

AMENDED FLOOD RISK
ASSESSMENT

REC. 4.10.2013

Flood Risk Assessment

**Gillas Lane, Houghton Le Spring,
Tyne & Wear DH5 8HJ**

Proposed 63 unit residential scheme

Persimmon Homes (North East) Ltd.

Report ref	Issue	Prepared by	Date	Reviewed by	Date
12749	1	J Mitchell	Dec 2012	M Pearse	Dec 2012
12749	2	M.Pearse	Feb 2013	S Hunter	Feb 2013
12749	2	M.Pearse	Sept 2013	S Hunter	Sept 2013

Client

Persimmon Homes (North East) Ltd
2 Esh Plaza
Sir Bobby Robson Way
Newcastle Great Park
Gosforth
NE13 9BA

3E Consulting Engineers Ltd
First Floor
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Flood Risk Assessment

**Gillas Lane, Houghton Le Spring,
Tyne & Wear DH5 8HJ**

Proposed 63 unit residential scheme

Persimmon Homes (North East) Ltd.

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1.00 Executive Summary

1.01 This report has been commissioned by Persimmon Homes (North East) Limited to examine the flood risk associated with proposed redevelopment of land at Lingfield, Houghton-Le-Spring. The site location plan can be seen in **Appendix A**. This Flood Risk Assessment is reviewed in accordance with the National Planning Policy Framework (NPPF). The proposed end use of the development is residential with associated infrastructure, gardens and driveways.

1.02 The nearest named watercourse to the development site is the Rough Dene Burn which passes through the southern end of the site. Flood maps indicate that the site is located within Flood Zone 1, which is deemed as low risk of flooding from sea or rivers. All other sources of flooding have been reviewed and the risk of flooding from each source can be deemed as low.

1.03 No detailed site investigations have yet been undertaken, however, given the anticipated ground conditions, infiltration methods are unlikely to be suitable. Further site investigations including soakaway tests will be required before this method of surface water disposal can be dismissed.

1.04 Surface water run-off should be discharged either to the Rough Dene Burn via a new outfall or to the existing Northumbrian Water sewer crossing the site. Run off should be restricted to a maximum 5 l/sec discharge rate.

1.05 Storm water should be managed in order that the sewers can accommodate the 1:30 year event without flooding and the 1:100 year event plus climate change should be retained on site without detriment to proposed units.

1.06 The proposed development will not exacerbate flood risk either on the site or downstream of it and the proposed development is not at risk of flooding. Development of the site is therefore considered appropriate.

2.0 Introduction

2.01 This document identifies risk to the proposed development from all sources of flooding. It also aims to set out the principles for the proposed surface water and foul water drainage disposal in order that the proposed development of the site does not exacerbate flooding elsewhere.

2.02 The site occupies a total area of approximately 3.41 hectares. It is proposed to develop approximately 2.5 hectares with the remainder left as open space areas and green corridors. The site will have an impermeable area of approximately 1.286 hectares. The site falls from 82.50m AOD in the northern corner of the site down to 69.68m AOD along the sites south western boundary. The remainder of the site to the south falls towards the existing Rough Dene Burn crossing the site. The site mainly comprises open grassland with a small wooded areas to the sites northern / north western boundary.

2.03 This report is based upon information received from the Environment Agency together with topographical survey information and a Phase 1 Desktop Study Report carried out by arc environmental in November 2012.

2.04 Section 3.00 of this report describes the site location, proposed development and topography. Section 4.00 identifies the existing watercourses and drainage. Section 5.00 identifies the various possible flood flow paths and flood zones. Section 6.0 discusses the surface and foul water drainage. Section 7.00 provides conclusions and recommendations.

3.00 Site Location, Proposed Development and Topography

3.01 The site is centred on National Grid Reference 434770, 548960 approximately 9.50km south west of Sunderland City Centre.

3.02 The development site covers approximately 3.41 hectares and is currently undeveloped. It is proposed to redevelop 2.5 hectares of the site. The topographical survey, shown in **Appendix B**, identifies that the site falls from 82.50m AOD in the northern corner of the site down to 68.68m AOD. Adjacent to the existing burn beyond the site boundary the levels fall down to 68.20m. The site comprises open grassland with a small wooded area to the sites northern/north western boundary.

3.03 The site is bound to the north and west by residential development and undeveloped open ground to the south and east. Further residential development is located approximately 100 metres to the south. The A182 Hetton Road runs in a north/south direction adjacent to the sites western boundary.

3.04 The proposed development will consist of 63 residential units together with associated highways and landscaping. The proposed impermeable area of the site is approximately 1.286 hectares. The proposed development layout is shown in **Appendix C**.

4.0 Existing Watercourses and Drainage

4.01 The nearest named watercourse to the development site is the Rough Dene Burn which passes through the southern end of the site. The watercourse passes under the A182, Hetton Road and heads in a westerly direction before converging with several other burns and heading in a northerly direction. The watercourse then turns and heads west before out-falling into the River Wear at Chester-Le-Street. Rough Dene Burn has a catchment of approximately 276 hectares as it passes the site.

4.02 The Northumbrian Water Limited (NWL) pre-planning sewer enquiry response is included in **Appendix D** and shows the public sewers located within and adjacent to the proposed development site. The sewer records also show an existing 600mm diameter sewer crossing the site and out-falling into the Rough Dene Burn.

5.00 Flood Flow Paths and Flood Zones

5.01 The development site has been assessed for flood risk based on the Environment Agency flood maps, site investigation report and topographical survey. All sources of flooding have been reviewed including fluvial, tidal, ground water, land run-off, and sewers.

5.02 An extract of the Environment Agency indicative Flood Map is shown in **Appendix E**. The online flood map is based upon the latest flood modelling data and shows the site to be located wholly within Flood Zone 1 'Low Probability'. This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).

5.03 Although the Environment Agency flood maps indicate the site is not at risk from fluvial flooding, it is noted that the Rough Dene Burn runs through land to the south of the proposed development site. The burn passes under the A182, Hetton Road within a brick lined culvert. This culvert could cause floodwaters to back up into the development and create an additional flood risk within the site.

5.04 The Flood Estimation Handbook (FEH) CD-ROM was used to provide details of the Rough Dene catchment including catchment size and urban extent. The Revitalised FSR/FEH rainfall run-off method was then used to estimate the peak flow within the watercourse. The results of this analysis are shown in **Appendix F**. The predicted 1 in 100 year flow rate within the Burn is 2.80 cu.m/sec.

5.05 A site survey revealed a culvert dimension of 2.50m wide x 1.47m high at the eastern, upstream, end of the culvert with a bed gradient of approximately 1 in 65. Using Manning's equation for open channel flow and taking an iterative approach, an assessment of the culvert capacity was made. Based on a conservative manning's 'n' value of 0.035, a flow of 2.834 cu.m/sec could be conveyed with a depth of approximately 0.45m. These results are shown in **Appendix F**.

5.06 A check on the capacity of the watercourse channel was also undertaken, using Mannings equation for open channel flow, for a section of the channel just upstream of the culvert opening. Based on a conservative manning's 'n' value of 0.035 and calculating the flow capacity of the channel for its depth to the top of the bank this confirmed that the

channel is capable of passing a flow of 8.133m³/s which is greater than the 1 in 100 year peak flow rate.

