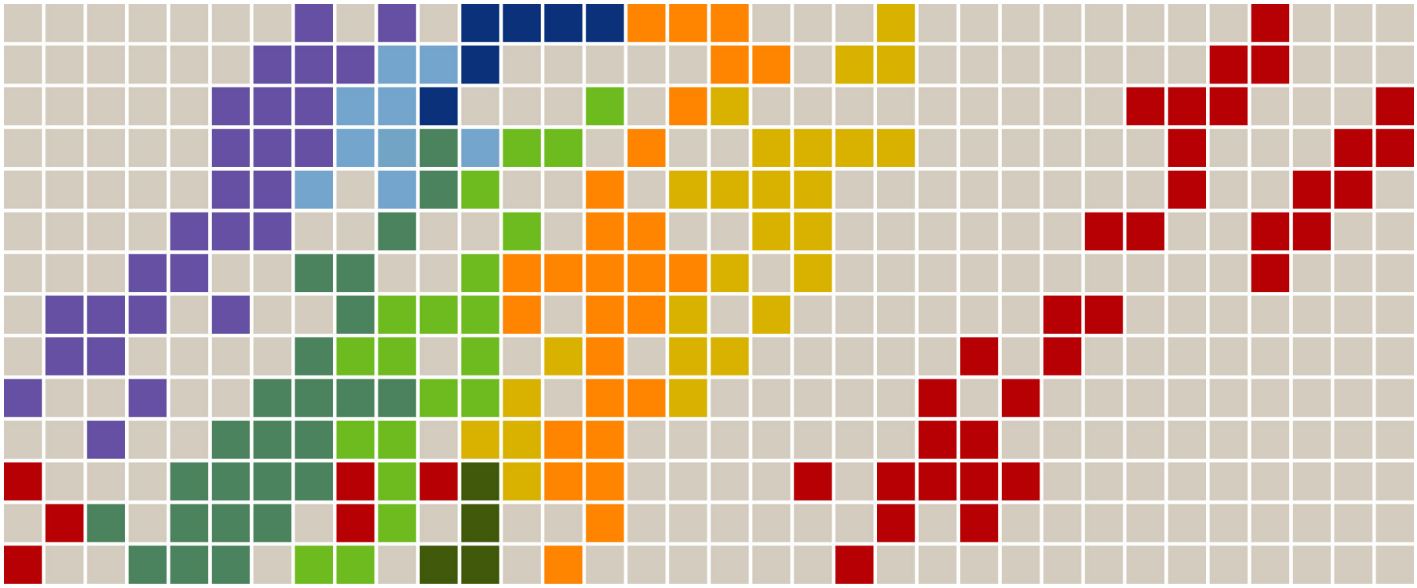
South West Bicester Environmental Statement
Countryside Properties (Bicester) Ltd

Technical Appendix 3 Hydrology and Water Quality

Contents



South West Bicester Environmental Statement

Technical Appendix: Hydrology and Water Quality

Countryside Properties (Bicester) Ltd

September 2006

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Executive Summary

This Technical Appendix to the Environmental Statement covers the existing surface water and land drainage system associated with the proposed South West Bicester development and reviews the potential storm water balancing requirements and attenuated discharge to existing watercourses.

1 Introduction

1.1 BACKGROUND

1.1.1 The purpose of this report is to set out the proposals for discharge and balancing of surface water drainage at the proposed development site of South West Bicester, Oxfordshire.

1.1.2 The site is located immediately south west of Bicester in the county of Oxfordshire and is currently a Greenfield agricultural site which is predominantly part of the Whitelands Farm development; which is situated within the subject area.

1.1.3 The site is bounded to the north by Middleton Stoney Road (B4030, formerly the A4421) to the west by the A4095 and to the east by the A41 Oxford Road. To the south of the site is Gagle Brook.

1.1.4 This report is based on enquiries with the Environment Agency (EA), the Highway Authority (Oxfordshire CC) and the Statutory Undertaker (Thames Water) to determine existing drainage networks and restrictions on Greenfield site runoff.

1.1.5 The investigations were carried out in the period April to November 2005. It is understood that the site requires new drainage infrastructure to support a mixed residential development of 1,585 dwellings together with schools and community centre with some commercial and retail units. An initial estimate of the impermeable surfaces developed by such a development has been determined in order to predict storm water run-off rates and potential on site balancing requirements.

