Gilston Park Estate
North of Harlow

7 - Flood Risk Assessment & Drainage Strategy

places for people

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AECOM Water

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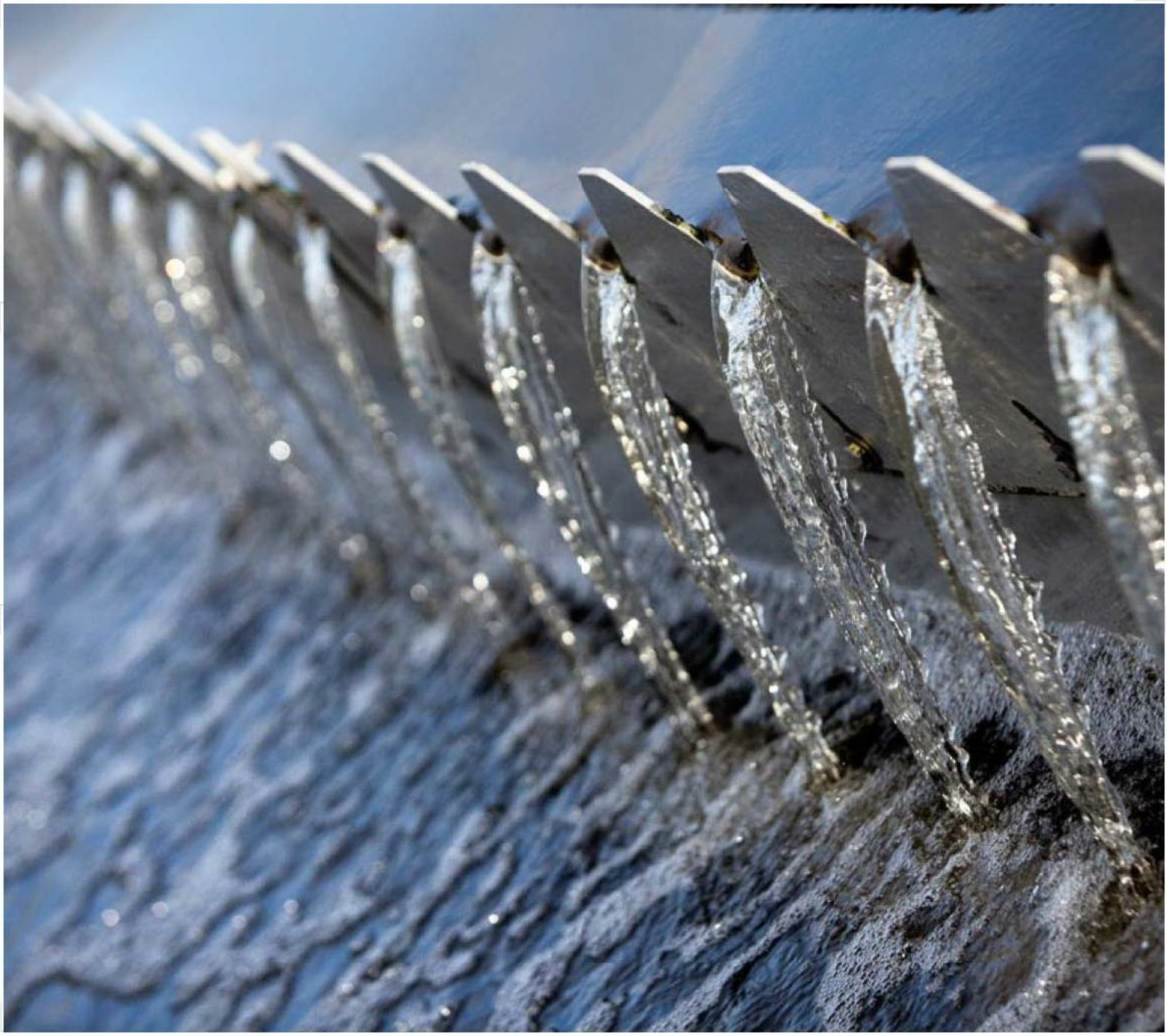
Gilston Park Estate

Flood Risk Assessment & Drainage Strategy



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Gilston Park Estate

Flood Risk Assessment & Drainage Strategy

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1 Introduction

1 Introduction

Gilston Park Estate is the name for an extensive area of land, acquired by Places for People, lying north of Harlow and on the north side of the River Stort valley, primarily within the East Herts District Council boundary.

Places for People is gathering all of the information it reeds to prepare a detailed and robust masterplan to promote its site through the East Hertfordshire Local Plan process. This involves producing a series of assessments and reports to assist with the evidence base for the Local Plan The material being produced could also be used to accompany a planning application if ever required.

This site specific Flood Risk Assessment (FRA) has been produced for this purpose in order to inform baseline conditions. A previous 'Strategic' Flood Assessment (SFRA) by AECOM in 2006 is superseded by this document in accordance and as requested by the Environment Agency (EA).

This FRA will identify the various flood risk sources to which the development area is potentially vulnerable and evaluate the risk to the area from those sources. It will also assess the impact that proposed development could have on flood risk both on and off site through additional runoff and any displaced water generated by the development and suggest measures to nullify any such additional flood risk. This FRA will enable a future developer to apply the sequential test (as required within the NPPF) to development proposals and any mitigation measures in order to control any residual flood risks.

The land acquired is approximately 1000 ha in total, largely within the parishes of Hunsdon, Eastwick, Gilston and High Wych. The masterplan proposals consist of a series of village developments on gently sloping land rising north above the River Stort valley and the adjacent A414. The villages and associated infrastructure occupy an area in the order of 280 ha. The remaining ownership is to be left as open space. Figure 1 gives a location plan and Figure 2 shows the boundaries of the development area.

Figure 1 – Location Plan

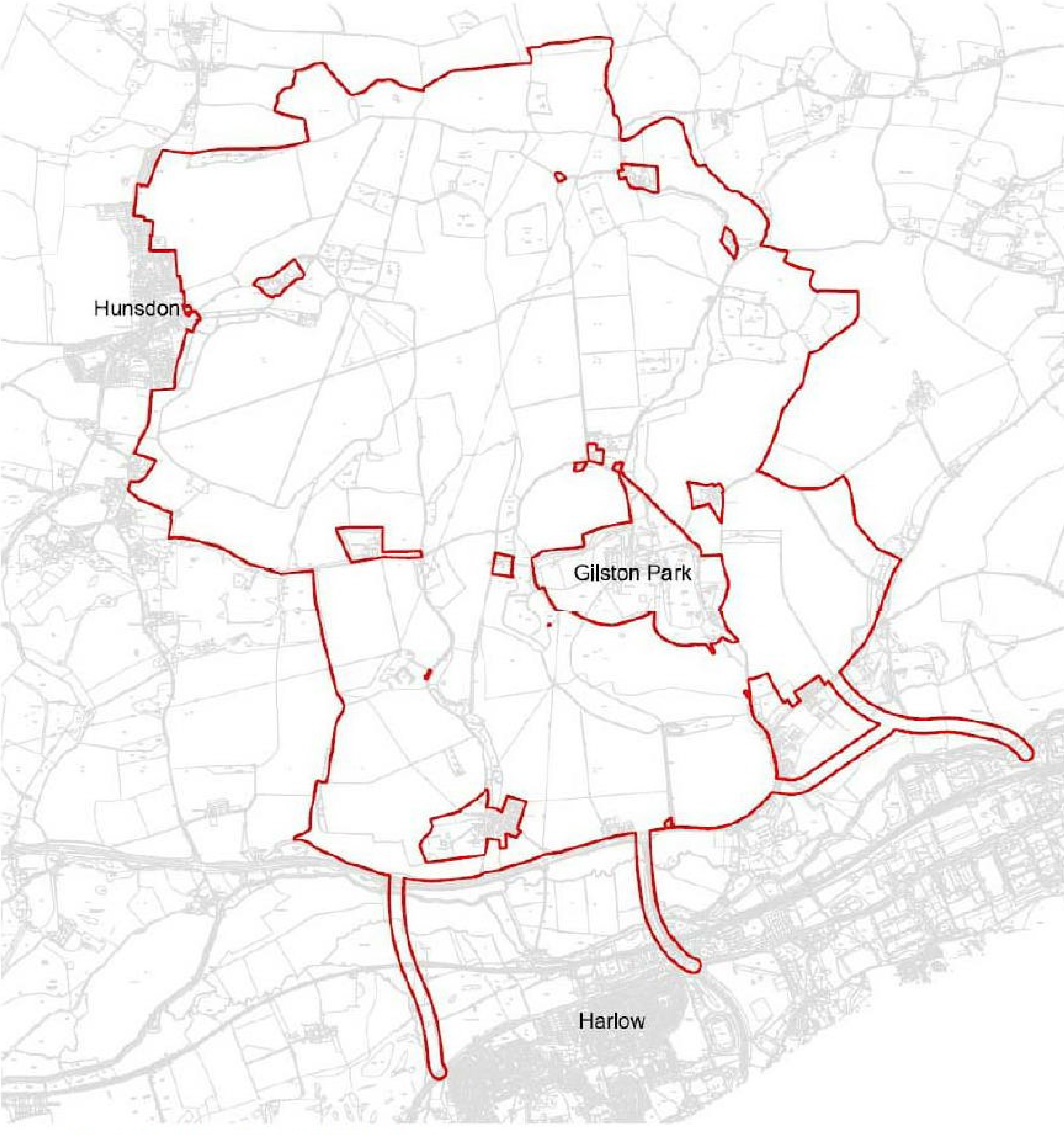

Figure 2 - Development Boundary

The great majority of proposed development will lie outside the EA designated flood zones 2 and 3 with only some associated infrastructure (road linkages, SuDS features, etc) located within flood zone 2. Proposed bridge crossings over the River Stort between Harlow and the A414 will have piers and abutments within flood zone 3 and the affect of these will be compensated for.

Proposed development occurs on 'Greenfield' land and a considerable volume of additional surface water runoff could be generated by the development if appropriate measures are not taken to attenuate the rate and volume of the additional runoff. This Flood Risk Assessment has therefore been prepared in compliance with the requirements set out for FRA's in the National Planning Policy Framework 2012 (NPPF), in order to:

- Develop an understanding of possible flooding mechanisms at the site.
- Review the development proposals within the context of the overall catchment.
- Identify and evaluate available data related to flood risk.
- Provide an initial and preliminary quantitative assessment of the potential impact of, and constraints to, the proposed development site.
- Examine the impact of future Climate change.

A Level 1 SFRA report has been assembled by East Herts Council (dated November 2008). The report is available from their websie and it has been reviewed as part of this assessment. This FRA will make use of information contained within the SFRA where appropriate.

