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GALLAGHER ESTATES LTD

WYKHAM PARK FARM, BANBURY

Flood Risk Assessment

November 2014

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GALLAGHER ESTATES LTD

Wykham Park Farm, Banbury

Flood Risk Assessment

November 2014

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DRAWINGS

CA10769-001	Site Location
CA10769-002	Indicative Surface Water Management Plan
CA10769-003	Existing Drainage Characteristics
JJG043-035-H	Wykham Park Farm Parameter Plan
17711 OGL	Topographical Surveys (Greenhatch Group, November 2012)

2 SITE AND CATCHMENT CHARACTERISTICS

2.1 Description and Location

2.1.1 A summary of the site and its characteristics is provided in Table 2 below.

Table 2: Site Location Summary	
Site Name	Wykham Park Farm
Site Address	Wykham Lane, Banbury, Oxfordshire OX16 9ER
Site Area (ha)	52.46ha (approx.)
National Grid Reference	444818,238673 (approx. centre of site)
Existing Land Use	Agricultural
Proposed Land Use	Mixed Use Comprising Residential Dwellings, a Primary School, a Local Centre to include local retail and community uses, Outdoor Sports Facilities and Public Open Space (POS)
Local Planning Authority	Cherwell District Council
Environment Agency Area	West Thames
Sewer Undertaker	Thames Water

2.1.2 The site, approximately 52.56 hectares in size, is roughly a rectangular area of land located to the south of the centre of Banbury as shown on Drawing No. CA10769-001 'Site Location'.

2.1.3 The surrounding area is characterised by agricultural land to the east, south and west, and residential areas to the north including two schools.

2.1.4 The site is bounded by Bloxham Road (A361) to the west, agricultural fields to the south and east and the Salt Way track (public footpath and bridleway) to the north. Wykham Park Farm is located on Wykham Lane approximately 400m to the south of the site.

2.1.5 A number of residential and agricultural properties are located within the vicinity of the site including Wykham Farm, Wykham Farm Cottage, Wykham Park Farm Cottage, Wykham Park Lodge, The Great Barn, and Georges Barn. These are all identified on Figure 1 below.

- 2.1.6 The site is characterised by approximately 8 large agricultural fields separated by hedgerows. The site topographical survey (Drawing No. 17711 OGL) shows the majority of the site to fall from north-west to south-east at an average gradient of approximately 1 in 80. The highest elevation within this part of the site is approximately 132.00mAOD in the north-western corner adjacent to the Salt Way track and the lowest elevation is approximately 122.50mAOD in the south-eastern corner of the large field immediately north of Wykham Farm Cottage. The corridor of land immediately adjacent to the eastern site boundary has an average gradient of approximately 1 in 80, falling in a north to south direction, with a lowest elevation of approximately 119.5mAOD at the interface of the site boundary with Wykham Lane.
- 2.1.7 A single field in south-western corner of the site falls in a south-westerly direction away from the access track oriented north-south through the western part of the site. This field falls at an average gradient of approximately 1 in 45 from the northern corner where the highest elevation is approximately 132.80mAOD, towards the south-western corner where the lowest elevation is approximately 121.40mAOD. The fall of the land steepens in the western half of field as shown on the topographical survey (Drawing No. 17711 OGL), where the average gradient is approximately 1 in 12.
- 2.1.8 The natural drainage of the site is, therefore, split into two catchment areas, Catchment Area 1 and Catchment Area 2. Drawing No CA10769-003 shows the approximate extents of these catchment areas, and the locations of the field ditches and local watercourses identified from the site walkover inspection and OS maps.
- 2.1.9 The site can be accessed off Bloxham Road in the north-western corner via a farm track which runs in a north-south orientation through the western part of the site. The farm track continues to the south of the site and ultimately joins Wykham Lane via the farm yard to Wykham Park Farm.

2.2 Local Watercourses

- 2.2.1 The nearest named watercourse is the Sor Brook which is located approximately 850m to the south of the site at its nearest point, as shown Drawing No CA10769-001 'Site Location'.
- 2.2.2 There are no other main rivers within the vicinity of the site. A field drainage ditch is located along the southern boundary of the site running in an easterly direction. Site inspections located this ditch which was found to be heavily overgrown and dry. A

headwall was located at the downstream end of the ditch within the site. The ditch appears to continue in culvert in an easterly direction for approximately 5 metres. The topographical survey shows a second headwall within the site approximately 5 metres east of the one located during the site walkover inspection. An open ditch is shown by the contours on the topographical survey downstream of this second headwall. It appears that the culvert is, therefore relatively short in length. The approximate diameter of the single culvert pipe is 450mm (based on two brick lengths) but was found to be almost 100% blocked as shown in Photo 1 below.

- 2.2.3 Ordnance Survey (OS) maps have been inspected to determine the route of the drainage ditch downstream of the site. The OS maps show an open watercourse continuing in an easterly direction from the site boundary for approximately 160m before connecting to a small pond. The OS maps show an open watercourse running in a southerly direction from the pond towards Wykham Lane. Due to access restrictions and dense vegetation it was not possible to confirm the drainage arrangements in this area during the site walkover inspection.



Photo 1. Brick Headwall at Culvert Inlet on Southern Site Boundary (Field Drainage Ditch).

- 2.2.4 To the south of Wykham Lane, the drainage ditch is shown as a watercourse on the available OS maps, and this was confirmed during the site walkover inspection. The watercourse continues in southerly direction to a small reservoir. The outfall from the reservoir continues in a southerly direction and forms a tributary to the Sor Brook.
- 2.2.5 The drainage ditch/watercourse was located during the site walkover inspection at Wykham Lane but was found to have no flowing water. A further 100m downstream of Wykham Lane running water could be heard but was not visible due to dense vegetation. The watercourse was not accessible or visible for the remainder of its reach downstream to the reservoir. The subsequent topographical survey shows a water level of 113.60mAOD immediately to the south of Wykham Lane.

2.3 Existing Drainage

- 2.3.1 Thames Water's public sewer record plans (see Appendix 1) show two public surface water sewers within the site boundary. The first is a 375mm diameter sewer running in an easterly direction within the far north-eastern field and parallel to the northern site boundary. This sewer appears to receive flows from the residential areas immediately to the north of the site.
- 2.3.2 The second public surface water sewer within the site is a 150mm diameter sewer running in a southerly direction adjacent to the western site boundary. The sewer is shown on the record plans to enter the site from Bloxham Road and continue in a southerly direction towards Wykham Lane.
- 2.3.3 It is considered unlikely that there are any formal private drainage systems within the site due to it being agricultural land.
- 2.3.4 The natural drainage of the site is split into two catchment areas, Catchment Area 1 and Catchment Area 2 (refer to Drawing No CA10769-003).
- 2.3.5 Catchment Area 1 drains in a south-westerly direction towards drainage ditches located alongside the A361 Bloxham Road.



Photo 2. Drainage Ditch Located Alongside the A361 Bloxham Road Reproduced from The Wykham Park Farm, Banbury Drainage Impact Assessment Final Report

- 2.3.6 Catchment Area 2 drains in a south-easterly direction towards the field drainage ditch located along the southern boundary of the site that runs in an easterly direction, prior to flowing in a southerly direction towards the Sor Brook.
- 2.3.7 The site walkover inspections identified a further 2No. small ditches along the hedgerows within the site which are assumed to be field drainage ditches. The ditches

were, however, found to be shallow, overgrown and extremely dry inferring that they rarely convey or store water.



Photo 3. Field Drainage Ditch Located Along the Southern Site Boundary Running In an Easterly Direction.

2.3.8 In addition, immediate eastern areas of the site drain towards a shallow drainage ditch that runs in a southerly direction adjacent to a public footpath, before routing surface water back to the ordinary watercourse that ultimately discharges to Sor Brook.

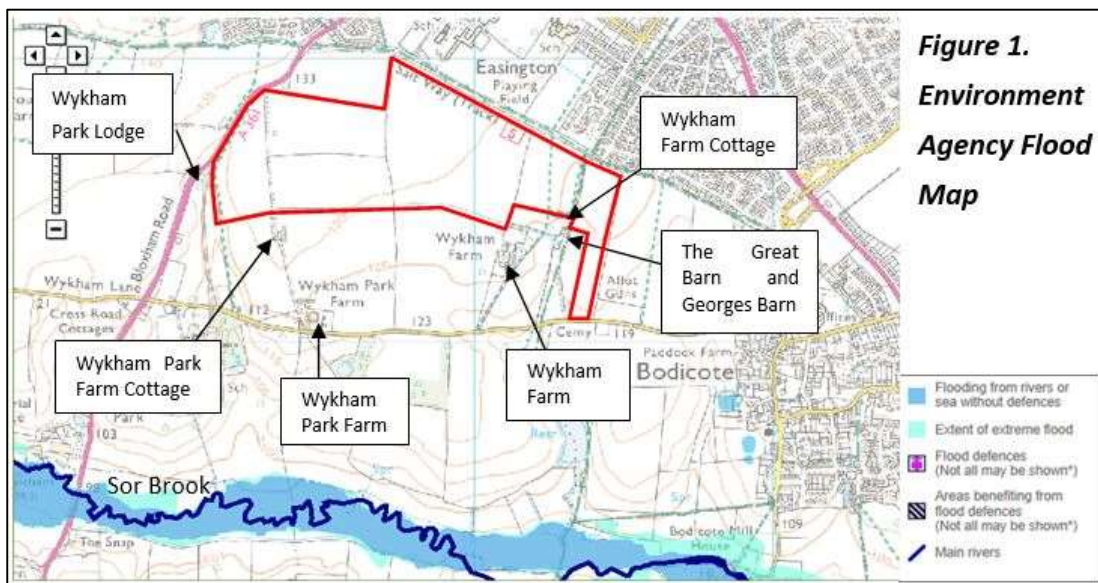
2.4 Flood Risk Setting

2.4.1 The flood map for the site shows that the development is located in an area defined as having a low risk of flooding from rivers (ie Flood Zone 1). An extract of the Environment Agency's Flood Map is shown in Figure 1 below. The annual probability of flooding is, therefore, less than 1 in 1000 years.

