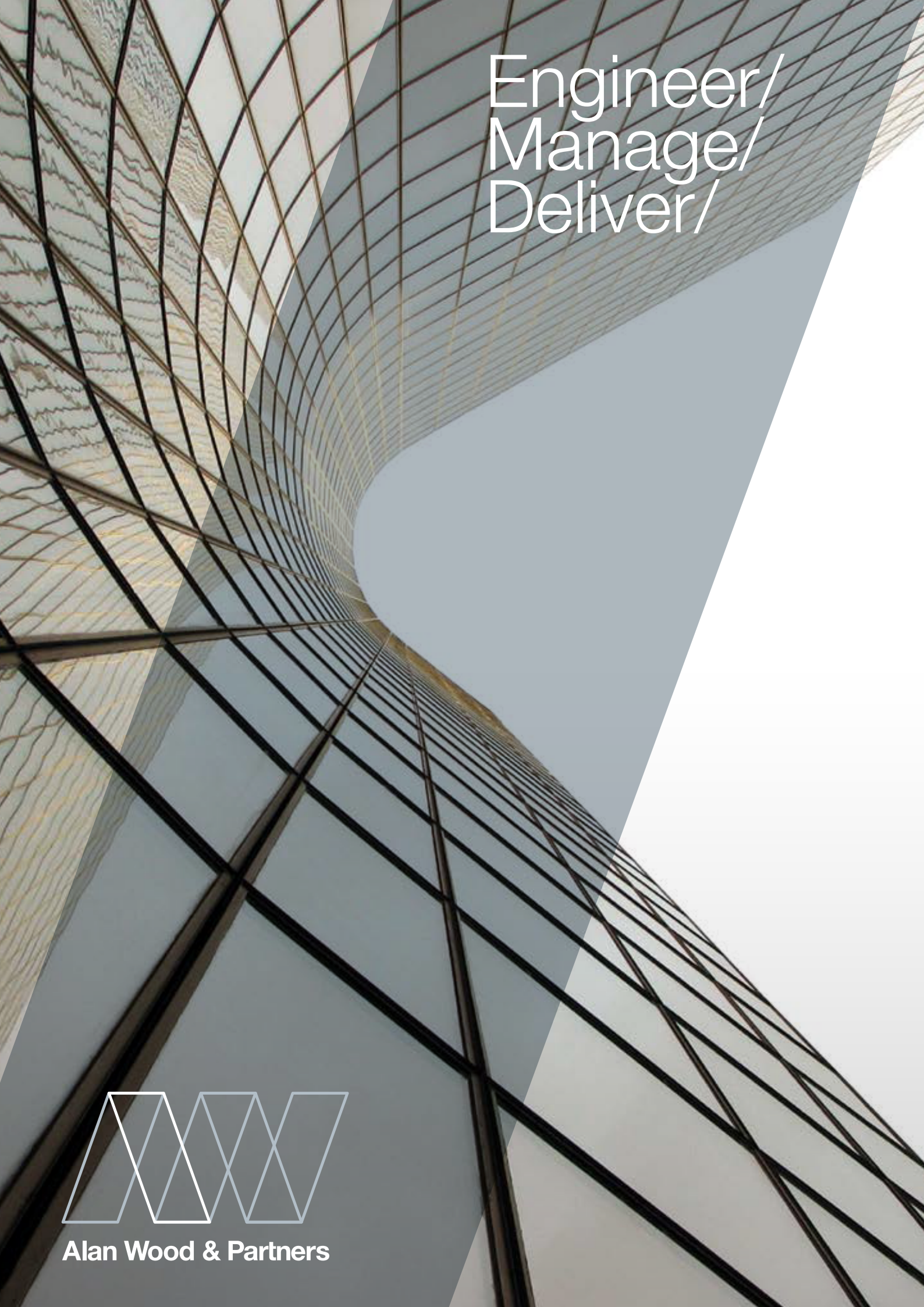

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FLOOD RISK ASSESSMENT FOR A PROPOSED RESIDENTIAL DEVELOPMENT AT BURNISTON, NORTH YORKSHIRE

Project Reference: JG/AD/JF/35267-Rp004 RevA

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Signed: 

Date: 23 February 2018

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Director

Signed: 

Date: 23 February 2018

Issue	Revision	Revised by	Approved by	Revised Date
A	Minor Updates	JAG	JAG	27/02/18
B	Further Minor Updates	JAG	JAG	02/03/18

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APPENDICES

1.0 INTRODUCTION

1.1 Background

1.1.1 A residential development is proposed on land adjacent to No. 38 Limestone Road, Burniston, Scarborough, North Yorkshire by Gascoines Group Limited. An historic planning application for a larger site has been considered under Scarborough Borough Council planning application reference 15/01435, but it was refused planning permission. The new application is for a smaller red-line site boundary, approximately 1.26 hectares in area.

1.1.2 Alan Wood & Partners undertook the original Flood Risk Assessment for the wider site, report reference NW/AD/JD/35267-Rp001 Rev E dated 31.01.2017, which accompanied the original planning application. The Gascoine Group Ltd requested that Alan Wood & Partners prepare a new Flood Risk Assessment report and a Drainage Impact Assessment report to address the new application boundary and reduced scale of development, taking into account the reasons for refusal.

1.1.3 The changed, and reduced site size can be technically delivered as a stand-alone development, and be self-sufficient regarding flood risk mitigation and its proposed drainage. However, in commercial terms the optimum drainage solution would be to include the drainage for the wider development area, as previously identified in the original submittal.

1.2 Layout of Report

1.2.1 Section 1 provides an introduction to the FRA, explains the layout of this FRA and provides an introduction to flood risk and the latest guidance on development and flood risk in England.

1.2.2 Section 2 provides an introduction to the site. The site description is based upon a desktop study, a site visit and information provided by the Gascoine Group Ltd, surveys undertaken by Alan Wood & Partners, surveys by the ecologist, surveys by the archaeologist and information provided by the architect and planning consultant.

1.2.3 Section 3 of this report details the information gathered through the consultation.

1.2.4 Section 4 of this report details the development proposals, and considers the development proposals in relation to the current planning policy on development and flood risk in England (and what type of development is considered appropriate in different flood risk zones). National Planning Policy Framework (NPPF): and its associated Technical Guidance (Communities and Local Government, March 2012) is the current planning policy on flood risk in England, and an introduction to NPPF is provided below.

1.2.5 Section 5 considers the drainage arrangements for the proposed development in simple terms and refers to a separate Drainage Impact Assessment report that was deemed necessary to further consider the site's proposed drainage systems to further demonstrate how potential flood risk can be suitably mitigated and to overcome the planning objection.

1.2.6 Section 6 of this report considers the flood risk to site, and the potential for the development proposals to impact on flood risk. The assessment of flood risk is based on the latest planning policy and uses all the information gathered as part of FRA.

1.2.7 Section 7 of this report provides mitigation measures and any recommendations for further work.

1.2.8 Section 8 of this report provides the summary.

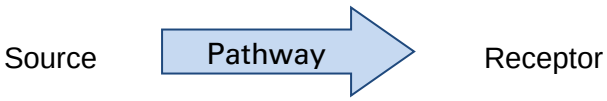
1.3 Flood Risk

1.3.1 Flood risk takes account of both the probability and the consequences of flooding.

1.3.2 Flood risk = probability of flooding x consequences of flooding

1.3.3 Probability is usually interpreted in terms of the return period, e.g. 1 in 100 and 1 in 200 year event, etc. In terms of probability, there is a 1 in 100 (1%) chance of one or more 1 in 100 year floods occurring in a given year. The consequences of flooding depends on how vulnerable a receptor is to flooding.

The components of flood risk can be considered using a source-pathway-receptor model.



1.3.4 Sources constitute flood hazards, which are anything with the potential to cause harm through flooding (e.g. rainfall extreme sea levels, river flows and canals). Pathways represent the mechanism by which the flood hazard would cause harm to a receptor (e.g. overtopping and failure of embankments and flood defences, inadequate drainage and inundation of floodplains). Receptors comprise the people, property, infrastructure and ecosystems that could potentially be affected should a flood occur.

1.4 National Planning Policy Framework

1.4.1 General

1.4.1.1 NPPF and its associated Technical Guidance replaces Planning Policy Statement 25 and provides guidance on how to evaluate sites with respect to flood risk.

A summary of the requirements of NPPF is provided below.

1.4.2 Sources of Flooding

1.4.2.1 NPPF requires an assessment to flood risk to consider all forms of flooding and lists six forms of flooding that should be considered as part of a flood risk assessment. These forms of flooding are listed in Table 1, along with an explanation of each form of flooding.

Table1: Forms of Flooding

Flooding From Rivers (Fluvial Flooding)
Watercourses flood when the amount of water in them exceeds the flow capacity of the river channel. Flooding can either develop gradually or rapidly, depending on the characteristics of the catchment. Land use, topography and the development can have a strong influence on flooding from rivers.
Flooding From the Sea (Tidal Flooding)
Flooding to low-lying land from the sea and tidal estuaries is caused by storm surges and high tides. Where tidal defences exist, they can be overtopped or breached during a severe storm, which may be more likely with climate change.
Flooding from Land (Pluvial Flooding)
Intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems can run quickly off land and result in local flooding. In developed areas this flood water can be polluted with domestic sewage where foul sewers surcharge and overflow. Local topography and built form can have a strong influence on the direction and depth of flow.

The design of development down to a micro-level can influence or exacerbate this. Overland flow paths should be taken into account in spatial planning for urban developments. Flooding can be exacerbated if development increases the percentage of impervious area.
Flooding from Groundwater
Groundwater flooding occurs when groundwater levels rise above ground levels (i.e. groundwater issues). Groundwater flooding is most likely to occur in low-lying areas underlain by permeable rocks (aquifers). Chalk is the most extensive source of groundwater flooding.
Flooding from Sewers
In urban areas, rainwater is frequently drained into sewers. Flooding can occur when sewers are overwhelmed by heavy rainfall, and become blocked. Sewer flooding continues until the water drains away.
Flooding from Other Artificial Sources (i.e. reservoirs, canals, lakes and ponds)
Non-natural or artificial sources of flooding can include reservoirs, canals and lakes. Reservoir or canal flooding may occur as a result of the facility being overwhelmed and /or as a result of dam or bank failure.

1.4.3 Flood Zones

1.4.3.1 For river and sea flooding, NPPF uses four Flood Zones to characterise flood risk. These Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences, and are detailed in Table 2.

Table 2: Flood Zones

Flood Zone	Definition
1	Low probability (less than 1 in 1,000 annual probability of river or sea flooding in any year (<0.1%).
2	Medium probability (between 1 in 100 and 1 in 1,000 annual probability of river flooding (1%-0.1%) or between 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5%-0.1%) in any year).
3a	High probability (1 in 100 or greater annual probability of river flooding (>1%) in any year or 1 in 200 or greater annual probability of sea flooding (>0.5%) in any given year).
3b	This zone comprises land where water has to flow or be stored in times flood. Land which would flood with an annual probability of 1 in 20 (5%), or is designed to flood in an extreme flood (0.1%) should provide a starting point for discussions to identify functional floodplain.

1.4.4 Vulnerability

1.4.4.1 NPPF classifies the vulnerability of developments to flooding into five categories. These categories are detailed in Table 3.

Table 3: Flood Risk Vulnerability Classification

Flood Risk Vulnerability Classification	Examples of Development Types
Essential Infrastructure	- Transport Infrastructure - Utility Infrastructure (e.g. water treatment works and wind turbines)
Water Compatible	- Flood Control Infrastructure - Water and Sewerage Infrastructure - Navigation Facilities - Water Based Recreation
Highly Vulnerable	- Emergency Services - Basement Dwellings - Mobile Home Parks
More Vulnerable	- Hospitals and other Health Services - Residential Establishments - Educational Establishments
Less Vulnerable	- Commercial Establishments (e.g. shops, restaurants and offices)

1.4.4.2 Based on the vulnerability of a development, NPPF states within what Flood Zones(s) the development is appropriate. The flood risk vulnerability and Flood Zone 'compatibility' of developments is summarised in Table 4.

Table 4: Flood Risk Vulnerability and Flood Zone Compatibility.

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	1	✓	✓	✓	✓	✓
	2	✓	✓	Exception Test	✓	✓
	3a	Exception Test	✓	x	Exception Test	✓
	3b	Exception Test	✓	x	x	x

1.4.5 The Sequential Test, Exception Test and Sequential Approach

1.4.5.1 The Sequential Test is a risk-based test that should be applied at all stages of development and aims to steer new development to areas with the lowest probability of flooding (Zone 1). This is applied by the Local Planning Authority by means of a Strategic Flood Assessment (SFRA).

1.4.5.2 The SFRA and NPPF may require the Exception Test to be applied to certain forms of new development. The test considers the vulnerability of the new development to flood risk and, to be passed, must demonstrate that:

- There are sustainability benefits that outweigh the flood risk and;
- The new development is safe and does not increase flood risk elsewhere.

1.4.5.3 The Sequential Approach is also a risk based approach to development. In a development site located in several Flood Zones or with other flood risk, the sequential approach directs the most vulnerable types of development towards areas of least risk within the site.

1.4.6 Climate Change

1.4.6.1 This is a planning requirement to account for climate change in the proposed design. The recommended allowances should be based on the most relevant guidance from the Environment Agency and the Lead Local Flood Authority.

2.0 THE SITE AS EXISTING

2.1 The site currently comprises agricultural pasture land with a total site area of approximately 1.26 hectares.

2.2 An aerial photograph in Appendix A which shows the location of the site.

2.3 A topographic survey of the site was undertaken which reveals that ground levels over the area of the proposed development vary from approximately 54m to approximately 71m above Ordnance Datum (OD(N)).

2.4 Levels on Limestone Road adjacent to the entrance to the development were found vary from approximately 65.9m OD(N) up to approximately 70.7m OD(N).

2.5 A copy of the topographic survey drawing is included in Appendix B.

2.6 The Ordnance Survey grid reference for the centre of the site is approximately 500385, 493345.

2.7 There are existing buildings at the site entrance off Limestone Road, one being a derelict house and the remaining are used to house animals that graze the fields. Positive drainage is recorded (refer to later sections) from the buildings, and other drainage systems are present in other parts of the site, and therefore the site is afforded an historic drainage right.

2.8 A local source of natural water rises from Storry Hills, over 250m to the west of the site, which runs in open ditch northwards to a culvert approximately 100m to the north of the site. The culvert ultimately connects in to Lindhead Beck, approximately 250m north of the site. There is a pond approximately 50m to the north of site, next to the ditch. None of these features are shown to cross the site and they are on the other side of the natural ridge (hill) and are therefore not within the site's hydrological watershed catchment. The hydrological context of the site and the surrounding area is shown in the image in Appendix C.

3.0 CONSULTATION AND INVESTIGATIONS

3.1 Consultation has taken place with the planning consultant, Pegasus, in order to obtain relevant information pertaining to the proposed development. This included the layout, pre-planning discussions and enquiries with the local authority.

3.2 Consultation has taken place with Scarborough Borough Council in the drainage team and the planning team to discuss the site's existing flood risk and the proposed development's impact on flood risk and drainage.

3.3 Consultation has taken place with North Yorkshire County Council as the Local Lead flood Authority in response to queries on the proposed scheme.

3.4 Consultation has taken place with the Environment Agency in order to obtain relevant information in respect of potential flooding and the source protection zone. The flood risk maps are included in Section 6 of this report.

3.5 Consultation has been undertaken with Yorkshire Water (YWS) in respect of the disposal of foul water and surface water from the development. The Pre-Planning Enquiry response from YWS is included in Appendix D, which includes a sewer record plan and recommendations on the potential disposal of foul and surface water flows.

3.6 Historic imagery of the site has been obtained and this is included in Appendix E.

3.7 Investigations have taken place by a number of specialist sub-contractors, including:

- Intrusive geo-technical works to prove ground conditions, groundwater levels and the potential for soakaways. An extract from the geotechnical report is included in Appendix F.
- Ecology surveys in relation to habitat and species and features were identified during site visits relevant to drainage (such as an outfall and a drainage depression off-site in a lower part of the site). An extract from the ecologist report is included in Appendix G.

- Archaeology surveys, including a geo-physical survey which identified pipes that were shown on the YWS sewer records and from site observations. An extract from the archaeology report is included in Appendix H.
- CCTV surveys on the existing private and public sewers on site and surrounding the site to confirm connectivity and the below ground sewer details. These are included in Appendix I.

