



FLOOD RISK ASSESSMENT

AT
**KERESFORTH ROAD
DODWORTH**

ON BEHALF OF
PERSIMMON HOMES WEST YORKSHIRE



ARP ASSOCIATES

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Flood Risk Assessment at Keresforth Road, Dodworth**302/22r1**

Revision/Date	Initial Issue 30th January 2018	Revision A	Revision B	Revision C
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1.0 INTRODUCTION

- 1.1 Persimmon Homes West Yorkshire is PROPOSING to develop a parcel of land off Keresforth Road within the existing settlement of Dodworth, South Yorkshire for residential development. As part of the viability of the site and to supplement a Planning Application, it was decided that a Flood Risk Assessment Report should be undertaken.
- 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 between October and December 2017.
- 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 SE 322 055, is located within the existing settlement of Dodworth, South Yorkshire, which is approximately 2.5km south west of Barnsley town centre. The proposed development site is an irregular shape of approximately 5.4ha, with access provided via Bark Meadows.
- 2.2 A site location plan is presented in Appendix A.

Current Use

- 2.3 The site is presently unused grassed fields and agricultural land, with areas of mature woodland around the boundary edges.

Site Features and Boundaries

- 2.4 The site is bounded to the west and south by natural woodland with an existing built up of residential development beyond. At the northern boundary is the recreation ground adjacent to Wareham Grove/South Road. Following the full extent of the eastern boundary is the M1, with Junction 37 slightly north of the site.
- 2.5 Dodsworth Dike flows along the southern boundary and continues for approximately 330m before passing under Keresforth Road. The watercourse ultimately ends up discharging into Dodsworth Dike approximately 760m to the southeast.

Topography and Vegetation

- 2.6 The topography of the site is a relatively steep gradient from north to south which is steeper towards the south, and a gradual fall from east to west. A copy of the topographical survey is presented in Appendix B.

- 2.7 In terms of vegetation, the site is presently an agricultural field with mature vegetation in the form of trees and bushes along the boundary edges.

Drainage

- 2.8 The site has no obvious positive drainage system, although land drainage may be present. Based on fall from north to south, the site will naturally drain into Dodworth Dike at the southern end of the site.

3.0 ENVIRONMENT AGENCY CONSULTATION

- 3.1 A consultation was requested from the Environment Agency and a copy of their response, reference RFI/2017/64626 dated 13th November 2017, is presented in Appendix C for reference purposes.
- 3.2 The Environment Agency has provided a Flood Map, which shows areas of land that could flood from rivers or the sea and are shaded blue. These areas do not take into account defences as water can overtop or can fail in extreme conditions. The Zone classifications are:-
- 3.2.1 Flood Zone 1 - 'Low Probability' is assessed as having a less than 1 in 1,000 annual probability of river or sea flooding in any year (less than 0.1%).
- 3.2.2 Flood Zone 2 - 'Medium Probability' is assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding in any year (1% - 0.1%) and between a 1 in 200 and 1 in 1,000 annual probability of flooding from the sea (0.5% - 0.1%).
- 3.2.3 Flood Zone 3 - 'High Probability' is assessed as having a 1 in 100 or greater annual probability of river flooding in any year (greater than 1%) and a 1 in 200 chance or greater annual probability of flooding from the sea (less than 0.5%).
- 3.3 The Environment Agency Flood Map shows that the site is located within Flood Zone 1.
- 3.4 The surface water flood map, shows areas where surface water only would be expected to flow or pond in England & Wales. All land in England and Wales will be within 'one' of a possible 'four' categories. The four categories shown on the map are:-

- 3.4.1 High - This area has a chance of flooding greater than 1 in 30 in any given year (annual probability of flooding 3.3%).
- 3.4.2 Medium - This area has a chance of flooding between 1 in 100 (1%) and 1 in 30 (3.3%) in any given year.
- 3.4.3 Low - This area has a chance of flooding between 1 in 1000 (0.1%) and 1 in 100 (1%) in any given year.
- 3.4.4 Very low - This area has a chance of flooding of less than 1 in 1000 (0.1%) in any given year.
- 3.5 Although the surface water flood map does not contain sufficient information for it to be used to determine flood risk to individual properties, it does give an indication of whether the site may be affected and to what extent. The majority of the site is shown to have a very low risk of surface water flooding, however, low to medium risk flow paths are present along the north eastern boundary adjacent to the M1.
- 3.6 The Environment Agency has confirmed that to the best of their knowledge there is no known flood history for this site.
- 3.7 Surface water discharges from the new development should ideally 'mimic' the pre-development situation using a sustainable drainage system so that the flow and volume of water in watercourses is not increased.

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 R751033 dated 8th November 2017, is presented in Appendix D 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 Foul water domestic waste should discharge to the 375 mm diameter public foul sewer recorded crossing the site.
- 4.4 Foul water domestic waste should discharge to the 225mm diameter public foul sewer recorded in Water Royd Drive, recorded to the south west of the site.
- 4.5 In respect of 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 before connection to sewer will be considered.
- 4.6 It is understood that a watercourse is located to the south of the site. This appears to be the obvious place for surface water disposal (if SUDS are not viable).

5.0 LAND DRAINAGE AUTHORITY CONSULTATION

- 5.1 A consultation was requested from Barnsley Council Metropolitan Borough Council, who is the Land Drainage Authority for this area, and a copy of their response dated 30th October 2017 is presented in Appendix E for reference purposes.
- 5.2 It has been confirmed that the watercourse located on the southern boundary, under the Land Drainage Act 1990, the maintenance falls to the riparian owner, i.e. The land owner through which the watercourse passes. Any works or discharges into a watercourse must consult with BMBC as Lead Local Flood Authority and gain any necessary consents.
- 5.3 There should be no increase in surface water run-off from the development into the watercourse.
- 5.4 Existing foul and surface water sewers are recorded adjacent to the site and it was recommended to contact Yorkshire Water if a connection to sewer was required.
- 5.5 Any balancing facility should be designed to accommodate a 1 in 30 year flow from the site and a 1 in 100 year flow retained within the site, including an allowance at 30% for climate change, without causing any flooding to buildings.
- 5.6 Where ground conditions are favourable, there are alternatives to conventional storage for the control of surface water run-off that are favoured by the Authority. Sustainable Urban Drainage techniques (SUDs) tackle surface run-off using features such as soakaways, permeable pavements, grassed swales, ponds and wetlands to attenuate flood peak flows, produce water quality improvements and environmental enhancements.
- 5.7 BMBC seek to promote the use of SUDs and expects the developer to submit detailed investigations such that the use of SUDs has been fully explored. The Authority has a policy of not adopting SUDs features unless they are specifically designed to drain adoptable Highways only. Other avenues of adoption with Yorkshire Water should be explored.

6.0 MATERIAL CONSIDERATION IN RESPECT OF THE NPPF AND PPG

Flood Classification

- 6.1 Environment Agency mapping confirms that the site falls within Flood Zone 1, which is land assessed as having a less than 1 in 1,000 annual probability of river flooding in any year (less than 0.1%). The proposed development site is therefore, situated wholly within a low risk of fluvial flooding area.

End Use

- 6.2 The development proposal is for the construction of residential dwellings on the site and a copy of the proposed sketch layout is presented in Appendix F for reference purposes.
- 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 "*dwellings*". With reference to NPPF, the citing of More Vulnerable development within Flood Zone 1 is deemed appropriate and assessment of other sites (the Sequential Test) is not deemed necessary.

