
Development at Moorland Avenue, Dodworth, Barnsley

Flood Risk Assessment

Client:

Gleeson Regeneration & Homes Ltd
6 Europa Court
Sheffield Business Park
Sheffield
S9 1XE

Prepared by:

joc consultants ltd

Park Farm House
Leathley Lane
Leathley
Otley
LS21 2JU

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GLOSSARY

A.E.P:	Annual exceedence probability
AOD(N):	Above Ordnance Datum (Newlyn)
Catchment:	The area of land over which rain falls which produces stream-flow
CCA:	Climate change allowance
CEH:	Centre for Ecology and Hydrology
DDF:	Depth-duration-frequency
FEH:	Flood Estimation Handbook
FRA:	Flood risk assessment
Freeboard:	The amount by which a ground or floor level is above the flood level.
HOST	Hydrology of soil types
MDC	Metropolitan District Council
NGR:	National Grid Reference
OBM:	Ordnance Survey Benchmark
PR:	Percentage run-off
SFRA:	Strategic Flood Risk Assessment
SPRHOST:	Standard percentage run-off derived from HOST soils data

1.0 INTRODUCTION AND BACKGROUND

JOC Consultants Ltd was instructed in February 2012 by Gleeson Regeneration and Homes Ltd to prepare a flood risk assessment (FRA), for a development site at Moorland Avenue, Dodworth, Barnsley, which is the subject of a planning application for a housing development.

References in this report to "the site" are references to the site to which the planning application applies. Specific references to sources of information used in the report are shown in square brackets and are listed in section 9. Figures 1 to 5 are presented immediately following page 12 and the appendices follow thereafter.

This report is prepared specifically for Gleeson Regeneration and Homes Ltd for the purpose of the aforementioned planning application and the report may not be used for any purpose other than for the purpose for which it was commissioned, and it may not be assigned to any third party without our written permission.

This flood risk assessment is based on data available at the time of its preparation and JOC Consultants Ltd accepts no liability for the consequences of any changes to or re-assessment of this data in the future.

2.0 OBJECTIVES

The objectives of this flood risk assessment are:

1. to establish whether the proposed development is likely to be affected by current or future flooding from any source;
2. to establish whether the proposed development will increase flood risk elsewhere;
3. to recommend, as appropriate, measures for managing flood risk; and
4. to establish whether the proposed development would satisfy the third requirement of the Exception Test¹, should it be necessary to apply the Exception Test.

3.0 PLANNING POLICY ON FLOOD RISK

3.1 Development and Flood Risk: Planning Policy Statement 25

Planning Policy Guidance Statement (PPS) 25 [1], provides guidance to planning authorities on matters of flood risk and its interpretation is discussed in the Practice Guide to PPS 25 [2].

PPS 25 emphasises that susceptibility to flooding is a material planning consideration and planning authorities are required to adopt a risk-based approach at all levels of the planning process. The requirements of a flood risk assessment are set out in Appendix E of PPS 25 which deals with all levels of assessment from regional to site-specific.

All land to which PPS 25 applies is grouped into flood zones which identify areas of varying flood risk. The following zones are defined in PPS 25:

¹ PPS 25: Paragraph D9(c)

- Zone 1: Low Probability: annual probability of flooding from rivers or sea is less than 0.1%;
- Zone 2: Medium Probability: annual probability of flooding from rivers is between 0.1% and 1% and from the sea is between 0.5% and 0.1%;
- Zone 3a: High Probability: annual probability of flooding from rivers is greater than 1% and from the sea is greater than 0.5%.
- Zone 3b: The Functional Floodplain: Land designated as such by the local authority in consultation with the Environment Agency and identified in the Strategic Flood Risk Assessment for the area. This is generally land where water has to flow or be stored in times of flood and where the annual probability of flooding is greater than 5% or where the land is designed to flood in an extreme flood event.

A flood risk assessment is required to be submitted with planning applications for all new developments in flood zone 2 and flood zones 3a and 3b, (medium and high probability and the functional floodplain). A flood risk assessment must also be submitted for all new development proposals of 1ha or greater in flood zone 1 (low probability).

The assessment must consider all forms of potential flooding that could affect the development itself and that could occur as a result of the development. Flood risk assessments should be *inter alia*, "proportionate to the risk and appropriate to the scale, nature and location of the development" and should take into account the effects of climate change.

Local planning authorities are required to direct development to areas of lowest risk by adopting a sequential approach. Available land in flood zone 1 should therefore be developed first, followed by land in flood zones 2 and 3a respectively. This policy is implemented by the application of the Sequential Test which compares a proposed development site with other sites available for similar development in the area.

Following the application of the Sequential Test, the Exception Test must be applied when "more vulnerable" development and "essential infrastructure" cannot be located in flood zones 1 or 2, and when "highly vulnerable" development cannot be located in flood zone 1. The three requirements of the Exception Test² are:

- a) The wider sustainability benefits of the development must outweigh the flood risk;
- b) The development must be on developable previously developed land or, if it is not previously developed land, there must be no reasonable alternative sites on developable previously developed land; and
- c) A site specific flood risk assessment must demonstrate that the development will be safe, without increasing flood risk elsewhere and, where possible, will reduce flood risk overall.

The suitability of a development in any particular flood zone depends on its vulnerability classification. The vulnerability classifications defined in PPS 25 are outlined in Table 3.1 below.

² The Exception Test is not required for Less Vulnerable and Water Compatible developments, (see Table 3.1)

Classification	Examples
Essential infrastructure	Essential transport infrastructure which has to cross flood risk areas, & strategic utility infrastructure including wind turbines which for operational reasons has to be located in a flood risk area and remain operational in times of flood.
Highly vulnerable	Emergency services; basement dwellings; caravan and mobile home parks used for permanent residence; hazardous substance installations.
More vulnerable	Hospitals, care homes, prisons, hostels and halls of residence; dwelling houses; health service establishments; educational establishments; waste management sites, holiday caravan and camping sites.
Less vulnerable	Police, ambulance and fire stations which are not required to remain operational during flooding. Commercial premises; agriculture and forestry sites; water and sewage treatment sites; minerals working and processing sites excluding sand and gravel; waste treatment sites excluding landfills and hazardous waste sites.
Water compatible	Flood control infrastructure; water and sewage pumping stations; sand and gravel workings; docks and navigation facilities; defence installations; shipbuilding; coastguard stations; etc.

All vulnerability classifications are compatible with Flood Zone 1.

In Flood Zone 2, all classifications are compatible except highly vulnerable developments unless they satisfy the Exception Test criteria.

In Flood Zone 3a, highly vulnerable development is not compatible and should not be permitted. Essential infrastructure and more vulnerable developments are compatible only if they pass the Exception Test, but water compatible and less vulnerable developments are acceptable.

In Flood Zone 3b, only water compatible development is acceptable. Essential infrastructure may also be acceptable provided it passes the Exception Test, but the remaining vulnerability classifications are not compatible and should not be permitted.

3.2 Barnsley Strategic Flood Risk Assessment

The Barnsley level 1 strategic flood risk assessment (SFRA) [6], published in September 2010, identifies areas of flood risk and flood hazard within the Barnsley borough, based on the Environment Agency flood maps. The SFRA provides information to allow the Sequential Test to be applied at a strategic level and also makes recommendations for managing flood risk through the development control process.

4.0 LOCATION AND DESCRIPTION OF THE SITE

The site is situated on the south-west side of Moorland Avenue, as shown in Figure 1, and extends to approximately 0.78ha. The site is bounded to the north-west by Number 17 Moorland Avenue; to the north-east by Moorland Avenue; to the south-east by land in the ownership of Barnsley Council and to the south-west by open land between the site and the M1 motorway.

The NGR coordinates at the approximate centre of the site are 432580E, 405860N.