3.8 Alan Wood & Partners has attended site and undertaken the topographic survey and witnessed the standing flood water that is outside the current red-line boundary, at the lower part of the site. Alan Wood & Partners engineers have been present when the standing flood water was removed by pumping and tanker operations and further investigations have been possible on an existing headwall within the lower part of the field that was discovered following the de-watering of the site. The existence of the head wall coincides with anecdotal evidence relating to some form of surface water drainage system at this part of the site (including the linear depression running away the head wall). This area now falls outside the proposed red-line boundary, but the details are still included within this report to provide a context for the main flood risk issues in the wider area.

4.0 THE PROPOSED DEVELOPMENT

4.1 The proposed development involves the construction of approximately 30 to 40 residential properties within the revised re-line boundary, together with associated service supplies and infrastructure works.

4.2 At this stage an Outline Planning Application is being made, and the exact site layout will be subject to a Reserved Matters application. An illustrative layout drawing of the proposed development is included in Appendix J.

4.3 The purpose of this supporting report is to enable a suitably worded Condition in relation to flood risk and drainage to be applied to the grant of planning permission. The proposed development is therefore subject to detailed design and confirmation, but its guiding principles in regards to flood risk and drainage are set out below:

- The finished floor level of the plots will be set at a level to suit the proposed ground levels and be set 150mm above surrounding ground where possible
- No works are planned to raise or lower the site ground levels at the boundaries.
- There will be no basements within the dwellings
- The foundations of the new dwellings will be designed and constructed appropriately.
- Surface water will be collected from new roofs, car parks and hardstanding areas formally and positively discharged, as further discussions in Section 5
- The development will be provided with a separate foul water sewer system which will connect to the local public sewer network
- The lifetime of the development is considered to be 100 years due to its residential nature.
- The foul and surface water sewers will be offered for adoption to Yorkshire Water via a formal S104 application, and the designs will need to meet the requirements of Sewers for Adoption, supplemented by Yorkshire Water's standards
- The highways (other than private drives) will be offered for adoption by North Yorkshire County Council via a formal S38 application and the designs will need to meet NYCC's standards

4.4 The development is classified as 'More Vulnerable' in accordance with Table 3 in Section 1.

4.5 In accordance with NPPF and as described in Table 5 in Section 1, the impact of climate change should be included in the analysis. Due to the development lifetime being 100 years, a 30% increase to rainfall intensity due to climate change will be included for in the 1 in 100 year analysis.

4.6 In accordance with Local lead Flood Authority guidance, the impact of urban creep over the lifetime of the development should be allowed for and this is taken as a 10% increase to impermeable areas.

5.0 DRAINAGE

Existing Site

5.1 From the aerial photograph included in Appendix A it can be seen that the development site currently comprises a number of agricultural fields and two buildings and hardstanding.

5.2 Based upon an agricultural run-off rate of 1.4 litres per second per hectare, the existing unrestricted surface water run-off from the permeable area is approximately 1.7l/s, and the run-off from the existing building roofs is approximately 3.8l/s (275m^2 x 140 litres per second per hectare (50mm/hr based on BS EN 752 methods), therefore a total of around 5.5 litres per second,

Runoff Destination

5.3 Requirement H3 of the Building Regulations 2000 establishes a preferred hierarchy for disposal of surface water. Consideration should firstly be given to soakaway, infiltration, watercourse and sewer in that priority order.

5.4 Percolation testing has revealed that the ground conditions are not suitable for soakaways/infiltration trenches to be used for the disposal of surface water run-off from the development.

5.5 In accordance with the surface water discharge hierarchy, and to reduce the risk to the source protection zone a discharge to watercourse is preferred. However, there are no watercourses within the site, and the nearest is on the other side of the 'hill' therefore discharge to it would break the natural water-shed, and this is to be avoided. It would also require third-party land negotiations, which effectively hold the developer to 'ransom' regarding wayleaves and riparian ownership permissions. A sewer requisition by Yorkshire Water still require s riparian permissions, therefore a 'ransom' still exists. For these reasons a discharge to watercourse is ruled out.

5.6 A connection to the Yorkshire Water surface water public sewer is therefore the only reasonable method of surface water disposal. Yorkshire Water have been consulted regarding the proposal to discharge surface water drainage from the development site to a public sewer and the pre-planning

enquiry (PPE) response It confirms that it is possible to do so at a restricted rate of 5l/s.

Peak Flow Control

5.7 Basing the impermeable area on 55% of the site area (0.693ha) and adding 10% for urban creep (0.0693ha), the total impermeable area equates to around 0.762ha. The uncontrolled surface water run-off from the new development could be approximately 106 litres per second, based on BS EN 752 calculations, using a rainfall intensity of 50mm/hour. However, to meet the flood risk planning requirements it is unacceptable to discharge flows freely from proposed development sites at an unrestricted rate. Therefore flows from the proposed development will be limited to the lowest practicable, adoptable rate of 5l/s. An adoptable pumping station will be required to lift controlled flows into the public sewer that is higher up the site. In line with Yorkshire Water requirements a vortex flow control is required upstream of the pumping station, rated at a minimum of 0.5l/s less than the pump rate, therefore the actual flow control rate on site will be 4.5l/s. The pumping station could be constructed to take flows from future phases, and whilst the optimum position for the pumping station (and storage) is at the lowest part of the site, it is technically feasible to locate the pumping station and attenuation tank with the red-line boundary of the revised, smaller site.

5.8 Excess flows will be balanced on site, up to and including the 1 in 100 year return period, with an allowance for climate change.

5.9 A copy of the preliminary WinDES hydraulic modelling calculations is included in Appendix K showing the storage volumes, which are summarised as follows:

- 1 in 30 year = 365m^3
- 1 in 100 year + 30% climate change impact = 480m^3

5.10 An indicative surface water drainage layout is included in Appendix L. Based on Sewers for Adoption guidance, and YWS's requirements at this stage, all flows could be stored in an on-line storage tank. Pipe sizes and gradients are subject to detailed design, but could range from 150mm at the site's upstream (higher) end adjacent to Burniston Road, to 525mm at the downstream end adjacent to the attenuation tank, at the site's low point.

Volume Control

5.11 The run-off volume post development will be more than pre-development by the creation of impermeable areas and the formal drainage systems which must be installed. Provision of water butts and recycling will be encouraged, but due to the limitations on infiltration methods of disposal and the fact that the surface water drainage system will be designed and constructed to meet Sewers for Adoption and Yorkshire Water requirements and highways to meet North Yorkshire County Council standards, the opportunity to reduce the surface water discharge volume is limited. Reducing the rate to 5l/s is marginally less than the calculated 5.5l/s previously.

Pollution Control

5.12 The risk of pollution is low as the proposed site is to be used for residential purposes only. Clean roof water drainage will be discharged into the below ground sewers via a closed system. Road drainage will be collected via trapped gullies and discharged to a sealed below ground surface water sewer system also. Discharge to a sewer upstream of the watercourse provides a level of protection.

Designing for Exceedance

5.13 Overland flood risk from exceedance flows and from off-site sources will be mitigated to a large extent by the creation of the new surface water sewerage system as described above. Where possible road levels and proposed ground levels will be set to channel flows away from the proposed dwellings. The site naturally falls towards the proposed public open space area and where the storage is proposed, thus flows will tend towards this unpopulated area. Off-site land is lower still, and therefore flows will lead towards this area.

5.14 Furthermore, the ground floor construction level for dwellings should ideally be raised to 150mm above the finished ground level in order to provide additional clearance above any likely flooding.

5.15 The fact that overland flood routing is shown going off-site does not mean that the flood risk to off-site parties is increased. This flood risk already exists, and whilst the proposed development should not increase this risk,

and will likely reduce it by the creation of a formal surface water drainage system, it can not remove this risk entirely.

Highways Drainage

5.16 Highway drainage will be dealt with by the design and construction of surface water sewers within the highways that will be offered to YWS for adoption via a formal S104 application. The highway will be offered to North Yorkshire County Council for adoption via a formal S38 application.

Climate Change

5.17 The impact of climate change is included in the proposed system for the 1 in 100 year event by including a 30% increase in rainfall intensity within the calculations. This is based on the lifetime of the development being 100 years and in line with local planning policy.

Urban Creep

5.18 We have undertaken a sample area showing that the site's impermeable area is approximately 55% of the overall area, and have added 10% to the impermeable area for the drainage assessment and WinDES calculations to allow for the impact of urban creep.

Operation and Maintenance

5.19 The sewers will be offered to YWS for formal adoption therefore YWS will be responsible for the operation, management and maintenance of the sewerage, in line with standard requirements and obligations.

<u>Foul Water Drainage</u>

5.20 Yorkshire Water have been consulted regarding the proposal to discharge foul water drainage from the development site to a public sewer and the pre-planning enquiry (PPE) response is included in the appendices.

5.21 YWS have advised that foul water domestic waste from the development should discharge to the existing public foul sewer which is recorded in The Limes.

5.22 Based upon a development of up to 40 dwellings and a peak flow rate of 4,000 litres per dwelling per day in accordance with Sewers for Adoption 7th Edition (Clause B5.1), the peak foul water flow from the full development site would be approximately 2 litres per second.

5.23 A separate foul sewer network will be designed and built to meet Building Regulations (private) and Sewers for Adoption (public) standards.

5.24 A 100mm pipe laid at 1/80 has the capacity to discharge the anticipated peak foul water flows from the site, and at this stage a pumping station discharge is envisaged.

5.25 Foul sewer pipe sizes will range from 100mm to 150mm in diameter and the pipe gradients will range from 1/40 to 1/150 to meet the required standards.

6.0 FLOOD RISK ASSESSMENT

6.1 Flood Zone

6.1.1 A copy of the Environment Agency Flood Outline Map is included in Figure 3 below, which identifies the area of the development to be located within an area designated as Flood Zone 1 (low probability of flooding), with a less than 1 in 1000 annual probability of flooding in any year.

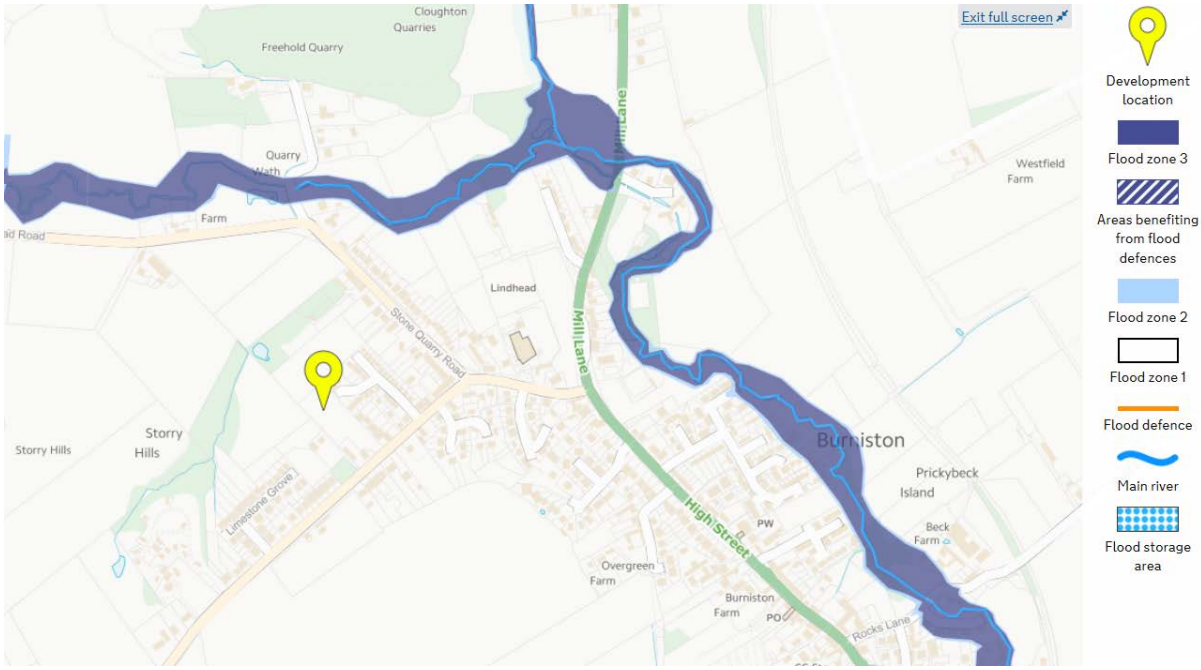


Figure 3: Environment Agency Flood Outline Map dated January 2018

6.2 Historical Flooding

6.2.1 There are no historical records of fluvial flooding in the settlement of Burniston, although the site has been subject to local ponding of surface water as referred to previously.

6.3 Fluvial Flooding

6.3.1 The potential sources of fluvial flooding to the development are the Lindhead Beck and Burniston Beck, both of which are over 300m from the site.

6.3.2 Ground levels at the location of the development site are in the region of 54m to 71m OD(N), whilst ground levels adjacent to the Becks are approximately on the 50m OD(N) contour, therefore the site is remote and high enough from the fluvial flood risk sources to be at low risk from flooding.

6.4 Flooding from Open Drainage Ditches

6.4.1 There are no open drainage ditches located within the site or immediate areas of the development site.

6.4.2 The risk to the development from this potential source of flooding is considered to be low and acceptable.

6.5 Groundwater Flooding

6.5.1 Groundwater flooding can occur when the sub-surface water levels are high and emerges above ground level.

6.5.2 The results of the ground investigation tests show that no groundwater was recorded at the time they were undertaken. There are no proposals to create any basements within the development.

6.5.3 The risk to the development from this potential source of flooding is considered to be low and acceptable.

6.6 Surface Water Flooding

6.6.1 A copy of the Environment Agency's map showing the potential risk of flooding from surface water is included in Figure 5 below.

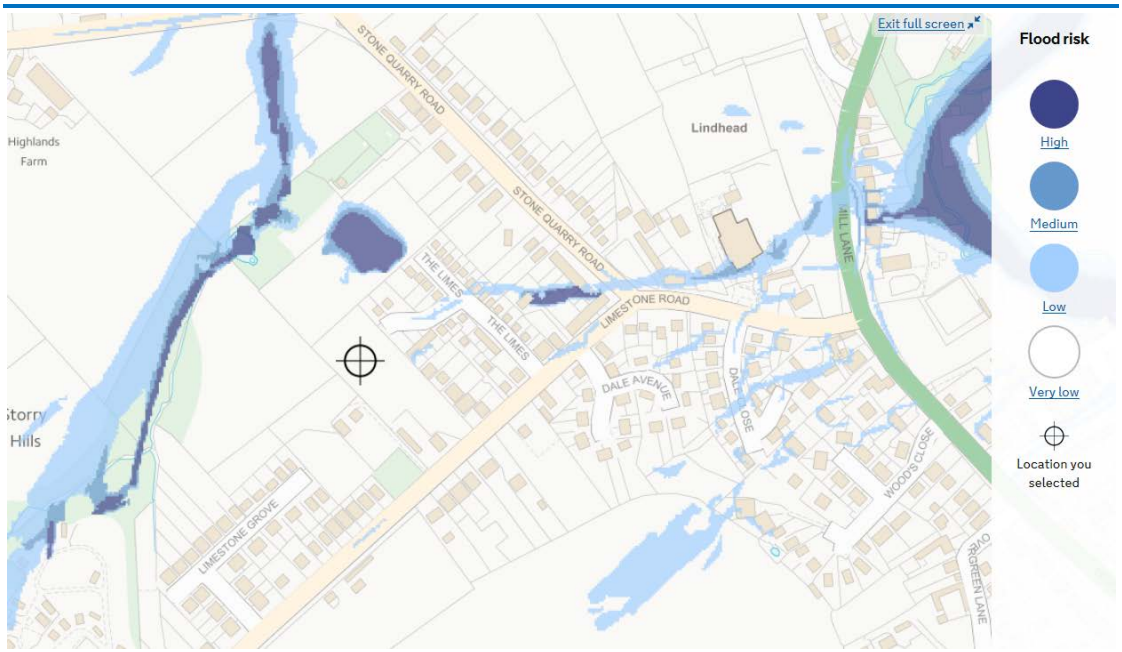


Figure 5 – Environment Agency's Map dated January 2018 showing the potential risk of flooding from surface water

6.6.2 The map produced by the Environment Agency shows that is no localised surface water flooding within the development site, primarily due to the site topography. An area outside the site's north-eastern boundary, which is lower than the site, is at risk from surface water flooding, but as this is outside the site boundary it does not materially affect the proposed development.