Flood Sources

- 6.4 Flooding from Rivers - Environment Agency flood mapping indicates that the site is wholly within Flood Zone 1 (Low Probability of fluvial flooding). Therefore, flooding from rivers is considered to be low risk.
- 6.5 Flooding from Local Watercourses - Dodworth Dike flows in a southerly direction from the southern boundary of the site. There is no hydrological or hydraulic modelling available for this watercourse to accurately quantify the level of flood risk. Therefore, a qualitative assessment has been undertaken based on observations undertaken during the site visit. Dodworth Dike is in a heavily incised channel, with a very steep bank up to the proposed

development site. Based on the height between the channel and the proposed development site and the topography of the surrounding area, it is extremely unlikely Dodworth Dike will inundate the proposed development site, and flooding from this source is very low risk.

- 6.6 Flooding from the Sea - The site is not located near enough to the sea to cause a problem of flooding from this source.
- 6.7 Flooding from Land - The Environment Agency surface water flood map shows the site is predominately at a very low risk of surface water flooding, up to and including the 1 in 1,000 year return period. A surface water flow path is present along the western boundary, which emanates from third party land, then follows the natural gradient to Dodworth Dike. There is a flow path which follows the line of tractor tyre tracks along the eastern site boundary. This is coincident with the flow paths shown on the EA flood map. Whilst the risk of surface water flooding on site is deemed to be very low, the natural surface water flow paths should be incorporated into the site wide masterplan as it evolves.
- 6.8 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.
- 6.9 The Geological Survey Map of Great Britain shows the site to be underlain by sandstone and gravel deposits. Although sandstone may be permeable 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. Historical boreholes across the proposed development site indicate groundwater was typically encountered at depths of 8m below ground level.
- 6.10 The Barnsley Preliminary Flood Risk Assessment (PFRA) utilises the national Environment Agency dataset; Areas Susceptible to Groundwater Flooding which indicates low risk of

groundwater flooding across Barnsley. Based on information available, the risk of groundwater flooding is deemed to be low.

- 6.11 Flooding from Sewer - Yorkshire Water sewers are present in the local residential area to the north. Surcharging of these sewers may inundate the site. A new drainage system will also be introduced for development on the site and it is possible, therefore, that any blockage of the sewers 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.
- 6.12 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.
- 6.13 The proposed development site is shown to be outside the maximum extent of reservoir flooding. There are no canals or 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

- 6.14 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.
- 6.15 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.
- 6.16 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, an increase of 50% flows is deemed unlikely to affect the proposed development site.

- 6.17 In accordance with the revised climate change data, the published figures show that, for an expected life of greater than 50 years for any new development, the anticipated increase in rainfall could be around 40% and the drainage system should be designed in accordance with this. However, the Barnsley Metropolitan Borough Council flood risk requirements for managing on/off-site flood risk from fluvial flooding is to assess the development using a 30% allowance for climate change for the 1 in 100 year event.
- 6.18 Due to the topography of the land and surrounding area overland run-off from adjoining land is unlikely to be an issue. On the eastern boundary, it is anticipated that there are existing drains at the foot of the highway battered slope supporting the carriageway. Therefore, any run-off from outside the site will be insignificant and on this basis, only rainfall falling within the site boundaries will need to be considered in respect of climate change.

Flood Mitigation

- 6.19 As the site falls within Flood Zone 1, flood mitigation measures are only required in the event of a catastrophic storm, overland run-off or blockage of the existing or proposed sewers. The following precautionary mitigation measures are, therefore, recommended:-
- 6.19.1 The finished floor levels to the properties shall be raised above external levels by a minimum of 150mm, and preferably 300mm, wherever possible.
- 6.19.2 The proposed dwellings will be designed without any basements and ground floor shall comprise solid concrete slabs or beam and block floors with screed construction.

6.19.3 Incoming electricity supplies shall be raised above ground floor level and ground floor electric sockets shall be served by loops from upper level.

6.19.4 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, where the water can pond without causing flooding to buildings.

6.19.5 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 southern boundary.

Sustainable Drainage

6.20 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 this report, 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. However, for the purpose of the report, a positive drainage system to watercourse will be required for surface water drainage.

Drainage

6.21 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

6.22 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. This shows that for a developed site area of 4.6ha, a rate of 19.7l/s has been calculated for the 1 in 1 year storm for the site. The indicative greenfield run-off calculations are presented in Appendix G.

Proposed Surface Water Drainage

- 6.23 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 will be required for surface water drainage.
- 6.24 The proposed site layout which is presented in Appendix F has been assessed as having a proposed impermeable area of approximately 2.3ha. Indicative calculations have been carried out using the WinDES Source Control Computer Program. 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 should be retained within the site in an area which will not affect the new buildings or third parties from flooding.
- 6.25 Restricting the discharge rate to no greater than 19.7l/s, on-site storage of 903.4m³ will need to be provided for a 1 in 30 year storm. This can be achieved by several methods including oversized pipes or underground tanks. Once such option would be to provide 54m of 14m x 1.2m deep underground attenuation or equivalent, to achieve the necessary volume. The drainage system will also need to accommodate the 1 in 100 year plus 30% climate change event without causing flooding of property or third party land. In the event that levels dictate that the 1 in 100 year plus climate change floodwater will flow off-site an additional or larger storage facility will be required. Therefore, on-site storage would increase to 1276.7m³. The surface water calculations are presented in Appendix H. However, detailed calculations and proposals will need to be prepared and submitted to the Planning Authority for approval prior to construction.

Proposed Foul Water Drainage

- 6.26 Foul water domestic waste should discharge to the 225mm diameter public foul sewer recorded in Water Royd Drive, recorded to the south west of the site.
- 6.27 Subject to detailed level design, if the site is not able to drain by gravity, an adoptable foul water pumping station may be required to facilitate connection to the public sewer network.

Emergency Egress during Times of Flood

- 6.28 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.
- 6.29 As the site falls within Flood Zone 1 and there is no flooding from the local watercourse, no special mitigation measures are required for emergency egress during times of flood.

Watercourse Condition

- 6.30 The discharge of surface water drainage to watercourse will be subject to infiltration testing in accordance with BRE Digest 365 "Soakaway Design" to determine if infiltration techniques will be suitable for the site.
- 6.31 The discharge of surface water to the watercourse will require the introduction of headwalls or works to the watercourse. This will need the Consent of the Land Drainage Authority by submitting an Application for Consent to Work Within a Watercourse. There is also a requirement for a 9m strip to be provided from the top of the banking where no

development can take place and access arrangements will need to be agreed with the local Drainage Authority for future improvements or maintenance.

7.0 COMMENTS

- 7.1 The site falls within Flood Zone 1 and the sequential test is satisfied. However, in order to accommodate the possibilities of flood from a catastrophic storm, overland run-off 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 shall be raised above external levels by a minimum of 150mm, and preferably 300mm, wherever possible.
 - 7.1.2 The proposed dwellings will be designed without any basements and ground floor shall comprise solid concrete slabs or beam and block floors 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 upper 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, where the water can pond 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 southern 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 will be required for surface water drainage.