5.07 A check was also undertaken on the predicted flood depth immediately upstream of the culvert inlet due to inlet control. This confirmed that this could result in a depth of approximately 0.81m or a flood level of 68.51m AOD. This flood event would be contained within the existing channel banks and would not pose any risk to the proposed development. Finished floor levels should therefore be set to suit the existing topography.

5.08 Another risk of flooding to the development is due to blockage of the culvert under Hetton Road or flows backing up through the culvert due to flooding downstream.

5.09 Should the culvert become blocked flows could back up within the channel of the watercourse until such time as the water can find an alternative route. The lowest level at which water would start to over flow is at the back of the footway adjacent to the culvert under Hetton Road at a level of 71.28mAOD. Should water levels rise above this level then flood waters could start to enter the south east corner of the development.

5.10 The finished floor level of the new properties in the south east corner of the development should be raised above existing ground levels to ensure any potential risk of flooding due to a blockage are reduced. External ground levels around the southern elevation of these properties should remain at existing ground level to ensure that any existing flood flow paths are unaffected.

5.11 Based on the above information it is considered that the risk of flooding from a watercourse or sea is low. The site is not considered to be at risk of flooding from groundwater.

5.12 A further source of flooding is as a result of excessive run-off from the development or over land run-off from adjacent land. It is important that the proposed ground levels are configured such that any flooding on site is directed away from the proposed units and towards the surface water facilities. It should also ensure that any overland flows resulting from run-off from the new development are retained on site within the development area up to the 100 year plus climate change event.

5.13 Overloaded sewer systems present a potential risk to the site in terms of flood risk. Therefore, the proposed surface water system should be designed to accommodate a 1 in 30 year storm event without flooding and the 1 in 100 year storm plus climate change event (in accordance with the National Planning Policy Framework) should be retained within the site in an area which will not affect the new units. This will reduce any potential flood risk within the proposed development and also to adjacent properties/land owners from overland flows.

5.14 Flood flow paths should be checked during the detailed design for good practice, to ensure that flooding of properties or adjacent land does not occur.

6.00 Surface & Foul Water Drainage

6.01 The proposed surface water drainage scheme should seek to meet the requirements of the National Planning Policy Framework (NPPF). Additionally the selection hierarchy for disposal of storm water within Building Regulations Part H should also be met. Consideration should be given firstly to infiltration techniques (to ground), to watercourse and then to sewer. Sustainable Urban Drainage Systems (SUDS) should also be used wherever possible to mimic as far as practicable the natural run-off regime, improve water quality and attenuate peak flows.

6.02 No detailed site investigations have yet been undertaken, however, given the anticipated ground conditions, infiltration methods are unlikely to be suitable. Further site investigations including soakaway testing in accordance with BRE Digest 365 'Soakaway Design' will be required before this method of surface water disposal can be dismissed.

6.03 The nearest watercourse to the development site is the Rough Dene Burn located at the southern end of the site. Should infiltration methods not prove feasible, surface water run-off should be directed to this watercourse.

6.04 Northumbrian Water have confirmed that they would accept a restricted run-off into the existing 600mm diameter surface water sewer crossing the site. A maximum discharge rate of 12 l/sec would be permitted. **Appendix D** includes an extract of an e-mail from the Northumbrian Water confirming their acceptance of the above. It should be noted that this sewer outfalls into the Rough Dene Burn immediately to the south of the proposed development.

6.05 With the site currently being undeveloped, a greenfield run-off rate should be incorporated into any positive drainage network. This flow has been calculated using the IH124 method of calculation. The flow has been based on the impermeable area of the development of 1.286 hectares. These calculations show that the existing 1 in 1 year green field flow rate from the site is 4.85 litres per second and the 1 in 100 year greenfield flow rate is 11.75 litres per second.

6.06 It will be necessary to provide attenuation together with a suitable flow control device to restrict the run-off from the site to ensure the post development flows do not exceed the Q1 year and Q100 year pre development flow rates. To reduce the risk of blockage to any flow control unit the 1 in 1 year flow should be restricted to a minimum of 5 litres per second. This will reduce any potential flood risk downstream of the site. Calculations are shown in **Appendix G**.

6.07 Northumbrian Water have confirmed that, at present, the existing Sewage Treatment Works into which the development will discharge does not have sufficient capacity to accept any further flows until planned upgrade works are completed in 2015. Once the upgrade works have been completed, foul water flows should be directed into the existing 225mm diameter combined sewer within Hetton Road (Manhole 7801).

6.08 The existing surface water sewer crossing the site may be diverted under Section 185 of the Water Industry Act 1991. Discussions should be held with Northumbrian Water to confirm the details of any proposed diversion.

6.09 All proposed public surface water systems should be designed to accommodate a 1 in 30 year storm event without flooding and the 1 in 100 year storm plus climate change event (in accordance with NPPF) should be retained within the site in an area which will not affect the proposed units.

6.10 All public foul and surface water drainage should be designed in accordance with the relevant edition of Sewers for Adoption.

6.11 All private foul and surface water plot drainage should be designed in accordance with Document H of Building Regulations.

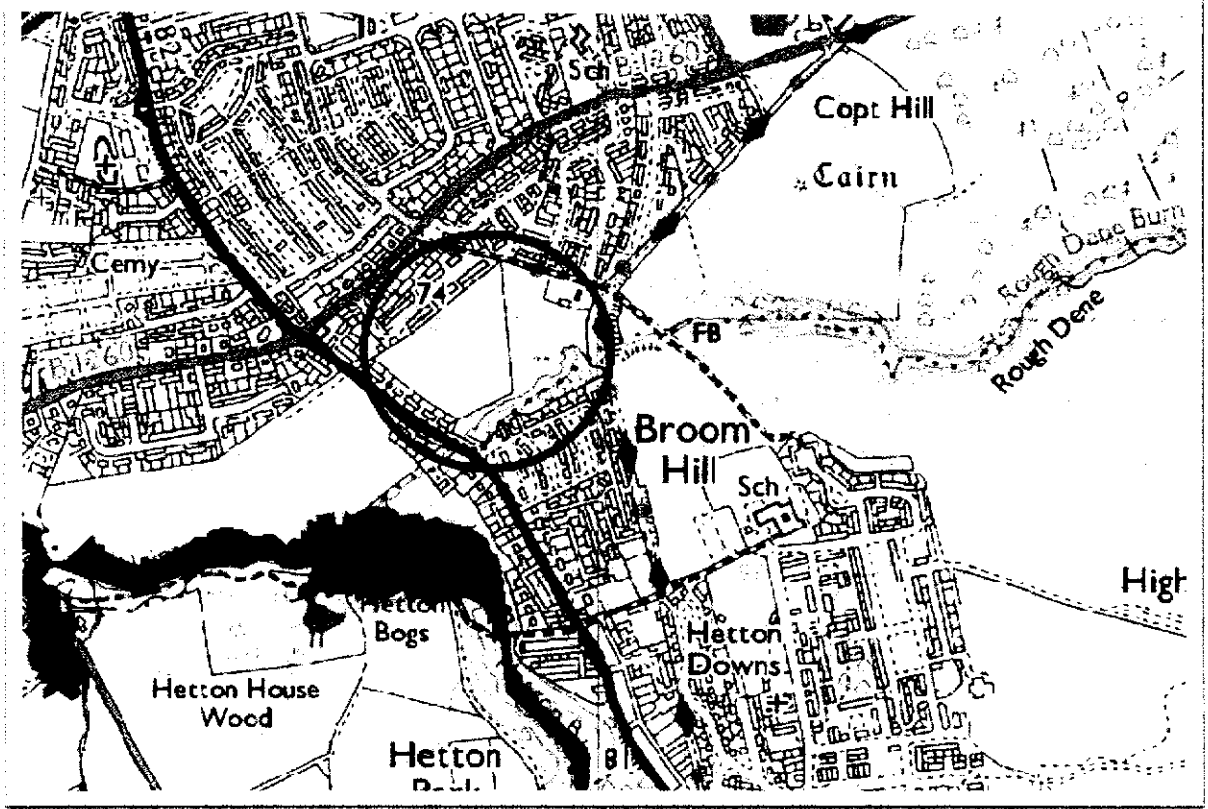
7.00 Conclusions and Recommendations

7.01 Assuming infiltration methods are not considered suitable, surface water run-off should be discharged either to the Rough Dene Burn via a new outfall or to the existing Northumbrian Water sewer crossing the site. Run off should be restricted to 5 litres per second in accordance with the Environment Agency requirements.

