

Chapter 7

Hydrology and water quality

7 Hydrology and water quality

Introduction

- 7.1 WSP was commissioned by Countryside Properties (Bicester) Ltd (hereafter referred to as Countryside Properties) to carry out a hydrology and water quality assessment for the South West Bicester development proposals. For the 2006 outline planning application hydrology and water quality was scoped as an issue of primary significance for consideration in the EIA.
- 7.2 There are three watercourses at or near to the site, Pingle Brook, Gagle Brook and an unnamed watercourse, as well as a number of field drains. Issues for consideration include the risk of flooding for the site itself and the potential for the development to increase the flooding risk downstream. The original development proposals for South West Bicester were submitted in 2006, granted planning permission in June 2008 and construction has commenced. However, Countryside Properties is now seeking to provide an additional 100 dwellings in the areas of the site that have not already been developed.
- 7.3 For further information on the ground conditions and contamination at the site, reference should be made to chapter 13 of the 2006 Environmental Statement (ES), (see technical appendix B).

Legislation and policy

- 7.4 Water resources in England and Wales are protected by law under the Water Resources Act (1991) and the Environmental Protection Act 1990 (as amended by the Environment Act 1995). It is the responsibility of the Environment Agency (EA) to enforce this legislation and control discharges to surface waters through the regulation of industry and through its powers as a statutory consultee in the planning process. Other discharges enter the public sewerage system and are controlled and monitored by the regional water companies under the provisions of the Public Health (Drainage of Trade Premises) Act 1937 and the Water Industry Act 1991. Discharge consents are required by the EA and the regional water companies respectively.
- 7.5 The Water Resources Act (WRA) 1991 is the principal legislation relating to water resources in England and Wales. Under section 85 of the Act, it is an offence to “*cause or knowingly permit the discharge or other entry of poisonous, noxious or polluting matters or any solid waste matter into controlled waters (as defined under s104 of the WRA 1991)*”. Most waters will meet this definition, including groundwater. Any parties intending to discharge such substances, or those discharging trade or sewage effluent directly into controlled waters, must obtain consent from the EA.
- 7.6 The Flood and Water Management Act 2010 which received Royal Assent on 8 April 2010, is being implemented by a series of ministerial orders. This Act focuses predominately on flood risk and how this is managed and gives a new role to lead local flood authorities to manage local flood risk.
- 7.7 Since the original application was granted in 2008 there have been changes in local policies for the area. The draft Cherwell Local Plan was subject to public consultation between August and October 2012 and it is expected that CDC will

make the submission in the spring 2013. A number of emerging policies within the draft plan relate to flood risk, hydrology and water quality:

7.8 “Policy ESD1: Mitigating and Adapting to Climate Change

Measures will be taken to mitigate the impact of development within the district on climate change. At a strategic level, this will include:

- Distributing growth development to the most sustainable locations*
- Delivering development that seeks to reduce the need to travel and which encourages sustainable travel options including walking, cycling and public transport*
- Designing developments to reduce carbon emissions and use resources more efficiently*
- Promoting the use of decentralised and renewable or low carbon energy where appropriate*
- Key considerations in terms of climate change adaptation include:*
 - Taking into account the known physical and environmental constraints when identifying locations for development.*
 - Considering design approaches that are resilient to climate change impacts including the use of passive solar design for heating and cooling*
 - Minimising the risk of flooding and making use of sustainable drainage methods, and*
 - Reducing the effect of urban ‘heat islands’ (through the provision of open space and water, planting, and green roofs for example.*

Adaptation through design approaches will be considered in more locally specific detail in the SPD for Sustainable Buildings in Cherwell.”

“Policy ESD6: Sustainable Flood Risk Management

The Council will manage and reduce flood risk in the district through using a sequential approach to development; locating vulnerable developments in areas at lower risk of flooding. Development proposals will be assessed according to the sequential approach and where necessary the exceptions test as set out in the NPPF. Development will only be permitted in areas of flood risk when there are no reasonably available sites in areas of lower flood risk and the benefits of the development outweigh the risks from flooding.

In addition to safeguarding floodplains from development, opportunities will be sought to restore natural river flows and floodplains, increasing their amenity and biodiversity value. Building over or culverting of watercourses should be avoided and the removal of existing culverts will be encouraged.

Existing flood defences will be protected from damaging development and where development is considered appropriate in areas protected by such defences it must allow for the maintenance and management of the defences and be designed to be resilient to flooding.

Site specific flood risk assessments will be required to accompany development proposals in the following situations:

- *All development proposals located in flood zones 2 or 3*
- *Development proposals of 1 hectare or more located in flood zone 1*
- *Development sites located in an area known to have experienced flooding problems*

- *Development sites located within 9m of any watercourses.*
- *Flood risk assessments should assess all sources of flood risk and demonstrate that:*
- *There will be no increase in surface water discharge rates or volumes during storm events up to and including the 1 in 100 year storm event with an allowance for climate change (the design storm event)*
- *Developments will not flood from surface water up to and including the design storm event or any surface water flooding beyond the 1 in 30 year storm event, up to and including the design storm event will be safely contained on site.*

Development should be safe and remain operational (where necessary) and proposals should demonstrate that surface water will be managed effectively on site and that the development will not increase flood risk elsewhere.”

“Policy ESD7: Sustainable Drainage Systems (SuDS)

All development will be required to use sustainable drainage systems (SuDS) for the management of surface water runoff.

Where site specific Flood Risk Assessments are required in association with development proposals, they should be used to determine how SuDS can be used on particular sites and to design appropriate systems.