2 Background and Supporting Information

2 Background and Supporting Information

2.1 Location and Description

The development area is at present an extensive tract of rolling farmland on the northern slopes of the Stort Valley, bisected by a series of three tributary valleys. It is a largely arable landscape although with a number of blocks of deciduous woodland on high land to the north of the development area. The small villages of Eastwick and Gilston are situated on the south of the development area, the former within the area and the latter just outside its southern boundary. Gilston Park, a large house surrounded by its own parkland, is situated near the centre of the development area.

2.2 Development Type

Principally residential, Gilston Park Estate will also include some local retail development and land dedicated to educational, recreational and amenity use. Within the development area there are a few small isolated parcels of residential property in other ownerships which will remain as at present and not be redeveloped.

2.3 Local Watercourses

The proposed villages are located around three tributary streams flowing towards the River Stort from the north. Eastwick Brook is on the western side, centrally Fiddlers Brook and on the east side, Pole Hole Brook. Gilston Park with its surrounding parkland and lake lies in the centre of this area. It does not form part of the proposed development.

The ownership area to the north of the proposed villages will remain undeveloped and retained undisturbed as a valuable natural habitat. It comprises a number of separate blocks of woodland (Eastwick, Black Hut, Lawns, Queens, Battles, Mole and Maplecroft Woods) and the intervening farmland.

2.4 New Stort Valley Crossings

Ownership includes areas south of the A414 within the Stort floodplain. It is not intended to extend any of the development into the floodplain which will be retained as an amenity and landscape area. The existing A414 (Harlow to Hertford) road which crosses the floodplain on an embankment is to be widened to cater for the increased traffic capacities. However, the increase in capacity will be achieved by an adjacent bridge structure over the flood plain. A further bridged crossing of the Stort valley is proposec to connect the A414 with Harlow New Town,to the East of the existing crossing.

2.5 Drainage Overview

The proposed development will incorporate Sustainable Urban Drainage Systems (SuDS) on a large scale as an integral part of the development. These will not only provide a high degree of flood flow attenuation before any storm runoff is discharged to a local watercourse but will also attemp: to maximise the infiltration of stored runoff to underlying strata within the constraints of the permeability of the soil and subsoil in the development area and thus reduce the overall volume of storm water discharged. The large scale use of SUDS will also provide an opportunity for significant ecological and landscape enhancement within the development area.

There are environmental constraints in addition to insufficient capacities with the existing public sewerage network and Rye Meads Sewage Treatment Works. Accommodating the planned growth in the whole region, coupled with the need for a reliable source for non-potable water to reduce pctable water consumption, has led to the selection of on-site local sewage treatment as the preferred option for Gilston Park Estate. The Environment Agency is supportive in principle of local treatment with the proviso that the effluent will not have a detrimental effect on the local streams.

The Foul water drainage will include:

- Collection of sewage using conventional foul drainage system, designed and built to adoptable standards.
- Treatment of sewage using strategically positioned local treatment plants using membrane bioreactor (MBR) technology.

- The ability to re-charge the system from the sustainable drainage system to dilute foul water flows as required.
- Discharge of excess treated effluent to the local watercourses / tributaries or direct to the River Stort.

Outline details of the proposed foul sewerage systems of the Gilston Park Estate development area are given in the Drainage Strategy and Assessment Section.

3 Assessment of Flood Risk

3 Assessment of Flood Risk

This Flood Risk Assessment is in accordance with the National Planning Policy Framework 2012 (NPPF). The Environment Agency (EA) need to be satisfied that the proposals for development address the risk of flooding to the development site and will not in turn increase the risk of flooding to neighbouring land and property.

This report will, in accordance with the NPPF (and the accompanying Technical Guidance document), propose preventative measures to mitigate against flooding from any source, if found necessary.

The report will also examine the surface water drainage strategy for the scheme to establish constraints and design requirements and to promote the use of Sustainable Drainage Systems (SuDS), as applicable.

3.1 Summary of Requirements of NPPF

NPPF requires the FRA to consider all potential forms of flooding, including river, sea, estuary, land drainage, groundwater, surface water run-off, flooding from sewer systems, flooding from reservoirs and canals, etc and should consider the impact of flooding on both the development and off site parties and land. Appendix 1 contains further information on its requirements.

3.1.1 Flood Risk and Vulnerability

Flood risk takes account of both the probability and the consequences of flooding (i.e. vulnerability of the development etc.). Flood frequency is usually interpreted in terms of the return period e.g. 1 in 50 and 1 in 100-year event etc. In betting terms, there is a 50/1 (2%) chance of one or more 1 in 50-year floods occurring in a given year. Similarly, there is a 100/1 (1%) chance of one or more 1 in 100-year floods occurring in a given year.

Vulnerability classifications, as defined in the NPPF Technical Guidance document, are Essential Infrastructure, Highly Vulnerable, More Vulnerable, Less Vulnerable and Water Compatible Development. Appendix 1 contains a detailed description of which types of development fall into each vulnerability classification.

3.1.2 Flood Zones

There are four classifications for flood zones, as defined in the NPPF:

- Zone 1
  Low probability (less than 1 in 1000 annual probability of river or sea flooding in any year);
- Zone 2
  Medium probability (between 1 in 100 and 1 in 1000 annual probability of river flooding or between 1 in 200 and 1 in 1000 annual probability of sea flooding in any year);
- Zone 3a
  High probability (1 in 100 or greater annual probability of river flooding in any year or 1 in 200 or greater annual probability of sea flooding in any given year);
- Zone 3b
  High probability (functional flood plain - essentially the 1 in 20 or greater annual probability of flooding in any given year).

3.1.3 The Sequential Test and Exception Test

The Sequential Test is a risk-based test that should be applied at all stages of development and aims to steer new development to areas with the lowest probability of flooding (Zone 1). This is applied by the Local Authority by means of a Strategic Flood Risk Assessment (SFRA).

Furthermore, large sites partially affected by Flood Zones 2 and 3 should be developed sequentially, placing the most vulnerable land uses in the areas with lowest risk of flooding. Further details of the Sequential Test are provided in Appendix 1.

The SFRA may require the Exception Test to be applied to certain forms of new development. The test considers the vulnerability of the new development to flood risk and, to be passed, must demonstrate:

- There are sustainability benefits that outweigh flood risk.
- It is on previously developed land or there are no other reasonably developable sites.
- The new development is safe without increasing flood risk elsewhere.

Further details of the Exception Test are provided in Appendix 1.

3.1.4 Climate Change

The NPPF makes it a planning requirement to account for climate change in the proposed design. The recommended allowances are summarised in Table 1.

Parameter / Horizon	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	+5%	+10%	+20%	+30%
Peak river flow	+10%	+20%		
Offshore wind speed	+5%		+10%	
Extreme wave height	+5%		+10%	

Table 1: Climate change allowances (Extract from NPPF Technical Guidance, Table 5)

3.1.5 Sustainable Drainage

The key planning objectives in the NPPF are to appraise, manage and where possible, reduce flood risk. The NPPF (and covered by Part H of the Building Regulations (DTLR, 2002 incorporating 2010 amendments)), directs developers toward the use of Sustainable Drainage Systems (SuDS) wherever possible.

3.2 The Sequential Test

Although the development area is located on land that is within various Flood zones the residential proposals all lie within Flood Zone 1. Associated SuDS and foul water treatment facilities may occur within Flood Zone 2. There is no highly vulnerable development within Flood Zone 2 hence proposals meet the requirements of the Sequential Test.

3.3 The Exception Test

The proposed scheme is classed as “More vulnerable” and considered appropriate within Flood Zone 1. Application of the Exception Test is therefore not required.

3.4 Impact of Climate Change

Since the proposed development is residential, a minimum 100 year design life is appropriate. For a design life up to 2115 an allowance of 30% increase to peak rainfall intensity is recommended. This allowance is incorporated within the design calculations for surface water run-off. An assessment of climate change on river levels should also be considered. Ground levels at residential properties nearest the River Stort are several metres higher than its 1000 year flood extent. Also, housing development is located away from the steeply sloping valleys of each of the River Stort tributary brooks. The change in river levels due to climate change is unlikely to affect the site.

3.5 Strategic Flood Risk Assessments

East Herts Council produced a Technical Study Level 1 Strategic Flood Risk Assessment issued November 2008 which is available on-line. Scott Wilson has also prepared for Essex County Council, a Level 1 Minerals and Waste Strategic Flood Risk Assessment, dated September 2010. Both these reports have been referred to for information relating to the risk of flooding in the area of the proposed development.

3.6 Floodplain Mapping

Various flood modelling and flood map development, for the site and locality, in consultation with the Environment Agency, has occurred over recent years as modelling software, methods and accuracy has advanced and improved. AECOM has recently modelled flood plain extents of the River Stort and the relevant tributaries near the development, arriving at agreed values for the 20, 100 (with and without climate change) and the 1000 year return events. The 100 year plus climate change and 1000 year event limits have been used to establish the form and assess the development and the associated infrastructure including SuDS proposals.

3.7 Sources of Potential Flooding

Flood risk from the following sources has been considered:

3.7.1 Tidal Flooding

Tidal flooding occurs when an exceptionally high tide usually accompanied by a storm tide surge, overtops and/ or breaches the tidal defences along a coastline or tidal estuary. The River Stort is situated well above the upstream tidal limit in the River Lea and there are no areas within the Stort Valley that are subject to tidal flooding.

3.7.2 Fluvial Flooding

Fluvial flooding occurs as a result of the overflowing or breaching of river or stream banks when the flow in the water course exceeds the capacity of the river channel to accommodate that flow. Gilston Park Estate is situated on the western side of the valley of the River Stort. The southern edge of the development area extends close to the bottom of the valley and abuts the raised carriageway of the A414 Hertford to Harlow road. The floodplain of the River Stort generally extends to the south embankment of the A414. The majority of the development lies along the lower flanks of the valley, an area of undulating countryside intersected by a number of minor right bank tributary valleys. The underlying geology of the site is London clay overlain with boulder clay.

When the flow in a river or stream exceeds the capacity of the channel to convey that flow, either because of limited cross-sectional area, limited fall, or a restricted outfall, then the water level in that channel will rise until the point is reached where the banks of the channel are overtopped. Water will then spill over the channel banks and onto the adjoining land. With an upland river the adjoining land is its natural flood plain, which will generally be of limited extent and fairly well defined. This is the case for the three Stort tributaries flowing north south through the development. Although all are classed as main rivers, none of these minor watercourses have any real floodplain and the risk of anything other than very localised flooding from them is minimal.