7.02 Storm water should be managed in order that the sewers can accommodate the 1:30 year event without flooding and the 1:100 year event plus climate change should be retained on site without detriment to proposed units.

7.03 Proposed ground levels should be configured such that any flooding on site is directed away from the proposed units and towards the surface water facilities.

**Appendix A
Site Location Plan**



Site Location Plan

(Red circle indicates site location)

Land Off Lingfield
Houghton-Le-Spring
Tyne & Wear
DH5 8HJ

Appendix B
Existing Topographical Survey



Any use of this drawing for purposes other than those intended by the author is prohibited and is strictly forbidden. The drawing is intended for use as a reference only and should not be used for any other purpose without the consent of the author. It is the responsibility of the user to ensure that the drawing is used in accordance with the intended purpose.

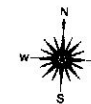


Note: The drawing is intended for use as a reference only and should not be used for any other purpose without the consent of the author.

DO NOT SCALE.

Peterson Homes (North East)	
Gilis Lane, Houghton M Spring Durham	
Existing Topographical Survey	
Date:	Scale:
Preliminary	
No. 12749	C1000 P1

Appendix C
Proposed Development Layout



PROPOSED LAYOUT

Turner	3 bed	7no.	1976 sqft.
Hogarth	5 bed	2no.	1642 sqft.
Hampden	5 bed	4no.	1714 sqft.
Calvert	5 bed	6no.	1622 sqft.
Potter	4 bed	9no.	1513 sqft.
Lewis	4 bed	20no.	1383 sqft.
Kelting	4 bed	13no.	1181 sqft.
Total		63no.	92487 sqft.

Site Area - 6.1 Acres
 Coverage - 15161 sqft./Acre

**SETTLEMENT
BREAK**

REVISIONS	DATE	BY

DRAWN	BLT	CHECKED	DATE	BY
			OCT 2012	

DPL No. **XXX/A/GA/001**

SCALE 1:500 ORIGINAL DRAWING SHEET SIZE A1

m/e Development at :-
**Gillas Lane
 Houghton-Le-Spring**

Site Layout

PERSIMMON HOMES

PERSIMMON HOMES NORTH EAST LTD
 PERSIMMON HOUSE
 CLASPER WAY
 SWALWELL
 NEWCASTLE UPON TYNE
 NE16 3BE

Tel. 0191 4990011 Fax. 0191 4991211

WRITTEN DIMENSIONS TO BE TAKEN IN PREFERENCE TO SCALE
 ALL DIMENSIONS TO BE CHECKED ON SITE AND ANY DISCREPANCIES REPORTED IMMEDIATELY.

Appendix D
Northumbrian Water Sewer Records

INCOMING E-MAIL MESSAGE

File Ref.: 1CL

Project No.: 12749
Client: Persimmon Homes (North East)
Description: Gillas Lane, Houghton le Spring
Location: Durham

From: Redford, Keith [k.redford@persimmonhomes.com]
Subject: FW: Gillas Lane Pre Dev Enq 12NO271D5B

To: stephen.hunter@3econsult.com

Attachments:

Doc Ref.: EML-INC/12749/1CL/26

Sent: 13th Dec 2012 at 16:54

Received:

13th Dec 2012 at 16:53

Message:

Steve, See e-mail below regarding using existing sewer to discharge to the burn.

Keith Redford
Principal Engineer

Persimmon Homes Limited t/a Persimmon Homes North East
2 Esh Plaza
Sir Bobby Robson Way
Newcastle Great Park
Gosforth
NE13 9BA

Tel: 0191 2389996 Mobile: 07947 248060
Email: k.redford@persimmonhomes.com
Web: www.persimmonhomes.com

From: Laura Cape [<mailto:Laura.Cape@nwl.co.uk>]

Sent: 13 December 2012 16:21

To: Redford, Keith

Subject: FW: Gillas Lane Pre Dev Enq 12NO271D5B

Hi Keith

Please see email below from Lenny regarding the surface water connection for Gillas Lane (I wasn't sure whether Lenny had already sent this email through to you separately this morning as on the email below he only included my name).

Regards

Laura Cape

Technical Administration Assistant



**NORTHUMBRIAN
WATER**

Ext: 36646
Direct Line: 0191 419 6646
Email: developmentenquiries@nwl.co.uk
Our Ref: 12NO271D5B
Your Ref:

Leal House, Pattinson Road, District 15,
Washington, Tyne & Wear, NE 38 8J B, UK
Telephone: +44 (0) 845 604 7468
Fax: +44 (0) 191 419 6763
Website: www.nwl.co.uk

08 November 2012

Persimmon Homes North East
2 Esh Plaza
Sir Bobby Robson Way
Newcastle Great Park
NE13 9BA

Dear Mr Bye,

Re: Pre-Development Enquiry – Gillas Lane, Houghton le Spring

Thank you for your enquiry regarding the above proposed development site which I received on 04 October 2012. I am now able to provide the following response.

The Sewage Treatment Works to which this development will discharge is at full capacity and cannot accept any further flows until our planned investment to upgrade the works is completed. We currently anticipate these upgrade works will be completed during 2015.

Once the upgrade works have been completed, the proposed foul flows of 2.8 l/sec can discharge into the 225mm diameter combined sewer at manhole 7801.

We have identified that the surface water flows may be able to discharge to Rough Dene Burn and we suggest that you contact the Environment Agency at Tyneside House, Skinnerburn Road, Newcastle upon Tyne, NE4 7AN to discuss this in further detail.

We wish to draw your attention to the existing sewer which passes through the site. This sewer should be diverted, protected or accommodated within your site layout with an appropriate easement.

To discuss the diversion of this asset in further detail, please contact Roger Perkins on 0191 419 6621.

To discuss the protection of this asset in further detail, please contact Dave Charlton on 0191 419 6672

I have enclosed an extract showing locations within the approximate vicinity of this site that have, from our records, experienced flooding. This has been provided to demonstrate the known flood risks within the vicinity which have been considered as part of our assessment on this enquiry. In addition I also enclose a scaled extract showing the position of the existing wastewater networks and associated assets.

Should you require any further assistance or information then please contact me at developmentenquiries@nwl.co.uk or alternatively on 0191 419 6646. Please quote our reference number above in any future correspondence.

