



The Trevor Price Partnership

Flood Risk And Drainage Assessment

Hospital for the Provision of Children and Adolescent Mental Health Services

880108 R1 (1)

SEPTEMBER 2011





RSK GENERAL NOTES

Project No.: 880108-R1 (0)
Title: Flood Risk And Drainage Assessment Hospital for the Provision of Children and Adolescent Mental Health Services
Client: The Trevor Price Partnership
Date: September 2011
Office: Helsby
Status: Final

Author C Whittingham **Technical reviewer** I Clark

Signature [delete row if not required] _____ Signature [delete row if not required] _____

Date: _____ Date: _____

Project manager C Blinkhorn **Quality reviewer [optional]** _____

Signature [delete row if not required] _____ Signature [delete row if not required] _____

Date: _____ Date: _____

RSK LDE (RSK) has prepared this report for the sole use of the client, showing reasonable skill and care, for the intended purposes as stated in the agreement under which this work was completed. The report may not be relied upon by any other party without the express agreement of the client and RSK. No other warranty, expressed or implied, is made as to the professional advice included in this report.

Where any data supplied by the client or from other sources have been used, it has been assumed that the information is correct. No responsibility can be accepted by RSK for inaccuracies in the data supplied by any other party. The conclusions and recommendations in this report are based on the assumption that all relevant information has been supplied by those bodies from whom it was requested.

No part of this report may be copied or duplicated without the express permission of RSK and the party for whom it was prepared.

Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

This work has been undertaken in accordance with the quality management system of RSK LDE.

CONTENTS

1	INTRODUCTION	1
2	CONTEXT AND SCOPE OF WORKS	2
3	SITE DESCRIPTION	3
3.1	Site Location	3
3.2	Geology, Hydrogeology and Hydrology	3
3.3	Site History	4
3.4	Environment Agency Consultation	4
4	DEVELOPMENT PROPOSALS	5
5	SOURCE OF FLOOD RISK	6
5.1	Environment Agency Flood Zone	6
5.2	Flooding From Rivers (Fluvial Flood Risk)	6
5.3	Flooding From the Sea (Tidal Flood Risk).....	6
5.4	Flooding From the Land (Overland Pluvial Flood Risk)	6
5.5	Flooding From Groundwater	7
5.6	Flooding From Sewers	7
5.7	Flooding From Reservoirs, Canals and Other Artificial Structures	7
6	SURFACE WATER DRAINAGE ASSESSMENT	8
6.1	Scope	8
6.2	Pre-Development Situation	8
6.3	Sustainable Drainage Options.....	8
6.4	Off Site Discharge	8
6.5	SuDs Drainage Principles	9
6.6	Post-Development Situation	10
7	SEQUENTIAL TEST	11
7.1	Land Use Vulnerability	11
8	MITIGATION MEASURES	14
8.1	Context	14
8.2	Finished Floor Levels	14
8.3	Surface Water Management	14
9	CONCLUSIONS AND RECOMMENDATIONS	15
10	REFERENCES	16
11	APPENDICES	1

FIGURES

Figure 1	Site Location Plan
Figure 2	Existing Site Topographic Survey
Figure 3	Proposed Development Plans
Figure 4	Environment Agency Flood Zone Map

APPENDICES

Appendix A	RSK Service Constraints
Appendix B	Environment Agency Correspondence
Appendix C	Yorkshire Water Sewer Records
Appendix D	On Site Drainage Plans
Appendix E	Permeability Testing Report
Appendix F	Microdrainage Calculations

1 INTRODUCTION

RSK LDE Limited has been commissioned by The Trevor Price Partnership to undertake a Flood Risk Assessment (FRA) and review the constraints for a Hospital for the Provision of Children and Adolescent Mental Health Services.

This report has been produced in support of a planning application for an autistic hospital including accommodation space and a sports and amenity building, associated access, soft landscaping and car parking and summarises the items and calculations that have been included in the RSK assessment. This report has been produced in accordance with PPS 25 (Ref. 1) and the Interim Code of Practice for Sustainable Drainage (Ref. 2) with site-specific advice from the Environment Agency, Yorkshire Water, the LPA and the client.

The Environment Agency have confirmed the extent of the Flood Zones adjacent to the site, this confirms that the latest flood map shows the entire site to be located within flood zone 1 (low probability of flood risk). The site area exceeds 1 Ha, and therefore is subject to a surface water drainage assessment under the requirements of PPS 25 to ensure that the proposed development can be suitably drained and does not pose a flood risk to itself or to the surrounding landowners.

The comments given in this report and the opinions expressed are subject to RSK Group Service Constraints provided in **Appendix A**.

2 CONTEXT AND SCOPE OF WORKS

A key element of project development is to prepare a Flood Risk Assessment to establish the risk associated with the proposed development and to propose suitable mitigation, if required to reduce the risk to a more acceptable level.

The scope of work relating to a flood risk assessment is based on the guidance provided in PPS 25 (Ref. 1) and the accompanying guidance published by the Communities and Local Government Office (Ref. 3) and comprise of the following elements:

- To obtain information on the hydrology and hydrological regime in and around the site.
- To obtain the views of the Environment Agency including scope, location and impacts.
- To determine the extent of new flooding provision and the influence on the site.
- To review site surface water drainage based on the proposed layout. To determine the extent of infrastructure required.
- To review architect plans and planning information and other studies to determine the existing site conditions.
- To assess the impact on the site from global warming effects and anticipated increases in rainfall over a 100 year period for residential use or 60 years for commercial uses.
- Preparation of a report including calculations and summaries of the source information and elements reviewed.

3 SITE DESCRIPTION

3.1 Site Location

The site forms the northeastern quarter of the Shortwood Business Park site. Shortwoods is located in a mixed rural/residential/commercial area to the south of Barnsley and 1km north of Hoyland. It may be located by National Grid reference SE 358 018. A site location plan is presented in **Figure 1**.

The site is bounded by:

- Northwest – by a dismantled railway with open land beyond
- Northeast – the lands around High Royd Farm
- South – Directly fronting High Royd Lane and the Shortwood Business Park

The total site area is 4.25Ha, with little or no hardstanding (buildings and roadways). The topographical survey of the site is presented in **Figure 2**. It shows that the site falls between 127.00m to the south to 105.00m AOD at the northern corner of the site, with a general fall towards the disused railway.

3.2 Geology, Hydrogeology and Hydrology

Available geological records for the area indicate the site to be underlain by Shales, Sandstones and Mudstones of the Middle Coal Measures of the Upper Carboniferous period at the horizon of the Kents Thin and Kents Thick Coal Seams.

The Groundwater Vulnerability Map indicates the site to be underlain by a Minor Aquifer (Coal Measures) overlain by soils of High (a worst case scenario due to the availability of less data for urban areas) and Low leaching potential, in the southern and northern sections of the site, respectively. Therefore the vulnerability of the groundwater to possible contamination at the site is considered to be relatively low.

The area, including the subject site, has also been undermined in the past in several deep-worked coal seams, at depths of between 65m and 420m. However, it is stated that any mining subsidence at the surface in association with this mining activity should have ceased by 1996.

Two disused mine shafts are present to the north west of the subject site. The approximate location of these shafts is shown on **Figure 2**. These shafts are thought to be sunk to a minimum depth of 65m to the Barnsley Seam, although the Coal Authority has no record of any treatment of these shafts. Anecdotal information indicates that during the clearance of the former brickworks buildings in 1997 that at least one of these shafts was encountered and comprised an approximately 5m diameter brick lined shaft, which was not capped, but loosely backfilled with brick rubble.

RJB Mining carried out more recent open cast works in the mid 1990s. It is not clear how much of the subject area was included within these works, however, it is known that the main access road ran through the subject site and this was infilled (with several metres thickness of colliery spoil) on completion of the works in 1997.

A balancing pond is located just to the south west of the subject site, which receives surface runoff and shallow perched water from the surrounding soils. The old pond still remains (to the south of the former Brickworks, however, it is understood that this no longer receives run-off water from the adjacent areas (as this is diverted into the new pond) and this will be infilled at

some future time. The water level in the new pond was approximately 4m below the surrounding ground level at the time of the site visit in January 2007.

A stream, Shortwood Dyke, lies approximately 250m to the north west of the subject site and appears to drain in a north-easterly direction, but (with the exception of the balancing pond) there are no other significant water features within 500m of the site.

