainage systems' in March 2015. They should be used in conjunction with the NPPF and planning practice guidance. Standard S7 states that the drainage system must be designed so that flooding does not occur on any part of the site for a 1 in 30 year rainfall event. Standard S8 goes on to state that the drainage system must be designed so that flooding does not occur during a 1 in 100 year rainfall event in any part of a building (including a basement); or in any utility plant susceptible to water within the development.

Ground Conditions

4.20. The British Geological Survey (BGS) geological mapping of the area shows the entire site is underlain by Head (Clay and Silt) superficial deposits (*which site investigations have identified as "brickearth"*), and London Clay Formation (Clay and Silt) bedrock deposits.

4.21. The Cranfield Soil and AgriFood Institute (CSAI), incorporating the National Soil Resources Institute (NSRI,) at Cranfield University maintains soil reports and maps for England and Wales. The Soilscapes dataset map indicates that soils in the area are 'Loamy soils with naturally high groundwater'. These soils are identified as having 'Naturally wet '. After heavy rainfall, particularly during the winter, the subsoil becomes waterlogged, resulting in very wet ground conditions.

4.22. An intrusive site investigation was undertaken by Soils Limited in October 2013. An extract from the Phase 2 Scoping Ground Investigation Report is reproduced as **Appendix 4**. Twenty four trial pits were dug to a depth of 2-3.5m. The results can be seen in **Table A**.

11 Planning practice guidance reference ID: 7-054-20150415

12 Planning practice guidance reference ID: 7-055-20140306

4.23. As part of the site investigation, six soakaway tests were carried out across the site in broad accordance with BRE Digest 365 in trial pits TP19-TP24. Due to the limited volume of water available on site only a single soakage test with no refills was performed at each location. No infiltration was recorded in any of the six tests and the Ground Investigation Report states that these results "*proves adoption of soakaway drainage system to be unsuitable*."

Table A: Ground Conditions Summary

Potential Risk		Typical Thickness (m)	Description
Top	Bottom		
Ground Level	0.30-1.30	0.60	Dark brown fine sandy silt with occasional gravel, fine brick, ash and gravel.
Ground Level	0.20-0.60	0.40	Brown to dark brown clayey fine sandy silt with roots, occasional fine to medium sub-rounded gravel.
0.20-1.30	1.90-3.30	2.7	Friable soft to firm orangish brown fine sandy silty CLAY.
1.90-3.30	2.40*-3.50*	0.40+	Stiff grey brown, greenish grey and orange brown mottled silty CLAY.

Note: *Full investigatory depth

4.24. Whilst the superficial brickearth deposits are to be removed as part of the development, the underlying London Clay is similarly unsuitable for the use of infiltration methods to deal with the disposal of surface water.

Groundwater Source Protection

4.25. From an inspection of the Environment Agency's Aquifer Designation Map on its website the site's underlying superficial and bedrock deposits are classified as non aquifer unproductive strata. These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow. A copy of the Environment Agency's Aquifer Designation Map is reproduced in **Figure 3** below.

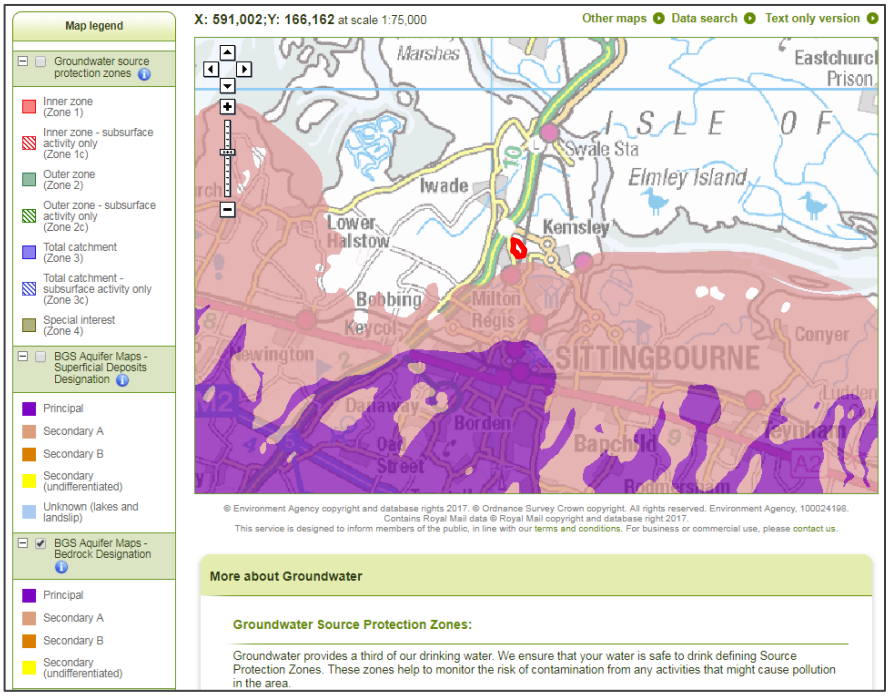

Figure 3: Environment Agency's Aquifer Bedrock Designation Map

4.26. From an inspection of the Environment Agency's Groundwater Source Protection Zone the site is not situated in a groundwater Source Protection Zone.

4.27. The Phase 2 Scoping Ground Investigation Report encountered seepage in TP20 at 2.00m below ground level (bgl) and in TP16 the soils were recorded as being damp at 2.70m bgl. The ground investigation report states "*isolated pockets of groundwater may be perched within only made ground found at other locations around the site*.". The presence of groundwater is not considered to be significant.

Site Specific Flood Risk

4.28. In addition to flooding from rivers and the sea it is also necessary to consider the potential consequences of flooding from all other sources, which include directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

4.29. The Government's GOV.UK website contains 'Long Term Flood Risk Information' which includes interactive maps showing 'Flood risk from rivers or the sea' and 'Flood risk from surface water'. These maps show the chance of flooding in one of four risk categories - High: greater than 1 in 30 (3.3%), Medium: between 1 in 100 (1%) and 1 in 30 (3.3%), Low: between 1 in 1000 (0.1%) and 1 in 100 (1%), and Very Low: less than 1 in 1000 (0.1%). The 'Flood risk from surface water' map indicates the extent, depth and velocity of water for High, Medium and Low risk scenarios. The Long Term Flood Risk Information also includes a 'Flood risk from reservoirs' map, which includes flood depth and flood speed.

