



*MR P ATKINSON
PROPOSED MIXED USE DEVELOPMENT
LAND OFF A635 DEARNE VALLEY BYPASS
Flood Risk and Run-off Assessment
J-D0512 – R001*



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PROPOSED MIXED USE DEVELOPMENT
LAND OFF A635 DEARNE VALLEY BYPASS
GOLDTHORPE
BARNSELY

Flood Risk and Run-off Assessment

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Contents

1	Executive Summary	1
2	Introduction	2
3	Existing Site	4
	3.1 Site Location	4
	3.2 Site Description	4
	3.3 Existing Site Drainage	4
	3.4 Existing Watercourses	5
	3.5 Existing Land Drains / Ditches	5
	3.6 Adopted Drainage	5
	3.7 Highway Drainage	5
4	Sources and Flood Risk Extents	7
	4.1 General	7
	4.2 Watercourses	7
	4.3 Existing Site Drainage	7
	4.4 Existing Land Drains	7
	4.5 Existing Adopted Drainage	7
	4.6 Highway Drainage	7
	4.7 Groundwater	8
	4.8 Proposed Re-development	8
5	Flood Risk Assessment	9
	5.1 Watercourses	9
	5.2 Existing Site Drainage	9
	5.3 Land Drainage	9
	5.4 Adopted Drainage	9
	5.5 Highway Drainage	9
	5.6 Groundwater	10
	5.7 Proposed Re-development	10
6	Sequential Test	11
	6.1 Application and Scope	11
7	Run-off Assessment	12
	7.1 Control of Surface Water Run-Off	12
	7.2 Allowable Site Discharge	13
	7.3 Site Attenuation	15
	7.4 Attenuation with Positive Outfall	15
	7.5 Attenuation Options	15
	7.6 Attenuation Summary	19
	7.7 Flood Routing	19

8	Flood Risk Mitigation.....	21
8.1	Site Levels	21
8.2	Flood Resilience and Resistance	21
8.3	Site Access	21
8.4	Site Drainage Strategy	21
9	Conclusions	22

Appendices

Appendix A – Site Location Plan – OJP Drawing ref J-D0512 – 100

Appendix B – Site Topographical Survey – APS July 1998

Appendix C – Yorkshire Water Pre-planning response

Appendix D – Dearne & Dove IDB Correspondence

Appendix E – Indicative Planning Layout

Appendix F – Open Channel Flow Calculations

Appendix G – OJP Drawing J-D0512-101 – SuDS masterplan

Appendix H – Preliminary WinDES Calculations

1 Executive Summary

Opus Joynes Pike (OJP) were commissioned to carry out a flood risk and runoff assessment for a proposed mixed use Hotel/Commercial development located on land between the A635 Dearne Valley Bypass and Barnsley Road.

The site is to be assessed in accordance with the requirements of Planning Policy Statement 25 – Development and Flood Risk (PPS25) to determine the suitability of the proposed type of development for this site.

As well as fluvial flood risk the report will also assess the risk posed locally by the development itself and the runoff it may potentially generate.

This element will include a general overview of the suitability of Sustainable Drainage Systems (SuDS) type systems.

If required, mitigation measures and recommendations will be made that will enable the site to be suitably developed while actively seeking to reduce flood risk locally.

The following guidelines and references have been used in the preparation of this report:

- a) Planning Policy Statement 25 – Development and Flood Risk (PPS25)
- b) Environment Agency Flood Risk Standing Advice for England - PPS25 National Version 2.0
- c) OJP archives

The report is also based on additional information received from the Environment Agency (EA), Yorkshire Water (YW) and Barnsley Metropolitan Borough Council (BMBC).

The report concludes that the development is suitable for this location and can be safely developed to mitigate all identified long term residual flood risks in this area.

Furthermore, it is demonstrated that the layout may be developed to incorporate an extensive system of SuDS that will not only provide adequate runoff protection but will also provide an improvement in the runoff quality.

2 Introduction

The Government has placed increasing priority on the need to take full account of the risks associated with flooding at all stages of the planning and development process, to reduce future damage to property and loss of life. PPS25 Development and Flood Risk identifies how the issue of flooding is dealt with in the drafting of planning policy and the consideration of planning applications.

The purpose of this report is to assist our client and the local Planning Authority to make an informed decision on the flood risks associated with the site redevelopment.

Local Planning Authorities have the powers to control development in accordance with the guidelines contained in PPS 25, and are expected to apply a risk-based approach to development with the Sequential Test in Annex D Table D.1. This sets out a sequential characterisation of flood risk in terms of annual probability of river, tidal and coastal flooding.

In accordance with the sequential test in PPS 25 sites are to be classed as follows:

Flood Zone	Appropriate Uses
Flood Zone 1 - Low Probability – This zone comprises land having less than 1 in 1000 annual probability of river or sea flooding (<0.1%)	All uses of land are appropriate in this zone
Flood Zone 2 - Medium Probability – This zone comprises land assessed as having between 1 in 100 and 1 in 1000 annual probability of river flooding (1%-0.1%) or between 1 in 200 and 1 in 10000 annual probability of sea flooding (0.5%-0.1%) in any year	The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure in Table D.2 are appropriate in this Zone Subject to the Sequential Test being applied, the highly vulnerable uses in Table D.2 are only appropriate in this zone if the Exception Test is passed
Flood Zone 3a - High Probability – This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year	The water-compatible and less vulnerable uses of land in Table D.2 are appropriate in this zone. The highly vulnerable uses in Table D.2 should not be permitted in this zone. The more vulnerable and essential infrastructure uses in Table D.2 should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this should be designed and constructed to remain operational and safe for users in time of flood.

**Flood Zone 3b - Functional
Floodplain**

– This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes)

Only the water-compatible uses and the essential infrastructure listed in Table D.2 that has to be there should be permitted in this zone. It should be designed and constructed to:

Remain operational and safe for users in times of flood;

Result in no net loss of floodplain storage;

Not impede water flows; and

Not increase flood risk elsewhere.

Essential infrastructure in this zone should pass the Exception Test.

3 Existing Site

3.1 Site Location

The site is located on existing undeveloped land to the east of the roundabout junction of the A635 Dearne Valley Bypass and Barnsley Road. This junction is located to the west of the settlement of Goldthorpe, approximately 10.5km west of Barnsley.

The location is shown on OJP Drawing No. J-D0512-100 included in Appendix A. It is centred on approximate National Grid Reference 445035 404286.

3.2 Site Description

The site is currently undeveloped and is bound by the A635 to the north, Barnsley Road to the south and recent residential development to the east. The junction of Barnsley Road and the A635 is located directly to the west of the site. The arrangement of the carriageways gives the site a roughly triangular shape.

A topographical survey of the site has been undertaken and is included in Appendix B for reference. The survey indicates that the site is approximately 1.79ha in area and currently comprises no formal development.

The survey shows that the site has an overall fall from a high point on the south east adjacent to Barnsley Road to the roundabout junction to the west. The highest recorded level on the site is approximately 42.75mAOD falling to minimum of 36.5mAOD adjacent to the roundabout indicating a gradient of 1v to 29h.

Along the northern boundary, the level of the adjacent carriageway of the A635 is higher than the development site. This is more prominent in the north eastern corner of the site where the difference in level is around 1.3m, however, nearer to the roundabout junction this difference reduces but still has a minimum differential of 600mm. This is also similar to the shared boundary with Barnsley Road. The maximum level difference is 850mm in the south east, however, at the junction with the roundabout the development site is actually some 250-300mm above the adjacent carriageway.

It is noted that the recent residential development to the east of the proposed site has been artificially elevated above the former ground levels. It is unclear as the definitive reason for this but it is suspected that this may be to enable the site to drain by gravity.

3.3 Existing Site Drainage

As the existing site is undeveloped, drainage will currently be via natural systems of runoff and infiltration.

The survey indicates the presence of a boundary ditch to the north of the site at the foot of the embankment to the adjacent carriageway. The ditch is not very well defined but is a maximum of approximately 200mm deep and typically 2.0 to 3.0m wide.

3.4 Existing Watercourses

The site is in the vicinity of several watercourses, all of which flow to the River Dearne 2.2km south of the site.

The watercourses are not designated as main river in this area and are controlled by the Dearne and Dove Internal Drainage Board (DDIDB). Thurnscoe Dyke is located 280m to the north of the site flowing in an east to west direction. This joins Carr Dyke approximately 490m north west of the site. This flows north to south towards the River Dearne. It passes under the carriageway of the A635 500m south west of the site before continuing to a confluence with the River Dearne.

3.5 Existing Land Drains / Ditches

The ditch identified to the north of the site would appear to be a drain for the development site rather than as part of a wider land drainage system. A site inspection indicates that this may connect to the highway drainage system in this area via a manhole recorded at the south east of the site.

3.6 Adopted Drainage

Sewer records have been received from YW. They are included in Appendix C for reference.

