SALDEN CHASE
OUTLINE PLANNING APPLICATION

Chapter 8: Hydrology and Hydrogeology

8.0 HYDROLOGY AND HYDROGEOLOGY

Introduction

8.1 Brookbanks Consulting is appointed by the Salden Chase Consortium to assess the potential environmental effects of the proposed development at Salden Chase on Water Resources. This Chapter reports on the assessment of the development proposals, including the Site Assessment Plan. The development proposals are contained within Chapter 2 of the Environmental Statement.

8.1.1 This section discusses hydrology and hydrogeology in the following sequence:

- flood risk; and
- drainage.

Methodology

8.2.1 The format of this section follows a standard study pattern, by setting out an appraisal of the baseline conditions, followed by an identification of potential environmental effects due to the proposed development. The importance of each mechanism and an assessment of each potential effect are then considered along with mitigation measures and recommendations for further investigations where necessary.

8.2.2 Methods of assessment have been employed that are consistent with current guidance and recommendations in the form statutory documents and recognised publications to ensure that the findings represent a robust approach to the Assessment.

8.2.3 Figures 8a and 8b, below outline the criteria for determining the magnitude and significance of the identified impacts.

Magnitude	Criteria
Major	Loss of attribute
Moderate	Losses on integrity or partial loss of attribute
Minor	Minor impact / minor loss of attribute
Negligible	Insignificant loss of attribute that does not affect use or integrity

Table 8a: Magnitude of effect

Magnitude	Importance			
	Very High	High	Medium	Low
Major	Very Significant	Highly significant	Significant	Low significance
Moderate	Highly significant	Significant	Low significance	Insignificant
Minor	Significant	Low significance	Insignificant	Insignificant
Negligible	Low significance	Insignificant	Insignificant	Insignificant

Table 8b: Significance of effect

8.2.4 During the development of this chapter, the following statutory bodies and interested parties have been consulted regarding the proposals:

- the Environment Agency;
- Aylesbury Vale District Council;
- Milton Keynes Council;
- Anglian Water; and
- the Internal Drainage Board

8.2.5 Published information has been obtained in the form of:

- the published geology; and
- environmental statutory registers

Baseline Conditions

Geology & Hydrology

8.3.1 Geology across the site is reported to consist of Oxford Clay bedrock with Glacial Till Boulder Clay drift deposits, which in places contain bodies of sand & gravel. Site specific site investigations completed by the RAW Group in August 2008 confirmed the presence of the Glacial Till in the form of a grey gravely clay for the full depths of the trial pits up to 3.8m BGL. The Oxford Clay was not encountered.

Flood Risk Hydrogeology

8.3.2 Allocation and planning of development must be considered against a risk based search sequence, as provided by PPS25: Development & Flood Risk. In terms of fluvial flooding, the guidance categorises flood zones in three principal levels of risk, as follows:

Flood Zone	Annual Probability of Flooding
Zone 1: Low probability	< 0.1 %
Zone 2: Medium probability	0.1 – 1.0 %
Zone 3a / 3b: High probability	> 1.0 %

Table 8c: PPS25 Flood Risk Parameters

8.3.3 According to the PPS guidance, residential and educational development at the proposed site, being designated as “More Vulnerable” classifications, should lie outside the envelope of the predicted 1 in 100 year (1%) flood, with preference given to sites lying outside the 1 in 1,000 (0.1%) year event and within Flood Zone 1.

8.3.4 The commercial areas, which are classified by PPS25 as a “Less Vulnerable” classification, may occupy land in Zone 1, 2 or 3a subject to adequate flood resilience measures and preference to sites having a lower flood risk.

8.3.5 The local centre, which is classified by PPS25 as a "Less Vulnerable" classification, may occupy land in Zone 1, 2 or 3a subject to adequate flood resilience measures and preference to sites having a lower flood risk.

8.3.6 Sites with the potential to flood during a 1 in 100 (1%) year flood event (Flood Zone 3a) are not normally considered appropriate for proposed residential or educational development unless on application of the "Sequential Test", the site is demonstrated to be the most appropriate for development and satisfactory flood mitigation can be provided. Additionally, "More Vulnerable" development or "Essential Infrastructure" proposed within Flood Zone 3a are required to pass the "Exception Test", which is discussed in the following paragraphs.