The site falls in elevation towards the west. The 1:25 000 OS map shows the south-west boundary of the site to be approximately on the line of the 145m contour. There is a summit of 155m to the south-east of the site but ground levels fall to the east and west of the site. The site is therefore situated approximately at a watershed.

The site is currently partly occupied by redundant buildings in the ownership of Barnsley Council. Approximately 40% of the gross site area has an impervious surface.

The ground investigation report for the site concludes that soakaways are not feasible for surface water drainage due to the presence of clay soils and mudstone, (see extract from ground investigation report at Appendix A).

5.0 THE PROPOSED DEVELOPMENT

The development comprises 33 residential dwellings with gardens. The site layout plan is provided in Appendix B.

Full details of the proposed development are provided in the plans and documents included with the planning application.

6.0 FLOOD RISK

6.1 Methodology

PPS 25 Appendix E provides guidance on the matters that should be addressed by a flood risk assessment. The level of detail however must be appropriate to the scale of development and the extent of available information.

The methodology adopted for this assessment has therefore been as follows:

- Site inspection;
- review of large scale maps and the topographical survey plans for the site;
- review of Barnsley Strategic Flood Risk Assessment and flood zone data;
- interpretation of data acquired and assessment of fluvial flood risk in accordance with PPS 25;
- assessment of surface water run-off volumes in the pre-development and post-development conditions of the site; and
- assessment of potential groundwater flooding at the site.

6.2 Data collection and consultations

The Environment Agency was not consulted for this flood risk assessment as the site is in flood zone 1 and there are no open watercourses in the vicinity which could affect the site.

The Land Drainage Officer at Barnsley Council was consulted for the purposes of this FRA and his response is reproduced in Appendix C.

6.3 Existing flood defences

The site does not benefit from any flood defences.

6.4 History of Flooding

The Barnsley SFRA Map 2 shows the site to have been unaffected by the flood events occurring between 1947 and 2007. There have been no flood events since 2007 that have affected the site.

6.5 Risk of fluvial flooding

The SFRA Maps 3 and 4 show that the site does not lie within flood zones 2 or 3. The site is therefore in flood zone 1: "Low probability", where the annual risk of fluvial flooding is less than 0.1% (1 in 1000 years). As there are no open watercourses that could affect the site there is no potential for fluvial flooding at the site.

6.6 Risk of surface water flooding

Risk to the site

The SFRA Map C-1 shows the site to be not in an area affected by pluvial flooding caused by the 1% A.E.P. rainstorm.

Excess rainfall over the site will run-off towards the low lying land to the west

Effect of the proposed development on rapid-response run-off

Development of the site for housing will increase surface water run-off volume due to the conversion of a significant proportion of the site to impervious area. The extent of impervious area resulting from the proposed development is not known in detail but a reasonable estimate, based on similar developments elsewhere, would be approximately 75% of the gross site area.

The effect of the development on rapid response surface water run-off generated by a storm of critical duration in the 3.3% and 1% A.E.P. events is shown in Figures 2 and 3 respectively.

Tables D1 to D4 (see Appendix D) show the effect of the development to be an increase in rapid response run-off volume of approximately 30%. This is a conservative estimate based on 75% impervious area and this figure should be reviewed and verified at the detailed design stage.

6.7 Risk of groundwater flooding

The risk of groundwater flooding at the site is negligible.

6.8 Risk of sewer flooding

Dodworth is not identified in the Barnsley SFRA as being an area prone to sewer flooding.

6.9 Appropriate Land Use

In accordance with PPS 25: Table D.2, the proposed residential development falls within the vulnerability classification of "More Vulnerable".

As the site lies within flood zone 1, the proposed development at the site is appropriate, in accordance with PPS 25: Table D.3, with no requirement for the Exception Test.

6.10 Effects of Climate Change

The impact of climate change must be assessed over the lifetime of the development. For residential development, the Practice Guide to PPS 25 recommends a minimum lifetime of 100 years. Climate change effects should therefore be considered up to the year 2112.

Current estimates of climate change effects suggest an increase in peak river flows of 20% in the period after 2025 and an increase in peak rainfall intensity of 30% in the period 2085 to 2115[1].

Fluvial flooding

As the sites are not at risk from fluvial flooding, the effects of climate change will have no impact on fluvial flood risk.

Loss of floodplain storage

The development will result in no loss of floodplain storage.

Surface water run-off

The effect of climate change on surface water run-off over the lifetime of the development is shown in Figures 4 and 5 for the 3.3% and 1% A.E.P. rainfall events respectively.

7.0 FLOOD RISK MANAGEMENT

7.1 Fluvial flood risk

No flood risk management measures are necessary in respect of fluvial flooding.

7.2 Surface water flood risk

The effect of the proposed development on surface water run-off volumes can be mitigated by the implementation of sustainable drainage principles. The Building Regulations require surface water to be discharged according to the following preference hierarchy:

1. to ground by infiltration;
2. to a watercourse;
3. to a sewer, if options (1) and (2) are not reasonably practicable.

The ground investigation report concludes that infiltration drainage will not be feasible due to the presence of low permeability clay soils and mudstone.

There is no direct access to a watercourse and so disposal of surface water by this method will not be feasible without crossing land in third party ownership. There is however, an existing surface water drainage connection from the site to the surface water sewer in Moorland Avenue and Yorkshire Water has agreed to a controlled discharge of 28 l/s from the new development to this sewer (see Appendix E).

The drainage system for the development should ensure:

- no surface water flooding resulting from a rainfall event having an A.E.P. of 33% (1 in 30 years);
- only "tolerable" flooding resulting from a rainfall event having an A.E.P. of 1% (1 in 100 years).

"Tolerable" flooding would be flooding to a depth that does not result in flooding of buildings and which does not prevent safe access and egress to and from the site.

Figures 4 and 5 show the rapid response run-off volumes from the impervious areas only, generated by storms having an annual probability of exceedence of 3.3% and 1% respectively, including a 30% increase in rainfall due to climate change effects. The controlled discharge volume, based on the agreed discharge rate of 28 l/s, is also shown and it is apparent that the critical duration in the 3.3% A.E.P. event is approximately 38 minutes, and for the 1% A.E.P. event the critical duration is approximately 39 minutes. The calculations supporting Figures 4 and 5 are shown in Appendix D Tables D5 and D6. The storage capacity required to detain the excess volume from these events is estimated to be 115m³ and 200m³ respectively.

It is emphasised that the estimates of storage capacity in this report are preliminary only and should be verified as part of the detailed drainage design.

7.3 Ground water flood risk

No flood risk management measures are required in respect of groundwater flooding.

7.4 Sewer flood risk

No flood risk management measures are required in respect of sewer flooding.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

1. The site is in flood zone 1 where the annual probability of fluvial flooding is less than 0.1%.
2. There is no historical evidence of the site having been affected by flooding.
3. The risk of surface water flooding at the site is assessed to be low.
4. It is estimated that the development will increase rapid response surface water run-off volumes by approximately 30% compared with existing conditions, assuming 75% impervious area.
5. Infiltration drainage will not be feasible due to low permeability clay soils and mudstone at the site.
6. Attenuation storage capacity for the excess surface water run-off will be required. The total storage capacity will need to be confirmed as part of the detailed drainage design, taking into account the characteristics of the drainage elements.
7. The risk of groundwater flooding at the site is assessed to be insignificant.
8. The risk of sewer flooding at the site is assessed to be insignificant.
9. The development will not result in the loss of any floodplain storage.
10. Climate change effects are currently predicted to increase peak rainfall intensity by 30% over the lifetime of the development which, for the purposes of this assessment is assumed to be at least 100 years. The drainage scheme for the site will need to make provision for this increase.
11. The development will not increase flood risk elsewhere provided the flood risk management recommendations outlined in section 7 above are implemented.
12. The development falls within the "More Vulnerable" classification in PPS 25: Table D.2 and is an appropriate land use with no requirement for the Exception Test.