The records show that there are two sewers located within an easement to the north east of the site. These evidently serve the new residential development to the east. Both sewers pass under the A635 in the north east. The surface water sewer is known to discharge to Thurnscoe Dyke approximately 290m north of the site. This is confirmed by a consent letter obtained from DDIDB and included in Appendix D.

The surface water drainage system provides downstream attenuation for the residential development via 3.0x2.1m culvert sections and a hydrobrake set to discharge to a maximum rate of 24l/s. Within the easement and under the A635 the surface water sewer is recorded to be 450mm in diameter.

The foul sewer is recorded to be 150mm in diameter and follows a similar route to the surface water sewer.

3.7 Highway Drainage

The site topographical survey identifies highway drainage within the curtilage of both Barnsley Road and A635.

Barnsley Road is observed to have two systems, the first is a traditional kerb and gully system recorded along the boundary adjacent to the development site. The second appears to be an over-the-edge system to a filter drain located on the opposite side of the carriageway. For both systems there is no confirmation of the outfall but it is assumed that the kerb and gully system falls towards the lower point next to the roundabout.

The drainage to the A635 appears to be more robust, in keeping with its more recent installation. Approaching the roundabout, all branches are drained using a combined kerb system,

manholes are also recorded to the rear of these kerbs potentially indicating a secondary pipe system to convey larger volumes.

The carriageway to the east of the roundabout appears to be drained by a kerb and gully system. The topographical survey indicates manholes both at the top and bottom of the bank adjacent to the northern boundary of the site which may be connected to this system.

Correspondence received from BMBC highways indicates that they do not have access to the records of this drainage in this area.

4 Sources and Flood Risk Extents

4.1 General

The site is shown to lie outside the flood envelope associated with fluvial sources and is classified by the EA as being within Flood Zone 1, having an annual probability of fluvial flooding less than 0.1%.

4.2 Watercourses

The site lies remote from all identified watercourses, both main river and DDIDB controlled in this area and so is not at risk of flooding from these sources.

4.3 Existing Site Drainage

The shallow ditch along the northern boundary would typically receive flows in the form of surface runoff from the existing site. The shallow and ill-defined nature of the ditch would indicate that these flows are small and infrequent and as such not of significant magnitude to present a residual flood risk.

4.4 Existing Land Drains

The site does not feature any existing land drainage and as such is not at risk from them long term.

4.5 Existing Adopted Drainage

The recorded sewers to the north east of the site are provided for the drainage of the recent residential development to the east. It is therefore safe to state that they are suitably sized for the development.

The catchment for the drainage system will be limited to the impermeable areas of the development and thus can be approximately defined. The development is measured to be approximately 5.6ha. At a typical development density of 50%, this would indicate a total impermeable area of 2.8ha.

Using the Lloyd-Davies method¹ for direct runoff, this identified impermeable area would generate approximately 350l/s for a typical M30-30 storm event (45mm/hr). This is comparable to the full bore capacity of a 450mm diameter pipe laid at 1 in 80, similar to the recorded sewer in the north east corner.

It will therefore be necessary to provide a flood flow route adjacent to the easement shown on the sewer records.

4.6 Highway Drainage

As the highways to both boundaries are located above the development site it is necessary to consider the effects of a failure of each upon the site.

¹ $Q = A.i.C$

Of the two, the drainage from the A635 has the largest potential upstream catchment. There is approximately 650m of 12m wide carriageway upstream of the site, extending to the bridge over the railway east of the recent residential development. This gives a conservative estimate of 7800m² of carriageway potentially drainage towards the development site.

Again, based on a typical M30-30 storm event this would correspond to a runoff rate approximately equal to 100l/s. Assuming that the highway drainage system were to fail this runoff could, in theory, be spilled to the surface. From here the flow will either be curtailed within the carriageway or spill down the adjacent embankment and on to the development site.

4.7 Groundwater

No site specific geotechnical testing has been undertaken for this development, however, extensive records exist in the form of British Geological Drift maps and also from OJP archives.

The area is predominately underlain by coal measures, this is evidenced in the extensive coal mining industry formerly present throughout this area. These areas typically have groundwater levels in excess of 5m below ground level and given the relatively elevated nature of the local area, the presence of shallow ground water is not thought to be an issue locally.

4.8 Proposed Re-development

The development of the site will increase the impermeable area of the site as a whole. An indicative site layout is included in Appendix E for review.

The layout indicates the current indicative arrangement of the various Hotel and Commercial components of the development in relation to the site access and the proposed car parking. While this is not the final design for the site it does give a good indication of the scale of the impermeable area likely to be generated by the development.

Using this layout as a template, it is estimated that the development will generate a total of 8775m² of new impermeable area comprising 2175m² of roof area and 6600m² of carpark/hardstanding.

5 Flood Risk Assessment

5.1 Watercourses

The site is not considered to be at risk of flooding from fluvial sources.

5.2 Existing Site Drainage

The runoff anticipated from the undeveloped site will be in the region of 14l/s using the rule of thumb of 5l/s/ha. This will easily be accommodated within the existing boundary ditches.

As the site is to be developed, the vast majority of rainfall will be intercepted prior to being converted to runoff. The development will therefore reduce the residual risk from site runoff to virtually zero.

5.3 Land Drainage

The site is not affected by land drainage.

5.4 Adopted Drainage

The worst case scenario outlined previously, assuming a catastrophic failure of the drainage system from the recent residential development to the east would typically generate a runoff of approximately 350l/s should this failure occur during a 1 in 30 year event.

The flow would emanate from the adjacent site along the route of the drainage easement, in the very north eastern corner of the site. With referenced to the proposed site plan it is evident that this area will not be developed but will be landscaped.

The existing boundary ditch in this area is recorded as 200mm deep and 3m wide at the base of the embankment to the A635. The typical flow capacity of such a ditch has been estimated to be 183l/s using conservative open channel flow calculations. Outputs from which are include in Appendix F.

Also included are outputs from a slightly enlarged channel, 3m wide but 300mm deep. This would increase the flow conveyance to approximately 362l/s.

It is recommended that the boundary drainage is deepened slightly to 300mm throughout this area and along the northern boundary such that it can be used to route flood flows from the adjacent residential site.

Given the above mitigation it is not considered that potential flood flows from the adjacent site would pose a residual flood risk to the development.

5.5 Highway Drainage

The peak runoff from the carriageway of the A635 has been estimated to be in the region of 100l/s. As noted in 5.4, the capacity of the existing drainage ditch at the base of the embankment is approximately 183l/s, indicating that the existing channel is suitably sized for the potential worst case failure of the highway drainage from A635.

With regards to the runoff from Barnsley Road, the topographical survey shows that the carriageway has a crossfall away from the development site, typically at 1v to 55h. In the event of a failure of the highway drainage for this stretch of the carriageway, runoff manifesting as overland flow will be directed away from the site by the gradient of the road.

As such the development is not considered to be at long term risk from this source.

5.6 Groundwater

The groundwater in this area is likely to be significantly lower than ground level (>5m). It is therefore not considered to be a flood risk for this development.

5.7 Proposed Re-development

The collection and control of surface water from the proposed site will be critical in the development of the layout of both habitable areas and the roads for this project. One of the Key Planning Objectives identified in PPS25 is;

- Reduce flood risk to and from new development through location, layout and design, incorporating sustainable drainage systems (SuDS)

It is important that the development of the site incorporates a strategy to not only control the run-off generated but also to improve the quality of the run-off using SuDS based drainage systems.

This report will identify suitable options as part of a strategy for this site which should be incorporated into the developing site layout.

6 Sequential Test

6.1 Application and Scope

As the site is located outside of Flood Zone 2, the application of the Sequential Test for this site is not required.

7 Run-off Assessment

7.1 Control of Surface Water Run-Off

Part H of the Building Regulations 2002 recommends that surface water run-off shall discharge to one of the following, listed in order of priority:

- a) an adequate soakaway or some other adequate infiltration system, or where that is not reasonably practicable,
- b) a watercourse, or, where that is not reasonably practicable,
- c) a sewer.

It is necessary to identify the most appropriate method of controlling and discharging surface water. The design should seek to improve the local run-off profile by using systems that can either attenuate run-off and reduce peak flow rates or positively impact on the existing flood profile.

7.1.1 Infiltration Based Systems

Based on local knowledge and OJP archives, it is likely that the development site is underlain by carboniferous coal measures. Such ground conditions are unlikely to be suitable for the use of infiltration based discharge systems.

It is recommended that in-situ soakaway testing to BRE365 is carried out on this site to determine the design infiltration potential of the natural ground underlying the site.

In the absence of this information and based on the anecdotal evidence, the use of infiltration based systems has not been pursued for this site.

7.1.2 Watercourse

The YW response suggests that the development should seek to utilise the watercourse to the north and east of the site. The nearest of which is 290m north of the development and to which the existing adopted drainage in this area already discharges.

The location of the site, between two busy roads, limits the options for making a new connection to a watercourse in either direction. Not only this, beyond the site boundaries, land is outside the control of the developer and as such access or permission to lay a new connection cannot be guaranteed.