8.3.7 The PPS document aims to:

> *"to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall."*[5]

8.3.8 PPS25 requires that developments covering an area of greater than one hectare prepare a Flood Risk Assessment (FRA) in accordance with Annex E of the guidance. The FRA is required to be proportionate to the risk and appropriate to the scale, nature and location of the development. A comprehensive Flood Risk Assessment has been prepared to support the Environmental Statement and planning application and is provided as a separate document.

8.3.9 The majority of the site lies within Flood Zone 1. However, a small strip of land on either side of the Tattenhoe Brook can be seen to lie within Flood Zones 2 and 3. A sequential test has been completed within the FRA which outlines that the proposed development lies in a preferable location in accordance with national guidance and that there are no other reasonable alternative sites able to provide the scale and

[5] PPS25: Development & Flood Risk

spectra of the proposed development within the South East of England Plan (May 2009) region.

8.3.10 The FRA concludes that the site is suitable for development from a flood risk viewpoint (see also assessment section discussing proposed surface water management strategy).

Storm Water Hydrology

8.3.11 The proposed development lies within the catchment of the Tattenhoe Brook. The head of the watercourse is found some 2km south of the site; from there the brook flows across open fields and agricultural land passing under the disused railway line south of the site before entering the site on the western boundary between Chase Farm and Lower Salden Farm. Within the site, the brook flows in a north easterly direction, following the route of the Mid Shires and Swans Way before leaving the site on the northern boundary, being culverted beneath the Bottledump Roundabout and then flowing north eastern wards via the Loughton Brook in the Tattenhoe Linear Park.

8.3.12 Reference to the Flood Estimation Handbook CD V2 dataset shows the Tattenhoe/Loughton Brook watercourse to have a catchment, upstream and including the site, of 6.67km^2. Having an URBEXT2000 of 0.009, in accordance with the FEH, the catchment may be described as "*Essentially Rural"*.

8.3.13 The Environment Agency currently monitor 40,000km of rivers across England. To help protect these areas each reach is monitored and given a river quality grade. This is based upon the chemical quality of the water. The rivers are then graded from A to E with A representing a river with very good water quality and E, a river with very poor water quality.

8.3.14 To improve the quality of water bodies, new European legislation known as the Water Frame Directive, 2000 (WFD) has been introduced to promote a new approach to water management through river basin planning. One aim of the Water Frame Directive is to improve the ecological health of inland and costal waters and

to prevent further deterioration. A requirement has been placed on nearly all inland and coastal waters to achieve 'good status' by 2015.

8.3.15 The site lies within the wider catchment of the River Ouzel. With regards to the above assessments of chemical and ecological quality, the Environment Agency has found that the Ouzel has gained a grade B - "Good" for both.

8.3.16 Further details of the baseline storm water hydrology are contained in the FRA.

Foul Drainage Hydrology

8.3.17 A copy of the Anglian Water sewerage network records has been obtained to confirm the presence of an adopted foul sewer passing through the south east corner of the site from the residential development to the east. Adopted foul sewers service the existing residential and commercial development areas to the east and north of the proposed development.

8.3.18 Foul water is conveyed in a network of gravity foul and combined sewers through the residential development to the east of the proposed development site. Flows are conveyed in a southerly direction towards Newton Longville.

8.3.19 Being in agricultural use, the site is presently not drained by the adopted foul water network.

8.3.20 Further details of the baseline foul water hydrology are contained in the FRA.

Development Proposals

8.4.1 To minimise the potential environmental effects of the development in the study area on Flood Risk and Drainage related matters, the following specific measures are being incorporated into the design.

- all building development will be located within Flood Zone 1;

- implementation of a 600mm slab freeboard above the level of proposed flood routes, to protect buildings in the event of localised blockage. Compliance with SFA 6th Edition in relation to flood routing through the proposed development;

- compliance with guidance in terms of flood routing and resilience for new developments;

- provision of a storm water SuDS management system (See FRA Section 4);

- connection to a point of adequacy on the foul water drainage network with completion of necessary downstream reinforcements to ensure adequate conveyance and treatment capacity. (See FRA Section 5);

- provision of ongoing maintenance for SuDS features, ordinary watercourse and existing artificial water bodies; and

- adoption and associated ongoing maintenance of development storm and foul drainage system.