2.4.2 The proposed mixed use development of the site falls into a number of vulnerability classifications as defined in Table 2 of the NPPF Technical Guidance. The highest vulnerability use proposed is residential development which is classified as 'More Vulnerable' development. Table 3 of the NPPF Technical Guidance shows that 'More Vulnerable' development is appropriate in Flood Zones 1 and 2.

2.4.3 There is no requirement to apply the Sequential Test since the site is located within Flood Zone 1.

- 2.4.4 The Exception Test, as detailed in paragraph 102 of the NPPF, should be applied only after the Sequential Test has been applied and in the circumstances when 'More Vulnerable' development and 'Essential Infrastructure' cannot be located within Flood Zones 1 or 2, or 'Highly Vulnerable' development cannot be located within Flood Zone 1.
- 2.4.5 In accordance with the NPPF, since the site is located within Flood Zone 1 and the proposed use is classified as 'More Vulnerable', it is not necessary to apply the Exception Test.



3 DEVELOPMENT PROPOSALS

3.1 Description of Site Proposals

- 3.1.1 The proposals are for a mixed use development incorporating residential development, a primary school, a local centre (to include local retail and community uses), outdoor sports facilities and formal and informal public open space (POS). The Wykham Park Farm Parameter Plan indicating the proposed disposition of land uses is included as Drawing No JG043-035-H.
- 3.1.2 The development will require new infrastructure and services including foul and surface water drainage, gas, electricity, water and telecommunications across the whole site.
- 3.1.3 Under the proposals a new roundabout off Bloxham Road will be constructed as the primary site access point.
- 3.1.4 A large area of public open space incorporating allotments and sports pitches will be provided at the eastern end of the site.

3.2 Drainage Proposals

- 3.2.1 Surface water drainage will be designed to mimic the existing drainage characteristics at the site. Surface water runoff rates will be restricted to greenfield (QBAR) runoff rates.
- 3.2.2 It is proposed that surface water runoff will be managed in a sustainable manner through the use of Sustainable Drainage Systems (SuDS). The SuDS techniques utilised within the site will be dependent on ground conditions in the first instance. If possible, surface water runoff will be designed to infiltrate to ground. Should the ground conditions prove to be unsuitable for infiltration methods, surface water runoff will be discharged to nearby local watercourses at pre-development greenfield runoff rates.
- 3.2.3 Foul water flows from the development will ultimately be discharged to public sewer. Thames Water Ltd has conducted a Formal Impact Study to assess the capacity of the public sewer network and to determine suitable connection points for the proposed development. A copy of the report is included as Appendix 6.
- 3.2.4 Two potential discharge points for foul water have been identified by Thames Water, both of which are over 1 km from the site and will require reinforcement works.

- 3.2.5 With regards to Option 1, the proposed connection point is at MH SP45395501, which is located at the junction of Hightown Road and Oxford Road (A4260) approximately 825m to the north-east of the site at its nearest point.
- 3.2.6 The connection will require the construction of a new pumping station to serve the site and a rising main approximately 1km in length. The proposed route of the rising main is through the Banbury School playing fields, Springfield Road, Farmfield Road and Oxford Road.
- 3.2.7 In addition to the new rising main, Thames Water will require the existing public sewer in Hightown Road to be upsized from 300mm to 450mm for approximately 277 metres, and from 300mm to 1800mm for approximately 116 metres.
- 3.2.8 In terms of Option 2, the proposed connection point is at MH SP45402102, which is located in New Road approximately 1,200 metres to the north of the site at its nearest point.
- 3.2.9 Similarly to Option 1, this connection would require the construction of a new pumping station to serve the site and a rising main approximately 1.7km in length. The proposed route of the rising main is along Bloxham Road, Beargarden Road and New Road.
- 3.2.10 In addition to the new rising main, Thames Water will require the existing public sewer in Crouch Street, downstream of the proposed connection point, to be enlarged from 450mm to 1500mm diameter, and the installation of a Hydrobrake to provide online storage.
- 3.2.11 Both Option 1 and 2 provide an acceptable engineering solution and both would be deliverable through requisition. Option 1 would currently appear to be the preferred option, however the options will be reviewed and the solution confirmed at detailed design stages.

4 FLOOD RISK

4.1 Flood Risk to the Site

4.1.1 The main sources of flooding identified within the NPPF are rivers, tidal waters and the sea, overland runoff, groundwater, sewers and drains, and artificial sources such as canals and reservoirs.

4.1.2 The presence of a potential flooding source does not necessarily translate into a high risk of flooding. Table 3 below summarises the potential flood sources and the related flood risk posed to the site.

Flood Source	Presence at Site	Potential Risk at Site	Description
Rivers (<i>fluvial flooding</i>)	N		
Tidal	N		
Groundwater	Y	Low	High water tables in local area
Surface Water (<i>pluvial flooding</i>)	Y	Low	Developed areas to north at higher elevation
Sewers	N		
Artificial	N		

4.1.3 The risk of tidal flooding to the site is discounted due to distance from the sea.

Fluvial Flooding

4.1.4 The site is located in Flood Zone 1 (low risk) as shown on the Environment Agency's Flood Map in Appendix 2. The annual probability of flooding to the site from fluvial source is, therefore, less than 1 in 1000 years (ie < 0.01%).

4.1.5 The nearest named watercourse is the Sor Brook which is located approximately 1.5km to the south of the site. Ordnance Survey mapping shows that the approximate difference in elevation between the Sor Brook and the development site is over 30m. It is considered, therefore, that the risk of flooding to the site from this source is negligible.

4.1.6 A small, unnamed watercourse along the southern boundary of the site is shown on the OS maps. Further details regarding the characteristics of this water feature and its connectivity are provided in Section 2.2 (Local Watercourses) of this report.

- 4.1.7 Under the development proposals, surface water runoff could be discharged into this water feature should ground conditions prove to be unsuitable for infiltration methods. Consequently, remediation and restoration, and ongoing maintenance of the watercourse will be required to provide a suitable discharge location and ensure that flood risk is not increased.
- 4.1.8 It is considered, that in its current situation, the unnamed watercourse poses a low risk of flooding to the site due to it having a relatively small rural catchment area producing little, if any, surface water runoff. Notwithstanding this, the recently produced Cherwell District Council Level 2 SFRA Boundary Updates and Additional Sites Assessment (Second Addendum) recommended that the potential flood risk posed by the ordinary watercourse would need to be quantified as part of the Wykham Park Farm site-specific Flood Risk Assessment. As a result, calculations have been completed using the Centre for Ecology & Hydrology Flood Estimation Handbook (FEH) CD-ROM 3, which provides guidance on rainfall and river flood frequency estimation in the UK.
- 4.1.9 The Revitalisation of the FSR/FEH rainfall-runoff method (ReFH model) has been used to generate a site-specific design flood hydrograph for the total rainfall catchment, which includes the proposed Wykham Park Farm development. The field drainage ditch/ordinary watercourse as shown on OS Maps, running east along the southern site boundary, feeds into this tributary immediately north of Wykham Farm.
- 4.1.10 It must be noted that the catchment provided by the FEH CD-ROM 3 considers a much larger catchment area than that actually contributing to the field drainage ditch/ordinary watercourse running east along the southern site boundary, however, for the purposes of this flood risk quantification, this is considered an appropriate preliminary method of detail modelling to assess if further investigation of the field drainage ditch/ordinary watercourse will be required.
- 4.1.11 The Revitalised FSR/FEH rainfall runoff method (ReFH model) calculation (refer to Appendix 7) has indicated a peak flow to the tributary of $0.6\text{m}^3/\text{s}$ for the 1 in 100 year 6 hour 15 minute duration for both winter and summer seasons.
- 4.1.12 In addition to the calculated peak flow, an assessment of the capacity of the field drainage ditch/ordinary watercourse running east along the southern site boundary, based on dimensions interpolated from topographical data/site observations and the

Manning's Formula and the capacity of the 450mm diameter culvert, as indicated in Photo 1, have been completed.

- 4.1.13 The field drainage ditch/ordinary watercourse as shown on OS Maps, has been calculated to have a capacity of between 0.96m³/s, based on an average topographical channel gradient of 1 in 180, and a capacity of 0.58m³/s based on an indicative flat channel gradient of 1 in 500. These figures have been calculated using a conservative Manning's 'n value' of 0.100 for 'natural stream main channels with very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush'. Refer to Appendix 7 for the Manning's Formula calculation.
- 4.1.14 The existing culvert capacity has been assessed using the Hydraulics Research Wallingford Tables for the Hydraulic Design of Pipes and Sewers. The 450mm diameter culvert has been calculated to have a capacity of 0.41m³/s based on an approximate gradient of 1 in 62.8 and ks value of 0.600mm.
- 4.1.15 The preliminary quantification has indicated that the peak flow of 0.6m³/s to the tributary of the River Sor would be accommodated within the existing field drainage ditch without breaching its banks, however, this peak flow considers a catchment approximately double the actual relatively small rural catchment area contributing to the field drainage ditch. Based on the calculated capacities of the field drainage ditch and culvert it is considered unlikely that the un-modelled ordinary watercourse would pose fluvial flood risk to the site.
- 4.1.16 The risk of flooding to the site from fluvial sources is, therefore, considered to be negligible.

Groundwater Flooding

- 4.1.17 Flooding can occur when prolonged rainfall causes the groundwater table to rise to the point where it affects development on a site. This is particularly a problem where buildings have basements.
- 4.1.18 The Strategic Flood Risk Assessment (SFRA) for Cherwell DC and the Oxfordshire CC Preliminary Flood Risk Assessment (PFRA) state that the superficial geology across the Councils area is predominantly clay which results in flashy runoff characteristics. In addition, the two assessments state that these are locations within the local area that are affected by high water tables and are susceptible to seasonal, spring-fed activity.

The settlements most at risk are those that lie at the base of steep sided valleys, such as Bodicote which is located to the south-east of the site.

4.1.19 The site is not located at the base of a steep sided valley and, therefore, is unlikely to be at a high risk of groundwater flooding. The 'Areas Susceptible to Groundwater Flooding' map contained within the Oxfordshire PFRA and Cherwell District Council Level 2 SFRA, shows the percentage risk of groundwater emergence at the site as being 0 – 25%.