In considering SuDS solutions, the need to protect ground water quality must be taken into account, especially where infiltration techniques are proposed. Where possible, SuDS should seek to reduce flood risk, reduce pollution and provide landscape and wildlife benefits. SuDS will require the approval of Oxfordshire County Council as SuDS Approval Body, and proposals must include an agreement on the future management, maintenance and replacement of the drainage structures.”

“Policy ESD8: Water Resources

The Council will seek to maintain water quality, ensure adequate water resources and promote sustainability in water use.

Water quality will be maintained and enhanced by avoiding adverse effects of development on the water environment. Development proposals which would adversely affect the water quality of surface or underground water bodies, including rivers, canals, lakes and reservoirs, as a result of directly attributable factors, will not be permitted.

Development will only be permitted where adequate water resources exist, or can be provided without detriment to existing uses. Where appropriate, phasing of development will be used to enable the relevant water infrastructure to be put in place in advance of development commencing.”

- 7.9 The original application in 2006 considered the following policies under the Cherwell District Council Revised Deposit Draft Local Plan (July 2004):

“Water resources

EN11 Development will only be permitted where adequate water resources exist, or can be provided without detriment to existing use.”

“Water quality

EN12 Development which will adversely affect to a material level, the water quality of surface or underground water bodies, including rivers, canals, lakes and reservoirs, as a result of directly attributable factors, will not be permitted.”

“Flood defence

EN14 In areas at risk from flooding, new development, the intensification of existing development or land raising will not be permitted if the proposals would:

- i) result in a net loss of floodplain storage*
- ii) impede the flow of flood water, or*
- iii) increase the risk of flooding elsewhere.”*

“Surface water runoff and source control

EN15 New development generating increased surface water runoff likely to result in an adverse impact to surface drains and water courses, such as an increased risk of flooding, river channel instability or damage to habitats, will not be permitted unless the proposals include appropriate source control and / or attenuation measures. Developers will be expected to cover the costs of assessing the impact of development on runoff generation and of any appropriate mitigation works, including long term management.”

Methodology

- 7.10 The EA, Cherwell District Council highways authority and the statutory undertakers (Thames Water Utilities) were originally consulted by WSP to determine the existing drainage networks and restrictions on greenfield site runoff. The investigations were carried out in the period from April to August 2005. The data sources and references used in preparation of this chapter are shown in table 7.1.

Cherwell District Revised Deposit Draft Local Plan, July 2004
Draft Cherwell Local Plan Draft Submission Plan May 2012
Environment Agency, Groundwater Vulnerability Map and Regional Appendices
Interim Code of Practice for Sustainable Drainage Systems, published by the National SuDS Working Group in July 2004
National Planning Policy Framework March 2012 and the accompanying Technical Guidance 2012
WSP, South West Bicester Environmental Statement, Technical Appendix H: Hydrology and Water Quality, December 2005

Table 7.1: Data sources consulted

- 7.11 The EA was consulted on the original 2006 application and provided relevant information. Flood maps were received from the EA setting out the extent of the 1 in 100 year flood plains of Pingle Brook and Gagle Brook. More detailed hydraulic modelling of the Pingle Brook was undertaken. This information has been incorporated into the EA's current flood mapping.
- 7.12 The EA previously advised that an FRA needed to be undertaken in support of the application in 2006. The FRA has been reviewed and an addendum undertaken in accordance with the NPPF and current guidance (technical appendix F).
- 7.13 The EA Groundwater Vulnerability Zones have been examined to identify whether the site is underlain by an aquifer. These plans and appendices make up part of the published Policy and Practice for the Protection of Groundwater. From 1st April 2010 new aquifer designations replaced the old system of classifying aquifers as major, minor and non-aquifer. These new designations provide classification for principal, secondary and unproductive strata.

Impact assessment

- 7.14 The impact assessment has been undertaken in a robust fashion, comparing the effects of the additional 100 dwellings in comparison to the future baseline. The existing situation in relation to the current construction within the development has also been described.
- 7.15 The proposals have been examined with regard to the baseline hydrology and water quality environment. An estimate of the impermeable surfaces developed by the proposals was previously determined in order to predict storm water runoff rates and potential effects on site balancing requirements. This has been updated to include the increase in dwelling numbers associated with the revised scheme and the overall impermeable area has not increased.
- 7.16 The impact assessment involves the identification of the potential hydrology and water quality effects arising from the development. This assessment therefore considers the potential changes to the baseline and the impact from the additional dwellings. Where adverse potential effects have been identified, consideration has been given to the mitigation measures. The residual effects, following mitigation, have subsequently been determined.

Assessment of significance

- 7.17 The significance of potential effects on the water environment has been determined from criteria developed from best practice techniques and specialist experience. The significance criteria used have been derived from measures of the magnitude or scale of effect, and the importance or sensitivity of the resource affected (see figures 7.1 and 7.2 respectively).
- 7.18 There are no standard significance criteria for assessing the effects of development on the water environment. Reference has therefore been made to a wide range of criteria relating to the nature of the receptors, expected duration of impact and the predicted change in relation to the baseline situation. The aforementioned magnitude and sensitivity criteria have been combined to produce the definitions of potential significance shown in figure 7.3.

Baseline

- 7.19 The assessment of the current baseline both on site and in close proximity incorporates the construction of the perimeter and access roads as well as part of the development. The baseline therefore includes the current development within the site as part of the approved planning permission.

Surface water features

- 7.20 The undeveloped site had two distinct established points of outfall; Pingle Brook and an unnamed watercourse, which springs from a point due east of Whitelands Farm. The topographical survey 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 south east of the farm falls into the minor unnamed watercourse.
- 7.21 Gagle Brook to the south of the site is the most significant of all these watercourses. Gagle Brook is outside of the proposed development area.
- 7.22 The implemented drainage for the built development as consented follows the natural regime of the site. This includes three surface water sewer networks serving the southern catchment of the proposed development site (approximately 70 ha), which will outfall to the Whitelands Farm watercourse.
- 7.23 Three surface water sewer networks will serve the northern catchment and outfall to the Pingle Brook.