In the case of a sizeable river, such as the Stort, the floodplain may be a hundred metres or more in width, though it may not be equally distributed on either side of the river channel. However, due to local variations in geomorphology, the width of the floodplain may vary considerably from point to point along the river valley. Floodplains are characterised by flat, riparian land along the valley floor. In pre-industrial England, such land was regarded as liable to flooding and was traditionally reserved for grazing and stock rearing. Human settlements were commonly established beyond the edge of the floodplain. In the industrial age and more recent times with different priorities, pressures for development have resulted in the widespread colonisation of floodplains, often with steps taken to mitigate the associated risks of flooding. The River Stort floodplain in the vicinity of the proposed developments consists generally of a series of meads, marshland

and recreational areas. Exceptions include Parndon Mill, Burnt Mill with the Lock House and the Moorhen public house. The railway is on embankment, generally raised above the floodplain.

Flooding, especially that caused by overflowing of watercourses, can be exacerbated by operational and maintenance failures. These failures can be due to neglected or inadequate maintenance of watercourses resulting in bottlenecking and a reduction of their hydraulic capacity. Flooding can also be caused or exacerbated by bridge or culvert blockages, although these are not necessarily due to maintenance failures and may be caused by debris, natural or man-made, swept along by flood flows.

3.7.3 Pluvial Flooding

Pluvial flooding results from rainfall generated overland flow before the run-off enters any watercourse, drain or sewer. It is often linked with high intensity rainfall events (typically in excess of 30mm per hour). It can also occur with lower intensity rainfall or melting snow when the ground is saturated, frozen, developed or otherwise where the surface is of low permeability. The consequence is overland flow with pond formation at depressions in the topography. In urbanised areas, pluvial flows are likely to follow the routes of highways and other surface connectivity to low points where flooding can occur. Where water levels overtop containment at low points, flow routes may deviate to sensitive locations.

The site is presently Greenfield in general. Consequently, the potential for significant overland flows to develop is limited. Topography across the site dictates that overland flows generally fall toward the valleys of the three adjacent tributaries and eventually will discharge into the relevant brook.

The proposed development site is to be served by SuDS which will be designed to control run-off at source and mimic the existing drainage regime as close as is practically possible. Final discharges along the relevant watercourse will be controlled via a vortex control units in order that a final Greenfield discharge rate can be confirmed at specific locations.

3.7.4 Groundwater Flooding

Groundwater flooding is caused by the emergence of water from sub-surface permeable strata. Fluctuations in the groundwater table can cause flooding if the water table rises above ground levels. These flooding events tend to have long durations lasting days or weeks.

Given the ground conditions and topography of the site, flooding due to groundwater is considered very unlikely. There are no recorded incidents of groundwater flooding in the vicinity noted in the East Herts SFRA and associated maps.

3.7.5 Flooding from drains and sewers

Sewer network plans obtained from Thames Water show no public surface water sewers in the proposed development area. It is assumed that existing properties within the area have private drainage outfalls to local watercourses or possibly discharge surface water runoff to soakaways where this has been found appropriate. It is possible there may be a few private surface water sewers in the area but these, where they exist, will serve only a single property or handful of properties and have an insignificant impact on flood risk in the brook to which they discharge.

Foul sewage from a wide area is conveyed to Thames Water's large sewage treatment works at Rye Meads, at the confluence of the Rivers Stort and Lea. The 975mm diameter Harlow Trunk Sewer runs from east to west under the Stort floodplain, receiving inflows from the Harlow urban area from the south at Town Park (450mm sewer) and at the A414 (150mm sewer). At Parndon Meads a 900mm diameter foul sewer from the western end of Harlow joins the Harlow Trunk Sewer which then increases in size to 1275mm.

The only inflow to the Harlow Trunk Sewer from the north is the 225mm foul sewer from Eastwick which joins the Trunk Sewer north of Parndon Mill. It is believed that foul sewage from Gilston and Terlings Park also joins the Trunk Sewer but the Thames Water sewer plan merely shows the local sewer from the village terminating abruptly alongside the A414 at Eastwick Lodge Farm without showing a downstream connection.

Only the Harlow Trunk Sewer is considered to pose any flood risk to the local area. It conveys sewage from urban areas upstream of Harlow. There are few older urban areas in its catchment that might be expected to contribute a combined (mixed foul and surface water) flow. The proportion of surface water runoff to the flow in the Trunk Sewer is therefore likely to be relatively small and the sewer is unlikely to be subject to excessive surcharging during storm conditions with a consequent risk of localised flooding. Also, infiltration leakage to the sewer and illegal surface water connections are considered unlikely to contribute significantly to flows in this sewer. Its potential flood risk is limited to the River Stort floodplain.

3.7.6 Flooding from Water mains

Twin Affinity Water trunk mains (21 and 18 inch diameter) run through the site between Villages 5 and 6. As they enter the proposed development area, they follow the Eastwick Brook valley before diverting east to the north of Eastwick Village. Road crossings and proposed SuDS are the only development close to the water mains and these will maintain a minimum 1.2m deep ground cover over as agreed with Affinity Water. The topography of the site is such, that if a burst should ever occur, flood water will follow the Eastwick brook valley, unlikely to directly affect the proposed development located on higher ground. The risk of flooding from a burst water main is generally low since it is in the interest of the water company to exercise a good monitoring and maintenance regime and ensure measures are in place to quickly isolate leakage or bursts.

3.7.7 Flood Risk from Artificial sources

Non-natural or artificial sources of flooding can include reservoirs, canals and lakes where water is retained above natural ground level. There are no reservoirs within the vicinity. Gilston Park Lake is an ornamental lake formed by artificially enlarging an area adjacent to Fiddlers Brook. It lies within the Gilston Park Estate, central to the proposed Villages and extends approximately 400m along the valley. A breach of the existing embankment at the eastern end of the lake could result in flooding downstream. However, since there is no development, other than SuDS proposed within the valley of Fiddlers Brook there will be no direct risk to the proposed development.

4 Drainage Strategy and Assessment

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4.1 The Proposed development

Gilston Park Estate (GPE) comprises six closely linked villages, each with an individual architectural character. Each village development is, for the purpose of reference, numbered 1 to 6. Village 1 ('Southern Slopes') would be the earliest development and lies opposite the existing A414 crossing of the River Stort. Each village is progressively numbered in an anti clockwise direction. The masterplan layout with associated major SuDS features is included in appendix 2. This version of the masterplan accommodates approximately 8600 dwellings with schools, some local retail and employment, play and recreation areas and other associated infrastructure. The villages are located each side of the valleys of three tributaries of the River Stort, namely from west to east, Eastwick Brook, Fiddlers Brook and Pole Hole Brook. The surface water drainage strategy will be split to take into consideration development phasing.

4.2 Proposed Surface Water Arrangements

The development of 'greenfield' land will inevitably result in the generation of additional surface water runoff from the land after development. Surface water run-off from hard, impermeable surfaces can increase the incidence of localised and regional flooding. Almost all of the Gilston Park Estate development is at present agricultural land and is therefore 'greenfield' in nature. It follows that the generation of additional surface water runoff will require attenuation before discharge to the local watercourse in order to limit and elongate flows to the watercourse in order to mimic as far as possible the existing Greenfield drainage regime.

GPE will incorporate the principles of sustainable development and the surface water drainage methods adopted will take account of the associated quantity, quality, biodiversity and amenity issues and aspirations. In order to achieve these principles, sustainable drainage systems (SuDS) will be used. Focal points of the drainage strategy will be water features that will be partially sustained by the surface water run-off from the development. A mix of detention basins and retention ponds generally run parallel with the tributary valleys which will provide the final and the anticipated bulk of surface water attenuation prior to release through strategic flow controls to the local watercourse. Surface water will discharge into these features from swales, surface flood pathways, piped networks, etc within the neighbourhoods of the development.

4.3 Existing Surface Hydrology

The site is drained by the River Stort and its tributaries, Eastwick Brook, Fiddlers Brook and Pole Hole Brook. The River Stort flows from east to west along the southern margin of the site to the confluence with the River Lee approximately 3km south-west of the site.

The River Stort has complex hydrology due to the presence of a series on inter-connecting drainage channels of various levels, irrigating the main valley floor and providing drainage and pollution control functions for the industrial areas on the south of the valley. Most notably the natural river channel has been canalised along part of the valley, except for a length of around 1km immediately to the south of the development. In this area an additional section of dedicated canal has been constructed together with a marina located to the north of Harlow station.

Eastwick Brook is located within the western part of the site and flows generally south to discharge into the River Stort. Only the proposed Village 6 lies west of Eastwick Brook. This is classified as a 'main river' and rises northwest of the development site. The Brook is fed by several springs and natural land drainage as it winds its way down a shallow valley to Eastwick Village. The Brook runs through the village, passes in culvert beneath the A414 and outfalls to the River Stort.

Fiddlers Brook, also known in part, as Golden Brook, is a 'main river' and flows through the site generally from north to south before outfalling to the River Stort. The Brook is crossed a number of times by road culverts. As the Brook runs through the ground of Gilston Manor, it has been artificially dammed to create a lake with a weir arrangement at the downstream end. It is understood the lake was created to provide power to drive an electric generator for Gilston House, in the early part of the twentieth century. The lake does not perform any balancing function. The weir on the lake and the culvert and road crossings are the only control structures on Fiddlers Brook through the site.

Pole Hole Brook is a 'main river' and bounds the site in the south-east of the development. The Brook follows a shallow valley and passes by Pole Hole Farm before joining the River Stort at the western edge of the gravel workings.

It is on record that most of the watercourses on the site, including Eastwick Brook, have low flows during rain-free periods and Fiddlers Brook has been dry along part of its length.

4.4 Ground Investigation and Soakage Tests

From review of existing soils reports, infiltration is not thought to be a viable SuDS technique to use on the site due to the cohesive nature of the underlying soils, subject to further soakage testing at a local level. Therefore, to establish the extent of the strategic SuDS, direct infiltration techniques have not been considered at this stage and a zero infiltration rate has been assumed in the assessment of the strategic SuDS.

4.5 SuDS Strategy – General Principles

The proposed drainage strategy will be designed so as not to exacerbate any existing flood risk associated with properties upstream or downstream of the site.

SuDS will be implemented throughout the development scheme. The conceptual SuDS strategy is in accordance with the principles outlined within Hertfordshire County Council (HCC) Interim SuDS Policy Guidance.

Climate change and its potential impact on development is a factor that influences the drainage strategy. The development is principally residential. Assuming a typical lifespan of 100 years, the contingency allowances for climate change set out in table 5 of NPPF technical guidance recommends a 30% increase in peak rainfall intensity up to the year 2115. Detailed flow routing and storage calculations will include a 30% allowance when determining the performance of the proposed drainage system.

All proposed attenuation basins and ponds are situated outside the agreed fluvial 1 in 100 year flood level, incorporating an allowance for climate change, to avoid loss of attenuation storage during flood conditions. Where possible, this will extend to the agreed fluvial 1 in 1000 year flood level.

It is intended that all SuDS located within communal areas will be offered up for adoption to HCC. Should HCC not be willing to adopt the SuDS, a third party Management and Maintenance Company will need to be established to maintain the features throughout the lifetime of the development. An adoption agreement between the Developer and the third party company will be based upon the CIRIA Interim Code of Practice MA2 SuDS Maintenance Framework Agreement.