4.30. The GOV.UK website advises that when planning a development the detailed flood risk from rivers or the sea information is not suitable for land-use planning, and the Environment Agency's Flood Map for Planning must be used for this purpose.

Flooding from Watercourses

4.31. There are no watercourses present on the Application site and the nearest local watercourses in the vicinity of the site is an unnamed watercourse 50m to the north of the site, to the north of Swale Way.

4.32. The Environment Agency's Flood risk from rivers or the sea map shows the site at very low risk of flooding from watercourses.

Flooding from Surface Water

4.33. The GOV.UK's Flood risk from surface water map indicates where surface water may be expected to flood or pond. Surface water flooding happens when rainwater does not drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead. The GOV.UK website advises that flooding from surface water is difficult to predict as rainfall location and volumes are difficult to forecast. The information shows the approximate areas that would flood, and which parts would be shallower or deeper. A copy of the GOV.UK's Flood risk from surface water map is reproduced in **Figure 4** below.

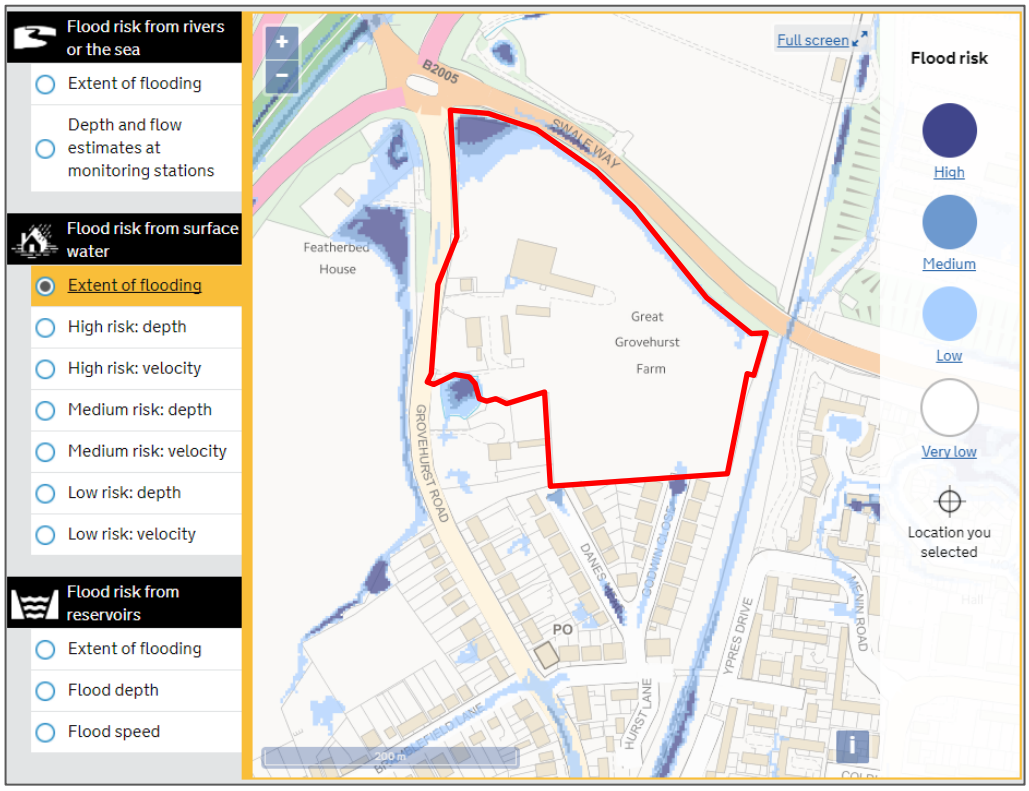

Figure 4: Environment Agency's Flood risk from surface water map

4.34. The GOV.UK's Flood risk from surface water map shows that the majority of the Application Site is at very low risk of surface water flooding and that the area identified as having a potential risk of flooding from surface water is the existing "low" point of the site where the potential surface water flow path is intercepted by the embankment at Swale Way.

4.35. This mapping assumes the existing drainage system (*under Swale Way*) is blocked. The areas of elevated flood risk identified are mitigated by the presence of the Filter Drain Toe Drainage to the south of the Swale Way embankment which would intercept overland flow and pipe it into the watercourse to the north of Swale Way.

4.36. The required standard of protection against flooding for the development is that no flooding of property should occur as a result of a 1 in 100 year flood event, which corresponds to the Medium risk scenario on the GOV.UK's 'Long Term Flood Risk Information' maps.

4.37. The Medium risk: depth map indicates that for the Medium risk scenario, between 1 in 100 (1%) and 1 in 30 (3.3%), there would be potential flooding in the northern corner of the site adjacent to the Grovehurst Road and Swale Way intersection. A copy of the GOV.UK's Medium risk: depth map is reproduced in **Figure 5** below. The area of the Application Site where residential development is proposed is shown to be flood free in the medium risk event.

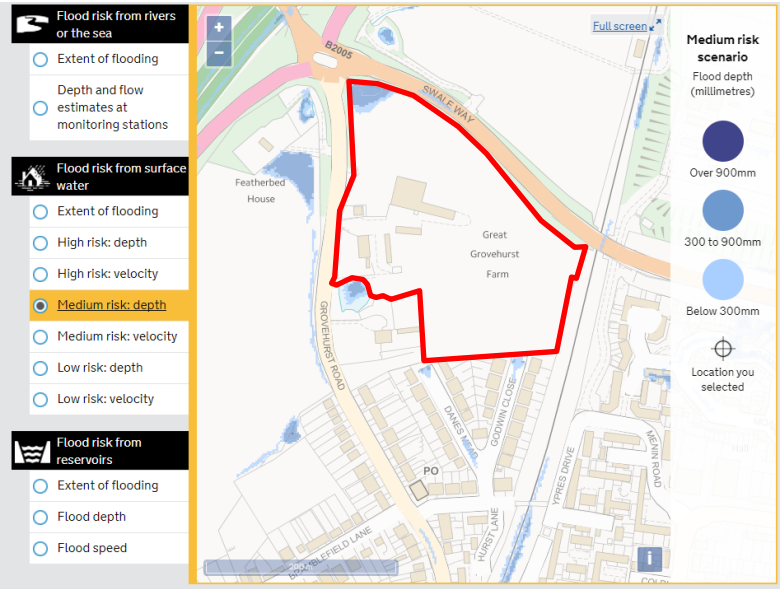

Figure 5: Environment Agency's Medium flood risk from surface water map

Flooding from Groundwater

4.38. Groundwater flooding is most likely to occur in low-lying areas underlain by water-bearing permeable rocks such as sands, gravels, limestone and chalk. The SFRA does not identify any incidents of groundwater flooding in the vicinity of the site. As discussed above the superficial and bedrock deposits are classified as unproductive strata and not a significant source of groundwater. The flood risk posed by groundwater emergence is assessed as low based on the available information.