6.7 Flood Risk from Water Mains

6.7.1 There are no known potable water mains that cross the development site.

6.7.2 The risk to the development from this potential flood source is therefore considered to be low to medium and acceptable.

6.8 Flooding from Existing Drainage

6.8.1 As referred to previously, the site is at flood risk from surface water flows, contributed by an existing outfall into the site that discharge surface water from The Limes. The existing buildings on the site are also formally drained via shallow and small surface water sewers that discharge off-site.

6.8.2 The risk to the development from this potential source is considered to be medium to high and mitigation will be required, as considered in Section 7.

6.9 Flooding from Reservoirs, Canals and Other Artificial Sources

6.9.1 Investigations indicate that there are no structures in the vicinity of the development which are likely to pose any risk of flooding.

6.9.2 A copy of the map produced by the Environment Agency showing potential risk of flooding from reservoirs is included in Figure 6 below.

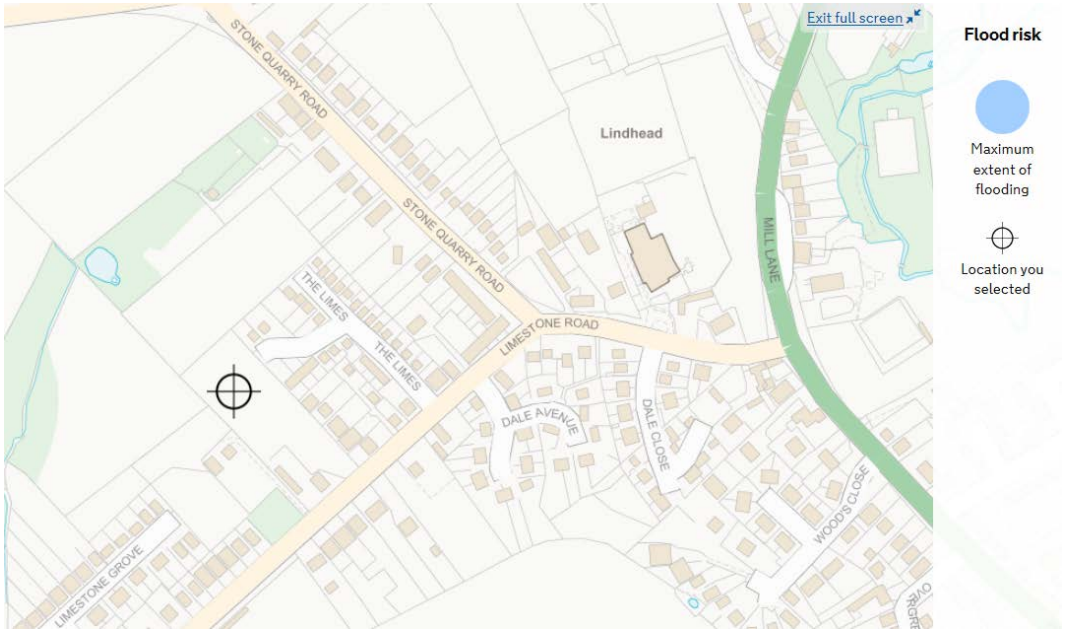


Figure 6 – Environment Agency's map dated January 2018 showing the potential risk of flooding from Reservoirs

6.9.3 The map shows that the development site is not considered to be at risk.

6.9.4 The risk to the development from any such potential flood source is considered to be low and acceptable.

6.10 Flooding from Proposed Drainage

6.10.1 Flood risk from the proposed foul water drainage is considered to be low and acceptable as the flows are low and YWS will be responsible for the operation, management and maintenance of the system.

6.10.2 Flood risk from the proposed surface water drainage is high due to the peak surface water flow rates created by the development and its new

impermeable areas. Mitigation is required, and as discussed in Section 5 and Section 7.

7.0 RECOMMENDATIONS

7.1 Surface water flood risk from the development will be mitigated by limiting discharge rates to the public sewer and storing excess flows on site. The surface water drainage system will be designed to meet recognised standards and the system will be formally adopted by YWS, thus there will be a responsible party for the system's operation, management and maintenance.

7.2 Overland flood risk from exceedance flows and from off-site sources will be mitigated to a large extent by the creation of the new surface water sewerage system as described above. Where possible road levels and proposed ground levels will be set to channel flows away from the proposed dwellings. The creation of a formal surface water runoff system that positively controls discharges will improve the existing situation.

7.3 The fact that overland flood routing could go off-site does not mean that the flood risk to off-site parties is increased. This flood risk already exists, and whilst the proposed development should not increase this risk, and will likely reduce it by the creation of a formal surface water drainage system, it can not remove this risk entirely.

7.5 With the site lying within an area considered not to be at risk from surface water, fluvial or reservoir flooding, we do not consider there to be any requirement for flood resilient construction methods to be adopted within the design of the buildings.

7.6 Surface water drainage will be discharged to the local public sewer at an agreed rate with excess flows balanced on the site to meet the local planning policy requirements. The system should be designed to meet building regulation requirements and Sewers for Adoption standards.

7.7 The approach road to the development (Limestone Road) is above predicted flood levels and consequently safe access to and egress from the development should still be achievable during a flood situation.

7.8 There should therefore be no requirements for evacuation of building occupants resulting from the development.

8.0 CONCLUSIONS

8.1 The report has been prepared to assess the flood risk and drainage implications for a new residential development which is located at Burniston, North Yorkshire.

8.2 The site falls in Flood Zone 1 (low flood risk) and the proposals are considered to be 'More Vulnerable'.

8.3 The proposed site and its red-line boundary is reduced compared to a planning application for a larger scheme that was refused planning permission in 2017 (reference 15/01435). Scarborough Borough Council's reason for refusal was included in their decision notice and stated:

> *Part of the application site is identified by the Environment Agency as being at high risk of surface water flooding, and this area regularly suffers significant ponding. Policy ENV3 of the Scarborough Borough Local Plan states that proposals will be expected to mitigate against the implications of environmental risk. The applicant's submission fails to demonstrate to the satisfaction of the Local Planning Authority that ground water sources are not contributing to this ponding, or that development of the site would not put new and existing properties at risk of flooding from groundwater sources. With this in mind, the proposal is contrary to policy ENV3 of the Local Plan and is unacceptable on its planning merits.*

8.4 The revised application site is not subject to surface water flood risk according to the EA mapping, and has not suffered from ponding. This is because this site is on a slope and is higher than the lower part of the field that is at risk from surface water ponding. The lower part of the site is not within this application's boundary.

8.5 Historically, this lower (off site) section has suffered from ponding, but it has not been permanent. Historical mapping and details from the ecologist and archaeologist reports that are referred to in this report's appendices demonstrate this. The proposed development will reduce ponding by reducing both the impact of rainfall and flows as explained in the following paragraphs.

8.6 With regards the refusal reference to the potential for groundwater sources contributing to the ponding, the ground investigation results that were included in the original application reports, and this application report's appendices, demonstrate that groundwater was not struck when digging down to a depth of 4m below ground level. The investigations acknowledge the presence of soft ground and that the soakaway tests conclude that infiltration will not be a suitable means of surface water disposal, but groundwater is not recorded, nor referenced. It is clear therefore that groundwater is not a contributory factor to flood risk.

8.7 With regards flood risk for new and existing properties due to groundwater sources, as described above, groundwater flood risk is not a flood risk concern for this site and therefore does not require mitigation. However, the developer is acutely aware of the issues on the lower part of the site, which is outside the application boundary, and intends to deliver a scheme that incorporates flood risk mitigation into the proposals.

8.8 The primary flood risk is therefore from the impact of rainfall.

8.9 A surface water drainage system is proposed that captures the impermeable area run-off, and stores water up to and including the 1 in 100 year (plus an allowance for urban creep and climate change). As the site currently is drained informally, the development of the site should reduce flood risk overall, as flows simply run down the field into the lower area.

8.10 Mitigation measures are proposed which we consider will reduce this risk to an acceptable level. This includes the positive management of surface water and the fact that the new development's drainage system will intercept approximately 60% of the rainfall, and by discharging into the public sewer at an agreed rate and balancing excess flows up to the 1 in 100 year plus 30% allowance for climate change, the proposed system will provide betterment.

8.11 In constructing a new surface water drainage system within the site that intercepts around 60% of the rainfall it provides a betterment compared to the existing situation. Currently rainfall runs off the sloping site at an uncontrolled rate towards the lower, off site area. With the proposed drainage intercepting this run off and controlling flows up to the 1 in 100 year plus climate change event, the low part of the site will receive less flow

than currently occurs and is accorded a significant level of protection against run off from the upper section of the field that is being developed.

8.12 The primary focus for flood risk assessment is to protect life, and then consideration should be given to buildings, contents, operation and re-use. Where possible ground levels around the dwellings should fall away from thresholds to reduce the overland flow flood risk.

8.13 This report has considered other potential sources of flooding to the site, including groundwater, land, existing sewers water mains and other artificial sources.

8.14 During the previous planning application Alan Wood & Partners held informal and formal discussions with Scarborough Borough Council in relation to the flood risk, drainage and technical solutions. No objections were raised in relation to the technical solutions prior to determination. Similar principles are proposed for the revised planning application.

8.15 In summary, the proposals will therefore improve the flood risk and drainage across the site as a whole and provide a betterment for the following reasons:

- Flood risk from groundwater sources is low
- The site is on a slope, but does not include the lower part of the field, and therefore is outside the area shown at risk from the Environment Agency surface water flood map
- The proposed scheme will deal with surface water to meet the Local Lead Flood Authority's requirements and affords the site and wider area protection compared to the current scenario

8.16 Overall, this report demonstrates that the flood risk to the site is reasonable and acceptable providing the mitigation measures are implemented and incorporated into the final site layout and detailed design. This can be controlled by suitably worded Conditions in relation to flood risk and drainage matters.

APPENDIX A

Aerial photo

AERIAL PHOTOGRAPH SHOWING SITE LOCATION

Alan Wood & Partners

APPENDIX B

Topographic Survey

Notes

A01. These notes are intended to augment drawings and specifications. Where conflict of requirements exists the order of precedence shall be as shown in the specification. Otherwise the strictest provision shall govern.

A02. This drawing to be read in conjunction with all other relevant engineers and architects drawings.

A03. Drawings not to be scaled. All dimensions to be checked on site by the contractor. Any discrepancies to be notified to the Engineer and further instructions obtained before work is commenced.

A04. The structure is designed to be self-supporting and stable after the building is fully completed. It is the contractors sole responsibility to determine the erection procedure and sequence and ensure that the building and its components are safe during erection. This includes the addition of whatever temporary bracing, guys or tie-downs which may be necessary, such material remaining the property of the contractor on completion, and for ensuring that the works and any adjacent properties are safe in the temporary condition.

Survey Notes

A) VERTICAL DATUM:

ALTITUDES FOR THE CONTROL ARE BASED UPON GPS DERIVED HEIGHTS AND CONVERTED TO ORTHOMETRIC HEIGHTS (ORDNANCE DATUM NEWLYN - ODN) USING OSGM02 TRANSFORMATION PARAMETERS.

B) GPS CONTROL

THE CO-ORDINATE SYSTEM USED FOR THE PRIMARY CONTROL IS OSGB36;

FOR THIS PARTICULAR PROJECT, THE "LEICA VIVA" NETWORK HAS BEEN USED. OBSERVATIONS HAVE BEEN TAKEN ON THE FOLLOWING DATE(S): 20th JANUARY 2014

MANUFACTURERS QUOTED ACCURACY IS RMSE 10 – 20 mm IN PLAN AND 20 – 30 mm IN HEIGHT, HOWEVER, RESULTS MAY VARY DURING THE DAY AND CERTAIN CONDITIONS COULD CAUSE DEGRADATION TO THE FINAL SOLUTIONS.

KEY

GU - GULLY
LP - LAMPPOST
TEL MH - BT MANHOLE
MH - MANHOLE
EL - EAVES LEVEL
RL - RIDGE LEVEL
- FENCE LINE
- HEDGE
- TREE CANOPY
T - TREE TRUNK

Rev.	Description	Date	Chk.	App.

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Building Surveyors

Also at:

York	T. 01904 611594
Scarborough	T. 01723 865484
Louth	T. 01507 610784
Sheffield	T. 01142 541307

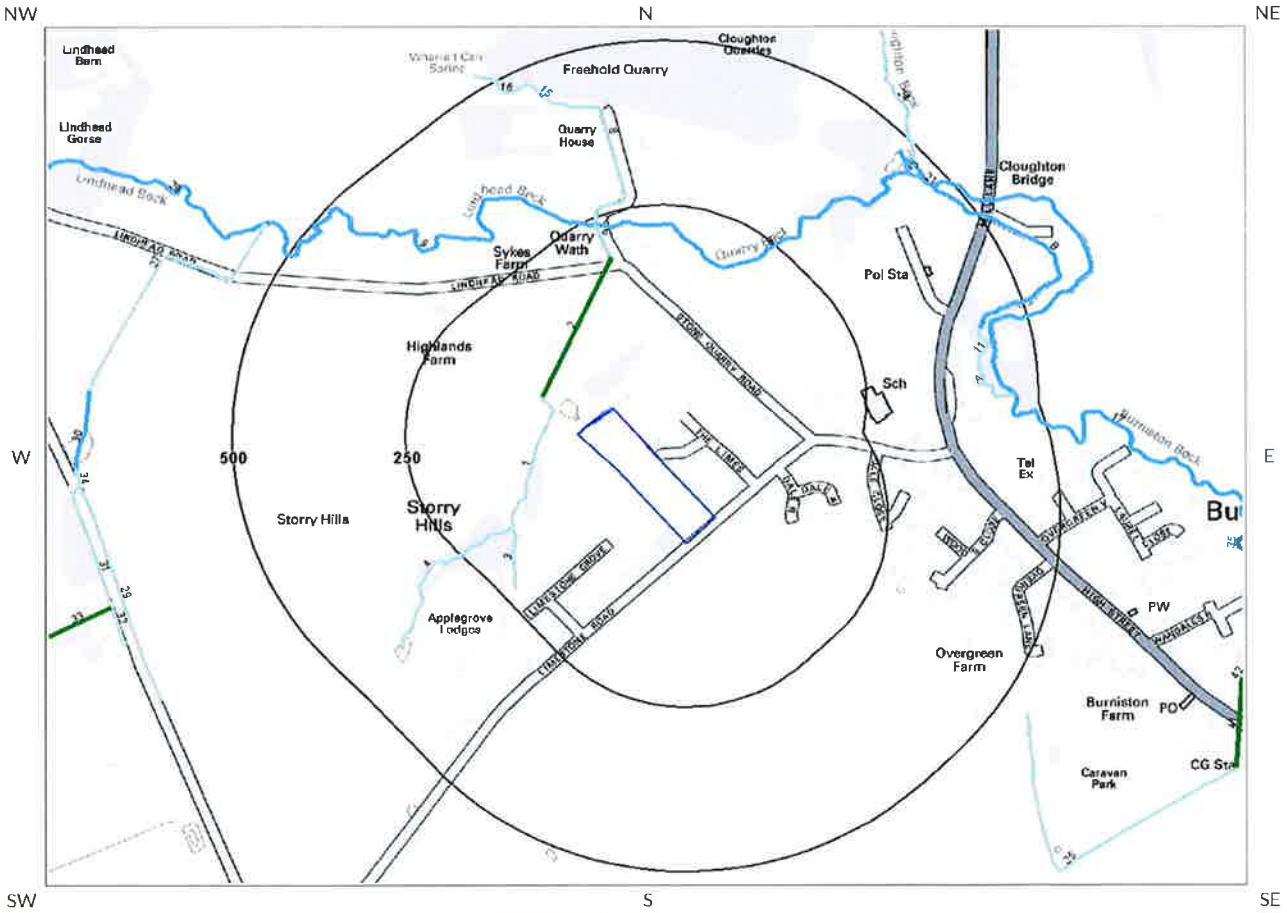
Project:	PROPOSED RESIDENTIAL DEVELOPMENT AT LIMESTONE ROAD, BURNISTON
Client:	GASCOINE GROUP LIMITED
Drawing:	TOPOGRAPHICAL SURVEY
Date:	27-01-14
Scale@A1:	1:500
Drawn By:	PS
Check By:	AR
Approved By:	CS
Drawing Status:	PRELIMINARY
Job. no.	35267
Dwg. no.	001
Rev.	