4.1.20 The risk of groundwater flooding to the site is, therefore, considered to be low.

Surface Water Flooding (Pluvial Flooding)

4.1.21 Pluvial flooding often occurs during intense rainfall, when water is unable to soak into the ground or enter drainage systems, and runs quickly overland resulting in local flooding.

4.1.22 The main source that could pose a risk of surface water flooding to the site is the residential area to the north which sits at a higher elevation than the site. It is understood that the developed areas to the north of the site are served by a formal, piped, drainage system which would convey surface water runoff away from the site in the first instance.

4.1.23 In the event that the formal drainage system fails or becomes overwhelmed, it is considered likely that surface water runoff would be intercepted by existing open space including the large playing fields associated with the secondary school located to the north of the Salt Way track.

4.1.24 Two drainage ditches run alongside the Salt Way track, which forms the northern boundary of the site. It is considered that any surface water runoff that does not enter the formal drainage systems and is not intercepted by the playing fields, would be intercepted by these two drainage ditches and not reach the site.

4.1.25 The Cherwell DC Strategic Flood Risk Assessment lists a number of sites and settlements that may be at risk of surface water flooding due to their location on low-lying, impervious ground. The proposed development site is not included on the list.

4.1.26 The Environment Agency (EA) has recently undertaken further modelling of surface water flood risk at a national scale (October 2013) producing maps referred to as the updated Flood Map for Surface Water (uFMfSW) identifying areas at risk during three annual exceedance probability (AEP) events:

- 1 in 30 year ($\geq 3.33\%$ AEP) - High Risk,
- 1 in 100 year ($\geq 1\%$ AEP) - Medium Risk, and
- 1 in 1000 year ($\geq 0.1\%$ AEP) - Low Risk.



4.1.27 The Environment Agency Risk of Flooding from Surface Water Map provides a visualisation of the potential for surface water flooding when rainwater does not drain away through piped drainage systems or soakaway into the ground, but lies on, or flows over the ground instead and collects due to its natural topography. The Flooding from Surface Water Map identifies a small area to the west of the site and a further two narrow areas at low risk ($\geq 0.1\%$ AEP) of flooding around the centre and eastern areas of the site, flowing in a southerly direction. A small area at medium risk ($\geq 1\%$ AEP) is also identified towards the western edge of the site adjacent to the A361 Bloxham Road.

- 4.1.28 The EA's Surface Water Flood Hazard Mapping presented in the Level 2 SFRA indicates that 'caution' should be taken across the vast majority of the site, although, a small area in the north-west corner alongside the A361 is considered to pose a 'danger to most' in terms of flood hazard to people.
- 4.1.29 It is considered that due to the designation of caution for the majority of the site in terms of higher elevated topography and the proposed installation of drainage systems that will manage surface water runoff, the risk of flooding from this source to people at the site and adjacent areas will be low. Proposed development located in the north-west corner of the site within the area designated as 'danger to most' will comprise of informal public open space and, therefore, the existing drainage regime for this part of the site will continue to function as the present situation.
- 4.1.30 The risk of pluvial flooding to the site is, therefore, considered to be low.

Flooding from Sewers and Drains

- 4.1.31 Flooding could theoretically occur from localised, high intensity storms of relatively short duration that might exceed the capacity of the local drainage network. The only potential source of flooding of this type is the 375mm public surface water sewer located in the north-western corner of the site (see Section 2.3 for further details).
- 4.1.32 It is assumed that the public sewer will be incorporated into the development with an appropriate easement and may or may not be diverted. It is considered that should the capacity of the sewer be exceeded, flood water will be routed away from any proposed buildings by careful design of road layouts and site levels.
- 4.1.33 The Cherwell DC Strategic Flood Risk Assessment makes reference to the Thames Water DG5 Flooding Register which is a database of flooding incidents from sewers, by postcode area (5-digit). The register does not indicate the level of risk of flooding from sewers but does highlight those areas which are more prone to such incidents. The dataset for the postcode area (OX16 9--) covering the proposed development site shows that there has been a low incidence of reported flooding from sewers in the last 10 years (ie 1 – 2 reported incidents).
- 4.1.34 The risk of flooding to the site from this source is, therefore, considered to be low.

Flooding from Artificial Sources

4.1.35 There are no artificial sources such as canals or reservoirs, within the vicinity of the site that could pose a risk of flooding to the proposed development. The risk of flooding from artificial sources is, therefore, considered to be negligible.

Historical Flooding

4.1.36 The Strategic Flood Risk Assessment (SFRA) for Cherwell DC makes reference to a number of historical flooding incidents. There have been numerous flood events in Banbury but these have been primarily along the River Cherwell corridor. There is no reference in the SFRA to any historical flooding incidents along the Sor Brook.

4.1.37 It is considered, therefore, that the proposed development site has not been affected by any historical flood events.

Safe Access

4.1.38 The Flood Risk Assessment Guidance for New Development Phase 2 Framework and Guidance for Assessing and Managing Flood Risk for New Development R&D Technical Report FD2320/TR2 (2006) produced by DEFRA/EA describes that safe access and egress is required to enable the evacuation of people from a development, provide the emergency services with access to the development during a flood and enable flood defence authorities to carry out any necessary duties during the period of flood.

4.1.39 The requirements for safe access and egress from new developments in flood risk areas are listed in the report, in a decreasing order of preference as:

- safe dry route for people and vehicles;
- safe dry route for people;
- if a dry route for people is not possible, a route for people where the flood hazard (in terms of depth and velocity of flooding) is low and should not cause a risk to people;
- if a dry route for vehicles is not possible, a route for vehicles where the flood hazard (in terms of depth and velocity of flooding) is low to permit access for emergency vehicles.

- 4.1.40 Access and egress will be important to the overall safety of the development and will include the provision of free pedestrian movement to areas/ground levels located above any design flood event.
- 4.1.41 The EA's Surface Water Flood Hazard Mapping presented in the Level 2 SFRA indicates that 'caution' should be taken across the vast majority of the site and, therefore, the degree of flood hazard to people for site access and egress is considered low. The small area to the north-west corner alongside the A361 indicated to pose a 'danger to most' in terms of flood hazard to people, will comprise of informal public open space and will not impede the movement of pedestrians or emergency vehicles in providing dry access to and egress from the site.
- 4.1.42 The provision for safe dry site access and egress is, therefore, considered to be high.

4.2 **Flood Risk posed by the Development**

- 4.2.1 New development can pose a risk of flooding to neighbouring properties and areas downstream of the site, as a result of an increase in impermeable area which has the effect of increasing the rate and volume of surface water runoff.
- 4.2.2 Flood risk can also be increased as a result of new development if the development reduces the floodplain storage area or alters flood flow paths, ultimately displacing flood water and resulting in an increased risk to the surrounding area.

Floodplain Storage and Flood Flow Paths

- 4.2.3 Since the site is located within Flood Zone 1 there will be no effect on flood flow routes or floodplain storage (ie floodwater will not be displaced from the site).

Surface Water Runoff

- 4.2.4 The development site is currently a greenfield site with no hard surfacing. The development will result in an increase in the impermeable area of the site which could result in increased surface water runoff rates and volumes. The risk of flooding to areas downstream of the development site could, therefore, increase as a result of the development.

- 4.2.5 Mitigation measures to ensure that flood risk is not increased will be required. This will include surface water management to restrict runoff rates from the development to pre-development rates. Any flows in excess of this will be attenuated on site for events up to and including the 1 in 100 year event, including an allowance for climate change.
- 4.2.6 Surface water management measures for flood risk mitigation are included in Section 4.3 of this report.

4.3 **Flood Risk Mitigation Measures**

- 4.3.1 The level of flood risk posed to the site from rivers, the sea, groundwater, sewers, surface water runoff and artificial sources has been assessed as low. Flood risk mitigation measures for these sources of flooding are, therefore, not necessary.
- 4.3.2 The risk of flooding to areas downstream of the site, as a result of the unmitigated development, has been assessed as high and, therefore, mitigation measures are required. The main source of flooding is increased surface water runoff resulting from an increase in the impermeable area of the site.

Surface Water Management

- 4.3.3 It is proposed that surface water runoff from the development is discharged to ground using infiltration based Sustainable Drainage (SuDS) methods. This is subject to suitable ground conditions, which will be confirmed at the detailed design stage. Should the ground conditions prove to be unsuitable for infiltrating surface water to ground, surface water will be discharged to nearby local watercourses at a rate equivalent to pre-development runoff rates and public sewers at a rate to be agreed with Thames Water Ltd. A combination of infiltration SuDS and attenuation may prove to be feasible.
- 4.3.4 It will be necessary to discharge surface water runoff from proposed highway infrastructure to be located in the immediate western areas of the site to the existing drainage ditches located alongside the A361 Bloxham Road at greenfield rates, or to the adjacent public surface water sewer due to the difference in ground levels

between this part of the site and the proposed surface water outfall to the watercourse (see Drawing No CA10769-003).

- 4.3.5 The existing public surface water sewer adjacent to the western site boundary is currently 150mm diameter and may require upsizing to serve the proposed highway infrastructure, however, this is considered unlikely as the nominal surface water generated may be comfortably attenuated within proposed strategic landscaping if required, to ensure that the sewer capacity is not exceeded.
- 4.3.6 With regards to the site area that will discharge to local watercourses (approximately 30 hectares), the pre-development Greenfield runoff rate (QBAR) has been assessed following the IH124 method. The estimated QBAR rate is 4.65 litres/second, which is equivalent to approximately 0.15 litres/second/hectare. This rate is considered to be low, due to the soil value (Wallingford WRAP maps) being approximately 0.15, indicating a relatively permeable site.
- 4.3.7 Following best practice guidance for 'permeable' sites, it is proposed to restrict surface water runoff rates to the minimum recommended rate of 2 litres/second/hectare, equivalent to a total runoff rate of 60 litres/second for the development site (see Appendix 5).
- 4.3.8 The Environment Agency was consulted in October 2012 with regards to the proposed discharge rate of 2 litres/second/hectare. Following a number of telephone conversations regarding the surface water discharge rate, the Environment Agency agreed in their letter on 9 May 2013 (see Appendix 3) that the proposed 2 litres/second/hectare rate is acceptable. There should be no change from the proposed greenfield runoff of 2 litres/second/hectare, which has been accepted by the EA in their correspondence, even if there is a slight increase or decrease of impermeable areas.
- 4.3.9 Any flows in excess of 60 litres/second will be attenuated on site for events up to and including the 1 in 100 year event including an allowance for climate change. Preliminary calculations of the attenuation volume that would be required have been estimated at 13,610 m³ (ie approximately 455m³ per hectare of development (assuming 30ha of development)) for the 1 in 100 year event including a 20% allowance for climate change (see Appendix 5). The allowance for climate change will be variable across the site, dependent on land use. Climate change allowance for residential use will be 30%, and all other uses will have a 20% allowance for climate change included.