1.1.6 The site's topography indicates that it slopes gently in an easterly direction. The site is approximately 1600m long (as measured along Middleton Stoney Road) with the highest point of the site being in the northwest corner at approximately 82.7 m AOD. The lowest point of the site is the southeast corner where the levels are approximately 66.0 AOD at the interface with Oxford Road.

1.1.7 The proposed development site has two distinct established points of outfall, Pingle Brook and an unnamed watercourse, which springs from a point due east of Whitelands Farm (to be referred to as Whitelands Farm Brook).

2 Baseline Conditions

2.1 EXISTING STORM DRAINAGE FROM HIGHFIELD ESTATE

2.1.1 Pingle Brook is the primary watercourse serving this area of Southwest Bicester. The Brook appears to spring from a location due south of Gowell Farm, which is located to the north of the Highfields Estate. The brook then passes down through this estate collecting surface/storm water from much of the Highfields development.

2.1.2 The Highfields Estate has clearly been subjected to storm water discharge control measures as part of the development. These measures comprised of the canalisation of the Pingle Brook into an open concrete channel, which varies between a 2.0m wide vertically sided channel section, to a 3.0m wide trapezoidal section (i.e. wider at the top than the bottom) channel further downstream.

2.1.3 A 'dry' balancing pond, with a surface area of approx 6,500 square metres, has been constructed on the line of the Brook near Shakespeare Drive. This balancing pond has a crescent overfall weir associated with the attenuation system; this is approximately 1.5m high and therefore the pond would contain approximately 10,000 cubic metres of water when filled during a severe rainfall event. Historic evidence suggests that this pond has never been flooded.

2.1.4 The balancing pond discharges into the trapezoidal channel section that passes down through the estate before crossing Middleton Stoney Road.

2.1.5 Drainage records received from Thames Water Utilities (TWU) indicate that a piped network of storm water sewers exists to serve the western end of the Highfields Estate. The drainage system discharges into the storm water balancing system where it is regulated and attenuated by the outfall weir, before discharge to Pingle Brook.

2.1.6 The TWU records indicate no formal storm water drainage network serving the eastern end of Highfields Estate; and discussions with Cherwell DC confirm that this area of the estate is drained by soakaways which discharge surface water by infiltration to the Cornbrash sub-strata aquifer.

2.2 HIGHWAY DRAINAGE FROM MIDDLETON STONEY ROAD

2.2.1 In addition the TWU records do not indicate any formal, piped, surface water sewers serving Middleton Stoney Road. It is therefore presumed that the surface water gullies along Middleton Stoney Road connect indirectly into Pingle Brook via Highway drains.

2.2.2 Clearly, as these road drains appear to discharge straight into Pingle Brook, there will be no attenuation of storm water. Therefore, the only contamination mitigation measures provided will be the sump to the road gullies, which will trap hydrocarbon spillage and silt.

2.3 ON SITE WATERCOURSES

2.3.1 The general gradient trend of the site is from Northwest to Southeast. Storm water falling within the site is captured by a succession of ditch watercourses across the site which fall towards Oxford Road.

2.3.2 These ditches discharge via three main watercourses; the Gagle Brook to the south, the Whitelands Farm Brook in the centre and Pingle Brook to the north.

2.3.3 The topographical survey information indicates that the majority of the area to the south of Whitelands Farm falls towards Gagle Brook; and that to the north of the

farm to Pingle Brook. Some of the centre section and to the southeast of the farm falls into the minor watercourse of Whitelands Farm Brook.

2.3.4 All three watercourses cross the Oxford Road and discharge to the River Lang.

2.3.5 The EA has advised that they would wish that the natural flow rates within the existing watercourses should not vary from the current status. The project should demonstrate the current surface water run-off behaviour of the site and the aim should be that the proposed storm water run-off discharges to the same watercourses.

2.3.6 Although Gagle Brook is the most significant of the three watercourses within the site area, as the proposed development is focussed on the area north of Whitelands Farm, which predominantly falls to Pingle Brook, this is not considered to be an acceptable outfall for the development.