Surface infiltration of rainwater will be through areas of soft landscaping or via leaking drains, if present. Movement of shallow perched water in fill materials or near surface permeable soils is likely to be to the north east, following the local topography.

3.3 Site History

The north-western corner of the subject site was formerly occupied by part of Hoyland Brickworks, with an associated refuse tip located approximately half way along the northern boundary of the site. It appears that the kilns were probably located on the north-western corner of the site. The eastern two-thirds of the site remained undeveloped. Opencast coal mining occurred extensively to the south of the subject site and part of the open cast workings extended into the centre subject site from the south. The site was formerly part of the High Royal Colliery and two coal-mining shafts associated with this use are present within the north-western part of the subject site.

Information made available to RSK indicates that the buildings on the former brickworks were demolished and cleared by VHE Construction Plc during 1997. At the same time the Dearne Towns Link Road was constructed to the south of the site and it is understood that arisings from this (some 30,000m³ of predominantly reworked mudstone) was placed over the former brickworks site to an average thickness of 1.5m.

3.4 Environment Agency Consultation

A number of previous flood risk assessment has been prepared by RSK for the proposed development site. These reports relate to an alternative layout for the site, however the principal for development remains. This report addresses the flood risk to the latest development layout.

More recent correspondence between RSK and the Environment Agency (**Appendix B**), has agreed a discharge rate for surface water from the site following development. It is proposed to limit the off site discharge of surface water to a maximum of 21l/s for the 1 in 100-year rainfall event including an allowance for climate change, with all additional flows retained on site. The point of discharge of surface water will be a Yorkshire Water sewer located along the northwest boundary of the site. This 300mm diameter storm water sewer discharges directly into Shortwood Dyke.

4 DEVELOPMENT PROPOSALS

This assessment has been based on the proposed site as detailed in **Figure 3**. The proposals are for the construction of an Autistic Hospital complex featuring 5 self-contained residential blocks, these surround a central activity resource hub. The main entrance to the site is from High Royd Lane to the south. A single-track one-way perimeter road is to surround the complex providing access to all of the new development. The main car park area for the site is located along the south and west boundary of the site.

The scheme also includes landscaping, car parking and embankments along the boundaries of the site.

The proposed total impermeable area (hardstanding and roof areas) will be in the order of 11,248m².

5 SOURCE OF FLOOD RISK

The flood risk elements that need to be considered for any site are defined in PPS25 as the “Forms of Flooding” and are listed as:

- Flooding from Rivers (fluvial flood risk)
- Flooding from the Sea (tidal flood risk)
- Flooding from the Land (overland pluvial flood risk)
- Flooding from Groundwater
- Flooding from Sewers (sewer and drain exceedance, pumping station failure etc)
- Flooding from Reservoirs, Canals and other Artificial Structures

The following section reviews each of these in respect of the subject site.

5.1 Environment Agency Flood Zone

The Environment Agency has produced Flood Zone maps for much of England and Wales. The current displayed map is reproduced as **Figure 4**. The latest Flood Zone map shows the flood risk to the site is a low.

5.2 Flooding From Rivers (Fluvial Flood Risk)

The Environment Agency flood zone map details the flood risk from fluvial and tidal sources. The site is located wholly within flood zone 1, therefore flood risk from this source is considered low.

5.3 Flooding From the Sea (Tidal Flood Risk)

On the coast storm surges and high tides can threaten low lying coastal areas, and can be sometimes large and rapid enough to overtop defence works, causing significantly more damage than river flooding. However, tidal flooding is not considered a risk to the site.

5.4 Flooding From the Land (Overland Pluvial Flood Risk)

If intense rain is unable to soak into the ground or be carried through man made drainage systems, for a variety of reasons, it can run off over the surface causing localised floods before reaching a river or other watercourse.

Excess surface water flows from the site are believed to drain naturally to the local water features, either by overland flow or through infiltration. Flooding from this source is considered low and will be considered within the layout of the site, ensuring properties are not at increased risk.

5.5 Flooding From Groundwater

In some areas underground permeable rocks can become saturated by rainfall, releasing water onto the surface as floods into intermittent channels, or gradually flooding areas as the local water table rises. This can sometimes be a seasonal phenomenon, water tables rising in the wetter winters before dropping again in the summer. It is related to specific geological conditions and rock types. It also is slower to develop and slower to recede than other types of flooding. This is not considered by the Environment Agency to be a significant flood risk factor in the area.

The site is not located within an area known to be at risk of groundwater flooding.

5.6 Flooding From Sewers

Most adopted surface water drainage networks are designed to the criteria set out in Sewers for Adoption (Ref. 4). One of the design parameters is that sewer systems be designed such that no flooding of any part of the site occurs in a 1 in 30 year rainfall event. By definition a 1 in 100 year event would exceed the capacity of the surrounding sewer network as well as any proposed drainage. When exceeded, the surcharged pipework will lead to flooding from backed up manholes and gully connections. This will lead to immediate flooding within highways surrounding the site.

A copy of the Yorkshire Water sewer records is included as **Appendix C**, these records show that there are no adopted sewer infrastructure under the developable area of the site.

Flooding of the site from this source is considered low, provided any new infrastructure is installed in line with current best practice.

5.7 Flooding From Reservoirs, Canals and Other Artificial Structures

The Environment Agency has recently published flood mapping as a result of potential failure of reservoirs. This map shows the site is not in an area at risk of flooding from this source. There are no other known structures in the vicinity of the site that could pose a flood risk to the site.

The site is not thought to be at risk from this source, therefore the flood risk to the site from reservoirs, canals and other artificial structures is low.

6 SURFACE WATER DRAINAGE ASSESSMENT

6.1 Scope

A drainage design strategy has been carried to identify the options for the design of the surface water drainage system and how it will affect the site layout. The following requirements apply to Greenfield and Brownfield sites alike and also sites which drain to a combined sewer.

This report will:

- Demonstrate how the principles of Sustainable Drainage Systems have been applied to the development identifying what techniques will be used.
- Set aside land specifically for SUDS.
- Estimate the discharge rate for the site. Greenfield discharge rates should be sought on Greenfield sites, and also on Brownfield sites (where possible).
- Estimate the volume of 1 in 100 year attenuation to be provided and what techniques will be used to provide the attenuation.
- Take into account PPS25's climate change requirements.

6.2 Pre-Development Situation

Drainage records and correspondence were obtained from Yorkshire Water for the site (**Appendix C**). These indicate that the adopted sewer terminates within the site boundary along the northern perimeter and that Yorkshire Water will accept surface water discharging to the 300mm public surface water sewer.

A plan showing on-site drainage was provided by WSP from records of the as-built Shortwood Business Park development drainage (included as **Appendix D**). This plan confirms the presence of a 300mm sewer at the west access point of the site and that this flows east before turning north, to connect to an existing public sewer located within the northern part of the site. This sewer has a minimum longitudinal gradient of 1 in 50.

6.3 Sustainable Drainage Options

In order to define the proposed post-development drainage solution, the use of sustainable drainage systems, for surface water management and the disposal of surface water run-off, has been considered in this assessment. The options available, based upon guidance given in the CIRIA publication 'The SUDS Manual' (Ref. 5), are summarised in the table below. The suitability of the use of each SUDS feature on this site is also commented upon in this table. For each infiltration component, the aim will be to have a dry buffer with a minimum depth of 1.0m between its underside and the water table.

6.4 Off Site Discharge

On all development sites an order of preference exists for drainage receptors. Infiltration drainage should be used where possible. Where this is not possible, or does not provide

sufficient capacity, attenuated discharge to watercourses should be sought. Only where neither of these two options is available should discharge to sewers be considered.

Infiltration

The recently published Flood and Water Management Act has implications for the design, approval, construction and maintenance of SuDS, and affect all new developments. On all development sites discharge of surface water to the ground, or infiltration, is the preferred drainage solution; however the effectiveness of infiltration is completely dependent on the physical conditions at the site. Permeability testing has been carried out at 4 locations within the site boundary, a copy of the report is included as **Appendix E**. The report concluded that infiltration was feasible within localised pockets on the site.

Discharge to Watercourse

Infiltration techniques are not sufficient to discharge all the surface water generated on the site, therefore discharge to watercourse should be considered. To ensure that downstream flood risk is not exacerbated, the run-off rate from the site into a watercourse should not exceed that of the agreed run-off rate, with any exceedance on this rate attenuated on site. The proposed point of discharge off the site is to a Yorkshire Water adopted sewer which discharges into the watercourse and therefore on site attenuation has been considered on the site.