- 4.3.10 In addition, an assessment of volumetric runoff has been carried out to quantify the additional volume of runoff that will be caused by the development, compared to the existing pre-development runoff. The difference between the pre and post development volumetric runoff for the site has been calculated as 15,533 m³ (ie approximately 518 m³ long term storage per hectare of development (assuming 30ha of development)) based on a 1 in 100 year 6 hour storm duration including an appropriate allowance for climate change and assuming 80% runoff from impermeable surfaces with no runoff from the permeable surfaces at post-development stage (see Appendix 5).
- 4.3.11 Proposed road infrastructure in the western part of the site will discharge to either existing drainage ditches located alongside the A361 Bloxham Road at greenfield rates, or to the public surface water sewer adjacent to the western site boundary. It is estimated that approximately 523m³ of attenuation storage, based on a rate of 2 litres/second/hectare and a 20% allowance for climate change, will be required for highway infrastructure in this area of the site.
- 4.3.12 It is proposed that surface water runoff is managed in a sustainable manner through the use of Sustainable Drainage Systems (SuDS). SuDS provide a range of benefits, including flood risk management, in comparison to conventional piped drainage systems. In particular, SuDS can reduce the rate and volume of surface water runoff. There is a wide range of SuDS techniques available, some of which could be utilised within the development site to provide Source Control, attenuation, conveyance routes and water quality treatment. A suitable SuDS management train, with an appropriate number of treatment stages, will be incorporated into the development to achieve both water quantity (volume and rate) and water quality objectives. The choice of SuDS techniques will be determined at the detailed design stage but could potentially include permeable paving, swales, ponds, and detention basins as described in Section 4.4 below.

Surface Water Pathways

- 4.3.13 The soils will incorporate drainage where appropriate to ensure that an adequate playing surface on the sports pitches is provided. It is considered that surface water runoff rates will be unaltered since there is unlikely to be any change in the permeability of the land.

4.3.14 To ensure that surface water does not run off site and cause flooding to neighbouring properties as a result of any land raising that may be required, mitigation measures such as cut-off ditches to intercept runoff will be incorporated within the POS. The characteristics of the mitigation measures will be considered further at the detailed design stage.

4.4 **Outline Surface Water Drainage Strategy**

General

4.4.1 An Indicative Surface Water Management Plan is included as Drawing No CA10769-002 to demonstrate potential SuDS options and the space required within the development to incorporate them (this is based on the assumption of no infiltration). The choice of SuDS techniques will be determined at the detailed design stage. Options for SuDS within the different areas of the proposed development are outlined below. It is proposed that all areas of the development are ultimately linked with a variety of conveyance features along the main spine roads, to a single SuDS feature prior to discharge to local watercourses.

4.4.2 Source control and attenuation are key factors in managing surface water runoff sustainably. It is proposed, therefore, that as far as practicable, surface water runoff is managed following a sub-catchment approach ie individual land parcels incorporating the necessary attenuation volumes for that area, with a pro-rata discharge rate.

4.4.3 The additional benefits provided by SuDS features, other than surface water management and water quality, will be further considered at the detailed design stage to ensure that they are enhanced as much as possible. This will include, for example, consideration of the benefits to wildlife which may require the inclusion of buffer zones around ponds and wetlands, and consideration of the type of planting.

Residential Land

4.4.4 SuDS options for the residential areas include, but are not limited to the following:

- permeable paving
- pervious surfaces;
- impervious surfaces with stone-blankets;
- filter drains;

- ponds and wetlands
- detention basins.

4.4.5 Any one, or combination of the above features could be incorporated into the residential development land. Use of permeable paving, pervious surfacing and/or stone blankets has the added benefit of not requiring any additional land take (ie attenuation can be provided beneath roads, driveways and parking areas).

4.4.6 Ponds, wetlands and detention basins require more land take. The Development Framework Plan shows two proposed detention basins within the POS at the eastern part of the site. Incorporating features such as ponds into POS creates a multi-functional space, providing enhanced amenity and biodiversity benefit.

Education Land

4.4.7 The proposed new school provides opportunities for incorporating similar SuDS features to the residential land. Any SuDS incorporated into the new school development could be designed with the additional educational benefit in mind, and therefore may include more visible features such as ponds and swales.

4.4.8 The large playing fields associated with the proposed new school could be designed to act as a temporary attenuation area for extreme rainfall events, therefore acting as a multi-functional space.

Local Centre

4.4.9 The drainage may be planned with that of adjoining residential areas.

Main Spine Roads

4.4.10 Drawing No CA10769-002 shows some of the proposed main spine roads within the development. It is proposed that SuDS features are provided including to act primarily as conveyance features.

4.4.11 Surface water runoff from the spine roads could be attenuated within the roads by incorporating stone blankets in the road construction, and providing inlets in the form of beany block kerbs, for example.

4.4.12 Alternatively, the road surfacing could be designed as either permeable (eg block paving) or pervious (eg porous asphalt) with attenuation provided beneath.

4.4.13 Attenuation also is also anticipated to be provided in a pond, wetland or detention area alongside the main spine or at the downstream end of the system.

Outfall Arrangements

4.4.14 It is proposed that an open SuDS feature such as a pond, wetland or detention basin, or a combination of these is provided at the downstream end of the main surface water drainage system. This provides a site control feature for managing surface water runoff and a temporary storage area for flows that exceed the design capacity of the system.

4.4.15 In addition, the open SuDS feature will also provide a final stage of treatment to ensure that water quality standards are met.

4.4.16 The outlet from the pond and/or detention basin will be designed as an open feature such as a channel where appropriate to do so, to enhance ecological value. The existing culvert within the site could be replaced with an open feature subject to confirmation of the location of existing utilities and services easements.

4.4.17 There are a number of surface water outfall locations available for the development. The locations of these options are shown on Drawing No CA10769-002. Option 1 is to discharge to the open ditch course in the south-eastern corner of the large central field. This ditch continues in an easterly direction and is understood to discharge to a pond, as shown on available OS maps (see Section 2.2 for further details). In Option 2, surface water could be directed southwards from the open SuDS feature towards Wykham Lane, through land under the control of Gallagher Estates, and ultimately discharge to the ordinary watercourse to the south of Wykham Lane. The characteristics of this feature will be determined at the detailed design stage and may be in the form of an open ditch course, swale or underground pipe. Requirements for service easements will be determined and accounted for in the design.

4.4.18 Option 3 provides a surface water outfall from the public open space in the eastern part of the site and ultimately discharges to the ordinary watercourse south of Wykham Lane as per Option 2. As with option 2, the characteristics of this feature will be determined at the detailed design stage and may be in the form of an open ditch course, swale or underground pipe. Requirements for service easements will be determined and accounted for in the design. The outfall would be located within land under the control of Gallagher Estates.

4.4.19 The south-western corner of the site lies at a lower elevation and falls towards the west ie away from the drainage ditch along the southern boundary. It is proposed that surface water runoff from this area of the site (highway infrastructure) is discharged to the west to either existing drainage ditches located alongside the A361 Bloxham Road at greenfield rates, or to the existing public surface water sewer, see Drawing No CA10769-002. This sewer may need to be enlarged over a length of approximately 1750m. The exact dimension for the enlarged pipe can be agreed with Thames Water at the detailed design stage.

4.4.20 The exact nature of the surface water outfall location will be decided at the detailed design stage.

4.5 **Residual Risk**

4.5.1 There is always a possibility of a storm event that exceeds the design standards of the proposed flood risk management measures for new developments. Potential risks include exceedance of on-site sewer systems during storm events with an annual probability of occurrence greater than 1 in 30 years and, exceedance of surface water drainage features, including SuDS, during storm events with an annual probability of occurrence greater than 1 in 100 years (including an allowance for climate change).

4.5.2 Additionally, for sites with open watercourses and culverts there is a residual risk of flooding should the culvert or channel become blocked, preventing surface water from discharging from the site and resulting in flows coming out of channel. There are, however, no open watercourses or culverts within the site that could act as a source of flooding.

4.5.3 The design capacity of the surface water drainage system for the development is the 1 in 100 year event, including an allowance for climate change, this includes conveyance and storage features. For storm events with an annual probability of occurrence greater than this, the on-site drainage system may be exceeded. It is considered, however, that the probability of this is extremely low and, therefore, the residual risk is negligible.

4.5.4 Should the design capacity of the drainage system become exceeded, overland flood flows will be directed to safe areas away from buildings and temporarily stored, for example with school playing fields and other areas of POS. This will be achieved by careful design of the roads so that they act as secondary conveyance routes. In addition, overland flow routing will be achieved by careful design of the surface water drainage system to ensure that in the first instance, the risk of blockage is minimised, and secondly to ensure there is connectivity throughout the site that allows water to flow to safe areas of storage.

