FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY AT LAND AT CARR ROAD, DEEPCAR

ON BEHALF OF HALLAM LAND MANAGEMENT LTD

APRIL 2017 (Initial Issue)

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Flood Risk Assessment for Land at Carr Road, Deepcar 1265/10r1				
Revision/Date	**Initial Issue** **19th April 2017**	**Revision A**	**Revision B**	**Revision C**
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Signature				
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Signature				
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C O N T E N T S

1.0 INTRODUCTION

1.1 Hallam Land Management Ltd is seeking the allocation of a parcel of land off Carr Road to the south west of Deepcar for residential development. To support the allocation of the land for residential development, a Flood Risk Assessment and Drainage Strategy has been prepared.

1.2 It is within the general development strategy of the country for development in areas where there is a risk of flooding to be assessed to avoid unnecessary increase in the requirement for flood defence. Under the National Planning Policy Framework (NPPF) and the Planning Practice Guidance (PPG), consultation is required with the Environment Agency, Land Drainage Authority and Water Authority and a Flood Risk Assessment Report should be prepared considering the development proposals and make recommendations for any flood mitigation measures.

1.3 ARP Associates have been appointed to carry out an assessment of the site, implement appropriate consultations and prepare a Flood Risk Assessment, in accordance with the NPPF, to satisfy the requirements of the Planning Authority.

1.4 The consultations and walkover survey have been carried out in May and June 2016 with the report updated in April 2017 to include the latest masterplan.

1.5 The report has been initially prepared for the use and reliance of the Client only. The report shall not be relied upon or transferred to any other parties without the written agreement of ARP Associates. For the avoidance of any doubt, where ARP Associates enters into a letter of reliance for the benefit of a third party, that third party will be permitted to rely on the report. No responsibility will be accepted where this report is used, either in its entirety or in part, by any other party without ARP Associates consent.

2.0 WALKOVER SURVEY

General

2.1 The proposed development site, which is centred on Ordnance Survey grid reference SK 277 974, is located to the south west of the existing settlement of Deepcar, which is approximately 12km north west of Sheffield City Centre. The proposed development site is an irregular shape of approximately 6.4ha in area with access provided via Carr Road and Hollins Busk Lane..

2.2 A site location plan is presented in Appendix A.

Current Use

2.3 The site is presently unused grassed fields, used for agricultural purposes. Dense, mature woodland is present towards the north of the site. The proposed development site includes a number of farm outbuildings together with established hedgerows and dry stone walling.

Site Features and Boundaries

2.4 The site is bounded to the east by Carr Road with the southern boundary adjacent to Hollins Busk Lane. The northern boundary is defined by mature and dense woodland which forms the banking to Clough Dike. The western boundary is predominately open grassed fields.

2.5 Clough Dike flows in a north easterly direction adjacent to the northern boundary.

Topography and Vegetation

2.6 The proposed development site is relatively level in the east to west direction, but there is a significant gradient south to north. Levels along the southern boundary, adjacent to

Hollins Busk Lane are in the order of 252m AOD with falls to 230m AOD at the northern boundary, adjacent to Clough Dike..

2.7 The site is covered by agricultural grassland, with mature woodland and dry stone walls occupying the site boundaries. A topographic survey is presented in Appendix A.

Drainage

2.8 The site has no obvious positive drainage system, although land drainage may be present. The site is assumed to drain to Clough Dike adjacent to the northern boundary.

3.0 ENVIRONMENT AGENCY CONSULTATION

3.1 A consultation has been requested from the Environment Agency. However, no response has been received to date. Therefore, a review of the Environment Agency website has been undertaken.

3.2 The Environment Agency flood map shows areas of land believed to be at risk of flooding from rivers. However, this does not cover other sources of flooding such as local drainage, surface water or groundwater. These areas do not take into account defences as water can overtop or they can fail in extreme conditions. The flood map shows:

- **Flood Zone 2 -** This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) in any year.

- **Flood Zone 3 -** This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) in any year.

3.3 Open Licence Environment Agency mapping shows the proposed development site is located entirely within Flood Zone 1 - low risk of fluvial flooding.

3.4 Open Licence Environment Agency mapping also includes the Updated Flood Map for Surface Water. This shows areas where surface water only would be expected to flow or pond in England & Wales. All land in England and Wales is within 'one' of a possible 'four' categories. The four categories shown on the map are:

- **High -** This area has a chance of flooding greater than 1 in 30 in any given year (annual probability of flooding 3.3%).
- **Medium -** This area has a chance of flooding between 1 in 100 (1%) and 1 in 30 (3.3%) in any given year.
- **Low -** This area has a chance of flooding between 1 in 1000 (0.1%) and 1 in 100 (1%) in any given year.

- **Very Low** - This area has a chance of flooding of less than 1 in 1000 (0.1%) in any given year.

3.5 According to Environment Agency records, there is no flood history in the vicinity of the site.

3.6 A copy of the Environment Agency mapping is provided in Appendix B for reference.

4.0 WATER AUTHORITY CONSULTATION

4.1 A consultation was requested from Yorkshire Water, who is the Water Authority for this area, and a copy of their response, reference R168280 dated 13th May 2016, is presented in Appendix C for reference.

4.2 Due to the change in legislation in October 2011, there may be public sewers within the site boundary which are not recorded on the statutory sewer map, the presence of which should be taken into account in the design of the site.

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

4.4 Foul water domestic waste can discharge to the 225mm diameter public foul sewer recorded in Carr Road, at a point to the north east of the site. The local Waste Water Treatment Works (WWTW) is Stocksbridge. It is understood that this WWTW may only have limited spare capacity, if any, available. A separate consultation was undertaken with Yorkshire Water to confirm capacity at Stocksbridge WWTW. The Yorkshire Water response dated 8th June, which is also presented in Appendix C, confirms that Stocksbridge WWTW will have available capacity to accept foul flows from the development. However, it is imperative that a separate outfall is provided for surface water.

4.5 In respect of surface water, reference is made to Requirement H3 of Building Regulations 2000 and Sustainable Drainage Systems. This establishes a hierarchy of surface water disposal. Consideration should firstly be given to discharge to soakaway, infiltration and watercourse, in that priority order, before connection to sewers will be considered. Where appropriate, soakaways, swales and infiltration trenches (SUDS) may be adopted as part of the public sewer network.

4.6 Surface water from this site should drain to either SUDS or directly to Clough Dike which runs adjacent to the northern boundary. Discharge rates and consents must be discussed and agreed with all interested parties. As the proposal site is currently undeveloped no surface water is known to have previously discharged to the public sewer network. Therefore, the local public sewer network does not have capacity to accept any surface water from the proposed site.

5.0 LAND DRAINAGE AUTHORITY CONSULTATION

5.1 A consultation has been requested from Sheffield City Council, but no response has been received at the time of writing this report.