Flooding from Overwhelmed Sewers and Drainage Systems

4.39. Flooding from sewers and drainage systems occurs when the sewer or drainage system is overwhelmed as a result of a blockage or excessive flow exceeding its capacity. Enquiries have been made to Southern Water to establish the location of the existing public sewers in the vicinity of the site. A copy of Southern Water's asset map are reproduced in **Appendix 6**.

4.40. There is an existing off-site sewer network comprising of a rising main being pumped from north to south adjacent to the Application Site in Grovehurst Road. This rising main discharges into a 225mm gravity foul water sewer also within Grovehurst Road. There are also 150mm diameter foul water sewers identified within Godwin Close and Danes Mead to the south of the site and no sewerage assets are identified within the Application Site.

4.41. The SFRA does not identify any incident of sewer flooding affecting the site.

4.42. The risk of flooding from overwhelmed sewers and drainage systems is assessed as low.

Flooding from Artificial Sources

4.43. The GOV.UK's Flood risk from reservoirs map indicates the site is unaffected by flooding from any reservoirs. A copy of the Flood risk from reservoirs map is reproduced in **Figure 6** below. No other artificial sources of flooding are identified and the risk from this flood source is considered to be very low.

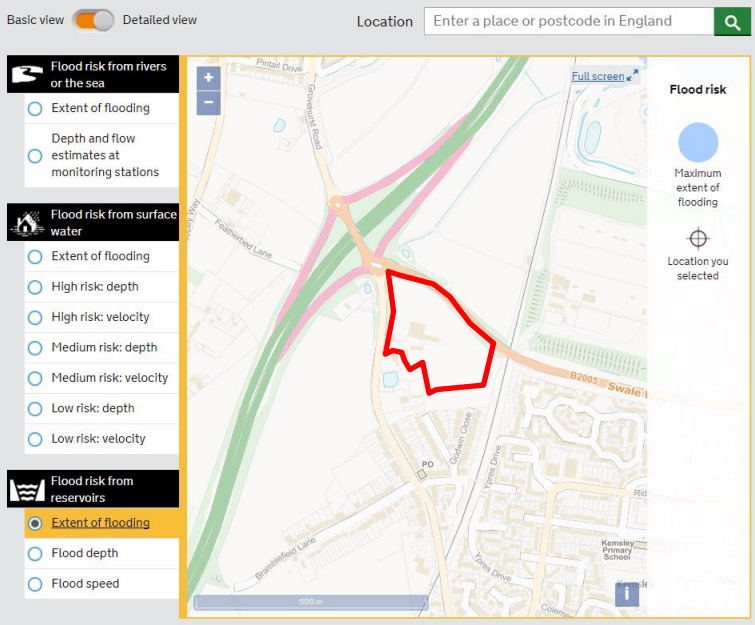

Figure 6: Environment Agency's Flood risk from reservoirs

Summary of Flood Risk

A summary of the potential risk from all sources of flooding associated with existing conditions pre-development is shown in **Table B** below.

Table B: Pre-development Potential Flood Risk from All Sources of Flooding

Flood Source	Potential Risk				Description
	Very Low	Low	Medium	High	
Watercourses	X				The site is situated in Flood Zone 1.
Surface Water	X				The topography of the land indicates that any overland flow would be directed north. The area where built development is proposed is in an area of very low flood risk.
Groundwater	X				The SFRA does not identify any groundwater flooding affecting the site and the site is underlain by non-aquifer deposits.
Overwhelmed Sewers	X				There is an existing off-site sewer network near the site. The SFRA does not identify any incident of sewer flooding affecting the site.
Artificial Sources	X				The site is not affected.

4.44. The SFRA, provides an assessment of the impact of all other sources of potential flooding. Based on the SFRA and Kent County Council's Preliminary Flood Risk Assessment (PFRA) (September 2011) there are no historic flood incidents recorded on the site from all sources of potential flooding.

4.45. The pre-development potential flood risk to the site from all sources of flooding is considered to be Very Low.

5. DRAINAGE STRATEGY

Sustainable Drainage Systems

5.1. Government policy set out in paragraph 103 of the NPPF expects local planning authorities to give priority to the use of sustainable drainage systems (SuDS) in determining planning applications.

5.2. Paragraph 51 in of the Flood Risk and Coastal Change Planning Practice Guidance[13] advises that sustainable drainage systems are designed to control surface water runoff close to where it falls and mimic natural drainage as closely as possible. Sustainable drainage systems provide opportunities to:

- reduce the causes and impacts of flooding;
- remove pollutants from urban runoff at source;
- combine water management with green space with benefits for amenity, recreation and wild life.

5.3. In terms of what sort of sustainable drainage system should be considered, paragraph 80 in the guidance[14] advises that, generally, the aim should be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable:

- into the ground (infiltration);
- to a surface water body;
- to a surface water sewer, highway drain, or another drainage system;
- to a combined sewer.

5.4. Approved Document H of the Building Regulations follows the drainage hierarchy and states at Section 3.2 that surface water drainage should discharge to a soakaway or other infiltration system where practicable; discharge to a watercourse may require consent from the Environment Agency; and where other forms of outlet are not practicable, discharge should be made to a sewer.

5.5. The Government published its 'Non-statutory technical standards for sustainable drainage systems' in March 2015. The technical standards relate to the design, construction, operation and maintenance of sustainable drainage systems and have been published as guidance. The Government expect these standards to apply to all developments of 10 homes or more. The Government's 'Non-statutory technical standards for sustainable drainage systems' set out peak flow control standards (S2 and S3) and volume control technical standards (S4, S5 and S6).