100mm at A1

APPENDIX C

Surrounding Hydrology

5d. Hydrology – Detailed River Network and River Quality



Map Legend

Mapping sourced from Ordnance Survey

- Site Outline
- 250 / 500 — Search Buffers (m)
- Primary River
- Secondary River
- Tertiary River
- Lake/Reservoir
- Underground River (inferred)
- General Quality Assessment: Biology
- General Quality Assessment: Chemistry
- Canal
- Canal Tunnel
- Culvert
- Multiple Channel Culvert
- Underground River (Potential Sewer)
- Underground River (local knowledge)

Alan Wood & Partners

APPENDIX D1

YWS Correspondence

Land Use Planning
Yorkshire Water Services Ltd
Midway
Western way
Bradford
BD6 2LZ

[redacted]
Fax:

E-mail
[redacted]

For telephone enquiries ring:
[redacted]

Director of Technical Services
Scarborough Borough Council
Town Hall
St. Nicholas Street
Scarborough
YO11 2HG

Your Ref: 15/01435/OL
Our Ref: S000942

5th February 2016

Dear Sir/Madam,

Land Adjacent To 38 Limestone Road Burniston Scarborough - Outline application for residential development, following demolition of existing structures (details of access to be considered)

Thank you for consulting Yorkshire Water regarding the above proposed development. We have the following comments:

Waste Water

If planning permission is to be granted, the following conditions should be attached in order to protect the local aquatic environment and YW infrastructure:

The site shall be developed with separate systems of drainage for foul and surface water on and off site.
(In the interest of satisfactory and sustainable drainage)

No development shall take place until details of the proposed means of disposal of foul drainage, including details of any balancing works and off-site works and the point of connection into the existing public sewer, have been submitted to and approved by the local planning authority. If sewage pumping is required the details shall include the means by which foul water discharge will not exceed 3 (three) litres per second. Furthermore, no buildings shall be occupied or brought into use prior to completion of the approved foul drainage works.
(To ensure that the development can be properly drained)

No development shall take place until details of the proposed means of disposal of surface water drainage, including details of any balancing works and off-site works, have been submitted to and approved by the local planning authority. If discharge to the existing public sewer is proposed, the details shall include evidence as to the reason why discharge direct to watercourse has been discounted and the means by which the discharge rate shall be attenuated to a maximum of five litres per second. Furthermore, unless otherwise approved in writing by the local planning authority, there shall be no piped discharge of surface water from the development prior to the completion of the approved surface water drainage works.
(To ensure that no surface water discharges take place until proper provision has been made for its disposal)

Unless otherwise agreed in writing by the local planning authority, no trees, landscape features or other obstruction shall be located over or within 3 metres either side of the centre line of the 225mm sewer i.e. a protected strip width of 6 metres, that crosses the site.
(In order to prevent damage to the public sewer and allow sufficient access to the sewer for maintenance and repair work at all times)

The following information is relevant to the conditions listed above:-

1) As the proposal site is currently undeveloped no positive surface water is known to have previously discharged to the public sewer network. As such the public sewer network does not have capacity to accept an unrestricted discharge of surface water. Surface water discharge to the existing public sewer network must only be as a last resort, the developer is required to eliminate other means of surface water disposal.

The Phase I & II Geo-Environmental Assessment Report prepared by Alan Wood & Partners - Report JS/AHB/35267-Rp001 dated April 2014) is acceptable. In summary, the report states that sub-soil conditions do not support the use of soakaways. However, a watercourse is located approximately 50 metres north west from the site and it is not clear from either this document or the Flood Risk Assessment (prepared by Alan Wood & Partners - Report NW/AD/JD/35267 -Rp001 - Revision D dated 01/07/2015) why surface water cannot outfall to this watercourse. Yorkshire Water promotes the surface water disposal hierarchy and the developer must provide evidence to demonstrate that surface water disposal watercourse (we are satisfied that soakaways are not practical in this location) is not reasonably practical before considering disposal to public sewer.

Upon satisfactory receipt of the above information, curtilage surface water may discharge to the 225 mm diameter public surface water sewer recorded crossing/within the site at an attenuated maximum rate of 5 (five) litres/second.

2) Foul water domestic waste should discharge to the public foul sewer recorded in The Limes, at a point approximately 32 metres from the site. From the information supplied, it is not possible to determine if the whole site will drain by gravity to the public sewer network. If the site, or part of it, will not drain by gravity, then it is likely that a sewage pumping station will be required to facilitate connection to the public sewer network. If sewage pumping is required foul water discharge must not exceed 3 (three) litres per second.

3) On the Statutory Sewer Map, there is a 225 mm diameter public surface water sewer recorded to cross the site. It is essential that the presence of this infrastructure is taken into account in the design of the scheme. The site layout details submitted on drawing YOR.2157.02 dated June 2015 that has been prepared by Pegasus Urban Design are **NOT** acceptable to Yorkshire Water as it appears to show tree planting directly over where the public sewer runs. **For further information, the developer should contact our Developer Services Team (telephone 0345 120 84 82, Fax 01274 372 834).**

4) 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. The developer should contact the Highway Authority with regard to acceptability of highway drainage proposals. Highway drainage, may however be accepted under certain circumstances. In this event, a formal agreement for highway drainage discharge to public sewer, in accordance with Section 115 of the Water Industry Act 1991, will be required.

Yours faithfully

[redacted]

Stephanie Walden - Land Use Planning Manager

APPENDIX D2

YWS Asset Details

Sewer Legend


Combined Sewer


S24 Combined Sewer


Surface Water Sewer


S24 Surface Water Sewer


Foul Sewer


S24 Foul Sewer


Section 104 Sewer

Public Rising Main


Pumping Station


Abandoned Sewer

Public Sewage Treatment Works


Syphon Sewer & Vacuum Sewer

+ Property Identifier

Water Legend

Water Main 4" and below

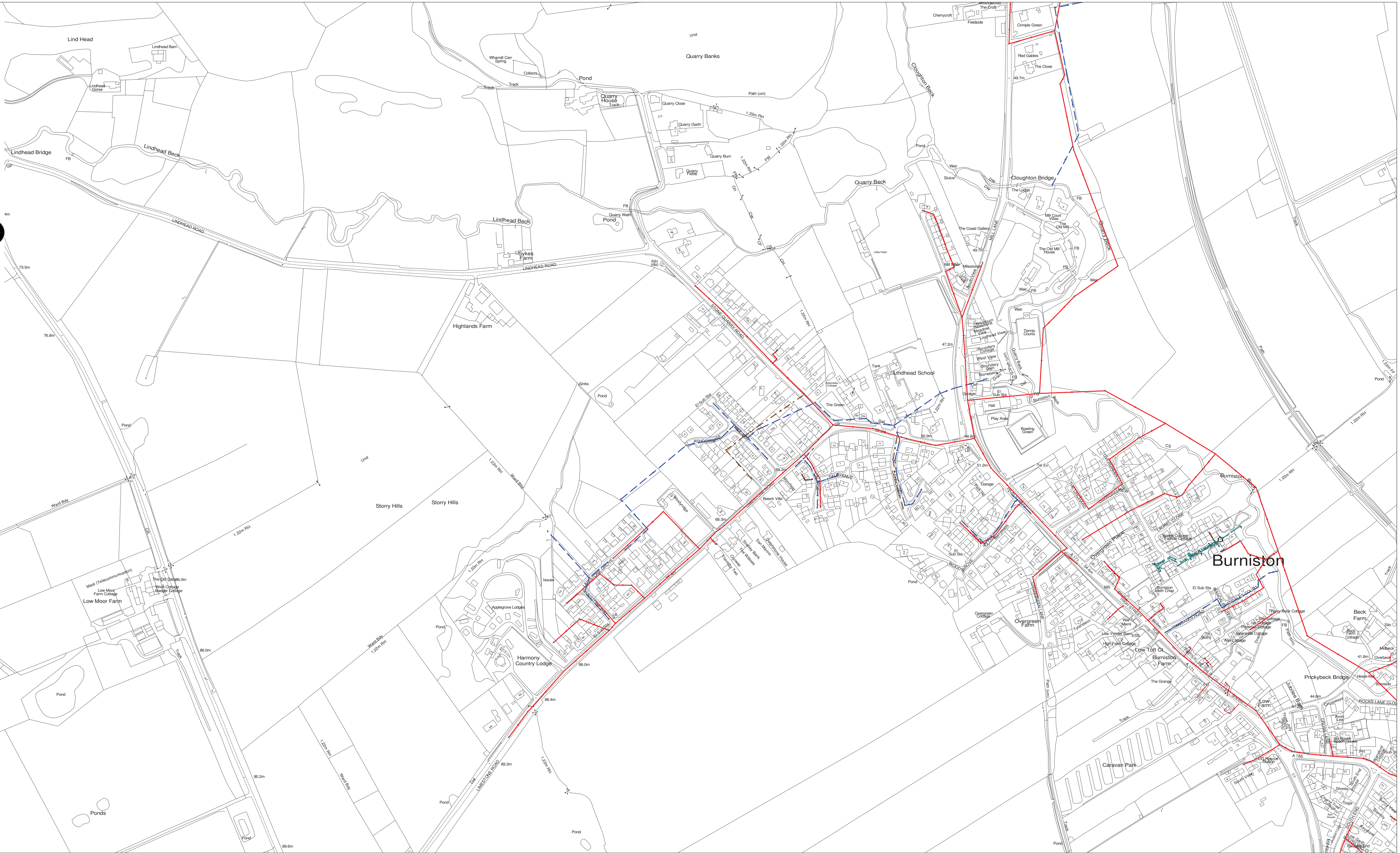
Water Main 4" and above

Raw Water Main

Private Water Main


Fire Hydrant


Pumping Station



499991 : 493109	Map Name : SE9992NW	Title	Partial Key

Yorkshire Water,
PO Box 500,
Halifax Road,
Bradford BD6 2LZ
Contact Name :
Julie Brook
Contact Tel :

Notes

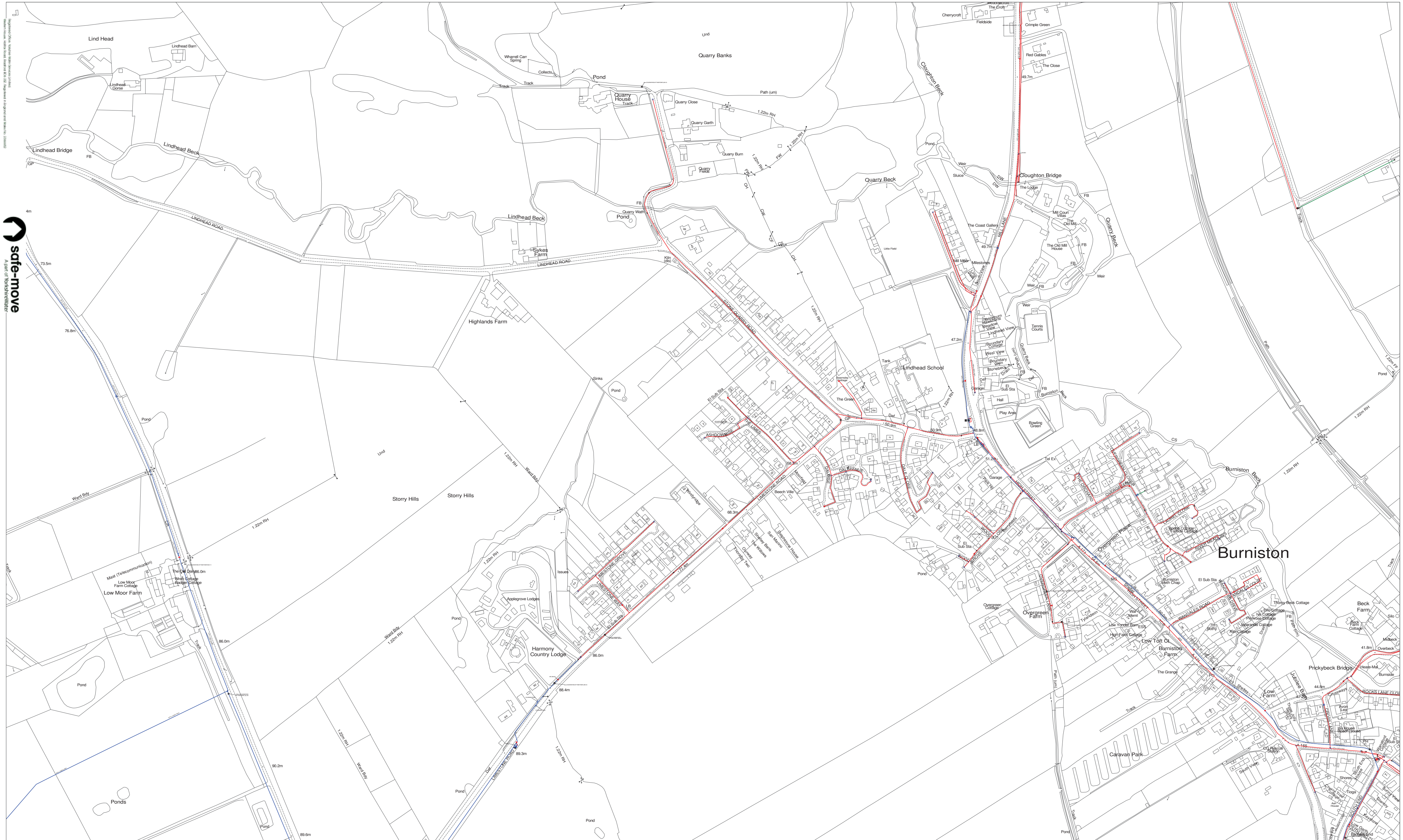
Partial Key

Foul Sewer = F
Combined Sewer = C
Surface Water Sewer = SW
Trade Sewer = TD
Partially Separate = PS

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.

