Commercial Estates Group, Hallam Land, TW Fields, BDW Trading Limited

Clifton Gate

Flood Risk Assessment

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Executive Summary

Arup has been commissioned by Commercial Estates Group (CEG) on behalf of a consortium of developers to produce a Flood Risk Assessment (FRA) for a residential land allocation north of Clifton Moor, York. Site designs are currently at Masterplan stage and include approximately 2,860 residential units, a primary school, approximately 30 business/commercial units and open space/amenity areas. The site is currently agricultural land with a few isolated farm buildings. There are no Main Rivers on the site however there are three drainage ditches crossing the site which are maintained by the Kyle and Upper Ouse Internal Drainage Board (KUOIDB). In addition there are a number of small field drains. There are no public sewers on the site.

A Flood Risk Assessment (FRA) is required as the site is greater than 1ha in area. This FRA provides an overview of current flood risk at the site from all sources. It identifies measures required to minimise flood risk on the site and to ensure the development does not increase flood risk elsewhere. Of particular importance is the management of surface runoff relating to the proposed increased areas of hardstanding. Yorkshire Water and KUOIDB have confirmed that their existing systems do not have sufficient capacity to accept any increases in peak runoff.

The FRA has found that the site is outside the 1 in 1,000 year river floodplain. A small area in the south-western corner of the site may be marginally within Flood Zone 2 (1 in 100 year to 1 in 1,000 year flood zone), however no development is planned within this area. The site is also considered to be at low risk of groundwater flooding, with a relatively deep groundwater table and no history of groundwater flooding affecting the site. Available information suggests the current land drainage systems work effectively and are well maintained by the local IDB. The risk of sewer flooding is very low.

The majority of the existing site is at no or low risk of surface water (pluvial) flooding. The risk of surface water ponding in isolated topographical low spots will be managed through localised ground re-profiling (whilst maintaining no net loss of storage and whilst not increasing flood risk in other locations on the site or elsewhere) and application of appropriate freeboard to finished floor levels.

Proposals for management of surface water runoff include attenuation to pre-development greenfield runoff rates through implementation of Sustainable Drainage Systems (SuDS) on site, in the form of attenuation ponds. These ponds will be designed to contain and attenuate surface water resulting from pluvial events up to the 100 year return period plus a 30% uplift in peak rainfall intensities for climate change. This attenuated discharge will then be discharged into existing drains at a rate no greater than the existing greenfield runoff rate. The exact contribution of discharge to each drain will be refined as more information becomes available on existing land drainage patterns, and in consultation with KUOIDB.

Following the implementation of flood risk management measures identified within this report it is concluded that the proposed development of the Clifton Gate site could be undertaken in a manner that keeps occupants safe from the effects of flooding and does not increase flood risk elsewhere over the lifetime of the development.

1 Introduction

1.1 Scope of work

Arup has been commissioned by Commercial Estates Group (CEG) on behalf of a consortium of developers to produce a Flood Risk Assessment (FRA) as a part of a feasibility study for residential land allocation at Clifton Gate, York. The site area is approximately 170 hectares and the proposed development comprises approximately 2860 residential units, a primary school and approximately 30 business/commercial units. The majority of the site is located in Flood Zone 1 meaning it is at low risk of flooding from rivers, however as the site is greater than 1ha in area a Flood Risk Assessment (FRA) is required to understand flood risk on the site from other potential sources and to understand the potential impact of the scheme on flood risk elsewhere.

This FRA provides an overview of current information available on all sources of flooding, providing quantification of the hazard where possible. Potential measures are then identified to minimise flood risk on the site over the lifetime of the development and to ensure the development does not increase flood risk elsewhere. Finally, residual risks are identified, together with recommendations for the management of these.

1.2 Site location and characteristics

The Clifton Gate site (see Figure 1) is centred on Grid Reference SE587567. The site is approximately 170 ha in area and is located to the north of the A1237, east of the A19, and west of the B1363. The site is currently classed as ‘greenfield’, being predominantly of agricultural land use and having only a few isolated farm buildings. There are no Main Rivers on the site however there are three main land drains: White Sike Drain, Pennel’s Drain (known as Burtree Dam in its lower reaches) and a drain to the east of the site which flows from Rodwell’s Plantation to the B1363/A1237 junction. These drains are maintained by the Kyle and Upper Ouse Internal Drainage Board (KUOIDB). In addition there are a number of small field drains on the site which are believed to be under the ownership of local landowners.