Discharge to Sewer

A number of Yorkshire Water sewers are located in the road directly adjacent to the site, should discharge to groundwater or watercourse not be possible, discharge to sewer should be considered, subject to further approvals. As mentioned above, the proposed point of discharge is a Yorkshire Water surface water sewer. This point of connection has been previously agreed with Yorkshire Water who are willing to accept a peak discharge rate of 60.0l/s. The Environment Agency have requested a peak discharge rate of 21.0l/s. The proposed discharge rate from the site will be 21.0l/s to meet the Environment Agency requirements.

6.5 SuDs Drainage Principles

A SuDs system aims to mimic natural systems whereby water is held close to the source, then released slowly over time, this acts to both reduce peak discharge and to promote the settlement of sediment thereby improving the water quality of any resulting discharge.

The final sustainable drainage strategy for this site will be designed in line with the SuDS management train. This requires that;

1. Source control techniques such as permeable paving, green roofs and rainfall harvesting are incorporated into the development design wherever reasonably possible.
2. Where appropriate infiltration drainage is encouraged
3. In situations where it is not possible to discharge all surface water to the ground, storm water will be controlled and discharged as locally as possible with excess storm water stored on the site in surface water features.
4. Off site solutions and hard engineering to achieve the design criteria will only be considered where it can be demonstrated that more sustainable options above are not possible.

6.6 Post-Development Situation

Yorkshire Water has accepted a point of connection to the storm water sewer discharging to the watercourse and will allow a maximum rate of discharge of 60.0l/s. The Environment Agency has also been consulted on the proposed discharge rate and will allow a maximum discharge rate of 21.0l/s (EA Ref: 2011/16790). The following is based on a discharge rate of 21.0l/s. The restriction in off site discharge to 21.0l/s rate may require additional on-site attenuation and other measures to ensure that flooding does not occur during times of increased or intense rainfall.

WINDES software was employed to calculate the potential storage requirements that would be needed on this site by limiting offsite run-off to 21.0 l/s for the 1 in 100 year event (it should also be noted that a 30% increase in rainfall was included to account for the impacts of climate change). A scope of rainfall events have been used from 15 to 10080 minutes, incorporating both winter and summer events to determine the required volume of on site storage based on a wide range of rainfall scenarios. Assuming a single infiltration basin, the required attenuation volume has been estimated to be 448.5m³, full details of the model are included as **Appendix F**. This volume has assumed no infiltration and therefore assumes the worst-case scenario. In addition, the storage volume estimate does not take into account other sustainable drainage features that may be utilised on site such as swales, bioretention areas and permeable paving. It is therefore likely that SuDS features may offer attenuation throughout the development reducing the need for a single storage structure.

A number of techniques could be employed at various levels on the site including source control such as water butts and rainwater harvesting to larger scales solutions such as swales to attenuate and convey surface water toward retention basins, which will store water at times of increased rainfall. Surface water attenuation will be provided to accommodate excess runoff generated from events up to and including the 1 in 100 year rainfall event including a 30% increase for climate change. A detailed solution should be submitted to, and approved by the Local Authority prior to development commencement.

7 SEQUENTIAL TEST

7.1 Land Use Vulnerability

Within PPS 25 Annex D (**Ref. 1**) each Flood Zone has a list of appropriate land uses dependent on vulnerability to flooding. The Flood Zones are described in Table D.1 of PPS 25: Flood Zones reproduced as Table 7.1 below.

<u>Zone 1 Low Probability</u> Definition This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%). Appropriate uses All uses of land are appropriate in this zone. FRA requirements For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a FRA. This need only be brief unless the factors above or other local considerations require particular attention. See Annex E for minimum requirements. Policy aims In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage techniques.
<u>Zone 2 Medium Probability</u> Definition This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1%) in any year. Appropriate uses The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure in Table D.2 are appropriate in this zone. Subject to the Sequential Test being applied, the highly vulnerable uses in Table D.2 are only appropriate in this zone if the Exception Test (see para. D.9.) is passed. FRA requirements A FRA should accompany all development proposals in this zone. See Annex E for minimum requirements. Policy aims In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage techniques.
<u>Zone 3a High Probability</u> Definition This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year. Appropriate uses The water-compatible and less vulnerable uses of land in Table D.2 are appropriate in this zone. The highly vulnerable uses in Table D.2 should not be permitted in this zone. The more vulnerable and essential infrastructure uses in Table D.2 should only be permitted in this zone if the Exception Test (see para. D.9) is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood. FRA requirements A FRA should accompany all development proposals in this zone. See Annex E for minimum requirements. Policy aims In this zone, developers and local authorities should seek opportunities to: - reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage techniques; - relocate existing development to land in zones with a lower probability of flooding; and - create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.

Zone 3b The Functional Floodplain

Definition

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

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

Appropriate uses

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

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

Essential infrastructure in this zone should pass the Exception Test.

FRA requirements

A FRA should accompany all development proposals in this zone. See Annex E for minimum requirements.

Policy aims

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

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

TABLE 7.1: Flood Zones

The vulnerability classes are related to the sensitivity of the development to flooding and consider the risk to people, property and services. The vulnerability classification Table D2 from PPS25 is reproduced below as Table 7.2.

Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk, • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, inc. electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. Wind turbines
Highly Vulnerable	• Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations required being operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent.¹ (where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as “Essential Infrastructure”²)
More Vulnerable	• Hospitals. • Residential institutions such as residential care homes, children’s homes, social services homes, prisons and hostels. • Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels. • Non-residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste.³ • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less Vulnerable	• Police, ambulance and fire stations not required to be operational during flooding • Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non-residential institutions not included in ‘more vulnerable’; and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment works which do not need to remain operational during times of flood • Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).

Water-compatible Development	• Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel workings. • Docks, marinas and wharves. • Navigation facilities. • MOD defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.
-------------------------------------	--

TABLE 7.2: Flood Risk Vulnerability Classification

The site is currently classified as open space and the redevelopment will change its planning designation to more vulnerable residential.

In applying the sequential test, reference is made to the following table (Table 7.3), contained within Annex D3 of PPS 25. It can be seen from the table below that the development is appropriate in the Flood Zone 1.

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1	Appropriate	Appropriate	Appropriate	Appropriate	Appropriate
	Zone 2	Appropriate	Appropriate	Exception Test Required	Appropriate	Appropriate
	Zone 3a	Exception Test Required	Appropriate	Should not be permitted	Exception Test Required	Appropriate
	Zone 3b (functional floodplain)	Exception Test Required	Appropriate	Should not be permitted	Should not be permitted	Should not be permitted

TABLE 7.3: Flood Risk Vulnerability Classification and Flood Zone 'Compatibility'

8 MITIGATION MEASURES

8.1 Context

The development areas of the site are not a direct risk of tidal or fluvial flooding and hence the mitigation measures relate to the provision of drainage controls as described above. The following are included for reference.

8.2 Finished Floor Levels

One of the most robust methods of removing a development from the floodplain is to raise the ground floor level above the predicted design flood levels.

The whole of the site is located within Flood Zone 1 with no other known sources of flood risk, therefore the setting of finished floor levels will be set no lower than 150mm above the surrounding ground to ensure that the thresholds of the development are not exceeded should surface water drainage systems be exceeded.

8.3 Surface Water Management

The volume of surface water runoff from the site will be restricted to maintain existing runoff rates from across the site. Surface water attenuation will be provided to accommodate excess runoff generated from events up to and including the 1 in 100 year rainfall event including a 30% increase for climate change.

Surface water in excess of that generated by the 1 in 100 year + 30% climate change rainfall event will be carefully considered at the detailed design stage and flood routing will be provided to steer flows away from any development.

9 CONCLUSIONS AND RECOMMENDATIONS

This flood risk assessment has been prepared in support of the proposed development of an Proposed Autistic Hospital including accommodation space and sports and amenity building, associated access, soft landscaping and car parking.

The site is located wholly within Flood Zone 1 according to the latest Environment Agency Flood Zone maps. Suitable mitigation can be incorporated into the site development to ensure that flood risk to the proposed development remains low and meets the requirements of PPS 25.

Data obtained from the SFRA and other sources also places the site at low risk of flooding from other sources.