Date Req : 18/06/2015, 08:26:02
Date Gen : 18/06/2015, 08:26:03
Source : Sewer Network Enquiry

UPN: Undefined Originator: Julie Brook, Safe Move,



499991 : 493109	Map Name : SE9992NW	Title	Partial Key	The position and depths of apparatus shown on this plan are approximate only. The exact positions and depths should be obtained by excavation trial holes.
YorkshireWater	Yorkshire Water, PO Box 500, Halifax Road, Bradford BD6 2LZ Contact Name : Julie Brook Contact Tel :	Notes	Water mains up to 4" in diameter Water mains over 4" in diameter Raw water mains Private water mains	Scale : 1:2500
			Drg No :	Maris No :
			Date Req : 18/06/2015, 08:26:25	Date Gen : 18/06/2015, 08:26:26
			Source : Water Network Enquiry	

UPN: Undefined Originator: Julie Brook, Safe Move,

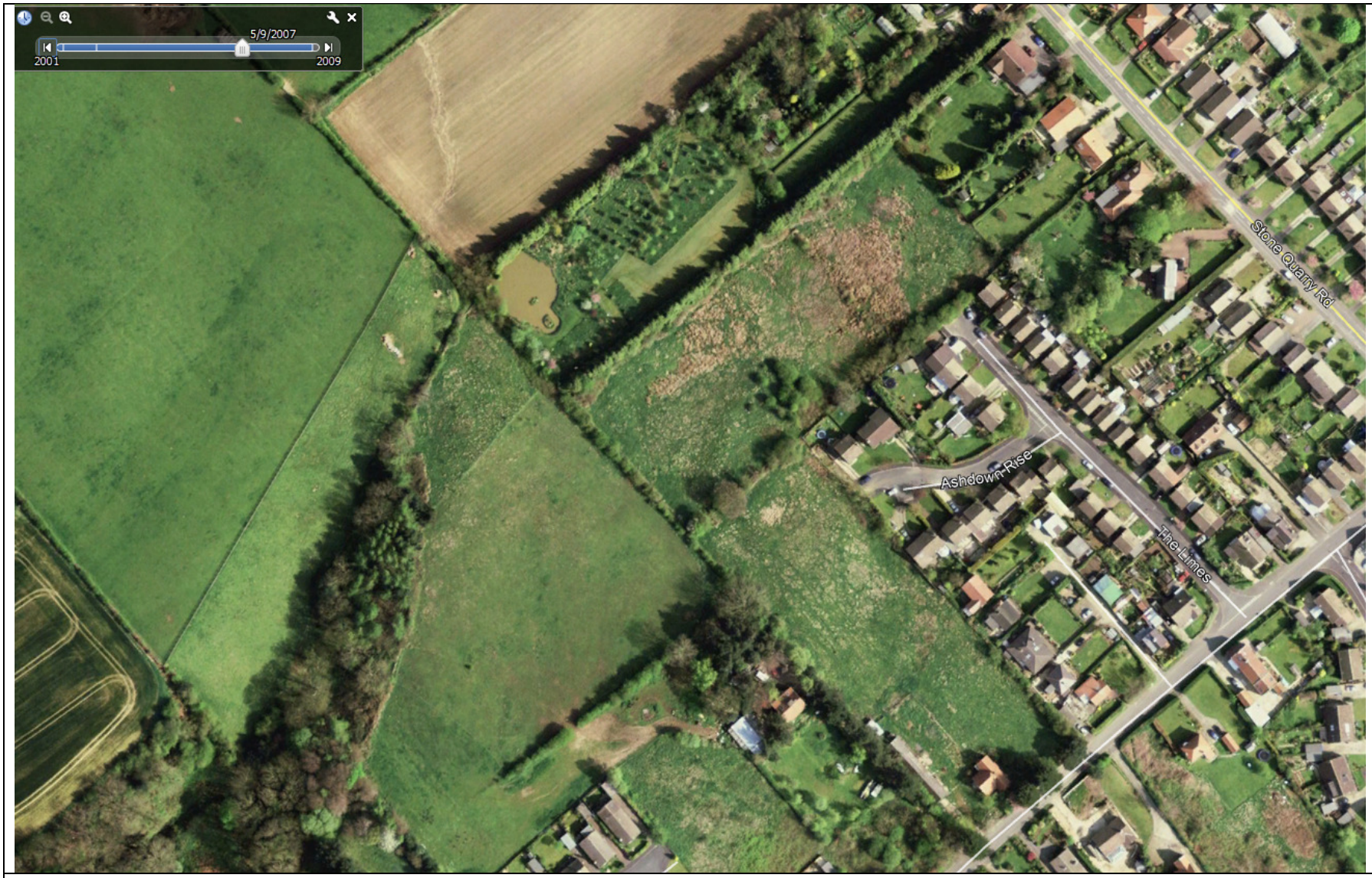
APPENDIX E

Historic Aerial Imagery

HISTORIC AERIAL IMAGERY

1) 2001 – NO POND

2) 2002 – NO POND



3) 2007 – NO POND

4) 2009 – NO POND

Alan Wood & Partners

APPENDIX F1

Ground Investigation Report Extracts

Alan Wood & Partners

PHASE I & II GEO-ENVIRONMENTAL ASSESSMENT REPORT

LAND OFF LIMESTONE ROAD, BURNISTON, SCARBOROUGH

~

FOR
THE GASCOINE GROUP

~

PROJECT REF:-

JS/AHB/35267-Rp001

APRIL 2014

EXECUTIVE SUMMARY

This presents the salient points of the report and should not be referred to in isolation. All recommendations are subject to approval by the Regulatory Authorities.

Site Location, Description & History	**Location and Description:** The site is located off Limestone Road, Burniston and is centred at approximate National Grid Reference (NGR), 500411mE 493353mN. The area investigated comprises grassed open land with a dilapidated derelict brick, pitch roofed dwelling in the southern portion of the site. Also, a brick building is noted in this area with, what appeared to be, an asbestos cement sheet roof. This building was being used to shelter livestock. The storage of chemicals or above and below ground storage tanks were not observed on site. Ponding surface water was noted to occupy a large area of the northern portion of the site. The ground surface was noted to dip steeply from the southwest to the northeast at a gradient of about 1:4.2 (14^0) and from the south to the north by a gradient of approximately 1:13 (5^0). **Historical Land Use:** Historical OS plans dating back to 1854 show the site to be open land. *Circa* 1950, buildings were constructed in the south-western corner of the site. The site remains in this configuration to the present. The surrounding land was open land until 1926 when it was developed for residential purposes.
Geology, Mining, Ground Stability, Hydrogeology, Hydrology & Floodplains	**Geology, Mining & Ground Stability:** Available information indicates that the superficial soils/drift geology at the site comprise glacial till (Diamicton) of the Devensian. These soils typically comprise interbedded layers of clay, silt, sand and gravel with boulders and cobbles of mixed lithology. The solid geology underlying the southern and central portion of the site is indicates to comprise sandstone of the Moor Grit Member and mudstone, sandstone and limestone of the Scarborough Formation. The northern portion of the site is noted to be underlain by sandstone, siltstone and mudstone of the Gristhorpe Member. The site is not located in or within 1000m of an area that has been subject to below ground coal mining activities. Risk associated with historic mine workings, on the basis of available information, is considered to be low. There are no geological faults recorded as being within 500m of the proposed development area. **Hydrogeology:** The superficial soils are indicated to be 'Unproductive', these being of low permeability and having negligible significance for water supply or river base flow. The underlying bedrock is indicated to be a 'Secondary A' aquifer. These soils are capable of supporting water supplied at a local, rather than strategic scale, and in some cases form an important source of baseflow to rivers. There are no source protection zones within 500m of the site. **Hydrology:** The nearest surface water feature to the site is indicated to

	be an unnamed stream being located 47m to the north-west. This is culverted 77m to the northwest. The Quarry Beck lies 176m to the northeast of the site. There is no available information with respect to river quality data. **Floodplains:** Available information indicates that the site lies within 250m of an Environment Agency indicative Zone 2 and Zone 3 floodplain. There are reported groundwater (superficial deposits) flooding susceptible areas within 50m of the site.
Geotechnical Assessment	The exploratory site works were carried out on 14th March 2014, with the ground investigation comprising 9 No. mechanically excavated trial pits (TP1 – TP9). **Topsoil:** This material was noted to comprise soft brown slightly sandy slightly gravelly clay. The gravel fraction comprised angular fragments of sandstone. During the intrusive ground investigation, it was noted that the JCB 3CX excavator sank to its axles in numerous locations on the site. Samples of the topsoil have been scheduled for a targeted programme of laboratory analysis for is suitability within proposed gardens. No made ground soils were encountered within any of the exploratory holes. However, access to the south-western corner of the site was not achievable due to the instable nature of the former dwelling and the storage of livestock. **Glacial Till (Diamicton)**: This was encountered within all of the trial pits at shallow depth, below the topsoil. The glacial deposits were noted to comprise firm becoming stiff red/brown mottled grey slightly sandy gravelly clay. The gravel fraction comprises angular to rounded sandstone, siltstone and coal with local inclusions of rounded quartzite. In situ have shear vane testing gave a shear strength of between 60kN/m^2 and 120kN/m^2 confirming its firm to stiff nature. The base of the glacial deposits was not encountered within any of the exploratory holes. No groundwater was encountered in any of the exploratory holes. With respect to both development areas, risk associated with shrink swell hazards, landslide, compressible ground, collapsible rocks and/or running sand are indicated in the GroundSure report to be very low to negligible.
Environmental Records Assessment	**Pollution Incidents**: There are no EA recorded pollution incidents within 500m of the site. **Waste Management:** There are no Environment Agency recorded landfill sites, Local Authority sites, waste treatment, transfer and/or disposal sites within 500m of the site. **Discharge Consents:** There are no recorded licenced discharge consents within 1000m of the site. **Radon: No** radon protective measures are required. **Abstractions:** There are no records relating to the abstraction of groundwater, surface water and/or potable water within 2km of the site.
Preliminary Development & Construction	**Site Preparation:** Subject to confirmation of proposed levels, it is envisaged that the bulk of the enabling works for the site will be associated with the demolition and breaking-out of existing buildings, floor-slabs,

Proposals	foundations and areas of hardstanding. These works will need to be integrated into any additional works where excavation is required to reduce and/or re-grade site levels given the elevation differences that exist locally across the proposed development area. Given the steeply inclined nature of the site current topography, finished site levels will need to be established by creating suitably designed and engineered development platforms and access roads. This may require a cut and fill operation during the initial site enabling works. Designed and engineered temporary/permanent earth retaining structures may be required to accommodate finished site ground levels. Any materials removed from site should be undertaken in accordance with the Duty of Care Regulations 1991. There will also be a requirement to classify the waste in accordance with the European Waste Catalogue. The waste should also be subject to Waste Acceptance Criteria (WAC) testing. In light of the new regulations it is recommended that discussion with landfill operators takes place at an early stage. **Foundations:** Made ground soils, where present, are unsuitable founding material due to their lateral and vertical variation. These soils are considered to have insufficient allowable safe bearing capacity to support traditional shallow foundations, without the likelihood of foundation shear failure and/or unacceptable total and differential settlements. Ground conditions indicate that traditional strip or trench fill foundations will be suitable for use within the farm site development area, these being taken through the upper soil and loam surface and into the underlying clay at a probable depth of between 750-900mm. Consideration will need to be given to the placement of the proposed plots in relation to any planned earth retaining structures, to achieve finished ground levels, in order to ensure their continued stability. Where traditional foundations are suitable, care will need to be taken where they are found to straddle strata of different type, or where soft or locally unstable ground is encountered at founding depth. Where this occurs foundations may need to be widened, deepened and/or strengthened to prevent differential settlement. **Precautions Near Trees:** Precautions may be required when in clay given the presence of trees along the edges of the site. The on-site soils have been proven to have a low Volume Change Potential. **Floor Slabs:** It is anticipated that ground floor slabs will be suspended where proposed plots are located within the vicinity of existing or removed trees. Otherwise, ground bearing slabs may however be adopted. **Concrete Design:** The Design Sulphate Class is anticipated to be DS-1, the Aggressive Chemical Environment for Concrete (ACEC) Class, AC1s. **Drainage:** Soakaways will not be suitable for use at the site. Surface water will need to be taken to a suitable drainage system (possibly to an existing drains that cross/exit the site), subject to obtaining approvals from regulatory authorities.

	Roads and Car Parks: A preliminary CBR value of 2.0% is suggested for the natural soils at the site. *In situ* testing should be carried out if required. **Potable Water Supply:** Whilst risk to potable water supply pipes is considered to be low, it may be that protective measures may be required. Consultation should also be undertaken with the local water authority with respect to any precautions they may require, prior to construction. **Stability:** On the basis of available information, risk associated with shallow mine workings is not anticipated. Given the steeply inclined ground surface and the very soft nature of the topsoil, instability of proposed site plant is to be anticipated. Therefore, designed and engineered platforms and temporary road ways will be required for the site plant to operate from. Further assessment should be undertaken. It is possible that some localised instability of excavations may be encountered during construction, particularly during periods of wet weather. Instability should therefore be anticipated, particularly where deep service trenches are excavated. No man entry into unsupported excavations should be allowed without an appropriate risk assessment. Reference to CIRIA report 97 (1983) should be made to establish suitable means of support or battering of excavation sides. **Outline Remediation and Environmental Management:** An elevated concentration of arsenic has been measured within a single sample of the shallow on-site soils. It is proposed that this will be removed during the initial site enabling works to remove the current topsoil. Further investigation and testing is required within the inaccessible areas in the northern and south-western areas of the site. At this stage, mitigating measures are not considered necessary following the removal of the topsoil. All materials used/imported to site will need to be proven to be clean prior to importation/use. Confirmation on the proposed capping thickness will need to be obtained from the Contaminated Land Office prior to construction.
Further Works	1. Additional investigation within currently inaccessible areas of the site following the demolition of the current site buildings, structures and the removal of ponding surface water. Additional soil sampling a testing of the near surface soils within these areas is required post demolition to include the potential for asbestos containing materials; 2. *In situ* CBR testing (where required); 3. An ecology survey. 4. Foundation design.

Alan Wood and Partners
AMP Technology Park, Brunel Way
Sheffield, South Yorkshire
S60 5WG
Tel: 0114 254 1307

Trialpit No
1
Sheet 1 of 1

Project Name: Limestone Road	Project No.: 35267	Co-ords: - Level: 67.34 m AOD	Date: 14/03/2014
Location: Burniston		Dimensions: 3.00m Depth 1.70m 0.60m	Scale: 1:25
Client: Gascoine Group Limited			Logged By: AHB

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.20	67.14		TOPSOIL: Soft brown slightly sandy slightly gravelly CLAY. Gravel is fine and medium sandstone.
0.20	D					Firm brown-orange sandy slightly gravelly CLAY. Gravel is fine to coarse angular to rounded sandstone, siltone and coal. (GLACIAL TILL)
0.50	IVN 1	90				
0.50	D					
1.00	IVN 2	100				
			1.70	65.64		Trialpit Complete at 1.70 m

Remarks: Percolation test.

Groundwater: None Encountered

AGS

Alan Wood and Partners
AMP Technology Park, Brunel Way
Sheffield, South Yorkshire
S60 5WG
Tel: 0114 254 1307

Trialpit No **2**
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Limestone Road	35267	Level: 64.58 m AOD	14/03/2014
Location: Burniston		Dimensions: 3.00m, Depth 3.50m, 0.60m	Scale 1:25
Client: Gascoine Group Limited			Logged By AHB

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
0.10	D					TOPSOIL: Soft brown slightly sandy slightly gravelly CLAY. Gravel is fine and medium angular sandstone.
			0.40	64.18		
0.50	D					Firm becoming stiff brown-orange sandy gravelly bouldery CLAY. Gravel is fine to coarse angular to rounded sandstone, siltstone and coal. Boulders are subrounded sandstone. (GLACIAL TILL)
0.60	IVN 1	70				
			3.50	61.08		Trialpit Complete at 3.50 m

Remarks:

Groundwater: None Encountered

Alan Wood and Partners
AMP Technology Park, Brunel Way
Sheffield, South Yorkshire
S60 5WG
Tel: 0114 254 1307

Trialpit No **3**
Sheet 1 of 1

Project Name: Limestone Road	Project No.: 35267	Co-ords: - Level: 59.68 m AOD	Date: 14/03/2014
Location: Burniston		Dimensions: 3.00m Depth 3.50m 0.60m	Scale: 1:25
Client: Gascoine Group Limited			Logged By: AHB

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.00	59.68		TOPSOIL: Soft brown slightly sandy slightly gravelly CLAY. Gravel is fine and medium angular sandstone.
0.20	D		0.20	59.48		Firm becoming stiff red/brown mottled grey sandy gravelly cobbly CLAY. Gravel is fine to coarse angular to rounded sandstone, siltstone and coal. Cobbles are rounded sandstone. (GLACIAL TILL)
0.60	D					
1.00	IVN 1	92				
			3.50	56.18		Trialpit Complete at 3.50 m

Remarks:

Groundwater: None Encountered

Alan Wood and Partners
AMP Technology Park, Brunel Way
Sheffield, South Yorkshire
S60 5WG
Tel: 0114 254 1307

Trialpit No **4**
Sheet 1 of 1

Project Name: Limestone Road	Project No.: 35267	Co-ords: - Level: 68.70 m AOD	Date: 14/03/2014
Location: Burniston		Dimensions: 3.00m Depth 3.80m 0.60m	Scale: 1:25
Client: Gascoine Group Limited			Logged By: AHB

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.20	68.50		TOPSOIL: Soft brown slightly sandy slightly gravelly CLAY. Gravel is fine and medium angular sandstone.
0.30	D					Stiff brown/red mottled grey sandy gravelly cobbly CLAY. Gravel is angular to rounded sandstone, siltstone, quartzite and coal. Cobbles are rounded sandstone. (GLACIAL TILL)
0.80	IVN 1	120				
0.80	D					
			3.80	64.90		Trialpit Complete at 3.80 m

Remarks: Percolation test.

