

**Prepared on behalf of**

**Stuart Brook**

# FLOOD RISK ASSESSMENT

**Proposed Residential Development  
Land off Redwood Close, Long Lee, Keighley**

**Flood Risk Assessment  
&  
Drainage Impact Assessment**

## Acknowledgements:

Yorkshire Water  
Environment Agency

### **Disclaimer**

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|                                |                 |              |              |
|--------------------------------|-----------------|--------------|--------------|
| <b>Report Ref:</b>             | 9704/DH/001/02  | July 2017    |              |
| <b>Author:</b>                 | Darren Hawkyard |              |              |
| <b>Checked &amp; Approved:</b> | Thomas Walker   | <b>Date:</b> | 14 July 2017 |

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## **1 Introduction**

- 1.1 Sanderson Associates (Consulting Engineers) Ltd have been appointed to undertake a Flood Risk Assessment and Drainage Impact Assessment for a proposed Residential (C3 use) development at a parcel of land off Redwood Close, Long Lee, Keighley.
- 1.2 The assessment discusses the present and future flood risk to the site over the lifetime of the development, using a risk based approach and reference to the Sequential Test and Exception Test where appropriate.
- 1.3 The report also assesses, evaluates and quantifies the existing and proposed drainage mechanisms of the site and considers any drainage requirements to ensure a suitable and acceptable strategy for surface and foul water discharge.
- 1.4 This Flood Risk Assessment has been undertaken in accordance with the National Planning Policy Framework (NPPF) March 2012 and the associated Planning Practice Guidance, 2014 (PPG 2014).
- 1.5 Consultation with Yorkshire Water has taken place to obtain a Pre-Development Enquiry for the site. The Environment Agency online map confirms the site is situated in Flood Zone 1, therefore further formal consultation with the EA has not taken place in regards to flood risk. This Flood Risk Assessment has been undertaken taking into account current EA standing advice for developments in Flood Zone 1 and with reference to the Environment Agency online mapping.

## **2 Existing Situation**

### **2.1 Existing Site Description**

2.1.1 The site is located on a piece of land off Redwood Close, Long Lee, Keighley approximately 2.0km southeast of Keighley Town Centre and 12km northwest of Bradford City Centre. Drawing 9704/001 included in Appendix A shows the site location and surroundings.

2.1.2 The site comprises of undeveloped Greenfield land which fronts Redwood Close.

2.1.3 The site is bound by Redwood Close to the north and by existing residential properties to the east, south and west.

2.1.4 The closest main watercourse to the site is the River Worth which is located 890m to the northwest of the site at its closest point. A minor watercourse in the form of Hog Holes Beck is located 170m southwest of the site.

2.1.5 The closest area of higher probability Flood Zones (2 and 3) is located 980m to the northwest of the site and relate to the River Worth.

### **2.2 Existing Site Analysis**

2.2.1 The existing site layout and makeup have been assessed to establish the estimated surface water runoff rate. Drawing 9704-002 shows the existing permeable and impermeable areas of the site.

2.2.2 The total site area is 11,200m<sup>2</sup> (1.12Ha) with 0m<sup>2</sup> of building/structure and 0m<sup>2</sup> of hard standing. 11,200m<sup>2</sup> is considered to be permeable (naturally drained). Therefore the site is considered to be 0% impermeable and 100% permeable.

2.2.3 The Greenfield run off rate has been assessed using Microdrainage (Xp Solutions) source control software, The IH124 Method has been used, which requires calculation to be carried out for an area of 50Ha and reduced to the site area. The

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Greenfield runoff rate has been calculated at 6.50l/s for the total area of 1.12Ha or 5.80l/s/Ha. The WinDES output file is contained in Appendix C.

- 2.2.4 The topography of the site slopes from north to south towards the southern boundary of the site at an approximate average gradient of 12% although there are steeper areas. The topographical survey is contained within Appendix A.

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## 3 Consultations

### 3.1 *Environment Agency (EA)*

- 3.1.1 The site is wholly contained within Flood Zone 1 which means that there is less than a 1 in 1000 chance of flooding in any one year (<0.1%) from fluvial sources.
- 3.1.2 There is no requirement to formally consult with the EA regarding this development. As the site area is greater than 1Ha in area, the Environment Agency standing advice is referred to and followed for development sites in Flood Zone 1 greater than 1 ha. This standing advice directs developers and consultants to look at the control of surface water from the development site so not to increase flood risk elsewhere and improve if possible.
- 3.1.3 The Environment Agency online groundwater mapping confirmed the site is not located within a Groundwater Source Protection Zone.
- 3.1.4 Environment Agency groundwater mapping shows the sites underlying strata consists of a Secondary A bedrock aquifer and a Secondary undifferentiated superficial (drift) aquifer. A secondary A aquifer are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers. Secondary Undifferentiated aquifers are assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type. These are generally the water-bearing parts of the former non-aquifers. It should be noted that the area of the site has a superficial strata that is designated as both unproductive and secondary undifferentiated aquifers.

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### **3.2 Yorkshire Water (YW)**

3.2.1 Yorkshire Water have provided a plan showing their drainage apparatus in the area. The plan is contained in Appendix B.

3.2.2 Foul water domestic waste should discharge to the 225 mm diameter public combined sewer recorded in Long Lee Lane, at a point to the south of the site.

3.2.3 Yorkshire Water have advised that the proposal site is currently undeveloped no surface water is known to have previously discharged to the public sewer network and as such, the local public sewer network does not have capacity to accept any surface water from the proposed site. If SuDS are not viable, the developer is advised to contact the Environment Agency/local Land Drainage Authority with a view to establishing a suitable watercourse (if any nearby for discharge).

3.2.4 On the 30<sup>th</sup> May 2017 Yorkshire Water provided comments on Flood Risk Assessment 9704/DH/001/01 which was issued on December 2016. They stated that the surface water sewer to the North of the site in Redwood Close should be used for the discharge of surface water. From the information supplied, it is not possible to determine if the whole site will drain by gravity to the public surface water sewer network. If the site, or part of it, will not drain by gravity, then it is likely that a surface water pumping station will be required to facilitate connection to the public surface water sewer network. If pumping is required, the peak pumped surface water discharge must not exceed 5 (five) litres per second.

### **3.3 Strategic Flood Risk Assessment (SFRA)**

3.3.1 There was no Strategic Flood Risk Assessment available to review for this area at the time of writing the report.

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## **4 Proposed Development**

- 4.1 It is proposed that the site is developed for residential (C3) use with the construction of 38 residential dwellings with associated hard standing and gardens/open green areas.
- 4.2 Access to the site is proposed from Redwood Close in the form of an extension of the existing carriageway in a southerly direction where Redwood Close turns in an easterly direction. This is shown on the Illustrative Masterplan contained in Appendix A of this report.
- 4.3 On assessing the proposed site layout, the overall site area has been calculated to remain at 1,120m<sup>2</sup> (1.12Ha) this can be divided into 2,402m<sup>2</sup> of buildings/structures and 3,129m<sup>2</sup> of hard standing and highways. The proposed permeable area of the site (gardens/public open space) has been calculated as 5,684m<sup>2</sup>. The proposed permeable and impermeable areas of the site are shown on plan 9458/003 contained within Appendix A.
- 4.4 The final drainage layout will be confirmed as part of the detailed drainage design and consultations held with the Local Highway Authority and Yorkshire Water with regards to the final design details and future adoption of the drainage techniques to be utilised.