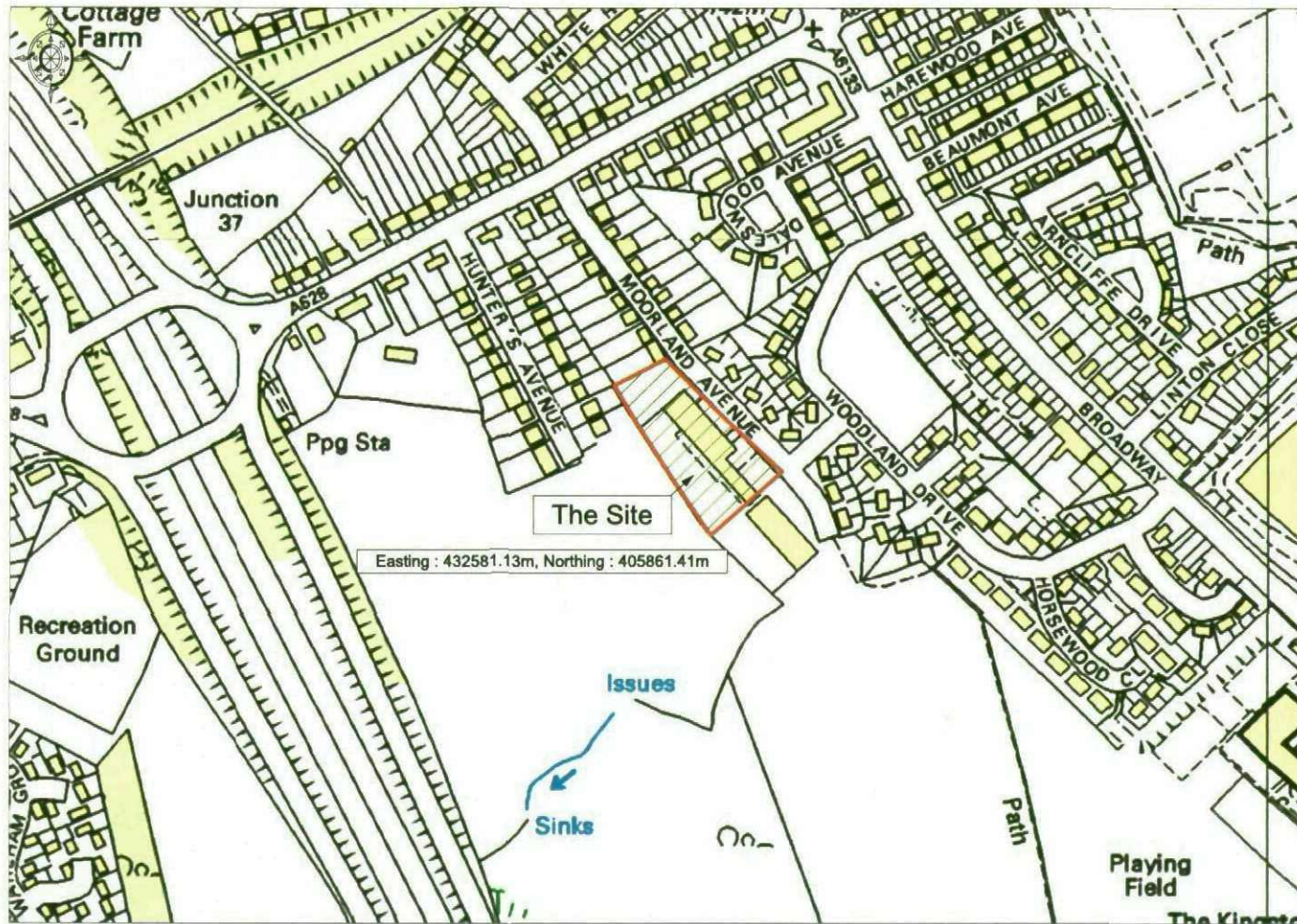
8.2 Recommendations

1. It is recommended that a detailed drainage design is prepared in accordance with the principles stated in section 7.2 above and submitted to Barnsley MBC for approval prior to construction. This recommendation can be secured by an appropriately worded condition in any Grant of Planning Permission.

9.0 REFERENCES

1. Planning Policy Statement 25: Development and Flood Risk. Department for Communities and Local Government. March 2010.
2. Planning Policy Statement 25: Development and Flood Risk: Practice Guide. Department for Communities and Local Government, December 2009.
3. Bamsley Strategic Flood Risk Assessment. Bamsley Metropolitan Borough Council, September 2010.
4. Development and flood risk. Guidance for the construction industry. CIRIA Report No. C624. 2004.
5. Strategic Planning for Flood Risk in the Growth Areas – Insurance Considerations. Association of British Insurers, July 2004.
6. Flood Estimation for Small Catchments. Report No. 124. Institute of Hydrology June 1994.
7. The SUDS Manual, Woods-Ballart *et al.* CIRIA Report C697, 2007.