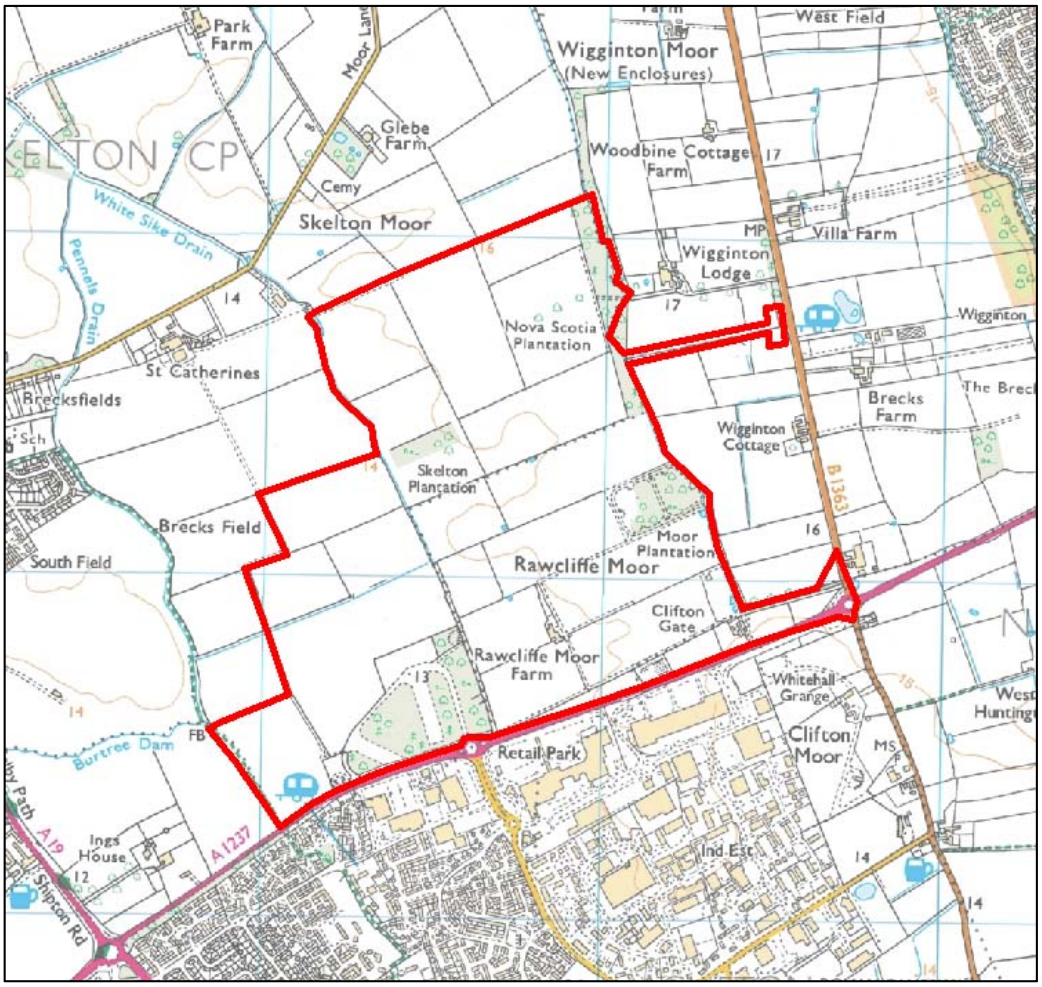

Figure 1 Site location, north of A1237, Clifton Gate, north York.

1.3 Site topography

A topographic survey was undertaken during 2014 for the purposes of developing a site Masterplan. Ground levels in the site vary between approximately 16.5mAOD and 13.0mAOD, with a gradual fall from north east to south west.

1.4 Development proposals

CEG and their partners are currently assessing the feasibility of developing the Clifton Gate site for a new predominantly residential development. The land at Clifton Gate has been identified as a Strategic Site by City of York Council (CYC). The current site Masterplan is shown in Figure 2. The proposed development includes approximately 2860 new residential housing units, a primary school, care homes and mixed use areas including commercial units. There will also be provision of amenity green open space outdoor sports facilities and extension of existing woodland areas.

An area of land in the south-west corner of the site and an area on the eastern boundary of the site have been identified as suitable locations for Sustainable Drainage System (SuDS) attenuation ponds. Drainage proposals are for these ponds to attenuate surface water runoff from the site before discharging into

Burtree Dam drain to the west and the unnamed drain to the east of the site respectively. This is discussed in more detail in Section 3.2.4.2.

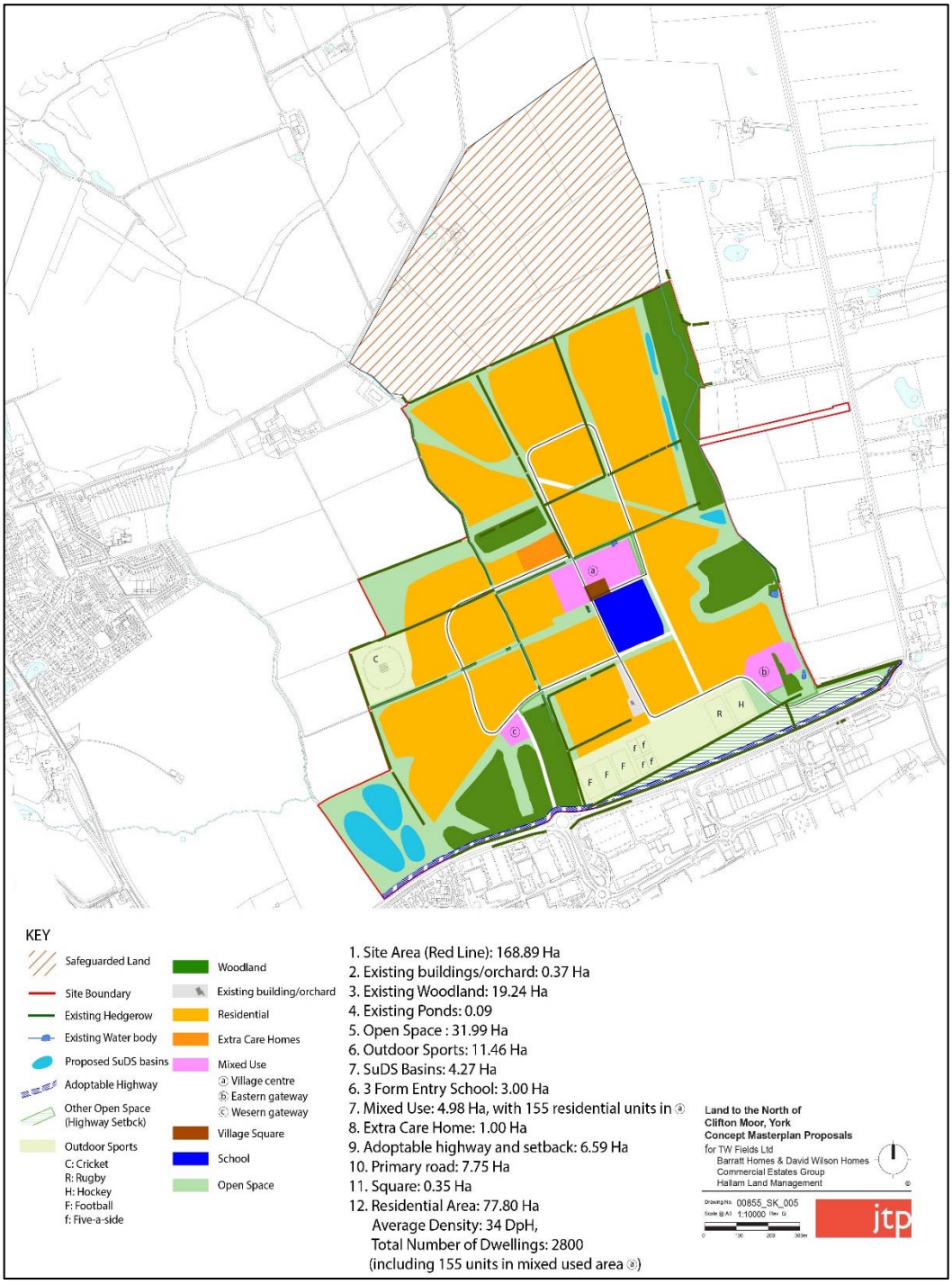

Figure 2 Site Masterplan (JTP Architects)