Strategic SuDS provision within the scheme design has been identified. Due to the level of detail within the scheme layout at this stage, local SuDS within the village neighbourhoods are not determined. However, the intention is for SuDS in the form of source control measures to be used as part of the management train to reduce pollution, flow rates and volumes.

4.6 Neighbourhood Details

As implied above, at this stage, a typical neighbourhood layout does not exist. Therefore, the number of different neighbourhood layouts and building typologies could be significant. In light of this, the SuDS Strategy below will set a series of principles that would be adopted dependent upon the type and size of actual plot development.

The strategy is to limit and control surface water runoff through hierarchal SuDS conveyance, as the following example:

- Where appropriate - water butts, green roofs, permeable paving within courtyards, local parking, etc, with restricted discharge into the downstream SuDS.
- Street side rills, ditches, bio swales etc. A swale and linkage pipe system that provides attenuation, possible partial infiltration during transfer of surface water through the system to downstream SuDS.

- Linked storage ponds constructed toward the termination of the SuDS before controlled discharge at discreet locations to the local watercourse.

4.7 Strategic SuDS

The site has relatively steep gradients (generally 1:30) and this presents a challenge in terms of creation and utilisation of storage volume. Where possible, swales will be aligned parallel to contour lines to maximize the storage and surface area for infiltration. Where this is not possible, due to a need to be aligned to suit the streetscape or landscape features, they may follow the slope. Weirs will need to be included at intervals and designed to retain the surface water, increase storage volume and also enable easy maintenance.

The SUDS system will be designed to accommodate a 100-year storm with a +30% allowance for climate change.

The drainage scheme will enhance the high quality open green spaces, with the swale and pond network providing 'green fingers' extending from the tributary valleys into the public realm, enhancing the local biodiversity. Health and safety will be a high priority in the planning and design stages.

Account of sustainable drainage at source has not been included specifically for reduction of run-off quantities and storage volumes required i.e. the provision of on street SuDS channels is considered as conveyance only and to contribute 100% run-off to the downstream drainage. Green roof, on plot retention and any infiltration is also not considered. This is to negate the current unknown details and to arrive at an overall strategic SuDS layout for this large development site. The strategic SuDS extents (basins and ponds discharging to the local watercourse) have been established on the assumption that attenuation basin areas are required to equal 10% of the hard surface areas. With hard (impermeable) surface assumed to be 50% of the developable area. Following this strategy, there is sufficient space to provide the attenuation required as indicated on the plan in the appendices. However, at this stage, detailed contouring and hence specific attenuation volumes have not been detailed. These will form part of any future detailed planning application and can be combined with proposed SuDS applications required that will form part of any future village masterplan. These will also identify source attenuation volumes prior to discharge to the SuDS basins. SuDS basins will therefore need further consideration at the detailed planning stage and will also be subject to the availability of detailed topographical and arboricultural information.

It is important that regular hydraulic reviews of phase by phase drainage planning are carried out with regard to the balance between source control and the run-off to watercourses.

4.8 Surface Water Runoff Rates and Volumes

The existing Site is currently undeveloped farm land, therefore a Greenfield runoff assessment has been carried out for the Site using an Interim Code of Practice run-off assessment which is based upon IoH 124 methodology. Results of Windes ICP calculation as follows:

Return Period (years)	100	30	1	QBAR
GF runoff rate (l/s/ha)	8.37	5.95	2.2	2.62

Refer to Appendix 3 for Windes calculations

SuDS Land Take – Indicative Attenuation Storage Area (All areas in Hectares)

Catchment Area (Village)	1	2	3	4	5	6	Total
Assumed impermeable area - 50% Development area (ha)	25.29	32.61	17.34	38.01	11.87	21.32	150.21
Assumed min basins area – 10% of impermeable area (ha)	2.53	3.26	1.73	3.8	1.19	2.13	15.02
Volume at 0.5m x basin area (m3)	12650	16300	8650	19000	5950	10650	75100
Windes Quick Storage estimate (m3) for 100 year return period + 30% climate change. Allowable discharge 8l/s/ha	12543 to 16640	16139 to 21456	8600 to 11410	18811 to 25009	5887 to 7809	10573 to 14027	73770 to 98699

4.9 Influence of on-site sewage treatment works

Four on-site local sewage treatment plants to treat the foul water flows from all of the development are proposed. These are shown on the Sewage Treatment Works Location Plan together with numbered reference for the attenuation basins and ponds. Refer to appendix 2. Outlets from the treatment works will be to the local strategic SuDS network of attenuation basins and ponds.

4.10.2 Treatment Works flow routing

- Treatment works (TW)1 is located at the southwest corner of Village 1. It is proposed to serve Village 1 and 5 and will cater for 2599 dwelling units. The base flow (non peak) has been calculated at 18l/s and this will outfall to pond ref 30.
- TW2 is located south of Village 2. It is proposed to serve Village 2 and 3 and will cater for 2829 dwelling units. The base flow has been calculated at 19.6l/s, proposed outfall to pond series ref 20.
- TW3 is located on the east side of Village 4. It will serve 1940 dwellings of Village 4. The base flow has been calculated at 13.5l/s, proposed outfall to pond ref 7.
- TW4 is located at the southwest corner of Village 6. It will serve 1213 dwellings of Village 6. The base flow has been calculated at 8.4l/s, proposed outfall to pond series ref 38.

It is recognised that flows from treatment works outfalls will contribute to the available storage volume allowed for SuDS. The potential affect is now reviewed.

Phased build out is assumed to increase foul water treatment in the same proportion as the rate of surface water run-off. Therefore the final figures (at completion of allocated units) are considered pertinent.

Considering TW1, pond 30 outfalls in two directions, east to 'master flow control' (MFC)2 and west to MFC3. The total allowable flow for the 1 in 100 year return is 207l/s. The base flow of 18l/s as a proportion of 207l/s is approximately 9%. Pond sizing upstream of MFC2 is indicated close to capacity. However, spare capacity is indicated upstream of MFC3 and this is well in excess of 9%.

TW2 flows to pond series ref 20 and will pass through MFC6. The final allowable flow for the 1 in 100 year return is 71.1l/s. The base flow of 19.6l/s as a proportion of 71.1l/s is approximately 27.5%. This is significant and is expected to be an issue as there is little space to increase the attenuation area. Levels generally fall from north to south towards TW2 so it is assumed pumping will be required. It is suggested the TW2 base flow is pumped to the wet pond ref 17, controlled by MFC9. Pond 17 has spare capacity in excess of 27.5%.

TW3 flows to pond ref 7 and will pass through MFC16. The final allowable flow for the 1 in 100 year return is 61.9l/s. The base flow of 13.5l/s as a proportion of 61.9l/s is 22%. The combination of ponds and basins downstream to MFC16 has spare capacity in excess of 22%.

All ponds that receive flow from TW4 are constructed in the first phase with flows split west to the Stone basin spring area via MFC12 and east to Eastwick Brook via MFC11. The total allowable flow for the 1 in 100 year return is 75.3l/s. The base flow of 8.4l/s as a proportion of 75.3l/s is approximately 11%. The series of receiving ponds has spare capacity in excess of 11%.

4.11 Health and Safety Assessment

Subject to local topography, the proposed layout of the SuDS features will be designed in accordance with the emerging National SuDS Standards and supplemented where appropriate with local SAB guidance to ensure that they are effective, not only from hydraulic but also from a safety perspective during construction, operation and maintenance.

A management strategy of improving public awareness and understanding of the risks of surface water within the public realm will be implemented, rather than erecting impenetrable barriers across the site. This could take the form of information boards throughout the site which would be used as an educational tool for the public.

5 Residual Risks & Mitigation

5 Residual Risks & Mitigation

Consideration of residual flood risk is required in accordance with the NPPF. There is a residual risk of flooding occurring from the following circumstances:

- An exceptionally extreme flood event in the river Stort and its north bank tributaries.
- An on-site rainfall event in excess of 1 in 100 years plus climate change allowance that results in flooding from the proposed site surface water systems.
- Breach or failure of the downstream impoundment of the Gilston Park ornamental lake.
- Flooding from blockage of bridge aperture, culvert, etc, particularly by large flood borne debris or fallen trees.
- Poorly maintained SuDS flow control devices.

Mitigation of these residual risks will be managed by:

- Ensuring proposed development is located well above the valley floors and higher than the established 1 in 1000 year flood level.
- Provide new or improved tributary road crossings with a minimum road surface level above the 100 year plus climate change flood level and that the bridge aperture or culvert is sized to pass a flood peak of that minimum magnitude without significant afflux upstream of the crossing.
- Provide safe, dry access/ egress to and from the site.
- Construction of finished floor levels to be 150mm above surrounding ground levels.
- Adoption and long term maintenance of SuDS by Herts County Council or Management Company as applicable.
- Regular inspection and maintenance of main river bridge aperture / culverts by the Environment Agency.

6 Conclusions

6 Conclusions

As a result of this flood risk assessment the following conclusions have been reached:

No part of the proposed development area is in the functional floodplain or high probability zone as defined by the NPPF.

Triggered by development phases, two River Stort crossings will be required. These will be bridge structures with pier support and foundations within the River Stort floodplain. Flood compensation areas will be established to offset the relatively small volumes of flood storage lost by the structure. Any landscaping works proposed within the River Stort floodplain is to maintain the existing public open space or improve accessibility without compromise to the existing flood zone.

Detailed hydrological and hydraulic modelling of the River Stort and its Harlow North tributaries undertaken in connection with previous assessment and recent update has enabled Flood Risk Maps of the development area to be prepared. These maps reinforce the conclusion indicated by the Agency's Flood Map that, apart from the public open spaces etc on riparian land no significant part of the proposed development is at risk of flooding from primary flood risk sources.

Development associated infrastructure, including strategic SuDS basins will generally be located within the established flood zone 1 area. Exception to this will only be subject to space restricted locations, i.e. due to topography and boundary conditions.

There are very few existing foul or surface water sewerage systems in the development area, none of which pose a flood risk to the development. The only sewer of any significance is the 975mm diameter Harlow Trunk Sewer, a major foul sewer which runs from east to west under the Stort floodplain parallel with the southern edge of the development and within land intended to remain as a public open space.

The development area drains naturally to the River Stort and to three of that river's tributaries which flow through the development area – the Pole Hole, Fiddlers and Eastwick Brooks. All these watercourses are Main Rivers under the Environment Agency classification.

Flood risk within the development area arising from surcharging of the local surface water drainage systems can be reduced or eliminated by appropriate design of those systems and the layout of the development so that any extreme event flooding is confined to public open spaces, roads or other paved areas with exceedence flood routing to follow natural topography through green corridors to the local Stort tributary valleys.