5 CONCLUSIONS

- 5.1.1 This report gives details of the Flood Risk Assessment, which has been carried out in relation to the proposed site in accordance with the National Planning Policy Framework 2012 (NPPF).
- 5.1.2 The site is located within Flood Zone 1 according to the Environment Agency's current Flood Map.
- 5.1.3 The proposals are for a mixed use development incorporating strategic residential units, a primary school, a local centre (community/retail uses) and formal and informal public open space. Residential use is classified as 'More Vulnerable' development in Table 2 of the NPPF Technical Guidance, which is an appropriate development type within Flood Zone 1. There are no local site-specific risks that would adversely affect this categorisation
- 5.1.4 The site has been assessed as being at a low or negligible risk of flooding from fluvial sources, groundwater, sewers, artificial sources and surface water runoff.
- 5.1.5 The risk of flooding posed by the development, from increased surface water runoff, is considered to be high without the recommended flood risk mitigation measures, which primarily include sustainable surface water management to restrict discharge rates from the site. With the recommended mitigation measures in place, the risk of flooding posed by the development is considered to be low.
- 5.1.6 Surface water runoff will either be discharged to ground by infiltration SuDS, or restricted to a minimum rate of 2 litres/second/hectare and discharged to nearby local watercourses or public sewer. Flows in excess of this will be attenuated on site for events up to and including the 1 in 100 year event including an appropriate allowance for climate change.
- 5.1.7 Attenuation will be provided throughout the site in a range of SuDS features, designed as part of a suitable SuDS management train. The choice of SuDS features will be determined at the detailed design stage and following an assessment of the ground conditions to determine the feasibility of infiltration methods.
- 5.1.8 Foul water flows from the proposed development will be discharged to the public sewer network in accordance with one of the options set out in Thames Water's Sewer Impact Study. This is subject to detailed assessment and design.

5.1.9 The site meets the requirements of the NPPF and the accompanying Technical Guidance that seek to require flood risk to be taken into consideration at all stages of the planning process in order to avoid inappropriate development in areas at medium-high risk of flooding, and is therefore considered suitable for the type of development proposed.

APPENDICES

APPENDIX 1

Thames Water Public Sewer Records

Asset Location Search

Emma Skelley
Wardell Armstrong LLP
Sir Henry Doulton House
Forge Lane
STOKE ON TRENT
ST1 5BD

Search address supplied 445267 238350
Wykham Park Farm
Wykham
Banbury
Oxfordshire
OX16 9ER

Your reference N/A

Our reference ALS/ALS Standard/2012_2299859

Search date 22 August 2012

You are now able to order your Asset Location Search requests online by visiting

www.thameswater-propertysearches.co.uk

Thames Water Utilities Ltd

Property Searches
PO Box 3189
Slough SL1 4WW

DX 151280 Slough 13

T 0118 925 1504
F 0118 923 6655/57
E searches@thameswater.co.uk
I www.thameswater-propertysearches.co.uk

Registered in England and Wales
No. 2366661, Registered office
Clearwater Court, Vastern Road
Reading RG1 8DB

Asset Location Search



Search address supplied: 445267 238350, Wykham Park Farm, Wykham,
Banbury, Oxfordshire, OX16 9ER

Dear Sir / Madam

An Asset Location Search is recommended when undertaking a site development. It is essential to obtain information on the size and location of clean water and sewerage assets to safeguard against expensive damage and allow cost-effective service design.

This search provides maps showing the position, size of Thames Water assets close to the proposed development and also manhole cover and invert levels, where available.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information. The replies contained in this letter are given following inspection of the public service records available to this company. No responsibility can be accepted for any error or omission in the replies.

You should be aware that the information contained on these plans is current only on the day that the plans are issued. The plans should only be used for the duration of the work that is being carried out at the present time. Under no circumstances should this data be copied or transmitted to parties other than those for whom the current work is being carried out.

Thames Water do update these service plans on a regular basis and failure to observe the above conditions could lead to damage arising to new or diverted services at a later date.

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0118 925 1504, or use the address below:

Thames Water Utilities Ltd
Property Searches
PO Box 3189
Slough
SL1 4WW

Tel: 0118 925 1504
Fax: 0118 923 6657

Email: searches@thameswater.co.uk
Web: www.thameswater-propertysearches.co.uk

Thames Water Utilities Ltd

Property Searches
PO Box 3189
Slough SL1 4WW

DX 151280 Slough 13

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E searches@thameswater.co.uk
I www.thameswater-propertysearches.co.uk

Registered in England and Wales
No. 2366661. Registered office
Clearwater Court, Vastern Road
Reading RG1 8DB

Asset Location Search



Waste Water Services

Please provide a copy extract from the public sewer map.

The following quartiles have been printed as they fall within Thames' sewerage area:

SP4438SW
SP4438NW
SP4438SE
SP4438NE
SP4439SE
SP4538SW
SP4538NW

Enclosed is a map showing the approximate lines of our sewers. Our plans do not show sewer connections from individual properties or any sewers not owned by Thames Water unless specifically annotated otherwise. Records such as "private" pipework are in some cases available from the Building Control Department of the relevant Local Authority.

Where the Local Authority does not hold such plans it might be advisable to consult the property deeds for the site or contact neighbouring landowners.

This report relates only to sewerage apparatus of Thames Water Utilities Ltd, it does not disclose details of cables and or communications equipment that may be running through or around such apparatus.

The sewer level information contained in this response represents all of the level data available in our existing records. Should you require any further Information, please refer to the relevant section within the 'Further Contacts' page found later in this document.

For your guidance:

- The Company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an 'as constructed' record. It is recommended these details be checked with the developer.

Clean Water Services

Please provide a copy extract from the public water main map.

Thames Water Utilities Ltd

Property Searches
PO Box 3189
Slough SL1 4WW

DX 151280 Slough 13

T 0118 925 1504
F 0118 923 6655/57
E searches@thameswater.co.uk
I www.thameswater-propertysearches.co.uk

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No: 2366661. Registered office
Cleanwater Court, Vastern Road
Reading RG1 8DB

Asset Location Search



The following quartiles have been printed as they fall within Thames' water area:

SP4438SW
SP4438NW
SP4438SE
SP4438NE
SP4439SE
SP4538SW
SP4538NW

Enclosed is a map showing the approximate positions of our water mains and associated apparatus. Please note that records are not kept of the positions of individual domestic supplies.

For your information, there will be a pressure of at least 10m head at the outside stop valve. If you would like to know the static pressure, please contact our Customer Centre on 0845 920 0800. The Customer Centre can also arrange for a full flow and pressure test to be carried out for a fee.

For your guidance:

- Assets other than vested water mains may be shown on the plan, for information only.
- If an extract of the public water main record is enclosed, this will show known public water mains in the vicinity of the property. It should be possible to estimate the likely length and route of any private water supply pipe connecting the property to the public water network.

Payment for this Search

An invoice is enclosed. Please send remittance to Thames Water Utilities Ltd., PO Box 223, Swindon, SN38 2TW.

Thames Water Utilities Ltd

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PO Box 3189
Slough SL1 4WW

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Reading RG1 8DB

Asset Location Search



Further contacts:

Waste Water queries

Should you require verification of the invert levels of public sewers, by site measurement, you will need to approach the relevant Thames Water Area Network Office for permission to lift the appropriate covers. This permission will usually involve you completing a TWOSA form. For further information please contact our Customer Centre on Tel: 0845 920 0800. Alternatively, a survey can be arranged, for a fee, through our Customer Centre on the above number.

If you have any questions regarding sewer connections, building over issues or any other questions regarding operational issues please direct them to our service desk. Which can be contacted by writing to:

Developer Services (Waste Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0845 850 2777
Fax: 0118 923 6613
Email: developer.services@thameswater.co.uk

Should you require any further information regarding budget estimates, diversions or stopping up notices then please contact:

DevCon Team
Asset Investment
Thames Water
Maple Lodge STW
Denham Way
Rickmansworth
Hertfordshire
WD3 9SQ

Tel: 01923 898 072
Fax: 01923 898 106
Email: devcon.team@thameswater.co.uk

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PO Box 3189
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I www.thameswater-propertysearches.co.uk

Registered in England and Wales
No. 2366661. Registered office
Clearwater Court, Vastern Road
Reading RG1 8DB

Asset Location Search



Clean Water queries

Should you require any advice concerning clean water operational issues or clean water connections, please contact:

Developer Services (Clean Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0845 850 2777
Fax: 0208 213 8833
Email: developer.services@thameswater.co.uk