1.5 Data availability

This FRA has been created with reference to the following information and guidance:

- Environment Agency Fluvial Flood Map
- Environment Agency Pluvial Flood Map
- Historical flood information
- Yorkshire Water public sewer records
- Local ground level topographic data
- Consultation with the Environment Agency(EA), City of York Council (CYC) and correspondence with Kyle and Upper Ouse Internal Drainage Board (KUOIDB) undertaken as part of the development of the Environmental Statement
- City of York Strategic Flood Risk Assessment (SFRA)[1]
- National Planning Policy Framework (NPPF)[2]
- Clifton Gate Environmental Statement[3]
- City of York Local Plan Publication (Draft)[4]

This report has been prepared for the developer consortium in connection with the Clifton Gate site. It is not intended for and should not be relied upon by any third party, and no responsibility is undertaken to any third party.

[1] *City of York Strategic Flood Risk Assessment, Draft 2* (March 2013)
[2] Department for Communities and Local Government, *National Planning Policy Framework* (March 2012)
[3] *Land North of Clifton Moor, York, Environmental Statement*, Chapter K, Water Environment, Arup (18th September 2014)
[4] *City of York Local Plan – Publication* (DRAFT 2014)

2 Sources of flood risk to the site

The following section describes the current flood risk at the development site from all known sources using the most recent information and data available for the site.

2.1 Fluvial flood risk (flooding from rivers)

Fluvial flooding occurs when river water levels exceed bank height and cause flooding of the surrounding land. This may be exacerbated by local blockages of structures such as bridges or culverts, wall collapses or failure of flood defences. The Environment Agency Flood Map for Planning[5] was consulted in order to gain an understanding of fluvial flood risk at the development site. Figure 3 shows the EA Flood Map with the development plot boundary marked in red. The majority of the site is located within Flood Zone 1 meaning the risk of is less than 1 in 1000 years (0.1% Annual Exceedence Probability (AEP)). Consultation with the Environment Agency[6] identified a very small corner of the south-west area of the site bordering Burtree Dam which may encroach into Flood Zone 2 (approximately 300m^2). This area is not visible on the scale of mapping provided on the EA website or as an information request and is indicated by an arrow on Figure 3. This area is assessed as having between a 1 in 100 and 1 in 1,000 (1% AEP to 0.1% AEP) annual probability of river flooding. Flood risk to the site from fluvial sources is considered to be low.

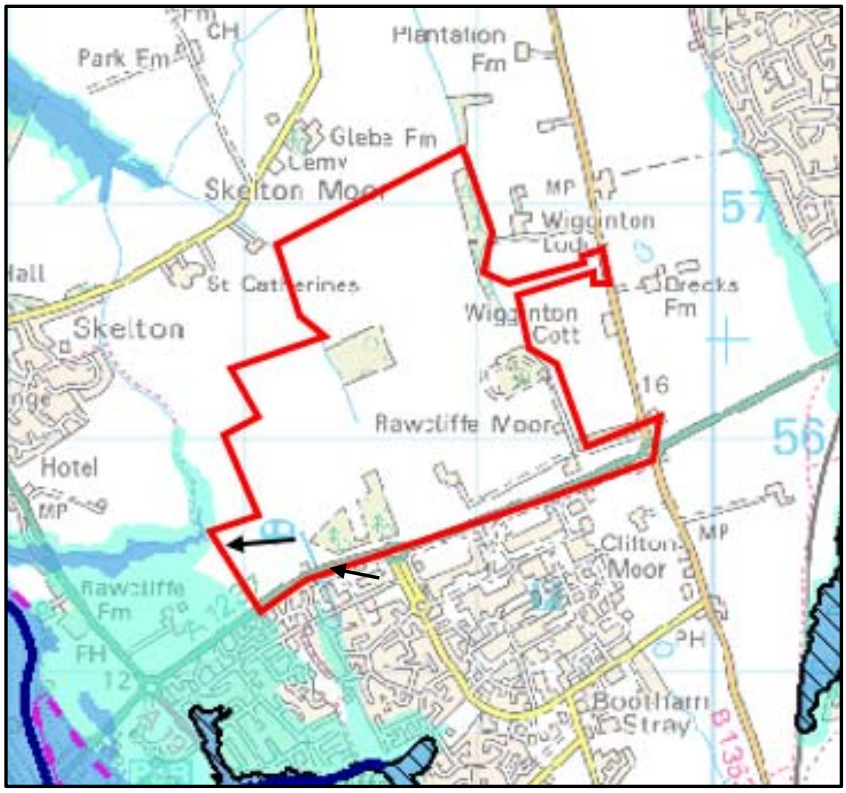

Figure 3 Extract from EA Flood Map for Planning showing the development site (outlined in red) and local area overlaid with the predicted extent of flooding from rivers

[5] Environment Agency Flood Map for Planning, (September 2014) http://www.environment-agency.gov.uk/homeandleisure/37837.aspx
[6] Personal correspondence with EA (24/9/14)

and sea. Flood Zone 3 is defined by the darker blue shading, whilst Flood Zone 2 is defined by lighter blue shading. Areas with no shading are in Flood Zone 1. Watercourses classified as Main Rivers are shown with solid blue lines. Black arrow indicates potential encroachment onto Flood Zone 2 identified by the EA.