In light of these constraints, the provision of new connection to Thurnscoe Dyke, to the north is not considered as the favoured option for this development.

The existing land drain at the base of the embankment to the A635 would currently collect the naturally occurring runoff from the existing site. As such it is considered that the ditch would be available for the discharge of the proposed development on a like for like rate. This approach is generally accepted by DDIDB in their response that recommends connections to existing watercourses to be restricted to 5l/s/ha.

7.1.3 Adopted Drainage

Adopted drainage assets have been established in the north east corner of the development site. This option should be used as the fall back option should the outfall to the watercourse prove unfeasible.

The adopted drainage assets will need to be modelled to confirm capacity, this would need to be done via a formal Pre-planning enquiry.

It should also be noted that the assets are located within a higher part of the development site and as such the provision of a gravity drainage system may not be possible to this point.

7.2 Allowable Site Discharge

At this stage it is recommended that site infiltration testing is undertaken to determine the potential of the natural ground for the discharge of surface water. However, it will be necessary to maintain a secondary outfall should infiltration prove unfeasible.

The discharge rate to the ditch will be determined by the equivalent Greenfield run-off (Q_{bar}) from the undeveloped site calculated using loH124.

7.2.1 Institute of Hydrology (IoH) 124 Method of Run-Off Assessment

The loH 124 method for determining rural run-off is based upon the observed response of a variety of small real life catchments. These catchments are all approximately less than 25km² in area and as such the loH 124 method is generally only valid for areas of smaller catchments.

This method was devised “from a study aimed specifically at small catchments” (i.e.<25km²). Efforts were made to include a greater proportion of commonly found catchments which are relatively permeable, lowland and partly urbanised.

Run-off is calculated using a variety of catchment descriptors that are translated in to input variables, these variables are listed below;

- Return Period (years)
The program generates results for a range of return periods and the specified RP.
- Area
Catchment Area (km²)
- SAAR
Average annual rainfall (1941-1970) from FSR² figure II.3.1 or equivalent.
- Soil
Soil index of the catchment from FSR figure I.4.18 or Wallingford Procedure Volume 3. Soil classes 1 to 5 have Soil Index values of 0.15, 0.3, 0.4, 0.45 and 0.5 respectively.

² Flood Studies Report – 1975 (NERC)

- Urban
Proportion of area urbanised expressed as a decimal 0.000.
- Region Number
Region number of the catchment based on FSR Figure I.2.4.

The output of the calculation is a value called $Q_{\text{BAR Rural}}$ and is given in litres/second. $Q_{\text{BAR Rural}}$ is calculated for rural areas from the following equation;

$$Q_{\text{BAR Rural}} = 0.00108 \times \text{AREA}^{0.89} \times \text{SAAR}^{1.17} \times \text{SOIL}^{2.17}$$

IoH 124 allows a modification factor to be applied should the catchment in question contain a proportion of urbanised area. However, in this case, as this is a new connection, the assessment is made pre-development i.e. no impermeable areas.

The value obtained from the equation above is an estimate of the run-off from the undeveloped site for an event of similar magnitude to a 1 in 1 or a 1 in 2 year storm event. The figure can be extrapolated to give run-off from events of larger return period (1 in 30 to 1 in 100). CIRIA Book 14 - Design of Flood Storage Reservoirs - table 3.3. gives recommended growth factors for events up to 1 in 1000 years. Modern design software can calculate the growth curve for the required site and return period both quickly and accurately.

Of the catchment descriptors the most difficult to accurately ascertain is SOIL. This factor is a generalisation of the predominant soil type in the area in question. For large catchments the error in this assumption becomes less significant to the derived $Q_{\text{BAR Rural}}$ value, however the opposite is true for smaller catchments.

7.2.2 IoH124 Assessment Summary

Catchment Parameter	Value
Area (ha)	1.79
SAAR (mm)	700
SOIL	0.45
URBAN	0.0
Region Number	4

- Area – Taken from current site development plan, this area is for the full area to the development boundary.
- SAAR – Taken from FSR data obtained via Windes Design Software.
- SOIL – as noted previously the SOIL factor is more significant for smaller catchments, to this end a sensitivity analysis has been included for the class above and class below the identified site classification. It should be noted that the soil classification indicated is type 4 (0.45) this is representative of a relatively impermeable underlying strata.
- URBAN – Site is taken to be totally rural with no existing impermeable areas.

- Region – Region number 4 taken from FSR Figure I.2.4

7.2.3 IoH124 Output

The output of the Windes IoH124 assessment is included in Appendix E for reference.

The calculations show that the anticipated value of Q_{bar} for the site is **11.3l/s** with corresponding values of $Q_{30} = 22.2l/s$ and $Q_{100} = 29.1l/s$.

7.2.4 IDB Recommendation

Correspondence received from the DDIDB indicates that a rate of 5l/s/ha would be recommended for new connections to the local watercourses. For this development this would equate to a Q_{bar} rate of 8.95l/s.

For the purposes of this assessment a rate of 9l/s will be used in the design of the surface water drainage system to reflect the worst case scenario imposed by the IDB in this location.

7.3 Site Attenuation

As the development of the site will increase the run-off rate in proportion to the increase in impermeable area, the requirement to control and mitigate this effect will be a major influencing factor upon the development of the design.

7.4 Attenuation with Positive Outfall

Using FSR characteristics of M5-60 = 19.0 and ratio R = 0.364 it is possible to estimate the volume of attenuation required for the proposed development using design software, this estimated volume of attenuation has been summarised in Table 1;

Table 1 - Estimated Volumes of Attenuation – Positive Site Outfall

Development density %	Impermeable Area Ha	Unrestricted 1 in 30 year Run-off l/s	Attenuation Required 1 in 30 m ³	Attenuation Required 1 in 100+20% m ³
50	0.8775	112	202 - 304	373 - 532

The figures in Table 1 should be used to approximate the volume/area required to accommodate suitable attenuation systems on site and thus influence the layout development of the site to incorporate suitable areas in which to locate these devices.

7.5 Attenuation Options

The most appropriate attenuation system will need to satisfy three main characteristics, firstly, provide the required volume of storage, secondly, minimise the loss of developable land and thirdly, where possible provide local amenity.

The current proposed layout presents several opportunities for the delivery of significant SuDs elements which would integrate well with the use of the site.

These systems are discussed in more detail below:

7.5.1 SuDS Systems - Swales, ponds and basins

The nature of these systems is such that the run-off from the development can be treated by biological action and stilling to significantly improve the quality of water discharged from the system.

Basins also provide large areas of open space that can be developed for recreational uses or as new habitats for wildlife.

Both systems do however take up significant amounts of developable land and have residual maintenance and liability issues attached to their implementation.

These systems work well in less dense development such as this where open space is available. The use of the system will also help to control the rate of runoff from the site. However, unless infiltration rates are proven on the site they will offer no reduction in discharge volume.

The current site layout would not provide sufficient open space for a sizeable pond and would adversely impact upon the development footprint. The use of swales would however appear to be compatible with the proposed landscaping along the northern and western boundaries.

7.5.2 Bio-retention Areas and Filter Trenches

Designated areas of landscaping are populated with specific planting designed to maximise water quality improvements. The areas are often replacements for 'normal' landscaped areas and as such the land take is generally in line with a standard development.

These areas have a limited volume of attenuation and are often used as a treatment feature rather than a storage element, with an outlet structure linked to downstream drainage and attenuation.

When specified efficiently, the benefits of these features can be significant. Table 5.7 of C697 rates these features highly on many of the water quality elements.

A scaled down version of the full retention area is a filter trench which takes the form of lined trench with or without planting. These perform much the same function but as conveyance rather than attenuation.

The current proposed landscaping to the northern and western boundaries provides ample area in to which these features could be integrated. As they coincide with the lower parts of the site they are ideally located for a gravity based system.

7.5.3 Permeable Paving

Larger areas of block paved hardstanding and driveway can economically be converted to provide significant volumes of storage. These systems also encourage biological treatment of flow and extraction of oils and heavy metals from the run-off.

Land take is reduced as storage is located under car parks and access roads. However, maintenance is potentially a long term issue and the possibility of the paving being damaged, dug up and not properly reinstated or not regularly swept could lead to compromising the future capacity of the system.

This system will negate the need for a separate collection system such as kerbs and gullies. It will also assist in reducing the flood profile of the site by significantly attenuating the run-off from the development within the sub base material.

Permeable paving also provides a significant potential for the improvement in runoff quality. The CIRIA SuDS Manual Table 5.7 indicates that permeable paving is one of the most proficient systems in improving water quality, being rated as 'High' in its ability to remove the following contaminants;

- Suspended solids
- Heavy metals
- Nutrients
- Bacteria
- Dissolved Pollutants

The performance of these systems is such that it may sometimes be used in lieu of a petrol interceptor. This would require the approval of the system by the EA.