Characteristics of the surface water features on site and in close proximity

- 7.24 Pingle Brook is the primary watercourse serving the surrounding area of South West Bicester. The brook appears to spring from a location due south of Gomwell Farm, which is to the north of the Highfields Estate (the housing area north of Middleton Stoney Road). It then passes down through this estate collecting surface and storm water from much of the residential development.
- 7.25 Pingle Brook is outside of this new application boundary, but passes through the north eastern corner of the 2006 consented site for approximately 700 m where it is joined by two watercourses, one of which appears to be highway runoff from

Highfields Estate and Middleton Stoney Road and the other of which is a spring that is probably issuing water from the aquifer.

- 7.26 Pingle Brook discharges from the north east corner of the 2006 site via a rectangular concrete culvert, which passes under Oxford Road at a location approximately 120 m south of the Middleton Stoney Road junction. The culvert has become significantly silted up because of the flat topography of the 2006 site at the north eastern corner, and this has progressively caused flooding back into the site.
- 7.27 The Pingle Brook and the Whitelands Farm watercourse have been diverted through the 2006 site as part of the original permitted development to maximise the development parcels.
- 7.28 There is also an unnamed watercourse that passes down a shallow ditch before crossing Oxford Road via a small diameter pipe.

Flooding potential of the existing watercourses

- 7.29 In addition to the previous work undertaken for the 2006 submission, more detailed hydraulic modelling was undertaken. This information has been incorporated into the EA's flood map. This information shows that the 2006 development site is located within flood zone 1 (little or no risk). The Flood Risk Assessment (FRA) Addendum (technical appendix F) provides an assessment of the flood risk for the development of an extra 100 houses over the original planning application boundary. The findings of this FRA are considered to be applicable to this application.
- 7.30 The EA has advised that the Pingle Brook is defined as a main river and that under the Water Resources Act 1991 and the local Land Drainage Byelaws 1981 the Agency's prior written consent is required for works in, over, under or within 8 m of these watercourses.

Storm drainage from the existing residential development, north of Middleton Stoney Road

- 7.31 The Highfields Estate has been subjected to storm water discharge control measures. These measures have comprised the canalisation of the Pingle Brook into an open concrete channel, which varies between a 2 m wide vertically-sided channel section, and a 3 m wide trapezoidal section (i.e. wider at the top than the bottom) channel further downstream.
- 7.32 A dry balancing lagoon, with a surface area of approximately 6,500 m², has been constructed on the line of the Pingle Brook near Shakespeare Drive. This balancing pond has a weir associated with the attenuation system. This is approximately 1.5 m high and the pond would contain approximately 10,000 cubic metres of water when filled during a severe rainfall event. However, historic evidence indicates that this pond has never been flooded. The balancing pond discharges into the trapezoidal channel section before progressing down through the estate, and then crossing Middleton Stoney Road.
- 7.33 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 discharging to Pingle Brook.

- 7.34 The TWU records indicate no formal storm water drainage network serving the eastern end of Highfields Estate. Discussions with CDC confirm that this area of the estate is drained by soakaways that discharge surface water by infiltration to the Cornbrash sub-strata aquifer.
- 7.35 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.
- 7.36 As the road drains appear to discharge straight into Pingle Brook, there is no attenuation of storm water. Therefore, the only contamination mitigation measures provided are the sump to the road gullies, which trap hydrocarbon spillage and silt.

Storm drainage from the 2006 approved development

- 7.37 In examining the baseline information in relation to the completed development under phase 1, the following baseline conditions need to be considered.
- 7.38 Drainage from the northern part of the 2006 site discharges through a combination of on plot source control Sustainable Drainage Systems (SuDS), which are then linked to a positive drainage network draining two site-scale detention basins within the north east of the development. These basins then discharge at the existing greenfield rates into the Pingle Brook.
- 7.39 Drainage from the southern part of the 2006 site again discharges through a combination of on plot source control SuDS, which are then linked to a positive drainage network draining to site-wide SuDS: one permanently wet basin and a dry detention basin, before outfall into the Whitelands Brook at the existing greenfield rates.

Water quality

- 7.40 When the original assessment was undertaken for the 2006 application the EA classified inland waterways (rivers and canals) according to the General Quality Assessment scheme (GQA). Classification is now undertaken to accommodate and incorporate the requirements of the Water Framework Directive (WFD).
- 7.41 Gagle Brook, Pingle Brook and the on-site drains are not classified for either chemical or biological quality. However, there is an unnamed off site drain to the east that has been classified as having moderate ecological quality, but has not been classified for chemical quality. The water quality of Pingle Brook is potentially affected by the existing road gullies in Middleton Stoney Road; it has therefore been assumed that the water quality of these watercourses is fair. No further water quality monitoring is considered necessary at this stage.
- 7.42 The EA also provides classifications for groundwater bodies. The Bicester-Otmoor Cornbrash aquifer is indicated as having currently a good quantitative quality and a poor chemical quality. The information available from the EA indicates that the development is not located within a source protection zone.