Laura Cape
Technical Administration Assistant
New Development



Northumbrian Water Limited
Registered in England and Wales No 2366763
Registered Office: Northumbria House,
Arlay Road, Pitty Me, Durham, DH1 5FJ

Appendix E
Environment Agency Flood Map

Development Control
New Development

Direct Line: 0191 419 6646
Email: laura.cape@nwl.co.uk

From: Lenny Hope
Sent: 13 December 2012 12:13
To: Laura Cape
Subject: RE: Gillas Lane Pre Dev Enq 12NO271D5B

Keith,

The 600 SW sewer at MH 7803 is downstream of a hydraulic control so there is little scope to connect additional flows into this sewer so any surface water discharges into MH 7803 must be restricted to 12 l/sec (any storm duration and intensity).

Lenny

From: Laura Cape
Sent: 21 November 2012 09:34
To: Lenny Hope
Subject: FW: Gillas Lane Pre Dev Enq 12NO271D5B

Hi Lenny

Can you check whether they could connect their sw into the manhole below instead of going direct to the watercourse?

Thanks

Laura Cape

Technical Administration Assistant
Development Control
New Development

Direct Line: 0191 419 6646
Email: laura.cape@nwl.co.uk

From: Redford, Keith [<mailto:k.redford@persimmonhomes.com>]
Sent: 13 November 2012 10:59
To: Laura Cape
Subject: Gillas Lane Pre Dev Enq 12NO271D5B

Laura,

Further to our discussion can you please advise if we can utilise existing NWL surface water sewer for discharge of development drainage to the Rough Dean Burn. We will probably connect in at MH7803 and, although I haven't confirmed with the EA yet, we will probably be required to discharge at Greenfield run off rate.

My new phone number at Persimmon is – 0191 238 9996

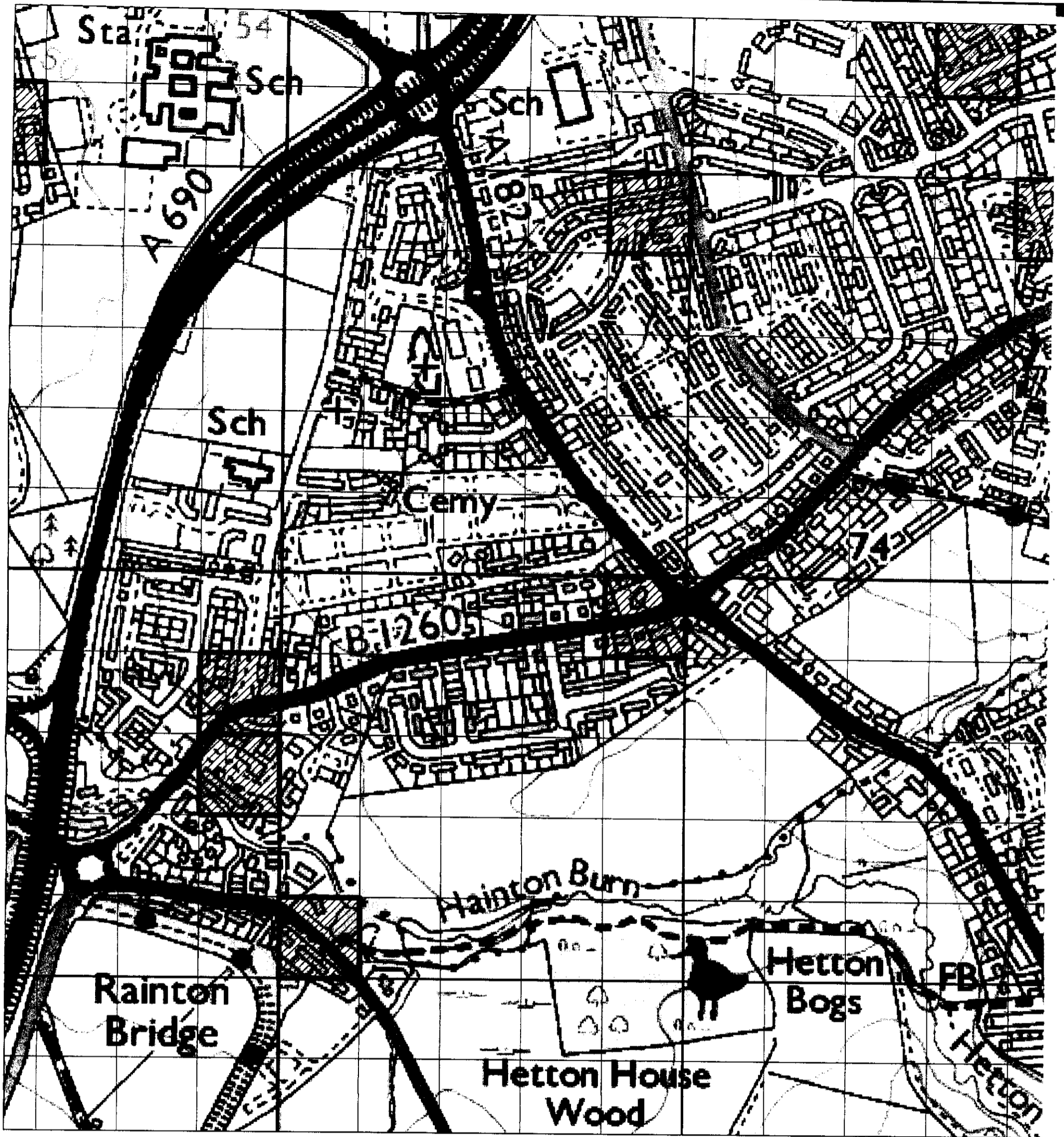
Regards
Keith

about:blank

19/12/2012



Trunk Main



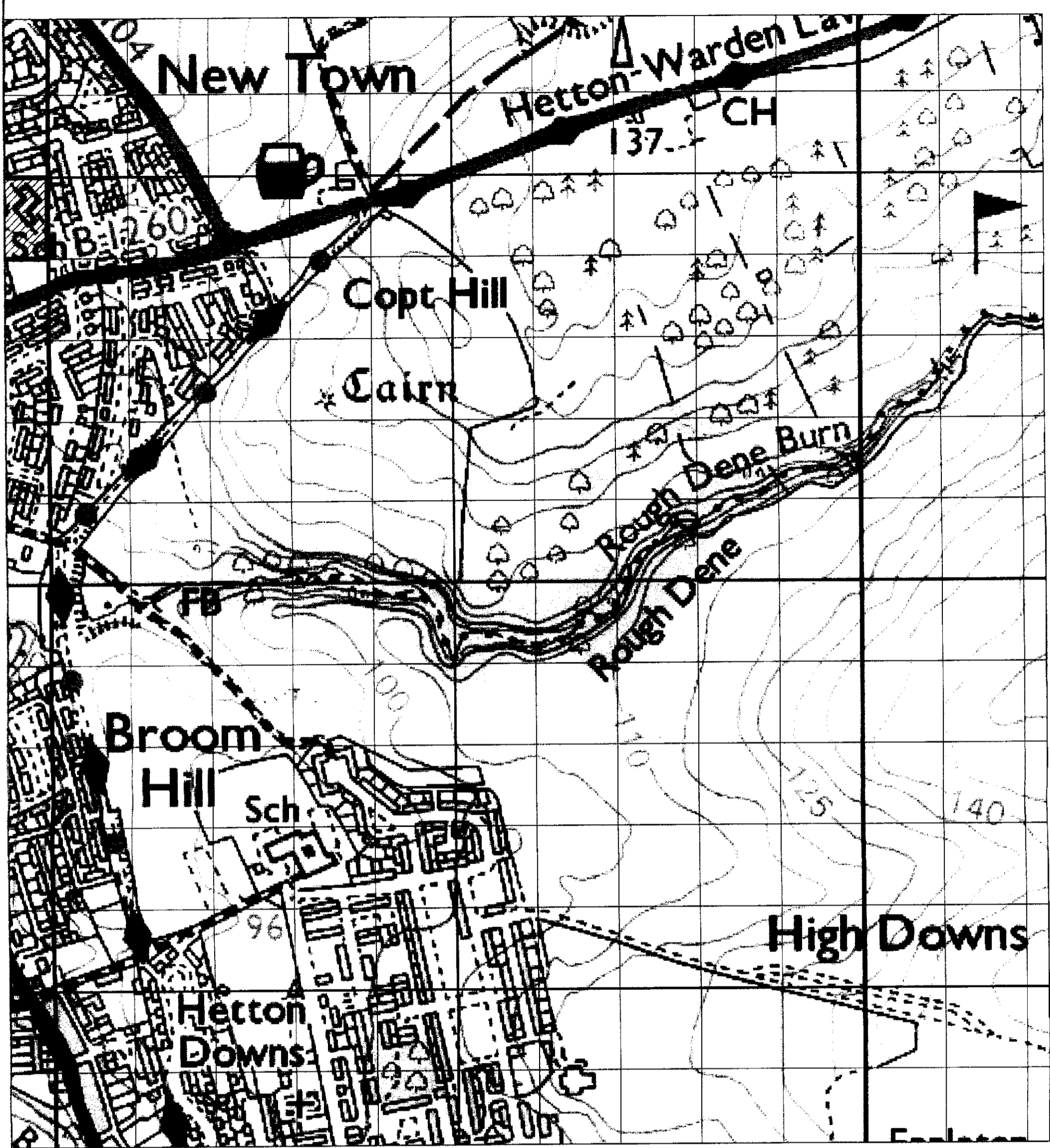
100m grid square where there has been reported sewer flooding.