A range of residual risks of flooding have been identified but none are considered to pose a significant risk to the development area.

The proposed development will result in the generation of significant quantities of additional surface water runoff but discharges of runoff to local watercourses can be restricted to existing Greenfield runoff rates by appropriate design of SuDS incorporating storm runoff storage and flow attenuation devices.

Infiltration rates through ground surfaces in the development area are likely to be restricted by the relatively limited permeability of the majority of the natural soils and subsoils within the area. This does not preclude the incorporation of SuDS assuming partial infiltration may occur. However, subject to any favourable results from local soakage testing, the design of SuDS will assume a zero infiltration rate in the design calculations.

The Environment Agency has agreed variable Greenfield runoff rates related to flood event return period for use in the design of the development's surface water drainage systems as far as practically possible. A sliding scale of Greenfield runoff rates applicable to the local tributary watercourses has been established for this purpose.

There is not considered to be any appreciable residual risk to the development area resulting from extreme hydrological events.

There is low risk to the development should flood waters flow down Fiddlers Brook due to breaching of the embankment at Gilston Park Lake as no development is proposed within the tributary valleys.

This Flood Risk Assessment has considered all potential sources of flooding that may be associated with the site and identified that the site is at low risk from flooding.

The proposed development would be considered as 'more vulnerable' according to the NPPF and considered acceptable within Flood Zone 1.

It is proposed to mimic the existing Greenfield runoff regime (as far as is practicable) of discharging surface water flows to the adjacent River Stort tributaries. Surface water discharge from the site will be attenuated to equivalent Greenfield runoff rates. Storage for attenuated volumes up to and including the 1 in 100 year plus 30% climate change event will be provided within 'strategic' on-line ponds and attenuation basins discharging via flow control devices.

Mitigation of residual flood risks is to be incorporated in to the development design and maintenance regime.

This Flood Risk Assessment has concluded that the flood risk to the existing site is acceptable in relation to the proposed scheme, and furthermore that the proposed scheme will not increase flood risk to other sites.

Appendices

Appendix 1: Extract from Technical Guidance to the NPPF

Flood risk

As set out in the National Planning Policy Framework, 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. For these purposes:

- "areas at risk of flooding" means land within Flood Zones 2 and 3; or land within Flood Zone 1 which has critical drainage problems and which has been notified to the local planning authority by the Environment Agency;
- "flood risk" means risk from all sources of flooding - 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.

The Sequential and Exception Tests

As set out in the National Planning Policy Framework, the aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. The flood zones (see table 1) are the starting point for this sequential approach. Zones 2 and 3 are shown on the flood map[1] with Flood Zone 1 being all the land falling outside Zones 2 and 3. These flood zones refer to the probability of sea and river flooding only, ignoring the presence of existing defences.

Strategic Flood Risk Assessments (see paragraphs 7-8) refine information on the probability of flooding, taking other sources of flooding and the impacts of climate change (see paragraphs 11-15) into account. They provide the basis for applying the Sequential Test, on the basis of the flood zones in table 1. Where table 1 indicates the need to apply the Exception Test (as set out in the National Planning Policy Framework), the scope of a Strategic Flood Risk Assessment will be widened to consider the impact of the flood risk management infrastructure on the frequency, impact, speed of onset, depth and velocity of flooding within the flood zones considering a range of flood risk management maintenance scenarios. Where a Strategic Flood Risk Assessment is not available, the Sequential Test will be based on the Environment Agency flood zones.

The overall aim should be to steer new development to Flood Zone 1. Where there are no reasonably available sites in Flood Zone 1, local planning authorities allocating land in local plans or determining planning applications for development at any particular location should take into account the flood risk vulnerability of land uses (see table 2) and consider reasonably available sites in Flood Zone 2, applying the Exception Test if required (see table 3). Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required.

1 To access the flood map, see the Environment Agency's website at:
http://www.environment-agency.gov.uk/homeandleisure/floods/default.aspx3

Table 1: Flood zones

(Note: These flood zones refer to the probability of river and sea flooding, ignoring the presence of defences)

Zone 1 - low probability **Definition** This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%). **Appropriate uses** All uses of land are appropriate in this zone. **Flood risk assessment requirements** For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a flood risk assessment. This need only be brief unless the factors above or other local considerations require particular attention. **Policy aims** In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage systems[2].
Zone 2 - medium probability **Definition** This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year. **Appropriate uses** Essential infrastructure and the water-compatible, less vulnerable and more vulnerable uses, as set out in table 2, are appropriate in this zone. The highly vulnerable uses are *only* appropriate in this zone if the Exception Test is passed. **Flood risk assessment requirements** All development proposals in this zone should be accompanied by a flood risk assessment. **Policy aims** In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage systems.

[2]Sustainable drainage systems cover the whole range of sustainable approaches to surface drainage management. They are designed to control surface water run off close to where it falls and mimic natural drainage as closely as possible.

Zone 3a - high probability

Definition

This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

Appropriate uses

The water-compatible and less vulnerable uses of land (table 2) are appropriate in this zone. The highly vulnerable uses should not be permitted in this zone.

The more vulnerable uses and essential infrastructure should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood.

Flood risk assessment requirements

All development proposals in this zone should be accompanied by a flood risk assessment.

Policy aims

In this zone, developers and local authorities should seek opportunities to:

- reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage systems;
- relocate existing development to land in zones with a lower probability of flooding; and
- create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.

Zone 3b - the functional floodplain

Definition

This zone comprises land where water has to flow or be stored in times of flood.

Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But land which would flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood in an extreme (0.1%) flood, should provide a starting point for consideration and discussions to identify the functional floodplain.

Appropriate uses

Only the water-compatible uses and the essential infrastructure listed in table 2 that has to be there should be permitted in this zone. It should be designed and constructed to:

- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage;
- not impede water flows; and
- not increase flood risk elsewhere.

Essential infrastructure in this zone should pass the Exception Test.

Flood risk assessment requirements

All development proposals in this zone should be accompanied by a flood risk assessment.

Policy aims

In this zone, developers and local authorities should seek opportunities to:

- reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage systems;
- relocate existing development to land with a lower probability of flooding.

Table 2: Flood risk vulnerability classification

Essential infrastructure • Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. • Wind turbines.
Highly vulnerable • Police stations, ambulance stations and fire stations and command centres and telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use[3]. • Installations requiring hazardous substances consent[4]. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as "essential infrastructure")[5].
More vulnerable • Hospitals. • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. • Non–residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste[6]. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.[7]

[3] For any proposal involving a change of use of land to a caravan, camping or chalet site, or to a mobile home site or park home site, the Sequential and Exception Tests should be applied.
[4] See Circular 04/00: *Planning controls for hazardous substances* (paragraph 18) at: www.communities.gov.uk/publications/planningandbuilding/circularplanningcontrols
[5] In considering any development proposal for such an installation, local planning authorities should have regard to planning policy on pollution in the National Planning Policy Framework.
[6] For definition, see *Planning for Sustainable Waste Management: Companion Guide to Planning Policy Statement 10* at www.communities.gov.uk/publications/planningandbuilding/planningsustainable
[7] See footnote 3.

Less vulnerable • Police, ambulance and fire stations which are not required to be operational during flooding. • Buildings used for shops, financial, professional and other services, restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non–residential institutions not included in "more vulnerable", and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment works which do not need to remain operational during times of flood. • Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).
Water-compatible development • Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel working. • Docks, marinas and wharves. • Navigation facilities. • Ministry of Defence defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, *subject to a specific warning and evacuation plan*.

Notes to table 2:

a. This classification is based partly on Department for Environment, Food and Rural Affairs and Environment Agency research on *Flood Risks to People* (*FD2321/TR2*)[8] and also on the need of some uses to keep functioning during flooding.

b. Buildings that combine a mixture of uses should be placed into the higher of the relevant classes of flood risk sensitivity. Developments that allow uses to be distributed over the site may fall within several classes of flood risk sensitivity.

c. The impact of a flood on the particular uses identified within this flood risk vulnerability classification will vary within each vulnerability class. Therefore, the flood risk management infrastructure and other risk mitigation measures needed to ensure the development is safe may differ between uses within a particular vulnerability classification.

[8] See website for further details. www.defra.gov.uk/science/Project_Data/DocumentLibrary/FD2320_3364_TRP.pdf

Table 3: Flood risk vulnerability and flood zone 'compatibility'

Flood Risk Vulnerability classification (see Table 2)		Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone (see Table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	×	Exception Test required	✓
	Zone 3b 'Functional Floodplain'	Exception Test required	✓	×	×	×

Key: ✓ Development is appropriate.
× Development should not be permitted.

Notes to table 3:
This table does not show:

a. the application of the Sequential Test which guides development to Flood Zone 1 first, then Zone 2, and then Zone 3;
b. flood risk assessment requirements; or
c. the policy aims for each flood zone.

Flood risk assessment

Properly prepared assessments of flood risk will inform the decision-making process at all stages of development planning. A Strategic Flood Risk Assessment is a study carried out by one or more local planning authorities to assess the risk to an area from flooding from all sources, now and in the future, taking account of the impacts of climate change, and to assess the impact that changes or development in the area will have on flood risk. It may also identify, particularly at more local levels, how to manage those changes to ensure that flood risk is not increased. A site-specific flood risk assessment is carried out by, or on behalf of, a developer to assess the risk to a development site and demonstrate how flood risk from all sources of flooding to the development itself and flood risk to others will be managed now, and taking climate change into account. There should be iteration between the different levels of flood risk assessment.

Strategic Flood Risk Assessment
As set out in the National Planning Policy Framework, Local Plans should be supported by Strategic Flood Risk Assessment. The Strategic Flood Risk Assessment should be prepared in consultation with the Environment Agency, local planning authorities' own functions of emergency response and drainage authority under the Land Drainage Act 1991, and where appropriate, internal drainage boards. Initially the Strategic Flood Risk Assessment will be used to refine information on the areas that may flood, taking into account other sources of flooding and the impacts of climate change, in addition to the information on the flood map. Local planning authorities should use the Strategic Flood Risk Assessment to inform their knowledge of flooding, refine the information on the flood map and determine the variations in flood risk from all sources of flooding across and from their area. These should form the basis for preparing appropriate policies for flood risk management for these areas. The Strategic Flood Risk Assessment should be used to inform the sustainability appraisal (incorporating the Strategic Environmental Assessment Directive) of local development documents, and will provide the basis from which to apply the Sequential Test and Exception Test in the development allocation and development control process.