Groundwater: None Encountered

Alan Wood and Partners
AMP Technology Park, Brunel Way
Sheffield, South Yorkshire
S60 5WG
Tel: 0114 254 1307

Trialpit No
5
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Limestone Road	35267	Level: 62.35 m AOD	14/03/2014
Location: Burniston		Dimensions: 3.00m	Scale 1:25
Client: Gascoine Group Limited		Depth 3.50m, 0.60m	Logged By AHB

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
0.20	D		0.30	62.05		TOPSOIL: Soft brown slightly sandy slightly gravelly CLAY. Gravel is fine and medium angular sandstone.
0.80	IVN 1	60				Firm becoming stiff sandy gravelly cobbly CLAY. Gravel is fine to coarse angular to rounded sandstone, siltstone and coal. Cobbles are angular to rounded sandstone and siltstone. (GLACIAL TILL)
1.00	D					Less gravelly.
			3.50	58.85		Trialpit Complete at 3.50 m

Remarks:

Groundwater: None Encountered

Alan Wood and Partners
AMP Technology Park, Brunel Way
Sheffield, South Yorkshire
S60 5WG
Tel: 0114 254 1307

Trialpit No **6**
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Limestone Road	35267	Level: 58.50 m AOD	14/03/2014
Location: Burniston		Dimensions: 3.00m	Scale 1:25
Client: Gascoine Group Limited		Depth 4.00m, 0.60m	Logged By AHB

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.00	58.50		TOPSOIL: Soft brown slightly sandy slightly gravelly CLAY. Gravel is fine and medium angular sandstone.
0.30	D		0.30	58.20		Firm becoming stiff brown/red mottled grey sandy gravelly cobbly bouldery CLAY. Gravel is fine to coarse angular to rounded sandstone, siltstone, coal and quartzite. Cobbles and boulders are rounded and subrounded sandstone. (GLACIAL TILL)
0.90	IVN 1	64				
0.90	D					
			4.00	54.50		Trialpit Complete at 4.00 m

Remarks:

Groundwater: None Encountered

Alan Wood and Partners
AMP Technology Park, Brunel Way
Sheffield, South Yorkshire
S60 5WG
Tel: 0114 254 1307

Trialpit No
7
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Limestone Road	35267	Level: 59.03 m AOD	14/03/2014
Location: Burniston		Dimensions: 3.00m Depth 3.50m 0.60m	Scale 1:25
Client: Gascoine Group Limited			Logged By AHB

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
						TOPSOIL: Soft brown slightly sandy slightly gravelly CLAY. Gravel is fine and medium angular sandstone.
0.40	D		0.40	58.63		Firm becoming stiff brown/red mottled grey sandy gravelly cobbly bouldery CLAY. Gravel is fine to coarse angular to rounded sandstone, siltstone, coal and quartzite. Cobbles and boulders are subrounded and rounded sandstone. (GLACIAL TILL)
0.70	D					
1.00	IVN 1	28				
			3.50	55.53		Trialpit Complete at 3.50 m

Remarks:

Groundwater: None Encountered

Alan Wood and Partners
AMP Technology Park, Brunel Way
Sheffield, South Yorkshire
S60 5WG
Tel: 0114 254 1307

Trialpit No **8**
Sheet 1 of 1

Project Name: Limestone Road	Project No.: 35267	Co-ords: - Level: 54.56 m AOD	Date: 14/03/2014
Location: Burniston		Dimensions: 3.00m Depth 3.80m 0.60m	Scale: 1:25
Client: Gascoine Group Limited			Logged By: AHB

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.00	54.56		TOPSOIL: Soft brown slightly sandy slightly gravelly CLAY. Gravel is fine and medium angular sandstone.
0.30	D		0.30	54.26		Firm brown/red mottled grey sandy gravelly cobbly CLAY. Gravel is fine to coarse angular to rounded sandstone, siltstone and coal. Cobbles are rounded sandstone. (GLACIAL TILL)
0.80	IVN 1	80				
0.90	D					
1.20	IVN 2	68				
			3.80	50.76		Trialpit Complete at 3.80 m

1
2
3
4

Remarks:

Groundwater: None Encountered

AGS

Alan Wood and Partners
AMP Technology Park, Brunel Way
Sheffield, South Yorkshire
S60 5WG
Tel: 0114 254 1307

Trialpit No
9
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Limestone Road	35267	Level: 54.80 m AOD	14/03/2014
Location: Burniston		Dimensions: 3.00m	Scale 1:25
Client: Gascoine Group Limited		Depth 4.00m, 0.60m	Logged By AHB

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.00	54.80		TOPSOIL: Soft brown slightly sandy slightly gravelly CLAY. Gravel is fine and medium angular sandstone.
0.20	D		0.20	54.60		Firm brown/red mottled grey sandy gravelly cobbly CLAY. Gravel is fine to coarse angular to rounded sandstone, siltstone and coal. Cobbles are rounded sandstone. (GLACIAL TILL)
0.50	IVN 1	84				
1.00	IVN 2	70				
1.00	D					
			4.00	50.80		Trialpit Complete at 4.00 m

1
2
3
4

Remarks:

Groundwater: None Encountered

AGS

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Depth m	Description of Sample
TP1	2	D	0.80	Brown mottled grey slightly gravelly very sandy CLAY.
TP5	2	D	1.00	Brown slightly gravelly very sandy CLAY.
TP8	1	D	0.40	Brown very gravelly very sandy CLAY.

PSL
Professional Soils Laboratory

Compiled by	Date	Checked by	Date	Approved by	Date
	21/03/14		24/03/14		24/03/14

LIMESTONE ROAD

Contract No: PSL14/1358

Client Ref: 35267

SUMMARY OF SOIL CLASSIFICATION TESTS

(B.S. 1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Depth (m)	Moisture Content % Clause 3.2	Bulk Density Mg/m^3 Clause 7.2	Dry Density Mg/m^3 Clause 7.2	Particle Density Mg/m^3 Clause 8.	Liquid Limit % Clause 4.3/4.4	Plastic Limit % Clause 5.	Plasticity Index % Clause 5.4	% Passing .425mm	Remarks
TP1	2	D	0.80	23				36	18	18	94	Intermediate plasticity CI.
TP5	2	D	1.00	20				24	15	9	95	Low plasticity CL.
TP8	1	D	0.40	16				30	16	14	65	Low plasticity CL.

PSL
Professional Soils Laboratory

Compiled by	Date	Checked by	Date	Approved by	Date
	21/03/14		24/03/14		24/03/14
LIMESTONE ROAD				Contract No:	PSL14/1358
				Client Ref:	35267

Alan Wood & Partners

APPENDIX F2

Infiltration Test Results

ROGERS GEOTECHNICAL SERVICES LTD

The Ground Investigation Specialists

OFFICES 1&2 BARNCLIFFE BUSINESS PARK
NEAR BANK
SHELLEY
HUDDERSFIELD
HD8 8LU

Tel 0843 50 666 87 Fax 0843 51 599 30

ISO 9001 REGISTERED FIRM

Constructionline
A UK GOVERNMENT CERTIFICATION SERVICE

REGISTERED MEMBER
www.citation.co.uk

Our Ref J2702/14/E
19th March 2014

Alan Wood and Partners,
AMP Technology Centre,
Advanced Manufacturing Park,
Brunel Way,
Sheffield,
S60 5WG.

For the attention of Mr Andy Borthwick,

Dear Sir,

Ref: Limestone Road, Burniston, Scarborough, YO13 0DG.

We thank you for your request to undertake soakaway testing at the above mentioned site and take pleasure in enclosing the results of this work. The investigation was undertaken on the 14th March 2014 in accordance with your instruction to proceed and under your site supervision. This letter describes the work undertaken, presents the data obtained and discusses the results of the tests.

Fieldworks

A total of two trialpits were excavated using a JCB 3CX excavator in order to undertake soakaway testing at positions specified and recorded by yourselves. The soakage tests where undertaken at the base of the pits at depths agreed on site and the results are attached to this letter.

Soakaway Tests

On reaching the elected soakaway test depth, the trial pits were squared and cleaned of debris using careful operation of the excavator bucket, and a soakaway test was undertaken in the base of each trial pit. The results obtained from the soakaway tests are appended to this letter and are summarised below:

Table 1: *Soakaway Test Results*

Location	Soakage Area Dimensions (average) (m)	Test Depth (m)	Infiltration Rate (m/sec)	Drainage Characteristics
TP1	2.2 x 0.60	1.70	-	Practically Impermeable
TP2	2.2 x 0.60	1.95	-	Practically Impermeable

It should be appreciated that the test did not achieve a fall from 75% to 25% effective depth of water during the test Therefore the soakage stratum in this instance should be considered practically impermeable. Moreover it cannot be recommended that soakaways be constructed within the area tested.

References

- Building Research Establishment (BRE) Digest 365, *Soakaway Design*, September 1991.

We trust that this information is of interest and should you have any other requirements do not hesitate to contact us.

For and on behalf of
Rogers Geotechnical Services Ltd,

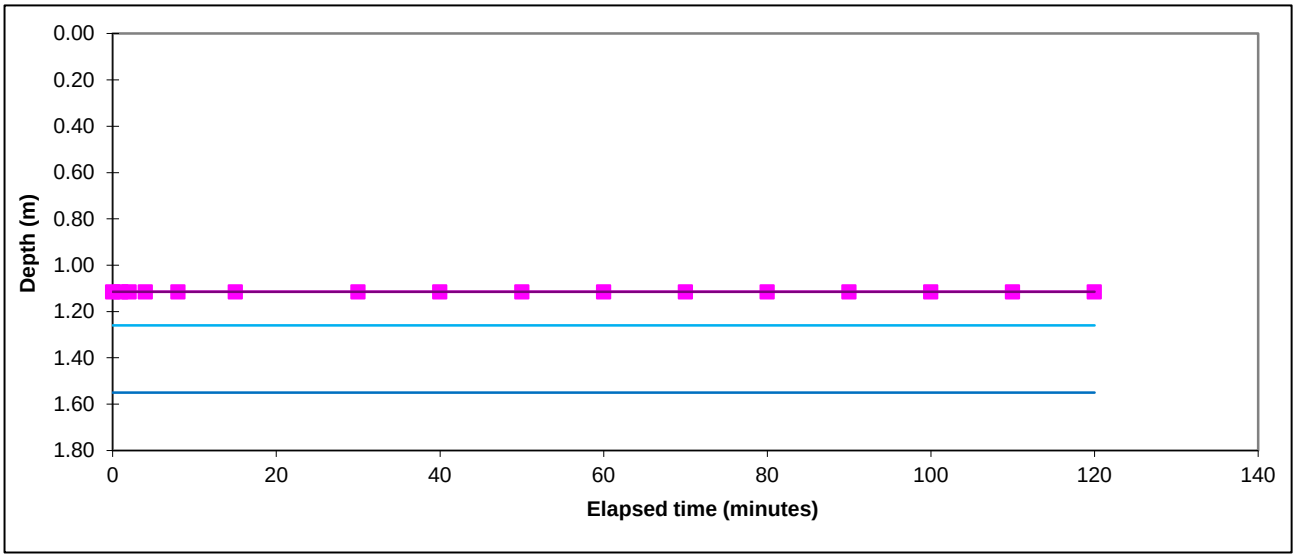
Emma Rogers LLB
Managing Director

Rogers Geotechnical Services Ltd

Soakaway Test

Trial Pit No:	TP1	Test No:	1	Date:	14/03/2014
Length (m):	2.200	Datum Height:		0.00	m agl
Width (m):	0.60	Granular infill:		None	
Depth (m):	1.70	Porosity of infill:		1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	1.115	110	1.115
1	1.115	120	1.115
2	1.115		
4	1.115		
8	1.115		
15	1.115		
30	1.115		
40	1.115		
50	1.115		
60	1.115		
70	1.115		
80	1.115		
90	1.115		
100	1.115		



Start water depth for analysis (mbgl):	1.12		
75% effective depth (mbgl):	1.26	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.41		
25% effective depth (mbgl):	1.55	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	1.70		
Volume outflow between 75% and 25% effective depth (m^3):			
Mean surface area of outflow (m^2):			2.94
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			

Soil infiltration rate (m/s):	**Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.**

Remarks	Results processed following BRE 365 (2007).
	No change in water level observed, therefore soil considered to be impermeable.

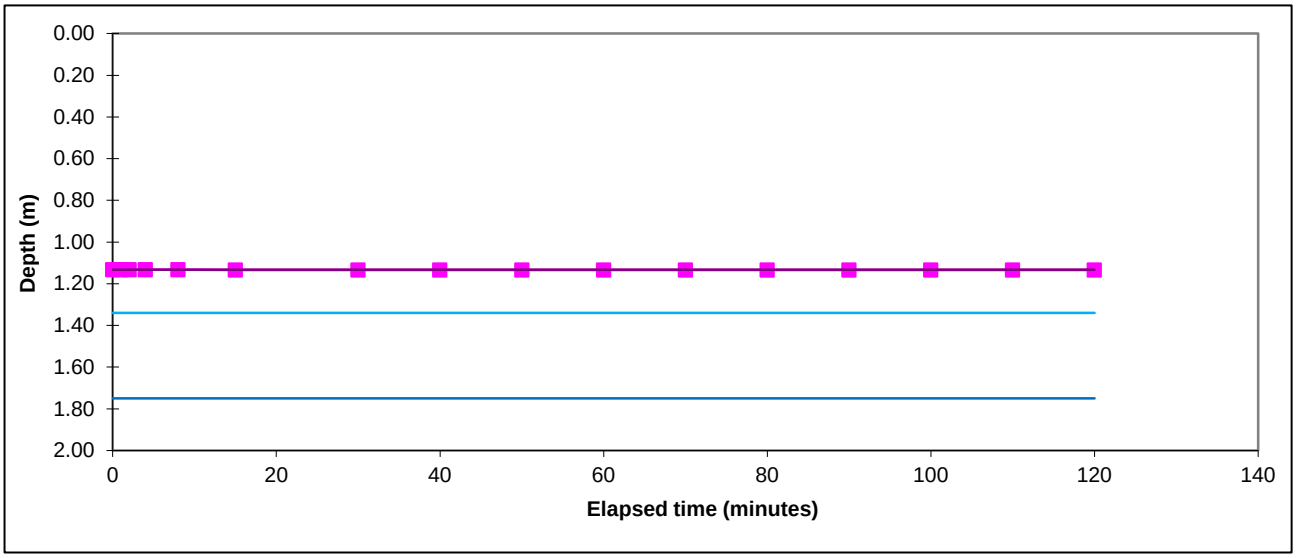
Client:	Alan Wood and Partners	**TP1**
Site:	J2702/14/E Limestone Road, Scarborough, YO13 0DG	

Rogers Geotechnical Services Ltd

Soakaway Test

Trial Pit No:	TP1	Test No:	1	Date:	14/03/2014
Length (m):	2.200			Datum Height:	0.00 m agl
Width (m):	0.60			Granular infill:	None
Depth (m):	1.95			Porosity of infill:	1 (assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	1.132	110	1.134
1	1.132	120	1.134
2	1.132		
4	1.132		
8	1.132		
15	1.134		
30	1.134		
40	1.134		
50	1.134		
60	1.134		
70	1.134		
80	1.134		
90	1.134		
100	1.134		



Start water depth for analysis (mbgl):	1.13		
75% effective depth (mbgl):	1.34	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.54		
25% effective depth (mbgl):	1.75	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	1.95		
Volume outflow between 75% and 25% effective depth (m^3):			
Mean surface area of outflow (m^2): (side area at 50% effective depth + base area)			3.62
Time for outflow between 75% and 25% effective depth (mins):			

Soil infiltration rate (m/s):	**Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.**

Remarks	Results processed following BRE 365 (2007).
	No change in water level observed, therefore soil considered to be impermeable.