5.2 It is anticipated that the Land Drainage Authority will confirm that the site falls within Flood Zone 1 and that surface water discharge should be restricted to greenfield run-off rate with discharge to Clough Dike if infiltration systems to ground are not practical.

6.0 MATERIAL CONSIDERATION IN RESPECT OF THE NPPF AND PPG

Flood Classification

6.1 Environment Agency flood mapping confirms that the whole site falls within land assessed as having less than a 1 in 1,000 annual probability of river or sea flooding in any year (less than 0.1%). Therefore, in accordance with Table 1 of the PPG, the site falls within Flood Zone 1 "low probability".

End Use

6.2 The development proposal is for the construction of residential dwellings on the site. A proposed masterplan layout is presented in Appendix D.

6.3 When applying Table 2 of the PPG, the flood risk vulnerability classification shows that the proposed end use will fall into a "*More Vulnerable*" classification under the general classification “dwelling houses”.

Sequential Test

6.4 In accordance with Table 3 of the PPG, More Vulnerable development is deemed appropriate within Flood Zone 1 and the Sequential Test is satisfied.

Flood Sources

6.5 Flooding from Rivers - Clough Dike (which is Ordinary Watercourse adjacent to the site) is classified as Main River approximately 260m downstream of the proposed development site. Clough Dike is a tributary of the Little Don River, with their confluence adjacent to Manchester Road, approximately 700m to the north east of the proposed development site.

6.6 Whilst Environment Agency mapping confirms that the whole site falls within land assessed as having less than a 1 in 1,000 annual probability of river or sea flooding in any year (less than 0.1%), it should be noted there are no flood zones associated with Clough Dike. It is assumed that Clough Dike has not been hydraulically modelled or mapped by the Environment Agency.

6.7 The Main River section of Clough Dike is a mixture of open channel and culverted sections. The long section profile of Clough Dike, which falls from approximately 225m AOD at its upstream end, down to 150m AOD at its confluence with the Little River Don indicates any flood flows from the watercourse would flow away from the proposed development site.

6.8 The proposed development site has therefore a low risk of fluvial flooding from Main Rivers.

6.9 Flooding from Local Watercourses - As discussed above, Clough Dike is classified as Ordinary Watercourse adjacent to the proposed development site, with no hydraulic model information available to quantify flood risk. Ordnance Survey mapping indicates Clough Dike is in a deeply incised channel, which flows away from the proposed development site.

6.10 Therefore any flood flows are likely to be contained to the channel or flow away from the proposed development. The Sheffield Surface Water Management Plan (SWMP) also concludes the surcharge risk from Clough Dike is "very low."

6.11 The risk of flooding from Ordinary Watercourses is therefore assessed to be low.

6.12 Flooding from the Sea - The proposed development site is located outside of the tidal influence zone.

6.13 Flooding from Land - The Environment Agency surface water flood map shows the site is predominately at a very low risk of surface water flooding. Surface water flow paths are present through the site which emanate from third party land to the south of Hollins Busk Lane and Cockshot Lane. Whilst the risk of surface water flooding on site is deemed to be very low, the natural surface water flow path should be incorporated into the proposed development layout.

6.14 Flooding from Groundwater - Flooding from ground water can happen when ground water levels are high. This may be due to rainfall in the groundwater source area, but can also happen on floodplains if river levels are held above the level of the flood plain by embankments.

6.15 The Geological Survey Map of Great Britain shows the site to be sandstone and gravel deposits. Although sandstone may be impermeable with the potential for groundwater to rise, the topography of the site indicates the risk of groundwater is deemed to be low on the proposed development site. Furthermore, borehole scans show groundwater was typically encountered at 8-9m below ground level.

6.16 The Sheffield Strategic Flood Risk Assessment (SFRA) states; *There are no known incidents of groundwater flooding in Sheffield, and it is considered reasonable to assume that the potential risk of groundwater flooding is extremely low*.

6.17 The risk of groundwater flooding at the proposed development site is deemed to be low.

6.18 Flooding from Sewer - There are existing sewers recorded adjacent to the site and a new drainage system for the development will need to be introduced. Should the existing sewer infrastructure fail in the immediate area, flows are likely to be channelled to the south and east. Any blockage will result in flooding from the lowest cover level of manholes or gullies. This will need to be considered as part of any proposed development.

6.19 Flooding from Reservoirs, Canals or Artificial Sources - The Environment Agency produce maps which show the expected inundation area should a reservoir fail and release its capacity. It should be noted however that reservoir flooding is extremely unlikely to happen and there has been no loss of life in the UK from reservoir flooding since 1925.

6.20 The proposed development site is shown to be outside the maximum extent of reservoir flooding. There are no other artificial sources within the vicinity of the proposed development site, therefore the risk of flooding from this source is deemed to be low.

Climate Change

6.21 The NPPF and PPG have indicated that the Global sea level will continue to rise, depending on greenhouse gas emissions, and the sensitivity of the climate system and there will be an increase in rainfall across the country.

6.22 United Kingdom climate change guidance was revised in February 2016 for peak river flows and peak rainfall intensities. With regards to peak river flows, a regionalised approach has now been adopted to climate change impacts based upon the river basin district of the proposed development site, the flood risk vulnerability of the proposed development and the present day Flood Zone classification.

6.23 The proposed development site is situated within the Humber river basin district, which based on an "upper end" climate change scenario, could see peak river flows increase by 50% by 2115. As the site is situated entirely within Flood Zone 1 and raised significantly above the fluvial floodplain of the Little River Don, the impact of climate change is not considered to affect the proposed development site.

6.24 In accordance with the guidance within the Strategic Flood Risk Assessment and SuDS design guide, an allowance of 30% should be applied for rainfall intensities due to climate change. Therefore, it will be necessary to design any new positive drainage system with a 30% increase in capacity to accommodate this requirement. Due to the topography of

the land and surrounding area, overland run-off from adjoining third party land may be an issue, and this should be factored into the final drainage design or dealt with at the site boundary of the site.

Flood Mitigation

6.25 A sequential approach has been developed with all residential development located in Flood Zone 1, and flood mitigation measures are only required in the event of a catastrophic storm or blockage of the existing or proposed sewers. The following precautionary mitigation measures are therefore recommended:-

6.25.1 The finished floor levels to the properties should be raised above external levels by a minimum of 150mm, wherever possible.

6.25.2 The surface water flow paths identified in Section 6.11 should be incorporated into the development masterplan and site drainage strategy.

6.25.3 Properties shall be designed without any basements and ground floors shall comprise solid concrete slabs or beam and block with screed construction to mitigate against future groundwater risk sources.

6.25.4 Incoming electricity supplies shall be raised above ground floor level and ground floor electric sockets shall be served by loops from the first floor level to create further flood resilience.

6.25.5 In the unlikely event of flooding on the site, it would be appropriate to design external levels with falls to non-critical areas, such as landscaping or the northern boundary, where the water can pond or run-off into Clough Dike without causing flooding to buildings.