Where local planning authorities have been unable to allocate all proposed development and infrastructure in accordance with the Sequential Test, taking account of the flood vulnerability category of the intended use, it will be necessary to increase the scope of the Strategic Flood Risk Assessment to provide the information necessary for application of the Exception Test. This should, additionally, consider the beneficial effects of flood risk management infrastructure in generally reducing the extent and severity of flooding when compared to the flood zones on the flood map. The increased scope of the Strategic Flood Risk Assessment will enable the production of mapping showing flood outlines for different probabilities, impact, speed of onset, depth and velocity variance of flooding taking account of the presence and likely performance of flood risk management infrastructure.

Site-specific flood risk assessment
As set out in the National Planning Policy Framework, local planning authorities should only consider development in flood risk areas appropriate where informed by a site-specific flood risk assessment9. This should identify and assess the risks of all forms of flooding to and from the development and demonstrate how these flood risks will be managed so that the development remains safe throughout its lifetime, taking climate change into account. Those proposing developments should take advice from the emergency services when producing an evacuation plan for the development as part of the flood risk assessment.

Minor developments[10] are unlikely to raise significant flood risk issues unless they would:

- have an adverse effect on a watercourse, floodplain or its flood defences;
- would impede access to flood defence and management facilities; or
- where the cumulative impact of such developments would have a significant effect on local flood storage capacity or flood flows.

[9] The Environment Agency provides 'standing advice' on flood risk – see the Agency's website at: http://www.environment-agency.gov.uk/research/planning/82584.aspx . Applicants for planning permission will find this advice helpful when preparing a site-specific flood risk assessment for, and before designing, a lower risk development (and for ensuring extensions or alterations are designed and constructed to conform to any flood protection already incorporated in the property and include flood resilience measures in the design). The Agency also provides standing advice to enable local planning authorities to clearly identify the type of planning applications on which they should consult the Agency, and to make decisions on low risk applications where flood risk is an issue, without directly consulting the Agency for an individual response.
[10] Minor development means: - Minor non-residential extensions: industrial/commercial/leisure etc. extensions with a footprint less than 250sqm. - Alterations: development that does not increase the size of buildings e.g. alterations to external appearance. - Householder development: e.g. sheds, garages, games rooms etc. within the curtilage of the existing dwelling in addition to physical extensions to the existing dwelling itself. This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling e.g. subdivision of houses into flats.

Taking climate change into account

Global sea level will continue to rise, depending on greenhouse gas emissions and the sensitivity of the climate system. The relative sea level rise in England also depends on the local vertical movement of the land, which is generally falling in the south-east and rising in the north and west. In preparing a Strategic Flood Risk Assessment or a site-specific flood risk assessment, the allowances for the rates of relative sea level rise shown in table 4 should be used as a starting point for considering flooding from the sea, along with the sensitivity ranges for wave height and wind speed in table 5.

Table 4: Recommended contingency allowances for net sea level rises

	Net sea level rise (mm per year) relative to 1990			
	1990 to 2025	**2025 to 2055**	**2055 to 2085**	**2085 to 2115**
East of England, east midlands, London, south-east England (south of Flamborough Head)	4.0	8.5	12.0	15.0
South-west England	3.5	8.0	11.5	14.5
North-west England, north-east England (north of Flamborough Head)	2.5	7.0	10.0	13.0

Notes to table 4:

a. For deriving sea levels up to 2025, the 4mm per year, 3mm per year and 2.5mm per year rates (covering the three geographical groups respectively), should be applied back to the 1990 base sea level year. From 2026 to 2055, the increase in sea level in this period is derived by adding the number of years on from 2025 (to 2055), multiplied by the respective rate shown in the table. Subsequent time periods 2056 to 2085 and 2086 to 2115 are treated similarly.

b. Refer to Department for Environment, Food and Rural Affairs FCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities – Climate Change Impacts, October 2006, for details of the derivation of this table. In particular, Annex A1 of this Note shows examples of how to calculate sea level rise.

c. Vertical movement of the land is incorporated in the table and does not need to be calculated separately.

The rise in sea level will change the frequency of occurrence of high water levels relative to today's sea levels, assuming no change in storminess. There may also be secondary impacts such as changes in wave heights due to increased water depths, as well as possible changes in the frequency, duration and severity of storm events. A 10 per cent sensitivity allowance should be added to offshore wind speeds and wave heights by the 2080s.

In making an assessment of the impacts of climate change on flooding from the land, rivers and sea as part of a flood risk assessment, the sensitivity ranges in table 5 may provide an appropriate precautionary response to the uncertainty about climate change impacts on rainfall intensities, river flow, wave height and wind speed.

Table 5: Recommended national precautionary sensitivity ranges for peak rainfall intensities, peak river flows, offshore wind speeds and wave heights

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	*+5%*	*+10%*	*+20%*	*+30%*
Peak river flow	*+10%*	*+20%*		
Offshore wind speed	*+5%*		*+10%*	
Extreme wave height	*+5%*		*+10%*	

Notes to table 5:

a. Refer to Department for Environment, Food and Rural Affairs FCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities – Climate Change Impacts, October 2006, for details of the derivation of this table.
b. For deriving peak rainfall, for example, between 2025 and 2055 multiply the rainfall measurement (in mm per hour) by 10 per cent and between 2055 and 2085 multiply the rainfall measurement by 20 per cent. So, if there is a 10mm per hour event, for the 2025 to 2055 period this would equate to 11mm per hour; and for the 2055 to 2085 period, this would equate to 12mm per hour. Other parameters in table 5 are treated similarly.

Sensitivity testing of the flood map produced by the Envronment Agency, using the 20 per cent from 2025 to 2115 allowance for peak flows, suggests that changes in the extent of inundation are negligible in well-defined floodplains, but can be dramatic in very flat areas. However, changes in the depth of flooding under the same allowance will reduce the return period of a given flood. This means that a site currently located within a lower risk zone (e.g. Zone 2 in table 1) could in future be re-classified as lying within a higher risk zone (e.g. Zone 3a in table 1). This in turn could have implications for the type of development that is appropriate according to its vulnerability to flooding (see table 2). It will therefore be important that developers, their advisors and local authorities refer to the current flood map and the Strategic Flood Risk Assessment when preparing and considering proposals.

Flooding in estuaries may result from the combined effects of high river flows and high sea surges. When taking account of impacts of climate change in flood risk assessments covering tidal estuaries, it will be necessary for the allowances for sea level rise in table 4 and the allowances for peak flow, wave height and wind speed in table 5 to be combined.[11]

Managing residual flood risk

Residual risks are those remaining after applying the sequential approach and taking mitigating actions. It is the responsibility of those planning development to fully assess flood risk, propose measures to mitigate it and demonstrate that any residual risks can be safely managed. Flood resistance and resilience measures should not be used to justify development in inappropriate locations.

[11] Refer to Defra *FCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities – Climate Change Impacts*, October 2006. Annex A2 gives details of joint

Flood resilience and resistance

The relative benefits of resilient and resistant construction have been assessed both through risk assessment and the real time testing of model forms of construction. Resilient construction is favoured because it can be achieved more consistently and is less likely to encourage occupiers to remain in buildings that could be inundated by rapidly rising water levels.

Flood-resilient buildings are designed to reduce the consequences of flooding and facilitate recovery from the effects of flooding sooner than conventional buildings. This may be achieved through the use of water-resistant materials for floors, walls and fixtures and the siting of electrical controls, cables and appliances at a higher than normal level. The lower floors of buildings in areas at medium and high probability of flooding should be reserved for uses consistent with table 1. If the lowest floor level is raised above the predicted flood level, consideration must be given to providing access for those with restricted mobility. In considering appropriate resilience measures, it will be necessary to plan for specific circumstances and have a clear understanding of the mechanisms that lead to flooding and the nature of the flood risk by undertaking a flood risk assessment.

Flood-resistant construction can prevent entry of water or minimise the amount of water that may enter a building where there is flooding outside. This form of construction should be used with caution and accompanied by resilience measures, as effective flood exclusion may depend on occupiers ensuring some elements, such as barriers to doorways, are put in place and maintained in a good state. Buildings may also be damaged by water pressure or debris being transported by flood water. This may breach flood-excluding elements of the building and permit rapid inundation. Temporary and demountable defences are not normally appropriate for new developments.

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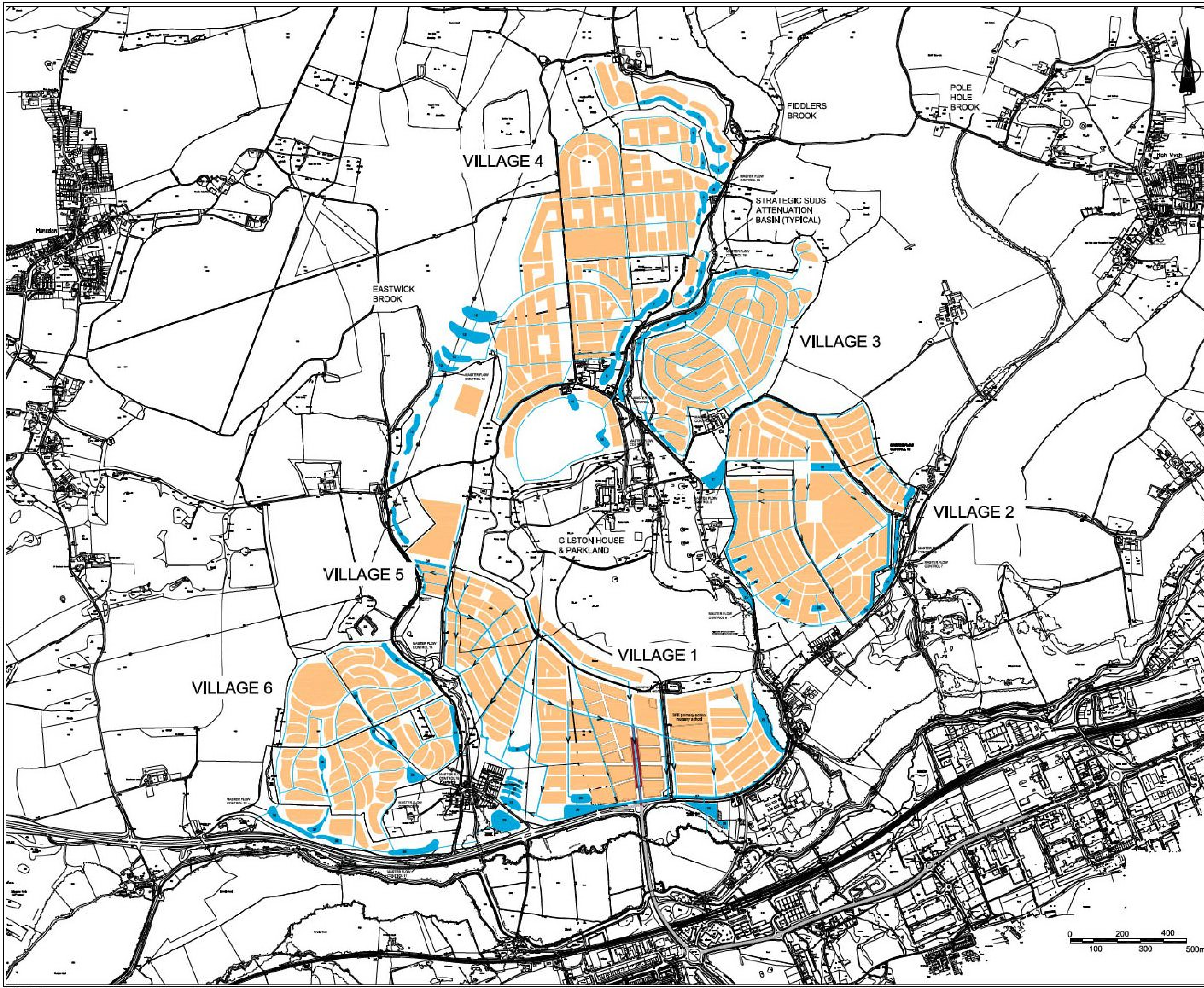
Appendix 2: Drawings