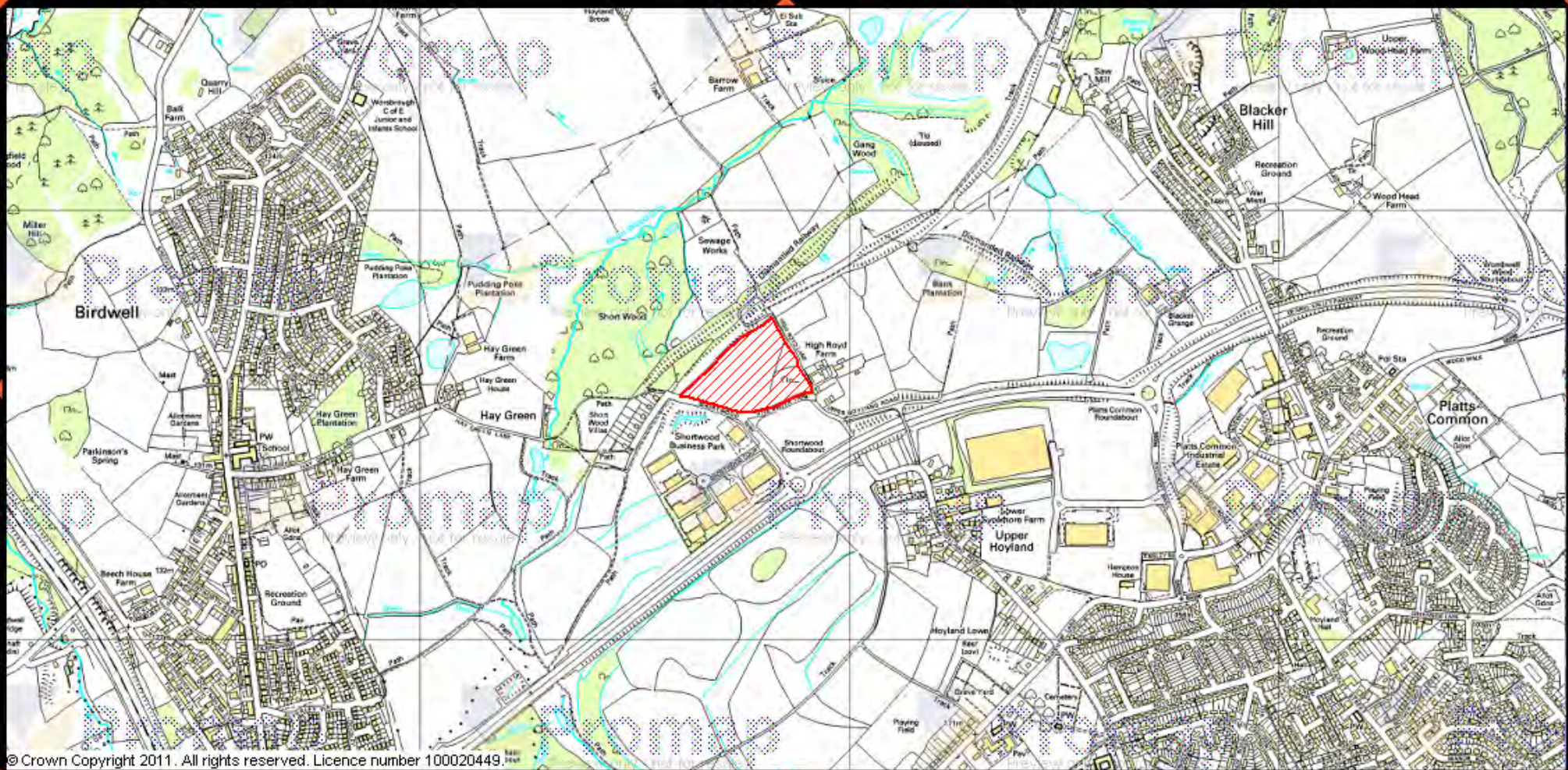
In accordance with PPS 25 and local policy, this FRA has considered the impact on the surface water regime in the area should development occur. Development of the site should be possible with careful consideration of the surface water and foul drainage, as well as other possible flooding issues. The proposals should restrict the office discharge to an agreed limit of 21.0l/s (for the 1 in 100-year event including an allowance for climate change) balance the flood storage volumes and should not impede flood flows.

Based on the information available the flood risk to the proposed development is **low** and **development should not be precluded** on flood risk grounds.

10 REFERENCES

1. Communities and Local Government “Planning Policy Statement – Development and Flood Risk” PPS 25, Mar 2010.
2. Communities and Local Government “Planning Policy Statement 25: Development and Flood Risk Practice Guide”, Dec 2009.
3. DEFRA “Interim Code of Practice for Sustainable Drainage Systems” National SUDS Working Group, July 2004.
4. WRC “Sewers for Adoption” 6th Edition, 2006.
5. Institute of Hydrology (IoH) “Flood Estimation for small catchments” Report 124, 1994

FIGURES



E: 436239.69 N: 401719.4 OS: SE362017 NGR: SE3601NW



Site Location Plan

Client: The Trevor Price Partnership

Figure: 1

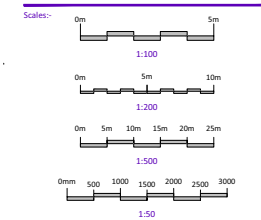
Site: Shortwood Way, Hoyland

Job No: 880108-01 (00)

Scale: NTS

Source: Promap

- Notes:
1. Do not scale this drawing
 2. All dimensions to be checked on site and any discrepancies to be reported to Foresite Architectural Limited immediately
 3. Any indication of services is approximate only and full investigation should be carried out on site prior to commencing the works
 4. It is the responsibility of the contractor to comply with building regulations whether or not wholly depicted on this drawing
 5. To be read in conjunction with any specialist Structural, Geotechnical or Mechanical design by others.
 6. Based on information provided by Holden Surveys Ltd
 7. Borehole / Rockhead depth information taken from data supplied by RSK - "Figure 17"
 8. Borehole depths as plotted on section are not necessarily on the true section line and data must therefore be interpolated as necessary



Revisions	Date	Desc.
A	23/04/2011	Landscape omitted

fore-site

Unit A
Halesfield 19
Telford
Shropshire
TF7 4QT

Tel: 01952 - 898078
Fax: 01952 - 457900
Email: info@fore-site.co.uk
Web: www.fore-site.co.uk

Client:- The Trevor Price Partnership

Project:- Proposed Hospital for the Provision of Children and Adolescent Mental Health Services

Drawing:- Proposed Site Plan

Scale:- 1:500 Drawn:- D. Briscoe Date:- Aug '11

Project Reference:- 09_FSLTD_065 Dwg. No:- PL01 Rev:- A



PROPOSED SITE PLAN - 1:500

A A A

[About us](#) [Jobs](#) [Contact us](#) [Sitemap](#) [Help](#)

Search

Go



Risk of Flooding from Rivers and Sea

Enter postcode or place name:

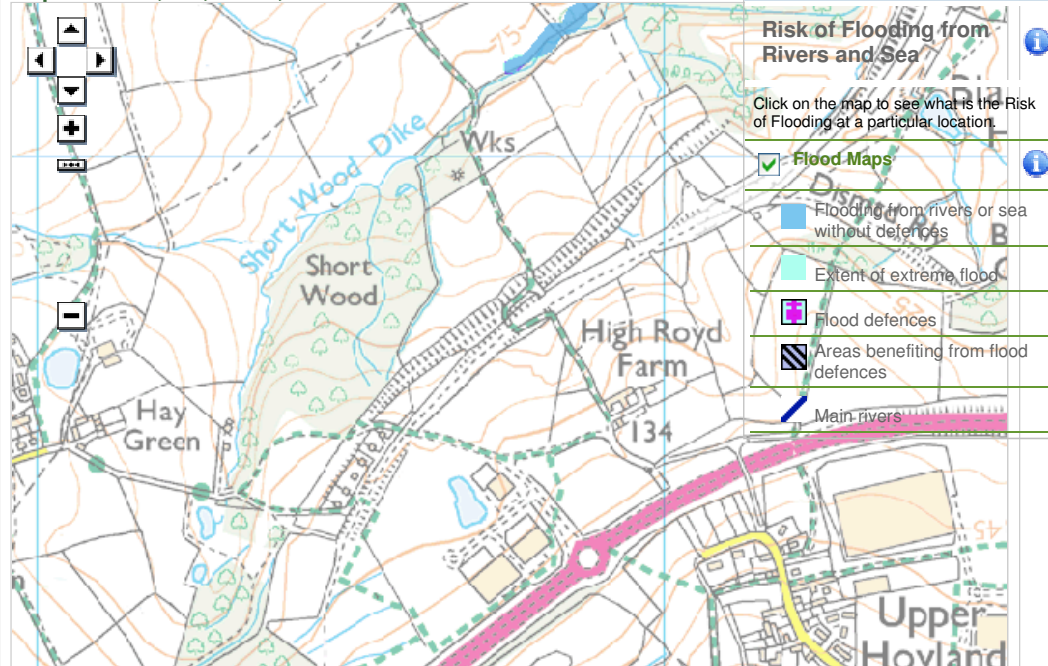
Overview map:



Other topics for this area...