There is no specific amenity provided by the system other than enabling other areas to be utilised for development rather than potentially sterilizing areas with an easement for a sewer or stand-off for a basin.

These systems may be incorporated into normal car parking areas but may not be suitable for areas accessed by larger vehicles. As the current layout proposes significant areas of car parking there are numerous opportunities to utilise these systems across the site.

7.5.4 Traditional Attenuation

It is often possible to provide the required volume of storage within the existing collection pipework of the proposed system. This may be incorporated by using oversized pipework and/or culverts designed to act as inline storage.

As the diameter of larger pipes readily available is limited the applicability of these types of systems is more suited to <200m³ of attenuation. Above this volume the length of pipe required is excessive and difficult to suitably fit into a typical site layout.

There is no intrinsic amenity provided by the use of these systems, neither is there any specific level of run-off treatment over and above that of a standard pipe and gully system.

The pipes are generally available direct from suppliers with little or no lead in time and the satisfactory long term performance of these systems is well documented.

7.5.5 Cellular Storage

Large volumes of storage can be provided under grassed and lightly trafficked areas by using proprietary plastic cellular systems. This will maximise the developable area of the site.

There is no specific mechanism within the system designed to treat flow but extended detention times will allow sedimentation, reducing the suspended solids within the discharge.

There is no creation of amenity by the installation of these types of systems, indeed by maintaining access to the system small areas may need to be reserved.

The current layout would permit the extensive use of Cellular system under the parking areas.

7.5.6 Rainwater Harvesting

The use of these systems is a growing area particularly when considering the whole life costs of a development. With the estimated average daily usage of water per head approaching 150 litres, the reuse of collected rainfall for flushing toilets and potentially in washing machines and other non-potable uses could provide a significant proportion of this demand.

The system will require a commitment to implement it from an early stage in the design process as it will require strategic decisions regarding the type of system, location of plant and storage and planning of pipework and services to successfully implement on site.

If these decisions are broached early the system can be economically and feasibly incorporated with no impact upon the design process.

Basic installations do not have any specific water treatment. However, more advanced systems can include filters and Ultra Violet disinfection systems if water is to be used in more sensitive uses. A typical WC flush system would not include such treatment.

With regard to overall drainage design, it will still be necessary to provide on-site attenuation at the outfall of the development as per a traditional system, however, a negotiated reduction in either design storm intensity or allowable discharge rate can often be negotiated to reflect the real life impact of the harvesting systems upstream.

The application of these systems would lend itself to occupant heavy buildings such as hotels and offices due to the higher proportion of usage in WC's etc in these types of premises. Specific industrial uses can also benefit from the installation of these systems, particularly where large volumes of water are needed for non-potable uses in manufacturing processes.

7.5.7 Surface Storage

The use of roads and landscaped areas as additional storage is becoming a widely accepted form of attenuation particularly for extreme events over and above the SfA 1 in 30 year standard.

Water spilling from drainage systems can be collected via roads and kerbs and channelled to lower lying areas where it would be stored until the capacity in the existing system returns.

These systems have the advantage of requiring little additional infrastructure merely detailing of the proposed roads and grassed areas to accept and retain flow.

As these systems will only be used in extreme events, when the private drainage system is exceeded (>1 in 10 years) they provide a very efficient way of catering for these events rather than providing permanent capacity.

There is no inherent water treatment capability in this system nor any particular increase in amenity, however, the costs associated with this provision are relatively small.

The layout of the site would permit the mobilisation of a sizable volume of surface attenuation throughout the lower lying area to the west of the site. It will be necessary to carefully detail the landscaping and external works in this area to enable safe use as surface attenuation while protecting the buildings during extreme events.

7.6 Attenuation Summary

The current proposed layout has the potential for application of most forms of attenuation. The large open car parking areas and the landscaping to the north and west offer opportunities for the application of two of the most beneficial SuDS options: Swales/Bio retention and Permeable Paving.

A schematic layout of the SuDS masterplan is included in Appendix G with calculations for the provisional sizing of the swale in Appendix H. The preliminary design indicates that a 110m Swale along the northern boundary will be required to provide approximately 270m³ of attenuation for the 1 in 30 year plus climate change event. An additional 110m³ will be required for the 1 in 100 year plus climate change event which it is envisaged will be provided by surface attenuation in the bio-retention area and lower reaches of the car park and landscaping.

As the external works for the site have yet to be resolved it is not possible to definitively demonstrate this surface attenuation option, however, the SuDS master plan clearly shows the drainage strategy to be developed in conjunction with the site layout.

7.7 Flood Routing

The performance of the system during extreme events (>1 in 100 years) should also be considered at this stage.

The routing of potential surface water run-off, should the capacity of the proposed system be exceeded, needs to be built into the layout of the site such that the residual risk of flooding from this element can be easily mitigated.

By identifying the most vulnerable manholes in the system, flooding routes on to public open space or landscaped areas may be incorporated relatively easily and economically at the planning stage.

Given the level of landscaping to be carried out on the site, the provision of suitable flood routing would be relatively straightforward and economical to provide, subject to appropriate detailing of landscaping and carriageway levels. The routing of flood waters from both the residential area to the east and the A635 to the north should also be considered at this stage.

Drawing J-D0512-101 included in Appendix G, illustrates the likely flood routes along the boundary of the site for both of these sources. The proposed development should maintain, and where necessary, improve the existing flood routes along the boundary of the site.

8 Flood Risk Mitigation

8.1 Site Levels

The existing site is identified within Flood Zone 1 and is demonstrably not at risk from other sources such as groundwater and sewer failure. No additional steps need to be undertaken to mitigate long term flood risk other than providing a nominal 150mm DPC clearance from the adjacent ground levels.

8.2 Flood Resilience and Resistance

The development of the layout should always consider that the site is potentially at risk from an extreme event in excess of 1 in 1000 years. As such the implementation of flood resilience and resistance is recommended for incorporation at this stage.

Relatively simple measures such as raising utility entry points, using first floor or ceiling down electrical circuits and sloping landscaping away from properties can be easily and economically incorporated into the development.

Flood routing through the site also needs to be tested and incorporated at this stage.

8.3 Site Access

A permanent, safe site egress will be provided to the carriageway of Barnsley Road to the south of the site.

8.4 Site Drainage Strategy

The site should utilise a SuDS based drainage system incorporating permeable paving, infiltration swale and a bio-retention area. The system will discharge to the existing land drainage ditch to the west of the site, adjacent to the A635 roundabout, at a rate of 9l/s.

Foul drainage will be discharged via a gravity drainage system to the existing adopted foul drainage in the north east of the site.

9 Conclusions

The site is demonstrated to be outside the influence of external flood sources and therefore is classified as being within Flood Zone 1.

The development is classified as 'More Vulnerable' and therefore with reference to PPS25 Table D.3 the proposed development is deemed appropriate for this site. The site will also provide a permanent safe egress route to Barnsley Road.

The development will yield a significant increase in the rate and runoff anticipated from the site and it will be necessary to provide a robust system to collect and control this runoff.

The use of infiltration based drainage disposal systems is not currently considered to be viable for this site given the anticipated underlying ground conditions. However, it is recommended that the site specific soakaway testing is undertaken to determine if the nature of the natural strata.

It is currently recommended that the site utilises the existing drainage ditch to the west of the site, with an outfall restriction of 9l/s, equivalent to the IDB recommended Q_{bar} rate for the pre-development condition.

Attenuation volumes in the region of 270m³ for the 1 in 30 year plus climate change event increasing to 380m³ for the 1 in 100 year + 20% Climate Change are anticipated and given the current proposed layout of the site the use of a storage swale/bio-retention is seen as the most suitable attenuation system at this stage.