AECOM

PROJECT
Gilston Park Estate

CLIENT
Places for People

NOTES
1. STRATEGIC SuDS BASIN REFERENCE NUMBERS FROM ARCHITECT'S PARAMETER PLAN DRAWING PP-09

DRAFT

ISSUE/REVISION

I/R	DATE	DESCRIPTION
P2	Jan 2014	Update and notation
P1	June 2013	Draft

KEY PLAN

PROJECT NUMBER
60286648

SHEET TITLE
Strategic SuDS Overview

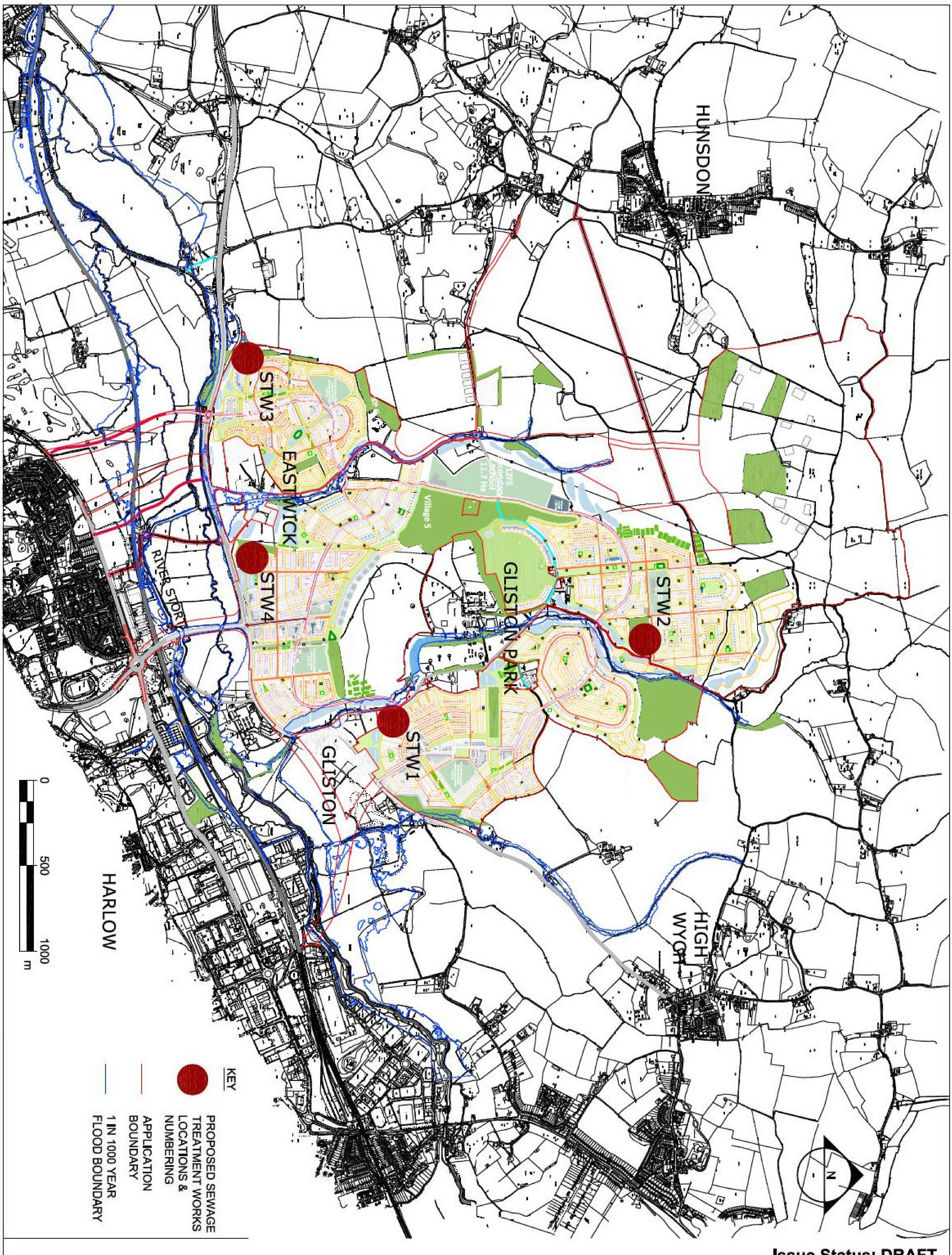
SHEET NUMBER
SK/115

Last saved by: WHISKINNRF(2014-01-10) Last Plotted: 2014-01-14
Filename: F:\PROJECTS\MUNICIPAL INFRASTRUCTURE - A NEW PLACE IN STORT VALLEY\CAD\X-REFS\012 SUDS_ALL_PH_OVERVIEW.DWG

Project Management Initials: Designer: Checked: Approved: ISO A1 594mm x 841mm

Printed on Rainforest Alliance Sustainable Forestry Paper

Project Management Initials: Designer: BDF Checked: KS Approved: KS ISO A3 297mm x 420mm



Issue Status: DRAFT

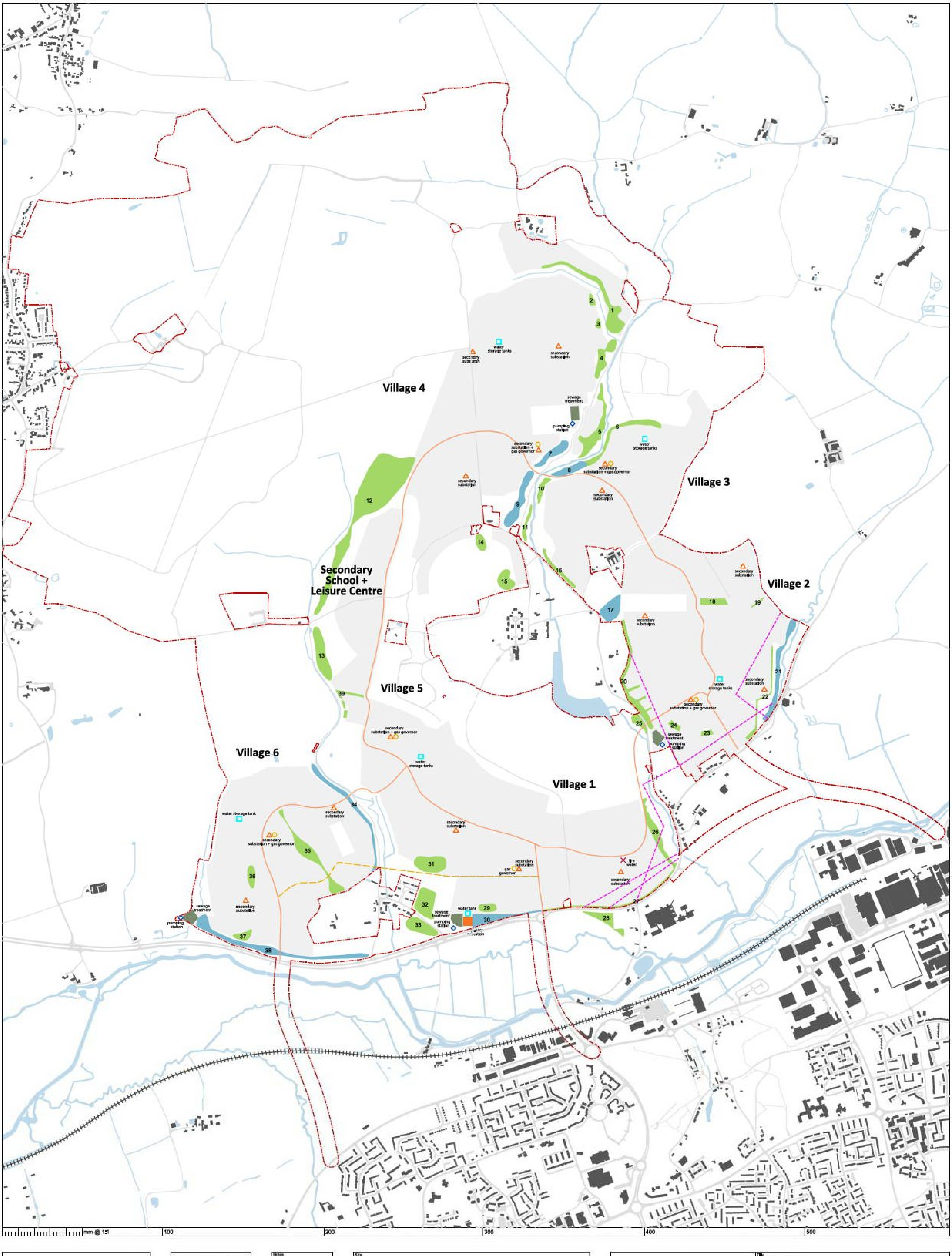
GILSTON PARK ESTATE

PLACES FOR PEOPLE
Project No.: 60286648 2013-12-19

PROPOSED_SEWAGE TREATEMENT_WORKS LOCATIONS

AECOM

60286648_SK201



GILSTON PARK ESTATE
TO THE NORTH OF HARLOW

PARAMETER PLANS

A1

N

Notes

Do not scale
All dimensions to be checked on site

Notes

Key

- Sewage Treatment
- Primary Substation
- Secondary Substation
- Water Storage Tank
- Fire water
- Pumping Station
- Gas Governor
- SUDS Wet Pond Zone
- SUDS Dry Pond Zone