## **5 Sequential and Exception Tests**

### **5.1 Sequential Approach**

- 5.1.1 The site is considered to lie within Flood Zone 1 as confirmed by the Environment Agency mapping.
- 5.1.2 The site is currently agricultural land, in accordance with Table 2 of (PPG 2014, Planning Practise Guidance 2014) its last use is classed as being 'Less Vulnerable' in terms of flood risk.
- 5.1.3 The proposed residential use of the site, in accordance with Table 2 (PPG 2014, Planning Practise Guidance 2014) is classed as being 'More Vulnerable' in terms of flood risk as the site will contain dwelling houses.
- 5.1.4 In accordance with Table 3 (PPG 2014, Planning Practise Guidance 2014) a 'More Vulnerable' (residential) development in Flood Zone 1 is an appropriate development in terms of flood risk, therefore the Exception Test would not be required as part of a planning application for this development.
- 5.1.5 As the site is located in Flood Zone 1 there can be no other sites in the area with a lower risk from fluvial flooding based upon the Flood Zone classification outlined in Table 1 of PPG 2014, (Planning Practise Guidance 2014).

## **6 Assessment of Flood Risk**

### **6.1 Surface Water Flooding**

6.1.1 The main risk of flooding from overland flow comes from the local highway network, impermeable areas within the vicinity of the site and land at a higher elevation.

6.1.2 The site has very limited connectivity to the local highway network. Therefore the potential for surface water to be conveyed by road is limited to the immediate, surrounding highways. Local topography shows that the land falls generally from north to south.

6.1.3 The online Environment Agency modelled surface water flood map shows that the site is at a very low risk of surface water flooding. A low risk is land classed as having less than 1 in 1000 (0.1%) probability of flooding in any given year.

6.1.4 The mitigation measures recommended in Section 7 will to be put in place to deal with any residual risk from this source.

### **6.2 Flooding from Rivers / Watercourses**

6.2.1 As discussed in Section 3, the site falls within Flood Zone 1 with a less than a 1 in 1000 (<0.1%) annual probability of flooding from a fluvial Source in any given year.

6.2.2 There are no areas of Flood Zones 2 & 3 associated with local watercourses that encroach within the boundary of the site. The closest area of higher probability Flood Zones (2 and 3) is located 980m to the northwest of the site and relate to the River Worth. The flood zones associated with this watercourse are confined to the immediate vicinity of the rivers channel. Due to the elevation difference between the watercourse and the site it is unlikely that the projected effects of climate change would bring the site into a higher probability flood zone.

### **6.3      *Flooding from Sewers***

6.3.1      If any of the sewers/drainage apparatus adjacent to the site were to surcharge and flood, it is likely that any floodwaters would be shallow, relatively slow moving and constrained within the limits of the carriageway.

6.3.2      At the time of writing the report there was no evidence available to suggest the site has been directly affected from flooding from overloaded sewers/drainage apparatus in the past; therefore the risk of flooding from sewers would be considered low.

6.3.3      The mitigation measures proposed for the development as discussed in section 7 will also protect against any flooding from this source should the risk increase over the lifetime of the development.

### **6.4      *Flooding from Groundwater***

6.4.1      The potential for groundwater flooding has been assessed with the aid of groundwater mapping from the Environment Agency and British Geological Survey geological and borehole records.

6.4.2      The Environment Agency groundwater mapping shows the sites underlying strata consists of a Secondary A bedrock aquifer and a Secondary undifferentiated superficial (drift) aquifer. A secondary A aquifer are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers. Secondary Undifferentiated aquifers are assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type. These are generally the water-bearing parts of the former non-aquifers. It should be noted that the area of the site has a superficial strata that is designated as both unproductive and secondary undifferentiated aquifers.

- 6.4.3 The online British Geological Survey geological map of the UK has been reviewed and it confirms a superficial strata of Devensian Diamicton/Till of sands, gravel and clay. The underlying bedrock is of the Pennine Lower Coal Measure Formation, the Millstone Grit Group and Guiseley Grit Group. The British Geological Survey do not hold publically accessible borehole for this area.
- 6.4.4 The British Geological Survey hold records of boreholes previously excavated in Dale View Road and Redwood Close to the north of the site. 3 Boreholes on Dale View Road shows a strata of topsoil underlain by firm brown sandy clay to a depth of 0.5m below ground level. 5 boreholes have been reviewed on Redwood Close which show a strata of topsoil underlain by firm yellow/brown clay to a depth of 3.0m. All reviewed boreholes remained dry during excavation apart from one which notes minor seepage in the bottom of an excavation.
- 6.4.5 Due to the impermeable nature of the sites underlying superficial strata, which is predominantly made up of clay. It is unlikely that groundwater would be an issue at this location. Little groundwater was encountered to 3.00m below ground level in excavated boreholes.
- 6.4.6 The mitigation measures recommended to protect the development from other sources of flooding would also protect against groundwater emergence should the risk increase in the future or should groundwater emerge remote from the site and flow overland.

## **6.5 *Flooding from Climate Change***

- 6.5.1 It is generally considered that the intensity of rainfall will increase by up to 30% by the year 2085 and that winter months will become proportionately wetter.
- 6.5.2 Peak river flows are anticipated to increase by up to 20% due to climate change. As the site is in Flood Zone 1 the anticipated increase in river flows are not considered to pose any increased risk to the site.

6.5.3 These factors have been considered in the assessment of flood risk from all sources including watercourses.

## **7 Mitigation of Flood Risk**

- 7.1 It is important that any proposed development that has the potential to change the flood mechanisms on a site is designed such that there is no increased flood risk to the site itself, or sites upstream and downstream of the development. Below is a list of possible mitigation measures that will be required to ensure the development.
- 7.2 Footways should be constructed to naturally fall towards and into garden/green areas to encourage the informal percolation of surface water runoff from these areas.
- 7.3 External surfaces should fall away from properties and properties should have a finished floor level higher than development carriageway levels and external levels to prevent potential surface water flooding of the dwellings.
- 7.4 Drains within the limits of the site should be regularly inspected and cleared where necessary to reduce the risk of blockages and flooding.

## **8 Drainage Design Considerations**

### **8.1 Foul Drainage**

8.1.1 Yorkshire Water have confirmed that foul water domestic waste should discharge to the 225 mm diameter public combined sewer recorded in Long Lee Lane, at a point to the south of the site

### **8.2 Methods of Surface Water Treatment**

8.2.1 The current building regulations, Part H3, detail the favoured hierarchy of surface water disposal being in order of preference, to ground by infiltration, to watercourse and then to sewer.