- 7.4 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 for a 1 in 100 year storm plus climate change. Detailed design and calculations shall be submitted to the Planning Authority for approval prior to construction on site.
- 7.5 The discharge of surface water, the construction of the headwalls or regrading of the watercourse will require the consent of the Land Drainage Authority by submitting an Application for Consent to Work with a Watercourse prior to construction on site.
- 7.6 No properties or other restrictions shall be constructed within 9m of the watercourse banking, and the development shall comply with all Land Drainage Bye-laws and the Land Drainage Act 1991.
- 7.7 Foul water domestic waste should discharge to the 225mm diameter public foul sewer recorded in Water Royd Drive, recorded to the south west of the site.
- 7.8 Subject to detailed level design, if the site is not able to drain by gravity, an adoptable foul water pumping station may be required to facilitate connection to the public sewer network.
- 7.9 No special mitigation measures are required for emergency egress during times of flood.
- 7.10 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.

APPENDIX A

SITE LOCATION PLAN



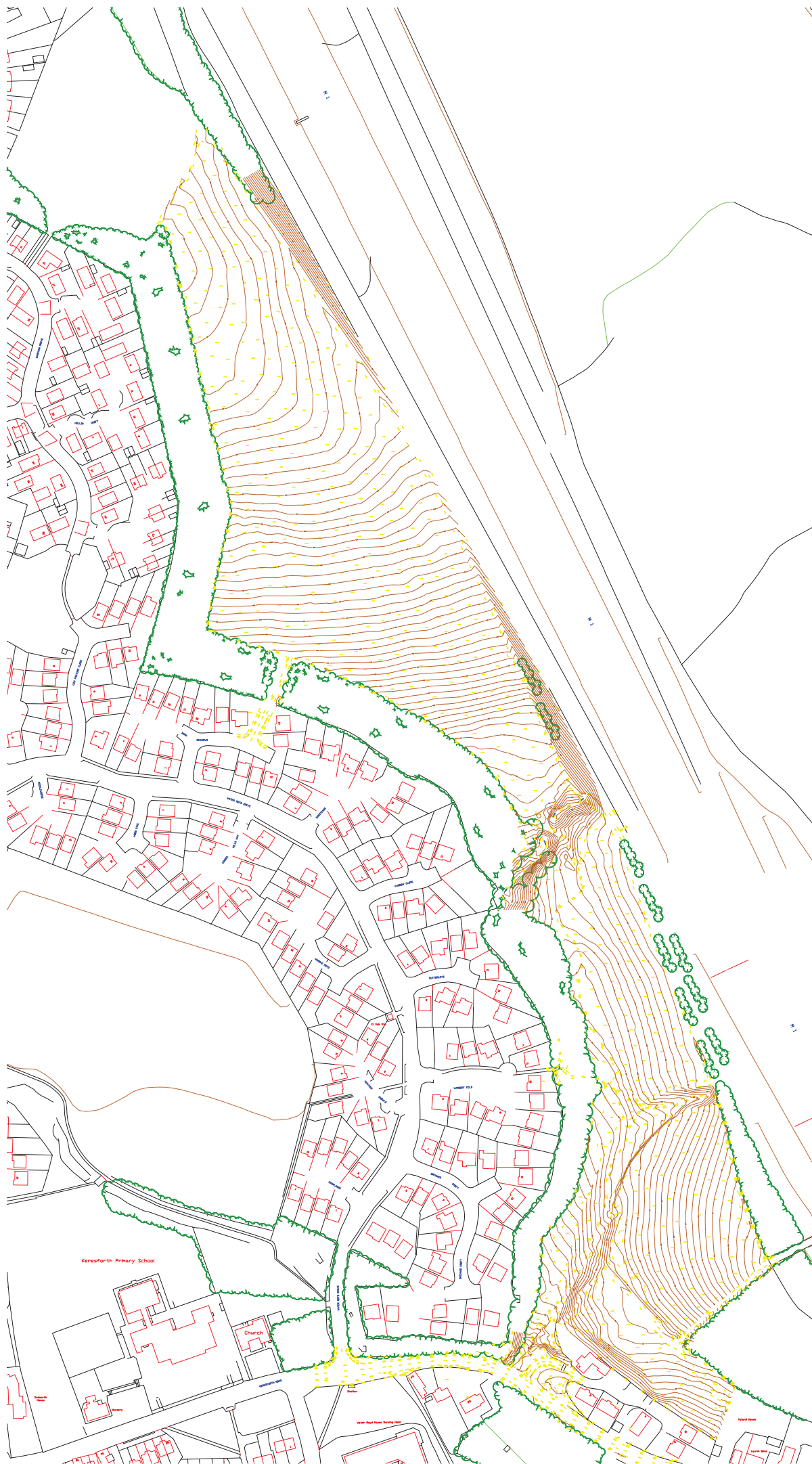
All levels to GPS

OS Grid Reference: SE 322 055

All levels to GPS OS Grid Reference: SE 322 055						
	/	JMG	26.10.17	Issued for information		PSC
	Rev	By	Date	Amendment		Chk
Title SITE LOCATION PLAN	 ARP ASSOCIATES CHARTERED CONSULTING ENGINEERS Northwest House • 5/6 Northwest Business Park Servia Hill • Leeds LS6 2QH Telephone : 0113 245 8498 • Fax : 0113 244 3864 E-Mail : leeds@arpassociates.co.uk			Scale 1:2500 @ A4	Drawn JMG	
				Date OCT-17	Chk. PSC	
				Drg. No. 302/22/NA		Rev /
Project/Client LAND OFF KERESFORTH ROAD, DODWORTH PERSIMMON HOMES WEST YORKSHIRE						

APPENDIX B

TOPOGRAPHICAL SURVEY



APPENDIX C

ENVIRONMENT AGENCY CONSULTATION

From: Glenton, Rob <Rob.Glenton@environment-agency.gov.uk>
Sent: Monday 13 November, 2017 4:02 pm
To: Paul Carter
Subject: Your Enquiry: RFI/2017/64626
Attachments: flood risk & flood consequence assessments.pdf; Surface Water Flood Risk Map 64626.pdf; Detailed River Network Map 64626.pdf; Flood Map 64626.pdf

Our Ref: RFI/2017/64626

Dear Paul

Provision of Product 4 for Keresforth Road, Dodworth

Thank you for your request of 26 October 2017 to use Environment Agency data in the development of the Product 4. The information is attached.

If you have requested this information to help inform a development proposal, then you should note the detail in the attached advisory text on the use of Environment Agency Information for Flood Risk Assessments.

Supporting Information

The Flood Map for Planning

The Environment Agency provides the Flood Map (see enclosed extract).

What is the Flood Map for Planning?

The Flood Map for Planning provides information on flooding from rivers and the sea for England and Wales. The Flood Map also has information on flood defences and the areas benefiting from those flood defences.

The Flood Map for Planning shows the following:

1. Flood Zone 3 (dark blue area on the enclosed map): natural flood plain area that could be affected by flooding from rivers and/or the sea – not taking into account the presence of any flood defences
 - For flooding from rivers the map indicates the extent of a flood with a 1% (1 in 100) chance of happening each year;
 - For flooding from the sea the map shows the extent of a flood with a 0.5% (1 in 200) chance of happening each year.
2. Flood Zone 2 (light blue area): natural flood plain area that could be affected by flooding from rivers and/or the sea – not taking into account the presence of any flood defences. Flood Zone 2:
 - indicates the extent of a flood with a 0.1% (1 in 1000) chance of happening each year.
 - and/or indicates the greatest recorded historic flood, whichever is greater.
3. Flood defences built in the last five years to protect against river floods with a 1% (1 in 100) chance of happening each year, together with some natural or constructed entities which retain, store or channel water and which may protect against smaller floods.
4. Areas benefiting from flood defences - areas that benefit from the flood defences shown, in the event of a river flood with a 1% (1 in 100) chance of happening each year, or a flood from the sea with a 0.5% (1 in 200) chance of happening each year. If the defences were not there, these areas would flood.