8.4.2 Salden Chase has been designed to avoid significant adverse effects resulting during operational phase and construction works. Particular design measures are also described in further detail below

Potential Effects

Operational Effects

8.5.1 As a result of the proposed development, four potential operational environmental effects are identified relating to water. The mechanisms are as follows:

- **direct and indirect flooding of surrounding watercourses, the wider catchment area, adjacent land and property** due to increases in surface water runoff from positively drained hard areas;

- **direct flooding of the Project** due to inadequate flooding resilience and management of residual flood risk;

- **direct contamination or deterioration of surface water quality** due to leakages of fuel oils, general spillages and other contaminants from within the development and the associated collection of surface water drainage from hardstanding areas;and

- **direct and indirect contamination of surface water, soil and potential groundwater contamination** due to surcharging of the foul water network or the discharge of untreated foul flows.

Construction Effects

8.5.2 Two potential construction phase environmental effects have been identified relating to hydrology and hydrogeology. These mechanisms are as follows:

- **direct and indirect contamination of surface water** due to mobilisation of soils, existing contamination and spillage of oils and the like from construction plant; and

- **direct and indirect flooding and changes to baseline drainage hydrology** due to disturbance of the ground during construction works.

Assessment and Mitigation of Effects

Operational Effect: **Direct and indirect flooding of surrounding watercourses, the wider catchment area, adjacent land and property** due to increases in surface water runoff from positively drained hard areas.

8.6.1 Hydrological effects in terms of flooding and the like arise from changes in the catchment drainage characteristics. Urbanisation of a catchment can increase peak storm water discharge from an area due to the accelerated run-off and reduced times of concentration associated with hard paved areas, with resulting increase in flood risk.

8.6.2 To mitigate against the potential impact of development on the baseline hydrological characteristics, it is important that the site drainage provision is designed to reflect the pre-development conditions as closely as possible. Both the maximum rate of run-off and the total direct discharge to adjacent watercourses needs to be controlled if the potential impact of the site is to be minimised. This is addressed within the FRA.

8.6.3 Salden Chase has been designed to avoid significant hydrological effects resulting from changes in the catchment drainage characteristics and provides for the control of stormwater to the baseline rate. By introducing Sustainable Drainage measures, the design takes account of the potential accelerated run-off and reduced times of concentration associated with hard paved areas to avoid increasing peak storm water discharge and consequential flood risk.

8.6.4 The FRA outlines a proposed storm water management system providing a SuDS management train, incorporating source control, open channels and infiltration / detention systems. The network will convey and attenuate storm water discharges from the Project before discharging to the watercourse receptors identified within the accompanying FRA. Assessments demonstrate that discharges during the 1 in 1

and 1 in 100 and 1 in 100 year plus 30% climate change events will be controlled to the baseline Greenfield rate.

8.6.5 The outline SuDS scheme has had regard to sustainable methods that are readily accepted for adoption by the relevant authorities in discharging their maintenance responsibilities. The SuDS system will be maintained by way of an appropriate management scheme operated by either AVDC or the Parks Trust. The below ground drainage system will be adopted and maintained by the drainage authority, Anglian Water. Maintenance will ensure that the storm water management system remains functional for the lifetime of the proposed development and protect the catchment from increased flood risk.

8.6.6 Accordingly, there will be no increase in storm water discharges from the study area therefore the environmental effect is assessed as a nil.

8.6.7 **Cumulative Effects:** It is anticipated that regulatory control will ensure that developments completed elsewhere in the catchment will be required to implement sustainable drainage measures and controls on drainage discharge rates that at least meet current standards. In such circumstances, the environmental effects resulting from cumulative development will be nil.

Operational Effect: Direct flooding of the study area due to inadequate flooding resilience and management of residual flood risk.