6.25.6 It will be necessary to ensure there is a route for overland run-off from third party land through the site without causing flooding to buildings. To achieve this boundary, cut-off drains may be required to direct the water through to the watercourse on the northern boundary.

Sustainable Drainage

6.26 In order to comply with the requirements of the NPPF, it will be necessary to consider aspects of Sustainable Drainage techniques for the new development. Whilst no intrusive soil investigation report has been carried out at the time of writing, it will be necessary to carry out appropriate infiltration tests in accordance with BRE Digest 365 'Soakaway Design' prior to construction on site and the results presented in a report for the approval of the Planning Authority. Due to the geology on site and the elevated groundwater levels in the Marple Bridge area, soakaways are unlikely to be suitable.

Drainage

6.27 It is a requirement to ensure that surface water run-off from any proposed development has negligible consequence on downstream areas either in sewer capacity or discharge to watercourse.

Existing Surface Water Run-off

6.28 The site is greenfield and, therefore, in accordance with the current guidelines and regulations, indicative surface water calculations have been undertaken using the IH124 Method of calculating greenfield run-off rates. The existing greenfield rate for the proposed development site has been assessed to be 51.9l/s. The calculations are presented in Appendix E.

Proposed Surface Water Drainage

6.29 Consideration of the proposed drainage should firstly be given to infiltration techniques (to ground). It will be necessary to carry out appropriate infiltration tests in accordance with BRE Digest 365 'Soakaway Design' prior to construction on site and the results presented in a report for the approval of the Planning Authority. If soakaways prove to be unviable then a positive drainage system to watercourse or sewer will be required for surface water drainage.

6.30 The proposed masterplan, which is presented in Appendix D, has been assessed as having a proposed impermeable area of approximately 3.5ha for semi-detached and detached properties. Indicative calculations have been carried out using the WinDES Source Control Computer Program. The proposed surface water system should be designed to accommodate the 1 in 30 year storm event without flooding and the 1 in 100 year storm plus climate change event should be retained within the site in an area which will not affect the new buildings or third parties from flooding.

6.31 A direct connection to watercourse is considered the most suitable method of discharging surface water based on site layout and topography. Clough Dike, which flows adjacent to the northern boundary, is deemed a suitable receptor. In line with guidance within the Sheffild SFRA, all developments on greenfield land should reduce runoff to greenfield runoff rates, taking climate change into consideration. Therefore post development run-off rates and volumes will have to mimic existing pre-development rates. The indicative calculations show that, in order to attenuate to the 1 in 30 year storm, a storage volume of 1054m^3 is deemed necessary.

6.32 The drainage system will also need to accommodate the 1 in 100 year storm plus 30% climate change event without causing flooding of property of third party land. In the event that levels dictate that the 1 in 100 year plus climate change floodwater would flow off-site, an additional or larger storage facility will be required. In these circumstances, on-site storage could increase to 2145m³. Based on the site masterplan

and environmental considerations, a combination of above and below ground storage is considered to be appropriate for surface water management. The indicative surface water calculations are presented in Appendix E. However, detailed calculations and proposals will need to be prepared and submitted to the Planning Authority for approval prior to construction.

Foul Water Drainage

6.33 Yorkshire Water have confirmed foul water domestic waste should discharge to the 225mm diameter public foul sewer recorded in Carr Road, at a point to the north east of the site.

Emergency Egress during Times of Flood

6.34 It is a requirement under the PPG that occupants should be able to egress any building during times of flood, without being trapped by flood conditions.

6.35 As all residential development and access routes fall within Flood Zone 1, no special mitigation measures are required for emergency egress during times of flood.

7.0 COMMENTS

7.1 A sequential approach to site development has been adopted and all residential development is restricted to Flood Zone 1. However, in order to accommodate the possibilities of flood from a catastrophic storm, or blockage of the existing or proposed sewers, the following precautionary mitigation measures are recommended:-

7.1.1 The finished floor levels to the properties should be raised above external levels by a minimum of 150mm wherever possible.

7.1.2 Properties shall be designed without any basements and ground floors shall comprise solid concrete slabs or beam and block with screed construction.

7.1.3 Incoming electricity supplies shall be raised above ground floor level and ground floor electric sockets shall be served by loops from the first floor level.

7.1.4 In the unlikely event of flooding on the site, it would be appropriate to design external levels with falls to non-critical areas, such as landscaping or the northern boundary, where the water can pond or run-off to Clough Dike without causing flooding to buildings.

7.1.5 It will be necessary to ensure there is a route for overland run-off from third party land through the site without causing flooding to buildings. To achieve this, boundary cut-off drains may be required to direct the water through to the watercourse on the northern boundary.

7.2 A 30% increase in rainfall shall be incorporated into any new positive drainage system to satisfy the requirements of climate change.

7.3 Consideration of the proposed drainage should firstly be given to infiltration techniques (to ground). It will be necessary to carry out appropriate infiltration tests in accordance

with BRE Digest 365 'Soakaway Design' prior to construction on site and the results presented in a report for the approval of the Planning Authority. If soakaways prove to be unviable then a positive drainage system to watercourse or sewer will be required for surface water drainage

7.4 Surface water discharge shall be restricted to no greater than the existing greenfield run-off rate with outfall to Clough Dike watercourse adjacent to the northern boundary. This will need to be confirmed and agreed as part of the Drainage Strategy for the site.

7.5 The proposed surface water drainage system shall be designed with an allowance for climate change and restricted to the agreed discharge rate with appropriate attenuation incorporated into the design. Detailed design and calculations shall be submitted to the Planning Authority for approval prior to construction on site.

7.6 Foul water domestic waste should discharge to the 225 mm diameter public foul sewer recorded in Carr Road, at a point to the north east of the site

7.7 No special mitigation measures are required for emergency egress during times of flood.

7.8 Subject to compliance with the above, the proposed development can satisfy the requirements of the National Planning Policy Framework and the Planning Practice Guidance in relation to flood risk.

A P P E N D I X A

SITE LOCATION PLAN

Survey carried out using GPS to Ordnance Survey Datum

OS Grid Reference: SK277974

Rev	By	Date	Amendment	Chk
/	JMG	28.04.16	Issued for approval	WMW

Title

SITE LOCATION PLAN

Scale 1:5000 @ A4

Drawn JMG

Date APR 16

Chk. WMW

Project/Client

Land at Carr Road, Deepcarr

Hallam Land Management

ARP ASSOCIATES
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Drg. No. 1265/10/NA

Rev /

and the National Geoid Model OSGM02GB.

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All roads and footpaths surrounding the site (with the exception of Carr Road) have been re-surfaced prior to the survey being carried out.