2.2 Surface water (pluvial) flood risk

Surface water flooding occurs when rainfall, usually of high intensity, fails to either soak into the ground or enter the local drainage system due to lack of capacity of blockage. Figure 4 shows the surface water flood risk map as provided on the Environment Agency (EA) website, with the approximate development plot boundary marked in red.

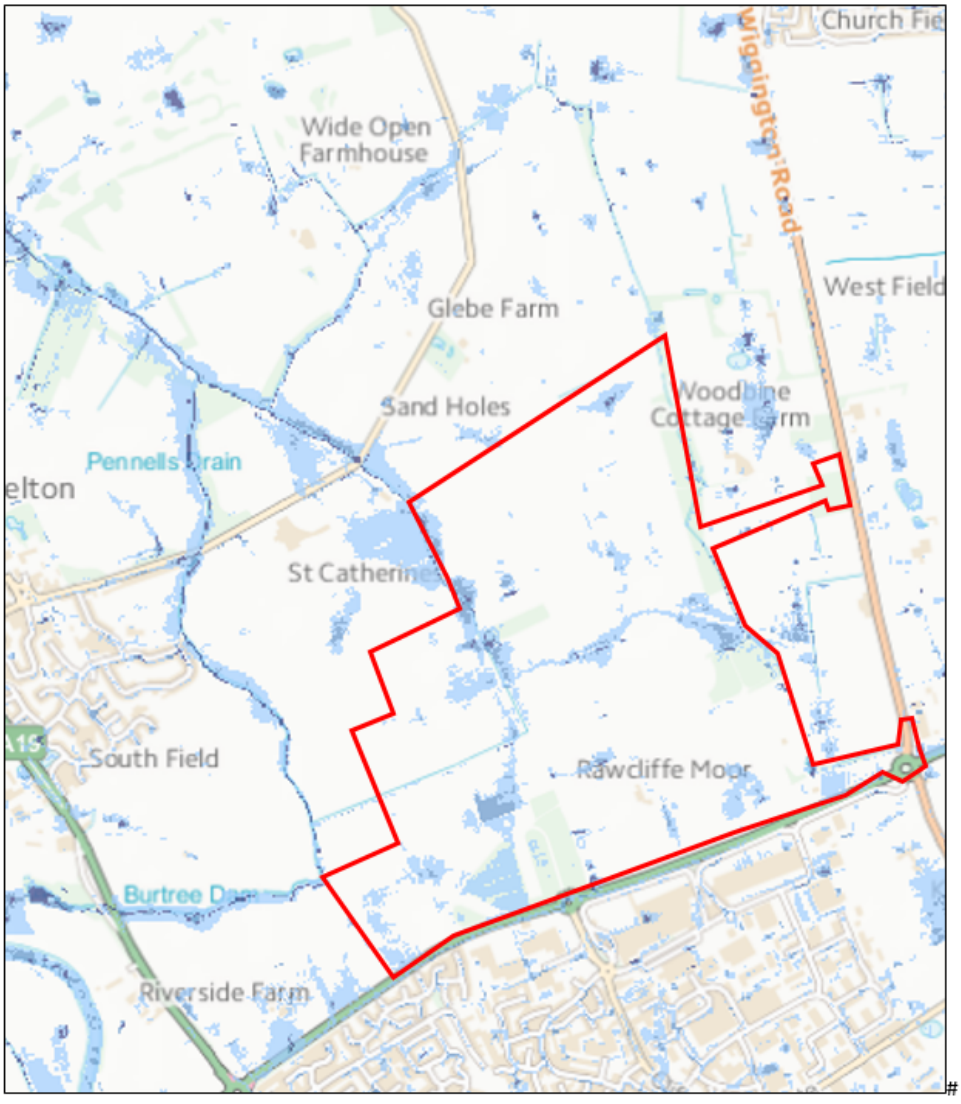

Figure 4 Surface water flood risk map (Environment Agency, 2014)

Figure 4 shows that the majority of the site is at very low risk or low risk of surface water flooding. This means the chance of flooding is either less than 1 in 1000 year (or 0.1% Annual Exceedance Probability (AEP)) or between 1 in 100 year (1% AEP) and 1 in 1000 year (0.1% AEP) for very low and low risk areas

respectively. There are some areas, typically along the line of land drains or other topographical low spots which are shown to be at medium risk of flooding (in 100 year (0.1% AEP) to 1 in 30 year (3.3% AEP). There are a few isolated locations where the risk of surface water flooding is considered high (greater than 1 in 30 year (3.3% AEP), again these areas tend to relate to topographical low spots such as drainage ditches.

Consultation with CYC[7] indicated that there are several isolated low spots on the site, which, due to the low permeability of the soil may make these areas prone to surface water ponding. This is reflected by isolated areas of higher risk on Figure 4.

Figure 4 also indicates higher risk along the line of drainage ditches. The hydraulic models used to generate these nationally produced surface water flood maps are not thought to account for large subsurface drainage elements such as the field drains and ditches within this site. This may significantly affect the modelled pattern of flooding. In reality land drains should allow some discharge of surface water from the site, reducing the risk from this source.

The City of York SFRA was consulted for references to surface water flood events at the site. No records relating to the site were known of, the nearest notable surface water flooding incidents being in the Haxby and Wiggington areas to the east of the site during the 2007 rainfall event. These events are mostly believed to have been caused by local maintenance issues, some of which have since been resolved (City of York SFRA, 2010).

CYC do not hold any records of historical surface water incidents on the site. The nearest recorded incidents have occurred in localised areas in the Mill Lane area of Wiggington, north east of the site. CYC noted that the area is very rural and therefore they may not have records of all incidents that have taken place.

2.3 Flood Risk from land drains

Figure 5 demonstrates that the site is crossed by three land drains. These are;

- White Sike Drain (running through the centre of the site)
- To the west of the site, Pennel's Drain / Burtree Dam, running from Skelton to outfall by gravity into the River Ouse
- An un-named drain to the east of the site which flows from Rodwell's Plantation in a north-south direction to the B1363/A1237 junction. It is thought that this discharges to the Blue Beck system which is an ordinary watercourse and responsibility of the EA/CYC.