Flood History

Flood History

To the best of our knowledge there is no known flood history for this site. For local drainage information please contact your water utility company and your local council.

For Yorkshire as a whole there are some flooded areas that may be missing from the extents, this is because of a lack of data or low confidence. We are still reviewing the evidence and therefore these extents should still be viewed as a draft output.

Water causing flooding can come from different places, for example from rivers or the sea; surface water (i.e. rainwater flowing over or accumulating on the ground before it is able to enter rivers or the drainage system); overflowing or backing up of sewers or drainage systems which have been overwhelmed or from groundwater rising up from underground aquifers.

Currently the Environment Agency can only supply flood risk data relating to the risk of flooding from rivers or the sea. However you should be aware that in recent years, there has been an increase in flood damage caused by surface water flooding or drainage systems that have been overwhelmed. Local Authorities and/or Water Companies may be able to provide some knowledge on the risk of flooding from sources other than rivers and the sea and we are working with these organisations to improve knowledge and understanding of surface water flooding.

Assets

There are no flood defences helping to reduce flood risk in your area of interest.

Modelling

Modelling Information

We do not have any modelling information at this location.

Climate Change

Please note that new guidance on climate change allowances for Flood Risk Assessments has been published in February 2016.

The new guidelines are available from:

<https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

River

Non Main River

The watercourse at this location is not designated as Main River. It is classed as an Ordinary Watercourse. The local authority holds responsibility for the maintenance of this river. The Environment Agency does not have any more information available in regard to past flooding issues or current flood risk. For any information on any past flooding and for any record of the impact of local drainage on that watercourse we suggest you speak to your City Council Drainage Section and to Yorkshire Water.

Other

Surface Water Map

Risk of flooding from surface water information.

Thank you for the enquiry regarding your site.

Attached is a map of showing the risk of flooding from surface water for this area, produced in partnership with Local Authorities.

Surface water flood risk is widely distributed and can happen far from rivers and the sea. It's sometimes hard to say whether you're in an area at risk of flooding from surface water because surface water flooding can follow many

more paths and can be affected by very small features such as kerb height and even speed bumps. We recommend you consider not only whether your property is shown in or near an area at risk, but also the broader scale and pattern of surface water flooding shown in your area. You may also wish to view this and other flood risk maps on our website.

Whether your property is at risk will depend on the accuracy of the mapping in this area, and on the details of your property – for example, how waterproof the structure is, the levels of doors and airbricks, and whether you have installed any flood resilience measures such as airbrick covers and flood boards.

Information Warning

Please note:

It is not possible to say for certain what the flood risk is but we use the best information available to provide an indication so that people can make informed choices about living with or managing the risks. The information we supply does not provide an indicator of flood risk at an individual property / site level.

The flood risk information provided on the attached map does not cover other sources of flooding such as from rivers and sea.

Surface Water Drainage

The Lead Local Flood Authority is the statutory consultee for planning matters relating to surface water drainage, therefore it is recommended they should be consulted separately regarding this.

Surface water discharge from new development should ideally ‘mimic’ the pre-development situation using a sustainable drainage system so that the flow and volume of water in watercourses is not increased.

A permit may be required, under the Environmental Permitting Regulations 2010 from the Environment Agency for any proposed works or structures in, under, over or within eight metres of a ‘main river’ (e.g. a new outfall). A permit is separate to and in addition to any planning permission granted. Further details and guidance are available on the GOV.UK website: <https://www.gov.uk/guidance/flood-risk-activities-environmental-permits>

Risk of Flooding from Reservoirs Map

Outlines and simplified depth and velocity maps can be viewed on our website:

<https://flood-warning-information.service.gov.uk/long-term-flood-risk/#x=438988&y=406600&scale=2>

Please, zoom into the location of interest, and then click on the inundated location for details. As a result a list of reservoirs will be provided with supporting information and a links to other data, such as estimated depths and speed of flooding, at the bottom of the result page.

A map of showing the outlines can also be provided on request.

Flood Warning

The site is not covered by a Flood Warning.

LIDAR Data

Please note that our LiDAR data is now available free of charge (Open Data) from

<http://environment.data.gov.uk/ds/survey/index.jsp#/survey> (once zoomed to the relevant location the available LiDAR products will be listed below the map).

Two LIDAR products are available:

1. Tiled LIDAR data - The full tiled dataset consists of historic LIDAR data which has been gathered since 1998. For some areas we have carried out repeat surveys and data is available in a range of resolutions.
2. Composite LIDAR data - The composite dataset is derived from a combination of our full tiled dataset which has been merged and re-sampled to give the best possible spatial coverage.

Light Detection and Ranging (LIDAR) is an airborne mapping technique, which uses a laser to measure the distance between the aircraft and the ground. This technique results in the production of an accurate, cost-effective terrain model suitable for assessing flood risk and other environmental applications.

The Environment Agency owns two LIDAR systems, which are installed in a survey aircraft along with its other operational remote sensing instruments.

The aircraft is positioned and navigated using Global Positioning System (GPS) corrected to known ground reference points. The aircraft typically flies at a height of about 800 metres above ground level and a scanning mirror allows a swath width of about 600 metres to be surveyed during a flight.

The Rights & Responsibilities of a Riverside Owner

The owner of property adjacent to a watercourse is usually deemed to be the riparian owner and, as such, has both riparian rights and responsibilities with regard to the watercourse within their ownership.

The responsibility for general maintenance and repair of the watercourse and its banks rests with the riparian owner. For more information on Rights and Responsibilities of a riverside owner, you can visit our website at: <https://www.gov.uk/government/organisations/environment-agency> go to the Flooding and coastal change section and click on 'Riverside ownership: rights and responsibilities ('living on the edge') under the River maintenance section and download the 'Living on the Edge' booklet.

Alternatively type the following address into your web browser:

<https://www.gov.uk/government/publications/riverside-ownership-rights-and-responsibilities>

Ordnance Survey Data

Under the terms of our licence agreement with the Ordnance Survey, we are unable to supply the OS data. Under this agreement we can only supply OS data to consultants/contractors carrying out work on our behalf.

Flood Portal

It's a new 'one-stop shop' web portal providing guidance and information on flood risk management in the UK. Arup have written and designed the site, in conjunction with CIRIA, the Local Government Association, the EA and Defra, primarily as a resource for local authority officers, flood risk management professionals, and others with an interest in flood risk. It's a part of the Capacity Building Strategy. <http://www.local.gov.uk/floodportal>

This information is provided subject to the Open Government Licence ([here](#)) - please read for details of permitted use.

If you have any queries or would like to discuss the content of this letter further please contact us on the telephone number below.

