

**FLOODING & DRAINAGE ASSESSMENT  
FOR A RESIDENTIAL DEVELOPMENT SITE AT  
TOWER WORKS, MOORFIELD ROAD,  
UPPER ARMLEY, LEEDS**

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**CoDa Structures**

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**FLOODING & DRAINAGE ASSESSMENT  
FOR A RESIDENTIAL DEVELOPMENT SITE AT  
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UPPER ARMLEY, LEEDS**

## **1.0 INTRODUCTION**

- 1.01 Following instructions from KMRE Group Ltd 16 May 2016, CoDA Structures have undertaken an initial assessment of flooding and drainage issues in relation to a potential residential development at Tower Works, Moorfield Road, Upper Armley, Leeds
- 1.02 The site was previously occupied by Tower Works which was demolished in approximately 2008.
- 1.03 It is proposed to develop the site with housing and apartments.
- 1.04 The Ordnance Survey coordinates for the centre of the site are 426200 mE and 433340 mN.
- 1.05 The site has previously had a planning permission (P/24/438/05/FU) for 9 houses and 53 apartments.
- 1.06 The site area is approximately 0.6 hectares.
- 1.07 The local authority is Leeds City Council (LCC).

## **2.0 POLICY CONSIDERATIONS AND OBJECTIVES**

### **2.01 National Planning Policy Framework:**

Section 10 of the National Planning Policy Framework (NPPF) published in March 2012 sets out Government policy on development and flood risk for England. It aims to ensure that flood risk is taken into account at all stages of the planning process, to avoid inappropriate developments in areas at risk of flooding, and to direct development away from areas of highest risk. Where new development is thought necessary in areas of flood risk, the NPPF aims to make it safe, without increasing flood risk elsewhere, and, where possible, reduce the overall flood risk.

The NPPF promotes a sequential risk-based approach to determine the suitability of land for development in flood risk areas. The broad aim of the NPPF is to reduce the number of people and properties within the natural and built environment at risk of flooding. To achieve this aim, planning authorities are required to ensure that flood risk is properly assessed during the initial planning stages of any development.

### **2.02 Consideration and Objectives:**

This Flooding and Drainage Assessment Report will consider the following:-

- whether the proposed development is likely to be affected by flooding.

- whether the proposed development will increase flood risk to adjacent properties.

The report will also demonstrate that any existing flood risk or flood risk associated with the proposed development can satisfactorily managed. This will include:-

- whether the proposed development is likely to be affected by flooding and whether it will increase flood risk elsewhere.
- specifying the measures proposed to deal with the identified risks, including, where appropriate, proposals to reduce existing and/or future flood risk levels.
- satisfy the Local Authority that any flood risk to the development or additional risk arising from the proposal will be successfully managed so the site can be developed and occupied safely with out risk to adjacent properties.

### 3.0 FLOODING ISSUES

#### 3.01 The Site:

The site is located to the north of Moorfield Road in Upper Armley, Leeds and is approximately 3.0 miles to the west of Leeds City Centre. A site location plan (Fig. 1) is attached in Appendix A.

The Ordnance Survey co-ordinates for the centre of the site are 426200 mE, 433740 mN.

The site is approximately 0.8 hectares in area.

The site can be accessed from a private road adjacent the south western boundary.

The general fall of the site is to the southeast. Site levels range from:-

Location	Level m AOD
North western boundary	104.34 – 106.20; 102.33 – 102.53
South eastern boundary	97.88 – 99.23
North eastern boundary	99.04 – 102.33
South western boundary	99.16 – 106.51

A site topographical survey (Fig. 2) is attached in Appendix B.

A site aerial photograph is attached in Appendix C.

There are no watercourses on or in the immediate vicinity of the site.

The Leeds Liverpool Canal lies approximately 720m to the northeast of the site.

The River Aire lies approximately 1000m to the north of the site.

LCC-Drainage have advised there is a culverted watercourse approximately 330m to the northeast and 450m to the southeast of the site.

There is a reservoir approximately 900m to the southwest of the site.

### 3.02 Flood Zone Classification:

The site is located within Flood Zone 1 on the EA website flood zone map. This zone comprises land assessed as having less than 1 in 1000 (<0.1%) annual probability of tidal or river flooding in any year.

A copy of the EA website flood zone map is attached in Appendix D.

### 3.03 Sources of Flood Risk:

The following table shows a summary of the forms of flood and the potential issues in relation to the site that require further assessment.

<b>Flood Source</b>	<b>Applicable</b>	<b>Comment</b>
Fluvial	X	There are no water courses on or in the vicinity of the site.
Tidal	X	
Run Off	✓	Potential for run off from higher land to the northwest
Groundwater	X	Relatively high groundwater levels are unlikely in this location.
Sewers	✓	A public combined sewer lies in Moorfield Road adjacent the site.
Reservoirs, Canals, etc.	✓	There is a reservoir approximately 900m to the southwest of the site.

### 3.04 Flood Risk Assessment:

The site is within Flood Zone 1. This zone comprises land assessed as having less than a 1 in 1000 (<0.1%) annual probability of tidal or river flooding in any one year.

From the inspection of the site topographical survey and following a site walkover the site may be at risk from potential overland flood waters from higher ground to the northwest.

From the inspection of the EA website Risk of Flooding from Surface Water Maps it would appear there is a very low risk (less than 1:1000 [0.1%]) of surface water flood affecting the majority of the site. However, it would appear there is a low (between 1 in 1000 [0.1%] and 1:100 [1.0%]) to high (greater than 1 in 30 [3.3%]) of surface water flooding affecting a small area of the site adjacent the western boundary and a small area of the site in the south western sector. It is indicated there is a low to medium chance of below 300mm depth of surface water flooding affecting the area adjacent the western boundary. It is indicated there is a low to medium chance of between 300 - 900mm depth of surface water flooding affecting the area in the southern sector and a high chance of less than 300mm depth of surface water affecting

this area. However, it should be noted that surface water flooding can be difficult to predict and occurs when rainwater does not drain away through the 'normal' drainage systems or soaks into the ground but lies on or flows over the ground instead.

The EA website Risk of Flooding from Surface Water Maps are attached in Appendix E.

The effect of groundwater as a flood source is not considered to be an issue at this location, particularly as groundwater levels recorded in gas monitoring boreholes on the site encountered groundwater between 11.65 and 15.85 below ground level.

The site is not at risk from overland flood waters from the potential overloading of the public combined sewer in Moorfield Road as the road is below the level of the site.

The site is not at risk from flooding from the reservoir to the southwest of the site as the reservoir is considerably below the level of the site.

### **3.05 Sequential Test:**

The Sequential Test should be applied at all stages of planning. Its aim is to steer new development to areas at the lowest probability of flooding.

Table 2 of the Technical Guidance to the NPPF (which categorises the flood risk vulnerability of land uses) indicates the proposed development is categorised as a 'more vulnerable' land use.

From the EA flood zone map site is identified as being Flood Zone 1.

Table 3 of the Technical Guidance to the NPPF indicates where the proposed land use is 'more vulnerable' development is appropriate in Flood Zone 1. Therefore, the Sequential Test has been passed.

### **3.06 Exception Test:**

Table 3 of the Technical Guidance to the NPPF indicates where the proposed land use is 'more vulnerable' development is considered appropriate in Flood Zone 1 and the Exception Test is not required.

Notwithstanding the above the following sections of this report will demonstrate that the proposed development will be safe from flooding and will not increase flood risk elsewhere.

### **3.07 Effect of Development on the Wider Catchment:**

The proposed re-development of the site will result in the reduction of impermeable areas on the site from that of the original Tower Works development so the flood risk

to the local catchment will be reduced.

### 3.08 Flood Risk Mitigation:

The proposed development is in Flood Zone 1.

The external levels on the development should be set to route any overland flood waters away/ around the proposed buildings to the south and on to Moorfield Road as the existing situation.

## 4.0 DRAINAGE

### 4.01 Public Sewers:

There is a 305mm diameter combined sewer in Moorfield Road adjacent the site.

There is a 229mm diameter combined sewer to the west of the site.

Yorkshire Water have advised the following:-

- Foul water can be discharged to the 305mm diameter combined sewer in Moorfield Road adjacent to the site.
- If possible, surface water should be discharged to soakaways or directly to watercourse.
- The local public sewer network does not have capacity to accept any additional discharge of surface water from the site.
- As a last resort curtilage surface water can be discharged to the 305mm public combined sewer in Moorfield Road at the current rate of discharge minus 30% at a similar point of connection. However, this should be justified by a survey of the existing drainage system and supporting calculations.

The correspondence from Yorkshire Water and a extract from the public sewer record are attached in Appendix F.

### 4.02 Existing Drainage:

An initial survey of the existing drainage on the site appears to indicate the site is drained to the 305mm combined sewer in Moorfield Road via a connection in the access road adjacent the western boundary of the site. However, at this stage it has not been possible to establish the diameter or gradient of the connection to the public system and further survey works will be required.

**4.03 Geology:**

1:25,000 BGS Geological Sheet of the Leeds area indicated the following:-

- The site is underlain by Lower Coal Measures (mudstones and siltstones) of the Westphalian Age. Sandstones may be present in the southern sector.
- Drift deposits are unlikely to be present at the surface.
- There is a fault adjacent the northern boundary of the site.
- There is a backfilled sandstone quarry approximately 150m to the west of the site.

**4.04 Ground Conditions:**

With reference to the ground investigation report prepared by Sirius Geotechnical and Environmental Ltd (Sirius) for the site (Reference CO313 dated April 2005) the following ground conditions were encountered on the site:-

**Trial Pits**

Made ground was encountered in all exploratory holes to a maximum depth of 2.9m. Generally, the thickness of the made ground, including surfacings was less than 1.0m.

In the central and north eastern sectors of the site the made ground was underlain with a firm/stiff sandy gravelly clay. Where encountered the depth of the sandy gravelly clay was between 0.85 – 2.40mm

Across the remainder of the site the made ground was underlain by sandstones, mudstones and/or siltstones.

**Rotary Drilling**

The following strata was encountered in the rotary drilling undertaken on the site:

<b>R1</b>		<b>R2</b>		<b>R3</b>	
<b>Strata</b>	<b>Thickness (m)</b>	<b>Strata</b>	<b>Thickness (m)</b>	<b>Strata</b>	<b>Thickness (m)</b>
Made ground	0.20	Made ground	0.15	Made ground	0.70
Sandstone	5.55	Sandstone	11.35	Sandstone	2.80
Sandstone/Siltstone	7.05	Mudstone	16.50	Mudstone	5.00
Mudstone	14.90			Mudstone/Siltstone	0.75
				Siltstone	2.75
				Mudstone	14.50
<b>Drilled Depth</b>	<b>27.50</b>	<b>Drilled Depth</b>	<b>28.00</b>	<b>Drilled Depth</b>	<b>28.50</b>



RH101		RH102		RH103	
Strata	Thickness (m)	Strata	Thickness (m)	Thickness (m)	Thickness (m)
Made ground	2.30	Made ground	0.30	Made ground	0.30
Sandstone	2.20	Sandstone	0.70	Sandstone	2.70
Mudstone	4.80	Mudstone	5.40	Mudstone	1.60
Sandstone	3.70	Sandstone	5.10	Mudstone/Siltstone	2.20
Mudstone	3.00	Siltstone	4.50	Sandstone	3.00
				Mudstone	3.20
<b>Drilled Depth</b>	<b>16.00</b>	<b>Drilled Depth</b>	<b>16.00</b>	<b>Drilled Depth</b>	<b>13.00</b>

RC201		RC202		RC203	
Strata	Thickness (m)	Strata	Thickness (m)	Strata	Thickness (m)
Made ground	0.30	Made ground	0.30	Made ground	0.50
Mudstone	3.10	Mudstone	4.20	Sandstone	0.80
Sandstone	8.10	Sandstone	5.00	Siltstone	0.30
				Mudstone	5.70
				Sandstone	2.84
				Mudstone	0.66
<b>Drilled Depth</b>	<b>11.50</b>	<b>Drilled Depth</b>	<b>9.50</b>	<b>Drilled Depth</b>	<b>10.50</b>

RC204	
Strata	Thickness (m)
Made ground	0.50
Clay	0.70
Sandstone	1.40
Siltstone	0.40
Sandstone	0.40
Mudstone	4.20
Sandstone	4.40
<b>Drilled Depth</b>	<b>12.00</b>

**Groundwater**

Groundwater was encountered in the ground investigation works as follows:-

Exploratory Hole	Groundwater Strike (m bgl)
TP7	2.90m, rising to 2.75 in 20 minutes
RH1	17.50m
RH2	19.50m
RC201	6.0m
RC203	7.0m
RC204	8.50m

All depths are below ground level.

Groundwater levels measured during the gas monitoring are indicated in the following table:-

Borehole	Date			
	07.03.05	18.03.05	21.03.05	30.03.05
WS103	Dry	Dry	Dry	Dry
WS106	Dry	Dry	Dry	Dry
WS108	Dry	Dry	Dry	Dry
WS109	Dry	Dry	Dry	Dry
RH1	14.20m	15.65m	11.65m	11.66m
RH2	14.35m	14.32m	14.26m	14.22m
RH3	15.85m	15.75m	15.65m	15.65m
RH101	14.0m	12.95m	12.95m	12.96m

All depths are below ground level.

The borehole and trial pit logs are attached in Appendix G. The trial pit and borehole locations are indicated on Fig. 2 attached in Appendix B.

#### 4.05 Foul Water:

It is proposed that a separate foul water drainage system is provided on the development discharging to the public combined sewer in Moorfield Road.

The depth of the sewer in Moorfield Road is such that gravity system can be adopted on the site.

#### 4.06 Environment Setting:

The site is underlain by a bedrock aquifer designated as a Secondary Aquifer – A which is strata which contains 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.