Development at Moorland Avenue, Dodworth, Barnsley, S70 6PQ

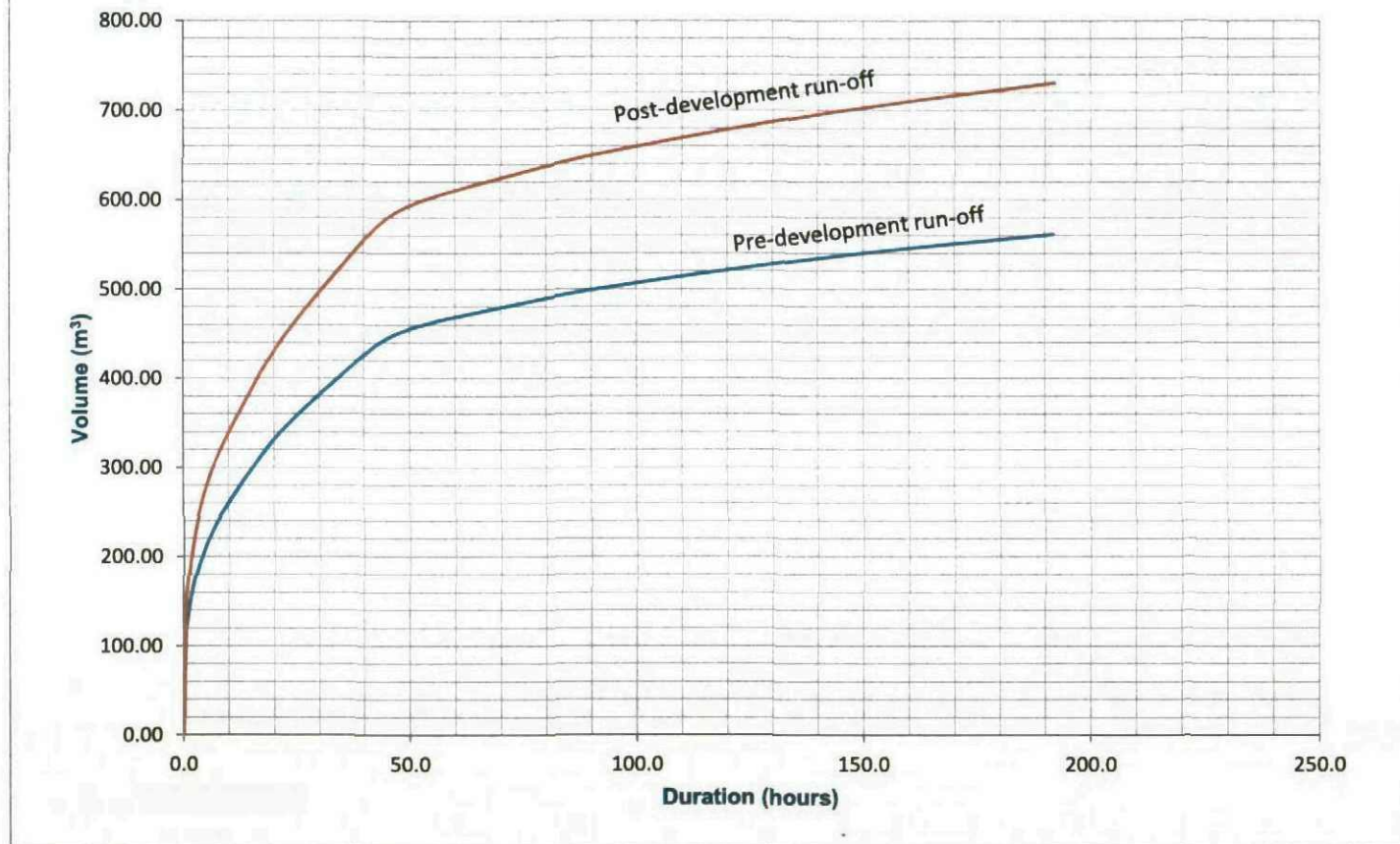


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Figure 1: Location Plan

**Figure 2: Effect of the development on rapid response surface water run-off
(3.3% A.E.P event)**



**Figure 3: Effect of the development on rapid response surface water run-off
(1% A.E.P. event)**

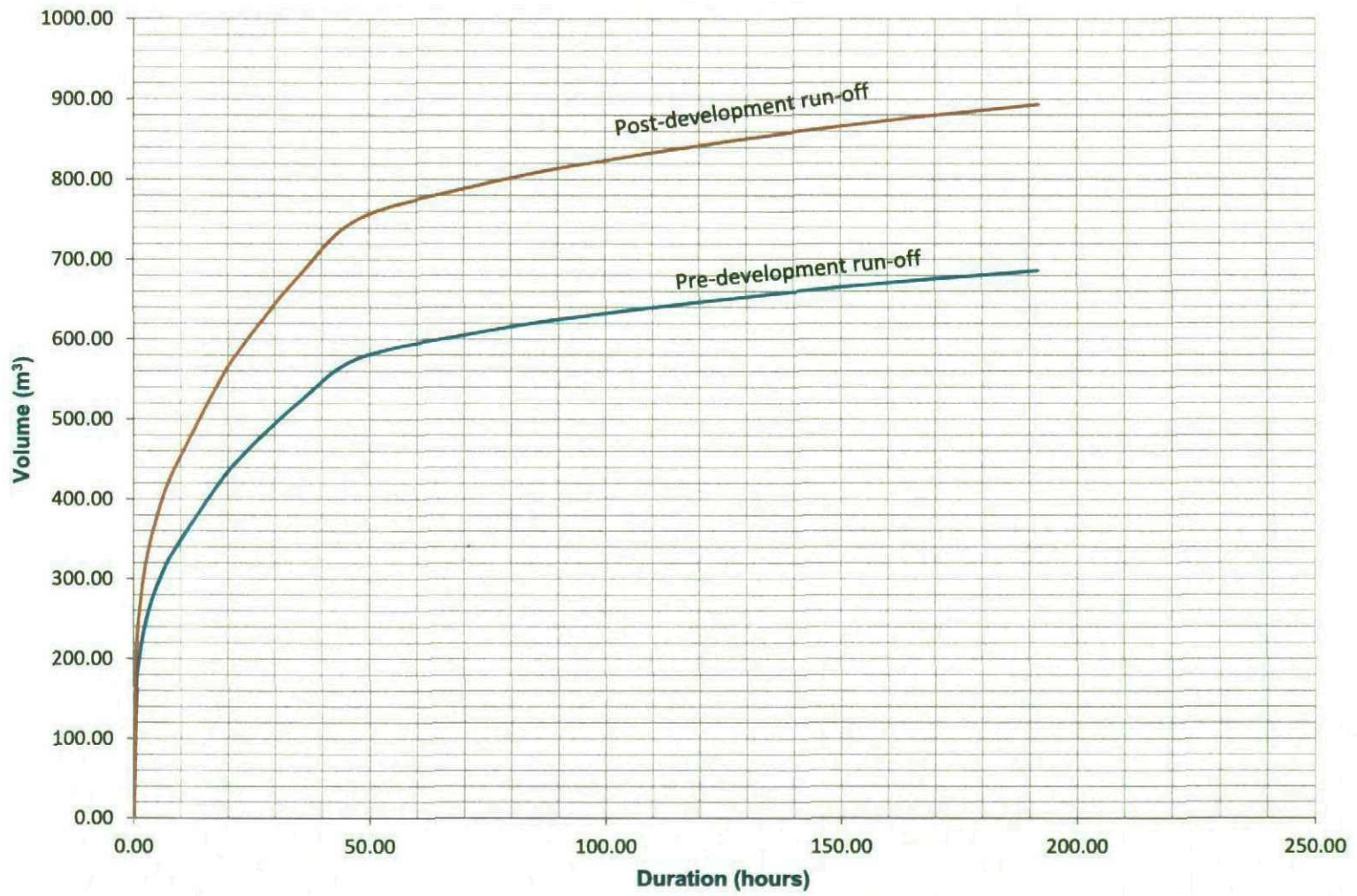


Figure 4: Surface water run-off from a 3.3% A.E.P. rainfall event including CCA (post-development)