#### **1. Infiltration**

#### **2. Watercourse**

#### **3. Sewer**

#### **1. Infiltration Drainage**

8.2.2 Infiltration methods of drainage such as soakaways and filter drains percolate surface water runoff allowing it to permeate into the subsoil at its natural rate mimicking the natural process of drainage and as such are subject to the local ground conditions. As reviewed records are for the local area they can only give an idea of the sites underlying strata, site specific testing should be carried out to obtain site specific results.

8.2.3 The British Geological Survey hold records of boreholes previously excavated in Dale View Road and Redwood Close to the north of the site. 3 Boreholes on Dale View Road shows a strata of topsoil underlain by firm brown sandy clay to a depth of 0.5m below ground level. 5 boreholes have been reviewed on Redwood Close which show a strata of topsoil underlain by firm yellow/brown clay to a depth of

3.0m. All reviewed boreholes remained dry during excavation apart from one which notes minor seepage in the bottom of an excavation.

8.2.4 The soils encountered beneath the area is shown to be predominantly clay which suggests that the underlay strata would have very low permeability characteristics. In light of the above soakaways are deemed an unviable method of surface water treatment, this should be confirmed by onsite testing during a site investigation.

8.2.5 It should also be noted that due to the sites location in an area of sloped topography, drainage via infiltration runs the risk of remerging at a lower elevation.

## **2. Discharge to Watercourse**

8.2.6 The closest watercourse to the site is the Hog Holes Beck which is located 170m southwest of the site.

8.2.7 Due to the location, topography and the fact carriageway and third party land would have to be crossed in order to gain connection into the watercourse this method is unlikely to be viable.

## **3. Discharge to Sewer**

8.2.8 Yorkshire Water have advised that the proposal site is currently undeveloped and no surface water is known to have previously discharged to the public sewer network and as such, the local public sewer network does not have capacity to accept any surface water from the proposed site.

8.2.9 Yorkshire Water have agreed that both infiltration and discharge to a nearby watercourse are deemed unviable methods and therefore the public surface water sewer can be used for discharge.

8.2.10 On the 30<sup>th</sup> May 2017 Yorkshire Water provided comments on Flood Risk Assessment 9704/DH/001/01 which was issued on December 2016. They stated that the surface water sewer to the North of the site in Redwood Close should be used for the discharge of surface water. From the information supplied, it is not possible to determine if the whole site will drain by gravity to the public surface water sewer network. If the site, or part of it, will not drain by gravity, then it is likely that a surface water pumping station will be required to facilitate connection to the public surface water sewer network. If pumping is required, the peak pumped surface water discharge must not exceed 5 (five) litres per second.

### **8.3 Attenuation Options**

#### ***Attenuation in ponds/basin and open water features***

8.3.1 As it is proposed that the site will be developed for residential use, having an open water structure to store rainwater within the site poses a risk to the safety of the potential occupants of the site especially children. The residual risk of such a system requires careful thought before implementation.

8.3.2 If discharge into the combined public sewer located in Long Lee Lane is deemed viable, it has been calculated that to enable a discharge rate of 5.0l/s between 261m<sup>3</sup> and 401m<sup>3</sup> of storage would be required for a 1 in 100 storm event including climate change (+30%) in line with the NPPF.

8.3.3 Due to the level of storage required for the proposed development and the existing gradient across the site it is considered that attenuation in ponds/basins and open water features is an unviable option for inclusion in a drainage strategy for this site due to the potential land take in accommodating a pond on the site.

#### ***Attenuate rainwater by storing in tanks or sealed water features***

8.3.4 Attenuating the surface water runoff into oversized pre-cast concrete pipes underneath the proposed highways is considered to be an option for the site.

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- 8.3.5 This form of storage could be in the form of pre cast concrete culverts, oversized pipes or other techniques such as Geo-cellular systems under public open spaces, private drives or car parks to provide some of the storage required to accommodate the 1 in 100 year storm event.
- 8.3.6 In line with current guidance, attenuation should be provided to ensure that the system does not flood during a 1 in 30 year storm event and for a 1 in 100 year storm event + 30% climate change the system can flood but the surcharge must not flood properties and be kept within the site's boundary.
- 8.3.7 Between 261m<sup>3</sup> and 401m<sup>3</sup> of storage would be required for a 1 in 100 storm event including climate change (+30%) in line with the NPPF. This has been calculated using WinDES software; the results are contained in Appendix C. This is an initial estimate of the likely storage to be required on the site and should be verified as part of any detailed drainage design of the site.

## 9 Proposed Surface Water Drainage Strategy

- 9.1.1 The application to be submitted is an outline proposal only and as such the purpose of the Surface Water Drainage Strategy is to detail the principle of a sustainable drainage strategy and layout. The final details should be designed and confirmed at the detailed design stage and following consultations with the Local Planning, Highway and Drainage Authority.
- 9.1.2 It is clear that there is an opportunity to provide a level of SuDs techniques appropriate for the new site which will contribute to a sustainable development and improve urban design, by balancing the different issues that influence the development.
- 9.1.3 The existing site is an undeveloped Greenfield site. The site falls towards the sites southern boundary at an approximate average gradient of 12%.
- 9.1.4 The soils encountered beneath the area is shown to be predominantly clay which suggests that the underlay strata would have very low permeability characteristics. In light of the above soakaways are deemed an unviable method of surface water treatment, this should be confirmed by onsite testing during a site investigation.
- 9.1.5 As infiltration and connection into a local watercourse have both been deemed unviable surface water discharge options, the only other means of surface water discharge would be into a Yorkshire Water system. Yorkshire Water have advised that the discharge point should be to the North of the site in Redwood Close. However If the site, or part of it, will not drain by gravity, then it is likely that a surface water pumping station will be required to facilitate connection to the public surface water sewer network. If pumping is required, the peak pumped surface water discharge must not exceed 5 (five) litres per second.
- 9.1.6 Assuming a minimum surface water discharge rate of 5.0l/s is agreed with Yorkshire Water into their system, then between 261m<sup>3</sup> and 401m<sup>3</sup> of storage

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would be required for a 1 in 100 storm event including climate change (+30%) in line with the NPPF.

- 9.1.7 The most viable method of storage due to the extreme gradient of the site would be methods such as pre cast concrete culverts, oversized pipes or other techniques such as Geo-cellular systems under public open spaces, private drives or car parks to provide some of the storage required to accommodate the 1 in 100 year storm event. This should be located to the south of the site due to the natural grade of the land.
- 9.1.8 The final drainage layout will be confirmed as part of the detailed drainage design and consultations held with the Local Highway Authority and Yorkshire Water with regards to the final design details and future adoption of the drainage techniques to be utilised.