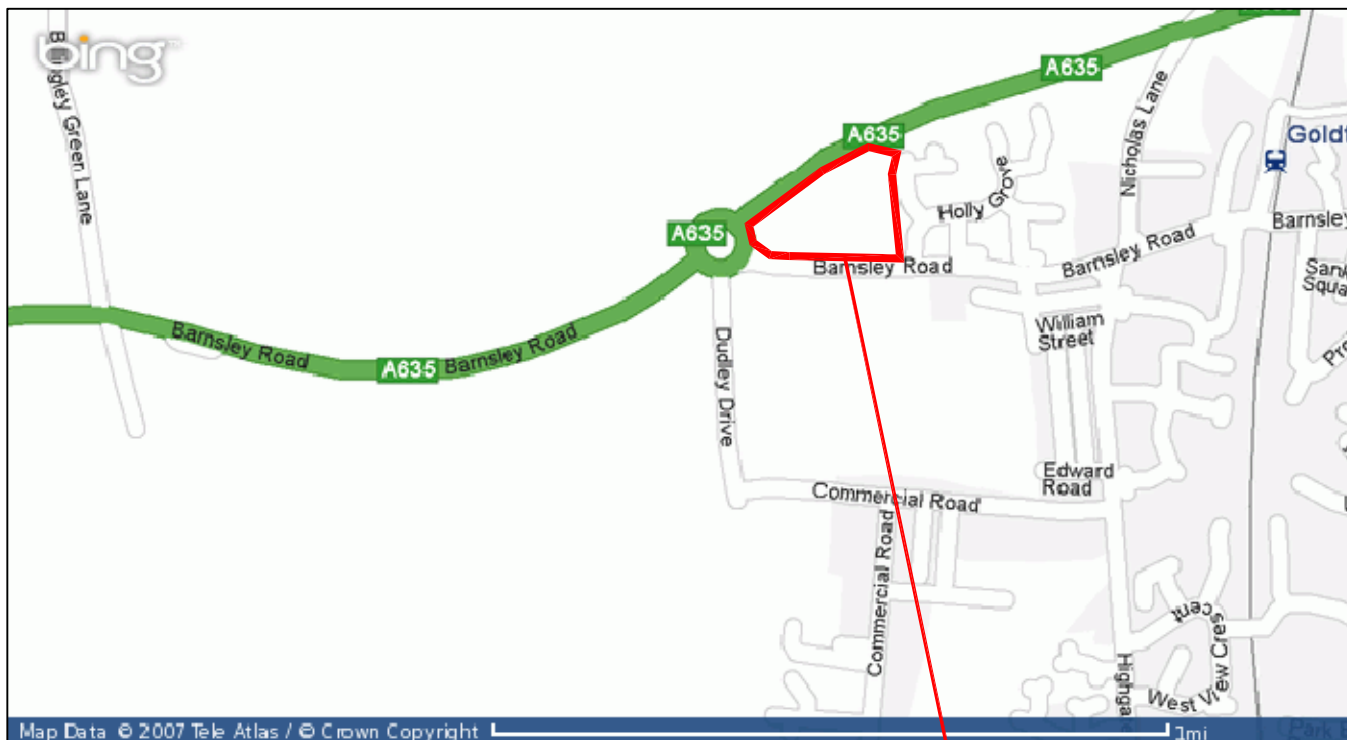
The site should include the provision of permeable paving to provide both additional storage and significant levels of water quality improvement.

It will be necessary to provide a formal outfall from the development to the drainage ditch. As the ditch is riparian there is no formal process for approval of the connection, however, it will be necessary for a 'Consent to Discharge' to be obtained from the EA and also formal permission from the BMBC highways. This should be applied for after detailed design of the site drainage system.

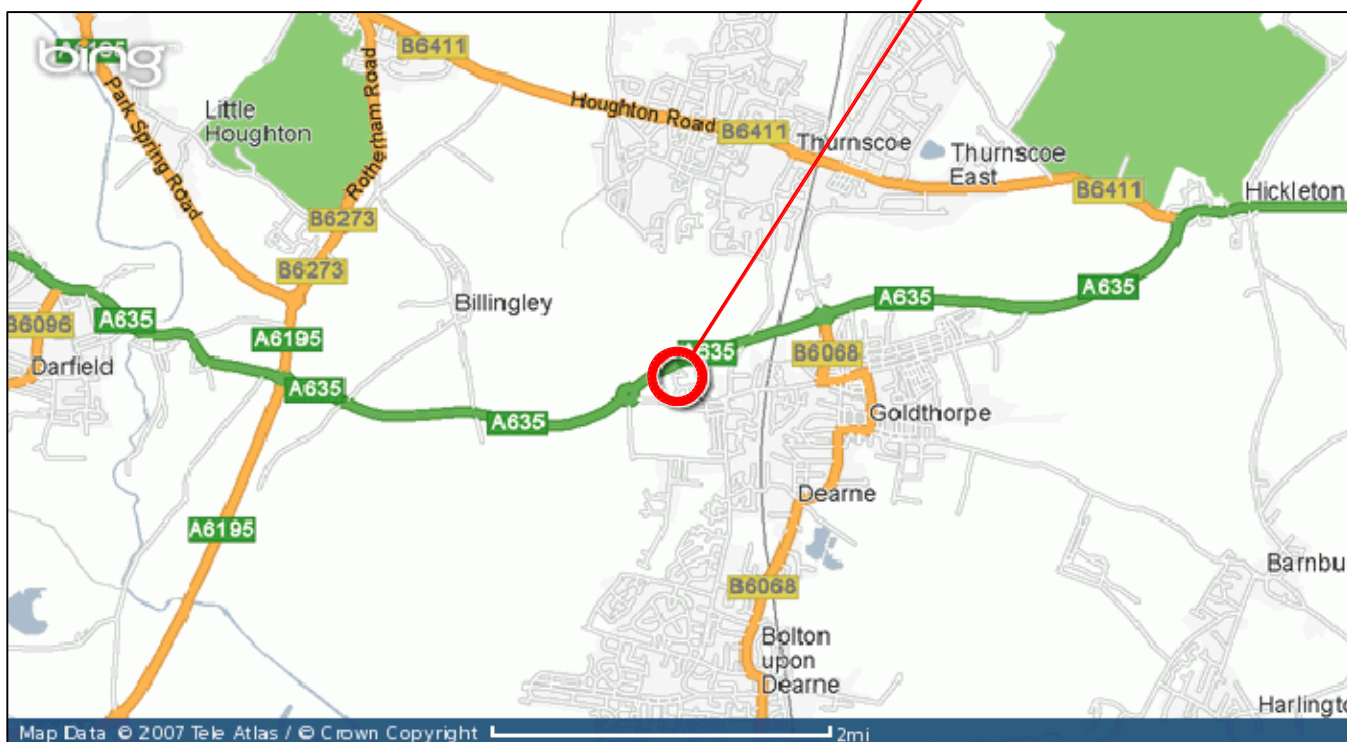
In accordance with the guidance identified in PPS25, the proposals and type of development is determined to be suitable for this location and it is demonstrated that the strategy to control and convey runoff from the new development will both reduce downstream flood risk and provide water quality improvements through the use of SuDS systems.

Appendix A – Site Location Plan – OJP Drawing ref J-D0512 – 100

0 10 50 100 mm



SITE LOCATION
Grid Ref 445035 404286
Post Code S63 9LB





OPUS JOYNES PIKE

1-2 Aire House
Richmond Business Park
Siddings Court
Doncaster DN4 5NL

Doncaster Office
Tel: +44 1302 322295
Fax: +44 1302 322296

Drawn: AJP
Disigned: AJP
Approved: _____
Revision Date: _____

Project No: J-D0511
Scale: _____

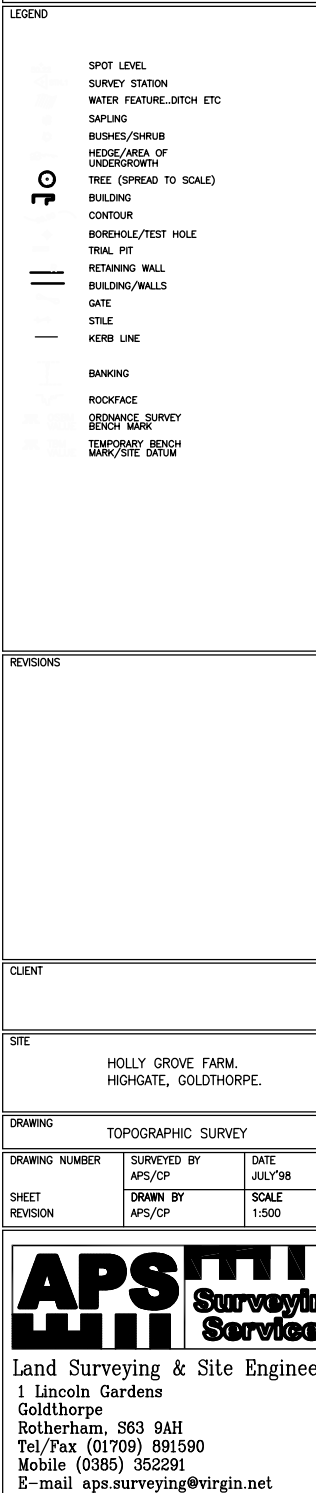
Project: FLOOD RISK AND RUNOFF ASSESSMENT
LAND OFF A638 & BARNSELY ROAD
GOLDTHORPE, BARNSELY

Sheet: SITE LOCATION PLAN

Drawing No: D0 J-D0511

Sheet No: 100
Revision: R0

Appendix B – Site Topographical Survey – APS July 1998



Appendix C – Yorkshire Water Pre-planning response



YorkshireWater

Head of Planning and Transportation
Service
Barnsley Metropolitan Borough Council
PO Box 604
Barnsley
S70 9FE

Land & Planning
Yorkshire Water Services Ltd
PO Box 500
Western House
Western Way
Halifax Road
Bradford
BD6 2LZ

Tel: (01274) 691111
Fax: (01274) 692643

Your Ref: 2010/0107
Our Ref: L000819

For telephone enquiries ring:
Matthew Naylor on (01274) 692916

E-mail
matthew.naylor@yorkshirewater.co.uk

4th March 2010

Dear Sir/Madam,

Land Off Barnsley Road, Gldthorpe, Rotherham - Erection of hotel/bar/restaurant and two roadside restaurants (Extension of time limit on 2007/0004)

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:

**Unless otherwise agreed in writing by the local planning authority, no building or other obstruction shall be located over or within 3 (three) metres either side of the centre line of the sewer, which crosses the site.
(In order to allow sufficient access for maintenance and repair work at all times)**

**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 and surface water drainage, including details of any balancing works and off-site works, have been submitted to and approved by the local planning authority.
(To ensure that the development can be properly drained)**

**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 and no buildings shall be occupied or brought into use prior to completion of the approved foul drainage works.
(To ensure that no foul or surface water discharges take place until proper provision has been made for their disposal)**

Surface water from vehicle parking and hardstanding areas shall be passed through an interceptor of adequate capacity prior to discharge to the public sewer. Roof drainage should not be passed through any interceptor.