2.3.7 Pingle Brook passes through the north eastern corner of the site for approximately 700m. Within this section it is joined by two watercourses. One appears to be highway run-off water from Highfields Estate and Middleton Stoney Road. The other is a spring which is probably issuing water from the aquifer, input via soakaways further uphill within the Highfields Estate

2.3.8 Pingle Brook discharges from the NE corner of the site via a rectangular concrete culvert, which passes under Oxford Road at a location approx 120m south of the Middleton Stoney Road junction. Due to the flat topography of the site, at the northeastern corner, the culvert has become significantly silted up and this has progressively caused flooding back into the site.

2.3.9 The presence of organic material at this corner of the site appears to be as a result of previous quarry workings, which have been carried out either side of Pingle Brook over the last 500m prior to Oxford Road. The boreholes indicate that the workings reached a depth of approximately 1.5 m below ground level, to apparently remove '*rare white limestone gravel*' (BH refs. TP79B and 84). Following the excavations these areas have been partially backfilled with '*made ground'* comprising '*clay – with many carbonized plant stems'*. Above this it has been infilled with organic material washed down with the brook. The NE corner of the site has established itself as a marsh/bog area with an influx of marsh reeds and bog plants.

2.3.10 The Whitelands Farm Brook is a smaller watercourse which passes down a shallow ditch before crossing under Oxford Road.

3 Environment Agency Constraints

3.1 FLOOD RISK ASSESSMENT

3.1.1 The Environment Agency has been consulted and their Flood Map obtained. This shows that all apart from a small area around the Pingle Brook in the northeast corner of the site is in Flood Zone 1 (lowest risk). Gagle Brook is also shown as flooding along its length; however, this does not enter the site.

3.1.2 In addition to the local watercourse flooding to Gagle and Pingle Brooks, the Environment Agency (EA) Flood Map also indicates that during a 100 year event the downstream watercourses from the Wendlebury and Merton also flood. The Flood Map indicates that the Pingle Brook may flood approximately 500 m into the site with up to 30m on each side of the brook. However the Flood Maps are indicative and the FRA determines the channel size required to contain the 1 in 100 year flood.

3.1.3 The EA has advised that Pingle Brook is defined as an 'ordinary watercourse' and that under the Land Drainage Act 1991 and the Land Drainage Byelaws 1981 their prior written consent is required for works in, over, under or adjacent to this watercourse. An adjacent undeveloped strip of 8 metres will be required to allow maintenance access and preserve the character of the watercourse.

3.1.4 Possible realignments of Pingle Brook have been proposed to the EA (refer to Drawing No. 1546/D/001 in Appendix A), to allow for minimising the constraint on the development area within the NE corner of the site, while at the same time maintaining the overall length of the stream within the site. The proposal to realign the Brook was deemed acceptable by the EA, providing the length of the brook's bed is not reduced and that the other adjoining watercourses remain connected and are not extended. They have determined that any realignment of the brook should seek to provide a two stage natural watercourse with graded banks rather than the artificial canalised brook provided upstream. It would clearly be essential to provide protected embankments to minimise bank erosion, this could be attained by use of proprietary geotextiles and soil nailing.

3.1.5 The EA has advised that a flood risk assessment (FRA) should be undertaken in accordance with PPG25. This FRA requirement is a requirement for all sites greater than 1 hectare, or where part of the site is within the flood plain, as is the case for this site. The FRA is provided as a separate document in support of the Environmental Statement.

3.1.6 An assessment of the drainage strategy for dealing with surface water discharge, while maintaining the Greenfield run-off rates has been proposed within the FRA. (Refer also to Section 4)

4 Drainage Proposals

4.1 SURFACE WATER DRAINAGE PROPOSALS

4.1.1 It is proposed that sustainable drainage systems (SUDS) will be used for surface water discharge from the site. This strategy will be developed in accordance with the Environment Agency's Best Management Practices (BMPs) for dealing with surface water run-off. These consist of a series of measures ranging from local source control through area measures such as swales to outfall attenuation features such as ponds. These measures aim to provide water quality improvements as well as maintain the natural runoff Greenfield regime.