The superficial aquifer is not designated.

The overlying soils are classified as having a high leaching potential unless proved otherwise.

There are 2 no. water abstraction licences held within 1000m of the site and details are summarised as follows:-

- groundwater abstraction for cooling      905m to the southwest.
- groundwater abstraction for general use      905m to the southwest.

The site does not lie in a Source Protection Zone.

The use of infiltration drainage on the site has not yet been discussed with the EA Groundwater Protection Team but it is envisaged it will be acceptable in principle. However, the scheme will need to include adequate treatment prior to infiltration and this should, following the guidance given in the CIRIA C753 The SUDS Manual.

#### 4.07 **Surface Water:**

A separate surface water drainage system should be provided on the development.

Whilst the trial pits have shown that sandstone is present directly below the site the rotary boreholes have shown that the sandstone is underlain by mudstones which will be relatively impermeable. Therefore, any percolating water, especially as the site is on a hillside, may migrate horizontally as soon as it encounters the mudstone and/or siltstone layers and may breakout of the hillside to the south of the site potentially causing off site flooding issues. Therefore, conventional soakaways are not considered an appropriate solution to drain the development

Initial survey works indicate that the former buildings and associated hardstandings on the site discharge to the public combined sewer in Moorfield Road. Whilst the former buildings on the site have been demolished the concrete slabs, tarmac and drainage system are still in place. Based on a rainfall intensity of 50mm/hr the 1.2 year storm the existing surface water discharge from the site was  $8000 \times 0.0138 = 110.4$  l/sec.

However, as the former buildings on the site have been demolished and the existing drainage is not being re-used LCC–Drainage normally require the site to be considered as a ‘greenfield development’ which would give a discharge rate of only  $0.8 \times 5.0 = 4.0$  l/sec based on a greenfield runoff of 5.0 l/sec/ha. This discharge rate would yield a very large storm water storage requirement. As the site is on a hillside this would also result in the pipes being very deep at the upstream end of the storage as the pipes would be located within the estate road.

The requirement has been discussed with LCC–Drainage and they usually ask for greenfield runoff post development, but with the caveat of it being ‘reasonably practicable’. In this case, LCC–Drainage would be willing to consider a 50% reduction of the original discharge from the site provided it can demonstrate that the existing drainage system is still intact, and subject from YW agreement.

The correspondence with LCC–Drainage is attached in Appendix H

Therefore, it is proposed to discharge surface water from the development into the public combined sewer in Moorfield Road at 55.2 l/sec. However, in order to site the stormwater storage in a relatively flat section of road it is proposed to allow the bottom section of road [approximately 460m<sup>2</sup>] discharge unattenuated. This equates to a flow of approximately 5.2 l/sec so the attenuated discharge would be limited to 50.0 l/sec.

Therefore following estimation of the stormwater storage requirement for the

development has been based on the following parameters:-

Proposed discharge rate: 50.0 l/sec  
 New hardcover area: 5580m<sup>2</sup>  
 (excluding bottom section of the road and including a 10% allowance for urban creep)  
 Stormwater storage requirement: 109.4m<sup>3</sup>  
 (Based on a 1:100 year storm return period and a 30% increase in rainfall intensity for climate change).

The stormwater storage estimate calculation is attached in Appendix I.

The depth of the sewer in Moorfield Road is such that a gravity system can be adopted on the development.

A schematic drainage arrangement (Fig. 3) for the development is attached in Appendix J.

## 5.0 SUMMARY

<b>The Site</b>	<p>The site is located to the north of Moorfield Road in Upper Armley, Leeds and is approximately 3.0 miles to the west of Leeds City Centre.          The Ordnance Survey co-ordinates for the centre of the site are 426200 mE, 433740 mN.          The site is approximately 0.8 hectares in area.          The site can be accessed from a private road adjacent the south western boundary.          The general fall of the site is to the southeast. Site levels range from:-</p> <table border="1" data-bbox="507 1249 1141 1384"> <thead> <tr> <th>Location</th><th>Level m AOD</th></tr> </thead> <tbody> <tr> <td>North western boundary</td><td>104.34 – 106.20; 102.33 – 102.53</td></tr> <tr> <td>South eastern boundary</td><td>97.88 – 99.23</td></tr> <tr> <td>North eastern boundary</td><td>99.04 – 102.33</td></tr> <tr> <td>South western boundary</td><td>99.16 – 106.51</td></tr> </tbody> </table> <p>There are no watercourses on or in the immediate vicinity of the site.          The Leeds/Liverpool Canal lies approximately 720m to the northeast of the site.          The River Aire lies approximately 1000m to the north of the site.          LCC-Drainage have advised there are culverted water courses in the surrounding area to the site approximately 330m to the northeast and 450m to the southeast of the site.          LCC-Drainage have advised there is a culverted watercourse approximately 330m to the northeast and 450m to the southeast of the site.          There is a reservoir approximately 900m to the southwest of the site.</p>	Location	Level m AOD	North western boundary	104.34 – 106.20; 102.33 – 102.53	South eastern boundary	97.88 – 99.23	North eastern boundary	99.04 – 102.33	South western boundary	99.16 – 106.51
Location	Level m AOD										
North western boundary	104.34 – 106.20; 102.33 – 102.53										
South eastern boundary	97.88 – 99.23										
North eastern boundary	99.04 – 102.33										
South western boundary	99.16 – 106.51										
<b>Flood Risk Assessment</b>	<p>The site is within Flood Zone 1. This zone comprises land assessed as having less than a 1 in 1000 (&lt;0.1%) annual probability of tidal or river flooding in any one year.          From the inspection of the site topographical survey and following a site walkover the site may be at risk from potential overland flood waters from higher ground to the northwest.          From the inspection of the EA website Risk of Flooding from Surface Water Maps it would appear there is a very low risk (less than 1:1000 [0.1%] of surface water flood affecting the majority of the site. However, it would appear there is a low (between 1 in 1000 [0.1%] and 1:100 [1.0%]) to high (greater than 1 in 30 [3.3%]) of surface water flooding affecting a small area of the site adjacent the western boundary and a small area of the site in the south western sector. It is indicated there is a low to medium chance of below 300mm depth of surface water flooding affecting the area adjacent the western boundary. It is indicated there is a low to medium chance of between 300 - 900mm depth</p>										

	<p>of surface water flooding affecting the area in the southern sector and a high chance of less than 300mm depth of surface water affecting this area. However, it should be noted that surface water flooding can be difficult to predict and occurs when rainwater does not drain away through the 'normal' drainage systems or soaks into the ground but lies on or flows over the ground instead.</p> <p>The effect of groundwater as a flood source is not considered to be an issue at this location, particularly as groundwater levels recorded in gas monitoring boreholes on the site encountered groundwater between 11.65 and 15.85 below ground level.</p> <p>The site is not at risk from overland flood waters from the potential overloading of the public combined sewer in Moorfield Road as the road is below the level of the site.</p> <p>The site is not at risk from flooding from the reservoir to the southwest of the site as the reservoir is considerably below the level of the site.</p>
<b>Sequential Test</b>	<p>The Sequential Test should be applied at all stages of planning. Its aim is to steer new development to areas at the lowest probability of flooding.</p> <p>Table 2 of the Technical Guidance to the NPPF (which categorises the flood risk vulnerability of land uses) indicates the proposed development is categorised as a 'more vulnerable' land use.</p> <p>From the EA flood zone map, the site is identified as being Flood Zone 1.</p> <p>Table 3 of the Technical Guidance to the NPPF indicates where the proposed land use is 'more vulnerable' development is appropriate in Flood Zone 1. Therefore, the Sequential Test has been passed.</p>
<b>Exception Test</b>	<p>Table 3 of the Technical Guidance to the NPPF indicates where the proposed land use is 'more vulnerable' development is considered appropriate in Flood Zone 1 and the Exception Test is not required.</p> <p>Notwithstanding the above the following sections of this report will demonstrate that the proposed development will be safe from flooding and will not increase flood risk elsewhere.</p>
<b>Flood Risk Mitigation</b>	<p>The proposed development is in Flood Zone 1.</p> <p>The external levels on the development should be set to route any overland flood waters away/ around the proposed buildings to the south and on to Moorfield Road as the existing situation.</p>
<b>Foul Drainage</b>	<p>It is proposed that a separate foul water drainage system is provided on the development discharging to the public combined sewer in Moorfield Road. A gravity system can be adopted on the site.</p>
<b>Surface Water</b>	<p>A separate surface water drainage system should be provided on the development.</p> <p>Whilst the trial pits have shown that sandstone is present directly below the site the rotary boreholes have shown that the sandstone is underlain by mudstones which will be relatively impermeable. Therefore, any percolating water, especially as the site is on a hillside, may migrate horizontally as soon as it encounters the mudstone and/or siltstone layers and may breakout of the hillside to the south of the site potentially causing off site flooding issues. Therefore, conventional soakaways are not considered an appropriate solution to drain the development</p> <p>Initial survey works indicate that the former buildings and associated hardstandings on the site discharge to the public combined sewer in Moorfield Road. Whilst the former buildings on the site have been demolished the concrete slabs, tarmac and drainage system are still in place. Based on a rainfall intensity of 50mm/hr the 1.2 year storm the existing surface water discharge from the site was <math>8000 \times 0.0138 = 110.4</math> l/sec.</p> <p>However, as the former buildings on the site have been demolished and the existing drainage is not being re-used LCC-Drainage normally require the site to be considered as a 'greenfield development' which would give a discharge rate of only <math>0.8 \times 5.0 = 4.0</math> l/sec based on a greenfield runoff of 5.0 l/sec/ha. This discharge rate would yield a very large storm water storage requirement. As the site is on a hillside this would also result in the pipes being very deep at the upstream end of the storage as the pipes would be located within the estate road.</p> <p>The requirement has been discussed with LCC-Drainage and they usually ask for greenfield runoff post development, but with the caveat of it being 'reasonably practicable'. In this case, LCC-Drainage would be willing to consider a 50% reduction</p>

of the original discharge from the site provided it can demonstrated that the existing drainage system is still intact, and subject from YW agreement.

Therefore, it is proposed to discharge surface water from the development into the public combined sewer in Moorfield Road at 55.2 l/sec. However, in order to site the stormwater storage in a relatively flat section of road it is proposed to allow the bottom section of road [approximately 460m<sup>2</sup>] discharge unattenuated. This equates to a flow of approximately 5.2 l/sec so the attenuated discharge would be limited to 50.0 l/sec.

Therefore following estimation of the stormwater storage requirement for the development has been based on the following parameters:-

Proposed discharge rate: 50.0 l/sec

New hardcover area: 5580m<sup>2</sup>

(excluding bottom section of the road and including a 10% allowance for urban creep)

Stormwater storage requirement: 109.4m<sup>3</sup>

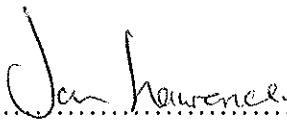
(Based on a 1:100 year storm return period and a 30% increase in rainfall intensity for climate change).

The depth of the sewer in Moorfield Road is such that a gravity system can be adopted on the development.

## 6.0 CAVEATS

- 6.01 The comments given in this report and recommendations made are based on the information that could be obtained from reasonably accessible sources. Detailed discussions have not yet been held with statutory bodies and the local authority.
- 6.02 This report has been prepared on information contained within a report prepared by Sirius. CoDA Structures cannot be held responsible for any inaccuracies within third party information that has been relied upon in the preparation of this report.
- 6.03 This report has been prepared for the sole use of KMRE Group Ltd and their development funders, unless agreed otherwise in writing by CoDA Structures.

Signed:

  
J Lawrence B Eng C Eng M I Struct E

## **APPENDIX A**

### **SITE LOCATION PLAN (Fig. 1)**



# CoDa Structures

Consulting Civil & Structural Engineers

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Gusley

Leeds LS20 8PD

Tel: 01943 872567

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Project Tower Works, Moorfield Road, Leeds

Title Location Plan

Drawn RD  
Date 10.04.12  
Checked MJ

Drw. No. 6906/Fig1

Rev. -

Scale NTS



## **APPENDIX B**

### **SITE TOPOGRAPHICAL SURVEY (Fig. 2)**



## **APPENDIX C**

### **SITE AERIAL PHOTOGRAPH**





Google

© 2016 Google

Imagery Date: 9/28/2011 53°47'57.50" N 1°36'12.43" W elev 103 m eye al

2002



## **APPENDIX D**

### **ENVIRONMENT AGENCY WEBSITE FLOOD MAP**

Enter a postcode or place name:

LS12 3SH

Other topics for this area...

Flood Map for Planning (Rivers and Sea)



## Flood Map for Planning (Rivers and Sea)

Other maps Data search Text only version

LS12 3SH at scale 1:15,000

**Map legend**

Click on the map to see what Flood Zone (National Planning Policy Guidance definitions) the proposed development is in.

☒ Flood Map for Planning (Rivers and Sea)

☐ Flood Zone 3

☐ Flood Zone 2

☐ Flood defences (Not all may be shown\*)

☐ Areas benefiting from flood defences (Not all may be shown\*)

☒ Main River Line

☐ Main River Line

☒ Other national environmental organisations

☐ Natural Resources Wales Area of responsibility

☐ Scottish Environment Protection Agency Area of responsibility



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## **APPENDIX E**

### **ENVIRONMENT AGENCY WEBSITE RISK OF FLOODING FROM SURFACE WATER MAPS**



## Risk of Flooding from Surface Water







Surface water flooding happens when rainwater does not drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead.

The shading on the map shows the risk of flooding from surface water in this particular area.

Click on the map for a more detailed explanation.