Land drains on the site are maintained by the Kyle and Upper Ouse IDB (KUOIDB). There are no pumping station facilities and no raised embankments or other flood defences on these drains.

[7] Personal correspondence (24/09/14)

In addition there are a number of smaller field drains (see Figure 5) which run across the site. Ownership and maintenance of these is believed to be the responsibility of the appropriate local landowners. Discussion with local landowners and inspection of land drainage records undertaken during the preparation of the Environmental Statement suggests that this land drainage operates effectively, with the main ditches maintained regularly by KUOIDB. According to their records, KUOIDB state that the only incidence of waterlogging in the vicinity of the site arose from the leisure complex to the east of Wigginton Road.

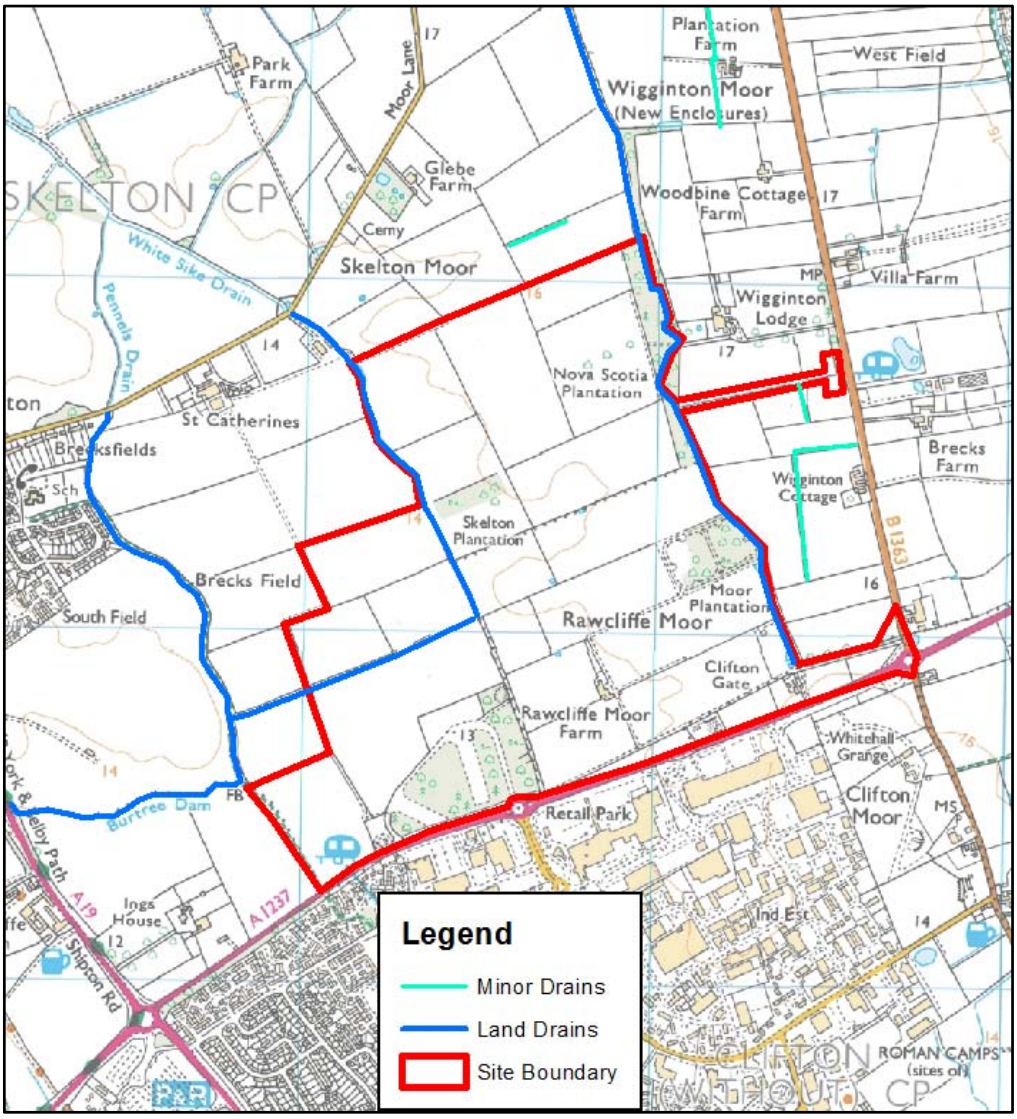

Figure 5 Drains on and surrounding the Clifton Gate site

2.4 Groundwater flood risk

Groundwater flooding occurs when groundwater levels rise following prolonged periods of rainfall. The Clifton Gate site is underlain by a solid bedrock geology of Sherwood Sandstone, a Major Aquifer formation. This is overlain by superficial glaciolacustrine deposits (clay/silts) and the Sutton Sand Formation. The drift deposits overlying the Sherwood Sandstone are classified as a Minor

Aquifer where the drift is relatively permeable, and a Non-Aquifer where the drift deposits are fairly thick and have low permeability (City of York SFRA, 2013). The ground at the site has a low permeability, and is not naturally free-draining however discussions with local landowners and inspection of land drainage records undertaken during the preparation of the Environmental Statement suggests that the current land drainage operates effectively, reducing the risk of flooding from this source (Environmental Statement, 2014).

The British Geographical Society (BGS) holds logs for a number of boreholes within and in the vicinity of the site. Some are confidential and many are too shallow to record water strikes. Three are deep enough to provide useful information on groundwater depth, which was encountered at 5.64m, 8.35m and 8.84m below ground. The risk of flooding from groundwater is therefore considered to be low.

2.5 Flood risk from sewers

Sewer flooding can occur due to lack of capacity or blockage of the surface water sewer system, foul system or a combined system.

There are no public sewers on the site. A foul rising main is located to the south of the site, running alongside the A1273. Yorkshire Water have confirmed the existing capacity of the sewer is adequate for its current use however it does not have additional capacity for increased flows resulting from the development.