(In the interest of satisfactory drainage)

The following information is relevant to the recommended conditions above:

- i) On the Statutory Sewer Map, there are 150mm and 450mm diameter public sewers recorded to cross/cross close to the site. In this instance, a stand-off distance of 3 (three) metres is required at each side of each sewer centreline.
- ii) Development of the site should take place with separate systems for foul and surface water drainage.
- iii) Foul water domestic waste should discharge to the 150mm diameter public foul water sewer recorded crossing/crossing close to the site.
- iv) Foul water from kitchens and/or food preparation areas of any restaurants and/or canteens etc. must pass through a fat and grease trap of adequate design before any discharge to the public sewer network.
- v) The developer is required to consult with Yorkshire Water's Industrial Waste Section (telephone 0845 1242429) on any proposal to discharge a trade effluent to the public sewer network.
- vi) From the information supplied, it is not possible to determine if the whole site will drain by gravity to the public sewer network.
- vii) If sewage pumping is required, the peak pumped foul water discharge must not exceed 5 (five) litres per second.
- viii) Sustainable Systems (SUDS), for example the use of soakaways and/or permeable hardstanding, may be a suitable solution for surface water disposal that is appropriate in this situation. The use of SUDS should be encouraged and the LPA's attention is drawn to PPS25. The developer and LPA are advised to seek comments on the suitability of SUDS from the appropriate authorities. The developer must contact the Highway Authority with regard to acceptability of highway drainage proposals.
- ix) The developer is also advised to contact the relevant drainage authorities with a view to establishing a suitable watercourse for the disposal of surface water. It is understood that a watercourse (Thurnscoe Dike) is located to the north and west of the site.
- x) The local public sewer network does not have capacity to accept any discharge of surface water from the proposal site.
- xi) From the information supplied, it is not possible to determine if the site is low-lying relative to the location(s) of the public sewer network. If the ground level of a site or the level of any basement is below the ground level of the point of connection to a public sewer, the developer may have to take precautions to prevent the risk of flooding of the site from surcharge of the public sewer network. Such precautions may include raising the level of the site, having (a) pumped discharge(s) from the site and/or the installation of (a) anti-flooding valve(s).
- xii) 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. Highway drainage, however, may be accepted under certain circumstances; for instance, if SUDS are not a viable option, there is no highway drain available, if there is available capacity, and if it is not detrimental to the public sewer network and the aquatic environment. In this event, the developer will be required to enter into a formal agreement with Yorkshire Water Services under Section 115 Water Industry Act 1991 to discharge non-domestic flows into the public sewer network.
- xiii) No land drainage to be connected/discharged to public sewer.

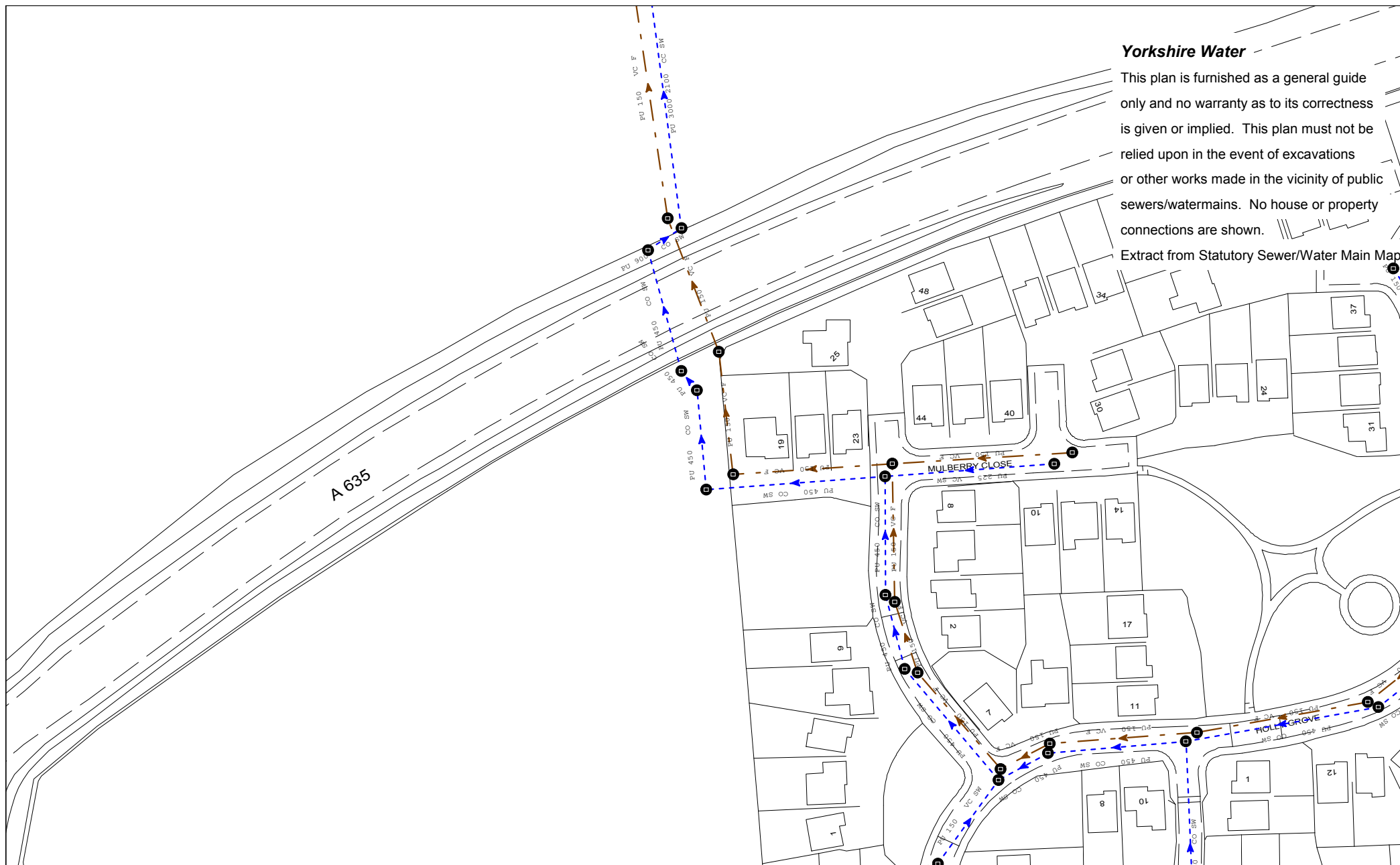
xiv) The developer should also note that the site drainage details submitted have not been approved for the purposes of adoption or diversion. If the developer wishes to have the sewers included in a sewer adoption/diversion agreement with Yorkshire Water (under Sections 104 and 185 of the Water Industry Act 1991), they should contact our Developer Services Team (tel 0845 120 84 82, Fax 01274 303 047) at the earliest opportunity. Sewers intended for adoption and diversion should be designed and constructed in accordance with the WRc publication 'Sewers for Adoption - a design and construction guide for developers' 6th Edition, as supplemented by Yorkshire Water's requirements.

It is important that Yorkshire Water is informed of the local planning authority's decision on this application. Please send me a copy of the decision notice.

Yours faithfully

A handwritten signature in black ink, appearing to read 'Stephanie Walden', with a stylized, flowing script.

Stephanie Walden
Land Use Planning Manager



Yorkshire Water

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/watermains. No house or property connections are shown.

Extract from Statutory Sewer/Water Main Map

Date Requested : 04/03/2010, 11:22:42

Date Generated : 04/03/2010, 11:22:52

Scale : 1:1250

The position and depth of any YW apparatus shown on this map are approximate only.

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UPN: Undefined

Originator: M NAYLOR, LAND AND PLANNING, 75 2916

Appendix D – Dearne & Dove IDB Correspondence

Andrew Precious

From: Christopher Wright [christopher.wright@jbaconsulting.co.uk]
Sent: 10 March 2010 09:42
To: Andrew Precious
Subject: FW: 2010 0308 - J-D0511 - L002 - D&D IDB
Attachments: Holly Grove Farm to Thurnscoe Dyke 18.05.99.pdf

Andrew

I have attached a copy of the consent form. This refers to a number of drawings showing the drainage proposals which I have on paper only.