## 10 Conclusion

- 10.1 This report serves to review and assess the sources of potential flooding to the site, the impact of the proposed development on the flood mechanisms of the site and the impact on the surrounding area in accordance with NPPF.
- 10.2 Sequential and Exception Tests have been assessed in accordance with NPPF and it is concluded that the development is suitable for this location.
- 10.3 Suitable mitigation measures have been recommended in Section 7 that will reduce this risk to acceptable levels for the end user should a flood event occur.
- 10.4 This report concludes that the site can be developed without increasing flood risk to the site itself and other sites in the vicinity and also without unacceptable residual risk of flooding, with the implementation of suitable mitigation measures.

## ***APPENDIX A - Drawings***

***Site Location: 9704/001***

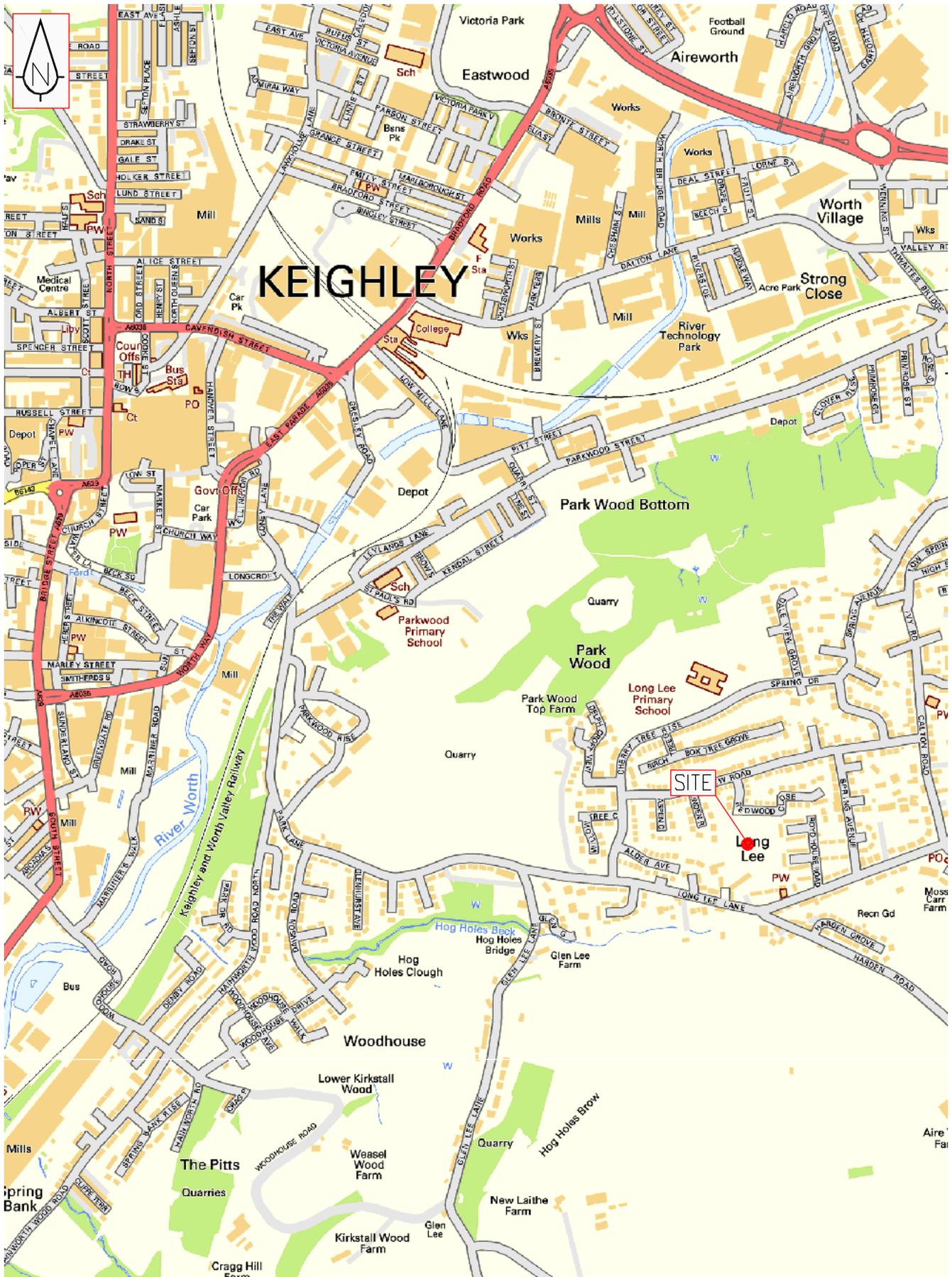
***Existing Permeable and Impermeable Areas: 9704/002***