[Risk of Flooding from Rivers and Sea](#)[Risk of Flooding from Reservoirs](#)[Flood Warning Areas](#)[Landfill](#)[Pollution](#)[Air Pollution](#)[River Quality](#)[Bathing Water Quality](#)[Groundwater](#)[Environment Agency Offices](#)[River Basin Management Plans - Rivers](#)[River Basin Management Plans - Lakes](#)[River Basin Management Plans - Coastal Waters](#)[River Basin Management Plans - Estuarine](#)[River Basin Management Plans - Groundwater](#)

Map of X: 435,757;Y: 401,714 at scale 1:10,000



© Environment Agency copyright and database rights 2011.

© Ordnance Survey Crown copyright. All rights reserved. Environment Agency, 100026380, contains Royal Mail data © Royal Mail copyright and database right 2011.

[view text version of all results](#)

Flood Mapping of the Manchester Ship Canal in Trafford, Salford and Warrington may be subject to revision in our May 2011 update as a result of representations.

For further information please contact us on 08708 506 506.

Users of the Flood Zone Map should be aware that we have received a judicial review challenge to the mapping of the Manchester Ship Canal at Trafford, Salford and Warrington on the ground that the preparation of the map is flawed in respect of our consideration of the role of the sluice gates in preventing flooding.

We are defending the challenge and believe and are advised that it is ill-founded. Nevertheless, pending determination of the challenge, users of the map need to consider whether the existence of the challenge, and the basis of it, affects the weight they judge may be given to the zoning of the Manchester Ship Canal within the Flood Map.

More about flooding:

Understanding the flood map

A more detailed explanation to help you understand the flood map shown above.

Current flood warnings

We provide flood warnings online 24 hours a day. Find out the current flood warning status in your local area.

Flood map - your questions answered

Answers to commonly asked questions about the flood map.

creating a better place

11 APPENDICES



APPENDIX A

RSK SERVICE CONSTRAINTS



RSK GROUP SERVICE CONSTRAINTS

1. This report and the Drainage design carried out in connection with the report (together the "Services") were compiled and carried out by RSK LDE Ltd (RSK) for (the "client") in accordance with the terms of a contract between RSK and the "client". The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable Civil Engineer at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.
2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.
3. Unless otherwise agreed the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.
4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date hereof, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.
5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.
6. The observations and conclusions described in this report are based solely upon the Services, which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.
7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.
8. The phase II or intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.
9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site.



APPENDIX B

ENVIRONMENT AGENCY CORRESPONDENCE

Colin Whittingham

From: Chris Blinkhorn
Sent: 05 September 2011 09:51
To: Colin Whittingham
Subject: FW: Your Enquiry: RFI/2011/16790
Attachments: Standard Notice.pdf

From: Beech, Cheryl [mailto:Cheryl.Beech@environment-agency.gov.uk]
Sent: 18 April 2011 10:20
To: Chris Blinkhorn
Subject: Your Enquiry: RFI/2011/16790

Our Ref: RFI/2011/16790

Your Ref:

Dear Sirs

RE: Proposed Autistic Hospital Development off Shortwood Way, Hoyland, Barnsley – Confirmation of Allowable Discharge Rate into Shortwood Dyke Adopted Public Sewer

Thank you for your enquiry dated 28 March 2011.

We have looked at the information you have supplied in your recent enquiry. We have discussed the site in more detail with the drainage engineer at Barnsley Council, he has dealt with the site for a number of years.

At the Outline planning application stage a condition was agreed by us and Barnsley Drainage ref 2007/0760 to the fact that a discharge rate of 60 litres per second was not acceptable. The condition stated that because of the change in policy from PPG 25 to PPS25 surface water drainage from the site should be attenuated to a maximum of 5 litres/second/hectare for the impermeable area. The balancing facility designed to accommodate a 1 in 30 year storm flow from the site and a 1 in 100 year flow retained within the site without causing flooding to property. This condition was to be attached to any subsequent planning consent for the development of the site.

This was interpreted by the applicant as a discharge rate of 4.88 l/s (5l/s/ha x approx. 0.9ha of paved area) This discharge rate was used for the preliminary design of the site drainage and submitted in the flood risk assessment accompanying the reserved matters planning application (2008/????) to discharge the conditions attached to application ref: 2007/0760. This figure was agreed by Yorkshire Water as the approved discharge rate into the public sewer. Therefore this discharge rate applies to the planning permission granted on this site.

We understand this may be seen as a low discharge rate for a site of this size and therefore are willing, on this occasion, to relax this condition to 5l/s/ha for the whole of the development area (i.e. 21l/s maximum discharge from the site).

If the developer wishes to increase the discharge from the site into the public sewerage system to 21l/s, he will need to formally consult Yorkshire Water to agree the new rate.

The Environment Agency will need to see Yorkshire Water's written consent to the revised rate prior to any agreement to this rate.

If you wish to discuss the site further with the engineer dealing with the Barnsley area, Lesley Slaney can be contacted on (0113) 213 4779.

This information is provided subject to the attached notice which you should read.

If you require any further help, please do not hesitate to contact me.

Yours sincerely

Cheryl Beech
External Relations Team
Direct Dial 0113 2134732
Email neyorkshire@environment-agency.gov.uk

Days of work - Mon to Thurs

Environment Agency
Phoenix House
Global Avenue
Leeds LS11 8PG

Part of the Environment Agency's Yorkshire and North East Region

We would be really grateful if you could spare five minutes to help us improve our service. Please click on the link below and fill in our survey – we use every piece of feedback we receive.

<https://web.questback.com/isa/qbv.dll/SQ?q=8w2Qkfx%2BivseokDpT0B1XBiMdadcYMuJJ8OUhDng6Hc%2Fbg%3D%3D>

Information in this message may be confidential and may be legally privileged. If you have received this message by mistake, please notify the sender immediately, delete it and do not copy it to anyone else.

We have checked this email and its attachments for viruses. But you should still check any attachment before opening it.

We may have to make this message and any reply to it public if asked to under the Freedom of Information Act, Data Protection Act or for litigation. Email messages and attachments sent to or from any Environment Agency address may also be accessed by someone other than the sender or recipient, for business purposes.

If we have sent you information and you wish to use it please read our terms and conditions which you can get by calling us on 08708 506 506. Find out more about the Environment Agency at www.environment-agency.gov.uk

Colin Whittingham

From: Chris Blinkhorn
Sent: 05 September 2011 09:51
To: Colin Whittingham
Subject: FW: Shortwood Way, Shortwood Business Park, Barnsley - Erection of autism hospital

CBlinkhorn@rsk.co.uk>

Yorkshire Water Services
Developer Services
Sewerage Technical Team
PO BOX 52
Bradford
BD3 7AY

Your Ref:
Our Ref: J001218

Tel: 0845 120 8482
Fax:
For telephone enquiries ring:
Robert Howard on 0845 120 8482

9th May 2011

Dear Sir,

Shortwood Way, Shortwood Business Park, Barnsley - Erection of autism hospital

I refer to your e-mail dated 5th May 2011 regarding the above proposed development.

Yorkshire Water has no objections to a surface water discharge rate of 21 (twenty one) l/sec to the 300mm diameter public surface water sewer within the site which discharges directly into Shortwood Dyke.