Map of LS12 3SH at scale 1:10,000

Data search

Map legend	
<input checked="" type="checkbox"/>	Risk of Flooding from Surface Water
	High
	Medium
	Low
	Very Low
<input checked="" type="checkbox"/>	Other national environmental organisations
	Natural Resources Wales Area of responsibility
	Scottish Environment Protection Agency Area of responsibility



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## Surface Water Depth - Low Chance of Occurring

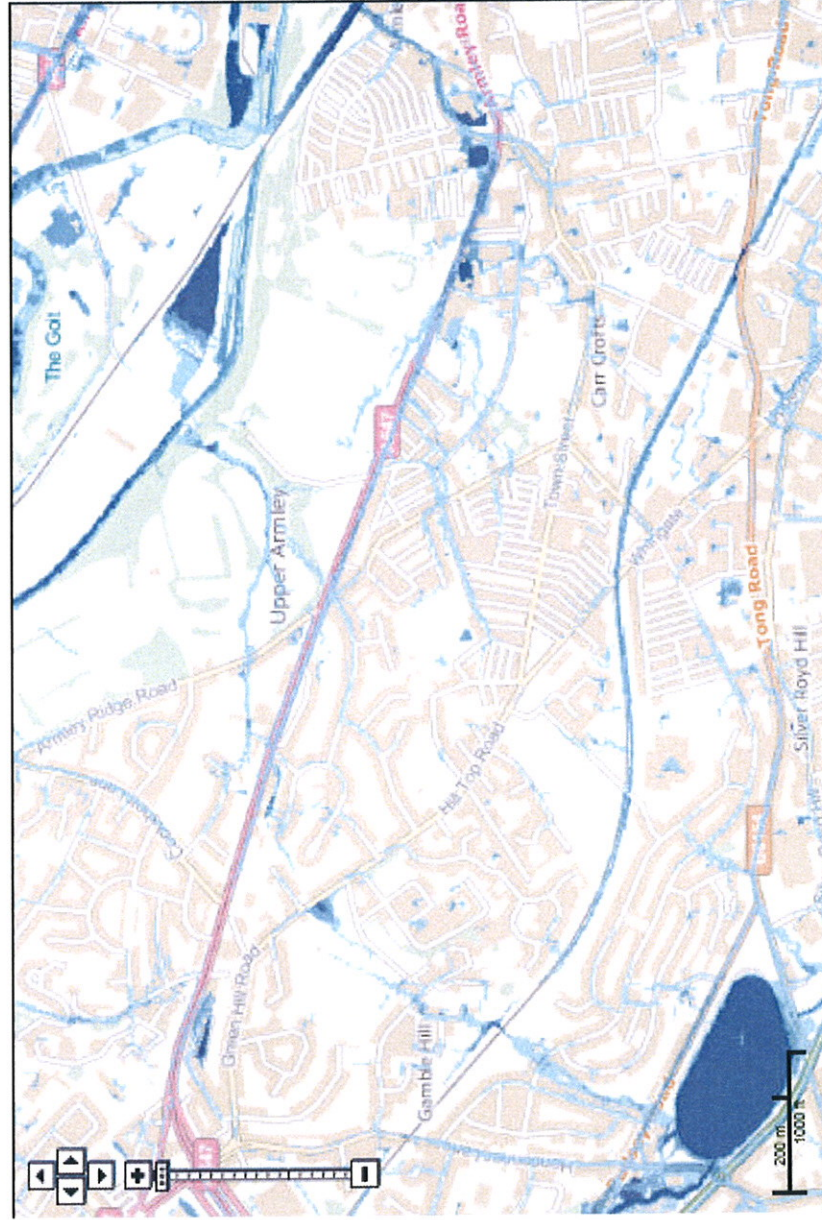
Surface water flooding happens when rainwater does not drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead.

The shading on the map shows the estimated water depth when there is a low chance of flooding.

Click in the legend to see estimated water depths for high and medium chances of flooding, and for estimated velocity (speed and direction of the water).

Map of X: 426,275; Y: 433,805 at scale 1:10,000

Data search



Map legend	
<input checked="" type="checkbox"/>	Surface Water Depth - Low Chance of Occurring
	Over 800mm
	300-800mm
	Below 300mm
<input checked="" type="checkbox"/>	Other national environmental organisations
	Natural Resources Wales Area of responsibility
	Scottish Environment Protection Agency Area of responsibility
Chance of occurring	
	Low
	Medium
	High
Other layers	
Switch to layer:	
	Surface water extent
	Surface water velocity

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## Surface Water Depth - Medium Chance of Occurring

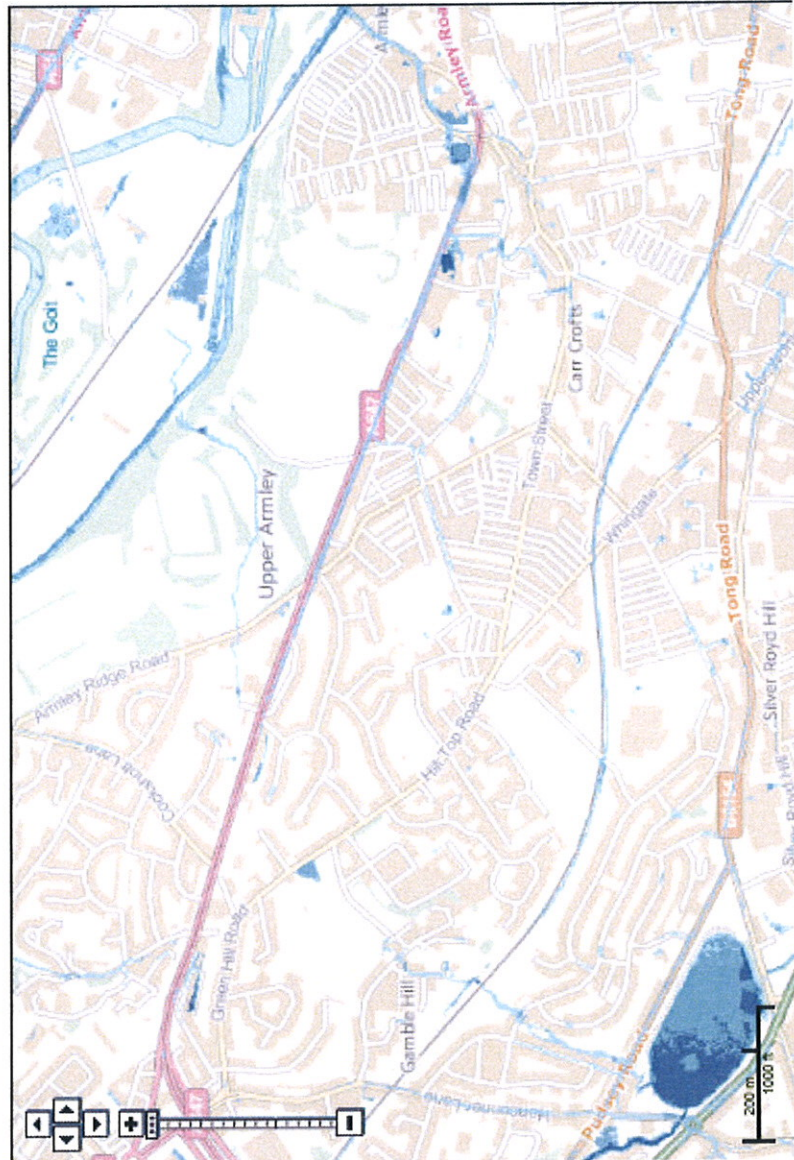
Surface water flooding happens when rainwater does not drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead.

The shading on the map shows the estimated water depth when there is a medium chance of flooding.

Click in the legend to see estimated water depths for high and low chances of flooding, and for estimated velocity (speed and direction of the water).

Map of X: 426,275; Y: 433,805 at scale 1:10,000

Data search



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Map legend	
<input checked="" type="checkbox"/>	Surface Water Depth - Medium Chance of Occurring
	Over 600mm
	300-600mm
	Below 300mm
<input checked="" type="checkbox"/>	Other national environmental organisations
	Natural Resources Wales Area of responsibility
	Scottish Environment Protection Agency Area of responsibility
Chance of occurring	
	Low
	Medium
	High
Other layers	
Switch to layer:	
	Surface water extent
	Surface water velocity



## Surface Water Depth - High Chance of Occurring

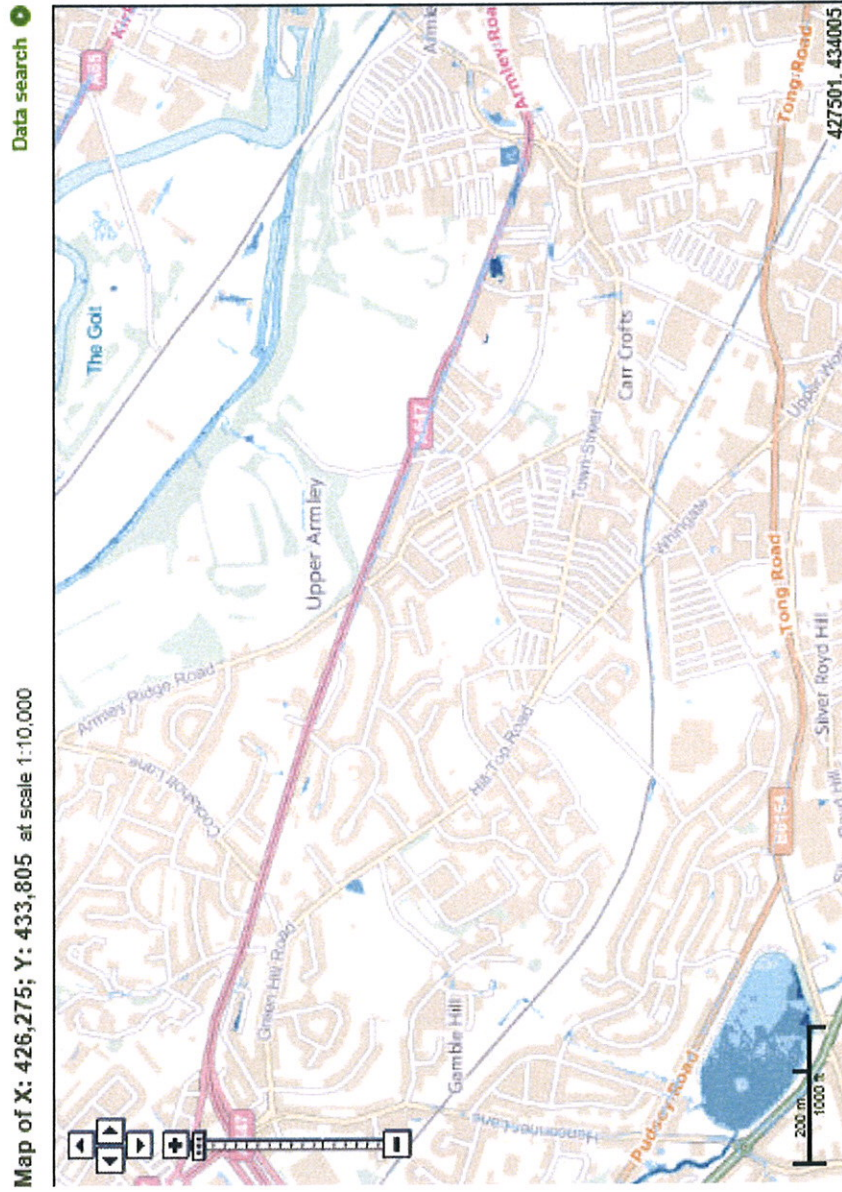
Surface water flooding happens when rainwater does not drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead.

The shading on the map shows the estimated water depth when there is a high chance of flooding.

Click in the legend to see estimated water depths for medium and low chances of flooding, and for estimated velocity (speed and direction of the water).

Map of X: 426,275; Y: 433,805 at scale 1:10,000

Data search



**Map legend**

☒ Surface Water Depth - High Chance of Occurring

- Over 600mm
- 300-600mm
- Below 300mm

☒ Other national environmental organisations

- Natural Resources Wales Area of responsibility
- Scottish Environment Protection Agency Area of responsibility

**Chance of occurring**

Low

Medium

High

**Other layers**

Switch to layer:

- Surface water extent
- Surface water velocity

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**CoDa Structures**

Consulting Civil & Structural Engineers  
14 Springfield Court  
Guisley  
Leeds LS20 8FD

**FLOODING & DRAINAGE ASSESSMENT  
FOR A RESIDENTIAL DEVELOPMENT SITE AT  
TOWER WORKS, MOORFIELD ROAD,  
UPPER ARMLEY, LEEDS**

## **APPENDIX F**

### **CORRESPONDENCE FROM YORKSHIRE WATER AND EXTRACT FROM THE PUBLIC SEWER RECORD**



YorkshireWater

CoDA Structures  
2 Harewood Yard  
Harewood  
Leeds  
LS17 9LE

FAO J Lawrence

Your Ref:  
Our Ref: M002107

JOB No.	6906 / 1.04
JD:	:
:	:
<b>RECEIVED</b> 18 APR 2011	
REPLIED	:
COPY TO	DATE

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

Tel: 0845 120 8482  
Fax: (01274) 372 834

Email:  
Planning.Sewerage@yorkshirewater.co.uk

For telephone enquiries ring:

Kashif Khan on (0845)120 8482

12th April 2011

Dear Sir,

Tower Works, Moorfield Road, Leeds - Pre-Planning Sewerage Enquiry - Commercial - J353627

Thank you for your letter received 25th March 2011 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, this indicates the recorded position of the public sewers.

The following comments reflect our view, with regard to the public sewer network only, based on a 'desk top' study of the site:

Development of the site should take place with separate systems for foul and surface water drainage. The separate system should preferably extend to the public sewer.

Foul water domestic waste should discharge to the 305 mm diameter public combined sewer recorded in Moorfield Road, at a point adjacent to the site.