***Proposed Permeable and Impermeable Areas: 9704/003***

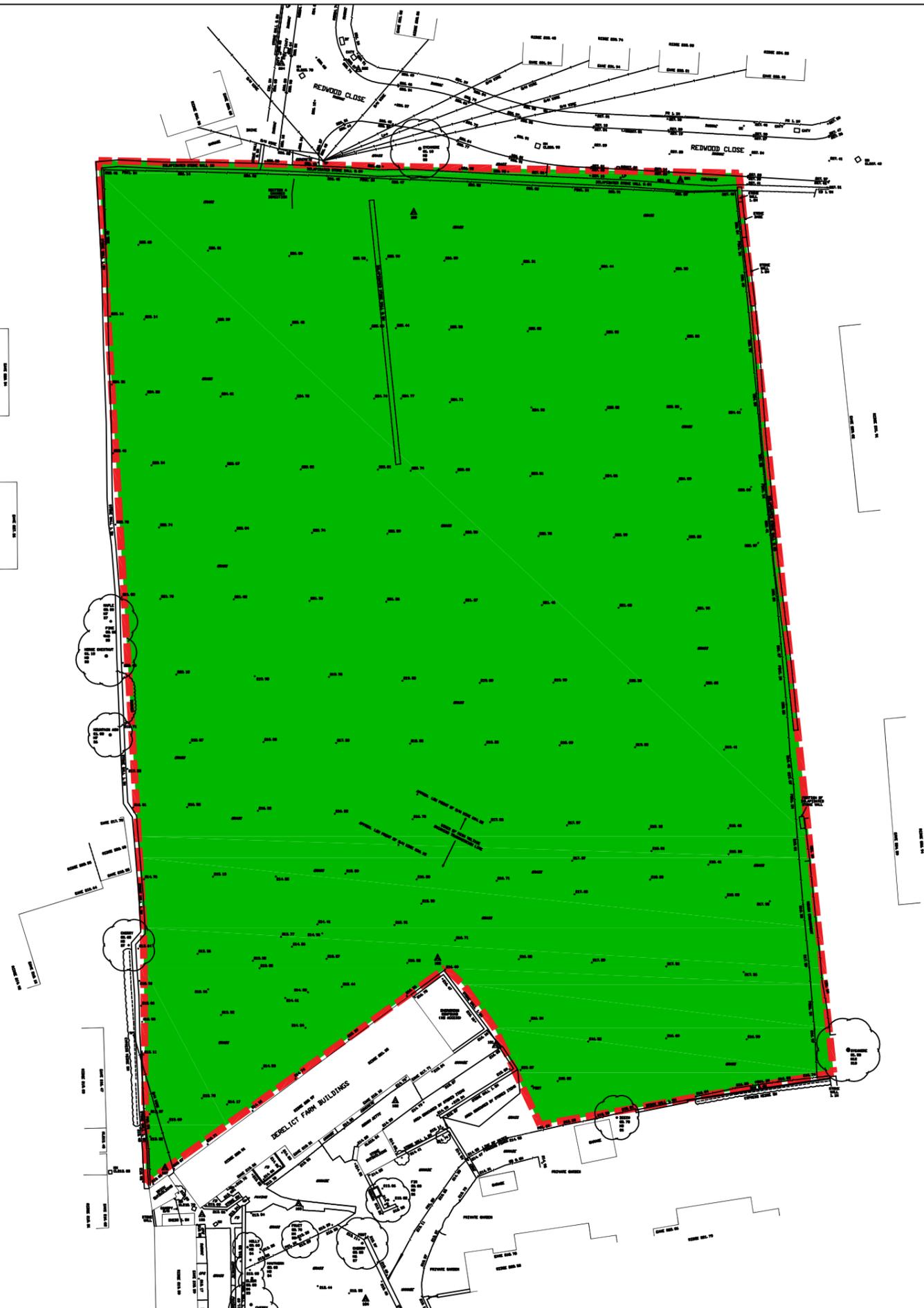
***Topographical Survey***

***Illustrative Masterplan***

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|          |                |   |
|----------|----------------|---|
| Drawn    | Scale          |  |
| BL       | NTS            |   |
| Checked  | Date           |   |
| DH       | Dec 16         |   |
| Approved | Drawing Number | Size  |
| DH       | 9704-001       | A4  |



Notes

Impermeable Areas

|   |              |                 |      |
|---|--------------|-----------------|------|
|  | Hardstanding | 0m <sup>2</sup> | (0%) |
|  | Buildings    | 0m <sup>2</sup> | (0%) |
|   | Total        | 0m <sup>2</sup> | (0%) |

Permeable Areas

|   |                   |                            |               |
|---|-------------------|----------------------------|---------------|
|  | Area              | 11,215m <sup>2</sup>       | (100%)        |
|   | <b>Total Area</b> | <b>11,215m<sup>2</sup></b> | <b>(100%)</b> |

| Rev | Amendment | Drawn | Date | Checked |
|-----|-----------|-------|------|---------|
|     |           |       |      |         |



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Project Name  
Proposed Residential Development  
Land off Redwood Close  
Long Lee, Keighley

Drawing Title  
Existing  
Impermeable and Permeable  
Areas

|                 |                |
|-----------------|----------------|
| Scale 1:500     | Drawn By DH    |
| Drawing Size A3 | Checked By TW  |
| Date Dec 16     | Approved By TW |

|   |                            |     |
|---|----------------------------|-----|
|  | Drawing Number<br>9704-002 | Rev |
|---|----------------------------|-----|



Notes

Impermeable Areas

|   |              |                     |       |
|---|--------------|---------------------|-------|
|  | Hardstanding | 3,129m <sup>2</sup> | (28%) |
|  | Buildings    | 2,402m <sup>2</sup> | (21%) |
|   | Total        | 5,531m <sup>2</sup> | (49%) |

Permeable Areas

|   |            |                      |        |
|---|------------|----------------------|--------|
|  | Area       | 5,684m <sup>2</sup>  | (51%)  |
|   | Total Area | 11,215m <sup>2</sup> | (100%) |

| Rev | Amendment | Drawn | Date | Checked |
|-----|-----------|-------|------|---------|
|     |           |       |      |         |



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Project Name  
Proposed Residential Development  
Land off Redwood Close  
Long Lee, Keighley

Drawing Title  
Proposed  
Impermeable and Permeable  
Areas

|                 |                |
|-----------------|----------------|
| Scale 1:500     | Drawn By DH    |
| Drawing Size A3 | Checked By TW  |
| Date Dec 16     | Approved By TW |

|   |                            |     |
|---|----------------------------|-----|
|  | Drawing Number<br>9704-003 | Rev |
|---|----------------------------|-----|

| LEGEND |                          | S1034 |
|--------|--------------------------|-------|
|        | Survey Station           |       |
|        | Direction of Floorboards |       |
|        | Step Up                  |       |
|        | Banking                  |       |
|        | Fence                    |       |
|        | Change in Ceiling Height |       |
|        | Foul Drainage            |       |
|        | Storm Drainage           |       |
|        | Electricity D/H          |       |
|        | Electricity U/G          |       |
|        | Bench Mark               |       |
|        | +76.72 Level Position    |       |
|        | Sloping Ceiling          |       |
|        | Sloping Masonry          |       |
|        | Gates                    |       |
|        | Grass                    |       |
|        | Sycamore Tree            |       |

**FENCE TYPES**

|     |                 |    |               |
|-----|-----------------|----|---------------|
| BW  | Barbed Wire     | IR | Iron Railings |
| CB  | Close Boarded   | PR | Post & Rail   |
| CI  | Corrugated Iron | PV | Post & Vine   |
| CLK | Chain Link      | OB | Open Boarded  |
| CPG | Chestnut Paling | WM | Wire Mesh     |

**ABBREVIATIONS (Where Applicable)**

|      |                             |     |                    |
|------|-----------------------------|-----|--------------------|
| AGL  | Above Ground Level          | IC  | Inspection Cover   |
| ASL  | Arch Springing Level        | IL  | Invert Level       |
| AHL  | Arch Head Level             | KD  | Kerb Ductlet       |
| AV   | Air Valve                   | LD  | Landing Level      |
| BOL  | Bollard                     | LP  | Lamp Post          |
| BRW  | Brick Wall                  | MC  | Mercury            |
| BRRW | Brick Ret Wall              | MI  | Manhole            |
| BSL  | Beam Soffit Level           | MKR | Marker             |
| BT   | British Telecom IC          | MR  | Metal Railings     |
| CATV | Cable TV                    | NB  | Notice Board       |
| CBSL | Clad Beam Soffit Lvl        | NFI | No Further Info.   |
| CD   | Cable Duct                  | D/H | Diverhead          |
| CE   | Cleaning Eye                | R   | From Records       |
| CIH  | Change in Height of Ceiling | RG  | Road Gully         |
| CL   | Cover Level                 | RL  | Roof Level         |
| CM   | Cable Marker                | RNB | Road Name Board    |
| CP   | Catch Pit                   | RS  | Road Sign          |
| CPS  | Conc Paving Slabs           | RSJ | Rolled Steel Joist |
| CSL  | Ceiling Soffit Level        | RW  | Retaining Wall     |
| D    | Door                        | RWP | Rainwater Pipe     |
| DP   | Down Pipe                   | SA  | Soakaway           |
| DHL  | Door Head Level             | SC  | Stop Cock          |
| DHL  | Duct Soffit Level           | ST  | Stone              |
| ECP  | Elec Cable Pit              | SV  | Stop Valve         |
| EJB  | Elec Junct. Box             | T   | Trunking           |
| EP   | Electricity Pole            | TL  | Threshold Level    |
| ERP  | Earthing Point              | TLT | Traffic Light      |
| FB   | Floor Bed                   | TP  | Telephone Pole     |
| FCSL | False Ceiling               | TPS | Tactile Paving     |
|      | Soffit Level                | U/G | Underground        |
| FH   | Fire Hydrant                | UTL | Unable To Lift     |
| FIG  | Feeds into Ground           | V   | Vent               |
| FL   | Floor Level                 | VP  | Vent Pipe          |
| G    | Gully                       | W   | Window             |
| GM   | Gas Meter                   | WHB | Wash Hand Basin    |
| GSC  | Gas Stop Cock               | WHL | Window Head Leve   |
| GV   | Gas Valve                   | WSC | Water Stop Cock    |
| H    | High/Height                 | WSL | Window Sill Level  |
|      |                             | WV  | Water Valve        |