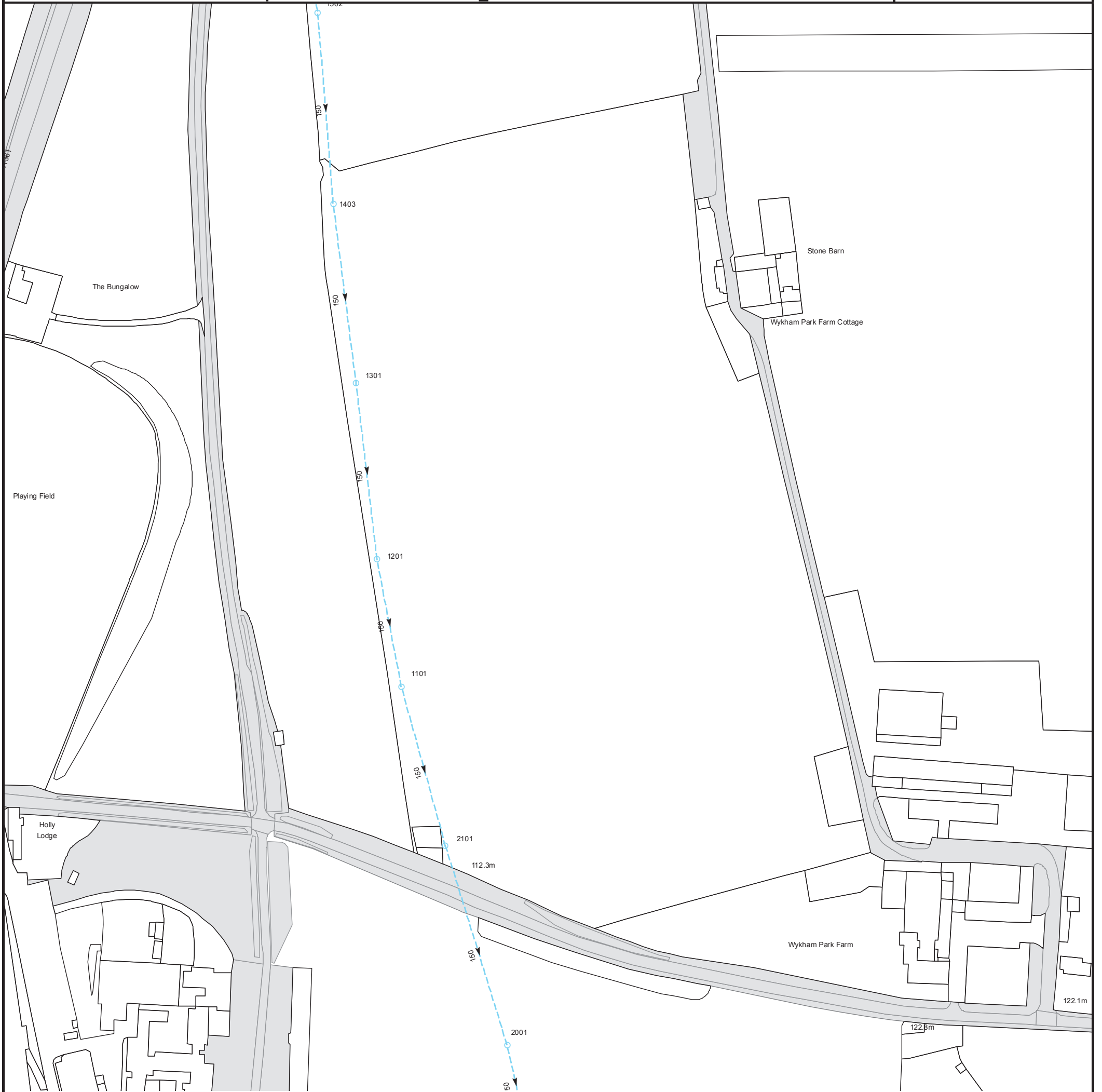
Thames Water Utilities Ltd

Property Searches
PO Box 3189
Slough SL1 4WW

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Clearwater Court, Vastern Road
Reading RG1 8DB



The width of the displayed area is 500m and the centre of the map is located at OS coordinates 444250,238250

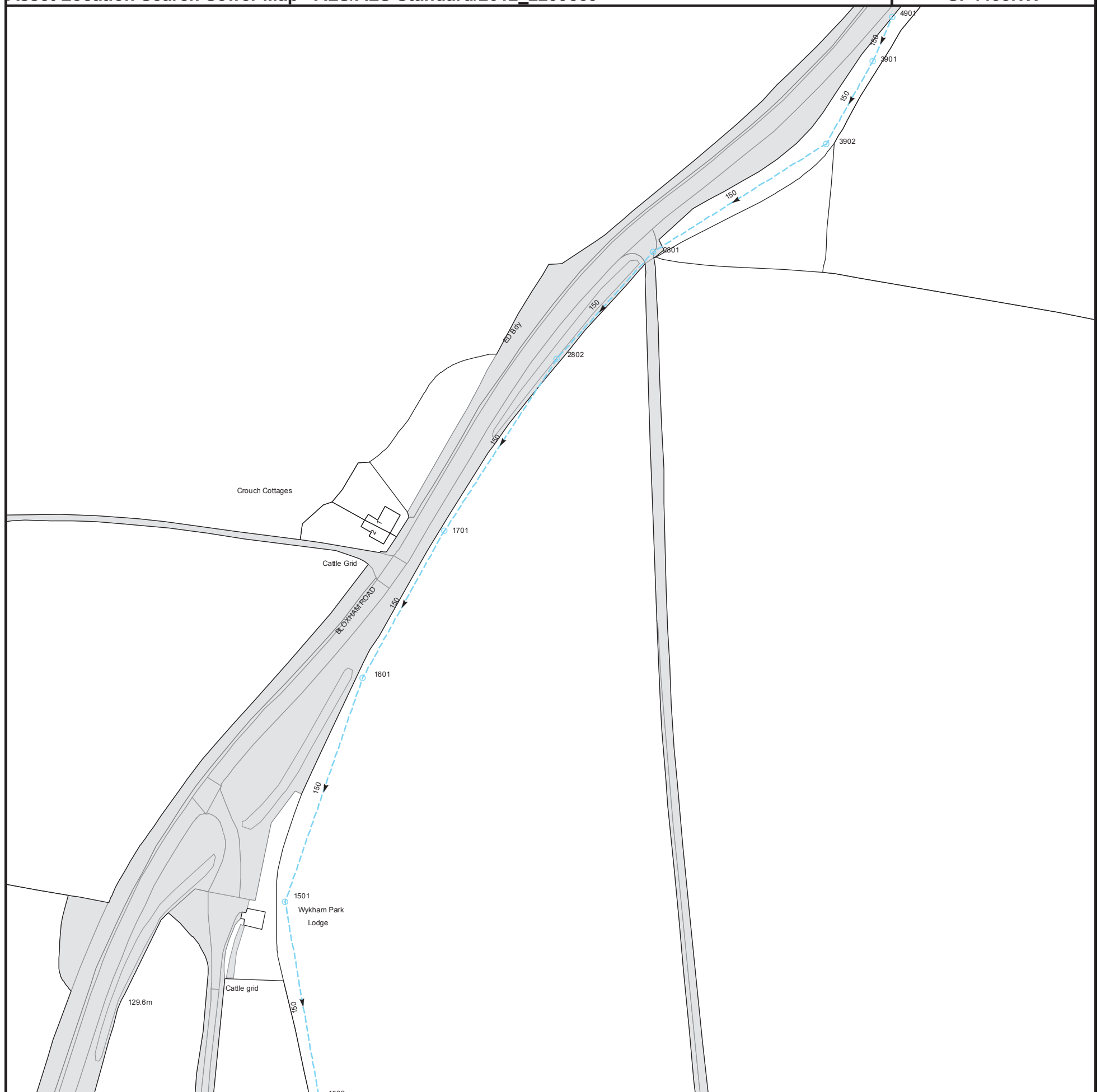
The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

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NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
2001	109.41	107.63
1101	113.68	112.13
2101	112.86	110.72
1502	123.18	121.2
1403	121.02	119.26
1301	118.66	117.12
-	-	-
1201	115.67	114.13

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.



The width of the displayed area is 500m and the centre of the map is located at OS coordinates 444250,238750

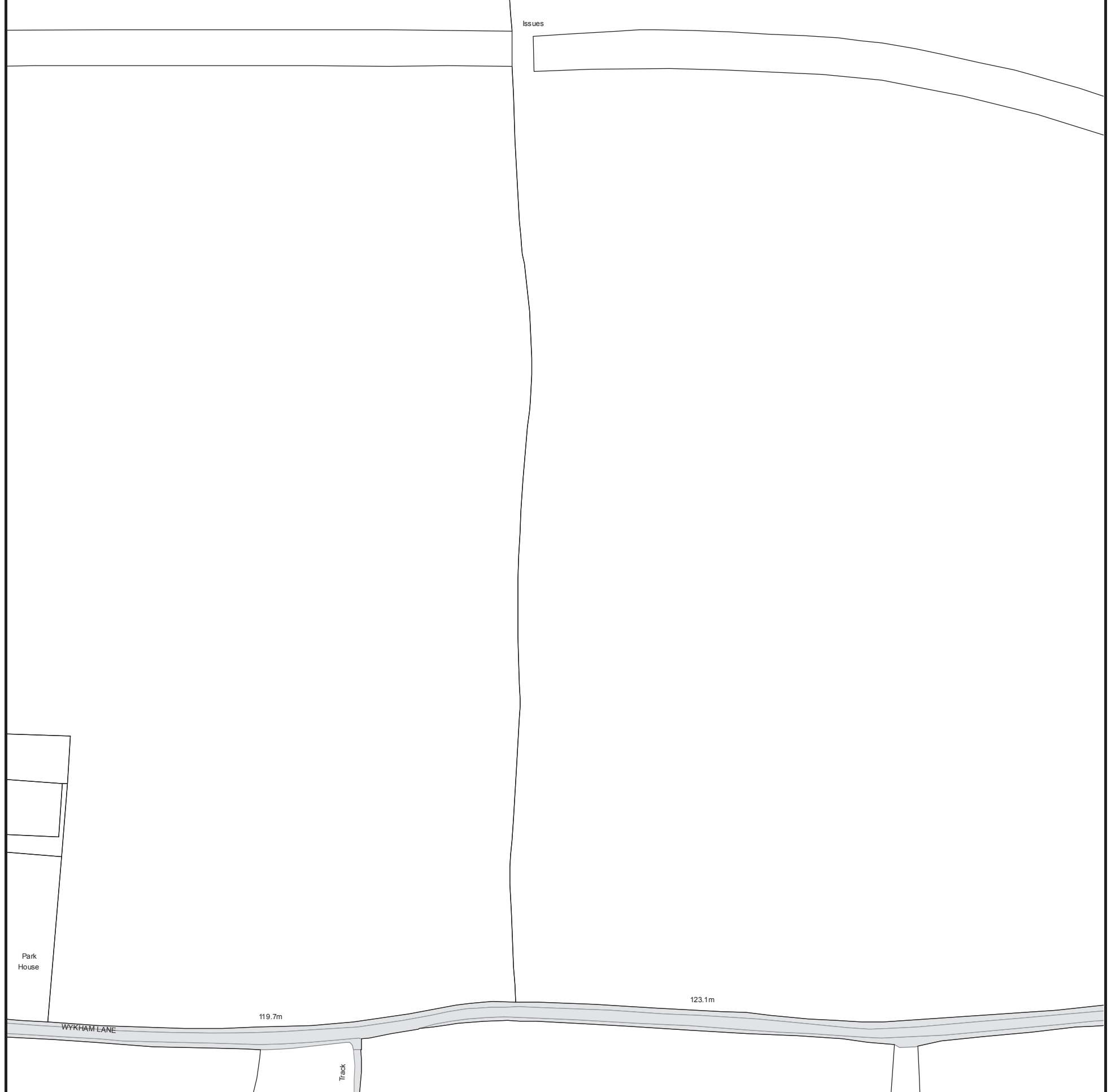
The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

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NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
3902	132.96	132.96
3901	133.05	130.49
4901	n/a	n/a
2802	132.34	129.21
2801	132.48	129.62
1701	130.55	128.72
1501	124.84	122.97
-	-	-
1601	128.11	126.52

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.



The width of the displayed area is 500m and the centre of the map is located at OS coordinates 444750,238250

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

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NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
N/a	n/a	n/a

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.