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.

Where appropriate, soakaways, swales and infiltration trenches (SUDS) may be adopted as part of the public sewer network. For general conditions for the adoption of SUDS please see the attached sheet. Further information may be seen in the DEFRA publication 'Interim Code of Practice for Sustainable Drainage Systems' (ISBN 0-86017-904-4). If the developer is considering adoption of SUDS they should contact our Developer Services Team on 0845 120 84 82.

The local public sewer network does not have capacity to accept any additional discharge of surface water from the proposal site. 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.

In the first instance, please provide evidence to show soakaways are not a viable option (eg, a ground investigation report) and that there are no watercourses in the vicinity of the site.

As a last resort and the evidence submitted being satisfactory, curtilage surface water discharges to the public sewer will be restricted to the level of run-off - i.e. same rate of discharge - to that from the existing use of the site. Discharges to the public sewer must also take into account a 30% reduction in existing discharge and climate change. To maintain the "status quo" in the public sewer network, any discharge of surface water from the site should take place with similar rates of flow and/or measured areas discharging to similar points of connection to that of the existing use of the site. You will need to demonstrate positive drainage, based on a 1 in 1 year storm, to the public sewer to Yorkshire Water by means of investigation and calculation carried out at your expense.

To do this, Yorkshire Water requires to see existing and proposed drainage layouts with pipe sizes, gradients and connection points, measured impermeable areas of the present and proposed use of the site, along with the calculations that show the existing and proposed discharge rate from the site to the public sewer.

Please note further restrictions on surface water disposal from the site may be imposed by other parties. You are strongly advised to seek advice/comments from the Environment Agency/Land Drainage Authority, with regard to surface water disposal from the site.

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 0845 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. Highway drainage, however, may be accepted under certain circumstances; for instance, if SUDS are not a viable option and there is no highway drain available and if capacity is available within the public sewer network. In this event, the developer will 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.

No land drainage to be connected/discharged to public sewer.

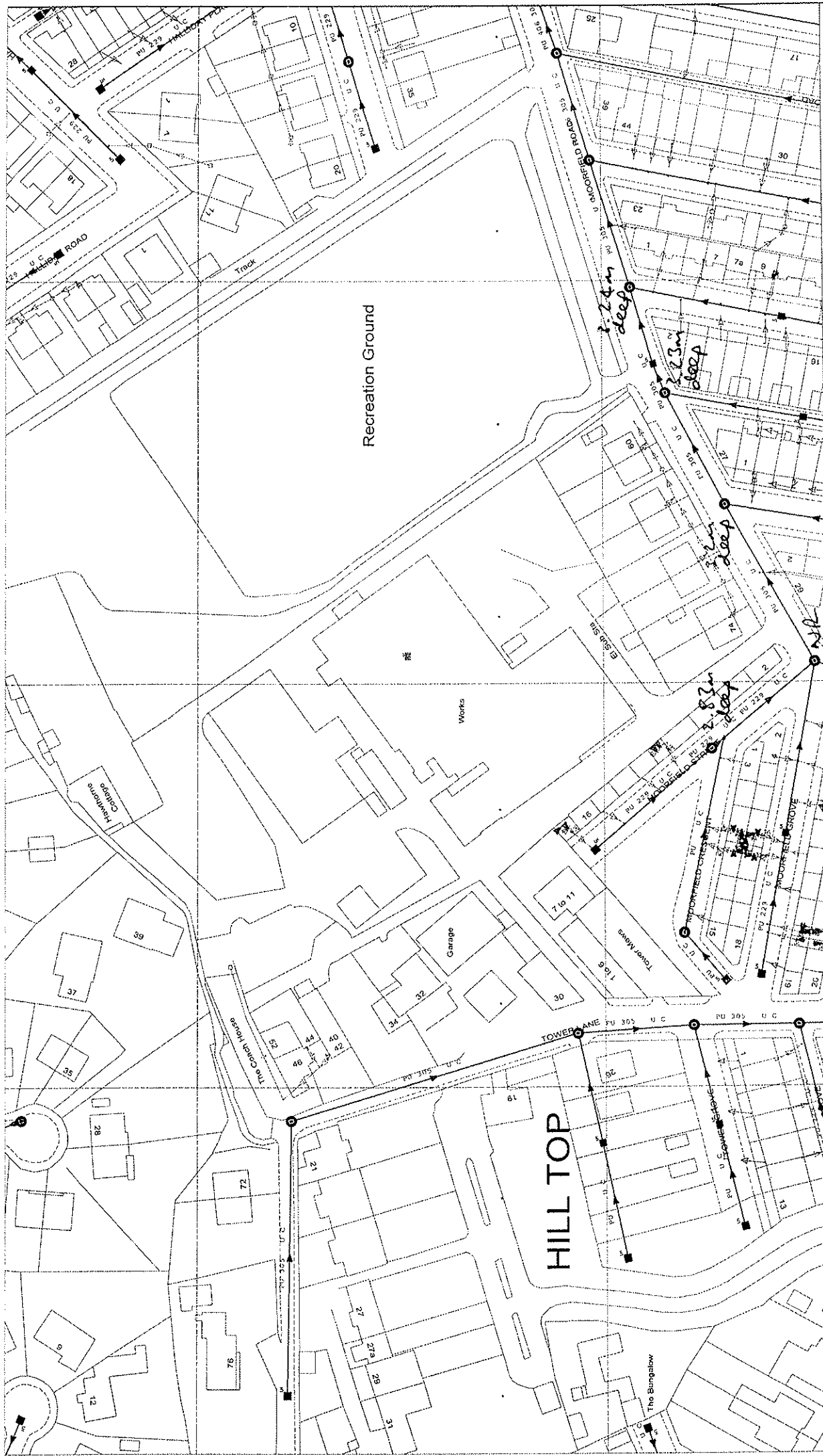
Any new connection to an existing public sewer will require the approval of Yorkshire Water. You may obtain an application form from our website ([www.yorkshirewater.com](http://www.yorkshirewater.com)) or by telephoning 0845 120 84 82.

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 faithfully



Developer Services Team



This plan is furnished as a general guide only and no warranty as to its correctness is given or implied. This plan must not be relied upon in the event of excavations or other works made in the vicinity of public sewers. No house or property connection		Partial Key	
		Foil Sewer = F Combined Sewer = C Surface Water Sewer = SW Trade Sewer = TD Partially Separate = PS	
		Date Req : 12/04/2011, 12:25:01	Date Gen : 12/04/2011, 12:25:03
		Source : Sewer Network Enquiry	
426014 - 433647		Map Name : SE2633NW	Title
Yorkshire Water, PO Box 500, Halifax Road, Bradford BD6 2LZ Contact Name : K KHAN Contact Tel : K KHAN, New Development - Waste Water,		Notes  NR = No recorded depth.	
UPN: Undefined		(C) COPYRIGHT STATEMENTS: Reproduced by permission of Ordnance Survey on behalf of HMSO © Crown copyright and database 2004. All rights reserved Ordnance Survey Licence number 100018559	

## **APPENDIX G**

### **BOREHOLE AND TRIAL PIT LOGS**





## TRIAL PIT RECORD

TP No. **TP1**

Sheet 1 of 1

Site : Tower Works, Armley

Contract No: **C0313**

Client : Commercial Estates Group Ltd.

Dates:  
09/06/2004

Method : JCB 3CX with 0.60m wide toothed bucket and pecker

Scale 1:25

### SAMPLE DETAILS

Groundwater

### STRATA RECORD

Logged By: **JWB**

Type	Depth From - To(m)	Vane Results kN/m <sup>2</sup>	Description	Depth (m)	PID (ppm)	Legend	Well
D J	0.10m		MADE GROUND: Tarmac hardstanding.	0.07			
D J	0.40m		MADE GROUND: Grey clayey sandy angular fine to coarse GRAVEL of limestone with occasional pieces of tarmac. ---at 0.10m PID reading = 0.0ppm.	0.30			
D J	0.70m	90	MADE GROUND: Brown slightly clayey very gravelly fine to coarse SAND with many cobbles of angular to subangular brick and occasional pieces of timber. Gravel is angular to subangular fine to coarse of sandstone, brick and slate. ---at 0.40m PID reading = 0.0ppm.	0.65			
D J	1.10m		Stiff light greyish brown slightly sandy gravelly CLAY. Gravel is angular fine to coarse of sandstone and mudstone. ---at 0.70m PID reading = 0.0ppm. ---at 1.10m PID reading = 0.0ppm.	1.10 1.20			
			Moderately weak to strong very thinly bedded light greyish brown fine to medium grained SANDSTONE with ripple marks along bedding planes. (Recovered as gravel, cobble and boulder sized fragments.) End of Trial Pit at 1.20 m				

### Remarks and Water Observations

- 1 No groundwater flows encountered during excavation
- 2 All faces stable
- 3 Trial pit terminated on impenetrable rock

Fig. No.

TP1



## TRIAL PIT RECORD

TP No. **TP2**  
Sheet 1 of 1

Site : Tower Works, Armley

Contract No:  
**C0313**

Client : Commercial Estates Group Ltd.

Dates:  
09/06/2004

Method : JCB 3CX with 0.60m wide toothed bucket and pecker.

Scale 1:25

### SAMPLE DETAILS

### STRATA RECORD

Logged By: **JWB**

Type	Depth From - To(m)	Vane Results kN/m <sup>2</sup>	Groundwater	Description	Depth (m)	PID (cm)	Legend	Well
D	0.20m			MADE GROUND: Tarmac hardstanding.	0.10			
D	0.50m	100		MADE GROUND: Grey clayey sandy angular fine to coarse GRAVEL of limestone with occasional pieces of tarmac. ---from 0.30m to 0.40m with some angular cobbles of brick and occasional pieces of timber.	0.40			
D	1.30m			Stiff light grey and orangish brown mottled slightly sandy very gravelly CLAY. Gravel is angular fine to coarse of sandstone and mudstone.	1.20			
D	1.70m			Moderately weak very thinly bedded light greyish brown fine to medium grained SANDSTONE with ripple marks along bedding planes. (Recovered as gravel, cobble sized fragments.)	1.60			
D	2.70m			Weak thinly laminated light greyish brown sandy MUDSTONE. (Recovered as gravel and cobble sized fragments.)				
D	3.70m							
				End of Trial Pit at 4.00 m	4.00			

### Remarks and Water Observations

1. No groundwater flows encountered during excavation.
2. All faces stable.
3. Trial pit terminated at maximum depth, 4.00m.

Fig. No.

**TP2**



## TRIAL PIT RECORD

TP No. **TP3**  
Sheet 1 of 1  
Contract No: **C0313**

Site: **Tower Works, Armley**

Client: **Commercial Estates Group Ltd.**

Dates:  
09/06/2004

Method: JCB 3CX with 0.60m wide toothed bucket and pecker.

Scale **1:25**

### SAMPLE DETAILS

Logged By: **JWB**

### STRATA RECORD

Type	Depth From - To(m)	Vane Results kN/m <sup>2</sup>	Groundwater	Description	Depth (m)	PID ppm	Legend	Well
D J	0.20m			MADE GROUND: Tarmac hardstanding.  MADE GROUND: Brown clayey gravelly fine to coarse SAND. Gravel is angular to subangular fine to coarse of brick, sandstone and tarmac. ---at 0.20m PID reading = 30.0ppm.	0.10			
D J	0.90m			Stiff light yellowish brown sandy gravelly CLAY with occasional cobbles of angular sandstone. Gravel is angular fine to coarse of sandstone. ---at 0.90m PID reading = 27.0ppm.	0.85			
D	1.30m			Moderately weak very thinly bedded light greyish brown fine to medium grained SANDSTONE with ripple marks along bedding planes. (Recovered as gravel, cobble and boulder sized fragments.)	1.20			
D J	2.30m 2.50m			Weak thinly laminated light greyish brown sandy MUDSTONE. (Recovered as gravel sized fragments.) ---at 2.50m PID reading = 22.0ppm.	2.40			
D J	3.50m			---at 3.50m PID reading = 0.8ppm.				
				End of Trial Pit at 4.00 m	4.00			

### Remarks and Water Observations

1. No groundwater flows encountered during excavation.
2. All faces stable.
3. Trial pit terminated at maximum depth, 4.00m

Fig. No.

**TP3**



# TRIAL PIT RECORD

TP No. **TP4**  
Sheet 1 of 1  
Contract No: **C0313**

Site: Tower Works, Armley

Client: Commercial Estates Group Ltd.

Dates:  
09/06/2004

Method: JCB 3CX with 0.60m wide toothed bucket and pecker

Scale 1:25

## SAMPLE DETAILS

## STRATA RECORD

Logged By: JWB

Type	Depth From - To(m)	Vane Results kN/m <sup>2</sup>	Groundwater	Description	Depth (m)	PIG (mm)	Legend	Well
				MADE GROUND: Concrete.	0.25			
D	0.30m			MADE GROUND: Orangish brown gravelly fine to coarse SAND with some cobbles and boulders (max. 0.40m x 0.40m x 0.20m) of angular to subangular concrete, brick and sandstone. Gravel is angular to subrounded fine to coarse of concrete, brick, slate and sandstone. ---at 0.25m plastic membrane.	0.90			
D	1.00m			Stiff light greyish brown sandy gravelly CLAY with occasional angular cobbles of sandstone. Gravel is angular fine to coarse of sandstone.	1.40			
D	1.50m	90		Stiff light grey and orangish brown mottled slightly sandy gravelly CLAY. Gravel is angular to subrounded fine to medium of mudstone.	2.60			
D	2.50m			Weak thinly laminated light greyish brown MUDSTONE. (Recovered as gravel sized fragments.)	4.00			
D	2.70m							
W	3.60m							
D	3.70m							
				End of Trial Pit at 4.00 m				

## Remarks and Water Observations

- 1 No groundwater flows encountered during excavation
- 2 Groundwater inflow overnight to a level of 3.60m
- 3 All faces stable
- 4 Trial pit terminated at maximum depth, 4.00m

Fig. No.