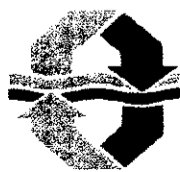
100m grid square where there has been reported sewer flooding in an extreme event.

Author : CAPEL
 Title : Gillas Lane
 Centre Point : 434943,549000

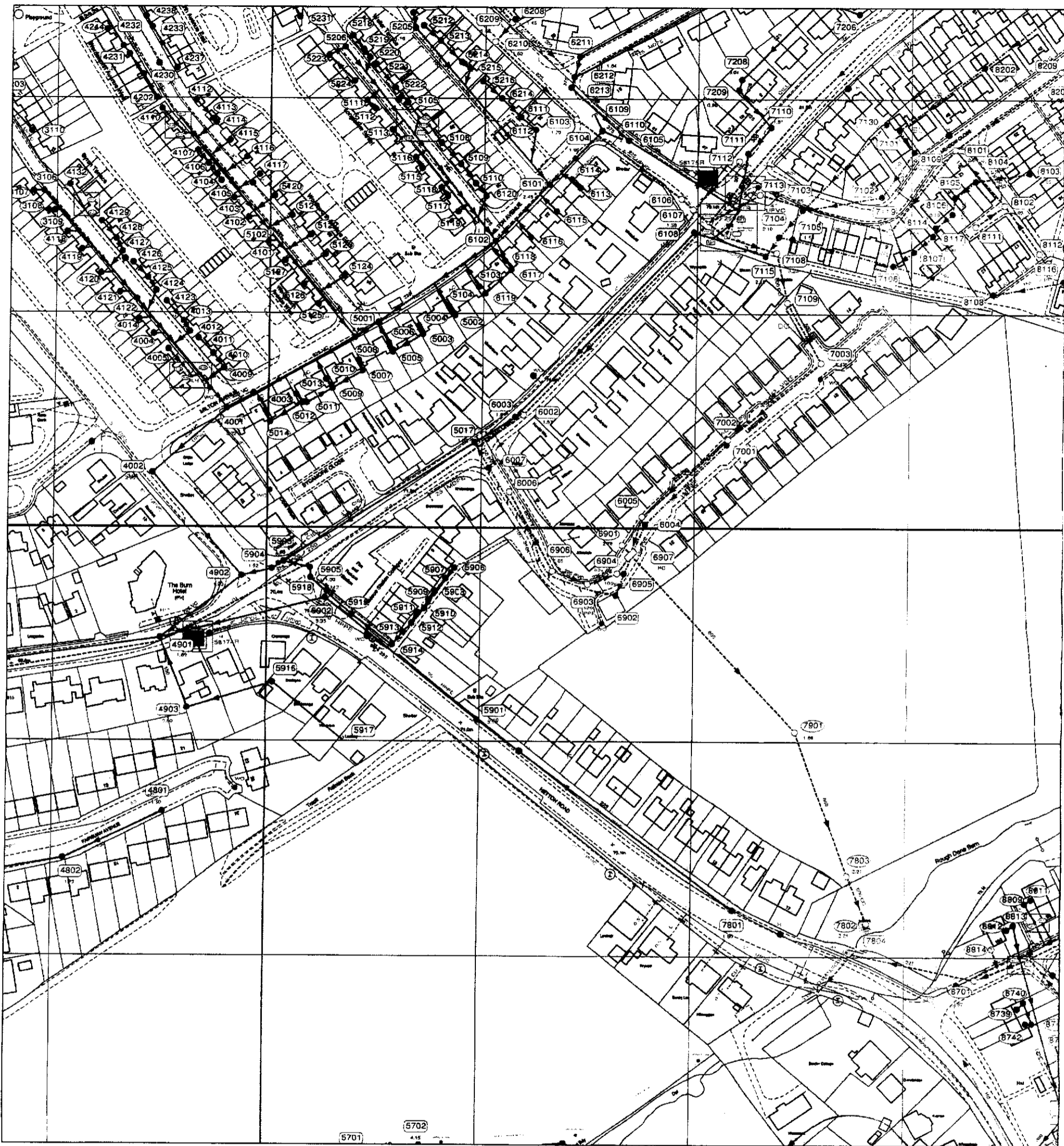
Date : 04-10-2012
 Sheet : NZ3449
 Scale : 1:4600



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NORTHUMBRIAN
WATER



	Distribution Main		Trunk Main
	Raw Water Main		Proposed Main
	Abandoned Asbestos Main		Abandoned Main
	Combined		Surface Water
	Foul		Watercourse

Author	: CAPEL	Date	: 04-10-2012
Title	: Gillas Lane	Sheet	: NZ3448NE
Centre Point	: 434872,548977	Scale	: 1:1250



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NORTHUMBRIAN
WATER

INCOMING E-MAIL MESSAGE

File Ref.: 2EA

Project No.: 12749
Client: Persimmon Homes (North East)
Description: Gillas Lane, Houghton le Spring
Location: Durham

From: Hunter, Rory [rory.hunter@environment-agency.gov.uk]
Subject: RE: Gillas Lane, Houghton le Spring

To: stephen.hunter@3econsult.com**Attachments:****Doc Ref.:** EML-INC/12749/2EA/15**Sent:** 16th Nov 2012 at 15:02**Received:**16th Nov 2012 at 15:03

Message:

Thanks Stephen,

You will need to calculate the existing Greenfield rate to base your proposed discharge on. However you should also investigate the culvert below the road downstream of the site as this may be the control over the permitted rate if there is limited capacity in the culvert at the existing 100 year flow on the Roughdene Burn.