5.6. Paragraph 81 in the guidance[15] states that in considering a development that includes a sustainable drainage system the local planning authority will want to be satisfied that the proposed minimum standards of operation are appropriate.

5.7. Paragraph 83 in the guidance[16] advises that in terms of the overall viability of a proposed development, expecting compliance with the technical standards is unlikely to be reasonably practicable if more expensive than complying with building regulations provided that where there is a risk of flooding the development will be safe and flood risk is not increased elsewhere.

13 Planning practice guidance reference ID: 7-051-20150323

14 Planning practice guidance reference ID: 7-080-20150323

15 Planning practice guidance reference ID: 7-081-20150323

16 Planning practice guidance reference ID: 7-083-20150323

5.8. Paragraph 85 in the guidance[17] advises that any sustainable drainage system should be designed so that the capacity takes account of the likely impacts of climate change.

5.9. Guidance on the design and construction of SuDS is also provided in the 'Interim Code of Practice for Sustainable Drainage Systems', published by the National SuDS Working Group in July 2004, in other Ciria documents including 'The SuDS Manual' (Ciria C753) published in November 2015, as well as in the Environment Agency's document entitled 'Sustainable Drainage Systems (SuDS) An introduction'.

5.10. Whilst there are a number of potential SuDS techniques that might be used on any particular site, ground conditions at this site limit the options to flow balancing methods including swales, ponds/detention basins, and underground storage facilities.

5.11. The SuDS Manual, and CIRIA C687 'Planning for SuDs - making it happen', promote the use of a SuDS 'management train', which seeks to address the quality and quantity of runoff at all stages of a drainage system. It uses a hierarchy of techniques, namely: i) prevention, ii) source control, iii) site control and iv) regional control. The drainage strategy for the proposed development seeks to follow the concept of a SuDS management train.

Greenfield Runoff

5.12. The 'Interim Code of Practice for Sustainable Drainage Systems' states that further information on the calculation of greenfield runoff can be found in DEFRA/Environment Agency R&D Technical Report W5-074/A 'Preliminary rainfall runoff management for developments'. The latest update published by the Environment Agency as 'Rainfall runoff management for developments' Report – SC030219 in October 2013.

5.13. Table 1 in Report – SC030219 states that for developments between 0-50 hectares one of two approaches can be used:

'1. *The Institute of Hydrology (IH) Report 124 Flood Estimation for Small Catchments (1994) method can be used to estimate the greenfield site flow rate, Q_{BAR} (the Mean Annual Flood).*

2. The Index Flood, Q_{MED} (the median of the set of annual maximum flood peaks) regression equation that forms part of the FEH statistical method can also be used where the appropriate parameters are known or can be derived/estimated.

Where developments are smaller than 50 ha, the analysis for determining the greenfield index flood flow rate should use 50 ha in the formula and linearly interpolate the flow rate value based on the ratio of the development area.'

5.14. Discharge rate criteria are set out in Point 8 of Report – SC030219. It states: *'The Environment Agency will normally require that, for the range of annual flow rate probabilities, up to and including the 1% annual probability (1 in 100 year) event, the developed rate of runoff into a watercourse should be no greater than the undeveloped rate of runoff for the same event based on the calculation of Q_{BAR} or Q_{MED} and the use of FSSR growth curves.'*

17 Planning practice guidance reference ID: 7-085-20150323

5.15. As infiltration drainage is not feasible on the Application Site it is not feasible to comply with the 100 year volume criterions set out in Report SC030219. As the additional runoff generated cannot be disposed of by infiltration it is proposed that the outflow from the drainage system is constrained to the mean annual peak rate of runoff for the greenfield site (Referred to as Q_{BAR} in IH Report 124), which approximates to a return period of 2.3 years, and hence a reduced rate of runoff for higher return periods.

5.16. Greenfield runoff rates have been determined using XP Solutions' Micro Drainage software system (Version 2016.1) based on the method set out in IH Report 124. Rainfall and soil parameters have been obtained from maps in Volume V of the Flood Studies Report (FSR) and within the Micro Drainage Source Control software. FSSR 2 and 14 regional growth curve factors are used to calculate the greenfield peak flow rates for 1, 30 and 100 year return periods.

5.17. On the basis of the site investigation and soakaway tests, and with reference to the WRAP Map, the soils underlying the site more closely relate to Soil Index Class 4 with a relatively higher standard percentage runoff. A Soil Index value of 0.45, which more closely represents the site specific soil value, has there been used to calculate Q_{BAR} in IH Report 124.

5.18. The existing impermeable areas can be accounted for in the pre development runoff calculation by utilising an urban factor of 0.13 in the Micro Drainage ICP SuDS calculation. The urban factor assesses the effects of approximately 13% of the site being impermeable which equates to the area of hardstanding and existing agricultural buildings.

5.19. Copies of the Micro Drainage greenfield runoff and pre development calculations for the site are included in **Appendix 7**. A summary of the greenfield and pre development runoff rates for the various return period events is shown in **Table C**. The mean annual peak rate of runoff, referred to as Q_{BAR} in IH Report 124, is 17.4 l/s or 3.6 l/s/ha.

Table C: Greenfield Runoff Rates

Return Period (Years)	1	Q_{BAR}	30	100
Greenfield Runoff Rates (l/s)	14.8	17.4	39.4	55.5
Pre Development Runoff Rates (l/s)	18.6	21.9	47.0	63.1

Surface Water Management

5.20. The proposed sustainable drainage measures for the site incorporate flow balancing facilities comprising a detention basin which outfalls into the existing Land Drainage system adjacent to Swale Way which ultimately discharges to a watercourse. Outflow from the storage facilities will be controlled by means of suitable flow control devices at greenfield runoff rates. Pollution control measures include the use of deep trapped gullies on all road areas and other areas that drain to gullies.

5.21. A preliminary surface water drainage strategy is shown on the Outline Surface Water Drainage Strategy Plan, a copy of which is contained in **Appendix 8**. Cross sections through the basins are shown on Drawing No. D118/15 Rev C reproduced in **Appendix 9**.

5.22. The proposed drainage strategy will ensure that surface water arising from the developed site would be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account.