We would be really grateful if you could spare five minutes to help us improve our service. Please click on the link below and fill in our survey – we use every piece of feedback we receive:

<http://www.smartsurvey.co.uk/s/EnvironmentAgencyCustomerSurvey/?a=Y>

Yours sincerely,

Rob

Rob Glenton | Customers and Engagement Team

Environment Agency | Lateral, 8 City Walk, Leeds, LS11 9AT

Enquiries Team Tel: 0208 474 8174 | Email: neyorkshire@environment-agency.gov.uk

Direct Tel: 0208 474 9815 | Email: rob.glenton@environment-agency.gov.uk

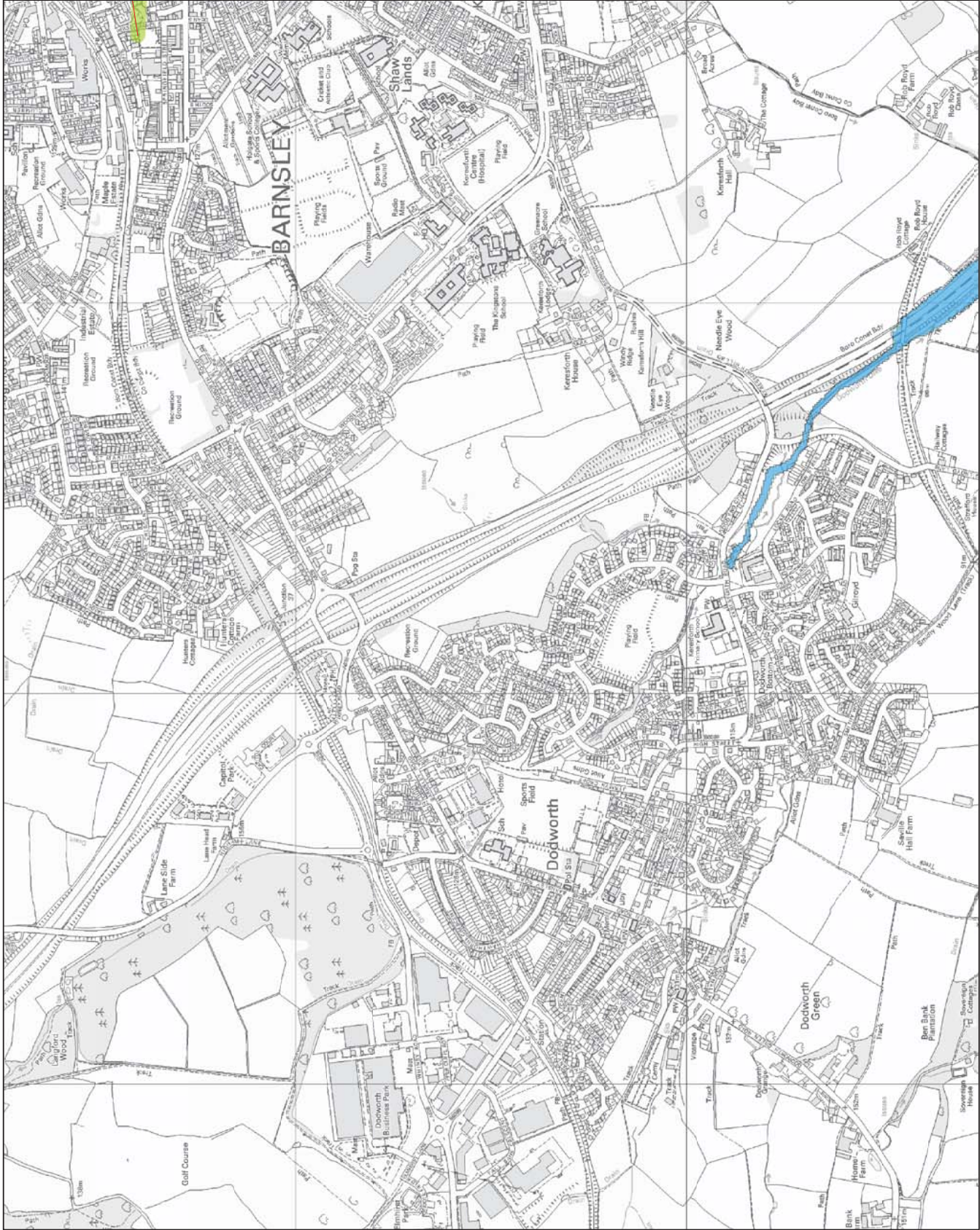
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RFI/2017/64626 Flood Map centred on Keresforth Road, Dodworth
Date created: 09/11/2017