Yours faithfully

Robert Howard
for : Developer Services Team

- -----
Putting the wrong things down toilets and sinks can cause your pipes to become blocked. Find out about our 'Are You Doing The Dirty?' campaign to see how you can avoid becoming the next victim. <http://www.yorkshirewater.com/doingthedirty>

Don't forget to request your free water saving pack, it could save you money on other utility bills whilst also helping to conserve water.
<http://www.yorkshirewater.com/savewater>

The information in this e-mail is confidential and may also be legally privileged. The contents are intended for recipient only and are subject to the legal notice available

at <http://www.keldagroup.com/email.htm>

Yorkshire Water Services Limited

Registered Office Western House, Halifax Road, Bradford, BD6 2SZ Registered in England
and Wales No 2366682

Colin Whittingham

From: Chris Blinkhorn
Sent: 05 September 2011 09:51
To: Colin Whittingham
Subject: FW: Your Enquiry: RFI/2011/16790 FO
Attachments: Standard Notice.pdf

From: Riley, Stacey [mailto:stacey.riley@environment-agency.gov.uk]
Sent: 12 May 2011 08:52
To: Chris Blinkhorn
Subject: Your Enquiry: RFI/2011/16790 FO

Our Ref: RFI/2011/16790 FO

Your Ref:

Dear Chris

RE: Shortwood Way, Barnsley

Thank you for your enquiry dated 9th May 2011.

I can confirm that we are in receipt of the e-mail received by Yorkshire Water dated 9 May 2011. Which states that they have no objections to a surface water discharge rate of 21 litres per second to the 300mm diameter public surface water within the site which discharges directly into Shortwood Dyke.

As a result of this confirmation the Environment Agency & Barnsley Metropolitan Borough Council Drainage Department can confirm that the surface water discharge rate of 21litres per second to the 300mm public sewerage system within the site is acceptable.

This information is provided subject to the attached notice which you should read.

If you require any further help, please do not hesitate to contact me.

Yours sincerely,

Stacey Riley

External Relations Officer

Tel: 0113 3954506 (Internal 728 4506)

Email: stacey.riley@environment-agency.gov.uk

Environment Agency

Phoenix House

Global Avenue

Leeds LS11 8PG

Part of the Environment Agency's Yorkshire and North East Region

We would be really grateful if you could spare five minutes to help us improve our service. Please click on the link below and fill in our survey – we use every piece of feedback we receive.

<https://web.questback.com/isa/qbv.dll/SQ?q=8w2Qkfx%2BivseokDpT0B1XBiMdadcYMuJJ8OUhDng6Hc%2Fbg%3D%3D>

Information in this message may be confidential and may be legally privileged. If you have received this message by mistake, please notify the sender immediately, delete it and do not copy it to anyone else.

We have checked this email and its attachments for viruses. But you should still check any attachment before opening it.

We may have to make this message and any reply to it public if asked to under the Freedom of Information Act, Data Protection Act or for litigation. Email messages and attachments sent to or from any Environment Agency address may also be accessed by someone other than the sender or recipient, for business purposes.

If we have sent you information and you wish to use it please read our terms and conditions which you can get by calling us on 08708 506 506. Find out more about the Environment Agency at www.environment-agency.gov.uk



APPENDIX C

YORKSHIRE WATER SEWER RECORDS



Yorkshire Water
Sewer Plan



APPENDIX D

ON SITE DRAINAGE PLANS

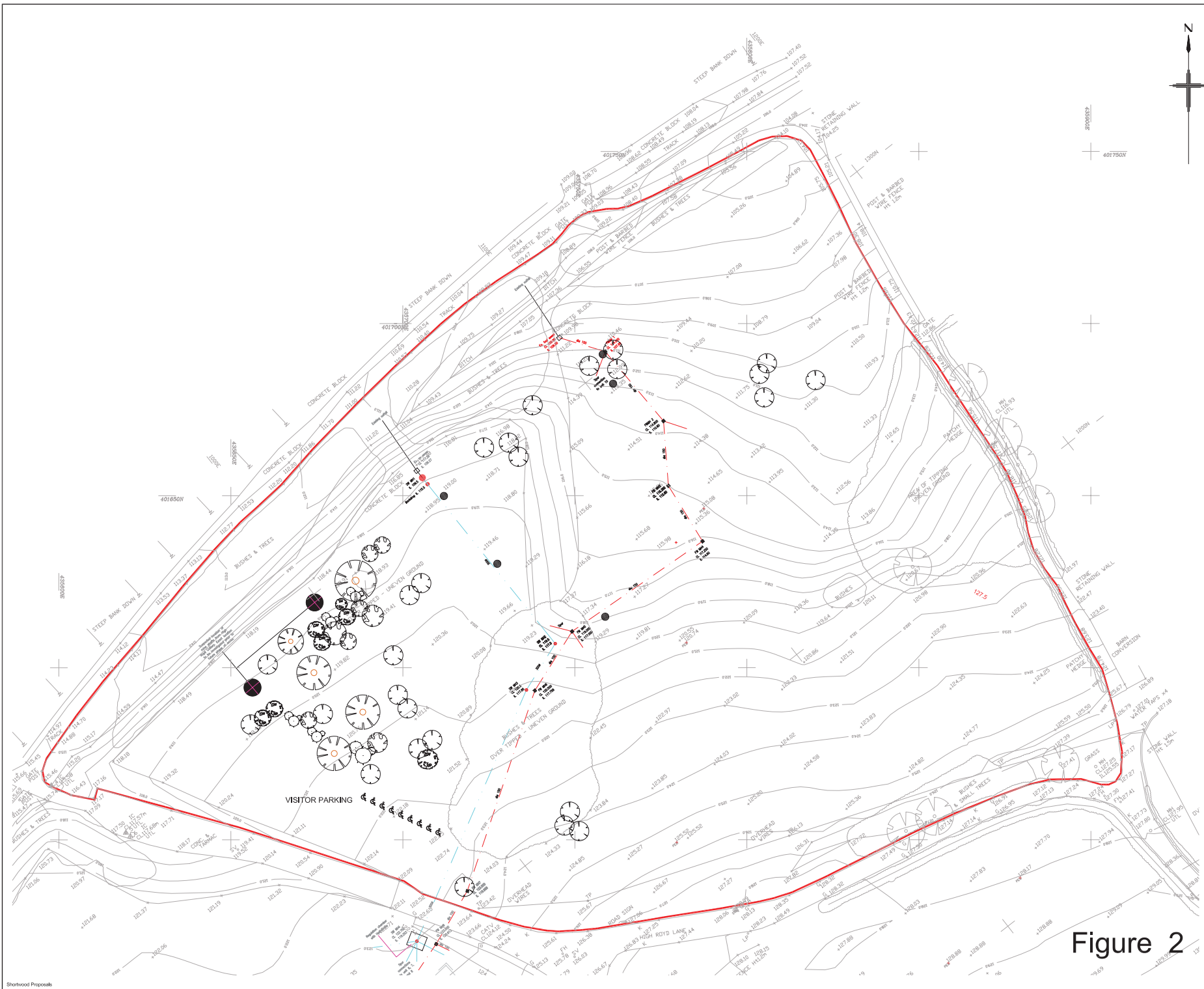


Figure 2

Rev.	Date	Amendment	Drawn	CHKD	Appt.
RSK. LAND AND DEVELOPMENT ENGINEERING LTD 18 Progress Road Hemel Hempstead Hertfordshire HP1 2RT United Kingdom Tel: +44 (0)1462 437500 Fax: +44 (0)1462 437500 Email: info@rsk.co.uk Web: www.rsk.co.uk					
Client Options Group					
Project Title Shortwood Business Park					
Drawing Title Existing Site Survey (showing existing drainage)					
Drawn CLP	Date 10/01/08	Checked	Date	Approved	Date
Scale 1:500	Chip Size A1	Dimensions m			
Project No. 130495		Drawing File Shortwoods Proposals			
Drawing No. LDE 1002		Rev. P2			



APPENDIX E

PERMEABILITY TESTING REPORT

Our ref: 16340PL04
21 September 2010

Wakemans Limited
11/12 Highfield Road
Edgbaston
Birmingham
B15 3EB

For the attention of: Mr Lionel Martin

Dear Lionel

PERMEABILITY TEST RESULTS FOR PROPOSED SOAKAWAY DESIGN

1. INTRODUCTION

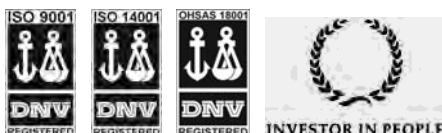
RSK STATS Geoconsult Limited (RSK) were commissioned by Trevor Price Partnership to provide information to help inform the requirement and/or design for soakaway design at the proposed Earlswood Centre for Autism development (the site), in accordance with RSK proposal dated 28 January 2010 (Reference 16340TL02). It is understood that the proposed development will consist of an array of residential units and associated sports/recreational buildings, with regrading of site soils being required to provide a stable development platform that will support service infrastructure and a site access road, with structures being piled into bedrock.