Groundwater

- 7.43 From 1st April 2010 a new system of designating aquifers has been introduced. This replaces the classification of aquifers of major, minor and non-aquifer. This new system is in line with Groundwater Protection Policy (GP3) and the WFD, and is based on British Geological Survey mapping.
- 7.44 Areas to the east and south of the development are located within the secondary 'A' superficial classification (figure 7.4) which are generally aquifers formerly classified as minor aquifers. They normally comprise permeable layers capable of supporting local water supplies and can form an important part of river baseflow. The development site itself is located within the unproductive layer for superficial classification. These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.
- 7.45 Results from the borehole survey undertaken as part of the original site investigation indicated that generally the occurrence of groundwater was intermittent across the site, seeping from within the Cornbrash or at the upper levels of the mudstone, wherever this was encountered. There was also groundwater seepage into the central eastern quarry area. The direction of groundwater flow is reasonably assumed to be south easterly, relating to the topography.
- 7.46 In the north east corner of the site, the occurrence of groundwater was considered to be as a result of the proximity of Pingle Brook. All groundwater levels may be seasonal, and historically high groundwater levels have occurred during the winter months on this site.
- 7.47 There are four licensed groundwater or surface abstractions located within the vicinity of the site, with one 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 caravan site east of the A41.
- 7.48 There are two consents to discharge, one to the north east of the site and the second to the south east of the site adjacent to the sewage treatment works.
- 7.49 With regard to groundwater quality, the ground conditions site investigation submitted for the 2006 application confirmed that there was no significant level of contamination in any of the groundwater samples taken (see chapter 13 of the original ES in technical appendix B). This indicates that it is unlikely that any mobile contaminants are being transferred off site and similarly that there is a low risk of contaminants migrating onto the site. However, there is a possibility that the groundwater at the site is affected by potential contamination at the Whitelands Farm complex.

Future baseline

- 7.50 In considering the future baseline it has been assumed that if the increase in 100 dwellings was not forthcoming the site would be completed for phase 1, this is the development completed under the approved planning permission granted in 2008.
- 7.51 The original development proposal for the phase 1 was for a mixed-use development, which consisted of the construction of 1,585 residential properties,

B1 and B2 employment uses, two primary schools and a secondary school, a hotel, a sports pavilion and a local centre consisting of shops, pub / restaurant, a children's nursery, offices and a community centre. A link road between the A41 and Middleton Stoney Road was also proposed. This baseline assessment assumed that the development would have an impermeability factor of 75% and the drainage designs were formulated to mitigate the runoff from that development.

- 7.52 The future baseline is therefore considered to be the approved phase 1, which is due to be completed by 2019.

Assessment of sensitivity

- 7.53 Watercourses at and near the site are considered to be of medium sensitivity to the potential changes to water quality arising from the proposals. This includes Pingle Brook, Gagle Brook and the unnamed watercourse.
- 7.54 In terms of changes to flood risk, Pingle Brook and any downstream properties are considered to be of high sensitivity. The groundwater and the abstraction points are considered to be of medium sensitivity.

Potential effects

- 7.55 The approved Bicester phase 1 Design Code (July 2008) requires parcel designers to limit the parcel runoff rates based on the 1-in-10 year greenfield runoff rate. This is not related to the number of dwellings on the parcel. Furthermore, the site-wide drainage strategy was based on 75% impermeable area, which is higher than the actual percentages will be (even with the additional 100 units which are proposed under this outline application). Therefore, although there will be a small increase in the impermeable area as a result of the additional dwellings, there will be no increase in runoff rates.

During construction

- 7.56 In considering the effects of development during construction the existing stage of development needs to be considered. The 2006 baseline has been altered by the existing development already completed, and at present the completed access and perimeter road form part of the baseline.
- 7.57 Further construction work to complete phase 1 has the potential to affect the existing surface water quality of Pingle Brook and the unnamed watercourse by pollution from spills or silt. 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 negligible, resulting in an adverse effect of slight significance.
- 7.58 Gagle Brook is also sensitive to pollution from spills. However, given 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.
- 7.59 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 slight significance.

- 7.60 During the construction phase the small increase in the number of dwellings will not result in increases in runoff, due to the requirements to limit the runoff from each parcel. Therefore, the impacts during construction above those already identified for the existing phase 1 development are considered to be negligible.

Post-construction

- 7.61 Post-construction, there is the potential for contamination to arise as a result of the increase in runoff from the development from the current stage to completion of phase 1. This is considered as a temporary phase, as the future baseline will be the completion of phase 1.
- 7.62 Pingle Brook and the unnamed watercourse are considered to be of medium sensitivity. The magnitude of the change is considered to be negligible and an adverse effect of slight significance will result.
- 7.63 Gagle Brook will not be affected because of the distance between the proposed development area and this watercourse. The magnitude of change is negligible and no significant effects have been predicted.
- 7.64 As there will be no increase in runoff from the development, it will have no effect on the groundwater quality from pollutants infiltrating through the soil. This receptor is considered to be of medium sensitivity and without appropriate controls included within the original development proposals there would be the potential for a small change and an adverse effect of slight significance. However, with these controls in place to ensure there will be no increase in runoff, groundwater effects will be negligible.
- 7.65 For any increase in development there is the potential for an increase in runoff quantity on site that could impact on flood risk. Downstream areas would then be at risk. The sensitivity of receptor is high and the magnitude of change is considered to be very small. Without mitigation, development could have significant effects. However, as discussed above, there will be no increase in runoff rate and the adverse potential effect is considered to be of negligible significance.
- 7.66 The groundwater could be affected by the change to the hydrology of the site through the incorporation of SuDS into the development. The groundwater is of medium sensitivity and the magnitude of change is considered to be very small, as there will be no increase in runoff. This will result in a negligible significance of effect.
- 7.67 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 likely use of SuDS in some parts of the site.
- 7.68 The proposals for foul water drainage are set out in chapter 3 of the original 2006 ES (see technical appendix B). There is capacity at the main Bicester sewage treatment works to serve the proposed development. A new sewer has been

constructed to connect the development to the sewage treatment works. This 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.