The site area draining to the Dyke was 5.65ha and the permitted discharge was based on a maximum flow of 5l/s/ha. The same restriction would be imposed on your proposed development.

The main storage section was proposed as immediately downstream of the crossing of the DVB, being 56m length of 3000 x 1800mm box culvert with the hydrobrake in the downstream manhole.

I look forward to receiving your proposals for review.

Regards

Chris Wright

Principal Engineer

From: Andrew Precious [mailto:andrew.precious@opusinternational.co.uk]
Sent: 08 March 2010 16:20
To: Christopher Wright
Subject: RE: 2010 0308 - J-D0511 - L002 - D&D IDB

Thanks Chris

From: Christopher Wright [mailto:christopher.wright@jbaconsulting.co.uk]
Sent: 08 March 2010 16:00
To: Andrew Precious
Subject: RE: 2010 0308 - J-D0511 - L002 - D&D IDB

Andrew

Ben Bailey Homes obtained consent from the IDB to discharge surface water to the watercourse (Thurnscoe Dyke) at a restricted rate. I will look up the consent in our archive and let you have it.

A consent will be required as there will be a change in the discharge rate into the Dyke. However, providing it is to the previous restriction, the consent will be granted.

I have no records of the DVB drainage. It was in when we took over management of the Board.

Regards

Chris Wright

Principal Engineer

JBA Consulting | Denison House, 1 Hexthorpe Road, Doncaster, South Yorkshire, DN4 0BF, UK
t: +44 (0)1302 342055 | f: +44 (0)1302 329887

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This email is covered by JBA Consulting's email disclaimer at www.jbaconsulting.co.uk/emaildisclaimer.

From: Andrew Precious [mailto:andrew.precious@opusinternational.co.uk]
Sent: 08 March 2010 10:12
To: Christopher Wright
Subject: 2010 0308 - J-D0511 - L002 - D&D IDB

Chris,

I think this site falls in your area of the D&D. I am looking at a FRA for a site at the roundabout junction of the Dearne Valley Bypass (DVB) and Barnsley Road at Goldthorpe. The adjacent site was developed by Ben Baileys some years ago and would appear to utilise an off-site connection, via Yorkshire Water adopted assets to a small watercourse to the north that eventually find its way in to the Dearne to the south west of the site.

One option at this stage is to tap into this existing drainage asset locally. Would this approach require any approval from D&DIDB given that it is a short distance upstream of the outfall, albeit to YW adopted assets. If so what would you guidance be or alternatively, are there any other outfalls available in this area, the DVB drainage must outfall in several places along this route.

Thanks in advance for your help

Regards



Andrew Precious
Principal Civil Engineer
OPUS JOYNES PIKE Ltd
andrew.precious@opusinternational.co.uk
Tel +44 1302 322295, Mobile +44 7786560449
<http://www.opusinternational.co.uk>

1-2 Aire House, Richmond Business Park, Sidings Court, Doncaster, United Kingdom, DN4 5NL
As at 18 March 2008, Joynes Pike Group Ltd became Opus Joynes Pike Ltd. Company Registration (England): 1421639

DEARNE AND DOVE INTERNAL DRAINAGE BOARD

Pillar House - 20 South Parade - Doncaster - South Yorkshire - DN1 2DP

Telephone Number (01302) 342055 - Fax Number (01302) 329887

- CONSENT TO CARRY OUT WORKS -

Our Reference : CGW/SD/D&D (43)

Your Reference :

To : Ben Bailey Homes Limited,
Elizabeth House,
Cliff Street,
MEXBOROUGH,
S64 9HU.

Dear Sirs,

LAND DRAINAGE ACT 1991 THURNSCOE DYKE - SURFACE WATER DISCHARGE FROM HOLLY GROVE FARM DEVELOPMENT

THE DEARNE & DOVE INTERNAL DRAINAGE BOARD, in the pursuance of their powers under Section 23 of the Land Drainage act 1991 **HEREBY CONSENT** to the execution and completion of works in accordance with details given on the submitted Application Form dated the 4th May 1999 and drawing Nos. 1191/02 (5 sheets), 1191/03, 1191/05, 1191/20, 1191/23 - /25, Micro Drainage output sheets and details of 168SMH Hydrobrake, subject to the following conditions:-

- a) Maximum discharge to Thurnscoe Dyke to be 24 litres per second.
- b) No other connections are to be made to the pipeline nor is any additional area to be drained to the pipeline without the prior consent of the Board.
- c) Stone pitching to be approximately 250mm cubes set in lean concrete bed and pointed smooth.
- d) Stone pitching to extend across the bed of the dyke and up the opposite bank to level of discharge pipe soffit.
- e) Stone pitching to cover all disturbed bed and banks and extend downstream of the outfall by 2m minimum.

THE WORKS SHALL BE COMPLETED WITHIN 12 MONTHS FROM THE DATE OF THIS NOTICE.

The Board, by granting Consent under the Land Drainage Act 1991 for these works accepts no liability for any loss of damage which may arise out of their design, construction, maintenance or use.

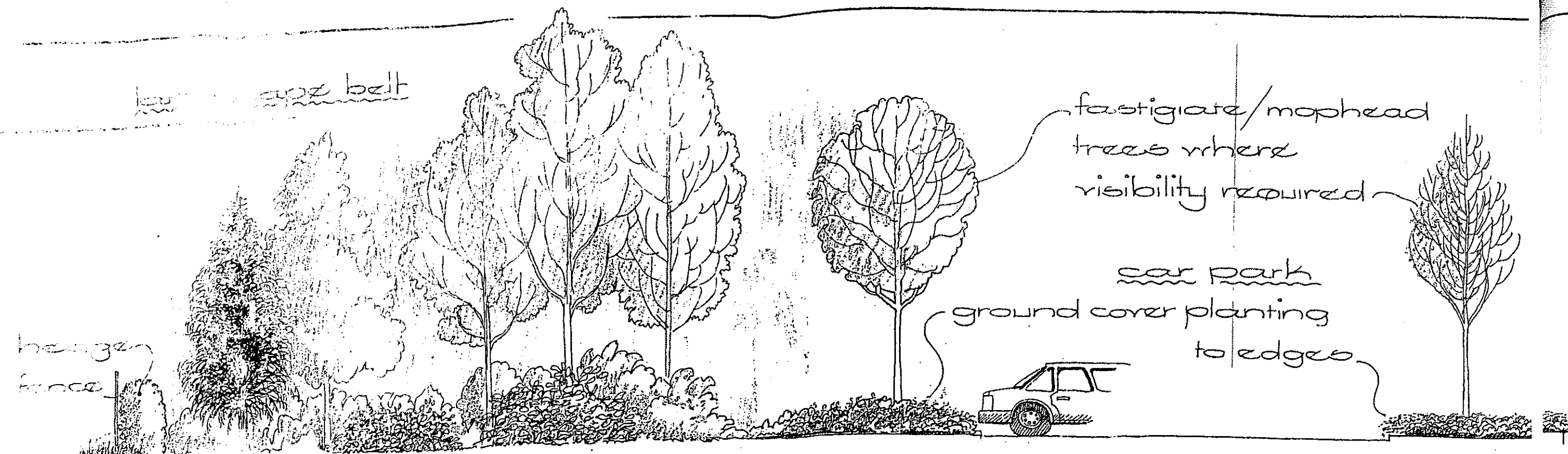
Your attention is drawn to the notes and requirements attached and the conditions listed in the accompanying letter.