**NOTES**

LEVEL DATUM OS GPS

THE ORIGIN AND ORIENTATION OF THE SURVEY GRID ARE THOSE OF THE NATIONAL GRID.

**UNDERGROUND SERVICES INFORMATION**

|             |     |
|-------------|-----|
| DRAINAGE    | N/A |
| ELECTRICITY | N/A |
| GAS         | N/A |
| TELECOM     | N/A |
| WATER       | N/A |

While all reasonable care has been taken in locating the underground services shown on this plan the completeness or accuracy of the information cannot be guaranteed. Users are advised to satisfy themselves before connections are made.

| REV | DATE | PREV JOB NO. | REVISION DETAILS |
|-----|------|--------------|------------------|
|     |      |              |                  |

**PLANET ARCHITECTURE LTD**  
 MILL COTTAGE  
 ICKORNASHAW  
 COWLING  
 BD22 0BD

JOB TITLE  
**LAND OFF LONG LEE LANE**  
 LONG LEE  
 KEIGHLEY

DRAWING TITLE  
**SITE SURVEY**

|                         |                           |
|-------------------------|---------------------------|
| DRAWING 2 OF 2          | AUTOCAD DRAWING FILE NAME |
| CLIENT JOB No.          | SITE.DWG                  |
| SCALE 1/200             | REVISION SUFFIX           |
| SHEET SIZE A1-B41x594mm | DATE MAY 2016             |
| SURVEYOR AL             | DRAWN JM                  |
| CHECKED PHK             |                           |



**STATION COORDINATE SCHEDULE**

| STN | EASTING    | NORTHING   | LEVEL   | DESCRIPTION            |
|-----|------------|------------|---------|------------------------|
| 101 | 407206.750 | 440332.812 | 216.091 | HILTI NAIL IN PEG      |
| 102 | 407193.109 | 440325.269 | 214.556 | HILTI NAIL IN SETTS    |
| 103 | 407179.914 | 440311.247 | 213.671 | HILTI NAIL IN PAVING   |
| 104 | 407189.061 | 440298.268 | 212.285 | HILTI NAIL IN PEG      |
| 105 | 407168.632 | 440277.929 | 209.829 | HILTI NAIL IN TARMAC   |
| 106 | 407166.737 | 440309.772 | 212.839 | HILTI NAIL IN CONCRETE |
| 107 | 407161.702 | 440316.131 | 212.996 | HILTI NAIL IN PEG      |
| 108 | 407198.880 | 440344.707 | 216.706 | HILTI NAIL IN PEG      |
| 109 | 407195.613 | 440446.335 | 226.427 | HILTI NAIL IN PEG      |





**Mix Schedule**

|                       |        |             |
|-----------------------|--------|-------------|
| Type A (2bd house)    | 650sf  | 9no         |
| Type B (3bd house)    | 850sf  | 17no        |
| Type C (2bd bungalow) | 425sf  | 2no         |
| Type D (3bd house)    | 975sf  | 8no         |
| Type E (3/4bd house)  | 1050sf | 2no         |
| <b>TOTAL</b>          |        | <b>38no</b> |

★ Suggested AH units (6No = 15%)

***APPENDIX B – Consultation***

***Yorkshire Water***

***Borehole Logs***

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YorkshireWater

Mr T Walker  
Sanderson Associates (Consulting Engineers)  
Ltd  
Sanderson House  
Jubilee Way  
Grange Moor  
Wakefield  
West Yorkshire  
WF4 4TD

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

Tel: 0345 120 8482  
Fax: (01274) 372 834

Email:  
Technical.Sewerage@yorkshirewater.co.uk

Your Ref: SAL001878N  
Our Ref: S017953

For telephone enquiries ring:  
Chris Roberts on 0345 120 8482

6th December 2016

Dear Mr Walker,

**Land off Redwood Close, Long Lee, Keighley - Pre-planning sewerage enquiry on R381388 - Residential**

Thank you for your recent enquiry and remittance. Our official VAT receipt has been sent to you under separate cover. Please find enclosed a complimentary extract from the Statutory Sewer Map which indicates the recorded position of the public sewers. Please note that as of October 2011 and the private to public sewer transfer, there are many uncharted Yorkshire Water assets currently not shown on our records.

The following comments reflect our view, with regard to the public sewer network only, based on a 'desk top' study of the site and are valid for a maximum period of twelve months.

**Existing Infrastructure**

Please note:- due to the change in legislation on 01/10/2011 there may be public sewers within the site boundary which are not recorded on the Statutory Sewer Map the presence of which should be taken into account in the design of the scheme.

**Foul Water**

Development of the site should take place with separate systems for foul and surface water drainage. The separate systems should extend to the points of discharge to be agreed.

Foul water domestic waste should discharge to the 225 mm diameter public combined sewer recorded in Long Lee Lane, at a point to the south of the site.

**Surface Water**

The developer's attention is drawn to Requirement H3 of the Building Regulations 2000. This establishes a preferred hierarchy for surface water disposal. Consideration should firstly be given to discharge to soakaway, infiltration system and watercourse in that priority order.

Sustainable Drainage Systems (SuDS), for example the use of soakaways and/or permeable hardstanding etc, may be a suitable solution for surface water disposal appropriate in this situation. You are advised to seek comments on the suitability of SuDS in this instance from the appropriate authorities.

As the proposal site is currently undeveloped no surface water is known to have previously discharged to the public sewer network





As such, the local public sewer network does not have capacity to accept any surface water from the proposed site. If SuDS are not viable, the developer is advised to contact the Environment Agency/local Land Drainage Authority with a view to establishing a suitable watercourse (if any nearby for discharge).