Midland Surveying & Engineering
Tel: 01773 811867 Email: info@midsurvey.co.uk

BH	Borehole	Mkr	Marker
BT	Telephone Cover	PO	Post
CATV	Communications	RS	Road Sign
CAB	Control Cabinet	RE	Rodding Eye
ER	Earth Rod	SV	Stop Valve
EB	Electricity Box	TCB	Telephone Call Box
EL	Elecricity Cover	TP	Telegraph Pole
EP	Electricity Pole	TS	Traffic Signal
FH	Fire Hydrant	TH	Trial Hole
GAS	Gas Cover	VP	Vent Pipe
GU	Gulley	WO	Wash Out
IC	Inspection Cover	WM	Water Meter
		WV	Wheel valve

Site

Land at Deepcar Sheffield

Plan

Topographical Survey

Project Ref.	Drawing No.	Date	Scale
HLM/MSE/3616	1	20.05.2016	1:1000 @ A1

Sports Ground

BRACKEN MOOR

Pavilion

BROOMFIELD LANE

232.8m

Youth Centre

El Sub Sta

BROOMFIELD GROVE

(Recreation Ground)

FB

Ponds

Clough Dike

Ford

Pond

Issues

LB

COULTAS AVENUE

Glenview

Bennewel

Royd Farm

CARR ROAD

ROYD COURT

THE ROYD

Royd Cottage

Royd House

ROYD LANE

Club House

FS

Hollin Busk Farm

The Barn

255.6m

HOLLIN BUSK ROAD

Walders Croft

Tharrawaddy

Stone Delph

Wharncliffe View

Ash Lea

255.5m

HOLLIN BUSK LANE

The Byre

Hollin Busk Farm

Ruin

Shaft

397700N

397600N

397500N

397400N

397300N

427200E

427300E

427400E

427500E

427600E

427700E

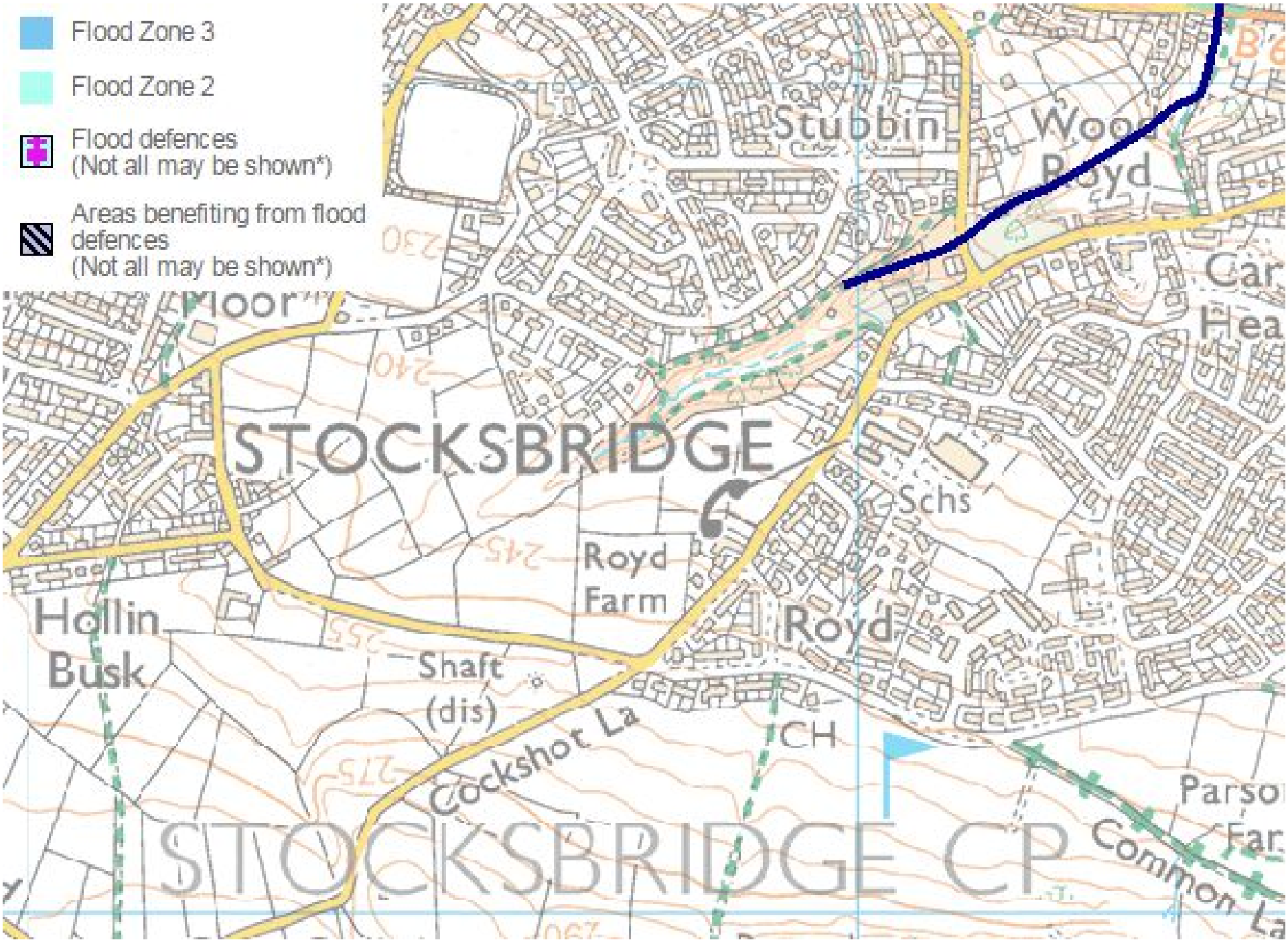
427800E

427900E

428000E

A P P E N D I X B

ENVIRONMENT AGENCY CONSULTATION


Flood Zone 3
Flood Zone 2
Flood defences
(Not all may be shown*)
Areas benefiting from flood defences
(Not all may be shown*)
Stubbin
Wood
Royd
Car
Hea
Floor
STOCKSBRIDGE
Schs
Royd
Farm
Royd
Hollin
Busk
Shaft
(dis)
Cockshot La
CH
Parso
Far
Common La
STOCKSBRIDGE CP


High
Medium
Low
Very Low
Knoll Top
Bracken Moor
Wood Royd
East Whitwell
Hollin Busk
Carr Head
Royd
Townend Common
Allman Well Hill
Bolderstone
Coal Pit Lane
Cockshot Lane

A P P E N D I X C

WATER AUTHORITY CONSULTATION

YorkshireWater

Mr M Stokes
Arp Associates
Unit 5/6 Northwest Business Pk
1ST FLR Servia Hill
Woodhouse
Leeds
LS6 2QH

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

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

Email:
Technical.Sewerage@yorkshirewater.co.uk

For telephone enquiries ring:
Chris Roberts on 0345 120 8482

Your Ref:
Our Ref: S007183

13th May 2016

Dear Mr Stokes,

Carr Road, Deepcar - Pre-Planning Sewerage Enquiry on R168280

Thank you for your recent enquiry. Our charge of £152.00 (plus VAT) will be added to your account with us, reference ARP013. You will receive an invoice for your account in due course.