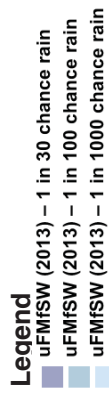
 Environment Agency

www.environment-agency.gov.uk

Scale: 1:10,000

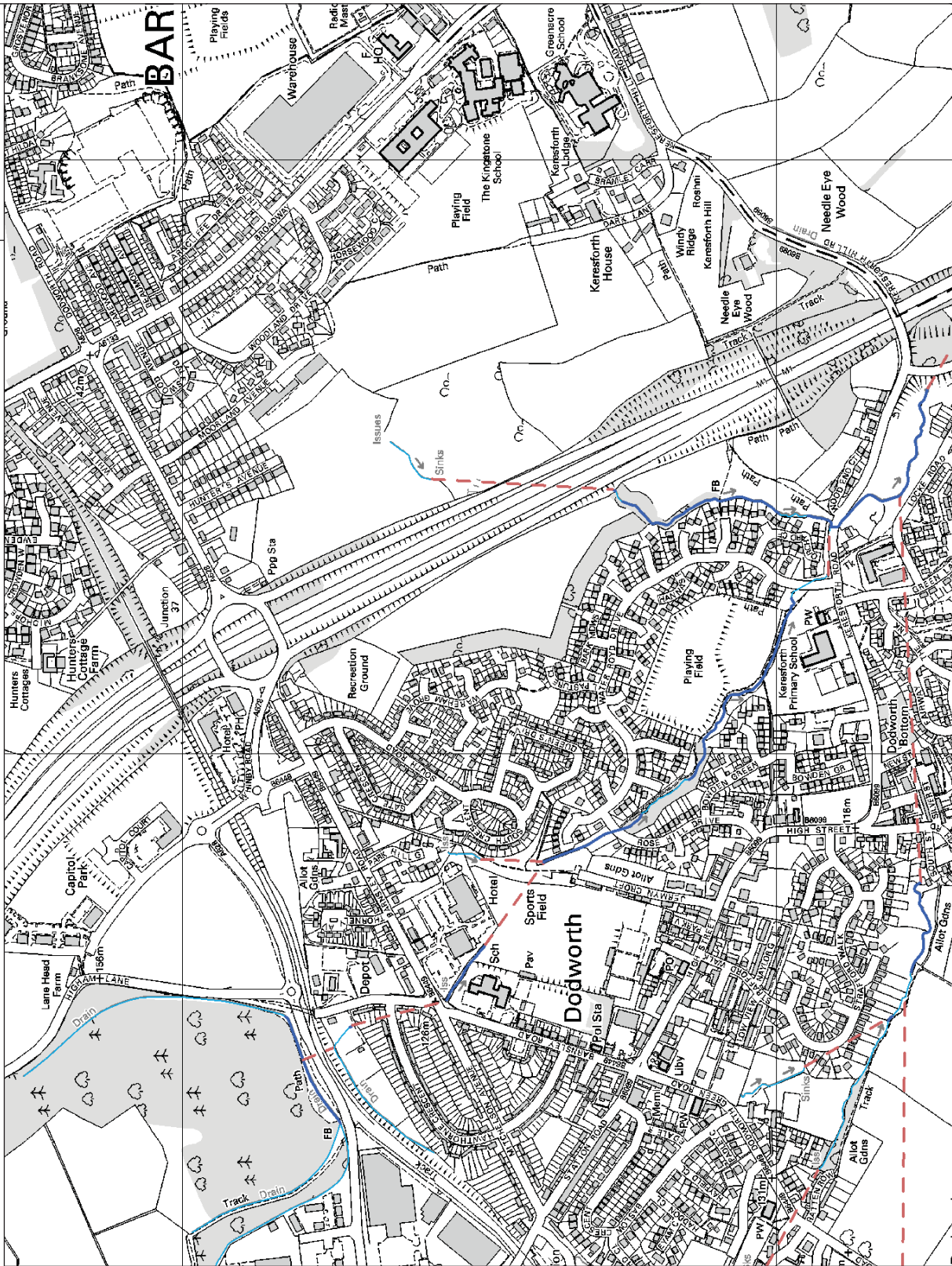


Environment
Agency



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Detailed River Network Map centred on Keresforth Road, Dodworth



- Legend**
- Sealed Main Rivers
 - Detailed River Network
 - Primary River
 - Secondary River
 - Tertiary River
 - Lake / Reservoir
 - Canal
 - Culvert
 - Canal Tunnel
 - Underground River (Inferred)
 - Underground River (local knowledge)
 - Underground River (Potential Sewer)



Use of Environment Agency Information for Flood Risk / Flood Consequence Assessments

Important

If you have requested this information to help inform a development proposal, then we recommend that you undertake a formal pre-application enquiry using the form available from our website:-

<http://www.environment-agency.gov.uk/research/planning/33580.aspx>

Depending on the enquiry, we may also provide advice on other issues related to our responsibilities including flooding, waste, land contamination, water quality, biodiversity, navigation, pollution, water resources, foul drainage or Environmental Impact Assessment.

In **England**, you should refer to the Environment Agency's Flood Risk Standing Advice, the technical guidance to the National Planning Policy Framework and the existing PPS25 Practice Guide for information about what flood risk assessment is needed for new development in the different Flood Zones. These documents can be accessed via:

<http://www.environment-agency.gov.uk/research/planning/82587.aspx>

<http://www.communities.gov.uk/publications/planningandbuilding/nppftechnicalguidance>

<http://www.communities.gov.uk/publications/planningandbuilding/pps25guideupdate>

You should also consult the Strategic Flood Risk Assessment produced by your local planning authority.

In **Wales**, you should refer to TAN15 for information about what flood consequence assessment is needed for new development in the different flood zones

<http://new.wales.gov.uk/splash;jsessionid=8ylGTfGZthmB0t2vhp6hS1GcB1LXvZzB3Ylczf20Xn7LK3zK0nMk!981825250?orig=/topics/planning/policy/tans/tan15/>

You should also consult the Strategic Flood Consequence Assessment if one has been produced by your local planning authority.

In both **England and Wales** you should note that:

1. Information supplied by the Environment Agency may be used to assist in producing a Flood Risk / Consequence Assessment (FRA / FCA) where one is required, but does not constitute such an assessment on its own.
2. This information covers flood risk from main rivers and the sea, and you will need to consider other potential sources of flooding, such as groundwater or overland runoff. The information produced by the local planning authority referred to above may assist here.
3. Where a planning application requires a FRA / FCA and this is not submitted or deficient, the Environment Agency may well raise an objection.
4. For more significant proposals in higher flood risk areas, we would be pleased to discuss details with you ahead of making any planning application, and you should also discuss the matter with your local planning authority.

APPENDIX D

WATER AUTHORITY CONSULTATION

Mr P Carter
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

Your Ref:
Our Ref: T018746

Email:
Technical.Sewerage@yorkshirewater.co.uk

For telephone enquiries ring:
Chris Roberts on 0345 120 8482

8th November 2017

Dear Mr Carter,

Land off Keresforth Road. Dodworth. - Pre Planning Sewerage Enquiry R751033 - Residential

Thank you for your recent enquiry. Our charge of £153.00 (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

There is a 150 mm diameter public sewer recorded crossing the northern part of the site. In this instance, building-over may take place under the control of Part H4 Building Regulations 2000.

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 225mm diameter public foul sewer recorded in Water Royd Drive to the south west 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.



YorkshireWater

It is understood that a watercourse is located to the south 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/Internal Drainage Board, 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.

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.

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

Yours sincerely

Chris Roberts
Sewerage Technician
Developer Services

APPENDIX E

LAND DRAINAGE AUTHORITY CONSULTATION

Paul Carter

From: Atkins , Wayne <WayneAtkins@barnsley.gov.uk>
Sent: Monday 30 October, 2017 11:02 am
To: Paul Carter
Cc: Wayne Walker
Subject: RE: 302/22 Land off Keresforth Road, Dodworth

Hi Paul,

There is a watercourse on the southern boundary of the area of interest, under the Land Drainage Act 1990 the maintenance of this watercourse falls to the riparian owner i.e. the land owner through which the watercourse passes. If anyone wishes to carry out works to or discharge flows into a watercourse they must consult with BMBC as Lead Local Flood Authority and gain any necessary consents for works within it or discharges to it.

I would confirm that to my knowledge it is not affected by any flood plains from major watercourses in the area.

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.

There are foul and surface water public sewers adjacent to the site. The developer should contact Yorkshire Water if they wish to discharge to this sewer to discuss allowable discharge rates.

Any balancing facility should be designed to accommodate a 1 in 30 year flow from the site 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. The Authority has a policy of not adopting SUDs features unless they are specifically designed to drain adoptable Highways only. The developer should explore other avenues for adoption e.g. Yorkshire Water.

Regards

Wayne Atkins
Principal Engineer – Drainage
Environment & Transport
Place Directorate
Barnsley Metropolitan Borough Council

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

From: Paul Carter [mailto:PaulCarter@arpassociates.co.uk]
Sent: 26 October 2017 14:54
To: Atkins , Wayne

APPENDIX F

PROPOSED SKETCH LAYOUT



Rev A - Photo pulled back to allow for bank. SAC 20-09-17



PERSIMMON
Together, we make a home

Proposed Development
KERESFORTH ROAD/BARK MEADOWS
DODD WORTH

SKETCH LAYOUT

Scale 1:500@A1	Drawing Number KRD-2017-SK01 Rev - A
Drawn By SAC	SEPT 2017

APPENDIX G

INDICATIVE GREENFIELD RUN-OFF CALCULATIONS

ARP Associates		Page 1
Northwest House Servia Hill Leeds LS6 2QH		
Date 25/01/2018 5:10pm	Designed by PaulCarter	
File KERESFORTH ROAD 1IN100 ...	Checked by	
Elstree Computing Ltd	Source Control 2017.1.2	

IH 124 Mean Annual Flood

Input

Return Period (years)	1	Soil	0.450
Area (ha)	50.000	Urban	0.000
SAAR (mm)	779	Region Number	Region 3