Greenfield rates should be calculated using loH124. Due to there being some existing flood risk on the watercourses downstream we would encourage as much attenuation as possible.

Rory

Rory Hunter

Flood & Coastal Risk Management Officer

Partnerships & Strategic Overview

Northumberland, Tyne & Wear

Telephone 0191 203 4192

Email rory.hunter@environment-agency.gov.uk

Environment Agency

Tyneside House

Skinnerburn Road

Newcastle Business Park

Newcastle

Tyne & Wear

NE4 7AR

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

<http://www.environment-agency.gov.uk>

From: Stephen Hunter [mailto:stephen.hunter@3econsult.com]
Sent: 16 November 2012 11:00
To: Hunter, Rory
Subject: Gillas Lane, Houghton le Spring

Click [here](#) to report this email as spam.

REFERENCE EML-OUT/12749/2EA/2
For the attention of Rory Hunter

Rory,

Further to our telephone conversation, please find attached information regarding the proposed Persimmon Homes development.

Regards,

Stephen Hunter
Engineer
3E Consulting Engineers Ltd
1st Floor, Block C, Holland Park, Holland Drive, Newcastle upon Tyne, NE2 4LD.
w: <http://www.3econsult.com>
e: stephen.hunter@3econsult.com
f: 0191 230 3677

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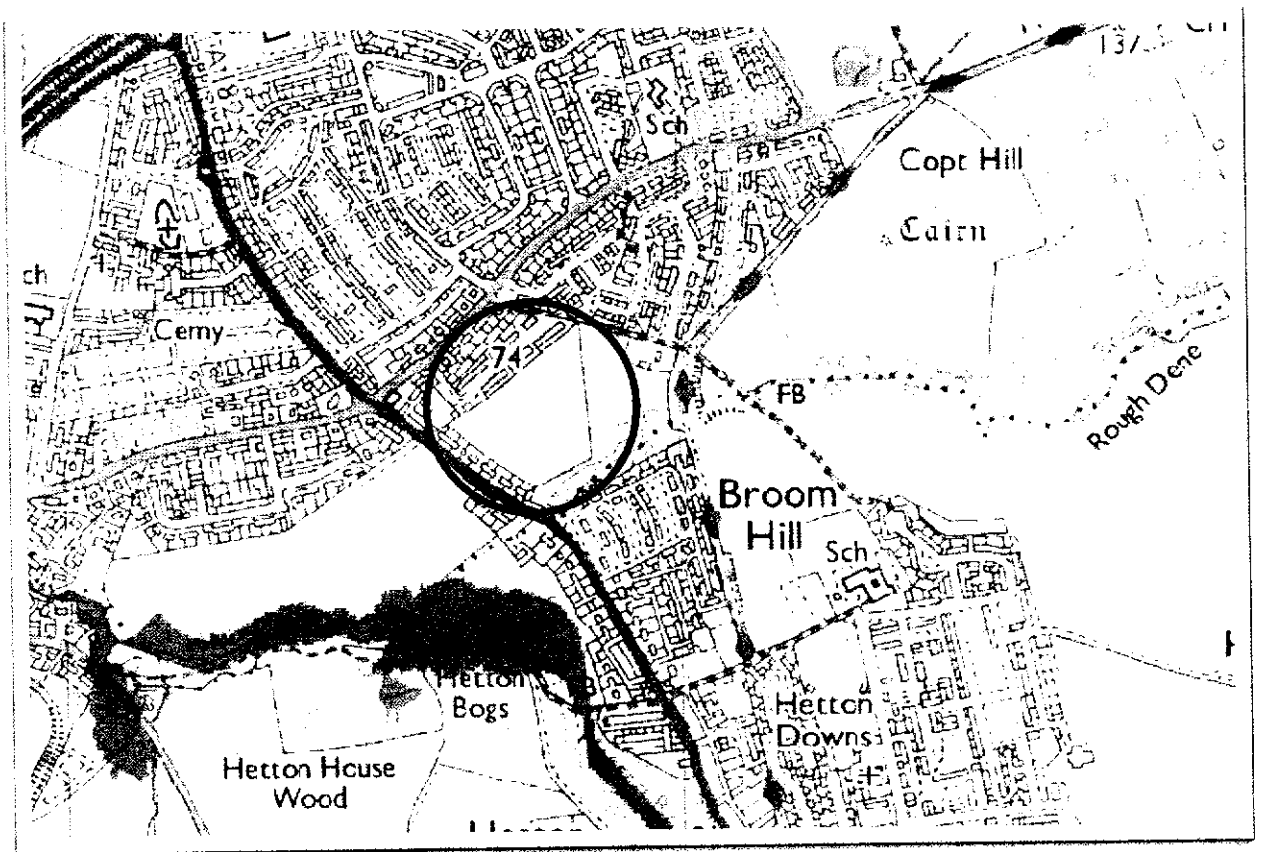
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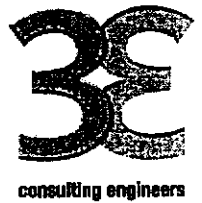
Environment Agency Indicative Flood Map

(Red circle indicates site location)

Appendix F
FEH CD-ROM Data, ReFH Output & Culvert Calculations

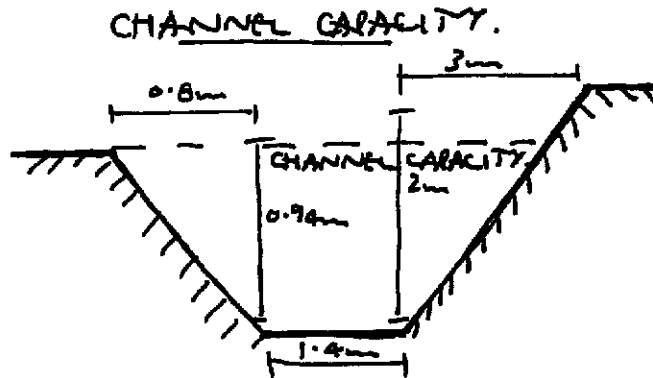
CALCULATIONS/SKETCHES

PROJECT GILLIES LANE, HOUGHTON LESPINE		
JOB No. 12749	PREPARED BY MP	SHEET No. 3
DATE FEB 2015.	CHECKED BY	REV



REF

OUTPUT



BASED ON DEPTH IN CHANNEL OF 0.94m (MAX)

$$d = 0.45m$$

$$A = 2.35m^2$$

$$p = 4.32m.$$

USING MANNING'S EQUATION

$$V = \frac{1.486}{n} \times S^{1/2} \times R^{2/3}$$

$$V = \frac{1.486}{0.035} \times 0.015^{1/2} \times \left(\frac{2.35}{4.32}\right)^{2/3}$$

$$V = 42.457 \times 0.1241 \times 0.656$$

$$= 3.461 \text{ m/sec}$$

USING $Q = V \times A$

$$Q = 3.461 \times 2.35$$

$$= 8.133 \text{ m}^3/\text{sec} \therefore 2.8 \text{ m}^3/\text{sec}$$

100 YEAR FLOW

100 YEAR FLOW WOULD BE WITHIN CHANNEL.

CALCULATIONS/SKETCHES

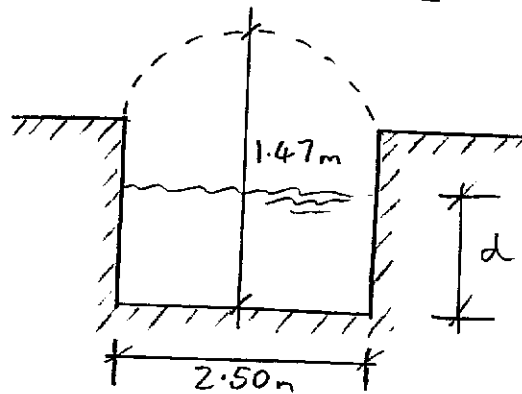
PROJECT GILLAS LANE, HOUGHTON-LE-SPRING		
JOB No. 12749	PREPARED BY JM	SHEET No. 1
DATE DEC 12	CHECKED BY MP	REV