TP4



## TRIAL PIT RECORD

TP No. **TP5**

Sheet 1 of 1

Site : Tower Works, Armley

Contract No:  
**C0313**

Client : Commercial Estates Group Ltd.

Dates:  
09/06/2004

Method : JCB 3CX with 0.60m wide toothed bucket and pecker.

Scale 1:25

### SAMPLE DETAILS

Type	Depth From - To(m)	Vane Results kN/m <sup>2</sup>
------	-----------------------	--------------------------------------

Groundwater

### STRATA RECORD

Description

Logged By: JWB

Depth (m)	PID (mm)	Legend	Well
--------------	-------------	--------	------

MADE GROUND: Concrete.

0.30

MADE GROUND: Brown gravelly fine to coarse SAND.  
Gravel is angular to subangular fine to coarse of  
sandstone, concrete and brick.

0.60

Moderately strong very thinly bedded light greyish  
brown fine to medium grained SANDSTONE with ripple  
marks along bedding planes. (Recovered as gravel,  
cobble and boulder sized fragments.)

1.50

End of Trial Pit at 1.50 m

### Remarks and Water Observations

- 1 No groundwater flows encountered during excavation
- 2 All faces stable
- 3 Trial pit terminated on impenetrable rock.

Fig. No.

TP5



# TRIAL PIT RECORD

TP No. **TP6**  
 Sheet 1 of 1  
 Contract No: **C0313**

Site : **Tower Works, Armley**

Client : **Commercial Estates Group Ltd.**

Dates:  
**09/06/2004**

Method : **JCB 3CX with 0.60m wide toothed bucket and pecker.**

Scale **1:25**

## SAMPLE DETAILS

Type	Depth From - To(m)	Vane Results kN/m <sup>2</sup>	Groundwater
D J	0.30m		
D	0.60m		

## STRATA RECORD

MADE GROUND: Concrete.

Moderately weak thinly laminated light greyish brown sandy MUDSTONE. (Recovered as sand, gravel and cobble sized fragments.)  
 ---at 0.30m PID reading = 400.0ppm.

Moderately strong very thinly bedded light greyish brown fine to medium grained SANDSTONE with ripple marks along bedding planes. (Recovered as gravel, cobble and boulder sized fragments.)

End of Trial Pit at 0.90 m

Logged By: **JWB**

Depth (m)	PID (ppm)	Legend	Well
0.20			
0.80			
0.90			

## Remarks and Water Observations

- 1 No groundwater flows encountered during excavation
- 2 All faces stable.
- 3 Trial pit terminated on impenetrable rock

Fig. No.

**TP6**



# TRIAL PIT RECORD

TP No. **TP7**  
 Sheet 1 of 1  
 Contract No: **C0313**

Site: **Tower Works, Armley**

Client: **Commercial Estates Group Ltd.**

Dates:  
**10/06/2004**

Method: **JCB 3CX with 0.60m wide toothed bucket and pecker.**

Scale **1:25**

## SAMPLE DETAILS

Type	Depth From - To(m)	Vane Results kN/m <sup>2</sup>	Groundwater
D	0.10m		
D	0.20m		
D	0.40m		
D	1.40m		
D	2.40m		
W	2.90m		
D	3.00m		

## STRATA RECORD

Description	Depth (m)	PID (mm)	Legend	Well
MADE GROUND: Tarmac hardstanding.	0.05			
MADE GROUND: Buff fine to coarse SAND and fine to medium GRAVEL of limestone.	0.15			
MADE GROUND: Black gravelly fine to coarse SAND. Gravel is angular to subangular fine to coarse of clinker and glass.	0.35			
MADE GROUND: Firm light greyish brown sandy gravelly CLAY with occasional cobbles of angular brick and concrete. Gravel is angular to subangular fine to coarse of mudstone, sandstone, brick and concrete.				
Weak thinly laminated light greyish brown MUDSTONE. (Recovered as sand and gravel sized fragments.)	2.90			
End of Trial Pit at 3.20 m	3.20			

Logged By: **JWB**

## Remarks and Water Observations

- Groundwater flow encountered at 2.90m, rose to 2.75m in 20 minutes
- Side walls unstable throughout the made ground
- Trial pit terminated at 3.20m due to heavy groundwater flow

Fig. No.

**TP7**



## TRIAL PIT RECORD

TP No. **TP8**  
Sheet 1 of 1  
Contract No: **C0313**

Site: **Tower Works, Armley**

Client: **Commercial Estates Group Ltd.**

Dates:  
**10/06/2004**

Method: **JCB 3CX with 0.60m wide toothed bucket and pecker**

Scale **1:25**

### SAMPLE DETAILS

Type	Depth		Vane Results kN/m <sup>2</sup>
	From	To(m)	
O	0	10m	
J			
O	0	20m	

Groundwater

### STRATA RECORD

Description

MADE GROUND: Tarmac hardstanding.

MADE GROUND: Light brown gravelly fine to coarse SAND with cobbles of angular to subangular limestone, sandstone and brick. Gravel is angular to subangular fine to coarse of sandstone, mudstone and limestone.  
---at 0.10m PID reading = 0.0ppm.

Moderately strong very thinly bedded light greyish brown clayey fine to medium grained SANDSTONE with ripple marks along bedding planes. (Recovered as gravel, cobble and boulder sized fragments.)  
End of Trial Pit at 0.80 m

Logged By: **JWB**

Depth (m)	PID (ppm)	Legend	Well
0.04			
0.15			
0.80			

### Remarks and Water Observations

- 1 No groundwater flows encountered during excavation.
- 2 All faces stable
- 3 Trial pit terminated on impenetrable rock

Fig. No.

**TP8**





# TRIAL PIT RECORD

TP No. **TP9**  
Sheet 1 of 1  
Contract No: **C0313**

Site: Tower Works, Armley

Client: Commercial Estates Group Ltd.

Dates:  
10/06/2004

Method: JCB 3CX with 0.60m wide toothed bucket and pecker.

Scale 1:25

Logged By: JWB

## SAMPLE DETAILS

## STRATA RECORD

Type	Depth From To(m)	Vane Results kN/m <sup>2</sup>	Groundwater	Description	Depth (m)	PID (ppm)	Legend	Well
D J	0 15m			MADE GROUND: Tarmac hardstanding.	0 10			
D J	0 40m			MADE GROUND: Buff sandy angular to subangular fine to coarse GRAVEL of limestone. ---at 0.15m PID reading = 0.0ppm.	0 30			
				Moderately strong very thinly bedded light greyish brown clayey fine to medium grained SANDSTONE with ripple marks along bedding planes. (Recovered as gravel, cobble and boulder sized fragments.) ---at 0.40m PID reading = 0.0ppm.	0 70			
				End of Trial Pit at 0.70 m				

## Remarks and Water Observations

- 1 No groundwater flows encountered during excavation
- 2 All faces stable
- 3 Trial pit terminated on impenetrable rock

Fig. No.

TP9



## TRIAL PIT RECORD

TP No. **TP101**

Sheet 1 of 1

Site: Tower Works, Armley

Contract No: **C0313**

Client: Commercial Estates Group Ltd.

Dates:  
16/02/2005

Method: JCB 3CX with 0.60m wide toothed bucket and pecker

Scale 1:25

### SAMPLE DETAILS

Logged By: **MJC**

### STRATA RECORD

Type	Depth From - To (m)	Vane Results kN/m <sup>2</sup>	Groundwater	Description	Depth (m)	PID (ppm)	Legend	Well
J	0.17m - 0.25m			MADE GROUND: Reinforced CONCRETE.	0.17			
D	0.25m - 0.40m			Weak to moderately weak brown weathered SILTSTONE with poorly defined extremely to very closely spaced subhorizontal bedding fractures and very closely to closely spaced subvertical discontinuities. Recovered as slightly sandy gravel and cobble size fragments.	0.63			
B	0.70m - 1.00m			0.17-0.25m: weathered to stiff clay along north face around fracture in concrete. Locally discoloured grey with a metholated spirits-like odour.  Moderately weak to moderately strong light brown fine grained SILTSTONE with extremely to very closely spaced subhorizontal bedding fractures and very closely to closely spaced subvertical discontinuities. Silt and sand infill (1-5mm) noted along bedding surfaces. Recovered as slightly sandy very gravelly cobble size fragments.  End of Trial Pit at 1.15 m	1.15			

### Remarks and Water Observations

Fig. No.

1. Hardstanding reinforced concrete at surface broken out with an hydraulic breaker
2. Trial pit sides remained stable during excavation
3. No groundwater encountered during excavation
4. Excavation terminated on solid bedrock at 1.15m and backfilled



## TRIAL PIT RECORD

TP No. **TP102**

Sheet 1 of 1

Site : Tower Works, Armley

Contract No:

**C0313**

Client : Commercial Estates Group Ltd.

Dates:  
16/02/2005

Method : JCB 3CX with 0.60m wide toothed bucket and pecker.

Scale 1:25

### SAMPLE DETAILS

Logged By: **MJC**

### STRATA RECORD

Type	Depth From - To(m)	Vane Results kN/m <sup>2</sup>	Groundwater	Description	Depth (m)	PID (ppm)	Legend	Well
D	0.15m - 0.25m			MADE GROUND: Reinforced CONCRETE.	0.15			
D	0.47m - 0.57m			MADE GROUND: Firm brown slightly sandy slightly gravelly CLAY. Becoming very gravelly by 0.40m. Gravel is angular to subangular fine to coarse of mudstone	0.47			
B	0.57m - 0.70m			0.15-0.25m: locally reworked with fragments of brick and topsoil noted.	0.57			
				Weak brown weathered SILTSTONE with extremely closely spaced subhorizontal bedding fractures. Recovered as slightly sandy gravel size fragments.	0.70			
				Moderately strong light brown fine to medium grained SANDSTONE with very closely spaced subhorizontal bedding fractures. Recovered as slightly sandy gravelly cobble size fragments.				
				End of Trial Pit at 0.70 m				

### Remarks and Water Observations

Fig. No.

- 1 Hardstanding reinforced concrete at surface broken out with an hydraulic breaker
- 2 Trial pit sides remained stable during excavation
- 3 No groundwater encountered during excavation
- 4 Excavation terminated on solid bedrock at 0.70m and backfilled.



## TRIAL PIT RECORD

TP No. **TP103**

Sheet 1 of 1

Site : Tower Works, Armley

Contract No:  
**C0313**

Client : Commercial Estates Group Ltd.

Dates:  
16/02/2005

Method : JCB 3CX with 0.60m wide toothed bucket and pecker

Scale 1:25

### SAMPLE DETAILS

Logged By: **MJC**

### STRATA RECORD

Type	Depth From - To(m)	Vane Results kN/m <sup>2</sup>	Groundwater	Description	Depth (m)	PID (cm)	Legend	Well
				MADE GROUND: Reinforced CONCRETE.	0.15			
D	0.20m - 0.35m			MADE GROUND: Brown slightly sandy slightly gravelly COBBLES and BOULDERS (upto 0.20 x 0.30m x 0.50m in size). Gravel size fragments are angular to subangular fine to coarse of sandstone. Cobble and boulder size fragments are angular of sandstone and occasional brick. At 0.62m: solid concrete encountered in northern section of pit.	0.62			
D	0.55m - 0.62m			Moderately weak to moderately strong light brown fine grained SANDSTONE with very closely to closely spaced subhorizontal bedding fractures and closely to medium spaced subvertical discontinuities. Sand infill (1-3mm) noted along bedding surfaces. Recovered as slightly gravelly cobble and boulder size fragments (upto 0.50m across).	0.95			
B	0.62m - 0.70m			End of Trial Pit at 0.95 m				

### Remarks and Water Observations

Fig. No.

- 1 Hardstanding reinforced concrete at surface broken out with an hydraulic breaker
- 2 Trial pit sides unstable to 0.62m during excavation
- 3 Second layer of concrete noted at 0.62m Pit extended to south to prove natural ground (bedrock)
- 4 No groundwater encountered during excavation
- 5 Excavation terminated on solid bedrock at 0.95m and backfilled



## TRIAL PIT RECORD

TP No. **TP104**

Sheet 1 of 1

Site : Tower Works, Armley

Contract No:

**C0313**

Client : Commercial Estates Group Ltd.

Dates:  
16/02/2005

Method : JCB 3CX with 0.60m wide toothed bucket and pecker.

Scale 1:25

Logged By: **MJC**

### SAMPLE DETAILS

Type	Depth From - To(m)	Vane Results kN/m <sup>2</sup>
D	0.08m - 0.25m	
D	0.25m - 0.40m	
D	0.50m - 0.70m	
D	0.80m - 1.00m	
B	1.05m - 1.15m	

Groundwater

### STRATA RECORD

MADE GROUND: TARMACADAM.

MADE GROUND: Brown clayey sandy GRAVEL. Gravel size fragments are angular to subrounded fine to coarse of sandstone and siltstone.

MADE GROUND: Dark brown sandy GRAVEL with much cobbles. Gravel size fragments are angular to subangular fine to coarse of brick, sandstone and concrete. Cobble size fragments are angular of brick.

Very weak light brown weathered MUDSTONE. Recovered as very clayey gravel size fragments.

0.75-1.05m: very weak to weak siltstone.

Moderately strong light brown fine to medium grained SANDSTONE with very closely spaced subhorizontal bedding fractures and closely to medium spaced subvertical discontinuities. Sand infill (1-4mm) noted along bedding surfaces. Recovered as slightly sandy gravelly cobbles with occasional boulder size fragments.