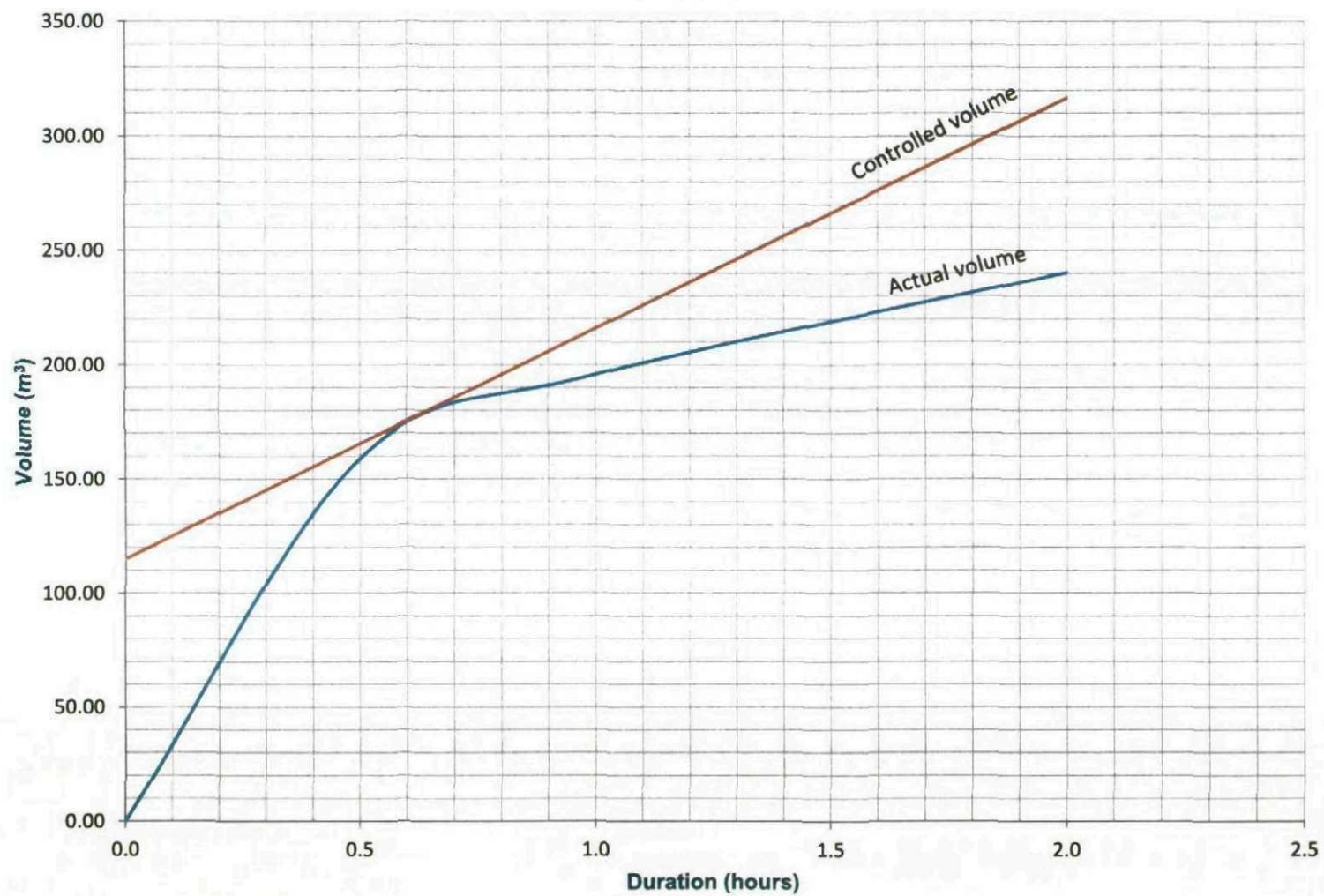
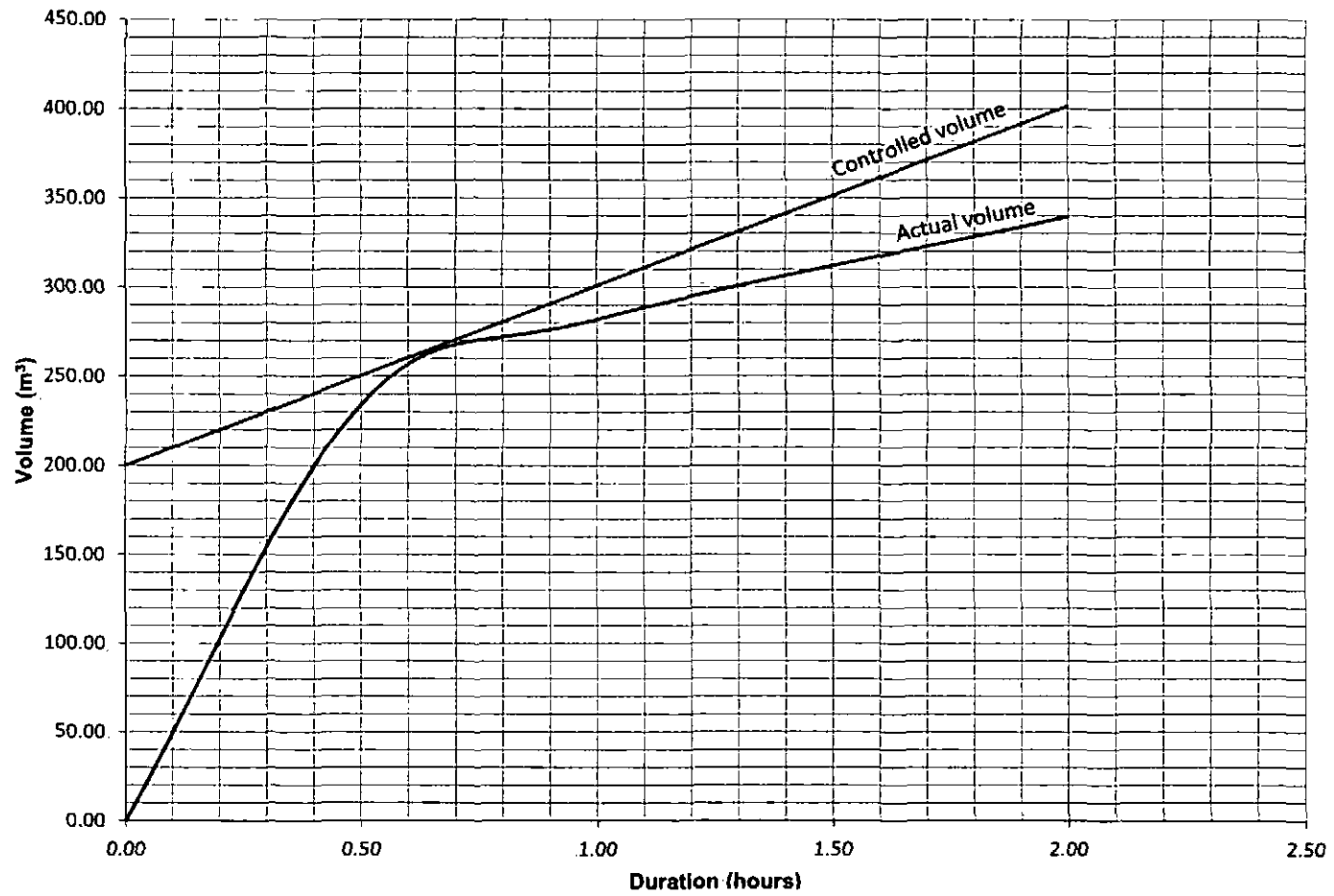


Figure 5: Surface water run-off from a 1% A.E.P. rainfall event including CCA (post-development)



APPENDIX A

Extract from Ground Investigation Report

**GEOTECHNICAL AND GEO-ENVIRONMENTAL
SITE INVESTIGATION**

**FORMER MOORLAND PLASTICS SITE
BARNSELY**

FOR

GLEESON DEVELOPMENTS LTD



34235-001

JANUARY 2012

**GEOTECHNICAL AND GEO-ENVIRONMENTAL
SITE INVESTIGATION**

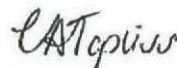
**FORMER MOORLAND PLASTICS SITE
BARNSLEY**

FOR

GLEESON DEVELOPMENTS LTD

Job No. : 34235
Report Status : Final
Document Date : 11 January 2012

Approved :



Catherine Topliss on behalf of J M Wood

Also at: Pearson Court, 3 Kings Road, Fleet, GU51 3DL Tel: 01252 360 580 Fax: 01252 360581

Directors: G M Seaman BSc, CEng, FICE, FIStructE S D Preston BEng, CEng, FICE, FIStructE N J Balnes BSc, CEng, MICE, MCIWEM
P Richardson BSc, CEng, MICE, MIStructE J M Wood BSc, CEng, MICE, FIStructE M J Yates BSc(Eng), ACGI, CEng, MICE, FIStructE
Senior Associates: K R Purzall BEng, CEng, MIStructE S R Ellis BEng, CEng, MIStructE, AMICE
Associates: K Newsome BSc, CEng, MICE, MIStructE S J Mitchell BSc, MSc, CEng, MEI, MCIBSE, MASHRAE
A Jones BEng, CEng, MICE, MIStructE M Young MA, CEng, MICE, MIStructE A Allison BEng
C A Wood BSc, CEng, MIStructE, AMICE C A Topliss BSc, CEnv, CSci, CGeol, SILC, AMICE, FGS

7.5 Superstructure Precautions

Any potential coal workings beneath the site are expected to be at a depth which will not affect development at the surface and therefore superstructure precautions are not considered to be required due to the ground conditions.

7.6 Excavation Problems

Sandstone was encountered at a shallow depth of 1.35 m bgl in TP2. It is expected that this is a sandstone band which may be present particularly around the Moorland Avenue part of the site, based on information from the geological map. There is also made ground covering the site. The stability of any trenches may be poor in the made ground. Support will be required in accordance with current Health & Safety Regulations wherever access is required to trenches deeper than 1.2 m or less where there is risk of collapse.