Please find enclosed a complimentary extract from the Statutory Sewer Map which indicates the recorded position of the public sewers. Please note that as of October 2011 and the private to public sewer transfer, there are many uncharted Yorkshire Water assets currently not shown on our records. The following comments reflect our view, with regard to the public sewer network only, based on a 'desk top' study of the site and are valid for a maximum period of twelve months.

Existing Infrastructure

The local Waste Water Treatment Works (WWTW) is . It is understood that this WWTW may only have limited spare capacity, if any, available. We have contacted the respective treatment team for more information regarding the impact of proposed development and will contact you when an assessment has been made.

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

Foul Water

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

Foul water domestic waste should discharge to the 225 mm diameter public foul sewer recorded in Carr Road, at a point to the north east of the site.

Surface Water

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

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

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

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

It is understood that a watercourse is located to the north of the site. This appears to be the obvious place for surface water disposal (if SuDS are not viable).

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.

Other Observations

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

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

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

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

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

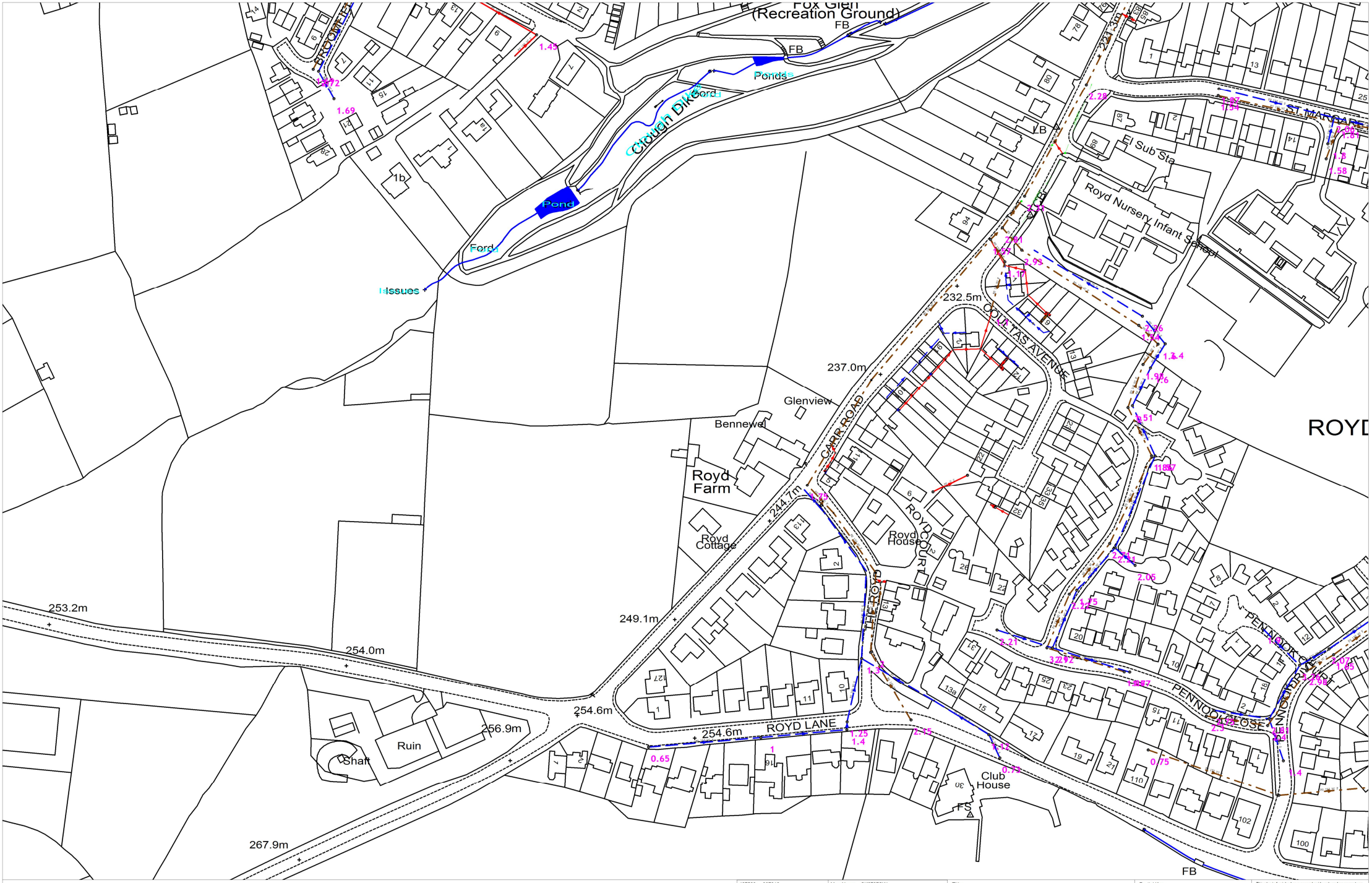
All the above comments are based upon the information and records available at the present time. The information contained in this letter together with that shown on any extract from the Statutory Sewer Map that may be enclosed is believed to be correct and is supplied in good faith.

YorkshireWater

Please note that capacity in the public sewer network is not reserved for specific future development. It is used up on a 'first come, first served' basis. You should visit the site and establish the line and level of any public sewers affecting your proposals before the commencement of any design work.

Yours sincerely

Chris Roberts
Sewerage Technician
Developer Services



427583 : 397310	Map Name : SK2797SW	Title	Partial Key	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 connections are shown.
YorkshireWater	Yorkshire Water, PO Box 500, Halifax Road, Bradford BD6 2LZ Contact Name : YorMap Advisor C ROBERTS Contact Tel : 87 2582	Notes	Foul Sewer = F Combined Sewer = C Surface Water Sewer = SW Trade Sewer = TD Partially Separate = PS	
		(Ody) COPYRIGHT STATEMENTS: Reproduced by permission of Ordnance Survey on behalf of HMSO © Crown copyright and database 2014. All rights reserved Ordnance Survey Licence number 100022432	Date Req : 13/05/2016, 11:11:03	Date Gen : 13/05/2016, 11:11:33
			Source : Sewer Network Enquiry	

UPN: Undefined Originator: C ROBERTS, YorMap, 87 2582

Matthew Stokes

From: Chris.Roberts@yorkshirewater.co.uk
Sent: Wednesday 31 August, 2016 12:25 pm
To: Matthew Stokes
Subject: Re: 1265/10 FW: Carr Road, Deepcar - Pre-Planning Sewerage Enquiry on R168280
Attachments: carr.pdf; roberts4_rad37417.PNG; pic02095.jpg; 1265-10-NA - land at carr road.pdf; YW Sewer Enquiry - 2.pdf

Hi Matthew,

Apologies,

The anticipated domestic foul flows can be accommodated at the Stocksbridge WWTW, however it is imperative that a separate outfall is provided for surface water

Regards

Chris

|---------->
| From: |
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>----------|
|Matthew Stokes <MatthewStokes@arpassociates.co.uk> |
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|---------->
| To: |
|---------->
>----------|
|"Chris.Roberts@yorkshirewater.co.uk" <Chris.Roberts@yorkshirewater.co.uk>,
|
>----------|
|---------->
| Date: |
|---------->
>----------|
|31/08/2016 12:08 |
>----------|
|---------->
| Subject: |
|---------->
>----------|
|1265/10 FW: Carr Road, Deepcar - Pre-Planning Sewerage Enquiry on R168280
|
>----------|

Good afternoon Chris

I am just chasing a response to the Carr Rd site. On your previous response you stated "The local Waste Water Treatment Works (WWTW) is . It is understood that this WWTW may only have limited spare capacity, if any, available. We have contacted the respective treatment team for more information regarding the impact of proposed development and will contact you when an assessment has been made".