End of Trial Pit at 1.15 m

Depth (m)	PID no(m)	Legend	Well
0.08			
0.27			
0.47			
1.05			
1.15			

### Remarks and Water Observations

- 1 Hardstanding tarmacadam at surface broken out with an hydraulic breaker
- 2 Trial pit sides remained stable during excavation
- 3 No groundwater encountered during excavation
- 4 Excavation terminated on solid bedrock at 1.15m and backfilled

Fig. No.



# TRIAL PIT RECORD

Site : Tower Works, Armley

Client : Commercial Estates Group Ltd.

Method : JCB 3CX with 0.60m wide toothed bucket and pecker.

TP No. **TP105**

Sheet 1 of 1

Contract No: **C0313**

Dates: **16/02/2005**

Scale **1:25**

Logged By: **MJC**

## SAMPLE DETAILS

Type	Depth From - To(m)	Vane Results kN/m <sup>2</sup>
D	0.10m - 0.25m	
D	0.30m - 0.45m	
D	0.50m - 0.70m	
B	0.90m - 1.10m	

Groundwater

## STRATA RECORD

Description

MADE GROUND: TARMACADAM.

MADE GROUND: Brown clayey sandy GRAVEL. Gravel size fragments are angular to subrounded fine to coarse of sandstone, siltstone and quartzite.

MADE GROUND: Dark brown sandy GRAVEL with much cobbles. Gravel size fragments are angular to subangular fine to coarse of brick, sandstone and concrete. Cobble size fragments are angular of brick.

At 0.40m: horizontally aligned metal sheet (5mm x 0.60m x 1.50m) noted.

Stiff becoming very stiff light brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to medium of mudstone.

Locally moderately weak to moderately strong light brown fine grained SANDSTONE with extremely to very closely spaced subhorizontal bedding fractures and closely to medium spaced subvertical discontinuities. Sand and sandy clay infill (1-8mm) noted along bedding surfaces.

End of Trial Pit at 1.15 m

Depth (m)	PID (mm)	Legend	Well
0.08			
0.27			
0.50			
0.85			
1.15			

## Remarks and Water Observations

1. Hardstanding tarmacadam at surface broken out with an hydraulic breaker
2. Trial pit sides remained stable during excavation
3. No groundwater encountered during excavation
4. Excavation terminated on solid bedrock at 1.15m and backfilled.

Fig. No.



# TRIAL PIT RECORD

Site : Tower Works, Armley

Client : Commercial Estates Group Ltd.

Method : JCB 3CX with 0.60m wide toothed bucket and pecker

TP No. **TP106**

Sheet 1 of 1

Contract No: **C0313**

Dates:  
16/02/2005

Scale **1:25**

Logged By: **MJC**

## SAMPLE DETAILS

Type	Depth From - To(m)	Vane Results kN/m <sup>2</sup>
D	0.07m - 0.25m	
D	0.25m - 0.35m	
D	0.50m - 0.70m	
B	1.00m - 1.30m	

Groundwater

## STRATA RECORD

Description	Depth (m)
MADE GROUND: TARMACADAM.	0.07
MADE GROUND: Dark brown and brown silty slightly sandy GRAVEL. Gravel is angular to subrounded fine to coarse of sandstone.	0.27
Dark brown silty slightly sandy GRAVEL. Gravel is angular to subrounded fine to coarse of sandstone.	0.47
Brown slightly clayey sandy to very sandy GRAVEL and COBBLES with occasional gravel to cobble size lenses / pockets of soft slightly sandy clay. Gravel is angular to subangular fine to coarse of sandstone. Cobbles are angular to subangular of sandstone.	0.92
Moderately weak to moderately strong light grey heavily stained light brown fine grained SANDSTONE with extremely to very closely spaced subhorizontal bedding fractures and closely to medium spaced subvertical discontinuities. Sand and clayey sand infill (1-15mm) noted along bedding surfaces. Recovered as sandy gravelly cobble size fragments.	1.50
End of Trial Pit at 1.50 m	

Depth (m)	PID (gpm)	Legend	Well
0.07			
0.27			
0.47			
0.92			
1.50			

Fig. No.

## Remarks and Water Observations

- 1 Hardstanding tarmacadam at surface broken out with an hydraulic breaker
- 2 Trial pit sides remained stable during excavation
- 3 No groundwater encountered during excavation.
- 4 Excavation terminated on solid bedrock at 1.50m and backfilled



# BOREHOLE RECORD

BH No. **RH2**  
Sheet 1 of 2

Site: Tower Works, Armley

Contract No:  
**C0313**

Client: Commercial Estates Group Ltd.

Dates:  
10/02/2005

Method: Beretta rotary open hole drilling, using air flush.

Scale **1:100**

## SAMPLE DETAILS

## STRATA RECORD

Driller: Cape Site Serv

Logged By: W.C.

Type: Depth From - To (m) TCR (%) SCR (%) RQD (%) N (Fl)

Groundwater (Caang)

Description

Depth (m) Level (mAOD) Legend Well

MADE GROUND: Concrete

Yellow fine grained SANDSTONE.

0.15

1

1

2

2

3

3

4

4

5

5

6

6

7

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15

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17

17

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19

19

20

20

---below 2.50m becomes grey/yellow.

---Partial loss of returns between 9.60m and 11.20m.

Silty MUDSTONE.

11.50

Continued next sheet

## Remarks and Water Observations

- 1 Groundwater seepage encountered at 19.50m
- 2 Borehole terminated at 20.00m
- 3 50mm diameter standpipe with gas tap installed to 20.00m

GL (m AOD)

Easting:

Northing:

Fig. No.

RH2





# TRIAL PIT RECORD

TP No. **TP107**

Sheet 1 of 1

Site: Tower Works, Armley

Contract No: **C0313**

Client: Commercial Estates Group Ltd.

Dates: 16/02/2005

Method: JCB 3CX with 0.60m wide toothed bucket and pecker

Scale 1:25

Logged By: MJC

## SAMPLE DETAILS

Type	Depth From - To(m)	Vane Results kN/m <sup>2</sup>
D	0.00m - 0.20m	
D	0.20m - 0.30m	
D	0.40m - 0.60m	
B	0.80m - 1.00m	

Groundwater

## STRATA RECORD

Description	Depth (m)	PID (mm)	Legend	Well
MADE GROUND: TARMACADAM.	0.09			
MADE GROUND: Dark brown slightly sandy GRAVEL. Gravel size fragments are angular to subangular fine to coarse of ash, clinker and occasionally sandstone.	0.20			
Dark brown clayey very sandy GRAVEL. Gravel is angular to subrounded fine to coarse of sandstone.	0.35			
Light brown clayey sandy GRAVEL with much cobbles. Gravel is angular to subangular fine to coarse of sandstone. Cobbles are angular to subangular of sandstone.	0.75			
Moderately weak to locally moderately strong light grey stained light brown fine grained SANDSTONE with extremely to very closely spaced subhorizontal bedding fractures and very closely to closely spaced subvertical discontinuities. Firm brown clay and sand infill (1-15mm) noted along bedding surfaces. Generally recovered as slightly clayey sandy gravelly cobble size fragments.	1.10			
Weak brown mottled orange brown sandy SILTSTONE with poorly defined extremely closely spaced subhorizontal bedding fractures. Recovered as angular to subangular tabular gravel size fragments.	1.65			
Very weak and locally weak brown occasionally mottled light grey SILTSTONE. Tending to mudstone in places. Recovered as silty slightly sandy gravel size fragments.	2.10			
Very weak to weak brown MUDSTONE with extremely closely spaced subhorizontal bedding fractures. Recovered as slightly clayey slightly sandy angular gravel size fragments.	3.00			
End of Trial Pit at 3.00 m				

Fig. No.

## Remarks and Water Observations

- 1 Hardstanding tarmacadam at surface broken out with an hydraulic breaker
- 2 Trial pit sides remained stable during excavation.
- 3 No groundwater encountered during excavation
- 4 Excavation terminated at 3.00m and backfilled



# TRIAL PIT RECORD

TP No. **TP108**

Sheet 1 of 1

Site : Tower Works, Armley

Contract No: **C0313**

Client : Commercial Estates Group Ltd.

Dates:  
16/02/2005

Method : JCB 3CX with 0.60m wide toothed bucket and pecker

Scale **1:25**

Logged By: **MJC**

## SAMPLE DETAILS

## STRATA RECORD

Type	Depth From - To(m)	Vane Results kN/m <sup>2</sup>	Groundwater	Description	Depth (m)	PID (ppm)	Legend	Well
D	0.10m - 0.27m			MADE GROUND: TARMACADAM.	0.10			
B	0.40m - 0.70m			MADE GROUND: Dark grey brown sandy GRAVEL. Gravel size fragments are angular to subangular fine to coarse of ash and clinker.	0.27			
				Weak to moderately weak light brown fine grained SANDSTONE with extremely to very closely spaced subhorizontal bedding fractures and very closely to medium spaced subvertical discontinuities. Sand and fine gravel infill (1-10mm) noted along subhorizontal bedding surfaces.	0.70			
				End of Trial Pit at 0.70 m				

## Remarks and Water Observations

Fig. No.

- 1 Hardstanding tarmacadam at surface broken out with an hydraulic breaker
- 2 Trial pit sides remained stable during excavation
- 3 No groundwater encountered during excavation
- 4 Excavation terminated on solid bedrock at 0.70m and backfilled



# BOREHOLE RECORD

BH No. **RH1**  
Sheet 1 of 2

Site: Tower Works, Armley

Contract No:  
**C0313**

Client: Commercial Estates Group Ltd.

Dates:  
10/02/2005

Method: Beretta rotary open hole drilling, using air flush.

Scale **1:100**

## SAMPLE DETAILS

## STRATA RECORD

Driller: Cape Site Serv

Logged By: W C

Type	Depth From - To (m)	TCR (%)	SCR (%)	RQD (%)	N (Ft)	Groundwater (Casing)	Description	Depth (m)	Level (mAOD)	Legend	Well
							MADE GROUND: Concrete	0.20			
					1		Yellow grey silty SANDSTONE.	1			
					2			2			
					3			3			
					4			4			
					5			5			
					6		---Partial loss of returns at 5.50m.	5.75			
					7		Grey SANDSTONE AND SILTSTONE.	6			
					8		---Partial loss of returns at 6.70m.	7			
					9		---Total loss of returns from 7.00m to 9.20m.	8			
					10			9			
					11			10			
					12		---Partial loss of returns at 10.00m.	11			
					13			12			
					14			13			
					15		Silty MUDSTONE.	12.80			
					16			14			
					17			15			
					18			16			
					19			17			
					20			18			
								19			
								20			

Continued next sheet

## Remarks and Water Observations

- 1 Groundwater strike encountered at 17.50m
- 2 Drilling rate constant throughout borehole
- 3 Borehole terminated at 27.50m.
- 4 50mm diameter standpipe with gas tap installed to 20.00m.

GL (m AOD)

Easting:

Northing:

Fig. No.

RH1



# BOREHOLE RECORD

BH No. **RH1**  
Sheet 2 of 2

Site: Tower Works, Armley

Contract No:  
**C0313**

Client: Commercial Estates Group Ltd.

Dates:  
10/02/2005

Method: Beretta rotary open hole drilling, using air flush.

Scale **1:100**

## SAMPLE DETAILS

## STRATA RECORD

Driller: Cape Site Serv

Logged By: WC

Type: Depth From - To (m) TCR (%) SCR (%) RQD (%) N (Fl)

Groundwater (Casing)

Description

Depth (m) Level (mAOD) Legend Well

Silty MUDSTONE.

21

22

23

24

25

26

27

28

29

30

31

32

33

34

35

36

37

38

39

40

End of Borehole at 27.50 m

21

22

23

24

25

26

27

27.50

28

29

30

31

32

33

34

35

36

37

38

39

40

## Remarks and Water Observations

- Groundwater strike encountered at 17.50m
- Drilling rate constant throughout borehole
- Borehole terminated at 27.50m
- 50mm diameter standpipe with gas tap installed to 20.00m

GL (m AOD)

Easting:

Northing:

Fig. No.

RH1



# BOREHOLE RECORD

BH No. **RH2**  
Sheet 2 of 2

Site: Tower Works, Armley

Contract No:  
**C0313**

Client: Commercial Estates Group Ltd.

Dates:  
10/02/2005

Method: Beretta rotary open hole drilling, using air flush.

Scale **1:100**

## SAMPLE DETAILS

## STRATA RECORD

Driller Cape Site Serv

Logged By W C

Type Depth From - To (m) TCR (%) SCR (%) RQD (%) N (Ft)

Groundwater (Casing)

Description

Depth (m) Level (mAOD) Legend Well

Silty MUDSTONE.

21

22

23

24

25

26

27

28

29

30

31

32

33

34

35

36

37

38

39

40

21

22

23

24

25

26

27

28 28.00

29

30

31

32

33

34

35

36

37

38

39

40

End of Borehole at 28.00 m

## Remarks and Water Observations

1. Groundwater seepage encountered at 19.50m
2. Borehole terminated at 28.00m.
3. 50mm diameter standpipe with gas tap installed to 20.00m.

GL (m AOD)

Easting:

Northing:

Fig. No.

RH2



# BOREHOLE RECORD

BH No. **RH3**  
Sheet 1 of 2

Site: Tower Works, Armley

Contract No:  
**C0313**

Client: Commercial Estates Group Ltd.

Dates:  
11/02/2005

Method: Beretta rotary open hole drilling, using air flush.