7.7 Obstructions

Relic foundations and infrastructure associated with the demolished and current buildings are likely to be present across the majority of the site, but especially in the west, such as the brick walls and footings encountered in trial pits TP5 and TP6.

7.8 Surface Water

The natural ground was found to be clay or clayey sand over mudstone and, in one hole, sandstone.

The mudstone and overlying fully weathered mudstone, represented by clay, are not considered to have sufficient permeability for soakways to be a viable option for surface water drainage. Soakaways could be suitable where the sandstone bedrock extends to at least 3 m below ground level, i.e. at least 1 m below a 2 m deep soakaway. Sandstone bedrock was only encountered in one of the six trial pits, TP2 near to the north-eastern edge of the site. The sand overlying this was recorded as having a clay component and it is not guaranteed that the sandstone or overlying sand would have sufficient permeability for soakways to be viable. However, in TP1 and TP3 also near to the north-eastern, Moorland Avenue, side of the site, mudstone was recorded at 2.1 and 2.5 m, respectively, below sandy material probably representative of fully weathered sandstone. Therefore, there will only be a very thin slither in the south-eastern corner of the site where soakaways could potentially work. Soakaways are therefore not considered a viable option for surface water drainage at this site.

APPENDIX B

Site layout plan

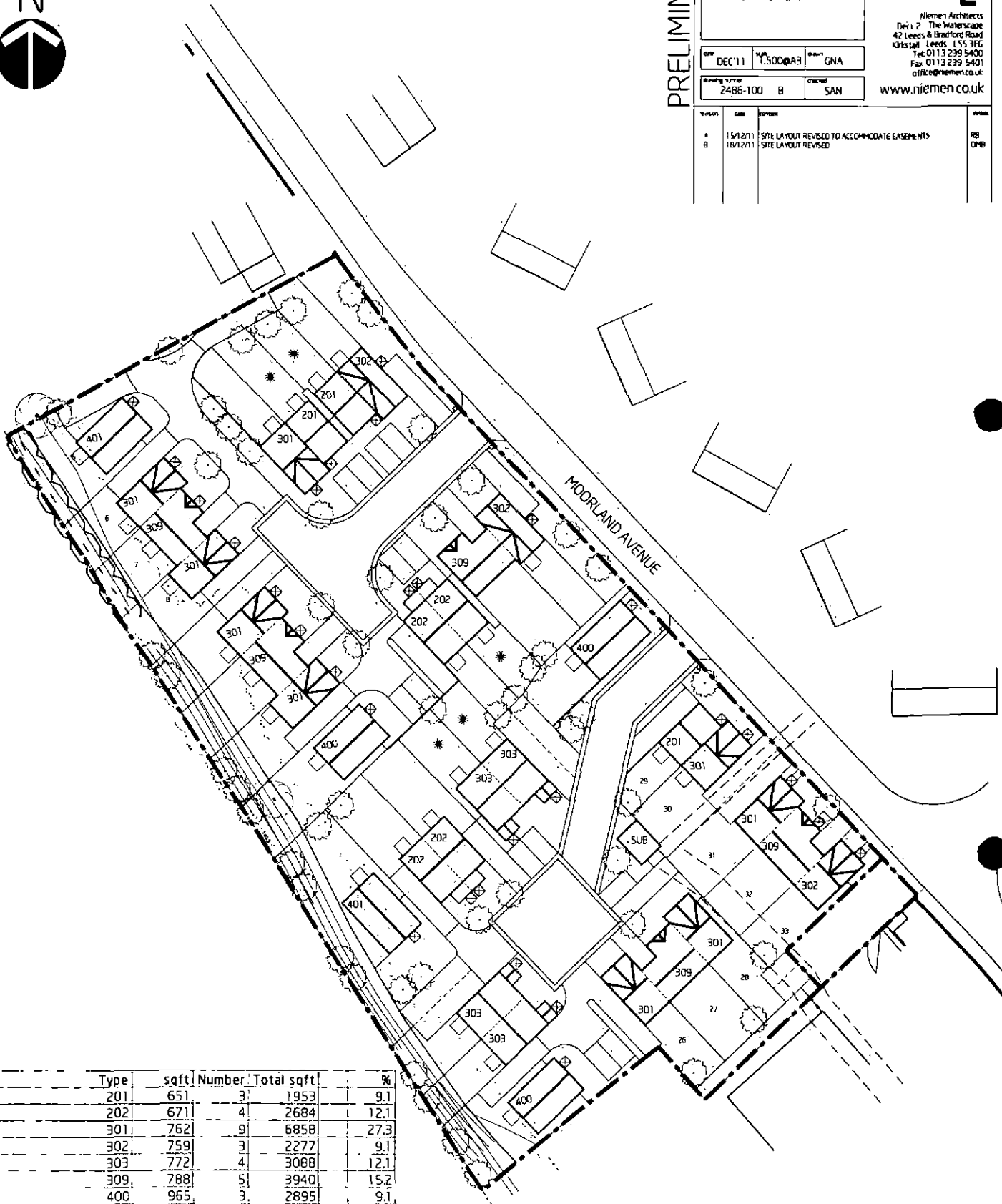


PRELIMINARY

Project: MOORLAND AVENUE DODETH			
Client: GLEESON			
Title: SITE LAYOUT PLAN			
Date: DEC'11	Scale: 1:500 @ A3	Drawn: GNA	
Drawing Number: 2486-100	B	Checked: SAN	
Version	Date	Comments	By
A	15/12/11	SITE LAYOUT REVISED TO ACCOMMODATE EASEMENTS	REG
B	18/12/11	SITE LAYOUT REVISED	CHP



Niemen Architects
 Dept 2 The Waterscape
 42 Leeds & Bradford Road
 Kristall Leeds LS5 3EG
 Tel: 0113 239 5400
 Fax: 0113 239 5401
 office@niemen.co.uk
 www.niemen.co.uk



Type	sqft	Number	Total sqft	%
201	651	3	1953	9.1
202	671	4	2684	12.1
301	762	9	6858	27.3
302	759	3	2277	9.1
303	772	4	3088	12.1
309	788	5	3940	15.2
400	965	3	2895	9.1
401	1066	2	2132	6.1
Totals		33	25,827	100.0

APPENDIX C

Consultation response from Barnsley MBC

John O'Connor

From: Atkins , Wayne [WayneAtkins@barnsley.gov.uk]
Sent: 20 February 2012 13:59
To: 'John O'Connor'
Subject: RE: Site at Moorland Avenue Ddworth

John

My Council have no records of any culverted or open watercourses crossing the site indicated on your attached plan.

I am not aware of any flooding issues associated with the site, and would confirm that to my knowledge it is not affected by any flood plains from major watercourses in the area.

There are both foul and surface water public sewers adjacent to the site which I assume the existing development drains to. Yorkshire Water should be consulted with regard to the discharge of flows from the proposed development to the Public Sewerage network.

There is an un-named watercourse approximately 150m southwest of the proposed development site. This watercourse is an ordinary watercourse for the purposes of the Land Drainage Act, 1991, and is in riparian ownership. The developer would have to cross third party land to connect to this watercourse.

If this watercourse is chosen by the developer as a point of discharge for surface water from the site the developer's attention is drawn to the following:

There should be no increase in surface water runoff from the new development. PPS25 recognises that the management of flood risk is not simply restricted to flood plains and that a catchment-wide approach should be employed.

if a new connection to a watercourse is proposed, then flows must be attenuated to a maximum of 5 litres/second/hectare.

Any balancing facility should be designed to accommodate a 1 in 30 year flow from the site below ground and a 1 in 100 year flow retained within the site (including an allowance of 30% for climate change), without causing any flooding to buildings.