Results l/s

QBAR Rural 248.9
QBAR Urban 248.9

Q1 year 214.1

Q1 year 214.1
Q2 years 234.9
Q5 years 311.2
Q10 years 360.9
Q20 years 408.8
Q25 years 424.7
Q30 years 437.6
Q50 years 471.5
Q100 years 517.8
Q200 years 587.5
Q250 years 609.9
Q1000 years 756.7

It is unusual to use the IH124 Method with an area < 50ha.
The Interim Code of Practice recommends that the IH124 method is applied with 50 ha and the resulting discharge is linearly interpolated for the required area.

$$\therefore 1 \text{ year} = 214.1 \div 50 = 4.28 \text{ L/s/ha}$$

$$4.28 \times 4.6 = 19.69 \text{ L/s}$$

APPENDIX H

SURFACE WATER DRAINAGE CALCULATIONS

ARP Associates		Page 1
Northwest House Servia Hill Leeds LS6 2QH	Keresforth Road Dodworth	
Date 26/01/2018 3:45pm File Keresforth Road lin30.srcx	Designed by PSC Checked by WMW	
Elstree Computing Ltd		
Source Control 2017.1.2		

Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	8.391	0.491	19.7	370.8	O K
30 min Summer	8.551	0.651	19.7	491.5	O K
60 min Summer	8.714	0.814	19.7	614.3	O K
120 min Summer	8.860	0.960	19.7	724.7	O K
180 min Summer	8.919	1.019	19.7	769.2	O K
240 min Summer	8.940	1.040	19.7	785.5	O K
360 min Summer	8.941	1.041	19.7	785.8	O K
480 min Summer	8.930	1.030	19.7	777.8	O K
600 min Summer	8.914	1.014	19.7	765.7	O K
720 min Summer	8.895	0.995	19.7	751.2	O K
960 min Summer	8.851	0.951	19.7	718.0	O K
1440 min Summer	8.752	0.852	19.7	643.5	O K
2160 min Summer	8.588	0.688	19.7	519.0	O K
2880 min Summer	8.451	0.551	19.7	415.8	O K
4320 min Summer	8.255	0.355	19.7	267.8	O K
5760 min Summer	8.146	0.246	19.1	185.9	O K
7200 min Summer	8.099	0.199	18.0	149.9	O K
8640 min Summer	8.077	0.177	16.0	133.6	O K
10080 min Summer	8.062	0.162	14.3	122.0	O K
15 min Winter	8.452	0.552	19.7	416.7	O K
30 min Winter	8.633	0.733	19.7	553.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	89.113	0.0	374.9	18
30 min Summer	59.880	0.0	506.1	33
60 min Summer	38.413	0.0	657.8	62
120 min Summer	23.801	0.0	815.9	122
180 min Summer	17.725	0.0	911.8	182
240 min Summer	14.278	0.0	979.6	240
360 min Summer	10.493	0.0	1080.0	330
480 min Summer	8.431	0.0	1157.1	386
600 min Summer	7.108	0.0	1219.6	452
720 min Summer	6.180	0.0	1272.4	518
960 min Summer	4.951	0.0	1358.9	656
1440 min Summer	3.616	0.0	1487.7	938
2160 min Summer	2.635	0.0	1633.0	1320
2880 min Summer	2.102	0.0	1736.6	1676
4320 min Summer	1.526	0.0	1888.5	2376
5760 min Summer	1.214	0.0	2009.3	3048
7200 min Summer	1.017	0.0	2101.8	3680
8640 min Summer	0.880	0.0	2181.6	4408
10080 min Summer	0.779	0.0	2250.2	5144
15 min Winter	89.113	0.0	420.7	18
30 min Winter	59.880	0.0	567.5	33

ARP Associates		Page 2
Northwest House Servia Hill Leeds LS6 2QH	Keresforth Road Dodworth	
Date 26/01/2018 3:45pm File Keresforth Road lin30.srcx	Designed by PSC Checked by WMW	
Elstree Computing Ltd		
Source Control 2017.1.2		

Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	8.819	0.919	19.7	693.4	O K
120 min Winter	8.985	1.085	19.7	819.0	O K
180 min Winter	9.056	1.156	19.7	873.0	O K
240 min Winter	9.086	1.186	19.7	895.6	O K
360 min Winter	9.097	1.197	19.7	903.4	O K
480 min Winter	9.078	1.178	19.7	889.4	O K
600 min Winter	9.057	1.157	19.7	873.1	O K
720 min Winter	9.031	1.131	19.7	853.7	O K
960 min Winter	8.969	1.069	19.7	806.6	O K
1440 min Winter	8.825	0.925	19.7	698.3	O K
2160 min Winter	8.570	0.670	19.7	505.9	O K
2880 min Winter	8.366	0.466	19.7	352.1	O K
4320 min Winter	8.136	0.236	19.0	177.9	O K
5760 min Winter	8.079	0.179	16.2	135.4	O K
7200 min Winter	8.056	0.156	13.7	117.8	O K
8640 min Winter	8.042	0.142	11.9	106.8	O K
10080 min Winter	8.031	0.131	10.5	98.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	38.413	0.0	737.2	62
120 min Winter	23.801	0.0	914.3	120
180 min Winter	17.725	0.0	1021.7	178
240 min Winter	14.278	0.0	1097.5	234
360 min Winter	10.493	0.0	1210.0	344
480 min Winter	8.431	0.0	1296.4	440
600 min Winter	7.108	0.0	1366.3	474
720 min Winter	6.180	0.0	1425.5	550
960 min Winter	4.951	0.0	1522.4	706
1440 min Winter	3.616	0.0	1666.4	1012
2160 min Winter	2.635	0.0	1829.3	1408
2880 min Winter	2.102	0.0	1945.5	1760
4320 min Winter	1.526	0.0	2116.2	2376
5760 min Winter	1.214	0.0	2250.6	2992
7200 min Winter	1.017	0.0	2354.4	3680
8640 min Winter	0.880	0.0	2443.9	4408
10080 min Winter	0.779	0.0	2521.5	5144

ARP Associates		Page 3
Northwest House Servia Hill Leeds LS6 2QH	Keresforth Road Dodworth	
Date 26/01/2018 3:45pm	Designed by PSC	
File Keresforth Road lin30.srcx	Checked by WMW	
Elstree Computing Ltd		Source Control 2017.1.2

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.351	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 2.300

Time (mins)	Area
From:	To: (ha)
0	4 2.300

ARP Associates		Page 4
Northwest House Servia Hill Leeds LS6 2QH	Keresforth Road Dodworth	
Date 26/01/2018 3:45pm File Keresforth Road lin30.srcx	Designed by PSC Checked by WMW	
Elstree Computing Ltd		
Source Control 2017.1.2		

Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 7.900

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	754.9	0.700	754.9	1.400	754.9	2.100	754.9
0.100	754.9	0.800	754.9	1.500	754.9	2.200	754.9
0.200	754.9	0.900	754.9	1.600	754.9	2.300	754.9
0.300	754.9	1.000	754.9	1.700	754.9	2.400	754.9
0.400	754.9	1.100	754.9	1.800	754.9	2.500	754.9
0.500	754.9	1.200	754.9	1.900	754.9		
0.600	754.9	1.300	754.9	2.000	754.9		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0195-1970-1200-1970
Design Head (m)	1.200
Design Flow (l/s)	19.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	195
Invert Level (m)	7.900
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	19.7
Flush-Flo™	0.378	19.7
Kick-Flo®	0.827	16.5
Mean Flow over Head Range	-	16.8