2. BACKGROUND

RSK undertook an intrusive investigation of the site between September and October 2007, which was reported in RSK site investigation report (Reference: 11061-R1 (01)). A brief summary of the ground conditions from this report are provided below.

The site covers an area of approximately 4ha and forms the north-eastern quarter of the Shortwood Business Park development, situated in a mixed rural/residential/commercial area on the outskirts of Barnsley. A site location plan is appended as Figure 1. The site is to be redeveloped with a centre for children affected by autism.

The site was previously occupied by Hoyland Brickworks, dating back to the end of the 19th Century, which was indicated as demolished in 1997. Prior to the brickworks, the site was occupied by High



Royd Colliery and a tannery. Historically, the site has been subject to extensive earthworks and a substantial thickness of made ground underlies the site.

Existing site levels vary significantly across the site, with a general fall from south to north. As part of the site redevelopment, re-grading of the landform will have to take place to provide the necessary development platform.

Ground conditions encountered during the site investigation were found to consist in the south eastern area of the site of thin made ground (maximum 0.4m bgl) overlying natural slightly sandy and slightly gravelly clay soils encountered to a maximum thickness of 2.6m. In the western area, boreholes BH101 to BH103 revealed made ground to depths of 5.9m and 10.6m bgl, respectively. The depth of made ground was observed to increase to a recorded maximum of 5.3m bgl further to the west of BH101 to BH103, and consist of reworked clay and bedrock fragments with occasional bands of ash and brick.

Underlying superficial deposits were encountered between thicknesses of 0.2m and 5.3m, typically comprising gravelly clay. Other natural soils situated towards the south eastern boundary of the site included horizons of silt and sand. Bedrock was encountered in all boreholes and four trial pits, and was generally comprised of interbedded horizons of sandstone and mudstone.

3. PERMEABILITY ASSESSMENT

Four existing boreholes (BH101, BH105, BH106 and BH108) that were drilled and installed by RSK during 2007 were utilised to assess the permeability of the response zone of the installation. The locations of the tested boreholes are indicated on Figure 2, and their respective borehole logs are also appended. The response zones for the tested boreholes are summarised below:

- BH101: gravelly clay (2.0m to 10.0m);
- BH105: silt (0.9m to 1.5m); clay (1.5m to 3.1m); weathered siltstone/sandstone (3.1m to 3.9m);
- BH106: made ground (1.8m to 2.0m); mudstone (2.0m to 5.8m); and
- BH108: made ground (1.7m to 8.7m).

Falling head permeability testing was undertaken on all four boreholes on 25 August 2010 by RSK in general accordance with BS 5930:1999. The test times for all four boreholes ranged from 90 minutes (BH105) to 215 minutes (BH108).

Estimates of permeability were assessed using the Hvorslev (1951) approach, which assumes that the effect of soil and water compressibility is negligible. The results for the calculated estimates of permeability for the response zones of the tested boreholes are attached and are also summarised below:

Borehole	Strata of Response Zone	Permeability (m/s)	Permeability (m/day)
BH101	Gravelly clay	1.4×10^{-7}	0.01
BH105	Silt, clay and weathered siltstone/sandstone	6.2×10^{-6}	0.54
BH106	Made ground and mudstone	1.02×10^{-5}	0.88
BH108	Made ground	1.43×10^{-7}	0.01

4. DISCUSSION OF THE RESULTS

The results indicate a broad range of calculated permeabilities for the different materials tested.

The tests included made ground at locations BH106 and BH108. Made ground is not considered suitable for installation of soakaways. The heterogeneous nature of such materials mean that they may be prone to wash-out and inundation settlement when exposed to water and such materials are therefore deemed unsuitable to receive surface water run off.

The underlying natural superficial soils beneath the site are predominantly clays (as in BH101) which will have low permeability and will be an unsuitable material in which to construct soakaways. Natural silt was encountered in BH105 and although this is likely to have a higher permeability than clay it is unlikely to have a sufficiently high infiltration rate to make soakaways a feasible option.

The underlying bedrock, which was present in two of the test locations (BH105 and BH106), is more likely to have a higher permeability. This is considered likely to be largely controlled by the presence of fractures within the bedrock. It is considered likely that soakaways within the bedrock may be suitable.

We trust that the comments provided above and information attached is of assistance. If you have any queries please do not hesitate to contact the undersigned.

Yours sincerely

For and on behalf of RSK STATS Geoconsult Limited



Siôn Roberts

Environmental Scientist



Jon Clayton

Principal Engineer

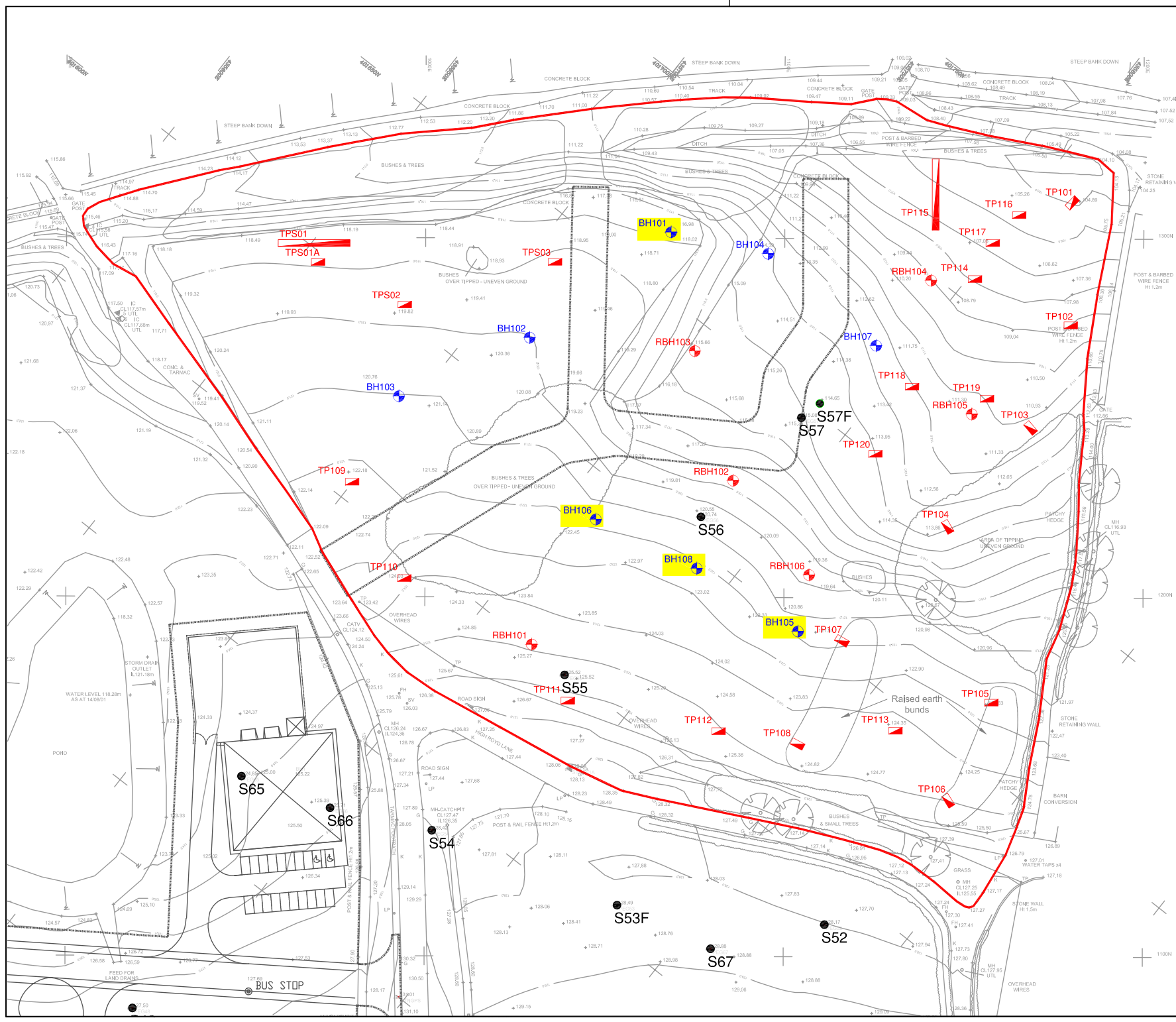
Enc.