There are alternatives to conventional storage for the control of surface water run-off that are favoured by the authority where ground conditions are suitable. Sustainable Urban Drainage techniques (SUD's) tackle surface water run-off problems at source using features such as soakaways, permeable pavements, grassed swales, infiltration trenches, ponds and wetlands to attenuate flood peak flows, produce water quality improvements and environmental enhancements.

The authority seeks to promote the use of SUD's techniques to this site and the authority expects the developer of the site to submit detailed investigations such that the use of SUD's has been fully explored.

Should you wish to discuss this matter further please contact me on the telephone number below.

Regards

Wayne Atkins

Senior Engineer - Drainage and Highways
Barnsley Metropolitan Borough Council
Environmental Services
Network Resilience and Asset Management
Westgate Plaza 1
PO Box 603
S70 9FA

Telephone: 01226 772182
Fax: 01226 772196
E-mail: wayneatkins@barnsley.gov.uk

From: John O'Connor [<mailto:jocconsultants@btconnect.com>]
Sent: 20 February 2012 11:35
To: Atkins , Wayne
Subject: Site at Moorland Avenue Ddworth

Dear Wayne,

Further to our telephone conversation this morning I attach a location plan showing the site in question.

As discussed, we are preparing a flood risk assessment for the site and I shall be grateful if you will advise me of any drainage or flooding problems affecting the site which are known to the Council. It will also be helpful to know of any limitations to surface water discharges from the site that the Council may set.

I look forward to hearing from you.

Regards,

John O'Connor

joc consultants ltd

Park Farm House
Leathley Lane
Leathley
Otley
LS21 2JU

Tel/fax: 0113 284 2838

www.jocconsultants.co.uk

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APPENDIX D

Surface water run-off calculations: Tables D1 – D6

Table D1: Rapid response run-off from 3.3% A.E.P. rainfall event: existing condition							
Duration hours	Rainfall at Site mm	Area (m ²)			Volume (m ³)		
		Impervious Area (ha)	Pervious Area (ha)	Total Area (ha)	Impervious Area	Pervious Area	Run-off Volume
		PR 90.0%	SPR HOST 39.2%				
0.0	0.0	0.31	0.47	0.78	0.00	0.00	0.00
0.5	23.2	0.31	0.47	0.78	64.69	42.76	107.45
1.0	28.6	0.31	0.47	0.78	79.74	52.72	132.46
2.0	35.1	0.31	0.47	0.78	97.87	64.70	162.56
3.0	39.6	0.31	0.47	0.78	110.41	72.99	183.40
4.0	43.1	0.31	0.47	0.78	120.17	79.44	199.61
6.0	48.5	0.31	0.47	0.78	135.23	89.39	224.62
8.0	52.8	0.31	0.47	0.78	147.22	97.32	244.54
12.0	59.5	0.31	0.47	0.78	165.90	109.67	275.57
18.0	68.8	0.31	0.47	0.78	191.83	126.81	318.64
24.0	76.2	0.31	0.47	0.78	212.46	140.45	352.91
36.0	88.1	0.31	0.47	0.78	245.64	162.38	408.02
48.0	97.6	0.31	0.47	0.78	272.13	179.89	452.02
72.0	104.0	0.31	0.47	0.78	289.97	191.69	481.66
96.0	108.8	0.31	0.47	0.78	303.36	200.54	503.89
144.0	115.9	0.31	0.47	0.78	323.15	213.63	536.78
192.0	121.2	0.31	0.47	0.78	337.93	223.39	561.32

Table D2: Rapid response run-off from 1% A.E.P. rainfall event: existing condition							
Duration hours	Rainfall at Site mm	Area (m ²)			Volume (m ³)		
		Impervious Area (ha)	Pervious Area (ha)	Total Area (ha)	Impervious Area	Pervious Area	Run-off Volume
		PR 90.0%	SPR HOST 39.2%				
0.00	0.0	0.31	0.47	0.78	0.00	0.00	0.00
0.50	34.2	0.31	0.47	0.78	95.36	63.04	158.39
1.00	41.2	0.31	0.47	0.78	114.87	75.94	190.81
2.00	49.6	0.31	0.47	0.78	138.29	91.42	229.72
3.00	55.2	0.31	0.47	0.78	153.91	101.74	255.65
4.00	59.5	0.31	0.47	0.78	165.90	109.67	275.57
6.00	66.2	0.31	0.47	0.78	184.58	122.02	306.60
8.00	71.4	0.31	0.47	0.78	199.08	131.60	330.68
12.00	79.3	0.31	0.47	0.78	221.10	146.16	367.27
18.00	90.6	0.31	0.47	0.78	252.61	166.99	419.60
24.00	99.5	0.31	0.47	0.78	277.43	183.40	460.82
36.00	113.6	0.31	0.47	0.78	316.74	209.39	526.13
48.00	124.7	0.31	0.47	0.78	347.69	229.85	577.53
72.0	131.2	0.31	0.47	0.78	365.81	241.83	607.64
96.0	136.0	0.31	0.47	0.78	379.20	250.67	629.87
144.0	143.0	0.31	0.47	0.78	398.71	263.58	662.29
192.0	148.2	0.31	0.47	0.78	413.21	273.16	686.37

Table D3: Rapid response run-off from 3.3% A.E.P. rainfall event: post development condition								
Duration hours	Rainfall at Site mm	Area (m ²)			Volume (m ³)			% increase in run-off volume
		Impervious Area (ha)	Pervious Area (ha)	Total Area (ha)	Impervious Area	Pervious Area	Run-off Volume	
		PR 90.0%	SPR HOST 39.2%					
0.0	0.0	0.59	0.20	0.78	0.00	0.00	0.00	
0.5	23.2	0.59	0.20	0.78	122.15	17.73	139.88	30.2%
1.0	28.6	0.59	0.20	0.78	150.58	21.86	172.44	30.2%
2.0	35.1	0.59	0.20	0.78	184.80	26.83	211.63	30.2%
3.0	39.6	0.59	0.20	0.78	208.49	30.27	238.76	30.2%
4.0	43.1	0.59	0.20	0.78	226.92	32.95	259.87	30.2%
6.0	48.5	0.59	0.20	0.78	255.35	37.07	292.43	30.2%
8.0	52.8	0.59	0.20	0.78	277.99	40.36	318.35	30.2%
12.0	59.5	0.59	0.20	0.78	313.27	45.48	358.75	30.2%
18.0	68.8	0.59	0.20	0.78	362.23	52.59	414.82	30.2%
24.0	76.2	0.59	0.20	0.78	401.19	58.25	459.44	30.2%
36.0	88.1	0.59	0.20	0.78	463.85	67.34	531.19	30.2%
48.0	97.6	0.59	0.20	0.78	513.86	74.61	588.47	30.2%
72.0	104.0	0.59	0.20	0.78	547.56	79.50	627.06	30.2%
96.0	108.8	0.59	0.20	0.78	572.83	83.17	656.00	30.2%
144.0	115.9	0.59	0.20	0.78	610.21	88.59	698.81	30.2%
192.0	121.2	0.59	0.20	0.78	638.12	92.65	730.76	30.2%

Table D4: Rapid response run-off from 1% A.E.P. rainfall event: post development condition