A 1200mm diameter Yorkshire Water raw water supply main runs underground through the site in a northwest-southeast direction as indicated in Figure 6. This pipe links a river intake on the River Ouse at Moor Monkton to the YW treatment works at Elvington. The pipe is used on occasion when required to supplement water supplies to Elvington. The intake is controlled by a pump and as such is hydraulically disconnected from river levels on the Ouse. There are no known manholes, access points or other openings to this pipe on the site.

There is no history of flooding from sewers or the water supply pipe on the site.

The current flood risk to the site from sewers is considered to be very low.

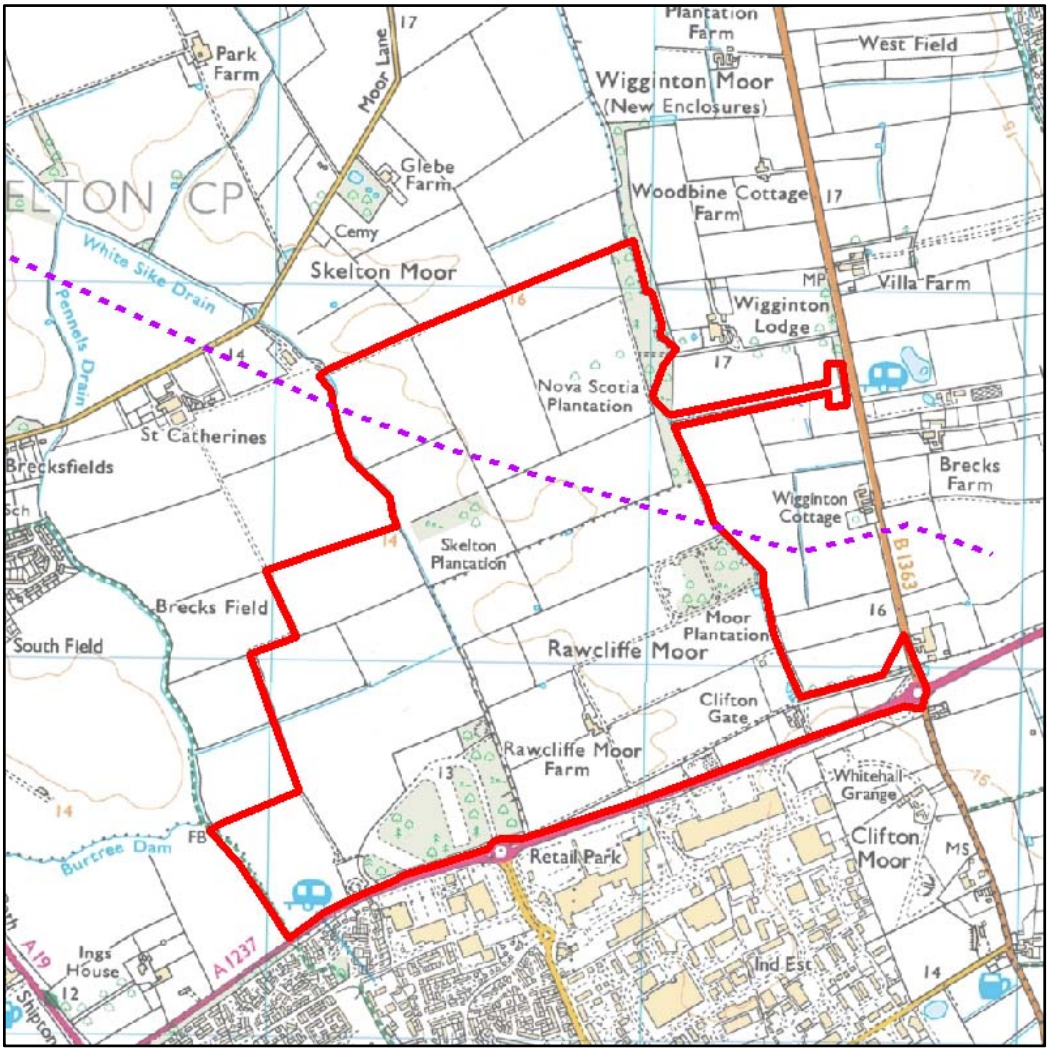

Figure 6 Approximate location of Yorkshire Water raw water main crossing development site (dashed line).

2.6 Flood risk from other sources

Consultation with CYC[8] indicates that there has been localised historical flooding issues relating to a private culvert on the site. The location of this culvert and ownership is not known. Consultation with individual landowners has not been undertaken for this FRA; the location and nature of this potential source of flood risk will be explored in more detail as design development progresses.

No other potential sources of flooding (e.g. tidal, reservoirs, canals) have been identified for this site.

[8] Personal Correspondence (24/9/14)

3 Flood risk management

The following section outlines national planning policy which applies to the development site and makes recommendations for the management of flood risk at the site over the lifetime of the development. The assessment takes into account the potential implications of climate change and the impacts of the development on flood risk elsewhere.

3.1 Guidance documents

3.1.1 National Planning Policy Framework

The development includes a range of land uses which, according to the National Planning Policy Framework (NPPF)[9], would range from 'more vulnerable' development, such as housing, through to 'less vulnerable' and 'water compatible' infrastructure such as amenity green open spaces. All the proposed development types are suitable for location within Flood Zone 1. NPPF states the following Policy for Flood Zone 1; *"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 systems".*

There is a very small area in in the south-western corner of the site which the EA have advised may be within Flood Zone 2. This area is planned as amenity open space and the SUDS ponds do not encroach on this zone. This development type is classed as water compatible and is appropriate development for Flood Zone 2 according to NPPF.

3.1.2 Local Planning Policy

The City of York Draft Local Plan includes a Policy of Flood Risk (Policy ENV4). Policy ENV4 states;

"New development shall not be subject to unacceptable flood risk and shall be designed and constructed in such a way that it mitigates against current and future flood events.