Client:	Alan Wood and Partners	**TP2**
Site:	J2702/14/E Limestone Road, Scarborough, YO13 0DG	

Alan Wood & Partners

APPENDIX G

Ecology Report Extract

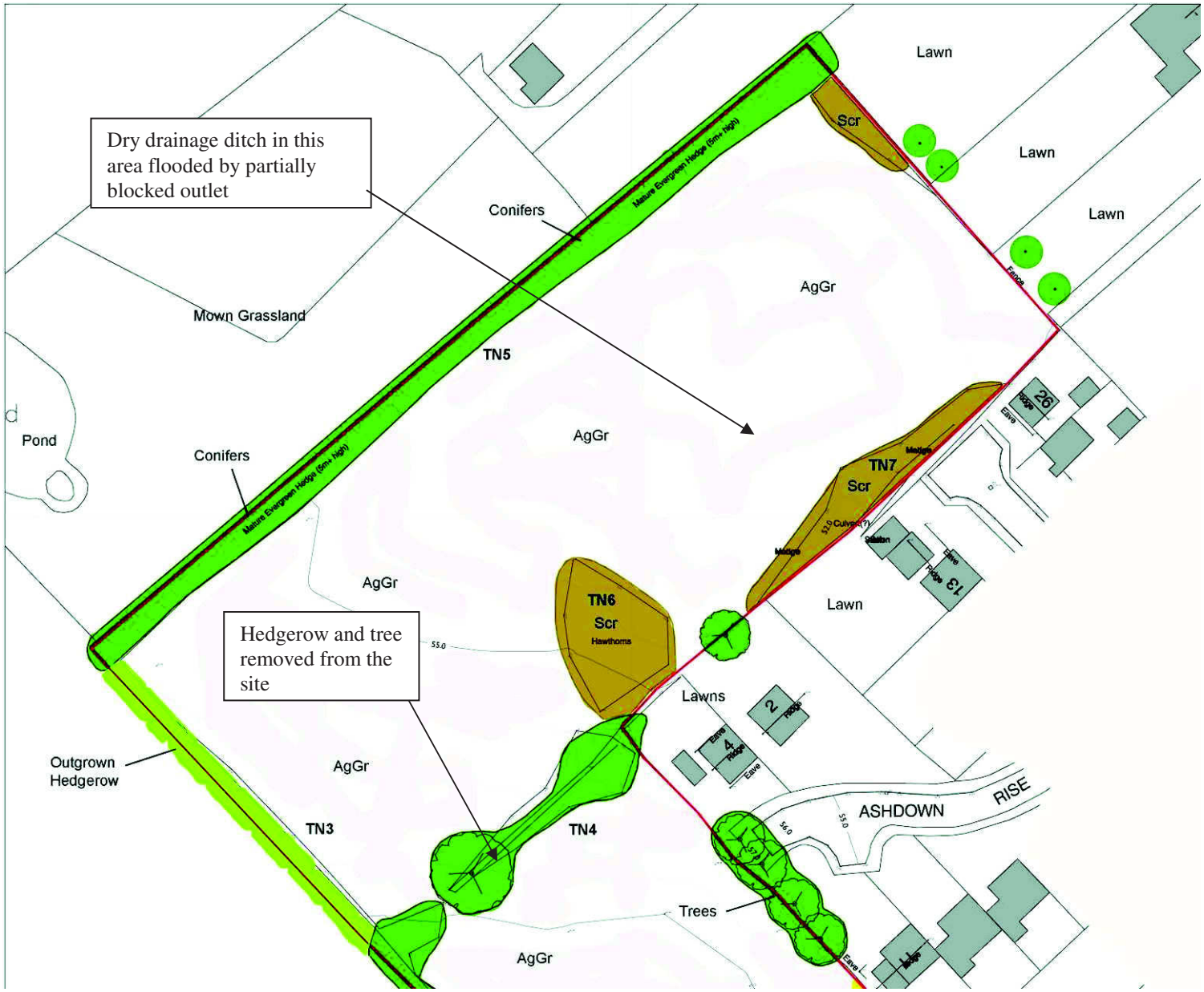


Figure 3A – 2012 Habitat Plan North

Alan Wood & Partners

APPENDIX H

Archaeologist Report Extract

Uncertain Origin (trend)

Natural

Pipe

Ploughing

Ferrous

Manhole - approximate position

GSB PROSPECTION Ltd

GSB Prospection Ltd
COWBURN FARM
21 MARKET STREET
THORNTON
BRADFORD
BD13 3HW
TEL: 01274 835 016
FAX: 01274 830 212
www.gsbprospection.com

Title: Magnetometer Survey Interpretation

Client: Pegasus Planning Group

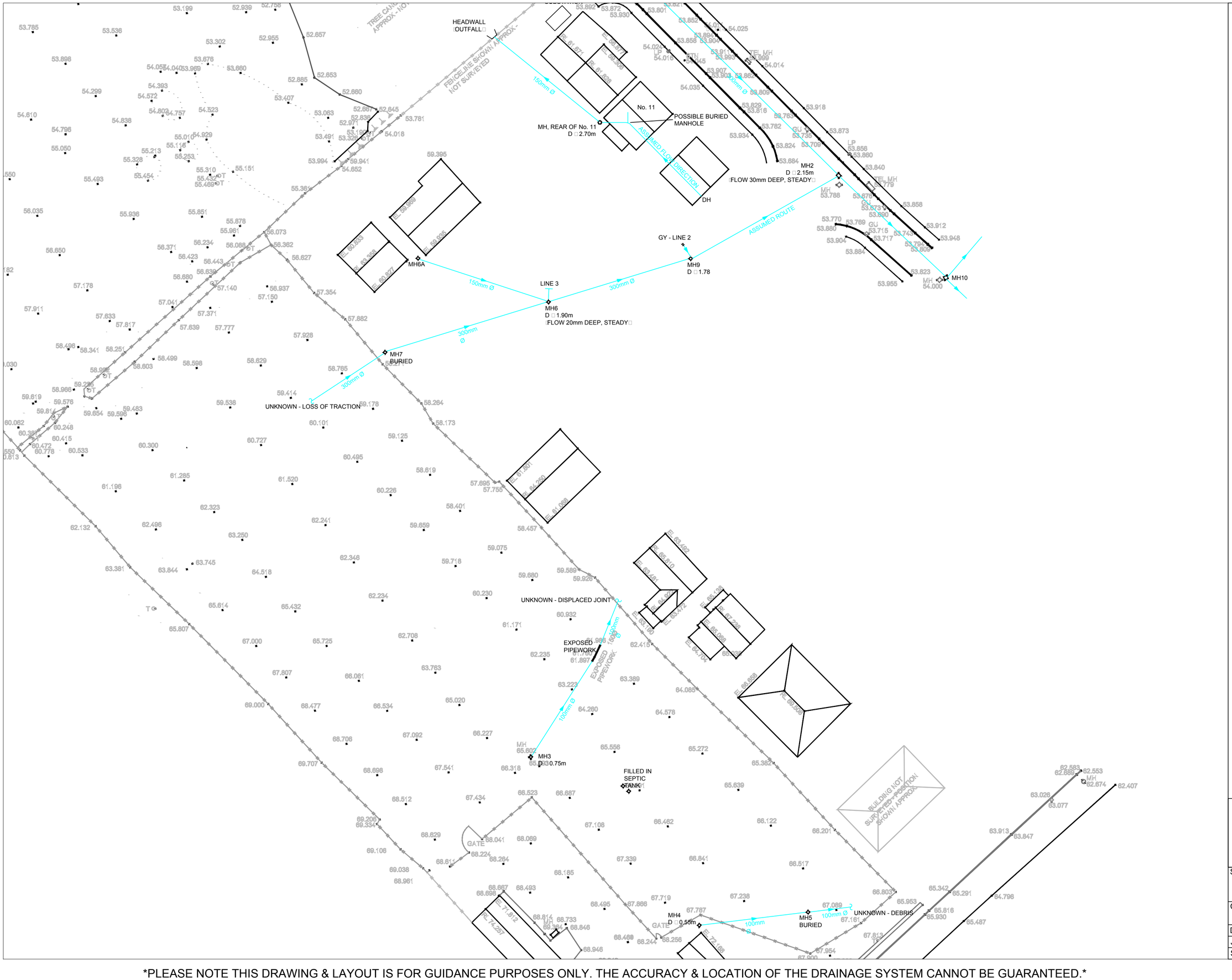
Project: G1667 Limestone Road, Burniston

Scale: 0 metres 40 — 1:1000 @ A3

Fig No: 4

APPENDIX I

CCTV Survey Plan



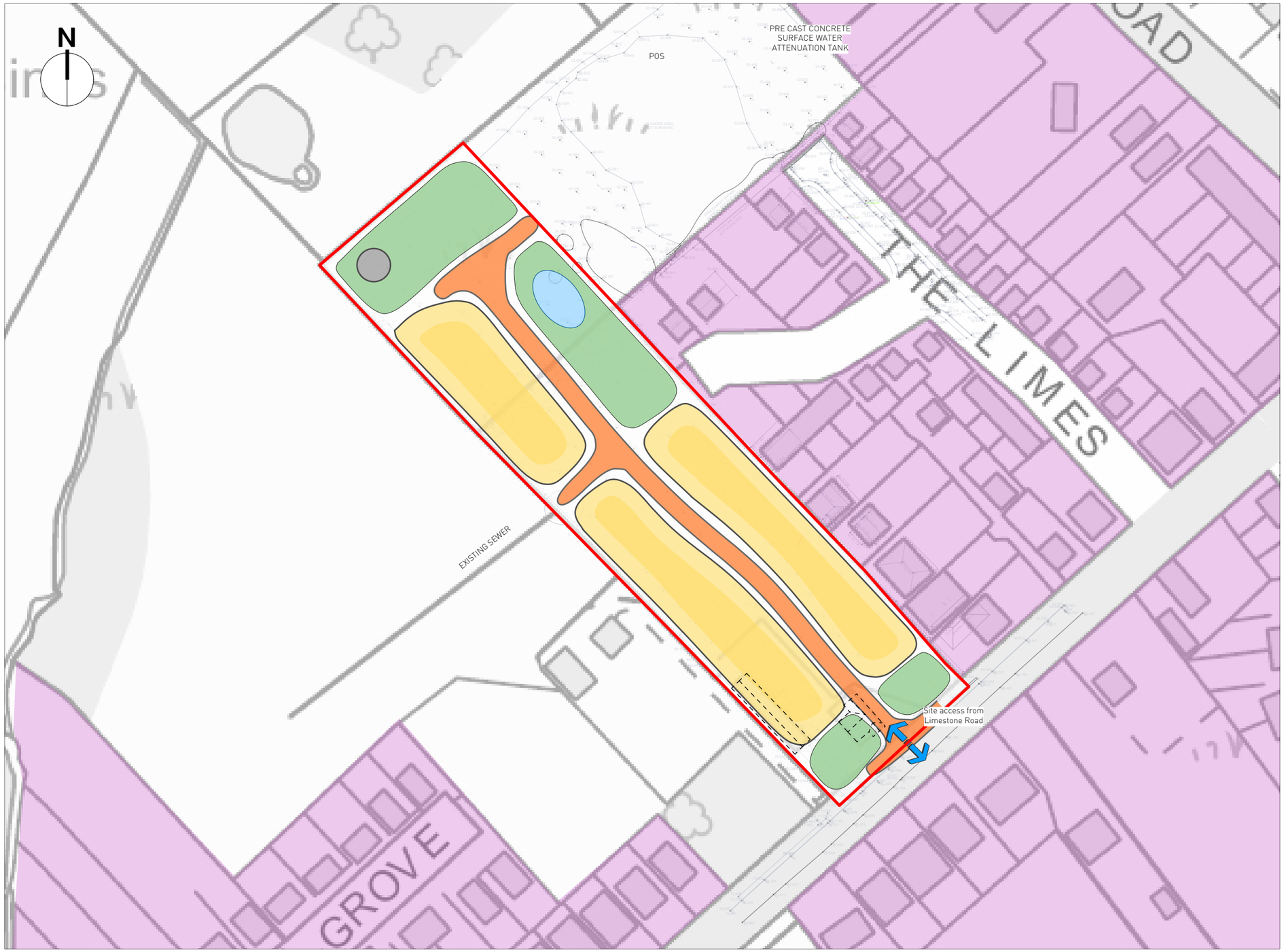
PLEASE NOTE THIS DRAWING & LAYOUT IS FOR GUIDANCE PURPOSES ONLY. THE ACCURACY & LOCATION OF THE DRAINAGE SYSTEM CANNOT BE GUARANTEED.

JET AIRE DRAIN CARE
Tel: 0113 3935500
Email: en□uiries@etaire.co.uk
Website: □□□.etaire.co.uk

Site:	Limestone Road Burninstone Scarborough
Client:	Alan Wood & Partners
Date:	07/11/2016
Job No:	50189
Scale:	Not To Scale @ A2

APPENDIX J

Proposed Layout



KEY

- Site location
- POS (Public open space)
- Primary road
- Residential parcels
- Proposed site access
- Existing residential
- Pond
- Pumping Station

0 50 100 m

LIMESTONE ROAD, BURNISTON, NORTH YORKSHIRE - **CONCEPT PLAN**

Pegasus Design

Alan Wood & Partners

APPENDIX K1

M1 Q4.5

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	10.462	0.462	4.5	36.0	O K
30 min Summer	10.595	0.595	4.5	46.4	O K
60 min Summer	10.728	0.728	4.5	56.8	O K
120 min Summer	10.818	0.818	4.5	63.8	O K
180 min Summer	10.848	0.848	4.5	66.1	O K
240 min Summer	10.861	0.861	4.5	67.1	O K
360 min Summer	10.856	0.856	4.5	66.8	O K
480 min Summer	10.835	0.835	4.5	65.2	O K
600 min Summer	10.809	0.809	4.5	63.1	O K
720 min Summer	10.780	0.780	4.5	60.9	O K
960 min Summer	10.717	0.717	4.5	55.9	O K
1440 min Summer	10.553	0.553	4.5	43.1	O K
2160 min Summer	10.358	0.358	4.5	27.9	O K
2880 min Summer	10.240	0.240	4.5	18.7	O K
4320 min Summer	10.135	0.135	4.1	10.5	O K
5760 min Summer	10.106	0.106	3.5	8.3	O K
7200 min Summer	10.092	0.092	3.0	7.2	O K
8640 min Summer	10.083	0.083	2.7	6.5	O K
10080 min Summer	10.077	0.077	2.4	6.0	O K
15 min Winter	10.521	0.521	4.5	40.7	O K
30 min Winter	10.676	0.676	4.5	52.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	27.431	0.0	39.1	18
30 min Summer	18.307	0.0	52.2	32
60 min Summer	11.942	0.0	68.2	62
120 min Summer	7.660	0.0	87.5	118
180 min Summer	5.886	0.0	100.8	148
240 min Summer	4.879	0.0	111.5	180
360 min Summer	3.717	0.0	127.4	250
480 min Summer	3.058	0.0	139.7	320
600 min Summer	2.628	0.0	150.1	390
720 min Summer	2.322	0.0	159.2	460
960 min Summer	1.911	0.0	174.6	598
1440 min Summer	1.453	0.0	199.2	852
2160 min Summer	1.104	0.0	227.0	1192
2880 min Summer	0.908	0.0	249.0	1528
4320 min Summer	0.691	0.0	284.0	2208
5760 min Summer	0.569	0.0	312.2	2936
7200 min Summer	0.489	0.0	335.4	3656
8640 min Summer	0.431	0.0	354.8	4384
10080 min Summer	0.388	0.0	372.2	5136
15 min Winter	27.431	0.0	43.8	18
30 min Winter	18.307	0.0	58.4	32

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	10.828	0.828	4.5	64.6	O K
120 min Winter	10.944	0.944	4.5	73.6	O K
180 min Winter	10.976	0.976	4.5	76.1	O K
240 min Winter	10.988	0.988	4.5	77.1	O K
360 min Winter	10.973	0.973	4.5	75.9	O K
480 min Winter	10.934	0.934	4.5	72.9	O K
600 min Winter	10.887	0.887	4.5	69.2	O K
720 min Winter	10.836	0.836	4.5	65.2	O K
960 min Winter	10.725	0.725	4.5	56.6	O K
1440 min Winter	10.448	0.448	4.5	35.0	O K
2160 min Winter	10.213	0.213	4.4	16.6	O K
2880 min Winter	10.125	0.125	4.0	9.8	O K
4320 min Winter	10.094	0.094	3.1	7.3	O K
5760 min Winter	10.080	0.080	2.6	6.2	O K
7200 min Winter	10.072	0.072	2.2	5.6	O K
8640 min Winter	10.067	0.067	2.0	5.2	O K
10080 min Winter	10.062	0.062	1.7	4.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	11.942	0.0	76.4	60
120 min Winter	7.660	0.0	98.0	116
180 min Winter	5.886	0.0	112.9	166
240 min Winter	4.879	0.0	124.8	190
360 min Winter	3.717	0.0	142.7	268
480 min Winter	3.058	0.0	156.5	346
600 min Winter	2.628	0.0	168.1	422
720 min Winter	2.322	0.0	178.3	498
960 min Winter	1.911	0.0	195.6	646
1440 min Winter	1.453	0.0	223.1	884
2160 min Winter	1.104	0.0	254.3	1192
2880 min Winter	0.908	0.0	278.9	1500
4320 min Winter	0.691	0.0	318.1	2204
5760 min Winter	0.569	0.0	349.7	2928
7200 min Winter	0.489	0.0	375.7	3664
8640 min Winter	0.431	0.0	397.4	4352
10080 min Winter	0.388	0.0	416.8	5040