**Other Observations**

Any new connection to an existing public sewer will require the prior approval of Yorkshire Water. You may obtain an application form from our website ([www.yorkshirewater.com](http://www.yorkshirewater.com)) or by telephoning 0345 120 84 82.

An off-site foul and surface water sewer may be required which may be provided by the developer and considered for adoption under Section 104 of the Water Industry Act 1991. Please telephone 0345 120 84 82 for advice on sewer adoptions. Alternatively, the developer may in certain circumstances be able to requisition off-site sewers under Section 98 of the Water Industry Act 1991 for which an application must be made in writing. For further information, please telephone 0345 120 84 82.

Prospectively adoptable sewers and pumping stations must be designed and constructed in accordance with the WRc publication "Sewers for Adoption - a design and construction guide for developers" 6th Edition as supplemented by Yorkshire Water's requirements, pursuant to an agreement under Section 104 of the Water Industry Act 1991. An application to enter into a Section 104 agreement must be made in writing prior to any works commencing on site. Please contact our Developer Services Team (telephone 0345 120 84 82) for further information.

The public sewer network is for domestic sewage purposes. This generally means foul water for domestic purposes and, where a suitable surface water or combined sewer is available, surface water from the roofs of buildings together with surface water from paved areas of land appurtenant to those buildings. Land and highway drainage have no right of connection to the public sewer network. No land drainage to be connected/discharged to public sewer.

As a last resort, highway drainage may be accepted under certain circumstances. If it can be demonstrated, through satisfactory evidence, that SUDS are not a viable option, there are no watercourses or highway drains available and if capacity is available within the public sewer network, highway drainage discharges to the public sewer network may be permitted. In this event, the developer may be required to enter into a formal agreement with Yorkshire Water Services under Section 115 Water Industry Act 1991 to discharge non-domestic flows into the public sewer network.

All the above comments are based upon the information and records available at the present time. The information contained in this letter together with that shown on any extract from the Statutory Sewer Map that may be enclosed is believed to be correct and is supplied in good faith. Please note that capacity in the public sewer network is not reserved for specific future development. It is used up on a 'first come, first served' basis. You should visit the site and establish the line and level of any public sewers affecting your proposals before the commencement of any design work.

Yours sincerely

**Chris Roberts**  
**Sewerage Technician**  
**Developer Services**





YorkshireWater

Head of Service  
City of Bradford Metropolitan District Council  
Planning, Transportation and Highways  
Development Services  
4th Floor  
Britannia House  
Hall Ings  
Bradford  
BD1 1HX

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

Tel: 0345 120 8482  
Fax: (01274) 372 834

Email:  
Technical.Sewerage@yorkshirewater.co.uk

For telephone enquiries ring :  
John Wellham on 0345 120 8482

Your Ref: 17/02809/MAO  
Our Ref: T007040

30th May 2017

Dear Sir/Madam,

Land At Redwood Close Long Lee Keighley - Outline planning application for up to 45 dwellings and associated works with all matters reserved except for access to the site (access within site is reserved)

Thank you for consulting Yorkshire Water regarding the above proposed development. We have the following comments:

#### Waste Water

If planning permission is to be granted, the following conditions should be attached in order to protect the local aquatic environment and YW infrastructure:

**The site shall be developed with separate systems of drainage for foul and surface water on and off site.  
(In the interest of satisfactory and sustainable drainage )**

**No development shall take place until details of the proposed means of disposal of surface water drainage, including details of any balancing works and off -site works, have been submitted to and approved by the local planning authority . The rate of discharge of surface water to surface water sewer shall not exceed 5 (five) litres per second, the point of connection to be agreed by the statutory sewerage undertaker . Furthermore, unless otherwise approved in writing by the local planning authority, there shall be no piped discharge of surface water from the development prior to the completion of the approved surface water drainage works .**

**(To ensure that no surface water discharges take place until proper provision has been made for its disposal)**

The Flood Risk Assessment and Drainage Impact Assessment (prepared by Sanderson Associates - Report 9704/DH/001/01 dated December 2016) is not acceptable.

Yorkshire Water accept that soakaways will not be appropriate at this site and there are no watercourses nearby. However, there is a Combined Sewer Overflow (CSO) immediately downstream of the proposed connection point, which controls the flow within the sewer. As such, the combined sewer cannot be used as the outfall point for surface water from this site as this would impact on our permitted discharge to watercourse agreed with the Environment Agency.

The surface water sewer to the North in Redwood Close should be used for the discharge of surface water. From the information supplied, it is not possible to determine if the whole site will drain by gravity to the public surface water sewer network. If the site, or part of it, will not drain by gravity, then it is likely that a surface water pumping station will be required to facilitate connection to the public surface water sewer network. If pumping is required, the peak pumped surface water discharge must not exceed 5 (five) litres per second.

The public sewer network is for domestic sewage purposes. This generally means foul water for domestic purposes and, where a suitable surface water or combined sewer is available, surface water from the roofs of buildings together with surface water from paved areas of land appurtenant to those buildings. Land and highway drainage have no right of connection to the public sewer network.

The developer should contact the Highway Authority with regard to acceptability of highway drainage proposals. Highway drainage, may however be accepted under certain circumstances. In this event, a formal agreement for highway drainage discharge to public sewer, in accordance with Section 115 of the Water Industry Act 1991, will be required.

Yours faithfully

**Developer Services Team**

LOCATION: LONG LEE LANE, KEIGHLEY

TRIAL PITS 1, 2 and 3

Method HAND EXCAVATION

British Geological Survey

Date 27.10.78

Casing

Sheet 1 of 2

| R.L.<br>m A.O.D. | DEPTH<br>m | SOIL DESCRIPTION  | SAMPLING |       | TEST  |
|------------------|------------|---|----------|-------|---|
|                  |            |   | No.      | Depth |   |
|                  |            | Trial pits were excavated from proposed formation level.          |          |       |   |
|                  | F.L.       | TRIAL PIT 1 0725 4054<br>F.L. 0.3m below general ground level.    |          |       | SE04SE                                      |
|                  | 0.3        | Firm brown sandy CLAY with gravel size sandstone fragments.       | B1       | 0-0.3 | CBR R 10<br>BD R :<br>m 2<br>LL 14<br>PL 14 |
|                  |            | End of Trial Pit.<br>Trial Pit dry.                               |          |       |   |
|                  |            |   |          |       | SE04SE                                      |
|                  | F.L.       | TRIAL PIT 2 0718 4051<br>F.L. 0.4m below general ground level.    |          |       |   |
|                  | 0.3        | Firm brown sandy CLAY with gravel size sandstone fragments.       | B1       | 0-0.3 | CBR R 8<br>BD R 1<br>m 26                   |
|                  |            | End of Trial Pit.<br>Trial Pit dry.                               |          |       |   |
|                  |            |   |          |       | SE04SE                                      |
|                  | F.L.       | TRIAL PIT 3 0710 4050<br>F.L. 0.4m to below general ground level. |          |       |   |
|                  | 0.3        | Firm brown very sandy CLAY with gravel size sandstone fragments.  | B1       | 0-0.3 | CBR R 13<br>BD R 2<br>m 15                  |
|                  |            | End of Trial Pit.<br>Trial Pit dry.                               |          |       |   |