- 7.69 There was previously a severe constraint on potable water supply extraction within the Bicester area and no spare capacity. This situation has been resolved by the laying of a new trunk water main to bring new supplies to the area from Farmoor reservoir west of Oxford. This will provide sufficient strategic supplies to Bicester. TWU has confirmed 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.
- 7.70 In considering the future baseline, that phase 1 is completed, the small increase in the number of dwellings across the site will have a negligible impact on contamination and water quality.
- 7.71 No other developments that could affect the area's water environment were identified, so a cumulative impact assessment has not been undertaken.

Mitigation

- 7.72 The Construction Environmental Management Plan (CEMP) will be used by all the developers during the remaining construction work. 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 excavated and removed to an appropriately licensed waste disposal site. Personal protective equipment 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.
- 7.73 As discussed above, the surface water drainage strategy requires each parcel to limit the discharge to the existing greenfield runoff rates for the 1-in-10 year event. This will be achieved using infiltration SuDS, e.g. soakaways, swales and pervious pavements. These measures will improve water quality and attenuate flows.
- 7.74 Regional attenuation has been provided in the form of a number of basins within the 2006 development site. A series of wet and dry ponds have been incorporated in the design, whilst the existing drainage regime has been retained. 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.
- 7.75 Surface water drainage measures have been designed in accordance with best practice with appropriate pollution prevention measures. This will ensure that the runoff from the development will not affect the surface water bodies or groundwater after 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 CDC and OCC. 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.

Residual effects

- 7.76 The best practice measures proposed for the further construction work to complete phase 1 will ensure there will be no residual effects on surface water or groundwater during this work.
- 7.77 The design of the SuDS and associated pollution prevention will be able to accommodate the increase in the number of dwellings and there will be no increase in runoff as a result of the additional dwellings that could 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.