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.800	Shortest Storm (mins)	15
Ratio R	0.336	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.762

Time (mins) From:	To:	Area (ha)
0	4	0.762

Model Details

Storage is Online Cover Level (m) 12.000

Tank or Pond Structure

Invert Level (m) 10.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	78.0	1.000	78.0	1.001	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0100-4500-1000-4500
Design Head (m)	1.000
Design Flow (l/s)	4.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	100
Invert Level (m)	10.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	4.5
Flush-Flo™	0.292	4.5
Kick-Flo®	0.630	3.6
Mean Flow over Head Range	-	3.9

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	3.3	1.200	4.9	3.000	7.5	7.000	11.2
0.200	4.4	1.400	5.3	3.500	8.1	7.500	11.6
0.300	4.5	1.600	5.6	4.000	8.6	8.000	12.0
0.400	4.4	1.800	5.9	4.500	9.1	8.500	12.3
0.500	4.2	2.000	6.2	5.000	9.6	9.000	12.7
0.600	3.8	2.200	6.5	5.500	10.0	9.500	13.0
0.800	4.1	2.400	6.8	6.000	10.4		
1.000	4.5	2.600	7.0	6.500	10.8		

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APPENDIX K2

M30 Q4.5

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	10.386	0.386	4.5	92.7	O K
30 min Summer	10.511	0.511	4.5	122.6	O K
60 min Summer	10.641	0.641	4.5	153.8	O K
120 min Summer	10.764	0.764	4.5	183.3	O K
180 min Summer	10.820	0.820	4.5	196.8	O K
240 min Summer	10.847	0.847	4.5	203.3	O K
360 min Summer	10.864	0.864	4.5	207.4	O K
480 min Summer	10.862	0.862	4.5	207.0	O K
600 min Summer	10.856	0.856	4.5	205.5	O K
720 min Summer	10.847	0.847	4.5	203.2	O K
960 min Summer	10.824	0.824	4.5	197.7	O K
1440 min Summer	10.768	0.768	4.5	184.4	O K
2160 min Summer	10.677	0.677	4.5	162.5	O K
2880 min Summer	10.567	0.567	4.5	136.0	O K
4320 min Summer	10.390	0.390	4.5	93.6	O K
5760 min Summer	10.270	0.270	4.5	64.8	O K
7200 min Summer	10.196	0.196	4.4	47.1	O K
8640 min Summer	10.151	0.151	4.2	36.2	O K
10080 min Summer	10.125	0.125	4.0	29.9	O K
15 min Winter	10.434	0.434	4.5	104.1	O K
30 min Winter	10.575	0.575	4.5	138.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	67.136	0.0	94.5	19
30 min Summer	44.999	0.0	127.0	33
60 min Summer	28.921	0.0	164.6	64
120 min Summer	18.050	0.0	205.5	122
180 min Summer	13.544	0.0	231.4	182
240 min Summer	10.989	0.0	250.3	242
360 min Summer	8.165	0.0	279.1	358
480 min Summer	6.610	0.0	301.2	412
600 min Summer	5.607	0.0	319.4	476
720 min Summer	4.899	0.0	334.9	540
960 min Summer	3.957	0.0	360.6	674
1440 min Summer	2.924	0.0	399.5	954
2160 min Summer	2.158	0.0	443.5	1380
2880 min Summer	1.738	0.0	476.1	1756
4320 min Summer	1.279	0.0	525.2	2464
5760 min Summer	1.028	0.0	563.8	3120
7200 min Summer	0.868	0.0	594.9	3816
8640 min Summer	0.756	0.0	621.8	4496
10080 min Summer	0.673	0.0	645.2	5144
15 min Winter	67.136	0.0	105.9	18
30 min Winter	44.999	0.0	142.3	33

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	10.723	0.723	4.5	173.6	O K
120 min Winter	10.864	0.864	4.5	207.2	O K
180 min Winter	10.931	0.931	4.5	223.5	O K
240 min Winter	10.967	0.967	4.5	232.0	O K
360 min Winter	10.995	0.995	4.5	238.9	O K
480 min Winter	10.996	0.996	4.5	239.1	O K
600 min Winter	10.984	0.984	4.5	236.1	O K
720 min Winter	10.972	0.972	4.5	233.4	O K
960 min Winter	10.940	0.940	4.5	225.5	O K
1440 min Winter	10.856	0.856	4.5	205.3	O K
2160 min Winter	10.714	0.714	4.5	171.5	O K
2880 min Winter	10.538	0.538	4.5	129.1	O K
4320 min Winter	10.288	0.288	4.5	69.0	O K
5760 min Winter	10.164	0.164	4.2	39.4	O K
7200 min Winter	10.117	0.117	3.9	28.1	O K
8640 min Winter	10.102	0.102	3.4	24.4	O K
10080 min Winter	10.091	0.091	3.0	21.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	28.921	0.0	184.4	62
120 min Winter	18.050	0.0	230.3	120
180 min Winter	13.544	0.0	259.2	178
240 min Winter	10.989	0.0	280.4	236
360 min Winter	8.165	0.0	312.6	346
480 min Winter	6.610	0.0	337.4	452
600 min Winter	5.607	0.0	357.7	502
720 min Winter	4.899	0.0	375.1	566
960 min Winter	3.957	0.0	403.9	722
1440 min Winter	2.924	0.0	447.4	1038
2160 min Winter	2.158	0.0	496.7	1492
2880 min Winter	1.738	0.0	533.3	1876
4320 min Winter	1.279	0.0	588.4	2548
5760 min Winter	1.028	0.0	631.5	3120
7200 min Winter	0.868	0.0	666.4	3728
8640 min Winter	0.756	0.0	696.5	4408
10080 min Winter	0.673	0.0	722.9	5144

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.800	Shortest Storm (mins)	15
Ratio R	0.336	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.762

Time (mins) From:	To:	Area (ha)
0	4	0.762

Model Details

Storage is Online Cover Level (m) 12.000

Tank or Pond Structure

Invert Level (m) 10.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	240.0	1.000	240.0	1.001	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0100-4500-1000-4500
Design Head (m)	1.000
Design Flow (l/s)	4.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	100
Invert Level (m)	10.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	4.5
Flush-Flo™	0.292	4.5
Kick-Flo®	0.630	3.6
Mean Flow over Head Range	-	3.9

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	3.3	1.200	4.9	3.000	7.5	7.000	11.2
0.200	4.4	1.400	5.3	3.500	8.1	7.500	11.6
0.300	4.5	1.600	5.6	4.000	8.6	8.000	12.0
0.400	4.4	1.800	5.9	4.500	9.1	8.500	12.3
0.500	4.2	2.000	6.2	5.000	9.6	9.000	12.7
0.600	3.8	2.200	6.5	5.500	10.0	9.500	13.0
0.800	4.1	2.400	6.8	6.000	10.4		
1.000	4.5	2.600	7.0	6.500	10.8		

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APPENDIX K3

M100+30 Q4.5

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	10.331	0.331	4.5	158.0	O K
30 min Summer	10.445	0.445	4.5	212.2	O K
60 min Summer	10.567	0.567	4.5	270.6	O K
120 min Summer	10.692	0.692	4.5	330.1	O K
180 min Summer	10.757	0.757	4.5	361.3	O K
240 min Summer	10.796	0.796	4.5	379.5	O K
360 min Summer	10.839	0.839	4.5	400.3	O K
480 min Summer	10.860	0.860	4.5	410.3	O K
600 min Summer	10.868	0.868	4.5	414.0	O K
720 min Summer	10.867	0.867	4.5	413.5	O K
960 min Summer	10.857	0.857	4.5	408.8	O K
1440 min Summer	10.829	0.829	4.5	395.5	O K
2160 min Summer	10.779	0.779	4.5	371.6	O K
2880 min Summer	10.726	0.726	4.5	346.4	O K
4320 min Summer	10.610	0.610	4.5	290.7	O K
5760 min Summer	10.493	0.493	4.5	235.0	O K
7200 min Summer	10.399	0.399	4.5	190.5	O K
8640 min Summer	10.325	0.325	4.5	154.8	O K
10080 min Summer	10.266	0.266	4.5	126.7	O K
15 min Winter	10.371	0.371	4.5	177.2	O K
30 min Winter	10.500	0.500	4.5	238.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	112.770	0.0	154.7	19
30 min Summer	76.353	0.0	210.1	34
60 min Summer	49.388	0.0	278.9	64
120 min Summer	30.851	0.0	348.7	124
180 min Summer	23.073	0.0	391.1	182
240 min Summer	18.635	0.0	421.1	242
360 min Summer	13.750	0.0	465.7	362
480 min Summer	11.078	0.0	499.7	482
600 min Summer	9.359	0.0	527.1	600
720 min Summer	8.150	0.0	550.0	714
960 min Summer	6.546	0.0	586.3	818
1440 min Summer	4.796	0.0	629.1	1070
2160 min Summer	3.506	0.0	718.8	1476
2880 min Summer	2.803	0.0	766.0	1904
4320 min Summer	2.041	0.0	835.5	2724
5760 min Summer	1.628	0.0	891.9	3456
7200 min Summer	1.366	0.0	935.2	4176
8640 min Summer	1.184	0.0	972.5	4840
10080 min Summer	1.050	0.0	1004.2	5544
15 min Winter	112.770	0.0	173.6	19
30 min Winter	76.353	0.0	235.2	33

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	10.639	0.639	4.5	304.6	O K
120 min Winter	10.779	0.779	4.5	371.8	O K
180 min Winter	10.854	0.854	4.5	407.6	O K
240 min Winter	10.899	0.899	4.5	429.0	O K
360 min Winter	10.953	0.953	4.5	454.5	O K
480 min Winter	10.981	0.981	4.5	468.1	O K
600 min Winter	10.995	0.995	4.5	474.6	O K
720 min Winter	10.999	0.999	4.5	476.5	O K
960 min Winter	10.990	0.990	4.5	472.2	O K
1440 min Winter	10.951	0.951	4.5	453.8	O K
2160 min Winter	10.883	0.883	4.5	421.1	O K
2880 min Winter	10.805	0.805	4.5	384.2	O K
4320 min Winter	10.636	0.636	4.5	303.2	O K
5760 min Winter	10.450	0.450	4.5	214.4	O K
7200 min Winter	10.318	0.318	4.5	151.8	O K
8640 min Winter	10.228	0.228	4.4	108.6	O K
10080 min Winter	10.169	0.169	4.3	80.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	49.388	0.0	312.5	62
120 min Winter	30.851	0.0	390.5	122
180 min Winter	23.073	0.0	437.9	180
240 min Winter	18.635	0.0	471.3	238
360 min Winter	13.750	0.0	521.0	354
480 min Winter	11.078	0.0	558.7	468
600 min Winter	9.359	0.0	588.7	582
720 min Winter	8.150	0.0	613.3	692
960 min Winter	6.546	0.0	650.1	904
1440 min Winter	4.796	0.0	662.5	1126
2160 min Winter	3.506	0.0	805.1	1600
2880 min Winter	2.803	0.0	857.8	2052
4320 min Winter	2.041	0.0	935.3	2980
5760 min Winter	1.628	0.0	999.1	3640
7200 min Winter	1.366	0.0	1047.6	4320
8640 min Winter	1.184	0.0	1089.5	4928
10080 min Winter	1.050	0.0	1125.4	5544

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)	18.800	Shortest Storm (mins)	15
Ratio R	0.336	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.762

Time (mins) From:	To:	Area (ha)
0	4	0.762

Model Details

Storage is Online Cover Level (m) 12.000

Tank or Pond Structure

Invert Level (m) 10.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	477.0	1.000	477.0	1.001	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0100-4500-1000-4500
Design Head (m)	1.000
Design Flow (l/s)	4.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	100
Invert Level (m)	10.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	4.5
Flush-Flo™	0.292	4.5
Kick-Flo®	0.630	3.6
Mean Flow over Head Range	-	3.9

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	3.3	1.200	4.9	3.000	7.5	7.000	11.2
0.200	4.4	1.400	5.3	3.500	8.1	7.500	11.6
0.300	4.5	1.600	5.6	4.000	8.6	8.000	12.0
0.400	4.4	1.800	5.9	4.500	9.1	8.500	12.3
0.500	4.2	2.000	6.2	5.000	9.6	9.000	12.7
0.600	3.8	2.200	6.5	5.500	10.0	9.500	13.0
0.800	4.1	2.400	6.8	6.000	10.4		
1.000	4.5	2.600	7.0	6.500	10.8		

APPENDIX L

Indicative Drainage Layout

DRAINAGE KEY

- EXISTING* MANHOLE (EXG MH)
- EXISTING* CW DRAIN RUN
- EXISTING* SW DRAIN RUN
- EXISTING* FW DRAIN RUN
- PROPOSED FW DRAIN 150Ø PIPE @ MIN. 1/100 U.N.O
- PROPOSED FW MANHOLE (MH)
- PROPOSED FW RISING MAIN
- PROPOSED SW DRAIN - 150Ø PIPE @ MIN. 1/100 U.N.O
- PROPOSED SW MANHOLE (MH)
- PROPOSED SW RISING MAIN
- PROPOSED FW & SW PUMPING STATION
- SW ATTENUATION

* EXISTING SEWER BASED ON YWS SEWER RECORDS AND ON SITE CCTV SURVEY INFORMATION. ASSUMED DRAINAGE NOT IDENTIFIED DURING CCTV SURVEY. SEWERS TO BE LOCATED ON SITE PRIOR TO CONNECTION.

LAYOUT KEY

- PROPOSED HIGHWAY
- PROPOSED RESIDENTIAL PARCEL
- PROPOSED PUBLIC OPEN SPACE

FOR ALL SITE LAYOUT INFORMATION REFER TO ARCHITECT'S DRAWINGS

NOTES:

1. THESE NOTES ARE INTENDED TO AUGMENT DRAWINGS AND SPECIFICATIONS. WHERE CONFLICT OF REQUIREMENTS EXIST THE ORDER OF PRECEDENCE SHALL BE AS SHOWN IN THE SPECIFICATION. OTHERWISE THE STRICTEST PROVISION SHALL GOVERN.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ENGINEERS AND ARCHITECTS DRAWINGS.
3. DRAWINGS NOT TO BE SCALED. ALL DIMENSIONS TO BE CHECKED ON SITE BY THE CONTRACTOR. ANY DISCREPANCIES TO BE NOTIFIED TO THE ENGINEER AND FURTHER INSTRUCTIONS OBTAINED BEFORE WORK IS COMMENCED.
4. THE STRUCTURE IS DESIGNED TO BE SELF-SUPPORTING AND STABLE AFTER THE BUILDING IS FULLY COMPLETED. IT IS THE CONTRACTORS SOLE RESPONSIBILITY TO DETERMINE THE ERECTION PROCEDURE AND SEQUENCE AND ENSURE THAT THE BUILDING AND ITS COMPONENTS ARE SAFE DURING ERECTION. THIS INCLUDES THE ADDITION OF WHATEVER TEMPORARY BRACING, GUYS OR TIE-DOWNS WHICH MAY BE NECESSARY, SUCH MATERIAL REMAINING THE THE PROPERTY OF THE CONTRACTOR ON COMPLETION, AND FOR ENSURING THAT THE WORKS AND ANY ADJACENT PROPERTIES ARE SAFE IN THE TEMPORARY CONDITION.

PIPE SIZES, GRADIENTS AND LEVELS ARE SUBJECT TO FINAL DETAILED DESIGN

Rev	Description	Date	By	Chk	App
P1	First Issue	07.02.18	TW	JG	JG

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Project: RESIDENTION DEVELOPMENT AT LIMESTONE ROAD, BURNISTON

Client: GASCOINE GROUP

Drawing: INDICATIVE DRAINAGE LAYOUT

Role: CIVIL ENGINEER

Drawing Status: APPROVAL

Job. no. 35267 | Scale@ A0: 1:500 uno | Rev. P1

Project Originator Volume Level Type Role Number

LRBU - AWP - ZZ - XX - DR - C - 0100


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