4.1.2 Attenuation of surface water can be achieved using wet or dry ponds. Wet ponds are designed to contain water at all times and can be utilised as a visual or recreational amenity. During periods of heavy rainfall an additional volume of water can be stored within the pond facility. Dry ponds are only utilised during periods of heavy rainfall and can therefore be used for dry recreational activities at other times. The EA's preference would be for wet pond provision in order to enhance the nature of the environment.

4.1.3 The proposed balancing ponds will be designed for a 1 in 100 year storm event plus 20% in line with current EA requirements and the recommendations in PPG25. Based on the current assumptions of developed impermeable area this will necessitate a storage volume of 20,000 m^3. This would equate to a single surface water balancing lagoon of 2.0 ha at an average depth of 1.0 m.

4.1.4 It is however proposed to provide separate balancing ponds for each catchment; subject to agreement with the EA, and these are shown on Drawing No. 1546/D/001 (Appendix A):

- Several ponds located in the north east of the site near to Middleton Stoney Road, discharging to Pingle Brook.
- One pond located south east of Whitelands Farm and discharging to Whitelands Farm Brook.

4.1.5 The *Interim Code of Practice for Sustainable Drainage Systems* requires that volumes of runoff for the developed scheme should not increase compared to the undeveloped (Greenfield). This should be achieved using infiltration SUDS, which should be possible for parts of the site. Roadside swales will be incorporated to provide storage and attenuation, with infiltration where practicable. If infiltration does not prove practicable, the excess volume needs to be stored on site and discharged at greenfield flow rates. This storage can be provided by overland flow routeing and temporary surface flooding of areas such as car parks and landscaped areas. These measures should ensure that the development has neutral impact on downstream areas of the catchment with respect to increased flood risk.

4.1.6 It may be necessary to provide light liquid separators on the car park drainage within the site prior in accordance with PPG3 (Use and Design of Oil Separators in Surface Water Drainage Systems). However, if SUDS features such as swales or permeable pavements are used, separators should not be needed. The EA have advised that there will be no special additional 'anti-pollution' measures required with respect to groundwater protection where residential and non-manufacturing business units and facilities are to be constructed.

4.1.7 It has been demonstrated in the Highfields Estate that the Cornbrash and Forest Marble sub-strates have sufficient infiltration rates to permit soakaways to be

used on the higher (north-western) side of the site. Therefore in addition to the ponds, it is also possible to consider the introduction of permeable pavements with associated sub-surface storage and infiltration layers to attenuate flows from hard landscaped areas.

4.1.8 Permeable paving allows water to permeate through the paving to a specifically graded sub base. The water is stored within the sub base, before discharge to the drainage system. The sub base is surrounded by a geotextile membrane to prevent migration of fine material into the porous material. Other alternatives are manufactured systems with a honeycomb matrix which has greater storage capacity e.g. Stormcell, Aquacell or similar. To make the most effective use of the storage provided by the storage medium, permeable paving is best suited to relatively flat areas. This may restrict use within certain areas of the site.

5 Water Quality

5.1 BACKGROUND

5.1.1 The Environment Agency classifies inland waterways (rivers and canals) according to the General Quality Assessment scheme (GQA). The GQA scheme is designed to provide an accurate and consistent assessment of the state of water quality changes over time. The chemistry GQA describes quality in terms of three chemical measurements, which detect the most common types of organic pollution.

5.1.2 The nearest surface watercourse to the site is Gagle Brook, which lies approximately 50 to 100m south of the site. There are also two on-site streams or drainage ditches (Pingle Brook and Whitelands Farm Brook), which drain into an off site watercourse lying approximately 350m east of the site. Gagle Brook and the on site drains are not classified, however the unnamed off site watercourse to the east has a GQA of Grade D (Fair).

5.1.3 The Environment Agency Groundwater Vulnerability Map and Regional Appendices, which make up part of the published "Policy and Practice for the Protection of Groundwater", divided the underlying strata in England and Wales into major, minor and non-aquifers dependent upon their potential for potable water supply. The underlying Cornbrash and Forest Marble formations are classified as a minor aquifer with the Kellaways Clay formation classified as a non-aquifer.

5.1.4 There are four licensed groundwater or surface abstractions located within 500 m of the site, one being on the site adjacent to Whitelands Farm. Three of the abstractions are to provide water for general agricultural use in adjacent farms whilst the fourth is the water supply for the adjacent caravan site.