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	6.8	1.200	19.7	3.000	30.5	7.000	45.9
0.200	18.1	1.400	21.2	3.500	32.9	7.500	47.5
0.300	19.5	1.600	22.6	4.000	35.1	8.000	49.0
0.400	19.7	1.800	23.9	4.500	37.1	8.500	50.5
0.500	19.4	2.000	25.1	5.000	39.0	9.000	51.9
0.600	19.1	2.200	26.3	5.500	40.9	9.500	53.3
0.800	17.1	2.400	27.4	6.000	42.6		
1.000	18.1	2.600	28.5	6.500	44.3		

ARP Associates				Page 5	
Northwest House Servia Hill Leeds LS6 2QH		Keresforth Road Dodworth			
Date 26/01/2018 3:17pm File KERESFORTH ROAD 1IN100 ...		Designed by PSC Checked by WMW			
Elstree Computing Ltd		Source Control 2017.1.2			
<u>Summary of Results for 100 year Return Period (+30%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	8.356	0.456	19.7	486.2	O K
30 min Summer	8.506	0.606	19.7	646.5	O K
60 min Summer	8.662	0.762	19.7	812.7	O K
120 min Summer	8.812	0.912	19.7	972.6	O K
180 min Summer	8.882	0.982	19.7	1047.2	O K
240 min Summer	8.916	1.016	19.7	1084.1	O K
360 min Summer	8.942	1.042	19.7	1111.9	O K
480 min Summer	8.941	1.041	19.7	1111.0	O K
600 min Summer	8.934	1.034	19.7	1103.2	O K
720 min Summer	8.924	1.024	19.7	1092.0	O K
960 min Summer	8.897	0.997	19.7	1063.5	O K
1440 min Summer	8.832	0.932	19.7	994.4	O K
2160 min Summer	8.720	0.820	19.7	875.2	O K
2880 min Summer	8.601	0.701	19.7	748.2	O K
4320 min Summer	8.409	0.509	19.7	543.4	O K
5760 min Summer	8.271	0.371	19.7	395.8	O K
7200 min Summer	8.180	0.280	19.4	299.1	O K
8640 min Summer	8.125	0.225	18.8	240.5	O K
10080 min Summer	8.098	0.198	17.9	210.7	O K
15 min Winter	8.412	0.512	19.7	545.7	O K
30 min Winter	8.581	0.681	19.7	726.7	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	115.846	0.0	480.2	19	
30 min Summer	77.844	0.0	649.3	33	
60 min Summer	49.937	0.0	851.3	64	
120 min Summer	30.941	0.0	1056.3	122	
180 min Summer	23.042	0.0	1180.5	182	
240 min Summer	18.561	0.0	1268.2	242	
360 min Summer	13.641	0.0	1398.3	360	
480 min Summer	10.960	0.0	1497.9	450	
600 min Summer	9.241	0.0	1578.5	506	
720 min Summer	8.034	0.0	1646.6	570	
960 min Summer	6.437	0.0	1757.8	694	
1440 min Summer	4.700	0.0	1921.4	978	
2160 min Summer	3.425	0.0	2120.2	1388	
2880 min Summer	2.733	0.0	2254.9	1760	
4320 min Summer	1.984	0.0	2450.6	2504	
5760 min Summer	1.579	0.0	2610.7	3176	
7200 min Summer	1.322	0.0	2730.6	3824	
8640 min Summer	1.144	0.0	2833.7	4496	
10080 min Summer	1.012	0.0	2921.3	5144	
15 min Winter	115.846	0.0	539.3	18	
30 min Winter	77.844	0.0	728.3	33	
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Elstree Computing Ltd		
Source Control 2017.1.2		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	8.759	0.859	19.7	916.3	O K
120 min Winter	8.928	1.028	19.7	1096.6	O K
180 min Winter	9.010	1.110	19.7	1183.6	O K
240 min Winter	9.052	1.152	19.7	1229.2	O K
360 min Winter	9.090	1.190	19.7	1269.2	O K
480 min Winter	9.097	1.197	19.7	1276.7	O K
600 min Winter	9.087	1.187	19.7	1265.9	O K
720 min Winter	9.068	1.168	19.7	1246.4	O K
960 min Winter	9.034	1.134	19.7	1210.1	O K
1440 min Winter	8.943	1.043	19.7	1112.8	O K
2160 min Winter	8.784	0.884	19.7	943.3	O K
2880 min Winter	8.596	0.696	19.7	742.1	O K
4320 min Winter	8.313	0.413	19.7	440.5	O K
5760 min Winter	8.152	0.252	19.1	269.2	O K
7200 min Winter	8.093	0.193	17.5	206.0	O K
8640 min Winter	8.071	0.171	15.3	181.9	O K
10080 min Winter	8.056	0.156	13.6	165.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	49.937	0.0	954.2	62
120 min Winter	30.941	0.0	1183.8	120
180 min Winter	23.042	0.0	1322.8	178
240 min Winter	18.561	0.0	1421.0	236
360 min Winter	13.641	0.0	1566.6	350
480 min Winter	10.960	0.0	1678.1	458
600 min Winter	9.241	0.0	1768.3	562
720 min Winter	8.034	0.0	1844.3	598
960 min Winter	6.437	0.0	1968.6	740
1440 min Winter	4.700	0.0	2150.6	1052
2160 min Winter	3.425	0.0	2375.1	1512
2880 min Winter	2.733	0.0	2526.3	1900
4320 min Winter	1.984	0.0	2746.6	2592
5760 min Winter	1.579	0.0	2924.5	3176
7200 min Winter	1.322	0.0	3059.0	3752
8640 min Winter	1.144	0.0	3174.8	4488
10080 min Winter	1.012	0.0	3274.2	5144

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.351	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 2.300

Time (mins)	Area
From:	To: (ha)

0	4 2.300
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Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 7.900

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	1066.8	0.700	1066.8	1.400	1066.8	2.100	1066.8
0.100	1066.8	0.800	1066.8	1.500	1066.8	2.200	1066.8
0.200	1066.8	0.900	1066.8	1.600	1066.8	2.300	1066.8
0.300	1066.8	1.000	1066.8	1.700	1066.8	2.400	1066.8
0.400	1066.8	1.100	1066.8	1.800	1066.8	2.500	1066.8
0.500	1066.8	1.200	1066.8	1.900	1066.8		
0.600	1066.8	1.300	1066.8	2.000	1066.8		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0195-1970-1200-1970
Design Head (m)	1.200
Design Flow (l/s)	19.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	195
Invert Level (m)	7.900
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	19.7
Flush-Flo™	0.378	19.7
Kick-Flo®	0.827	16.5
Mean Flow over Head Range	-	16.8

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	6.8	1.200	19.7	3.000	30.5	7.000	45.9
0.200	18.1	1.400	21.2	3.500	32.9	7.500	47.5
0.300	19.5	1.600	22.6	4.000	35.1	8.000	49.0
0.400	19.7	1.800	23.9	4.500	37.1	8.500	50.5
0.500	19.4	2.000	25.1	5.000	39.0	9.000	51.9
0.600	19.1	2.200	26.3	5.500	40.9	9.500	53.3
0.800	17.1	2.400	27.4	6.000	42.6		
1.000	18.1	2.600	28.5	6.500	44.3		