8.6.8 Section 3 of the FRA identifies a range of measures to provide flooding resilience and manage residual flood risk at the Project.

8.6.9 Development, as defined by the development framework plan and the the FRA demonstrates that best practice principles of flooding resilience and residual flood risk management will be implemented. Accordingly, the environmental effect is assessed as nil impact.

8.6.10 **Cumulative Effects:** It is anticipated that regulatory control will ensure that developments completed elsewhere in the catchment will be required to comply with

PPS25 in terms of flooding resilience and residual flood risk management, which will ensure no significant environmental effects result from cumulative effects.

Operational Effect: **Direct contamination or deterioration of surface water quality** due to leakages of fuel oils, general spillages and other contaminants from within the development and the associated collection of surface water drainage from hardstanding areas.

8.6.11 In assessing the environmental impact of the development in terms of pollution prevention, a water impact appraisal has been completed to assess the potential pollution receptors. The prime water receptors at risk are the ground water, the Tattenhoe Brook and the surrounding ordinary watercourses.

8.6.12 Chemical and Ecological water quality in the River Ouzel to the east of the site has been assessed as Grade B – "Good" by the Environment Agency. National and European legislation will ensure water quality is improved over time, primarily by the implementation of more stringent controls. Accordingly, if the potential impact of development activities is to be avoided, surface water discharged from the development will need to be treated to improve water quality prior to discharge from the site.

8.6.13 Direct contamination of surface and ground water may arise from accidental spillages of chemicals sometimes employed in commercial and industrial development. Such spillages can result in major pollution incidents. Protection of the environment through the usage of chemicals in industry is rigorously defended through appropriate environment legislation, requiring statutory registration of such use and implementation of appropriate means of control. In such circumstances, products that present the most risk are controlled with measures such as double lined tanks, bunded areas and protected cells. To protect the immediate ground and surface water adjacent to such installations, it is normal to provide fully hard covered areas discharging to drainage systems that provide for emergency isolation of such spillage. Where such installations are proposed at the site, the full protection of the ground and surface water environment will be ensured through appropriate installations. The volumes of chemicals stored in development areas being of

residential end usage represent no material pollution risk as long as the phased development follows normal good practice in the design of the site drainage system.

8.6.14 Surface water run-off from development sites routinely contains a series of contaminants, including petrochemical compounds, heavy metals and suspended solids, being predominant in industrial service yards and large car parks. In residential development the small volumes of fuel oils washed from cars represents a far lower pollution risk to surface or ground water quality. The direct discharge of development drainage to adjacent watercourses can potentially lead to a degradation of water quality with associated ecological effects.

8.6.15 Typical chemical concentrations are as follows:

Water Source	Mean Pollutant Concentration (mg/l)					
	Solids	BOD	COD	NH_4	Pb	Oils
Rainfall	8 - 80	1 – 15	2.5 - 32	-	0.024 - 10.4	-
Typical residential areas	187	8.5	80	0.6	0.14	5.1

Table 8d: Typical pollutant concentrations

8.6.16 In mitigation of the risk of silts, chemicals and oil products being conveyed to surface and ground water, it is proposed to implement measures from current best practice surface water management guidance. All service yards, parking areas, roadways and garaging within the development will have concrete or bituminously hard paved surfaces to avoid the direct spillage of materials to ground. Where appropriate, preference will be given to lined permeable paving systems that result in a significant removal of contaminants at source.

8.6.17 Water discharged from such areas will be collected efficiently and receive passive treatment to improve water quality as part of a sustainable drainage system. The system for the collection, conveyance, treatment and disposal of surface water will be designed, in accordance with latest recommendations [(6)], to avoid the risk of leaching potentially contaminated materials to the soil and ground water. This

[6] CIRIA C522, C609, C697 et al

approach is recommended in the Environment Agency documents Pollution Prevention Guidance - Prevention of Pollution (PPG1) and Use and Design of Oil Separators in Surface Water Drainage Systems (PPG3), together with other associated guidance.

8.6.18 Water will be collected and conveyed in main drainage that is adopted by either Anglian Water or an alternative water company. Flows will then be conveyed and detained in a network of detention features prior to discharge to the surrounding watercourses.