Refer to schedule n,xx for retention volume of wet and dry SUDS

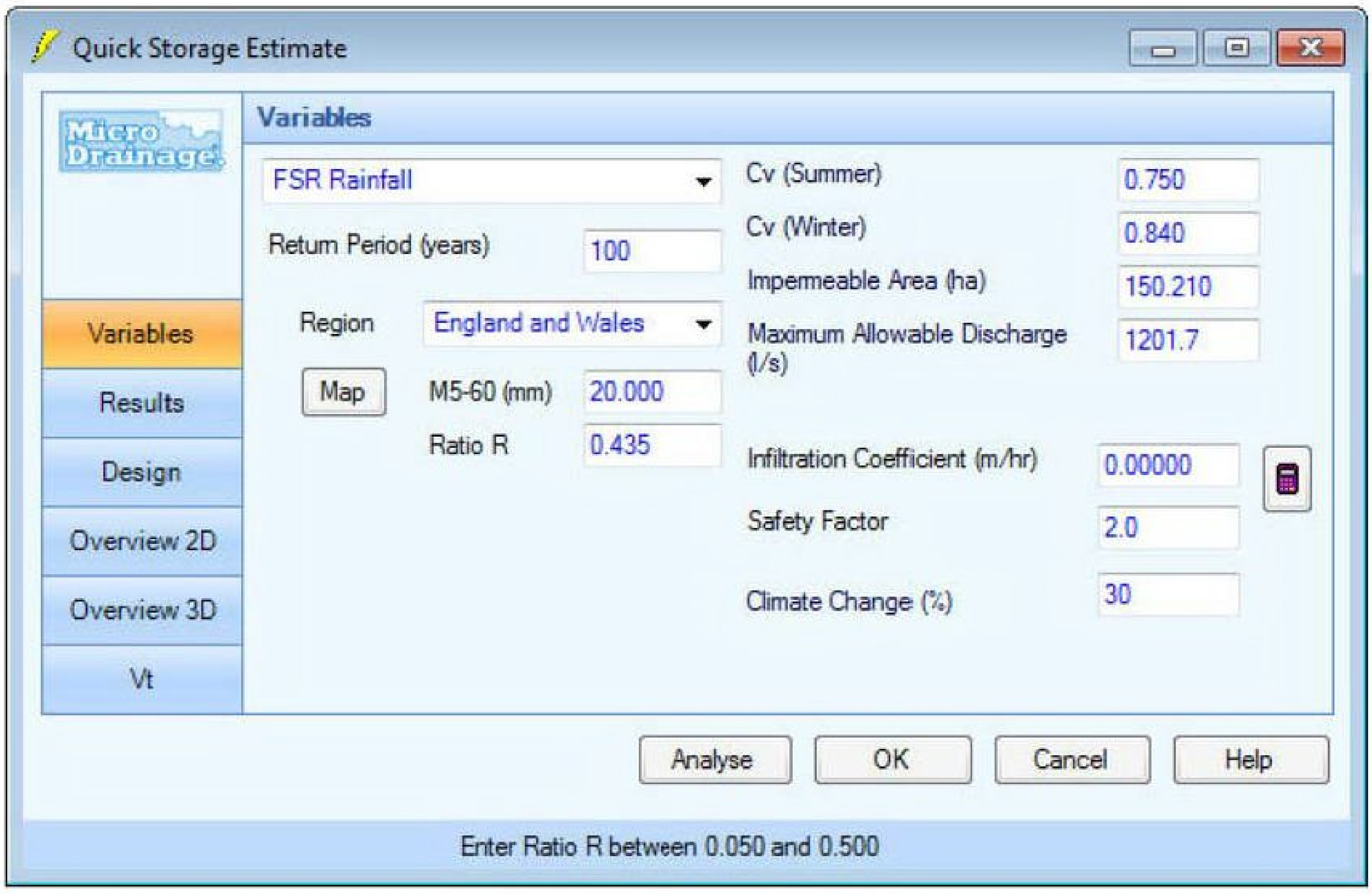
- Potential Alignment of Gas Main
- Primary Road Network
- Application Boundary
- Existing overhead cables to be re-aligned underground

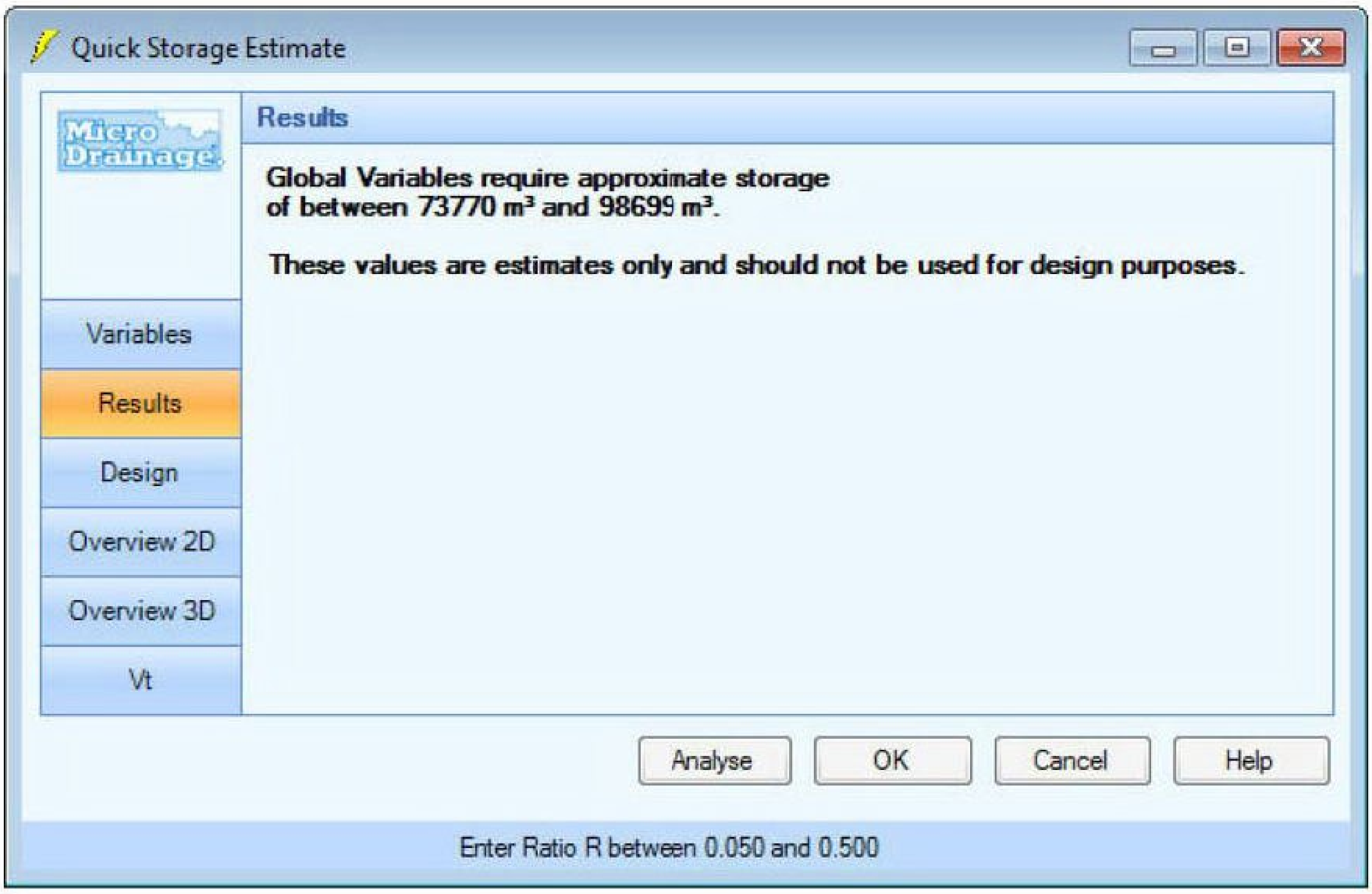
GRIMSHAW

RICK MATHER

Title		
Utility Infrastructure		
Date: 20 Dec 2013	Scale @ A1: 1:7500	
Drawn: JB	Checked: NT	Authorised: CL
Reason for Issue: FOR INFORMATION		
Status: DRAFT	Drawing No.: PP-09	Revision: 03

Appendix 3: WinDes Calculations





Indicative attenuation storage volume based on assumed total development impermeable area

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.400
Area (ha)	103.000	Urban	0.000
SAAR (mm)	600	Region Number	Region 6

Results l/s

QBAR Rural 270.2
QBAR Urban 270.2

Q100 years 862.1

Q1 year 229.7 ÷ 103 = 2.2 l/s/ha
Q30 years 612.5 ÷ 103 = 5.9 l/s/ha
Q100 years 862.1 ÷ 103 = 8.4 l/s/ha

Appendix 4: Correspondence

From: Keen, Rachel [mailto:rachel.keen@environment-agency.gov.uk]
Sent: 16 December 2008 17:05
To: Sweetnam, John C
Subject: FW: Harlow North - Sewage Treatment Works
Importance: High

Dear John

Hopefully you have now had a chat with Dan Bicknell about the Water Cycle Strategy and this will have confirmed point 1.

Point 2.
Modelling on this particular scheme has not been carried out on a Regional Level to date. A proper modelling study can take some time to complete and cannot always be turned around in just a matter of days. We would need to be given adequate information and evidence in order for us to be able to carry out this for any new development and be given fair warning to complete the work to a standard we are satisfied with.

We have carried out a very basic model to give an indication of the discharge consent limits that would be required directly in the Stort. These are not set in stone and could be subject to change if a consent is applied for and by any new direction from the Water Framework Directive (see comments below re SSSI's).

The discharge consent limits that the developer should be aiming to meet are as follows:

5mg/l BOD, 1mg/l Ammonia and 1mg/l Phosphorus.

These represent the current Best Available Technology figures for Sewage Treatment works

The Stort is a BAP Chalk Stream. Early indications from a sampling point near Burnt Mill would indicate that the current Phosphate levels are well above the current suggested levels under the Water Framework Directive limits set by UKTAG. We do not yet know what our policy will be on allowing further discharges into waterbodies that are not meeting "good" status is. It may be that we could object to them. Ideally we would recommend that some sort of catchment Phosphorus analysis should be completed.

We would like to stress that we are currently trying to reduce Phosphate in the Stort and will be carrying out ongoing investigations into how best we can achieve this.

An in-depth study into the impact of any proposed works on Hunsden Mead and Royden Mead SSSIs would be needed. Ideally these sites require inundation to bring them into favourable condition.

The Stort is partly a navigation. These sections of the river system are managed for level rather than flow. This will have implications for any discharge because of the lower velocity of flow. Discharge really needs to be into the river Stort within a stretch that is less affected by the navigation.

I hope you find these comments of use. Please contact me if you have any queries with this. I have received the next set of information from Simon and I shall send these round for comment. I am highly unlikely to return a response before Christmas, however it may be useful to have a meeting in the New Year to discuss all of the issues to date, and a likely timetable for future input,

Regards

Rachel

Major Projects Officer
Planning Liaison
01707 632406

Environment Agency
Apollo Court, 2 Bishop Square Business Park, St Albans Road West, Hatfield, Herts, AL10 9EX