Duration hours	Rainfall at Site mm	Area (m ²)			Volume (m ³)			% increase in run-off volume
		Impervious Area (ha)	Pervious Area (ha)	Total Area (ha)	Impervious Area	Pervious Area	Run-off Volume	
		C _v 90.0%	C _v 39.2%					
0.00	0.0	0.59	0.20	0.78	0.00	0.00	0.00	
0.50	34.2	0.59	0.20	0.78	180.06	26.14	206.21	30.2%
1.00	41.2	0.59	0.20	0.78	216.92	31.49	248.41	30.2%
2.00	49.6	0.59	0.20	0.78	261.14	37.91	299.06	30.2%
3.00	55.2	0.59	0.20	0.78	290.63	42.19	332.82	30.2%
4.00	59.5	0.59	0.20	0.78	313.27	45.48	358.75	30.2%
6.00	66.2	0.59	0.20	0.78	348.54	50.60	399.15	30.2%
8.00	71.4	0.59	0.20	0.78	375.92	54.58	430.50	30.2%
12.00	79.3	0.59	0.20	0.78	417.51	60.62	478.13	30.2%
18.00	90.6	0.59	0.20	0.78	477.01	69.25	546.26	30.2%
24.00	99.5	0.59	0.20	0.78	523.87	76.06	599.93	30.2%
36.00	113.6	0.59	0.20	0.78	598.10	86.84	684.94	30.2%
48.00	124.7	0.59	0.20	0.78	656.55	95.32	751.87	30.2%
72.00	131.2	0.59	0.20	0.78	690.77	100.29	791.06	30.2%
96.00	136.0	0.59	0.20	0.78	716.04	103.96	820.00	30.2%
144.00	143.0	0.59	0.20	0.78	752.90	109.31	862.20	30.2%
192.00	148.2	0.59	0.20	0.78	780.27	113.28	893.56	30.2%

Table D5: Post-development rapid response run-off from impervious area (3.3% A.E.P. rainfall event including CCA)									
Duration hours	Rainfall at Site mm	Area (m ²)			Volume (m ³)			Controlled run off m ³	Tangent m ³
		Impervious Area (ha)	Pervious Area (ha)	Total Area (ha)	Impervious Area	Pervious Area	Run-off Volume		
		C _v 90.0%	C _v 0.0%					Controlled rate (l/s) 28.0	
0.0	0.0	0.59	0.20	0.78	0.00	0.00	0.00	0.00	115.00
0.5	30.2	0.59	0.20	0.78	158.79	0.00	158.79	50.40	165.40
1.0	37.2	0.59	0.20	0.78	195.75	0.00	195.75	100.80	215.80
2.0	45.6	0.59	0.20	0.78	240.24	0.00	240.24	201.60	316.60
3.0	51.5	0.59	0.20	0.78	271.04	0.00	271.04	302.40	417.40
4.0	56.0	0.59	0.20	0.78	295.00	0.00	295.00	403.20	518.20
6.0	63.1	0.59	0.20	0.78	331.96	0.00	331.96	604.80	719.80
8.0	68.6	0.59	0.20	0.78	361.39	0.00	361.39	806.40	921.40
12.0	77.4	0.59	0.20	0.78	407.25	0.00	407.25	1209.60	1324.60
18.0	89.4	0.59	0.20	0.78	470.90	0.00	470.90	1814.40	1929.40
24.0	99.1	0.59	0.20	0.78	521.55	0.00	521.55	2419.20	2534.20
36.0	114.5	0.59	0.20	0.78	603.00	0.00	603.00	3628.80	3743.80
48.0	126.9	0.59	0.20	0.78	668.02	0.00	668.02	4838.40	4953.40
72.00	135.2	0.59	0.20	0.78	711.83	0.00	711.83	7257.60	7372.60
96.00	141.4	0.59	0.20	0.78	744.68	0.00	744.68	9676.80	9791.80
144.00	150.7	0.59	0.20	0.78	793.28	0.00	793.28	14515.20	14630.20
192.00	157.6	0.59	0.20	0.78	829.55	0.00	829.55	19353.60	19468.60
Total Storage Requirement (m ³)									115.00

Table D6: Post-development rapid response run-off from impervious area (1% A.E.P. rainfall event including CCA)									
Duration hours	Rainfall at Site mm	Area (m ²)			Volume (m ³)			Controlled run-off m ³	Tangent m ³
		Impervious Area (ha)	Pervious Area (ha)	Total Area (ha)	Impervious Area	Pervious Area	Run-off Volume		
		C _v 90.0%	C _v 0.0%					Controlled rate (l.s. ⁻¹ ha ⁻¹) 28.0	
0.00	0.0	0.59	0.20	0.78	0.00	0.00	0.00	0.00	200.00
0.50	44.5	0.59	0.20	0.78	234.08	0.00	234.08	50.40	250.40
1.00	53.6	0.59	0.20	0.78	281.99	0.00	281.99	100.80	300.80
2.00	64.5	0.59	0.20	0.78	339.49	0.00	339.49	201.60	401.60
3.00	71.8	0.59	0.20	0.78	377.82	0.00	377.82	302.40	502.40
4.00	77.4	0.59	0.20	0.78	407.25	0.00	407.25	403.20	603.20
6.00	86.1	0.59	0.20	0.78	453.11	0.00	453.11	604.80	804.80
8.00	92.8	0.59	0.20	0.78	488.70	0.00	488.70	806.40	1006.40
12.00	103.1	0.59	0.20	0.78	542.77	0.00	542.77	1209.60	1409.60
18.00	117.8	0.59	0.20	0.78	620.11	0.00	620.11	1814.40	2014.40
24.00	129.4	0.59	0.20	0.78	681.03	0.00	681.03	2419.20	2619.20
36.00	147.7	0.59	0.20	0.78	777.54	0.00	777.54	3628.80	3828.80
48.00	162.1	0.59	0.20	0.78	853.51	0.00	853.51	4838.40	5038.40
72.00	170.6	0.59	0.20	0.78	898.00	0.00	898.00	7257.60	7457.60
96.00	176.8	0.59	0.20	0.78	930.85	0.00	930.85	9676.80	9876.80
144.00	185.9	0.59	0.20	0.78	978.76	0.00	978.76	14515.20	14715.20
192.00	192.7	0.59	0.20	0.78	1014.35	0.00	1014.35	19353.60	19553.60
Total Storage Requirement (m ³)									200.00

APPENDIX E

Yorkshire Water e-mail dated 3rd February 2012

From: Kashif.Khan@yorkshirewater.co.uk
Sent: 03 February 2012 15:24
To: Shaun@stonge.fsnet.co.uk
Subject: Fw: Moorland Avenue, Dodworth, Barnsley - Pre-Planning Sewerage Enquiry - residential

Shaun

please see letter below.

Regards,

Kashif.,

----- Forwarded by Kashif Khan/Waste Water/YWS/Yorkshire Water on
03/02/2012 15:23 -----

Shaun@stonge.fsnet.co.uk

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

Your Ref:
Our Ref: M008485

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

Email:
Planning.Sewerage@yorkshirewater.
co.uk

For telephone enquiries ring:

Kashif Khan on (0845)120 8482

3rd February 2012

Dear Sir,

Moorland Avenue, Dodworth, Barnsley - Pre-Planning Sewerage Enquiry -
residential

Further to your email of yesterday:

It is understood from the recent drainage survey carried out that the 100 mm diameter private surface water drain shown on our records is in fact a 150 mm diameter drain with a gradient of 1 in 31 and a carrying capacity of 32 l/s

Therefore based on the information provided, curtilage surface water from the site may discharge to the 150 mm diameter surface water drain. The surface water discharge from the site to be restricted to not greater than 28 (twenty eight) litres/second.

Yours faithfully

Developer Services Team

Spotted a leak?

If you spot a leak please report it immediately. Call us on 0800 57 3553 or go to <http://www.yorkshirewater.com/leaks>

Get a free water saving pack

Don't forget to request your free water and energy saving pack, it could save you money on your utility bills and help you conserve water.

<http://www.yorkshirewater.com/savewater>

The information in this e-mail is confidential and may also be legally privileged. The contents are intended for recipient only and are subject to the legal notice available at <http://www.keldagroup.com/email.htm>

Yorkshire Water Services Limited

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