8.6.19 The drainage proposals contained within the FRA demonstrate compliance with current guidance by providing appropriate sustainable drainage features that passively treat storm water from the site.

8.6.20 Guidance published in CIRIA C522, SuDS Design Manual for England & Wales, recommends that surface waters from development being primarily of a residential nature have at least one stage of treatment through an appropriately sized sustainable drainage feature. Similarly, at least one treatment stage should be provided on a non-trunk road. Two levels of treatment are recommended for higher risk commercial and employment areas.

8.6.21 In any higher polluting areas, two stages of treatment will be employed by implementing a management train approach of pre-treatment prior to discharge to the ordinary watercourses across the site.

8.6.22 Research and procedures, outlined in CIRIA C609, shows that the incorporation of a treatment train as part of a sustainable urban drainage system provides the most effective method of removing polluting materials from surface water. Removal of between 80 - 95% of the suspended solids, heavy metals and oils can be achieved. Corresponding reductions in Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) can also be achieved. Water quality assessments completed in accordance with CIRIA C609 are contained in the accompanying FRA.

8.6.23 As a result of the planned storm water management proposals, which incorporate sustainable drainage systems, the environmental effect is assessed as an insignificant adverse impact.

8.6.24 **Cumulative Effects:** Regulatory control of other development within the catchment to dictate that equivalent mechanisms are implemented at site level will ensure that potential cumulative effects are insignificant.

Operational Effect: **Direct and indirect contamination of surface water, soil and potential groundwater contamination** due to surcharging of the foul water network or the discharge of untreated foul flows.

8.6.25 When assessing potential effects of the foul drainage, it is important that the proposed system is designed to convey foul waters safely from the site to a suitable treatment facility, without overloading the existing sewerage systems. Furthermore, it is also important that the treatment facility is designed to accommodate the load from the proposed development and that same achieves a discharge quality that does not impact on water quality standards in the receiving watercourse.

8.6.26 In the baseline condition, the Project does not benefit from a connection to the foul sewerage network. However, DETR Circular 3/99 and Building Regulations state that the first presumption when considering new development is to provide positive drainage from that development in conjunction with the local sewerage undertaker. Accordingly, Anglian Water has been involved in investigating the impact of the proposed development on their existing sewerage infrastructure and treatment facilities.

8.6.27 Development proposals to mitigate for the potential environmental effect of the phased delivery of Salden Chase are outlined in the Flood Risk Assessment.

8.6.28 Consultations with Anglian Water confirm that recent studies outline that the current network does not have sufficient capacity to accommodate flows from the proposed

development. Hence to meet the needs of future developments, it will be necessary for Anglian Water to upgrade their existing networks.

8.6.29 The development proposals are therefore being promoted in consultation with Anglian Water to ensure that adequate capacity in the network is provided in a timely fashion. Development activities will be phased in line with available capacity in the foul network and with the improvements to the off-site infrastructure.

8.6.30 Development will be phased in such a way that it poses no threat to the continuing improvements to the existing foul drainage network. Connections will be made solely where sufficient capacity is available. Hence, final proposals to deal with foul drainage at the site will be developed having due regard to flood risk and associated environmental constraints, to ensure that the hydrology of the area is not detrimentally affected.

8.6.31 Water companies have a statutory obligation through the Water Industry Act 1991, 2003 et al, to provide capital investment in strategic treatment infrastructure to meet development growth. This investment planning is managed and regulated by OFWAT through the Asset Management Plan (AMP) process. The five yearly cyclical process requires that water companies allocate finances to a range of strategic projects to meet their statutory obligations.

8.6.32 The strategy for dealing with foul drainage is outlined in greater detail within the FRA.

8.6.33 As a result of the environmental effects of the proposal is assessed as nil.

8.6.34 **Cumulative Effects:** Development Proposals coupled with other development across the strategic drainage catchment will contribute to improvements of the foul water network that will provide headroom in flow and treatment capacity and therefore ensure that no significant cumulative environmental effects occur.

Construction Effect: **Direct and indirect contamination of surface water** due to mobilisation of soils, existing contamination and spillage of oils and the like from construction plant.