5.1.5 There are two consents to discharge, one in the north-east corner of the site and the second approximately 750m east of the site adjacent to the sewage treatment works.

5.1.6 The site has been used for many years as a mixed use agricultural and dairy farm. There is evidence of silage and animal waste storage on site and this will need to be cleared prior to development. In addition, areas around the farms fuel storage tank should be considered as hazardous and will need to be tested and disposed of to a special waste site.

5.1.7 The ground contamination testing has indicated slightly elevated levels of arsenic across the whole site. These are predominantly below prescribed threshold levels. However, there are several ‘hot spots’ associated with landfill which has been imported to the site, with levels above acceptable limits for residential developments. These areas are discussed in more detail under the geotechnical environmental assessment.

6 Assessments and Residual Effects

6.1 SENSITIVITY AND MAGNITUDE ASSESSMENT

6.1.1 The impacts of the proposed development are assessed in the sensitivity and magnitude table located in Appendix B.

6.2 POTENTIAL EFFECTS

During Construction

6.2.1 During construction, the surface water quality of Pingle Brook and the unnamed watercourse could potentially be affected by pollution from spills or silt, unless appropriate measures are taken. These watercourses are considered to be of medium sensitivity. However, the magnitude of change varies as a result of proximity of the proposed works to these watercourses. With regard to Pingle Brook and the unnamed watercourse, the magnitude of change is considered to be small, resulting in an adverse effect of moderate significance.

6.2.2 Gagle Brook is also sensitive from pollution from spills. However, due to the distance between the proposed development area and this stream, the magnitude of change is considered to be negligible and no significant effects have been predicted.

6.2.3 The proposed realignment of Pingle Brook and the unnamed watercourse during construction could potentially result in an increase in silt affecting water quality, potential flood risk and the ecology of the watercourses. A section of Pingle Brook will be realigned (approximately 230m) and part of the unnamed watercourse also realigned. This will be carried out as part of the development's ecological/landscape features. The EA has advised that this should be in the format of a two-staged channel not shorter than the existing watercourses, with all connections maintained, which will minimise any residual effects.

6.2.4 There is also potential for groundwater quality to be affected by spills arising during the construction work. The groundwater could be affected by seepage and it is considered to be of medium sensitivity. Without appropriate controls during construction, there is the potential for a small change and an adverse effect of moderate significance.

6.2.5 A further issue is the potential impact of groundwater flow on foundations. However this is unlikely to be significant, as foundations will be taken to competent soil.

Post Construction

6.2.6 Post-construction, there is the potential for contamination to arise as a result of the increase in run-off from the development. Pingle Brook and the unnamed watercourse are sensitive to this change and are considered to be of medium sensitivity. The magnitude of the change is considered to be small and an adverse effect of moderate significance will result.

6.2.7 Gagle Brook will not be affected due to the distance between the proposed development area and this watercourse. The magnitude of change is negligible and no significant effects have been predicted.

6.2.8 The increase in run-off from the development could also potentially affect the groundwater quality by pollutants infiltrating through the soil. This receptor is considered to be of medium sensitivity and without appropriate controls, there is the potential for a small change and an adverse effect of moderate significance.

6.2.9 The development proposals will potentially lead to an increase in run-off quantity on-site which could impact on flood risk. The on-site watercourses and downstream areas are at risk. The sensitivity of receptor is high and the magnitude of change is considered to be medium to high. Without mitigation, this adverse potential effect is considered to be of very substantial significance.

6.2.10 There will be a minor realignment of Pingle Brook to accommodate the proposals. Discussions with the EA have confirmed that a realignment is acceptable providing the length of the Brook's bed is not reduced and the adjoining watercourses remain connected and are not extended. The realignment maintains the overall length of the Brook and the adjoining watercourses will remain connected. With regard to changes to the hydrology of Pingle Brook, the magnitude of change associated with the realignment is considered to be negligible and no significant effects have been predicted.

6.2.11 The alignment of the unnamed watercourse will change as a result of the development proposals. This unnamed watercourse will be incorporated into the proposed drainage scheme for the balancing pond to the south-east of the site. However, the existing discharge point of outfall of the unnamed watercourse will remain. This unnamed watercourse is very minor and is not considered to be sensitive to the proposed changes. No significant effects have been predicted.