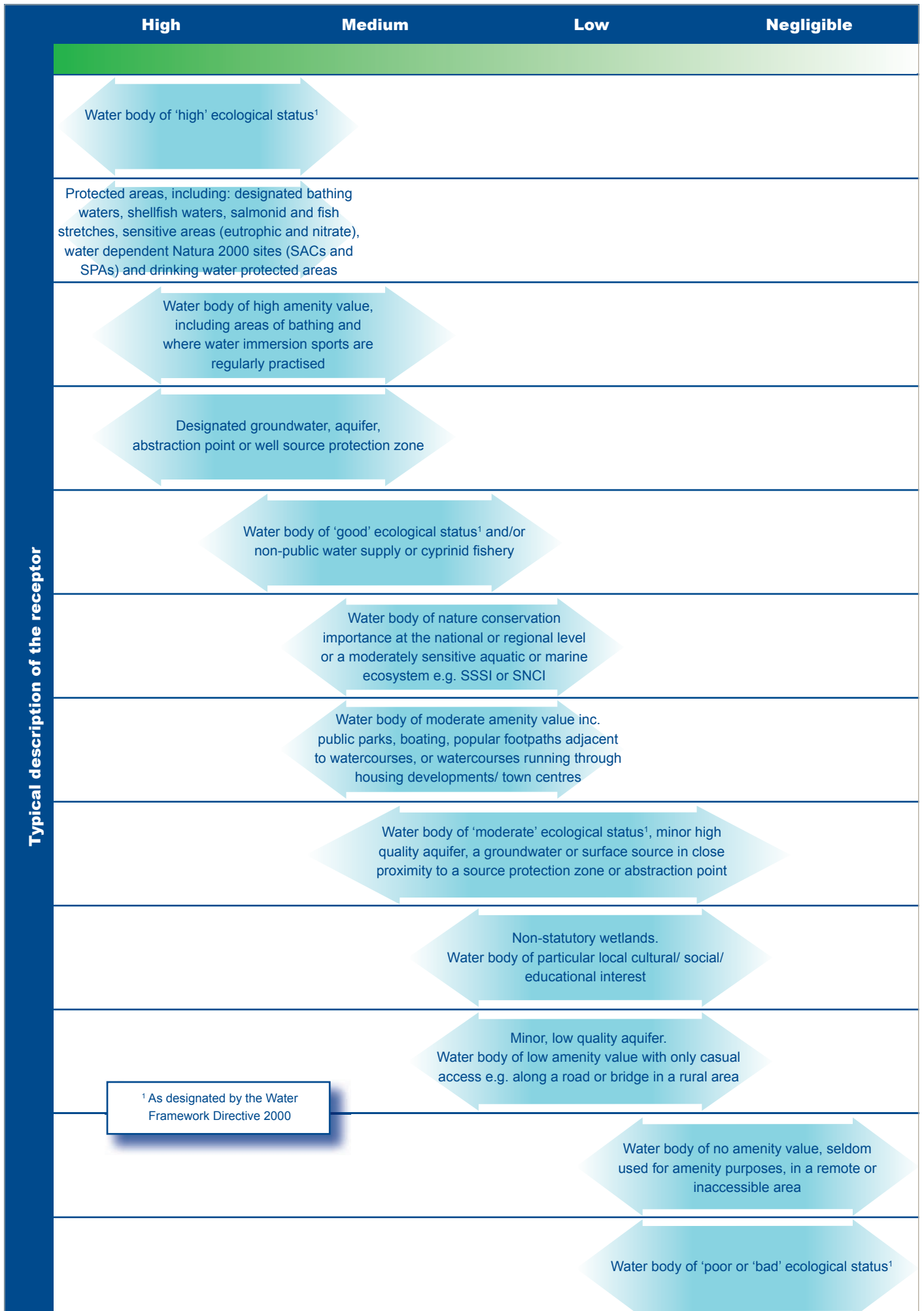


Figure 7.1 Sensitivity of receptor - hydrology and water quality

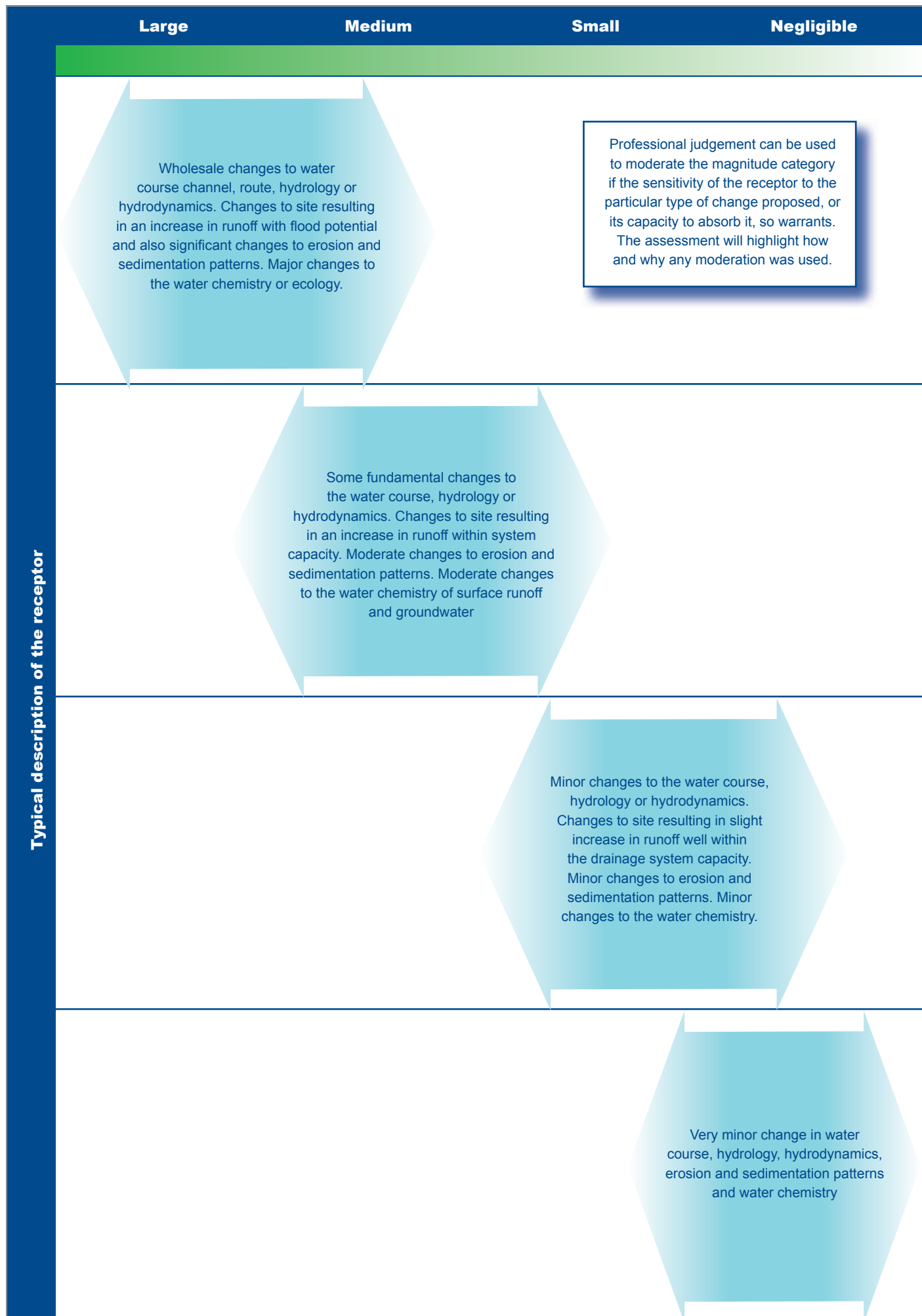


Figure 7.2 Magnitude of change - hydrology and water quality

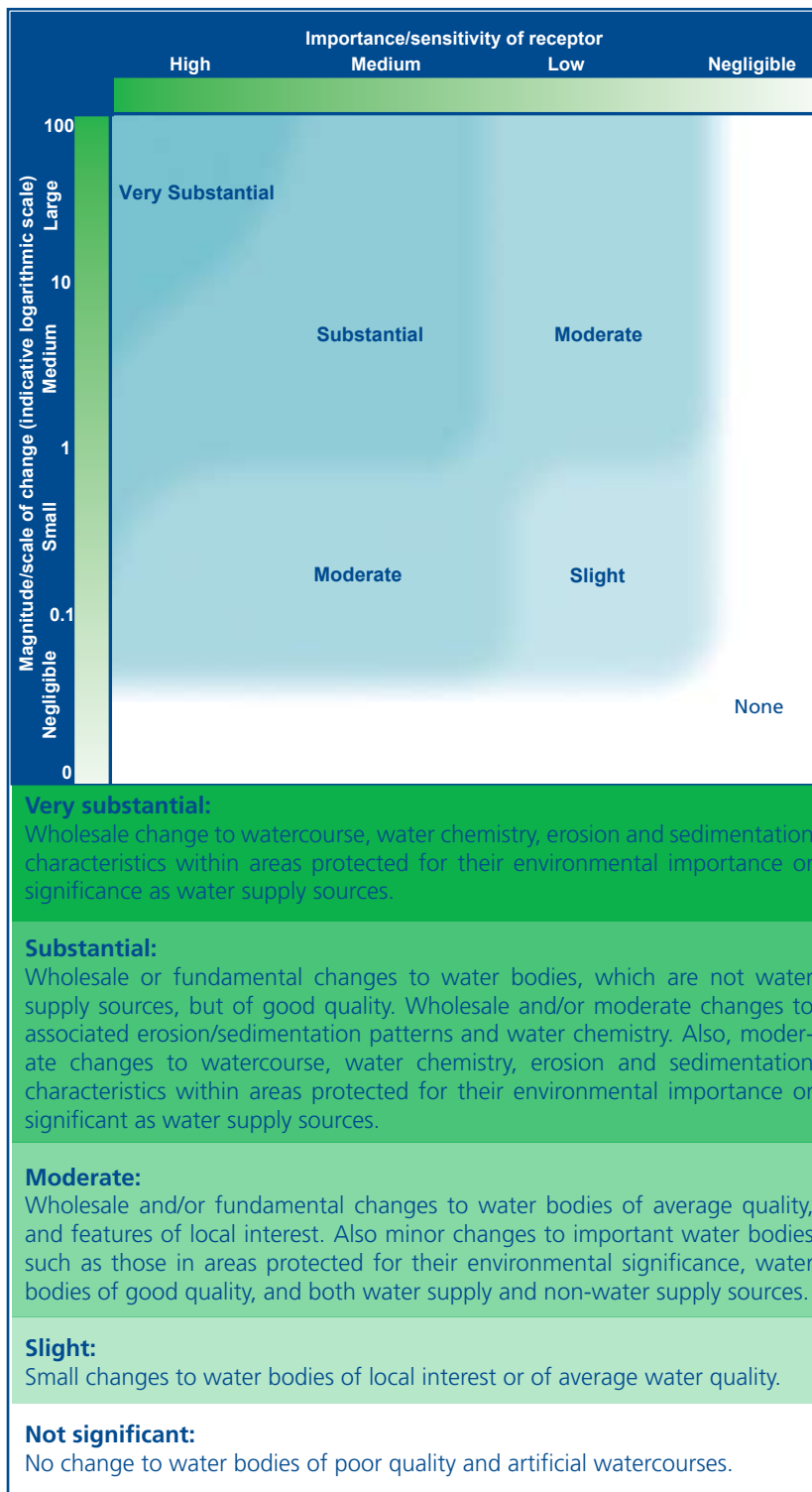








Figure 7.3 Significance of effect - hydrology and water quality

-  APPLICATION BOUNDARY
-  OTHER LAND WITHIN APPLICANTS OWNERSHIP
-  ORIGINAL PHASE 1 OUTLINE APPLICATION BOUNDAR
-  SITE SURFACE WATER FLOW DIRECTION
-  WATERCOURSES
-  STORAGE PONDS