Surface Water Flow Balancing

5.23. Preliminary storage calculations have been undertaken to establish the required storage for the development catchment areas on the site using the Quick Storage Estimate module in XP Solutions' Micro Drainage software system (Version 2016.1) for the 1 and 100 year events plus a 20% and 40% increase in peak rainfall intensity to take account of climate change. The outflow from the drainage system has been constrained to Q_{BAR}, which approximates to a return period of 2.3 years, and hence a reduced rate of runoff for higher return periods. Copies of the Micro Drainage Quick Storage Estimate results for the development catchment areas are reproduced in **Appendix 10**.

5.24. The preliminary storage calculations are based on the illustrative Masterplan which has assumed that the residential development areas would give rise to net impermeable areas of 65% of the respective development catchment area. In accordance with Kent County Council's Drainage and Planning Policy Statement (June 2017) a 10% uplift has been applied to this value to make allowance for urban creep. It is considered that this is a precautionary approach to the estimation of impermeable areas on the site.

5.25. **Table D** below shows the development catchment areas, the allowable discharge based on the catchment area and a Q_{BAR} value of 17.4 l/s, the required average storage in the detention basin for the 1 in 100 year event, including a 40% allowances for climate change.

Table D: Attenuation Summary

Developable Area (Ha)	Assumed % Impermeability	Estimated Impermeable Area (Ha)	Estimated Impermeable Area with 10% uplift for Urban Creep (Ha)	Allowable Discharge (l/s)	1 in 100 Year + 40% climate change Attenuation Volume (m^3)
3.089	65	2.008	2.209	17.4	~2000

5.26. To simulate the detention basin and the resulting discharge to the Land Drainage System the SuDS features have been modelled with the appropriate flow control device using the Source Control module in Micro Drainage. **Table E** shows the peak runoff rate from the development during the 1 in 1 year and 1 in 100 year rainfall events for the greenfield, and post development situations from the proposed drainage system. Copy of the Source Control results files are reproduced in **Appendix 11**. For the avoidance of doubt FEH (Flood Estimate Handbook) rainfall has been used to model the detention basin for the 1 in 100 year storm events. FSR (Flood Studies Report) rainfall data has been used to model the 1 in 1 year storm event as the FEH 2013 dataset is not calibrated below the 1 in 2 year storm event.

Table E: Runoff Rates Comparison

Storm Event	Runoff Rates (l/s)	
	Pre-development	Post-development
1 in 1 year	18.6	14.8
1 in 100 year	63.1	14.8
1 in 100 year plus 20% climate change	-	15.6
1 in 100 year plus 40% climate change	-	16.6

5.27. The detention basin shown on the Outline Surface Water Drainage Strategy Plan, Drawing No. D118/14 Rev C in **Appendix 8**, indicate the location and size of the required storage facility to serve the various development areas and is subject to detailed design.

5.28. By limiting the developed rate of runoff to the mean annual peak rate of runoff, Q_{BAR}, for all rainfall events up to the 100 year return period event, including an allowance for climate change, it can be seen from **Table E** that the proposed development would reduce flood risk overall when compared to pre-development rates.

5.29. The proposed drainage strategy reduces the peak runoff rates entering the existing Land Drainage System on the site's northern boundary compared with the pre development situation.

5.30. From an inspection of **Table D** and **Table E** it can be seen that the peak runoff rate from the development for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event never exceed the peak pre-development runoff rate for the same event. The proposed surface water drainage measures therefore ensure the proposed development satisfies the peak flow control standards in the Government's 'Non-statutory technical standards for sustainable drainage systems'.

5.31. It is proposed that the detention basin will be delivered in the first phase of the development to ensure sufficient attenuation volume is provided as the development is built out.

5.32. The above plan and calculations demonstrate that a suitable means of drainage can be provided to drain the developed site in terms of surface water runoff in accordance with the guidance and standards laid down.

5.33. Consent may need to be obtained for the construction of the various outfalls to the land drainage system under Section 23 of the Land Drainage Act 1991.

SuDS Management Train

5.34. In terms of the SuDS 'management train', the drainage strategy for the proposed development seeks to address the quality and quantity of runoff as follows:-

i) Prevention

5.35. Prevention is the use of good site design and housekeeping measures to prevent pollution. Good site design includes the provision of trapped gullies to retain sediment, and suitably designed grassed detention basin contributes to the pollutant and sediment removal capability of the management train. The housekeeping measures cover maintenance of the drainage system, including the detention basin, and general site maintenance.

ii) Source Control

5.36. Source control is defined in the 'The SuDS Manual' (Ciria C753) as the control of runoff at or near its source, so that it does not enter the drainage system or is delayed and attenuated before it enters the drainage system. Source control measures such as detention areas are priority features of SuDS networks serving urbanised networks and highways. Planting within these areas encourages evapotranspiration.

iii) Site Control

5.37. Site control is the management of water from several sub-catchments within a site. The proposed surface water drainage system amalgamates the runoff from the roofs, roads, and paved areas, for each area of development on the site, and deals with it in a detention basin, to attenuate flows and reduce the rate of runoff from the site.

5.38. The detention basin would provide attenuation, and would also contribute to the pollutant and sediment removal capability of the SuDS management train, as well as enhance the site's amenity value and provide biodiversity betterment.

iv) Regional Control

5.39. Regional control is the management of runoff from more than one site and so in this case is covered by the site control techniques.

Outline Detention Basin Design

5.40. It is proposed that the detention basin will have a grassed 'dry base' and drain completely so that permanent water features are not created.

5.41. The outline detention basin design is on the basis of 1.8m total depth. This will incorporate a 1.5m design depth of water during the 1 in 100 (+ 20%) event and a 0.3m freeboard with 1:4 side slopes. A 1.5m wide bench is proposed at 0.5m depth with a 1:15 gradient. This will assist in the demarcation of the higher risk areas of the feature which are subject to more regular inundation.

5.42. The proposals have been tested for the 1:100 + 40% allowance for climate change and the water level during this event extends into the freeboard area but remains contained entirely within the detention basin. The results of these simulations are contained in **Appendix 11**.

5.43. The detention basin incorporates a buffer strip around the feature to facilitate future maintenance.

5.44. The detention basin is designed to be online and receive runoff from developed areas during all storm events. All water draining from the proposed development will therefore pass through the vegetated SuDS feature before discharging into the Land Drainage System and offsite watercourse. The detention basin provides attenuation, and also contributes to the pollutant and sediment removal capability of the SuDS management train through sedimentation, biological uptake and UV action, as well as enhancing the site's amenity value and providing biodiversity betterment. The use of an open, above ground attenuation features also encourages evapotranspiration and utilises any soil storage capacity which may be present contributing to interception. These measures contribute to the interception philosophy and seek to provide a level of treatment for 'first flush' flows.