The width of the displayed area is 500m and the centre of the map is located at OS coordinates 444750,238750

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

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NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
N/a	n/a	n/a

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
9455	n/a	n/a
9307	n/a	n/a
9452	n/a	n/a
9208	n/a	n/a
9318	n/a	n/a
9312	n/a	n/a
9207	n/a	n/a
9309	n/a	n/a
9320	n/a	n/a
9301	131.43	128.75
9319	n/a	n/a
9453	n/a	n/a
9206	n/a	n/a
9311	n/a	n/a
9314	n/a	n/a
9310	n/a	n/a
9315	n/a	n/a
9313	n/a	n/a
9402	133.76	132.55
9451	133.64	132.79
9204	n/a	n/a
9316	n/a	n/a
9454	n/a	n/a
9210	n/a	n/a
9209	n/a	n/a
9317	n/a	n/a
9305	n/a	n/a
9306	n/a	n/a
931A	n/a	n/a
931B	n/a	n/a
9308	n/a	n/a
9214	n/a	n/a
9213	n/a	n/a
9201	130.88	129.41
9212	n/a	n/a
9205	n/a	n/a
9211	n/a	n/a
8451	131.33	130.66
8353	132.4	130.64
8301	132.49	128.82
8350	132.13	130.25
831A	n/a	n/a
8452	132.09	131.37
8404	131.02	128.84
8454	131.01	129.66
8450	130.84	130.22
8403	130.84	130.06
8357	n/a	n/a
8402	131.55	128.31
8356	n/a	n/a
8358	n/a	n/a
8453	131.6	129.09
8401	131.53	128.06
8355	n/a	n/a
9202	n/a	n/a
9302	131.59	129.07
9303	n/a	n/a
9203	n/a	n/a
9304	n/a	n/a
7251	133.73	131.81
7250	134.09	131.45
721A	n/a	n/a
7302	134.25	131.29
7352	134.11	132.38
7301	133.72	130.92
7350	133.61	132.99
7351	133.64	131.22
8354	132.89	131.02
7303	132.99	131.11
8351	132.79	130.66
8302	132.82	130.18
7402	132.31	129.57
7451	132.29	129.9
7401	133.23	130.36
7450	133.23	130.58
6205	134.91	133.31
6253	134.85	132.98
6204	135.1	133.04
6252	135.01	133.79
6201	134.78	131.77
6103	n/a	n/a
6101	135.07	133.62
6250	135.15	132.77
6203	135.62	132.8
6251	135.8	133.02
6202	135.19	132.53
5105	134.13	130.21
5106	134.17	130.14
5101	134.5	130.32
5150	135.35	133.69
511A	n/a	n/a

Manhole Reference	Manhole Cover Level	Manhole Invert Level
511C	n/a	n/a
5001	133.51	130.79
6001	133.15	131.18
511B	n/a	n/a
611A	n/a	n/a
521A	n/a	n/a
5250	136.28	133.52
5201	136.34	133.24
5251	136.86	134.44
5202	136.88	134.12

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The width of the displayed area is 500m and the centre of the map is located at OS coordinates 445250,238250

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NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
N/a	n/a	n/a

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The width of the displayed area is 500m and the centre of the map is located at OS coordinates 445250,238750

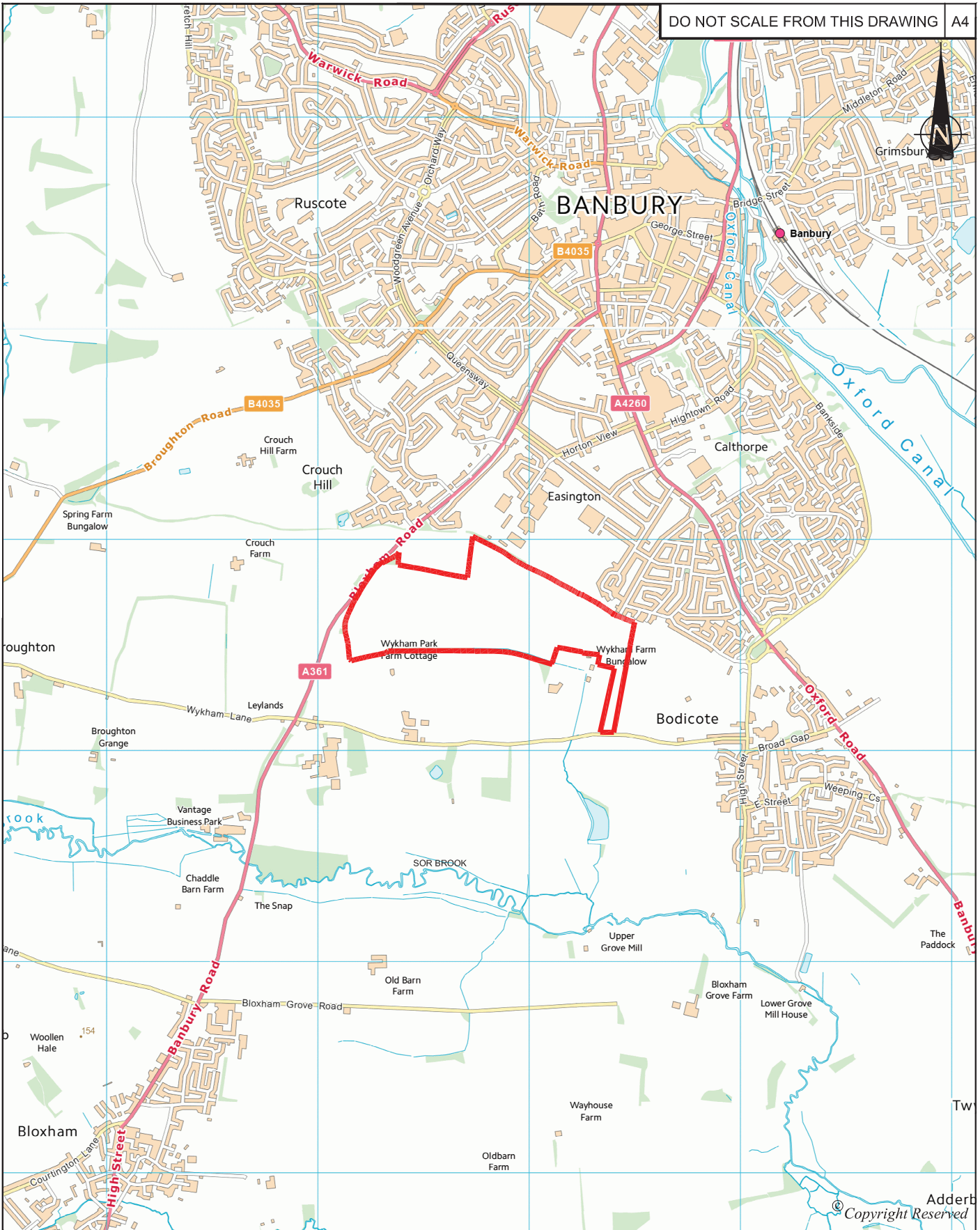
The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

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NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

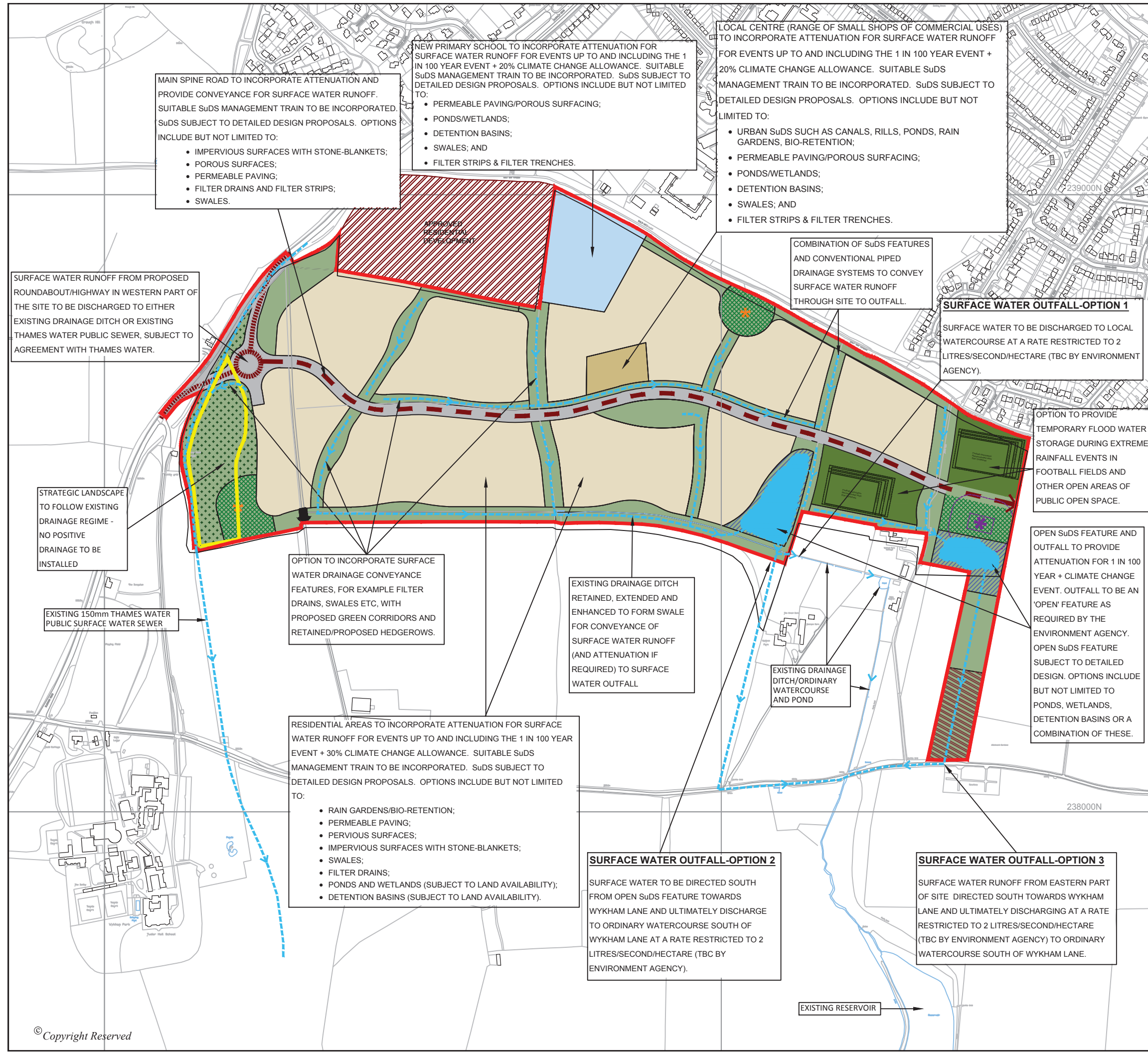
Manhole Reference	Manhole Cover Level	Manhole Invert Level
4852	n/a	n/a
3801	n/a	n/a
3803	n/a	n/a
4802	128.63	127.91
4850	128.62	127.97
4801	128.51	127.82
4902	128.52	127.75
4951	128.56	127.8
4950	128.5	127.4
4901	128.48	127.53
3705	n/a	n/a
3712	n/a	n/a
3711	n/a	n/a
3704	n/a	n/a
3710	n/a	n/a
4704	n/a	n/a
3703	n/a	n/a
3709	n/a	n/a
3702	n/a	n/a
3708	n/a	n/a
3701	n/a	n/a
4853	n/a	n/a
4854	n/a	n/a
3802	n/a	n/a
3804	n/a	n/a
4855	n/a	n/a
4652	n/a	n/a
3603	n/a	n/a
3602	n/a	n/a
4604	126.86	126.16
4651	126.81	125.5
4602	126.61	125.96
4603	126.56	126.11
4601	126.56	125.54
3601	n/a	n/a
4650	126.56	124.25
4703	n/a	n/a
3714	n/a	n/a
3707	n/a	n/a
3713	n/a	n/a
3706	n/a	n/a
4701	126.74	125.71
471G	n/a	n/a
471H	n/a	n/a
471I	n/a	n/a
471J	n/a	n/a
471K	n/a	n/a
471L	n/a	n/a