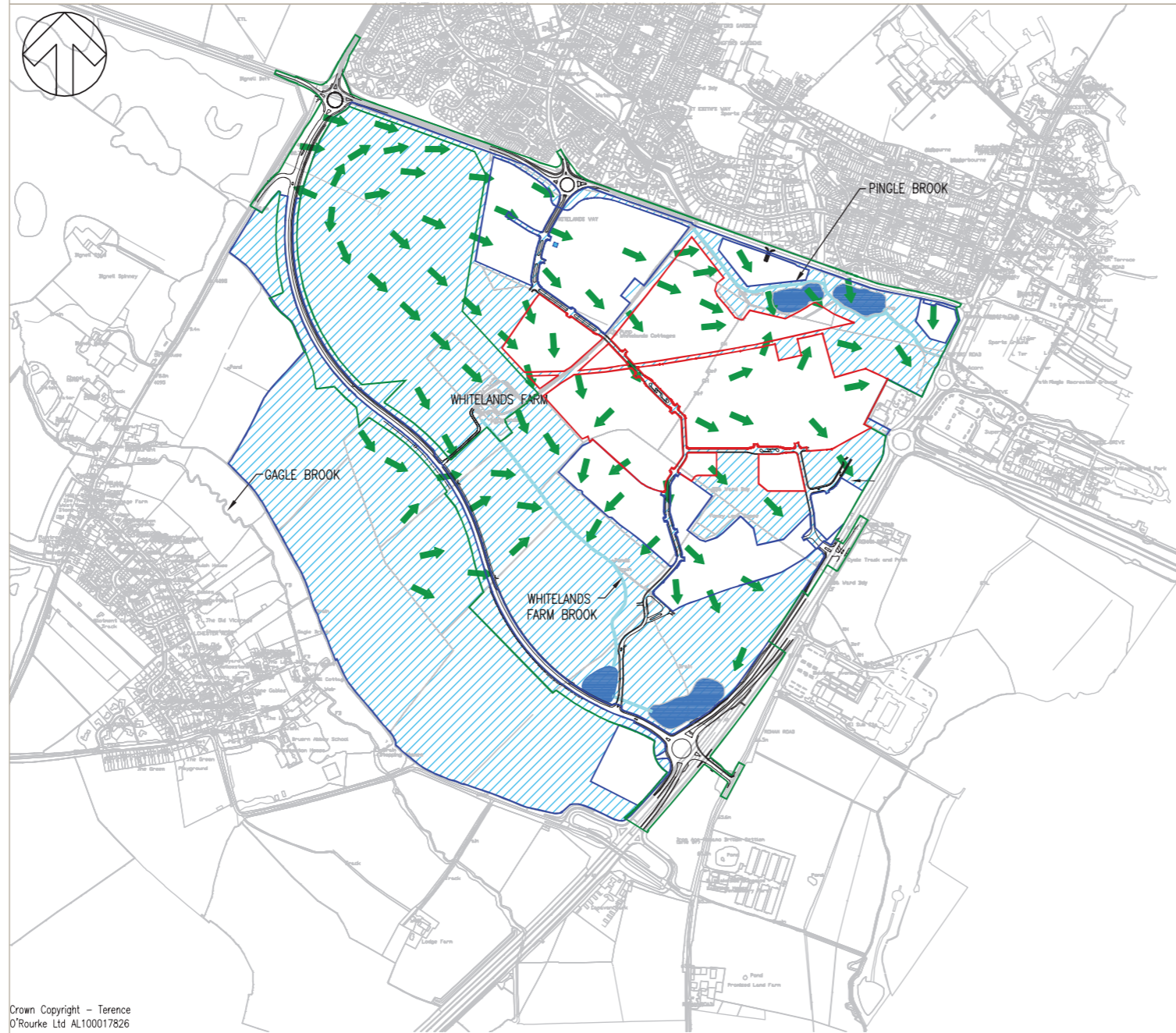
NOTES

1. AQUIFER MAPS AND GROUNDWATER VULNERABILITY MAPS ARE TAKEN FROM THE ENVIRONMENT AGENCY WEBSITE (www.environment-agency.gov.uk) AND HAVE NOT BEEN PRODUCED BY WSP.
2. CONSTRUCTION STATUS OF DEVELOPMENT PARCELS CORRECT ON 30/07/12.



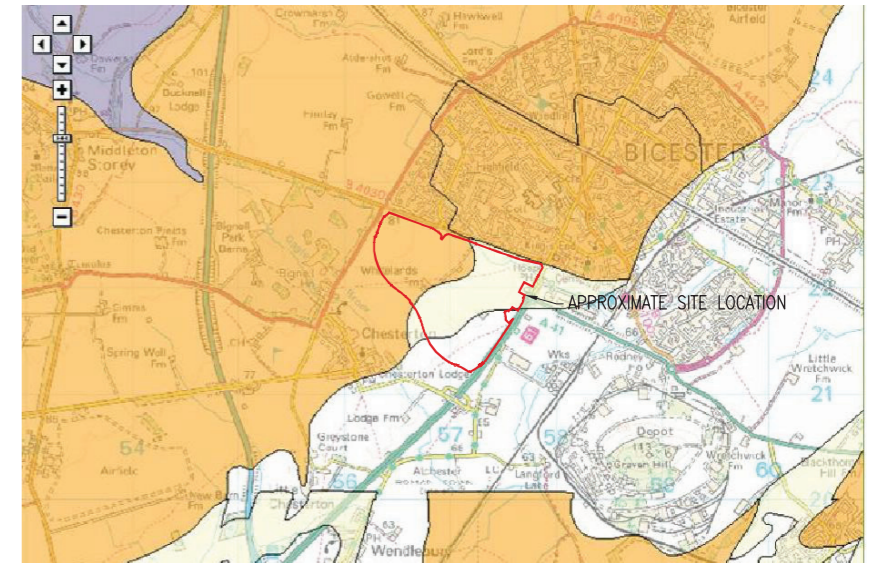
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ENVIRONMENT AGENCY GROUNDWATER VULNERABILITY




KEY

-  Major Aquifer High
-  Major Aquifer Intermediate
-  Major Aquifer Low
-  Minor Aquifer High
-  Minor Aquifer Intermediate
-  Minor Aquifer Low

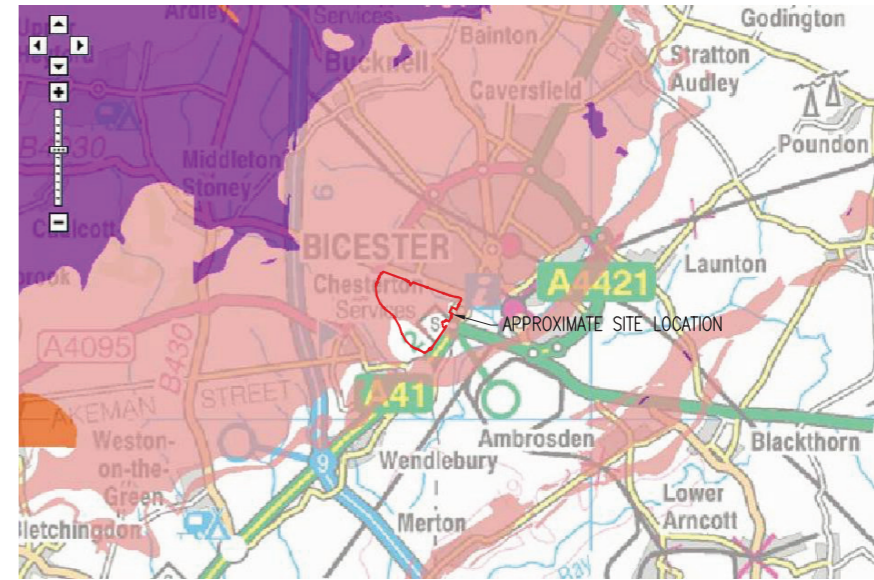
ENVIRONMENT AGENCY AQUIFER MAP – BEDROCK DESIGNATION



KEY

-  Principal
-  Secondary A
-  Secondary B
-  Secondary (undifferentiated)
-  Unknown (lakes and land slip)

ENVIRONMENT AGENCY AQUIFER MAP – SUPERFICIAL DEPOSITS DESIGNATION



KEY





-  Principal
-  Secondary A
-  Secondary B
-  Secondary (undifferentiated)

Figure 7.4 Environment Agency aquifer and groundwater information

Not to scale