Scale **1:100**

## SAMPLE DETAILS

## STRATA RECORD

Driller: Cape Site Serv

Logged By: W.C

Type	Depth From - To (m)	TCR (%)	SCR (%)	RQD (%)	N (Ft)	Groundwater (Casing)	Description	Depth (m)	Level (mAOD)	Legend	Well
							MADE GROUND: Concrete	0.10			
							MADE GROUND: Ash and brick.	0.70			
					1		Yellow fine grained SANDSTONE	1			
					2			2			
					3			3			
					4		Yellow/grey silty MUDSTONE.	3.50			
					5		---below 4.50m becomes dark grey.	4			
					6		Yellow/brown silty MUDSTONE.	5.75			
					7			6			
					8			7			
					9		Yellow SILTSTONE and MUDSTONE.	8.50			
					10		Grey SILTSTONE.	9.25			
					11			10			
					12			11			
					13		Grey silty MUDSTONE	12.00			
					14			13			
					15		---Soft ground between 14.50m and 15.50m.	14			
					16		Grey MUDSTONE.	15.50			
					17		Brown/grey Mudstone.	16.00			
					18			17			
					19			18			
					20			19			
							Continued next sheet	20			

### Remarks and Water Observations

- 1 No groundwater strike encountered during drilling.
- 2 Borehole terminated at 28.50m.
- 3 50mm diameter standpipe with gas tap installed to 18.00m.

GL (m AOD)

Eastings:

Northings:

Fig. No.

**RH3**





# BOREHOLE RECORD

BH No. **RH3**  
Sheet 2 of 2

Site: Tower Works, Armley

Contract No:  
**C0313**

Client: Commercial Estates Group Ltd.

Dates:  
11/02/2005

Method: Beretta rotary open hole drilling, using air flush.

Scale **1:100**

## SAMPLE DETAILS

## STRATA RECORD

Driller: Cape Site Serv

Logged By: W.C.

Type	Depth From - To (m)	TCR (%)	SCR (%)	RDD (%)	N (Ft)	Groundwater (Casing)	Description	Depth (m)	Level (mAOD)	Legend	Well
						21	Brown/grey Mudstone.	21			
						22		22			
						23		23			
						24		24			
						25		25			
						26		26			
						27		27			
						28		28			
						28.50	End of Borehole at 28.50 m	28.50			
						29		29			
						30		30			
						31		31			
						32		32			
						33		33			
						34		34			
						35		35			
						36		36			
						37		37			
						38		38			
						39		39			
						40		40			

### Remarks and Water Observations

1. No groundwater strike encountered during drilling.
2. Borehole terminated at 28.50m.
3. 50mm diameter standpipe with gas tap installed to 18.00m

GL (m AOD)

Easting:

Northing:

Fig. No.

**RH3**



# BOREHOLE RECORD

BH No. **RH101**  
Sheet 1 of 1

Site: Tower Works, Armley

Contract No:

**C0313**

Client: Commercial Estates Group Ltd.

Dates:

17/02/2005

Method: Beretta rotary open hole drilling, using air flush.

Scale **1:100**

## SAMPLE DETAILS

## STRATA RECORD

Driller: Cape  
Logged By: MJC

Type	Depth From - To (m)	TCR (%)	SCR (%)	ROD (%)	N (Ft)	Groundwater (Casing)	Description	Depth (m)	Level (mAOD)	Legend	Well
							MADE GROUND: CONCRETE.	0 15			
							MADE GROUND: Red brown sandy GRAVEL.	0 30			
					1		MADE GROUND: Dark brown sandy GRAVEL.	1			
					2			2			
							Brown weathered SANDSTONE.	2 30			
					3		Brown SANDSTONE.	3	2 80		
					4			4			
							Grey and brown MUDSTONE.	4 50			
					5			5			
					6			6			
					7			7			
					8			8			
					9			9			
							Brown broken SANDSTONE. 9.30-10.40m: very poor returns of chippings and significant loss of flush noted.	9 30			
					10			10			
					11		10.40-13.00m: intermittent loss of flush and returns noted.	11			
					12			12			
							Grey brown MUDSTONE.	13 13 00			
					13		Brown MUDSTONE.	13 50			
					14			14			
					15			15			
					16		End of Borehole at 16.00 m	16 16 00			
					17			17			
					18			18			
					19			19			
					20			20			

### Remarks and Water Observations

- 1 Hardstanding concrete at surface broken out using a hand held breaker
- 2 No groundwater strike encountered during drilling
- 3 Intermittent hammering action noted by odex hammer between 9.30m and 13.00m. Possible void or fractured/weathered bedrock.
- 4 On completion a 50mm nominal diameter standpipe was installed to 16.00m (slotted from 2.50 to 16.00m with associated pea gravel filter).

GL (m AOD)

Eastings:

Northing:

Fig. No.

**RH101**



# BOREHOLE RECORD

BH No. **RH102**  
Sheet 1 of 1

Site: **Tower Works, Armley**

Contract No:

**C0313**

Client: **Commercial Estates Group Ltd.**

Dates:

**17/02/2005**

Method: **Beretta rotary open hole drilling, using air flush.**

Scale **1:100**

## SAMPLE DETAILS

## STRATA RECORD

Driller **Cape**

Logged By

**MJC**

Depth  
(m)

Level  
(mAOD)

Legend

Well

0.10

0.30

1 1.00

2

3

4

4.30

5

5.10

6

6.40

6.60

7

7.40

8

9

10

11

11.00

11.50

12

13

14

15

16

16.00

17

18

19

20

MADE GROUND: TARMACADAM.

MADE GROUND: Dark grey sandy GRAVEL.

Light grey SANDSTONE.

Grey and brown MUDSTONE.

Grey and brown MUDSTONE.

Grey and brown MUDSTONE.

Grey and brown MUDSTONE.

Grey and brown MUDSTONE.

Grey and brown MUDSTONE.

Grey and brown MUDSTONE.

Grey and brown MUDSTONE.

Grey and brown MUDSTONE.

Grey and brown MUDSTONE.

Grey and brown MUDSTONE.

Grey and brown MUDSTONE.

Grey and brown MUDSTONE.

Grey and brown MUDSTONE.

Grey and brown MUDSTONE.

Grey and brown MUDSTONE.

Grey and brown MUDSTONE.

Grey and brown MUDSTONE.

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Grey and brown MUDSTONE.

Grey and brown MUDSTONE.

Grey and brown MUDSTONE.

Grey and brown MUDSTONE.

Grey and brown MUDSTONE.

## Remarks and Water Observations

1. Hardstanding tarmacadam at surface broken out using a hand held breaker
2. No groundwater strike encountered during drilling.
3. Intermittent hammering action noted by odex hammer between 7.40m and 11.00m. Possible void or fractured/weathered bedrock.

GL (mAOD)

Easting:

Northing:

Fig. No.

**RH102**



# BOREHOLE RECORD

BH No. **RH103**  
Sheet 1 of 1

Site: Tower Works, Armley

Contract No:

**C0313**

Client: Commercial Estates Group Ltd.

Dates:  
17/02/2005

Method: Beretta rotary open hole drilling, using air flush.

Scale 1:100

## SAMPLE DETAILS

## STRATA RECORD

Order Cape

Logged By: MJC

Depth (m) Level (mAOD) Legend Well

MADE GROUND: CONCRETE.

MADE GROUND: Brown sandy GRAVEL and COBBLES.

Brown SANDSTONE.

Grey MUDSTONE.

Grey and brown MUDSTONE with occasional bands of siltstone.

Brown SANDSTONE.

Brown SANDSTONE.

Grey and brown MUDSTONE.

End of Borehole at 13.00 m

## Remarks and Water Observations

1. Hardstanding concrete at surface broken out using a hand held breaker
2. No groundwater strike encountered during drilling.
3. Intermittent hammering action noted in occasional places by odex hammer between 8.10m and 9.80m. Possible fractured/weathered bedrock.

GL (m AOD)

Eastings:

Northings:

Fig. No.

**RH103**



# BOREHOLE RECORD

BH No. **RC201**  
Sheet 1 of 1

Site: **Tower Works, Armley**

Contract No:

**C0313**

Client: **Commercial Estates Group Ltd.**

Dates:

**18/03/2005**

Method: **Beretta rotary open hole drilling and rotary core, using air flush.**

Scale **1:100**

## SAMPLE DETAILS

## STRATA RECORD

Driller **SIS**

Logged By **MJC**

Description

Depth (m)

Level (mAOD)

Legend

Well

MADE GROUND: TARMACADAM.

MADE GROUND: Dark grey sandy GRAVEL.

Yellow brown MUDSTONE.

Brown MUDSTONE.

Brown SANDSTONE.

Moderately strong light brown fine grained SANDSTONE.  
Bedding fractures 0-10 degrees, closely to medium spaced, planar, rough, brown stained.

7.50-8.50m: with 75-90 degree, closely to medium spaced, planar, rough, brown stained discontinuities.

Below 8.50m: becoming predominantly strong and light grey with penetrative light brown discolouration.

9.12-9.25m: bedding fractures very closely spaced.

9.30-10.00m: with two 30-40 degree, medium spaced, planar, rough, brown stained, closed discontinuities.

10.15-10.60m: with two 70-80 degree, closely spaced, planar, rough, brown stained discontinuities.

End of Borehole at 11.50 m

## Remarks and Water Observations

1. Groundwater seepage encountered at 6.00m
2. No voids detected during drilling.
3. Borehole backfilled on completion.

GL (m AOD)

Easting:

Northing:

Fig. No.

**RC201**



# BOREHOLE RECORD

BH No. **RC202**  
Sheet 1 of 1

Site: Tower Works, Armley

Contract No:

**C0313**

Client: Commercial Estates Group Ltd.

Dates:  
18/03/2005

Method: Beretta rotary open hole drilling and rotary core, using air flush.

Scale **1:100**

## SAMPLE DETAILS

## STRATA RECORD

Driller: SIS

Logged By: MJC

Description

Depth  
(m)

Level  
(mAOD)

Legend

Well

MADE GROUND: TARMACADAM.

MADE GROUND: Roadstone subbase (driller's description).

Yellow brown MUDSTONE.

Grey and brown MUDSTONE.

Brown SANDSTONE.

Moderately strong light brown fine grained SANDSTONE. Bedding fractures 0-10 degrees, closely to medium spaced, planar, smooth to slightly rough, brown stained.

5.00-5.16m: weak to moderately weak grey brown mudstone.

5.50-5.63m: with interlamination of grey brown siltstone and mudstone.

5.86-6.25m: moderately weak grey brown mudstone.

7.47-8.58m: strong and light grey.

8.58-8.61m: moderately weak to moderately strong brown ironstone.

8.90-9.20m: with very closely to closely spaced sets of 35-55 degree and 70-90 degree, planar, rough, brown stained, closed discontinuities.

End of Borehole at 9.50 m

## Remarks and Water Observations

1. No groundwater strike encountered during drilling.
2. No voids detected during drilling.
3. Borehole backfilled on completion.

GL (m AOD)

Easting:

Northing:

Fig. No.

**RC202**





# BOREHOLE RECORD

BH No. **RC203**  
Sheet 1 of 1

Site: Tower Works, Armley

Contract No:

**C0313**

Client: Commercial Estates Group Ltd.

Dates:

21/03/2005

Method: Beretta rotary open hole drilling and rotary core, using air flush.

Scale 1:100

## SAMPLE DETAILS

## STRATA RECORD

Driller SIS

Logged By MJC

Type	Depth From - To (m)	TCR (%)	SCR (%)	RQD (%)	N (F)	Groundwater (Casing)	Description	Depth (m)	Level (mAOD)	Legend	Well
							MADE GROUND: Reinforced CONCRETE.	0.20			
							MADE GROUND: Brown sandy GRAVEL and COBBLES.	0.50			
						1	Brown SANDSTONE.	1.30			
						2	Brown SILTSTONE.	1.60			
							Grey brown MUDSTONE.	2			
						3		3			
						4	Grey MUDSTONE.	3.50			
						5		5			
						6		6			
						6	Brown MUDSTONE.	6.00			
						7		7			
	7.50 - 9.00					7	Moderately weak and locally weak thinly to thickly laminated light brown fine grained SANDSTONE with occasional siltstone laminations. Bedding fractures 0-15 degrees, very closely to closely spaced, planar, smooth, brown stained. Discontinuities 75-90 degree, closely spaced, planar, rough, brown stained.	7.00			
		100	83	23	(12)	8		8			
					(7)	9		8.15			
	9.00 - 10.50					9	Moderately strong light brown fine grained SANDSTONE. Bedding fractures 0-10 degrees, closely to medium spaced, planar, smooth to slightly rough, brown stained, locally silt and clay infilled (up to 1mm). 8.15-8.65m: with two intersecting 80-90 degree, planar, rough, brown stained discontinuities. 9.19-9.27m: moderately weak siltstone. 9.60-9.84m: with 45-70 degree, incipient fractures.	9			
		100	67	34	(13)	10		9.84			
					(10.50)	11		10.50			
						12	Moderately weak grey MUDSTONE with occasional very closely to closely spaced laminations of sandstone. Bedding fractures 0-20 degrees, very closely to closely spaced, planar, smooth, brown stained.	12			
						13	End of Borehole at 10.50 m	13			
						14		14			
						15		15			
						16		16			
						17		17			
						18		18			
						19		19			
						20		20			

## Remarks and Water Observations

- Groundwater seepage encountered at 7.00m
- No voids detected during drilling
- Borehole backfilled on completion.

GL (m AOD)

Eastings:

Northings:

Fig. No.

**RC203**



# BOREHOLE RECORD

BH No. **RC204**  
Sheet 1 of 1

Site: Tower Works, Armley

Contract No:

**C0313**

Client: Commercial Estates Group Ltd.

Dates:

21/03/2005

Method: Beretta rotary open hole drilling and rotary core, using air flush.