5.45. The design of the detention basin and surface water drainage can be subject to a suitably worded planning condition requiring the submission of details to be submitted and approved by the Local Planning Authority.

Non-statutory technical standards for sustainable drainage systems

5.46. The Government published its 'Non-statutory technical standards for sustainable drainage systems' in March 2015. The technical standards relate to the design, construction, operation and maintenance of sustainable drainage systems and have been published as guidance. The Government expect these standards to apply to all developments of 10 homes or more and to major commercial development.

5.47. **Table F** demonstrates how the proposed development complies with the relevant standards of the Government's 'Non-statutory technical standards for sustainable drainage systems'.

Table F: Compliance with Non-statutory technical standards for sustainable drainage systems

Standard	Justification for compliance
Flood risk outside the development	
S1	N/A – Proposed development discharges to Land Drainage System.
Peak flow control	
S2	N/A – Areas of the site area previously developed so S3 applies.
S3	From inspection of **Table E** it can be seen that the peak runoff rates from the proposed drainage system for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event never exceed the peak pre-development rate for the same event.
Volume control	
S4	N/A – Areas of the site area previously developed so S5 and S6 apply.
S5 & S6	As a result of the proposed development the amount of impermeable area increases which has implications for runoff volume. Ground conditions dictate that the use of infiltration drainage would be unsuitable and therefore would not be viable means to dispose of this additional volume. The runoff volume is discharged at a rate that does not adversely affect flood risk which equates to Q_{BAR}.
Flood Risk within the development	
S7	The surface water drainage system and site ground levels will be designed so that flooding does not occur on any part of the site for a 1 in 30 year rainfall event. The proposed detention basin is sized to accommodate the 1 in 100 year rainfall event (including a 40% allowance for climate change) with no flooding. S7 is satisfied based on the calculations contained in **Appendix 11**.
S8	The surface water drainage system will be designed so that flooding does not occur in any part of a building for a 1 in 100 year rainfall event. The proposed detention basin is sized to accommodate the 1 in 100 year rainfall event (including a 40% allowance for climate change) with no flooding. S8 is satisfied based on the calculations contained in **Appendix 11**.
S9	For extreme events (greater than 1 in 100 year storm) the proposed development's drainage system will intercept any uncontrolled overland flow. The site levels will be designed to direct exceedance flows along their pre development routes to minimise the risks to people and property on the proposed development.
Structural integrity	
S10	Components would be designed to ensure structural integrity of the drainage system under anticipated loading conditions over the design life of the development.
S11	The materials specified by the designer at the detailed design stage would be of a suitable nature and quality for their intended use.
Designing for maintenance considerations	
S12	N/A - Pumping is not proposed.

Construction	
S13	The mode of construction with the existing Land Drainage System would comply with the appropriate standards and be inspected by the relevant authority so would not be prejudicial to the structural integrity and functionally of the drainage system. The outflow rate from the proposed drainage system will be restricted to Q_{BAR} which is significantly less than the pre development peak runoff rate for larger storm events. The proposed drainage scheme together with the development of the Application Site will reduce the peak runoff rate draining into the existing Land Drainage System and therefore would not be prejudicial to its structural integrity and functionality compared with the pre development situation.
S14	Any damage to the drainage system would be rectified before the drainage system is completed to the satisfaction of the relevant authority.

Flood Risk Management Measures

Safe Access and Egress

5.48. Safe access and egress to and from the development is a route that is safe for use without the intervention of the emergency services or others. The site is entirely within Flood Zone 1 and safe access and egress is therefore achievable.

Overland Flood Flow Paths

5.49. Standard S9 in the Government's 'Non-statutory technical standards for sustainable drainage systems' states that the design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of 1 in 100 year rainfall event are managed in exceedance routes that minimise the risk to people or property.

5.50. Overland flood flow paths would follow the natural topography of the land towards the proposed Detention Basin in the northern area of the site. The design of the internal road network would convey flows towards Grovehurst Road and the proposed Detention Basin in line with the existing situation. The site levels will be designed to direct exceedance flows along their pre development routes to minimise the risks to people and property on the proposed development. Indicative overland flow paths for an extreme event are shown on Drawing No. D118/26 contained in **Appendix 12**.

Off Site Impacts

5.51. By reducing the rate of runoff and intercepting uncontrolled overland flows the proposed development would reduce flood risk overall in the surrounding area.

Summary of Flood Risk Management Measures

5.52. A summary of the potential risk from all sources of flooding post-development with the various development mitigation measures incorporated is shown in **Table G** below.

Table G: Post-development Potential Flood Risk from All Sources of Flooding

Flood Source	Potential Risk				Description
	Very Low	Low	Medium	High	
Watercourses	X				The site is situated in Flood Zone 1.
Surface Water	X				The risk would be further mitigated by the provision of a surface water drainage system utilising a detention basin which manages surface water on the site.
Groundwater	X				Underlying bedrock is not considered to be a significant source of groundwater.
Overwhelmed Sewers	X				The proposed drainage system and detention basin would further mitigate any potential off-site sewer flooding affecting the site.
Artificial Sources	X				The site is not affected.
Off-site Impacts	X				By reducing the rate of runoff and intercepting overland flows the proposed development would reduce flood risk overall.

5.53. The incorporation of flood mitigation measures the proposed development would further reduce any risk from surface water flooding. By reducing the rate of runoff and intercepting overland flows the proposed development would reduce flood risk overall.

Residual Risk

5.54. Paragraph 41 in the Flood Risk and Coastal Change Planning Practice Guidance[18] advises that residual risks are those remaining after applying the sequential approach to the location of development and taking mitigating actions.

5.55. The site lies within Flood Zone 1 and so the proposed development is fully in accordance with the sequential approach to development set out in the NPPF, the aim of which is to steer new development to areas with the lowest probability of flooding.

5.56. The proposed drainage measures would ensure that there is little or no residual risk of property flooding occurring during events well in excess of the minimum acceptable standard of protection for new property, which requires that no flooding of property should occur as a result of a one in 100 year storm event including an appropriate allowance for climate change.