An assessment of whether proposed development is likely to be affected by flooding and whether it will increase flood risk locally and elsewhere in the catchment must be undertaken. The assessment of proposed development against its flood risk vulnerability and its compatibility with this vulnerability, as defined in the most up to date Strategic Flood Risk Assessment (SFRA), will determine whether development is appropriate, what detailed policies for the resultant flood zone classification, as stated in the SFRA will apply, and whether a further Exception Test (that makes provision for sites in a zone with a higher probability of flooding to be assessed against wider sustainability benefits, provided that the flood risk posed is controlled and mitigated to an acceptable level) is subsequently required.

[9] National Planning Policy Framework (March 2012), Department for Communities and Local Government

Where flood risk is present, development will only be permitted the local planning authority is satisfied that any flood risk within the catchment will be successfully managed (through a management and maintenance plan for the lifetime of the development) and there are details of proposed necessary mitigation measures

A Flood Risk Assessment must be submitted with any planning application where flood risk is an issue, regardless of its location within the Flood Zones. In addition, a site-specific Flood Risk Assessment that takes account of future climate change must be carried out for all planning applications of 1 hectare or greater in Flood Zone 1 and for all applications in Flood Zones 2, 3a, 3a(i) and 3b.

Areas of greater risk may be utilised for appropriate green infrastructure spaces." (City of York Plan -Draft Publication 2014).

3.1.3 City of York Strategic Flood Risk Assessment

In accordance with guidance outlined within the City of York SFRA, planners are required to consider a variety of material planning considerations, including flood risk, in the allocation of land to major developments. The City of York SFRA underlines the requirements for land allocations to be appropriate with regards to the vulnerability of the development and the level of flood risk of the site. The SFRA states that planning decisions should support Policy Aims for each Flood Zone as outlined in NPPF. This can be achieved through consideration of NPPF guidance on the type of development which may be appropriate for each flood risk zone and the mitigation measures that may needed in developments in this area to manage flood risk issues.

3.1.4 Flood risk consultee guidance

Flood risk consultation has been undertaken both for the preparation of this FRA and for the preparation of the flood risk section of the Environmental Statement. The following parties have been consulted for these reports;

- Environment Agency
- City of York Flood Risk Management department
- Yorkshire Water
- Kyle and Upper Ouse Internal Drainage Board

3.2 Flood risk management measures

The Masterplan design has sought opportunities to achieve policy aims for Flood Zone 1 as defined within NPPF, specifically through seeking "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 systems". The following sub-sections demonstrate how the Masterplan achieves these aims.

3.2.1 Appropriate site layout

NPPF advocates a sequential approach to land use planning whereby more vulnerable development types are preferentially placed in areas at lowest risk of flooding. The majority of the site is at low risk of flooding. According to the available information provide in Section 3, the areas most vulnerable to flood risk occur along the line of existing land drains. Open space in the form of buffer strips are planned along the line of existing drains to allow access for maintenance. Finished floor levels of buildings will include an appropriate freeboard allowance to protect the buildings from surface water flooding or high water levels in the drains.

The EA have identified a very small area in the south-western corner of the site which is shown to be potentially within Flood Zone 2 according to more detailed Flood Map information held by the EA. This area is planned to be amenity open space with no development. The SuDS ponds do not encroach into this zone.

3.2.2 Management of pluvial flood risk

Areas shown to be at medium and higher risk of surface water flooding generally relate to topographical low points. Where appropriate, localised ground re-profiling would be undertaken to minimise the risk of areas of surface water ponding on site (albeit without net loss of storage across the whole site). Surface water runoff will be collected and conveyed towards attenuation ponds at the south west corner and to the east of the site. Site surface water drainage design will ensure surface water runoff rates from the site are attenuated on site to pre-development agricultural runoff rates and that SuDS ponds can contain the 100 year return period pluvial event plus climate change allowance as described in Section 3.2.4.2.

The current Masterplan design does not state finished floor levels for buildings or freeboard allowances to be applied. These details will be considered at detailed design stage and will consider local topography and drainage design to ensure properties remain safe from the risk of localised overland flow during pluvial events. Site design will ensure that existing overland flow routes on the site are not diverted towards buildings and drains and that localised re-profiling of low spots does not divert overland flows towards buildings and drains.

Properties will be constructed with sufficient freeboard to these features to avoid flooding in the 1 in 100 year storm event, with a 30% allowance for climate change.

3.2.3 Management of sewer flood risk

The City of York SFRA states:

> "Sewer flooding – proposed sites should have no surface flooding during a 1 in 30-year (3.3%) storm event, and should retain any sewer flooding from a 1 in 100-year (1%) storm within the confines of the site. No property flooding should occur as a result of a 1 in 100-year (1%) storm.."

Since there are no public sewers serving the existing site, the risk of sewer flooding can be considered to be negligible currently. The design of new separate systems for foul and surface water drainage serving the proposed development shall ensure that standards of flood protection defined in Sewers For Adoption and the City of York SFRA are met.

3.2.4 Management of surface water runoff

3.2.4.1 Surface water management guidance

Recommendations for the management of surface water runoff from the site have been made following consultation with CYC Flood Risk Management department, YW, KUOIDB and the EA, and with reference to the City of York SFRA and Sewers for Adoption guidance[10].

For greenfield sites within Flood Zone 1 the SFRA requirements for surface water management are; *"1 in 100-year (1%) surface water runoff rates for developments in this zone should be, where practicable, restricted to; unless otherwise calculated, agricultural runoff rates (if the site has no previous development) will be based on 1.4 l/s/ha. To achieve this, additional run off volume will require balancing. The use of sustainable drainage systems must be considered, where practicable, to enable this target to be met. Site allocations on larger sites, exceeding 1Ha, should include a suitable allowance for public open spaces, for the location of any SuDS"[1].*

Generally the EA would expect to see surface water attenuated to greenfield runoff rates; SuDS attenuation features should provide sufficient storage up to the 1 in 30 year pluvial event, and the 1 in 100 year event plus a 30% allowance for climate change should be contained on site without affecting nearby watercourses or property. The EA advised that the drainage strategy for this site should be ultimately be agreed with CYC and the KUOIDB[11].