Figure 1 – Site Location Plan

Figure 2 – RSK 2007 Borehole and Trial Pit Location Plan

Borehole Logs

Permeability Results



LEGEND

 **BH108** RSK Boreholes locations

 **RBH106** RSK Rotary borehole locations

**TP120/TPS03**

 RSK Trial pit locations

 Site Boundary

**S55**

Ground Marker

**BH101**

Falling head test wells, August 2010



A	09.09.10	FIRST ISSUE	HD	JC	JC
REV	DATE	DESCRIPTION	BY	CHD	APR.
Dimensions	Projection		Scale	Orig Size	
m			1:1000	A3	


Spring Lodge
123 Chester Road
Helsby
Cheshire
WA6 0AR
Tel: +44 1928 726006
Fax: +44 1928 725633
Web: www.rsk.co.uk

CLIENT	TREVOR PRICE PARTNERSHIP				
PROJECT	EARLSWOOD CENTRE				
TITLE	RSK 2007 BOREHOLE AND TRIAL PIT LOCATION PLAN				
JOB No.:	16340		DRAWING FILE: PL16340PL01-D002A		
BY:	DATE:	CONTRACT NO.	REV:		
HD	09.09.10		FIGURE 2 A		

Scale 1:1000





APPENDIX F

MICRODRAINAGE CALCULATIONS

RSK LDE Ltd				Page 1			
18 Frogmore Road Hemel Hempstead Herts, HP3 9RT		Earlswood Post development Attenuation volume					
Date Sept 2011 File ATTENUATION BASIN...		Designed By CW Checked By					
Elstree Computing Ltd		Source Control W.12.5					
<u>Summary of Results for 100 year Return Period (+30%)</u> Half Drain Time : 184 minutes.							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	99.276	0.776	0.0	21.0	21.0	215.4	O K
30 min Summer	99.462	0.962	0.0	21.0	21.0	284.9	O K
60 min Summer	99.612	1.112	0.0	21.0	21.0	345.9	O K
120 min Summer	99.693	1.193	0.0	21.0	21.0	380.9	O K
180 min Summer	99.688	1.188	0.0	21.0	21.0	378.7	O K
240 min Summer	99.665	1.165	0.0	21.0	21.0	368.9	O K
360 min Summer	99.617	1.117	0.0	21.0	21.0	348.2	O K
480 min Summer	99.569	1.069	0.0	21.0	21.0	328.0	O K
600 min Summer	99.519	1.019	0.0	21.0	21.0	307.5	O K
720 min Summer	99.467	0.967	0.0	21.0	21.0	286.8	O K
960 min Summer	99.361	0.861	0.0	21.0	21.0	246.3	O K
1440 min Summer	99.152	0.652	0.0	21.0	21.0	173.0	O K
2160 min Summer	98.879	0.379	0.0	21.0	21.0	90.3	O K
2880 min Summer	98.687	0.187	0.0	21.0	21.0	40.8	O K
4320 min Summer	98.586	0.086	0.0	18.1	18.1	18.0	O K
5760 min Summer	98.569	0.069	0.0	14.4	14.4	14.2	O K
7200 min Summer	98.558	0.058	0.0	12.1	12.1	11.9	O K
8640 min Summer	98.550	0.050	0.0	10.6	10.6	10.3	O K
Storm Event	Rain (mm/hr)	Time-Peak (mins)					
15 min Summer	115.962	28					
30 min Summer	77.884	41					
60 min Summer	49.937	68					
120 min Summer	30.926	122					
180 min Summer	23.026	164					
240 min Summer	18.546	196					
360 min Summer	13.625	260					
480 min Summer	10.946	328					
600 min Summer	9.228	396					
720 min Summer	8.022	464					
960 min Summer	6.426	596					
1440 min Summer	4.691	848					
2160 min Summer	3.418	1196					
2880 min Summer	2.727	1516					
4320 min Summer	1.979	2204					
5760 min Summer	1.575	2936					
7200 min Summer	1.318	3616					
8640 min Summer	1.140	4376					
©1982-2010 Micro Drainage Ltd							

RSK LDE Ltd

Page 2

18 Frogmore Road

Hemel Hempstead

Herts, HP3 9RT

Date Sept 2011

File ATTENUATION BASIN...

Earlswood

Post development

Attenuation volume

Designed By CW

Checked By

Elstree Computing Ltd

Source Control W.12.5

Micro Drainage®

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	98.544	0.044	0.0	9.3	9.3	9.0	O K
15 min Winter	99.355	0.855	0.0	21.0	21.0	244.2	O K
30 min Winter	99.559	1.059	0.0	21.0	21.0	323.8	O K
60 min Winter	99.728	1.228	0.0	21.0	21.0	396.6	Flood Risk
120 min Winter	99.834	1.334	0.0	21.0	21.0	444.7	Flood Risk
180 min Winter	99.842	1.342	0.0	21.0	21.0	448.5	Flood Risk
240 min Winter	99.813	1.313	0.0	21.0	21.0	434.9	Flood Risk
360 min Winter	99.750	1.250	0.0	21.0	21.0	406.2	Flood Risk
480 min Winter	99.681	1.181	0.0	21.0	21.0	375.8	O K
600 min Winter	99.606	1.106	0.0	21.0	21.0	343.7	O K
720 min Winter	99.528	1.028	0.0	21.0	21.0	311.1	O K
960 min Winter	99.365	0.865	0.0	21.0	21.0	247.7	O K
1440 min Winter	99.040	0.540	0.0	21.0	21.0	137.1	O K
2160 min Winter	98.649	0.149	0.0	21.0	21.0	31.9	O K
2880 min Winter	98.586	0.086	0.0	18.1	18.1	17.9	O K
4320 min Winter	98.563	0.063	0.0	13.2	13.2	12.9	O K
5760 min Winter	98.550	0.050	0.0	10.4	10.4	10.2	O K
7200 min Winter	98.542	0.042	0.0	8.8	8.8	8.5	O K
8640 min Winter	98.536	0.036	0.0	7.6	7.6	7.3	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
10080 min Summer	1.009	5016
15 min Winter	115.962	28
30 min Winter	77.884	41
60 min Winter	49.937	68
120 min Winter	30.926	122
180 min Winter	23.026	178
240 min Winter	18.546	224
360 min Winter	13.625	282
480 min Winter	10.946	358
600 min Winter	9.228	432
720 min Winter	8.022	504
960 min Winter	6.426	642
1440 min Winter	4.691	890
2160 min Winter	3.418	1176
2880 min Winter	2.727	1464
4320 min Winter	1.979	2184
5760 min Winter	1.575	2856
7200 min Winter	1.318	3584
8640 min Winter	1.140	4384

©1982-2010 Micro Drainage Ltd

RSK LDE Ltd				Page 3			
18 Frogmore Road Hemel Hempstead Herts, HP3 9RT		Earlswood Post development Attenuation volume					
Date Sept 2011 File ATTENUATION BASIN...		Designed By CW Checked By					
Elstree Computing Ltd		Source Control W.12.5					
<u>Summary of Results for 100 year Return Period (+30%)</u>							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	98.532	0.032	0.0	6.8	6.8	6.5	O K
		Storm Event		Rain (mm/hr)	Time-Peak (mins)		
		10080 min Winter		1.009	5048		
©1982-2010 Micro Drainage Ltd							

RSK LDE Ltd		Page 4
18 Frogmore Road Hemel Hempstead Herts, HP3 9RT	Earlswood Post development Attenuation volume	
Date Sept 2011 File ATTENUATION BASIN...	Designed By CW Checked By	
Elstree Computing Ltd	Source Control W.12.5	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.352	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time / Area Diagram

Total Area (ha) 1.124

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.281	4-8	0.281	8-12	0.281	12-16	0.281

RSK LDE Ltd		Page 5
18 Frogmore Road Hemel Hempstead Herts, HP3 9RT	Earlswood Post development Attenuation volume	
Date Sept 2011 File ATTENUATION BASIN...	Designed By CW Checked By	
Elstree Computing Ltd	Source Control W.12.5	

Model Details

Storage is Online Cover Level (m) 100.000

Infiltration Basin Structure

Invert Level (m) 98.500 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	200.0	1.500	500.0

Depth/Flow Relationship Outflow Control

Invert Level (m) 98.500

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	21.0000	1.500	21.0000