8.6.35 Disturbance of the ground during construction operations has the potential to contaminate the soil and both ground and surface waters due to discharge of solids into water or by the short term mobilisation of any background contaminants within the soil matrix.

8.6.36 The discharge of suspended solids to watercourses and ground waters will be avoided by prohibiting any temporary construction discharge without the prior approval of the Environment Agency. Discharges of waters resulting from construction activities will generally be directed to foul sewers, subject to approval of the drainage authority.

8.6.37 Site topography is such that limited if any earthworks will be required to provide gravity surface water drainage. Filling of the land where necessary will be by way of 'cut and fill' earthworks and imported inert material to trim building levels and highway infrastructure to provide gravity drainage across the land. These works will be completed in a manner that protects the water quality environment and ecological interest of the watercourse. The nature of the works and the proposed implementation methods will be agreed with the Environment Agency in advance and all works will accord with the recommendations of EA Pollution Prevention Guidance for Works in, Near or Liable to Affect Watercourses.

8.6.38 Other potential effects relate to the contractor's working practices. For example, there is the potential for fuel oil spillage from stored materials supplying site plant. This potential impact will be controlled by storing such materials within bunded tanks. The works will be completed in a manner that is consistent with the need to protect the surface and ground water quality environment.

8.6.39 It will be incumbent on the selected contractor to assess working practice related risks and effects before implementation and control such by employing industry good practice techniques. Furthermore, the contractor will be required to develop

emergency spillage, flood, fire and contamination control procedures such that any inadvertent incidents are immediately controlled to minimise the potential impact. All works will be completed in accordance with the Environment Agency documents, PPG 6 Working at Construction and Demolition Sites and PPG21 Pollution Incident Response Planning together with current best practice measures for the management of construction activities.

8.6.40 Proposed implementation methods will be developed with the Environment Agency in advance of all works, with appropriate construction phase method statements developed to ensure that no impact on the site hydrology or hydrogeology results from the construction activities

8.6.41 It is assessed that the proposals may result in a short term negative environmental effect, although this will be a relatively low significance due to appropriate mitigation being employed.

Construction Effect: **Direct flooding and changes to baseline drainage hydrology** due to construction related disturbance of the ground.

8.6.42 Flooding and changes to the baseline hydrology can occur due to various construction related activities, such as; deposition of materials within the floodplain, temporary diversion of watercourse, infilling of land altering preferential drainage flow paths and flood routes, and dewatering of excavations. Such effects can have major consequences.

8.6.43 In mitigation of this potential impact, the contractor will be required to:

- where a temporary diversion of a watercourse is necessary, the contractor shall implement an alternative flow route, as close to the source as possible, which will be designed to have no lesser capacity than the original feature. The proposals for such diversions shall be agreed with the regulatory bodies and implemented for the shortest possible time to progress the works;

- the contractor will not be permitted to temporarily store materials or introduce 'borrow pits' or the like in areas that may affect drainage flow paths; and

- any proposed dewatering will be designed to have no material impact on potential receptors such as local watercourse and points of ground water abstraction. Where necessary, the contract will be required to implement ground water recharge as mitigation.

8.6.44 Implementation of appropriate working practices will ensure that no flooding or hydrological environmental effects result from the construction activities.

Summary of Effects

8.7.1 The implementation of appropriate and sustainable Development Proposals coupled with appropriate mitigation will ensure that the Project does not result in a significant environmental effect during either the operational or construction phases.

8.7.2 The following tables summarise the water related impacts:

Operational Impacts	Significance					
	Nil	Insignificant	Low	Significant	High	-ve, neutral +ve impact
Flooding	●					Neutral
Storm water	●					Neutral
Foul water	●					Neutral
Water quality		●				-ve effect

Table 8e: Matrix of Operational Effects

Constructional Impacts	Significance					
	Nil	Insignificant	Low	Significant	High	-ve, neutral +ve impact
Flooding	●					Neutral
Water quality		●				-ve effect short term

Table 8f: Matrix of Constructional Effects

8.7.3 It may be summarised that no significant environmental effects will result in relation to Hydrology and Hydrogeology from the development proposals at Salden Chase.