The ST14 Panel Pack prepared by City of York Council states that the site should provide sufficient attenuation and long term storage to accommodate a 1 in 30 year storm and ensure that storm water resulting from a 1 in 100 year event, plus climate change, can be stored on site without risk of flooding to people or property and without overflowing into a watercourse.
Yorkshire Water and KUOIDB have advised that the public sewer network and land drainage systems respectively have insufficient capacity to accept any

[10] Sewers for adoption (7th edition, 2012)
[11] Personal correspondence with EA 24/9/14.

increased discharge of surface water from the development. As such, SuDS solutions should be employed to ensure that surface water discharges from the site do not exceed the pre-development greenfield runoff rate, with appropriate consultation and agreement from the EA, CYC and IDB.

3.2.4.2 Surface water management design for site

The details of existing site drainage, and the contributing areas to each land drain are currently being investigated, aided by archaeological digs and available land drainage information. The current understanding is that approximately half of the site drains to the west towards Burtree Dam, and that there is likely to be some contribution of runoff to the unnamed land drain on the eastern boundary of the site. Once these investigations are complete, the existing drainage regime will be presented to CYC and KUOIDB in order to agree allowable rates of discharge to each watercourse. The principle employed is that no watercourse receives discharges in excess of those it is receiving under the pre-development drainage regime.

Current proposals are for surface water to be managed through SuDS measures that will convey runoff to attenuation ponds in the south-west corner and on the eastern boundary of the site, located within and beside allocations for amenity open space (see Figure 2). The ponds will attenuate the surface water runoff rates from the development to agricultural runoff rates before discharging to existing watercourses. The attenuation ponds will be designed to contain and attenuate the 1 in 100 year storm event including a 30% uplift to account for climate change. This will ensure that a storm event of this magnitude does not cause risk of flooding to people or property within the site, or to neighbouring communities downstream.

The exact contribution of discharge to each drain will be refined as more information becomes available on existing land drainage patterns, and in consultation with CYC/KUOIDB.

3.3 Climate change

NPPF requires developers/drainage designers to consider climate change and increasing rainfall intensities during site design. The Technical Guidance for NPPF recommends that ‘indicative sensitivity ranges’ are considered by designers in assessing the most sustainable means of addressing potential climate change impacts. It recommends an increase of 30% in rainfall intensities for developments with a design life greater than 75 years.

The site surface water drainage design allows for the 1 in 100 year storm event, including an allowance for climate change of 30% to be stored on site.

3.4 Residual risks

There is a residual risk of a pluvial event occurring in excess of the drainage design standard of the surface water system. However the design of on-site SuDS attenuation ponds allow for attenuation up to the 100 year pluvial event plus 30% uplift to allow for the potential implication of climate change. The risk of any event occurring in excess of this design is very low.

Following development there may be localised risks of flooding from public and private sewers on the site. This would be the responsibility of Yorkshire Water and private sewer owners respectively.

Consultation with CYC indicates that there have been localised historical flooding issues relating to a private culvert on the site. The location of this culvert and ownership is not known. As consultation with individual landowners has not taken place as part of this FRA, the location and nature of this source of flood risk will be explored in more detail as the design of the scheme develops.

3.5 Off-site impacts

Given the size of the proposed development, the potential impacts on adjacent land has been considered as part of this site-specific FRA. A development of this type has potential to increase flood risk elsewhere through an increase in impermeable hardstanding areas.

Provided the site drainage design principles described above are incorporated into the development, flood risk up to the 100 year storm event (plus 30% climate change) will be mitigated, and there should be no off-site flood risk impacts arising from the scheme.

4 Conclusions

A summary of the findings and recommendations of the study are given below:

- The majority of the site is at low risk of flooding from rivers, being located within Flood Zone 1 (outside the 1 in 1000 year, or 0.1% AEP flood zone). All development types proposed within this predominantly residential development are appropriate for this zone. There is a very small area in in the south-western corner of the site which the EA have advised may be within Flood Zone 2. This area is planned as amenity open space and the SUDS ponds do not encroach on this zone. This is a compatible land use for Flood Zone 2 in accordance with NPPF.
- There is no history of groundwater flooding at the site. Borehole data suggests the normal groundwater table depth is between 5.64m and 8.84m below the surface. The site is considered to be at low risk of flooding from groundwater sources.
- Available information suggests the current land drainage works effectively and is well maintained by the local IDB. The IDB have confirmed that current land drains have insufficient capacity to take any increase in discharge from the proposed development.
- Yorkshire Water have also confirmed that the current sewer network does not have sufficient capacity to accept additional discharge associated with the new development.
- Surface water runoff from the proposed development will be attenuated to pre-development agricultural runoff rates through SuDS attenuation ponds in the south west corner and on the eastern boundary of the of the site. These ponds will be designed to contain and attenuate surface water resulting from pluvial events up to the 100 year return period plus a 30% uplift for climate change. This attenuated discharge will then be discharged into the existing drains at a rate no greater than the existing agricultural runoff rate. The exact contribution of discharge to each drain will be refined as more information becomes available on existing land drainage patterns, and in consultation with KUOIDB.
- There will be no additional discharge of surface water entering the existing Yorkshire Water sewers. New foul sewers will be provided on site as part of the detailed design for the scheme.
- The majority of the existing site is at no or low risk of surface water (pluvial) flooding. The risk of surface water ponding in isolated topographical low spots will be managed through localised ground re-profiling (whilst maintaining no net loss of storage and whilst not increasing flood risk in other locations on the site or elsewhere) and application of appropriate freeboard to finished floor levels. This will be defined in the detail design stage. CYC brought to attention a potential localised flood risk issue relating to a private culvert on the site, the location of which is not known. The nature of this risk will be explored in more detail during detailed design of the scheme.
- There are no other known sources of flood risk at the site, such as reservoirs, canals or tidal sources.

Following the implementation of flood risk management measures identified within this report it is concluded that the proposed development of the Clifton Gate site could be undertaken in a manner that keeps occupants safe from the effects of flooding and does not increase flood risk elsewhere over the lifetime of the development. Consultation with the EA, CYC, KUOIDB and YW will continue through development of the scheme's design.