We have had a conversation that spare capacity is available - is this still correct?

Regards

Matt

-----Original Message-----
From: Chris.Roberts@yorkshirewater.co.uk [mailto:Chris.Roberts@yorkshirewater.co.uk] On Behalf Of Technical_Sewerage@yorkshirewater.co.uk
Sent: Friday 13 May, 2016 1:29pm
To: Matthew Stokes
Subject: Carr Road, Deepcar - Pre-Planning Sewerage Enquiry on R168280

Dear Mr Stokes,

Please find my response below.

(See attached file: carr.pdf)(See attached file: roberts4_rad37417.PNG)

If I can be of any further assistance please contact me on 03451 20 84 82.

Regards

Chris Roberts
Sewerage Technical Team

|---------->
| From: |
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>----------|

|Matthew Stokes <MatthewStokes@arpassociates.co.uk>
|

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|---------->
| To: |
|---------->

>----------|

|"Technical.Sewerage@yorkshirewater.co.uk"
<Technical.Sewerage@yorkshirewater.co.uk>,
|

>----------|

|---------->
| Date: |
|---------->

>----------|

|29/04/2016 14:38
|

>----------|

|---------->
| Subject: |
|---------->

>----------|

|1265/10 Land at Carr Rd, Deepcar
|

>----------|

Dear Sirs

Please find attached data request for information

Kind regards

Matt

Matthew Stokes

t: 0113 245 8498

matthewstokes@arpassociates.co.uk

ARP ASSOCIATES &

ARP GEOTECHNICAL LTD

(Embedded image moved to file: pic02095.jpg)

www.arpassociates.co.uk

5/6 Northwest Business Park, Servia Hill, Leeds LS6 2QH

Pre-planning Geotechnical Civil Engineering Structural Engineering

Click here to report this email as spam.
(See attached file: 1265-10-NA - land at carr road.pdf)(See attached file: YW Sewer Enquiry - 2.pdf)

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

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Yorkshire Water Services Limited
Registered Office Western House, Halifax Road, Bradford, BD6 2SZ Registered in England and Wales No 2366682
(See attached file: carr.pdf)(See attached file: roberts4_rad37417.PNG)(See attached file: pic02095.jpg)(See attached file: 1265-10-NA - land at carr road.pdf)(See attached file: YW Sewer Enquiry - 2.pdf)

A P P E N D I X D

PROPOSED LAYOUT

Hallam Land Management

1. SITE ENTRANCE FROM CARR ROAD
2. SIGNIFICANT AREA OF WOODLAND (FOX GLEN) WITH OPPORTUNITY FOR PEDESTRIAN CONNECTIONS
3. HEDGE AND TREE PLANTING ALONG BOUNDARY
4. PLAYSPACE WITHIN GREEN SETTING
5. OUTWARD FACING DEVELOPMENT THROUGHOUT
6. EXISTING RESIDENTIAL DEVELOPMENT
7. EXISTING DRY STONE WALLS RETAINED AND ENHANCED WITHIN PUBLIC DOMAIN
8. SPECIES RICH GRASSLAND - GREENSPACE MANAGED FOR BIODIVERSITY AND RECREATIONAL BENEFITS
9. PEDESTRIAN LINK TO PLAYSPACE
10. NO DIRECT VEHICLE ACCESS ONTO CARR ROAD IN THIS AREA
11. DRAINAGE AREA AND GREENSPACE MANAGED FOR BIODIVERSITY BENEFITS
12. INTERMITTENT TREES AND HEDGEROWS TO THE BACK OF DRY STONE WALLS
13. 10M WIDE WOODLAND BELT TO CONNECT WITH FOX GLEN
14. EXISTING LANDSCAPE BOUNDARY

DEVELOPMENT SUMMARY

Nett Area: 6.61 acres / 2.67 hectares

At 30 -35 dwellings per hectare the scheme could achieve: 80 – 93 dwellings

STEN ARCHITECTURE
STEN Architecture Ltd
Suite 10, Unit 3
Benton Office Park
Bennett Avenue
Horbury
WF4 5RA
TEl: 01924 669424

0 100

CONCEPT MASTERPLAN SK08 | 1:1000@A1 | JAN 2017

LAND OFF CARR ROAD | DEEPCAR

A P P E N D I X E

SURFACE WATER RUN-OFF CALCULATIONS

IH 124 Mean Annual Flood

Input

Return Period (years)	1	Soil	0.500
Area (ha)	50.000	Urban	0.000
SAAR (mm)	1106	Region Number	Region 3

Results	**l/s**
QBAR Rural	471.5
QBAR Urban	471.5
Q1 year	405.5
Q1 year	405.5
Q2 years	444.9
Q5 years	589.4
Q10 years	683.6
Q20 years	774.3
Q25 years	804.3
Q30 years	828.8
Q50 years	893.0
Q100 years	980.7
Q200 years	1112.7
Q250 years	1155.1
Q1000 years	1433.3