5.57. For extreme events it is considered that the proposed development would intercept any uncontrolled overland flow and direct it into the proposed drainage system. The proposed drainage measures would ensure the proposed development would have adequate flood protection for extreme events over the lifetime of the development.

Foul Water Drainage

5.58. Enquiries have been made to Southern Water to establish the location of the existing public sewers in the vicinity of the site, a copy of Southern Water's email response and public sewer map are reproduced in **Appendix 6**. A copy of the Public Sewer map is reproduced in **Figure 7** below.

18 Planning practice guidance reference ID: 7-041-20140306

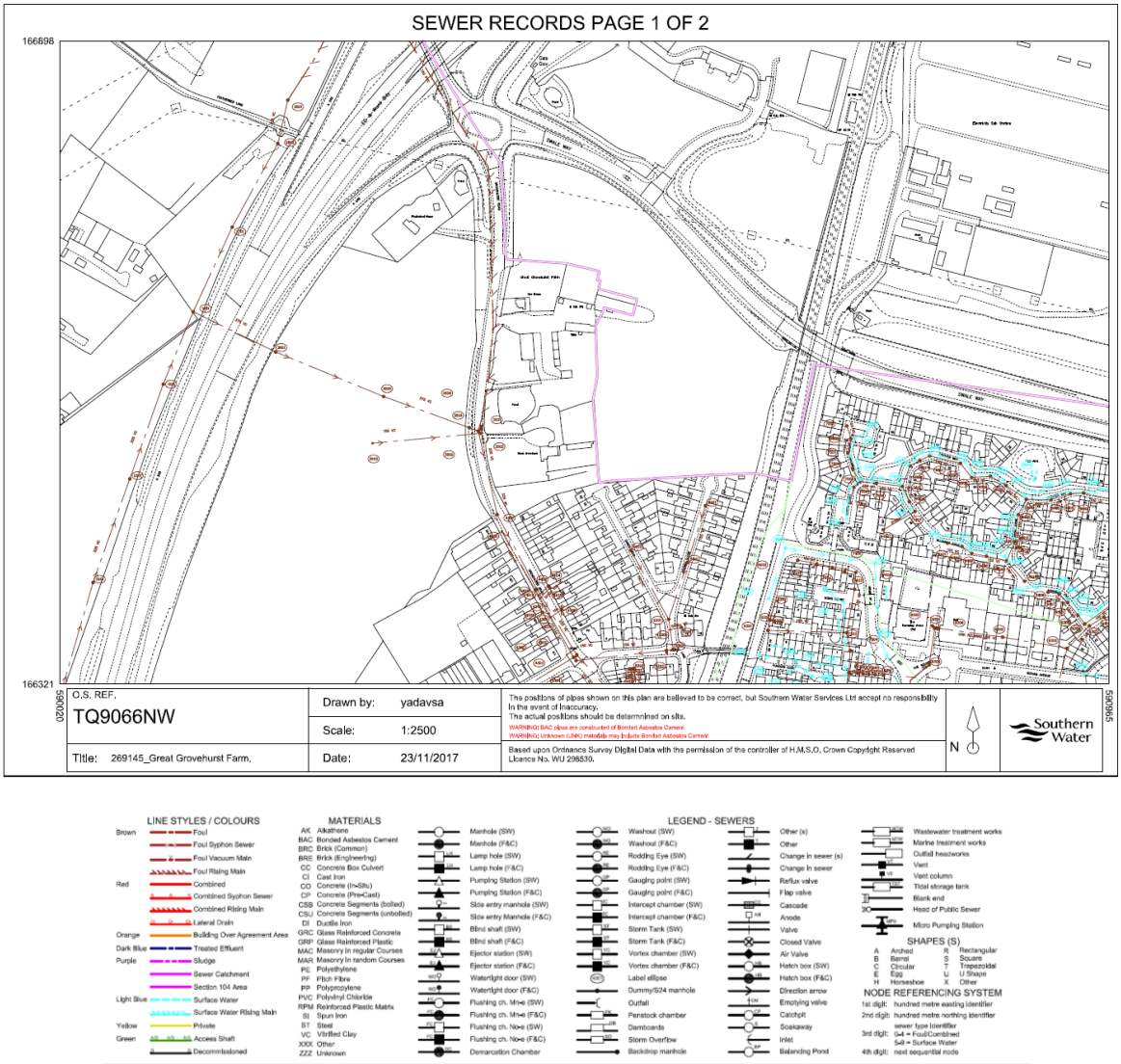

Figure 7: Southern Water's Public Sewer Map

5.59. The sewer record plans provided by Southern Water shows a rising main being pumped from north to south adjacent to the site in Grovehurst Road. This rising main discharges into a 225mm gravity foul water sewer within Grovehurst Road. There are also 150mm diameter foul water sewers identified within Godwin Close and Danes Mead to the south of the site.

5.60. The public sewer map indicates there are existing public foul water sewers located to the south and west of the site.

5.61. In terms of the point of connection for foul flows from the proposed development to the public foul water sewer system, the development can drain into an existing manhole on Grovehurst Road.

5.62. In terms of foul water drainage, it has been demonstrated that a suitable means of drainage can be provided to serve the proposed development.

Maintenance Strategy

5.63. Paragraph 81 in the Flood Risk and Coastal Change Planning Practice Guidance[19] advises that in considering a development that includes a sustainable drainage system the local planning authority will want to be satisfied that there are clear arrangements in place for ongoing maintenance. Paragraph 85 goes onto advise that when planning a sustainable drainage system, developers need to ensure their design takes account of maintenance requirements of both surface and subsurface components so that it continues to provide effective drainage for properties.

5.64. In terms of the maintenance strategy for the proposed drainage measures, the main surface and foul water drainage systems would be adopted by Southern Water, in its role as sewerage undertaker, under a Section 104 Agreement of the Water Industry Act 1991. Southern Water would therefore be responsible for the future maintenance of the adopted drainage systems.

5.65. It is proposed that the detention basin would be adopted and maintained either by a private Management Company or by the District Council.

5.66. Roads and footways, including highway drainage and gullies, to be adopted under Section 38 of the Highways Act 1980, would be maintained by Kent County in its role as the local highway authority.