6.2.12 The groundwater could be affected by the change to the hydrology of the site due to the incorporation of SUDS into the development. The groundwater is of medium sensitivity and the magnitude of change is considered to be medium. This will result in an adverse effect of substantial significance.

6.2.13 The development proposals could potentially lower the groundwater levels at the site through an increase in impermeable surfaces and reduction in recharge levels. This is unlikely to cause significant effects given the large permeable areas of the site and the potential use of SUDS in some parts of the site.

6.2.14 Thames Water has advised that there is capacity at their main Bicester sewage treatment works to serve the proposed development. A new sewer will be needed to connect the development to the sewage treatment works. It may be necessary for the lower southern parts of the site to be served by a sewage pumping station. It is expected that a gravity connection can be made for the majority of the site. These measures will ensure that the development is adequately served with respect to foul water drainage. No significant effects on hydrology or water quality have been predicted.

6.2.15 There is a severe constraint on potable water supply extraction within the Bicester area and no spare capacity. This situation is being resolved by the laying of a new trunk water main to bring new supplies to the area from Farmoor reservoir west of Oxford. This is expected to be complete before construction of the proposed development. This will provide sufficient strategic supplies to Bicester. The local distribution system within Bicester may need some upgrades and reinforcements to serve the new development. These measures will ensure that an adequate potable water supply can be provided for the development. This will not impact on existing supply in the area. No significant effects have been predicted.

6.2.16 Cleaning and maintenance of the Pingle Brook culvert and the Whitelands Farm pipe can be carried out by or with the permission of the asset owner, this is believed to be the Highway Authority.

6.3 MITIGATION

6.3.1 Best practice techniques will be used by all the developers during the construction phase. This will include reference to emergency equipment for use in the event of accidental spillage. Any ground contaminated by spillage of fuel oils and hydraulic oils during construction will be treated appropriately and, where necessary, excavated and removed to an appropriately licensed waste disposal site. Personal protective equipment (PPE) will be provided to construction workers where necessary. These measures will ensure that any spills during construction are dealt with promptly and appropriately to ensure no residual effects on surface water or groundwater will result. Any identified hazardous material will need appropriate treatment and, where necessary, be excavated and removed to an appropriately licensed waste disposal site.

6.3.2 Surface water drainage measures will be designed in accordance with best practice with appropriate pollution prevention measures. This will ensure that the run-off from the development will not affect the surface water bodies or groundwater post-construction. Maintenance of the trapped gullies, swales, highway drainage systems, interception facilities and infiltration basins, including the pollution prevention equipment, will ultimately be the responsibility of Cherwell District Council and Oxfordshire County Council. Until adoption, however, the developers will carry out the necessary maintenance of these systems and facilities. Waste water and materials removed during routine maintenance will be disposed of to an appropriately licensed waste disposal site.

6.3.3 The Interim Code of Practice for Sustainable Drainage Systems requires that volumes of run-off for the developed scheme do not increase compared to undeveloped or Greenfield sites. This will be achieved using infiltration SUDS, eg soakaways and swales, where appropriate. If infiltration does not prove practicable for certain areas of the site, the excess volume will be stored on site and discharged at greenfield flow rates. This storage can be provided by overland flow routeing and temporary surface flooding of areas such as car parks and landscaped areas. These measures will ensure that the development has a neutral impact on downstream areas of the catchment with respect to increased flood risk.

6.4 RESIDUAL EFFECTS

6.4.1 The best practice measures proposed for the construction work will ensure there will be no residual effects on surface water or groundwater during this work.

6.4.2 The design of the sustainable drainage system and associated pollution prevention and control measures will ensure that the increase in run-off from the development will not affect surface water or groundwater. These measures will also ensure that the local aquifers are not affected by the incorporation of SUDS into the development. The magnitude of change will be reduced to negligible and no significant residual effects have been predicted.

6.4.3 The measures proposed to address the change to run-off quantity and associated flood risk will reduce the magnitude of change to negligible. No significant residual effects will result.

Appendices, Figures & Tables

Appendix A Drawings