SITE AREA = 6.4 ha

$$Q1\ yr = 405.5 \times \frac{6.4}{50}$$

$$Q1\ yr = 51.90\ l/s$$

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Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	100.350	0.350	51.0	0.0	51.0	461.4	O K
30 min Summer	100.462	0.462	51.8	0.0	51.8	609.6	O K
60 min Summer	100.572	0.572	51.8	0.0	51.8	755.5	O K
120 min Summer	100.659	0.659	51.8	0.0	51.8	869.6	O K
180 min Summer	100.689	0.689	51.8	0.0	51.8	909.1	O K
240 min Summer	100.702	0.702	51.8	0.0	51.8	926.4	O K
360 min Summer	100.707	0.707	51.8	0.0	51.8	933.7	O K
480 min Summer	100.696	0.696	51.8	0.0	51.8	918.4	O K
600 min Summer	100.676	0.676	51.8	0.0	51.8	892.2	O K
720 min Summer	100.652	0.652	51.8	0.0	51.8	860.0	O K
960 min Summer	100.598	0.598	51.8	0.0	51.8	789.3	O K
1440 min Summer	100.495	0.495	51.8	0.0	51.8	652.9	O K
2160 min Summer	100.377	0.377	51.4	0.0	51.4	497.8	O K
2880 min Summer	100.304	0.304	50.1	0.0	50.1	401.9	O K
4320 min Summer	100.247	0.247	41.6	0.0	41.6	325.6	O K
5760 min Summer	100.218	0.218	34.9	0.0	34.9	287.2	O K
7200 min Summer	100.198	0.198	30.1	0.0	30.1	261.1	O K
8640 min Summer	100.183	0.183	26.7	0.0	26.7	241.7	O K
10080 min Summer	100.172	0.172	24.0	0.0	24.0	226.6	O K
15 min Winter	100.393	0.393	51.5	0.0	51.5	518.9	O K
30 min Winter	100.521	0.521	51.8	0.0	51.8	688.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	67.984	0.0	469.1	0.0	22
30 min Summer	46.253	0.0	644.7	0.0	36
60 min Summer	30.183	0.0	858.7	0.0	66
120 min Summer	19.094	0.0	1088.8	0.0	124
180 min Summer	14.413	0.0	1234.0	0.0	154
240 min Summer	11.755	0.0	1342.6	0.0	186
360 min Summer	8.816	0.0	1511.5	0.0	254
480 min Summer	7.178	0.0	1641.4	0.0	324
600 min Summer	6.115	0.0	1748.3	0.0	390
720 min Summer	5.362	0.0	1839.9	0.0	460
960 min Summer	4.355	0.0	1992.4	0.0	592
1440 min Summer	3.242	0.0	2223.2	0.0	840
2160 min Summer	2.410	0.0	2490.8	0.0	1192
2880 min Summer	1.950	0.0	2686.5	0.0	1532
4320 min Summer	1.446	0.0	2981.6	0.0	2212
5760 min Summer	1.170	0.0	3230.9	0.0	2944
7200 min Summer	0.993	0.0	3427.0	0.0	3672
8640 min Summer	0.869	0.0	3595.3	0.0	4408
10080 min Summer	0.776	0.0	3740.5	0.0	5136
15 min Winter	67.984	0.0	527.6	0.0	22
30 min Winter	46.253	0.0	724.2	0.0	36

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Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	100.649	0.649	51.8	0.0	51.8	856.8	O K
120 min Winter	100.756	0.756	51.8	0.0	51.8	998.0	O K
180 min Winter	100.792	0.792	51.8	0.0	51.8	1045.4	O K
240 min Winter	100.799	0.799	51.8	0.0	51.8	1054.2	O K
360 min Winter	100.796	0.796	51.8	0.0	51.8	1050.4	O K
480 min Winter	100.770	0.770	51.8	0.0	51.8	1016.1	O K
600 min Winter	100.732	0.732	51.8	0.0	51.8	966.6	O K
720 min Winter	100.689	0.689	51.8	0.0	51.8	909.7	O K
960 min Winter	100.599	0.599	51.8	0.0	51.8	791.0	O K
1440 min Winter	100.440	0.440	51.7	0.0	51.7	580.4	O K
2160 min Winter	100.295	0.295	49.9	0.0	49.9	389.9	O K
2880 min Winter	100.251	0.251	42.5	0.0	42.5	330.8	O K
4320 min Winter	100.206	0.206	32.2	0.0	32.2	272.2	O K
5760 min Winter	100.181	0.181	26.2	0.0	26.2	239.3	O K
7200 min Winter	100.165	0.165	22.3	0.0	22.3	217.4	O K
8640 min Winter	100.153	0.153	19.6	0.0	19.6	201.4	O K
10080 min Winter	100.143	0.143	17.5	0.0	17.5	188.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
60 min Winter	30.183	0.0	962.9	0.0	64
120 min Winter	19.094	0.0	1220.6	0.0	122
180 min Winter	14.413	0.0	1383.2	0.0	176
240 min Winter	11.755	0.0	1504.9	0.0	220
360 min Winter	8.816	0.0	1694.0	0.0	278
480 min Winter	7.178	0.0	1839.6	0.0	356
600 min Winter	6.115	0.0	1959.4	0.0	428
720 min Winter	5.362	0.0	2062.0	0.0	498
960 min Winter	4.355	0.0	2233.0	0.0	632
1440 min Winter	3.242	0.0	2492.2	0.0	872
2160 min Winter	2.410	0.0	2790.6	0.0	1192
2880 min Winter	1.950	0.0	3010.1	0.0	1532
4320 min Winter	1.446	0.0	3341.8	0.0	2252
5760 min Winter	1.170	0.0	3619.2	0.0	2952
7200 min Winter	0.993	0.0	3839.1	0.0	3680
8640 min Winter	0.869	0.0	4028.0	0.0	4408
10080 min Winter	0.776	0.0	4192.3	0.0	5144

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Model Details

Storage is Online Cover Level (m) 101.100

Tank or Pond Structure

Invert Level (m) 100.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1320.0	0.700	1320.0	1.400	0.0	2.100	0.0
0.100	1320.0	0.800	1320.0	1.500	0.0	2.200	0.0
0.200	1320.0	0.900	1320.0	1.600	0.0	2.300	0.0
0.300	1320.0	1.000	1320.0	1.700	0.0	2.400	0.0
0.400	1320.0	1.100	0.0	1.800	0.0	2.500	0.0
0.500	1320.0	1.200	0.0	1.900	0.0		
0.600	1320.0	1.300	0.0	2.000	0.0		

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0298-5190-1050-5190
Design Head (m)	1.050
Design Flow (l/s)	51.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	298
Invert Level (m)	100.000
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.050	51.7
Flush-Flo™	0.457	51.8
Kick-Flo®	0.818	45.9
Mean Flow over Head Range	-	41.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	9.1	1.200	55.2	3.000	86.0	7.000	130.0
0.200	30.7	1.400	59.4	3.500	92.7	7.500	134.4
0.300	50.0	1.600	63.4	4.000	98.9	8.000	138.7
0.400	51.6	1.800	67.1	4.500	104.7	8.500	142.9
0.500	51.7	2.000	70.6	5.000	110.3	9.000	147.0
0.600	50.9	2.200	74.0	5.500	115.5	9.500	150.9
0.800	46.7	2.400	77.1	6.000	120.5		
1.000	50.5	2.600	80.2	6.500	125.3		