REF

OUTPUT

CULVERT CAPACITY



BASED ON DEPTH
OF 0.45m

$$d = 0.45$$

$$A = 1.125$$

$$P = 3.400$$

USING MANNING'S EQUATION:

$$V = \frac{1.486}{n} \times S^{\frac{1}{2}} \times R^{\frac{2}{3}}$$

$$V = \frac{1.486}{0.035} \times 0.0154^{\frac{1}{2}} \times \left(\frac{1.125}{3.40}\right)^{\frac{2}{3}}$$

$$= 42.457 \times 0.1241 \times 0.4784$$

$$= 2.52 \text{ m/sec}$$

USING $Q = VA$

$$Q = 2.52 \times 1.125$$

$$= \underline{\underline{2.834 \text{ m}^3/\text{sec}}}$$

WHERE

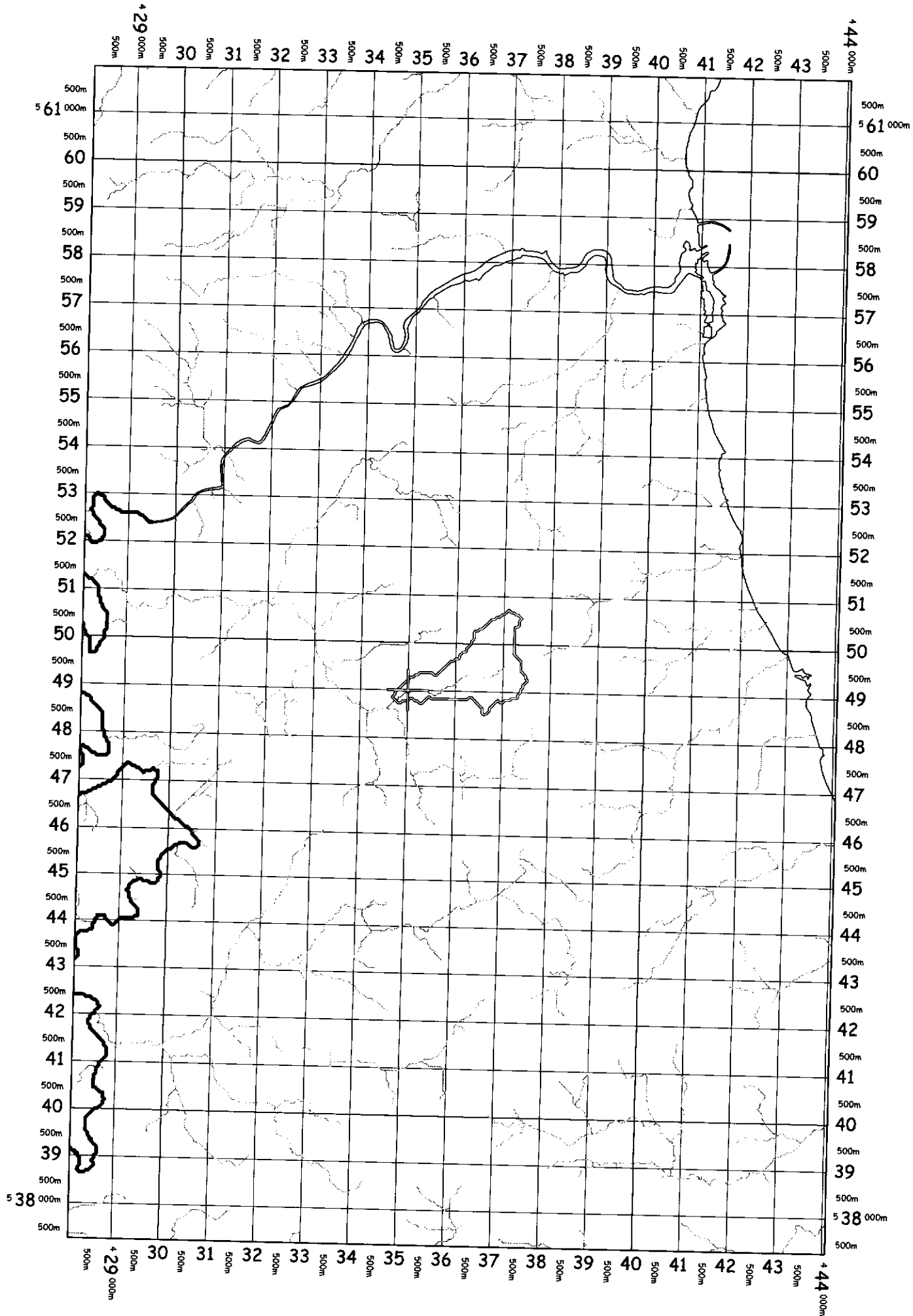
V = VELOCITY
n = MANNING'S ROUGHNESS
COEFFICIENT
S = SLOPE
R = HYDRAULIC RADIUS
= AREA / PERIMETER.

CALCULATIONS/SKETCHES

PROJECT	GILLAS LANE, HOUGHTON-LE-STREET		
JOB No.	12749	PREPARED BY	JM
		SHEET No.	2
DATE	DEC 12	CHECKED BY	MP
		REV	



REF	OUTPUT
<u>INLET CONTROL CHECK</u>	
	$d = 1.47\text{m}$ $= 4.82\text{ft}$ $b = 2.50\text{m}$ $= 8.20\text{ft}$
<p>USING FIG 17-29 FROM 'OPEN CHANNEL HYDRAULICS' - CHOW, 1959:</p> $Q = 2.80\text{ m}^3/\text{s} = 98.9\text{ ft}^3/\text{s}$ $Q/b = 12.06$ <p>FROM FIG 17-29 $H/d = 0.55$</p> $H = 2.651\text{ ft}$ $= \underline{0.81\text{ m}}$	
<p>\Rightarrow INLET CONTROL PRODUCES AN UPSTREAM DEPTH OF <u>0.81 m</u></p>	



434750 548800 [NZ 34750 48800]

0 2.5 5
Kilometres

Revitalised FSR/FEH rainfall runoff method

Spreadsheet application report

User name	John Mitchell	Catchment name	Rough Dene Burn	Date/time modelled	19-Nov-2012 09:41
Company name	3e Consulting Engineers	Catchment easting	434750	Version	1.4
Project name	Rough Dene Burn	Catchment northing	548800		
		Catchment area	2.76		

Summary of model setup

Design rainfall parameters		Loss model parameters		Routing model parameters		Baseflow model parameters	
Return period (yr)	100	C_{max} (mm)	271	T_p (hr)	2.7	BL (hr)	31.9
Duration (hr)	4.75	C_{ini} (mm)	123	U_p	0.65	BR	0.74
Timestep (hr)	0.25	α factor	0.83	U_k	0.8	BF₀ (m³/s)	0.1
Season	Winter						