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<p>CLIENT Gallagher Estates Ltd</p>	<p>DRG No. CA10769-001</p>	<p>SCALE 1:25,000</p>	<p>DATE 05/09/14</p>
<p>PROJECT Wykham Park Farm</p>	<p>DRAWN BY JD</p>	<p>CHECKED BY LC</p>	<p>APPROVED BY JG</p>
<p>DRAWING TITLE Site Location</p>			



MAIN SPINE ROAD TO INCORPORATE ATTENUATION AND PROVIDE CONVEYANCE FOR SURFACE WATER RUNOFF. SUITABLE SuDS MANAGEMENT TRAIN TO BE INCORPORATED. SuDS SUBJECT TO DETAILED DESIGN PROPOSALS. OPTIONS INCLUDE BUT NOT LIMITED TO:

- IMPERVIOUS SURFACES WITH STONE-BLANKETS;
- POROUS SURFACES;
- PERMEABLE PAVING;
- FILTER DRAINS AND FILTER STRIPS;
- SWALES.

NEW PRIMARY SCHOOL TO INCORPORATE ATTENUATION FOR SURFACE WATER RUNOFF FOR EVENTS UP TO AND INCLUDING THE 1 IN 100 YEAR EVENT + 20% CLIMATE CHANGE ALLOWANCE. SUITABLE SuDS MANAGEMENT TRAIN TO BE INCORPORATED. SuDS SUBJECT TO DETAILED DESIGN PROPOSALS. OPTIONS INCLUDE BUT NOT LIMITED TO:

- PERMEABLE PAVING/POROUS SURFACING;
- PONDS/WETLANDS;
- DETENTION BASINS;
- SWALES; AND
- FILTER STRIPS & FILTER TRENCHES.

LOCAL CENTRE (RANGE OF SMALL SHOPS OF COMMERCIAL USES) TO INCORPORATE ATTENUATION FOR SURFACE WATER RUNOFF FOR EVENTS UP TO AND INCLUDING THE 1 IN 100 YEAR EVENT + 20% CLIMATE CHANGE ALLOWANCE. SUITABLE SuDS MANAGEMENT TRAIN TO BE INCORPORATED. SuDS SUBJECT TO DETAILED DESIGN PROPOSALS. OPTIONS INCLUDE BUT NOT LIMITED TO:

- URBAN SuDS SUCH AS CANALS, RILLS, PONDS, RAIN GARDENS, BIO-RETENTION;
- PERMEABLE PAVING/POROUS SURFACING;
- PONDS/WETLANDS;
- DETENTION BASINS;
- SWALES; AND
- FILTER STRIPS & FILTER TRENCHES.

SURFACE WATER RUNOFF FROM PROPOSED ROUNDABOUT/HIGHWAY IN WESTERN PART OF THE SITE TO BE DISCHARGED TO EITHER EXISTING DRAINAGE DITCH OR EXISTING THAMES WATER PUBLIC SEWER, SUBJECT TO AGREEMENT WITH THAMES WATER.

COMBINATION OF SuDS FEATURES AND CONVENTIONAL PIPED DRAINAGE SYSTEMS TO CONVEY SURFACE WATER RUNOFF THROUGH SITE TO OUTFALL.

SURFACE WATER OUTFALL-OPTION 1
SURFACE WATER TO BE DISCHARGED TO LOCAL WATERCOURSE AT A RATE RESTRICTED TO 2 LITRES/SECOND/HECTARE (TBC BY ENVIRONMENT AGENCY).

OPTION TO PROVIDE TEMPORARY FLOOD WATER STORAGE DURING EXTREME RAINFALL EVENTS IN FOOTBALL FIELDS AND OTHER OPEN AREAS OF PUBLIC OPEN SPACE.

STRATEGIC LANDSCAPE TO FOLLOW EXISTING DRAINAGE REGIME - NO POSITIVE DRAINAGE TO BE INSTALLED

OPTION TO INCORPORATE SURFACE WATER DRAINAGE CONVEYANCE FEATURES, FOR EXAMPLE FILTER DRAINS, SWALES ETC, WITH PROPOSED GREEN CORRIDORS AND RETAINED/PROPOSED HEDGEROWS.

EXISTING DRAINAGE DITCH RETAINED, EXTENDED AND ENHANCED TO FORM SWALE FOR CONVEYANCE OF SURFACE WATER RUNOFF (AND ATTENUATION IF REQUIRED) TO SURFACE WATER OUTFALL

EXISTING DRAINAGE DITCH/ORDINARY WATERCOURSE AND POND

OPEN SuDS FEATURE AND OUTFALL TO PROVIDE ATTENUATION FOR 1 IN 100 YEAR + CLIMATE CHANGE EVENT. OUTFALL TO BE AN 'OPEN' FEATURE AS REQUIRED BY THE ENVIRONMENT AGENCY. OPEN SuDS FEATURE SUBJECT TO DETAILED DESIGN. OPTIONS INCLUDE BUT NOT LIMITED TO PONDS, WETLANDS, DETENTION BASINS OR A COMBINATION OF THESE.

EXISTING 150mm THAMES WATER PUBLIC SURFACE WATER SEWER

RESIDENTIAL AREAS TO INCORPORATE ATTENUATION FOR SURFACE WATER RUNOFF FOR EVENTS UP TO AND INCLUDING THE 1 IN 100 YEAR EVENT + 30% CLIMATE CHANGE ALLOWANCE. SUITABLE SuDS MANAGEMENT TRAIN TO BE INCORPORATED. SuDS SUBJECT TO DETAILED DESIGN PROPOSALS. OPTIONS INCLUDE BUT NOT LIMITED TO:

- RAIN GARDENS/BIO-RETENTION;
- PERMEABLE PAVING;
- PERVIOUS SURFACES;
- IMPERVIOUS SURFACES WITH STONE-BLANKETS;
- SWALES;
- FILTER DRAINS;
- PONDS AND WETLANDS (SUBJECT TO LAND AVAILABILITY);
- DETENTION BASINS (SUBJECT TO LAND AVAILABILITY).

SURFACE WATER OUTFALL-OPTION 2
SURFACE WATER TO BE DIRECTED SOUTH FROM OPEN SuDS FEATURE TOWARDS WYKHAM LANE AND ULTIMATELY DISCHARGE TO ORDINARY WATERCOURSE SOUTH OF WYKHAM LANE AT A RATE RESTRICTED TO 2 LITRES/SECOND/HECTARE (TBC BY ENVIRONMENT AGENCY).

SURFACE WATER OUTFALL-OPTION 3
SURFACE WATER RUNOFF FROM EASTERN PART OF SITE DIRECTED SOUTH TOWARDS WYKHAM LANE AND ULTIMATELY DISCHARGING AT A RATE RESTRICTED TO 2 LITRES/SECOND/HECTARE (TBC BY ENVIRONMENT AGENCY) TO ORDINARY WATERCOURSE SOUTH OF WYKHAM LANE.

EXISTING RESERVOIR

NOTE:
THIS DRAWING HAS BEEN BASED ON DRAWING NUMBER JJG043-035-1 "WYKHAM PARK FARM PARAMETER PLAN" DATED OCTOBER 2014, AS PROVIDED BY THE CLIENT.

INDICATIVE ONLY

REVISION	DETAILS	DATE	DRAWN	CHK'D	APP'D
A	Development Framework Plan Updated	15/10/14	DR	LC	JG

CLIENT
Gallagher Estates Ltd

PROJECT
Wykham Park Farm

DRAWING TITLE
Indicative Surface Water Management Plan

DRG No. CA10769-002	SCALE NTS	DATE 15/10/14
DRAWN BY DR	CHECKED BY LC	APPROVED BY JG

<input checked="" type="checkbox"/> STOKE-ON-TRENT (HEAD OFFICE) TEL 0845 111 7777	<input type="checkbox"/> CARDIFF TEL 029 2072 9191
<input type="checkbox"/> NEWCASTLE UPON TYNE TEL 0191 232 0943	<input type="checkbox"/> LEIGH TEL 0114 245 6244
<input type="checkbox"/> WEST BROMWICH TEL 0121 580 0909	<input type="checkbox"/> EDINBURGH TEL 0131 555 3311
<input type="checkbox"/> LONDON TEL 020 7287 2872	<input type="checkbox"/> LIVERPOOL TEL 0151 494 5431