Scale **1:100**

## SAMPLE DETAILS

## STRATA RECORD

Driller: SIS

Logged By: MJC

Type	Depth From - To (m)	TCR (%)	SCR (%)	RQD (%)	N (FI)	Groundwater (Casing)	Description	Depth (m)	Level (mAOD)	Legend	Well
							MADE GROUND: CONCRETE.	0.40			
							MADE GROUND: Roadstone Subbase (driller's description).	0.50			
							Brown sandy CLAY (driller's description).	1.20			
							Brown SANDSTONE.	2.60			
							Brown SILTSTONE.	3.00			
							Brown SANDSTONE.	3.40			
							Grey and brown MUDSTONE.	4.00			
								5.00			
								6.00			
								7.00			
							Grey and brown SANDSTONE.	7.60			
								8.00			
	9.00 - 10.50						Moderately strong light brown fine and medium grained SANDSTONE. Bedding fractures 0-15 degrees, closely to medium spaced, planar, smooth, brown stained.	9.00			
		100	80	65			9.60-9.90m: 85 degree, closed discontinuity.	10.00			
	10.50 - 12.00				(10)		moderately weak to moderately strong grey sandy siltstone.	11.00			
		100	90	32			10.40-10.44m: weak mudstone.	11.50			
							10.50-12.00m: with closely to medium spaced, 70-90 degree, planar, rough, brown stained, closed discontinuities.	12.00			
							11.75-11.81m: weak to moderately weak grey sandy siltstone.	12.50			
							11.80-12.00m: 60 degree, planar, rough, brown stained, closed discontinuity.	13.00			
							End of Borehole at 12.00 m	14.00			
								15.00			
								16.00			
								17.00			
								18.00			
								19.00			
								20.00			

### Remarks and Water Observations

- Groundwater seepage encountered at 8.50m
- No voids detected during drilling.
- Borehole backfilled on completion

GL (m AOD)

Easting:

Northing:

Fig. No.

**RC204**

## **APPENDIX H**

### **CORRESPONDANCE WITH LCC-DRAINAGE**

**Jon Lawrence**

---

**From:** Pedder, Stuart [Stuart.Pedder@leeds.gov.uk]  
**Sent:** 11 July 2016 10:00  
**To:** Jon Lawrence  
**Subject:** RE: Tower Works, Moorfield Road Armley

Hi John,

My mistake, a 50% reduction on the existing rate of discharge, would be 55L/s, as per your email below.

However, this figure will only be acceptable if you can demonstrate that the existing drainage system is still intact, and subject to YW agreement.

Regards,  
Stuart

---

Stuart Pedder  
Group Engineer (Development Control)  
Leeds City Council  
Flood Risk Management Section  
Tel: 0113 247 8779  
Fax: 0113 395 2407  
Email: [stuart.pedder@leeds.gov.uk](mailto:stuart.pedder@leeds.gov.uk)  
[www.leeds.gov.uk](http://www.leeds.gov.uk)

 Follow us on Twitter - [@leeds\\_highways](https://twitter.com/leeds_highways)

---

**From:** Jon Lawrence [mailto:JonLawrence@constructiondesign.co.uk]  
**Sent:** 11 July 2016 09:26  
**To:** Pedder, Stuart  
**Subject:** RE: Tower Works, Moorfield Road Armley  
**Importance:** High

Hi Stuart

If we reduce the existing discharge by 50% this actually gives a figure of 55.2 l/sec.  
Do you mean we should consider an initial 30% reduction, followed by a further 50%? This gives 38.6 l/sec which rounded up is the 39.0 l/sec.  
Could you confirm please.

Many thanks  
JON

**CoDA Structures**  
**14 Springfield Court**  
**Guiseley**  
**Leeds**  
**LS20 8FD**

**T: 01943 872567**  
**M: 07970 713448**  
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**From:** Pedder, Stuart [<mailto:Stuart.Pedder@leeds.gov.uk>]

**Sent:** 27 June 2016 10:37

**To:** Jon Lawrence

**Subject:** RE: Tower Works, Moorfield Road Armley

Hi John,

Whilst we usually ask for greenfield runoff post development, that is usually with the caveat of it being 'reasonably practicable'. So, if for example, this would mean that a surface water pumping station would be required, we would usually increase the discharge rate, in order to avoid that.

In this case, we would be willing to consider a 50% reduction on the existing rate of discharge, ie 39L/s, provided that you can demonstrate that the existing drainage system is still intact, AND subject to YW agreement. (Please note: given this is a sloping site, we would expect the drainage system to be designed for the 1 in 100 yr storm + 30% uplift for CC).

Yes, we will require the drainage design to include a 10% allowance for urban creep.

Regards,

Stuart

Stuart Pedder  
 Group Engineer (Development Control)  
 Leeds City Council  
 Flood Risk Management Section  
 Tel: 0113 247 8779  
 Fax: 0113 395 2407  
 Email: [stuart.pedder@leeds.gov.uk](mailto:stuart.pedder@leeds.gov.uk)  
[www.leeds.gov.uk](http://www.leeds.gov.uk)



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**From:** Jon Lawrence [<mailto:JonLawrence@constructiondesign.co.uk>]

**Sent:** 27 June 2016 08:52

**To:** Pedder, Stuart

**Subject:** Tower Works, Moorfield Road Armley

**Importance:** High

Hi Stuart

We are again looking at the above site, which used to have a consent for houses and apartment which has expired.  
 A new application is being lodged very shortly and obviously drainage assessments etc have changed quite a bit recently.

Whilst the buildings have been knocked down on the site, the slabs, tarmac and original drainage system are still in place.

On the original approval, based on a rainfall intensity of 50mm/hr the 1.2 year storm the existing surface water discharge from the site was  $8000 \times 0.0138 = 110.4$  l/sec. This was then going to be reduce by 30% to 77.3

14/07/2016

l/sec

Obviously with current assessment, and as we are not re-using the existing drainage, the site should be considered as greenfield giving a discharge of only  $0.8 \times 5.0 + 5.0$  l/s . This yields a very large storm water storage requirement.

As the site is on a hillside the storage also end up being very deep as it has to be in the road.

Is there scope here to agree a discharge rate between the two extremes? If so what can we agree?

I assume we do need to make an allowance of 10% for urban creep in the calculations?

Cheers

JON

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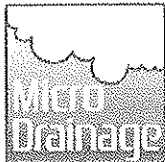
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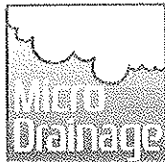
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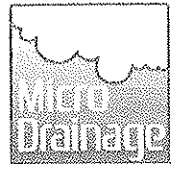
## **APPENDIX I**

### **STORMWATER STORAGE ESTIMATE CALCULATION**

CODA			Page 1		
2 Harewood Yard		Tower Works, Armley			
Harewood		Storage Check 50L/sec			
Leeds LS17 9LF		lin100Yr + 30%CC			
Date 11.7.16		Designed by RTM			
File STORAGE CHECK 50LSEC 11....		Checked by JL			
Elstree Computing Ltd		Source Control 2014.1.1			
Summary of Results for 100 year Return Period (+30%)					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	8.187	1.187	48.5	75.8	O K
30 min Summer	8.445	1.445	48.5	93.9	O K
60 min Summer	8.477	1.477	48.5	95.9	O K
120 min Summer	8.291	1.291	48.5	83.4	O K
180 min Summer	8.065	1.065	48.5	66.4	O K
240 min Summer	7.842	0.842	48.5	49.0	O K
360 min Summer	7.530	0.530	48.5	25.6	O K
480 min Summer	7.390	0.390	45.3	16.2	O K
600 min Summer	7.326	0.326	40.1	12.3	O K
720 min Summer	7.287	0.287	35.6	10.1	O K
960 min Summer	7.240	0.240	29.1	7.5	O K
1440 min Summer	7.189	0.189	21.5	5.1	O K
2160 min Summer	7.151	0.151	15.7	3.5	O K
2880 min Summer	7.130	0.130	12.5	2.6	O K
4320 min Summer	7.106	0.106	9.1	1.8	O K
5760 min Summer	7.091	0.091	7.2	1.4	O K
7200 min Summer	7.082	0.082	6.1	1.1	O K
8640 min Summer	7.075	0.075	5.2	0.9	O K
10080 min Summer	7.069	0.069	4.6	0.8	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	115.731	0.0	121.1	21	
30 min Summer	77.804	0.0	162.8	31	
60 min Summer	49.937	0.0	209.0	48	
120 min Summer	30.956	0.0	259.1	82	
180 min Summer	23.058	0.0	289.5	114	
240 min Summer	18.577	0.0	311.0	144	
360 min Summer	13.656	0.0	342.9	198	
480 min Summer	10.974	0.0	367.4	254	
600 min Summer	9.254	0.0	387.3	312	
720 min Summer	8.046	0.0	404.1	372	
960 min Summer	6.447	0.0	431.7	492	
1440 min Summer	4.709	0.0	473.0	734	
2160 min Summer	3.432	0.0	517.1	1088	
2880 min Summer	2.739	0.0	550.1	1468	
4320 min Summer	1.989	0.0	599.2	2172	
5760 min Summer	1.583	0.0	635.9	2872	
7200 min Summer	1.325	0.0	665.4	3560	
8640 min Summer	1.147	0.0	691.1	4288	
10080 min Summer	1.015	0.0	713.8	5008	
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CODA				Page 2	
2 Harewood Yard		Tower Works, Armley			
Harewood		Storage Check 50L/sec			
Leeds LS17 9LF		1in100Yr + 30%CC			
Date 11.7.16		Designed by RTM			
File STORAGE CHECK 50LSEC 11....		Checked by JL			
Elstree Computing Ltd		Source Control 2014.1.1			
Summary of Results for 100 year Return Period (+30%)					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	8.360	1.360	48.5	88.3	O K
30 min Winter	8.736	1.736	49.1	109.1	O K
60 min Winter	8.745	1.745	49.2	109.4	O K
120 min Winter	8.354	1.354	48.5	87.8	O K
180 min Winter	7.975	0.975	48.5	59.4	O K
240 min Winter	7.638	0.638	48.5	33.4	O K
360 min Winter	7.363	0.363	43.5	14.5	O K
480 min Winter	7.288	0.288	35.7	10.1	O K
600 min Winter	7.248	0.248	30.3	8.0	O K
720 min Winter	7.222	0.222	26.4	6.6	O K
960 min Winter	7.188	0.188	21.2	5.0	O K
1440 min Winter	7.150	0.150	15.5	3.4	O K
2160 min Winter	7.122	0.122	11.3	2.4	O K
2880 min Winter	7.105	0.105	9.1	1.8	O K
4320 min Winter	7.086	0.086	6.6	1.2	O K
5760 min Winter	7.075	0.075	5.2	0.9	O K
7200 min Winter	7.067	0.067	4.4	0.7	O K
8640 min Winter	7.061	0.061	3.8	0.6	O K
10080 min Winter	7.057	0.057	3.4	0.5	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Winter	115.731	0.0	135.6	21	
30 min Winter	77.804	0.0	182.3	32	
60 min Winter	49.937	0.0	234.1	50	
120 min Winter	30.956	0.0	290.2	88	
180 min Winter	23.058	0.0	324.2	120	
240 min Winter	18.577	0.0	348.3	146	
360 min Winter	13.656	0.0	384.0	194	
480 min Winter	10.974	0.0	411.5	252	
600 min Winter	9.254	0.0	433.7	312	
720 min Winter	8.046	0.0	452.6	372	
960 min Winter	6.447	0.0	483.5	490	
1440 min Winter	4.709	0.0	529.7	734	
2160 min Winter	3.432	0.0	579.1	1088	
2880 min Winter	2.739	0.0	616.1	1468	
4320 min Winter	1.989	0.0	671.1	2180	
5760 min Winter	1.583	0.0	712.2	2904	
7200 min Winter	1.325	0.0	745.3	3624	
8640 min Winter	1.147	0.0	774.1	4336	
10080 min Winter	1.015	0.0	799.5	4984	
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Tower Works, Armley  
Storage Check 50L/sec  
1in100Yr + 30%CC



Designed by RTM

Checked by JL

Source Control 2014.1.1


### Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

### Time Area Diagram

Total Area (ha) 0.558

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To:	(ha)	From: To:	(ha)	From: To:	(ha)
0 4	0.186	4 8	0.186	8 12	0.186

CODA		Page 4
2 Harewood Yard	Tower Works, Armley	
Harewood	Storage Check 50L/sec	
Leeds LS17 9LF	1in100Yr + 30%CC	
Date 11.7.16	Designed by RTM	
File STORAGE CHECK 50LSEC 11....	Checked by JL	
Elstree Computing Ltd	Source Control 2014.1.1	

Model Details

Storage is Online Cover Level (m) 10.000

Pipe Structure

Diameter (m) 1.800      Length (m) 43.000  
Slope (1:X) 800.000      Invert Level (m) 7.000

Hydro-Brake® Outflow Control

Design Head (m) 1.800      Hydro-Brake® Type Md6 SW Only      Invert Level (m) 7.000  
Design Flow (l/s) 50.0      Diameter (mm) 253

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.4	1.200	44.7	3.000	63.3	7.000	96.6
0.200	23.1	1.400	45.8	3.500	68.3	7.500	100.0
0.300	37.1	1.600	47.6	4.000	73.0	8.000	103.3
0.400	45.9	1.800	49.8	4.500	77.5	8.500	106.5
0.500	48.3	2.000	52.1	5.000	81.7	9.000	109.6
0.600	48.5	2.200	54.4	5.500	85.6	9.500	112.6
0.800	46.6	2.400	56.7	6.000	89.5		
1.000	44.8	2.600	59.0	6.500	93.1		

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## **APPENDIX J**

### **SCHEMATIC DRAINAGE DEVELOPMENT (Fig. 3)**

Redeem



Rev.	Content	Date

Client	B&B Group Ltd		
Project	Woodfield Road, Upper Junction, Leeds		
Title	Site Plan		
Drawn	RTM	Date	22.6.16
Scale	1:250	Checked	EL
Rev.	6906/ETC3		

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