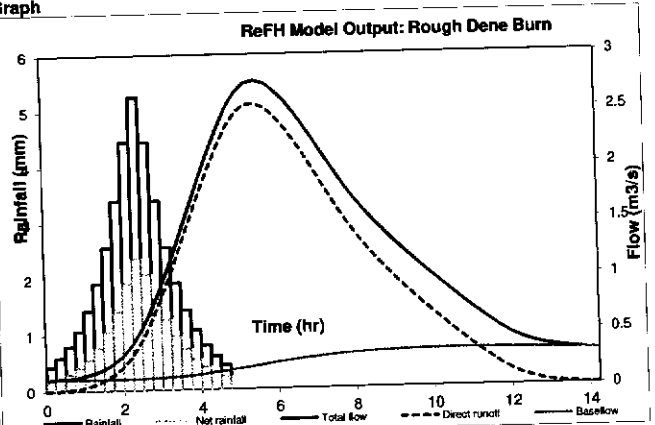
Summary of results

FEH DDF rainfall (mm)	59.7	Peak rainfall (mm)	5.3
Design rainfall (mm)	38.6	Peak flow (m³/s)	2.8

Results

Series	Design Rainfall	Net rainfall	Direct runoff	Baseflow	Total flow
Unit	mm	mm	m ³ /s	m ³ /s	m ³ /s
0.00	0.4	0.2	0.0	0.1	0.1
0.25	0.6	0.2	0.0	0.1	0.1
0.50	0.8	0.3	0.0	0.1	0.1
0.75	1.1	0.4	0.0	0.1	0.1
1.00	1.4	0.6	0.0	0.1	0.1
1.25	1.9	0.8	0.1	0.1	0.2
1.50	2.6	1.0	0.1	0.1	0.2
1.75	3.4	1.4	0.1	0.1	0.3
2.00	4.5	1.9	0.2	0.1	0.4
2.25	5.3	2.4	0.3	0.1	0.6
2.50	4.5	2.1	0.4	0.1	0.7
2.75	3.4	1.6	0.6	0.1	0.9
3.00	2.6	1.3	0.8	0.1	1.2
3.25	1.9	1.0	1.0	0.1	1.4
3.50	1.4	0.7	1.3	0.1	1.6
3.75	1.1	0.5	1.5	0.1	1.9
4.00	0.8	0.4	1.8	0.1	2.1
4.25	0.6	0.3	2.0	0.1	2.3
4.50	0.4	0.2	2.2	0.2	2.5
4.75	0.0	0.0	2.4	0.2	2.7
5.00	0.0	0.0	2.5	0.2	2.7
5.25	0.0	0.0	2.5	0.2	2.7
5.50	0.0	0.0	2.6	0.2	2.8
5.75	0.0	0.0	2.5	0.2	2.7
6.00	0.0	0.0	2.4	0.2	2.7
6.25	0.0	0.0	2.3	0.2	2.6
6.50	0.0	0.0	2.2	0.3	2.5
6.75	0.0	0.0	2.1	0.3	2.4
7.00	0.0	0.0	1.9	0.3	2.2
7.25	0.0	0.0	1.8	0.3	2.1
7.50	0.0	0.0	1.7	0.3	1.9
7.75	0.0	0.0	1.5	0.3	1.8
8.00	0.0	0.0	1.4	0.3	1.7
8.25	0.0	0.0	1.3	0.3	1.6
8.50	0.0	0.0	1.2	0.3	1.5
8.75	0.0	0.0	1.1	0.3	1.4
9.00	0.0	0.0	1.0	0.3	1.3
9.25	0.0	0.0	0.9	0.3	1.2
9.50	0.0	0.0	0.8	0.3	1.2
9.75	0.0	0.0	0.7	0.3	1.1
10.00	0.0	0.0	0.7	0.3	1.0
10.25	0.0	0.0	0.6	0.3	0.9
10.50	0.0	0.0	0.5	0.3	0.8
10.75	0.0	0.0	0.4	0.3	0.8
11.00	0.0	0.0	0.4	0.3	0.7
11.25	0.0	0.0	0.3	0.3	0.6
11.50	0.0	0.0	0.2	0.3	0.6
11.75	0.0	0.0	0.2	0.3	0.5
12.00	0.0	0.0	0.1	0.3	0.5
12.25	0.0	0.0	0.1	0.3	0.4
12.50	0.0	0.0	0.1	0.3	0.4
12.75	0.0	0.0	0.0	0.3	0.4
13.00	0.0	0.0	0.0	0.3	0.3
13.25	0.0	0.0	0.0	0.3	0.3
13.50	0.0	0.0	0.0	0.3	0.3
13.75	0.0	0.0	0.0	0.3	0.3
14.00	0.0	0.0	0.0	0.3	0.3
14.25	0.0	0.0	0.0	0.3	0.3
Total (mm)	38.6	17.3	17.3	4.5	21.8

Graph



Audit comments

Model run with ReFH dll version 1.4.0005

Catchment

Catchment descriptors imported from file
 Catchment descriptor file = 'Rough Dene Burn.csv'
 Catchment descriptor file exported from CD ROM version 3
 Catchment descriptor file exported on 19-Nov-2012 09:19
 BFIHOST value of 0.325 used
 PROPWET value of 0.32 used
 SAAFR value of 664 used
 DPLBAR value of 2.39 used
 DPSBAR value of 67.5 used
 URBEXT value of 0.0118 used
 C value of -0.02456 used
 D1 value of 0.41518 used

Revitalised FSR/FEH rainfall runoff method

Spreadsheet application report

D2 value of 0.37737 used
D3 value of 0.26664 used
E value of 0.28125 used
F value of 2.32491 used

Rainfall

Recommended season is Winter, as URBEEXT < 0.125
ReFH design standard Seasonal Correction Factor of 0.67 applied
ReFH design standard Areal Reduction Factor of 0.97 applied

Loss Model

C_{max} derived from catchment descriptors
ReFH design standard C_{10} used
ReFH design standard α factor used

Routing Model

T_p derived from catchment descriptors
ReFH design standard used for U_p
ReFH design standard used for U_k

Baseflow Model

BL derived from catchment descriptors
BR derived from catchment descriptors
ReFH design standard BF_0 used

Appendix G
Greenfield Run-off Rate Calculations

12749 - Flood Risk Assessment
Persimmon Homes (North East) Ltd

Gillas Lane, Houghton Le Spring
Proposed 63 unit residential scheme
December 2012

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (ha)	50.000	Urban	0.000
SAAR (mm)	700	Region Number	Region 3

Results 1/s

OBAR Rural 219.7
 OBAR Urban 219.7

 Q100 years 456.9

 Q1 year 188.9
 Q2 years 207.3
 Q5 years 274.6
 Q10 years 318.5
 Q20 years 360.7
 Q25 years 374.7
 Q30 years 386.1
 Q50 years 416.0
 Q100 years 456.9
 Q200 years 518.4
 Q250 years 538.2
 Q1000 years 667.8

$$Q_1 \text{ YEAR} = \frac{188.9}{50 \text{ ha}} \times 1.286 \text{ ha} = 4.85 \text{ L/s}$$

$$Q_{100} \text{ YEAR} = \frac{456.9}{50 \text{ ha}} \times 1.286 \text{ ha} = 11.75 \text{ L/s}$$

PROPOSED IMPERMEABLE AREA 1.286 ha.
 RESTRICT SW TO MAX 5 L/s.