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Weir Overflow Control

Discharge Coef 0.544 Width (m) 3.000 Invert Level (m) 101.050

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Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	100.295	0.295	49.9	0.0	49.9	793.0	O K
30 min Summer	100.399	0.399	51.6	0.0	51.6	1071.1	O K
60 min Summer	100.509	0.509	51.8	0.0	51.8	1366.1	O K
120 min Summer	100.611	0.611	51.8	0.0	51.8	1640.9	O K
180 min Summer	100.655	0.655	51.8	0.0	51.8	1759.7	O K
240 min Summer	100.675	0.675	51.8	0.0	51.8	1812.8	O K
360 min Summer	100.694	0.694	51.8	0.0	51.8	1863.7	O K
480 min Summer	100.701	0.701	51.8	0.0	51.8	1882.4	O K
600 min Summer	100.701	0.701	51.8	0.0	51.8	1882.0	O K
720 min Summer	100.696	0.696	51.8	0.0	51.8	1868.5	O K
960 min Summer	100.677	0.677	51.8	0.0	51.8	1816.7	O K
1440 min Summer	100.622	0.622	51.8	0.0	51.8	1669.4	O K
2160 min Summer	100.533	0.533	51.8	0.0	51.8	1430.1	O K
2880 min Summer	100.453	0.453	51.8	0.0	51.8	1217.5	O K
4320 min Summer	100.341	0.341	50.9	0.0	50.9	915.7	O K
5760 min Summer	100.282	0.282	48.5	0.0	48.5	757.0	O K
7200 min Summer	100.253	0.253	42.9	0.0	42.9	679.3	O K
8640 min Summer	100.232	0.232	38.4	0.0	38.4	623.2	O K
10080 min Summer	100.217	0.217	34.8	0.0	34.8	582.8	O K
15 min Winter	100.331	0.331	50.7	0.0	50.7	889.7	O K
30 min Winter	100.449	0.449	51.8	0.0	51.8	1204.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	113.737	0.0	737.2	0.0	22
30 min Summer	78.159	0.0	1037.4	0.0	37
60 min Summer	51.304	0.0	1432.8	0.0	66
120 min Summer	32.426	0.0	1820.3	0.0	126
180 min Summer	24.345	0.0	2054.1	0.0	184
240 min Summer	19.737	0.0	2222.7	0.0	244
360 min Summer	14.692	0.0	2484.9	0.0	306
480 min Summer	11.893	0.0	2683.6	0.0	368
600 min Summer	10.084	0.0	2845.1	0.0	434
720 min Summer	8.807	0.0	2981.8	0.0	502
960 min Summer	7.104	0.0	3206.3	0.0	640
1440 min Summer	5.235	0.0	3539.0	0.0	912
2160 min Summer	3.847	0.0	3958.3	0.0	1300
2880 min Summer	3.087	0.0	4231.0	0.0	1652
4320 min Summer	2.260	0.0	4624.2	0.0	2340
5760 min Summer	1.814	0.0	4996.1	0.0	3000
7200 min Summer	1.530	0.0	5262.6	0.0	3744
8640 min Summer	1.331	0.0	5487.5	0.0	4416
10080 min Summer	1.184	0.0	5674.0	0.0	5152
15 min Winter	113.737	0.0	833.6	0.0	22
30 min Winter	78.159	0.0	1169.7	0.0	37

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Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	100.574	0.574	51.8	0.0	51.8	1540.1	O K
120 min Winter	100.693	0.693	51.8	0.0	51.8	1859.4	O K
180 min Winter	100.747	0.747	51.8	0.0	51.8	2005.8	O K
240 min Winter	100.775	0.775	51.8	0.0	51.8	2079.7	O K
360 min Winter	100.799	0.799	51.8	0.0	51.8	2145.5	O K
480 min Winter	100.798	0.798	51.8	0.0	51.8	2143.7	O K
600 min Winter	100.793	0.793	51.8	0.0	51.8	2129.8	O K
720 min Winter	100.782	0.782	51.8	0.0	51.8	2099.7	O K
960 min Winter	100.747	0.747	51.8	0.0	51.8	2004.5	O K
1440 min Winter	100.654	0.654	51.8	0.0	51.8	1755.4	O K
2160 min Winter	100.513	0.513	51.8	0.0	51.8	1376.3	O K
2880 min Winter	100.398	0.398	51.6	0.0	51.6	1069.5	O K
4320 min Winter	100.277	0.277	47.7	0.0	47.7	744.4	O K
5760 min Winter	100.237	0.237	39.5	0.0	39.5	637.1	O K
7200 min Winter	100.213	0.213	33.7	0.0	33.7	571.7	O K
8640 min Winter	100.195	0.195	29.5	0.0	29.5	524.8	O K
10080 min Winter	100.182	0.182	26.4	0.0	26.4	489.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
60 min Winter	51.304	0.0	1609.2	0.0	66
120 min Winter	32.426	0.0	2043.1	0.0	124
180 min Winter	24.345	0.0	2304.8	0.0	182
240 min Winter	19.737	0.0	2493.6	0.0	238
360 min Winter	14.692	0.0	2787.1	0.0	346
480 min Winter	11.893	0.0	3009.5	0.0	440
600 min Winter	10.084	0.0	3190.3	0.0	474
720 min Winter	8.807	0.0	3343.5	0.0	552
960 min Winter	7.104	0.0	3595.0	0.0	700
1440 min Winter	5.235	0.0	3968.4	0.0	986
2160 min Winter	3.847	0.0	4436.8	0.0	1368
2880 min Winter	3.087	0.0	4743.1	0.0	1732
4320 min Winter	2.260	0.0	5187.3	0.0	2340
5760 min Winter	1.814	0.0	5598.0	0.0	3056
7200 min Winter	1.530	0.0	5897.3	0.0	3752
8640 min Winter	1.331	0.0	6150.8	0.0	4496
10080 min Winter	1.184	0.0	6364.1	0.0	5240

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Model Details

Storage is Online Cover Level (m) 101.100

Tank or Pond Structure

Invert Level (m) 100.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2685.0	0.700	2685.0	1.400	0.0	2.100	0.0
0.100	2685.0	0.800	2685.0	1.500	0.0	2.200	0.0
0.200	2685.0	0.900	2685.0	1.600	0.0	2.300	0.0
0.300	2685.0	1.000	2685.0	1.700	0.0	2.400	0.0
0.400	2685.0	1.100	0.0	1.800	0.0	2.500	0.0
0.500	2685.0	1.200	0.0	1.900	0.0		
0.600	2685.0	1.300	0.0	2.000	0.0		

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0298-5190-1050-5190
Design Head (m)	1.050
Design Flow (l/s)	51.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	298
Invert Level (m)	100.000
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.050	51.7
Flush-Flo™	0.457	51.8
Kick-Flo®	0.818	45.9
Mean Flow over Head Range	-	41.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	9.1	1.200	55.2	3.000	86.0	7.000	130.0
0.200	30.7	1.400	59.4	3.500	92.7	7.500	134.4
0.300	50.0	1.600	63.4	4.000	98.9	8.000	138.7
0.400	51.6	1.800	67.1	4.500	104.7	8.500	142.9
0.500	51.7	2.000	70.6	5.000	110.3	9.000	147.0
0.600	50.9	2.200	74.0	5.500	115.5	9.500	150.9
0.800	46.7	2.400	77.1	6.000	120.5		
1.000	50.5	2.600	80.2	6.500	125.3		

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Weir Overflow Control

Discharge Coef 0.544 Width (m) 3.000 Invert Level (m) 101.050

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