5.67. Guidance on the operation and maintenance requirements of sustainable drainage systems is contained in The SuDS Manual (CIRIA C753). There are three categories of maintenance: regular, occasional and remedial. The Management Company would be responsible for putting in place a suitable maintenance plan. An outline Maintenance plan for the SuDS components are set out in **Table H** below.

Table H: SuDS Maintenance Plan

Maintenance Schedule	Required Action	Frequency
Regular maintenance	Litter and debris removal	Monthly (or as required)
	Grass cutting for spillways and access routes to retain grass height to site owner's specification.	As required (monthly during growing season)
	Vegetation cutting for vegetation in the base of the basin.	As required in line with the landscape management plan.
	Inspection of marginal and bankside vegetation and removal of nuisance plants.	Monthly (at start, then as required)
	Tidy all dead growth before the start of the growing season.	Annually.
	Inspection of inlets, outlets, banksides, structures, pipework etc for evidence of blockage and/or physical damage	Monthly
	Remove sediment from inlets and outlets. Undertake contamination testing to inform silt management and disposal options.	Annually (as required).
	Inspection of water body for signs of poor water quality	Monthly (May – October)
	Manage wetland plants in outlet pool – where provided.	Annually.
	Check flow controls.	Annually.

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Maintenance Schedule	Required Action	Frequency
Occasional maintenance	Check for poor vegetation growth due to lack of sunlight or dropping of leaf litter, and cut back adjacent vegetation where possible.	Annually
	Re-seed areas of poor vegetation growth. Alter plant types to better suit conditions, if required.	Annually, or if bare soil is exposed over 10% or more of the basin area.
	Remove sediment from micropools if volume reduced by >20%.	3 – 10 years (or as required).
Remedial actions	Repair erosion or other damage by re-turfing, reseeding or replanting.	As required.
	Re-level uneven surfaces, realign rip-rap and reinstate design levels.	As required.
	Repair/ rehabilitation of inlets, outlets and overflows.	As required.
Monitoring	Inspect inlets, outlets and overflows for blockages, and clear if required.	Half yearly/ after large storms.
	Inspect banksides, structures, pipework, etc for evidence of physical damage.	Half yearly / after large storms.
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Half yearly.

6. CONCLUSIONS

6.1. This Flood Risk Assessment has been prepared to support a planning application for a residential development on land at Great Grovehurst Farm, Kemsley, Sittingbourne.

6.2. The overall site is around 4.8 hectares, and is located to the east of Grovehurst Road and to the south of Swale Way. The development proposals comprise up to 110 dwellings.

6.3. The Application Site forms part of the wider Land at north-west Sittingbourne allocation (Policy MU1) set out in the adopted Bearing Fruits 2031: The Swale Borough Local Plan.

6.4. The site falls within Flood Zone 1. Where all uses of land are appropriate.

6.5. In addition to flooding from rivers and the sea, this Flood Risk Assessment has considered the potential consequences of flooding from all other sources, which include directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

6.6. An assessment has been made of the potential risk from all sources of flooding to and from the development site, with reference to available flood risk information, for existing conditions pre-development, and post-development with the various development mitigation measures incorporated.

6.7. The Strategic Flood Risk Assessment (SFRA), and historic flood information, provides an assessment of the impact of other sources of potential flooding. Based on the SFRA there are no historic flood incidents recorded on the site from all sources of potential flooding. The pre-development potential flood risk to the site from all sources of flooding is considered to be very low.

6.8. The British Geological Survey (BGS) geological mapping of the area shows the site is underlain by London Clay bedrock and Head superifical deposits.

6.9. A site investigation was undertaken by Soils Limited in October 2013. As part of the site investigation, soakaway tests were carried out across the site in broad accordance with BRE Digest 365 which confirm that the use of soakaways would not provide a suitable means of draining surface water runoff from development.

6.10. A sustainable drainage strategy comprising an on-line detention basin is proposed in order to attenuate surface water runoff to greenfield runoff rates with discharges to the existing Land Drainage System which discharges to a local watercourse 50m to the north of the proposed development.

6.11. The proposed drainage strategy would ensure that surface water arising from the developed site would be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account.

6.12. Existing “Greenfield” runoff peak flow rates have been derived using the guidance in the Environment Agency’s ‘Rainfall runoff management for developments’ Report – SC030219 published in October 2013. In accordance with this guidance the limiting discharge for any return period up to the 100 year event would not be greater than the mean annual peak rate of runoff for the greenfield site, referred to as $Q_{BAR,}$ which approximates to a return period of 2.3 years, and hence a reduced rate of runoff for higher return periods.

6.13. By limiting the development rate of runoff to the mean annual peak rate of runoff, Q_{BAR}, for all rainfall events up to the 1 in 100 year return period event, including an allowance for climate change of 20% and 40%, the proposed development would reduce flood risk overall when compared to existing greenfield rates.

6.14. The proposed drainage measures would ensure that there is little or no residual risk of property flooding occurring during events well in excess of the minimum acceptable standard of protection for new property, which requires that no flooding of property should occur as a result of a one in 100 year storm event taking account of climate change.

6.15. For extreme events it is considered that the proposed development would intercept any uncontrolled overland flow and direct it into the proposed drainage system. The proposed drainage measures would therefore ensure the proposed development would have adequate flood protection for extreme events over the lifetime of the development.

6.16. The Micro Drainage calculations contained in this Flood Risk Assessment demonstrate that a suitable means of drainage can be provided to drain the developed site in terms of surface water runoff in accordance with the guidance and standards laid down.

6.17. The proposed development complies with the relevant standards of the Government's 'Non-statutory technical standards for sustainable drainage systems'.

6.18. In terms of foul water drainage, it has been demonstrated that a suitable means of drainage can be provided to serve the proposed development.

6.19. The proposed foul and surface water drainage arrangements can be covered by a suitably worded condition requiring the submission of details to be submitted to and approved by the Local Planning Authority.

6.20. A maintenance strategy for the proposed surface water drainage measures to serve the development has been set out in this document.

6.21. This Flood Risk Assessment has demonstrated that the proposed development is compliant with the NPPF, DEFRA/Environment Agency guidance, and Local Plan Policies.

6.22. The overall conclusions drawn from this Flood Risk Assessment are that the development would be appropriately safe for its lifetime taking account of the vulnerability of its users, the development would not increase flood risk elsewhere, and would reduce flood risk overall.