British Geological Survey

British Geological Survey

British Geological Survey

| Hole No. | Date    | Grd. Water | Depth | R.L. | Description of Strata                    |
|----------|---------|------------|-------|------|--|
| 4.       | 6.11.75 |            |       |      | 0730 4051 SED45E-192                     |
|          |         |            | 350   |      | TOPSOIL                                  |
|          |         |            | 1000  |      | FIRM YELLOW CLAY                         |
|          |         | HOLE DRY   | 1450  |      | WEATHERED GRITSTONE                      |
| 5.       | 6.11.75 |            |       |      | 0733 4051 SED45E-193                     |
|          |         |            | 150   |      | TOPSOIL                                  |
|          |         |            | 2340  |      | FIRM YELLOW CLAY                         |
|          |         | HOLE DRY   | 3450  |      | FIRM DARK BLUE CLAY                      |
|          |         |            |       |      | WEATHERED GRITSTONE                      |
| 6.       | 7.11.75 |            |       |      | 0732 4050 SED45E-194                     |
|          |         |            | 350   |      | TOPSOIL                                  |
|          |         |            | 1000  |      | FIRM YELLOW CLAY                         |
|          |         | HOLE DRY   | 1400  |      | FIRM BROWN CLAY WITH GRITSTONE FRAGMENTS |

**RECORD OF TRIAL HOLES**

BRADFORD METROPOLITAN DISTRICT COUNCIL  
 DIRECTORATE OF DEVELOPMENT SERVICES  
 ENGINEERING DIVISION

DRG.No. 2002/47/2

Scale 1:50

ROYD HOUSE FARM, LONG LEE, KEIGHLEY.

Prepared D.W.F.

JULY 04/10/72

British Geological Survey

British Geological Survey

British Geological Survey

| Hole No. | Date    | Grd. Water      | Depth | R.L. | Description of Strata  |
|----------|---------|-----------------|-------|------|------------------------|
| 7        | 7.11.75 |                 |       |      | 0731 4048 SED45E-195   |
|          |         |                 | 300   |      | TOPSOIL AND HUM        |
|          |         | HOLE DRY        | 450   |      | FIRM YELLOW CLAY       |
|          |         |                 | 650   |      | FIRM BROWN CLAY        |
|          |         |                 |       |      |                        |
| 8        | 7.11.75 |                 |       |      | 0734 4048 SED45E-196   |
|          |         |                 | 250   |      | TOPSOIL                |
|          |         | HOLE DRY        | 600   |      | FIRM YELLOW CLAY       |
|          |         |                 | 1400  |      | FIRM YELLOW-BROWN CLAY |
|          |         |                 | 1600  |      | WEATHERED CRISTONE     |
|          |         |                 |       |      |                        |
| 9        | 7.11.75 |                 |       |      | 0733 4047 SED45E-197   |
|          |         |                 | 300   |      | TOPSOIL                |
|          |         | WATER IN BOTTOM | 550   |      | FIRM YELLOW CLAY       |
|          |         |                 | 1600  |      | FIRM GREY CLAY         |
|          |         |                 | 1800  |      | WEATHERED CRISTONE     |
|          |         |                 |       |      |                        |
| 10       | 7.11.75 |                 |       |      | 0731 4046 SED45E-198   |
|          |         |                 | 150   |      | TOPSOIL                |
|          |         | HOLE DRY        | 900   |      | SOFT YELLOW CLAY       |
|          |         |                 | 2200  |      | FIRM YELLOW CLAY       |
|          |         |                 |       |      |                        |

**RECORD OF TRIAL HOLES**

|   |  |                   |        |
|---|--|-------------------|--------|
| BRADFORD METROPOLITAN DISTRICT COUNCIL<br>DIRECTORATE OF DEVELOPMENT SERVICES<br>ENGINEERING DIVISION |  | DRG.No. 2002/47/3 |        |
| ROYD HOUSE FARM, LONG LEE, KEIGHLEY   |  | Scale             | 1:50   |
|   |  | Prepared          | D.W.F. |

BAF 0119/75

***APPENDIX C – WinDES Calculations***

***Existing Greenfield Run Off Estimate***

***Proposed Storage Calculations***

---

Sanderson House  
Jubilee Way  
Huddersfield, WF4 4TD



Date 15/12/2016 14:30  
File

Designed by darren.hawkyard  
Checked by

Micro Drainage Source Control 2016.1

IH 124 Mean Annual Flood

Input

|                       |        |               |           |
|-----------------------|--------|---------------|-----------|
| Return Period (years) | 1      | Soil          | 0.450     |
| Area (ha)             | 50.000 | Urban         | 0.000     |
| SAAR (mm)             | 1000   | Region Number | Region 10 |

**Results      l/s**

|             |        |
|-------------|--------|
| QBAR Rural  | 333.4  |
| QBAR Urban  | 333.4  |
|             |        |
| Q1 year     | 290.1  |
|             |        |
| Q1 year     | 290.1  |
| Q2 years    | 310.5  |
| Q5 years    | 396.8  |
| Q10 years   | 460.1  |
| Q20 years   | 524.2  |
| Q25 years   | 546.8  |
| Q30 years   | 565.3  |
| Q50 years   | 616.8  |
| Q100 years  | 693.5  |
| Q200 years  | 786.8  |
| Q250 years  | 816.9  |
| Q1000 years | 1013.6 |

**Existing Greenfield Run-off**

$290.1 / 50\text{ha} = 5.80\text{l/s / ha}$

$5.80 / 1.12\text{ha} = \underline{6.50\text{l/s}}$

**Quick Storage Estimate**

Micro Drainage

**Variables**

|                       |                   |                                   |         |
|-----------------------|-------------------|-----------------------------------|---------|
| FSR Rainfall          |                   | Cv (Summer)                       | 0.750   |
| Return Period (years) | 100               | Cv (Winter)                       | 0.840   |
| Region                | England and Wales | Impervious Area (ha)              | 0.550   |
| Map                   | M5-60 (mm) 17.000 | Maximum Allowable Discharge (l/s) | 5.0     |
|                       | Ratio R 0.300     | Infiltration Coefficient (m/hr)   | 0.00000 |
|                       |                   | Safety Factor                     | 2.0     |
|                       |                   | Climate Change (%)                | 30      |

Analyse OK Cancel Help

Enter Maximum Allowable Discharge between 0.0 and 999999.0

**Quick Storage Estimate**

Micro Drainage

**Results**

**Global Variables require approximate storage of between 261 m<sup>3</sup> and 401 m<sup>3</sup>.**

**These values are estimates only and should not be used for design purposes.**

Analyse OK Cancel Help

Enter Maximum Allowable Discharge between 0.0 and 999999.0