Dated this 18th Day of May 1999


Grantham Brundell and Farran - Engineers to the Board

Any enquiries relating to the consent should be made to the Drainage Board
Contact : Mr C.G. Wright on the above Telephone Number

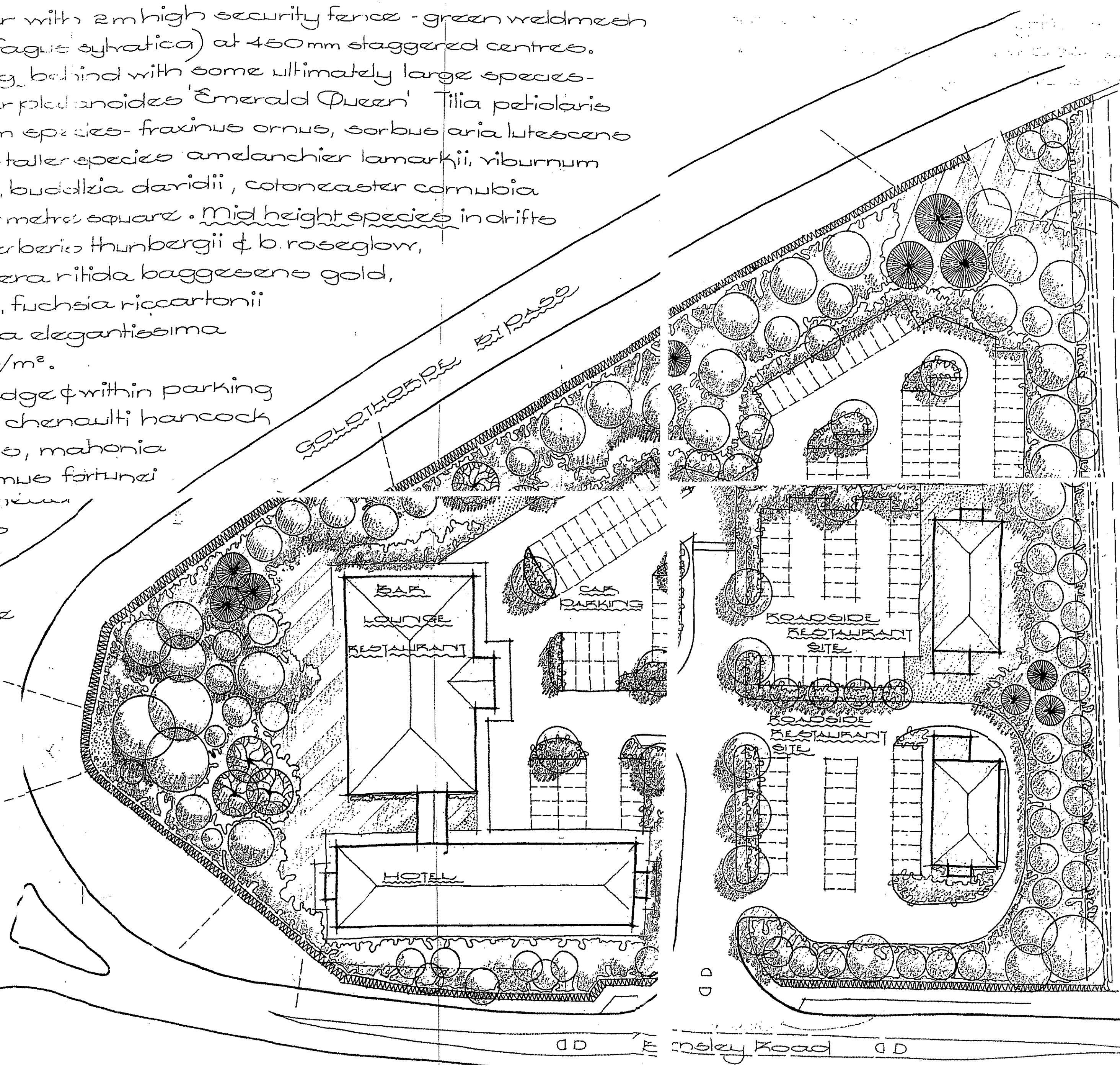
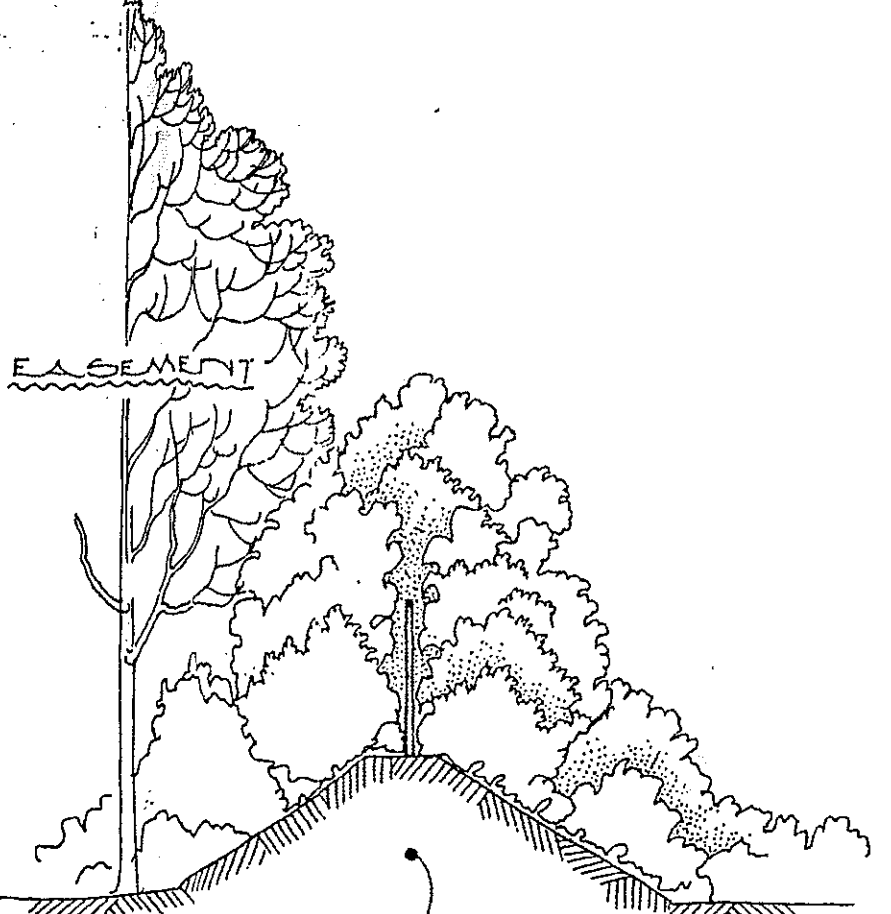
Appendix E – Indicative Planning Layout



hedge row to outer perimeter with 2m high security fence - green weldmesh
 Beech hedge (*Fagus sylvatica*) at 450mm staggered centres.
 Heavy tree & shrub planting behind with some ultimately large species -
Fraxinus excelsior, *Acer platanoides* 'Emerald Queen', *Tilia petiolaris*,
Pinus sylvestris etc. Medium species - *Fraxinus ornus*, *Sorbus aria*, *Luteocornus*,
Alnus cordata etc. Shrubs - taller species *Amelanchier lamarckii*, *Viburnum*
tinus, *Prunus laurocerasus*, *Buddleia davidii*, *Cotoneaster cornubia*,
Ilex pyramidalis etc. at 1 per metre square. Mid height species in drifts
Cornus midwinter beauty, *Berberis thunbergii* & *B. rosea*, *Spiraea thunbergii*,
Lonicera nitida baggesens gold, *Photinia fraseri* 'red robin', *Fuchsia riccartonii*,
Weigela florida, *Cornus alba elegantissima*, *Cornus alba spæthii* at 3/m².

Smaller species to front edge & within parking areas -
Symphoricarpos chenaultii hancock, *Vinca minor purpurascens*, *Mahonia*,
Aquilegia apollo, *Euonymus fortunei*.
 Trees in these areas - mophead
 or ascending trees - *Sorbus*
intermedia brouwers,
Malus tschonoskii,
Sorbus in variety to maximise
 security & visibility

EXISTING
 LANDSCAPED
 BOUNDARY



LIVE EARTH BUNDING - 2 METRES
 HIGH WITH A 2 METRE HIGH ACOUSTIC
 FENCING

ADJACENT
 RESIDENTIAL
 DEVELOPMENT

NORDEK LTD.,
 BARNDSLEY ROAD,
 GOLDTHORPE
 LANDSCAPE - SKETCH
 PROPOSALS FOR HOTEL
 CANCELLARY DEVELOPMENT.

MAY 99 1:500 DWG N° 232 - 2L.

GARRY GREETHAM AND ASSOCIATES

BARNDSLEY
 Metropolitan Borough Council
 2 JUN 1999
 DEPARTMENT OF PLANNING
 AMENDED PLANS

BARNDSLEY
 Metropolitan Borough Council
 APPROVED TOWN PLANNING
 23 JUN 1999

Appendix F – Open Channel Flow Calculations

Project Holly Grove Farm				Job Ref. J-D0512	
Section Estimate Channel Flow				Sheet no./rev. 1	
Calc. by AJP	Date 24/03/2010	Chk'd by	Date	App'd by	Date

STEADY FLOW IN OPEN CHANNELS

TEDDS calculation version 1.0.01

Channel details

Bed slope $S_0 = 0.016850$ (1 in 59)

Channel section 1

Wetted perimeter $P_1 = 3.000$ m

Area of flow $A_1 = 0.300$ m²

Manning roughness factor $n_1 = 0.045$

Hydraulic radius $R_1 = A_1 / P_1 = 0.100$ m

Discharge $Q_1 = A_1 \times (R_1 / 1 \text{ m})^{2/3} \times S_0^{1/2} \times 1 \text{ m/s} / n_1 = 0.186$ m³/s

Compound channel flow

Total discharge $Q_{\text{total}} = Q_1 = 0.186$ m³/s

STEADY FLOW IN OPEN CHANNELS

TEDDS calculation version 1.0.01

Channel details

Bed slope

 $S_0 = 0.016850$

(1 in 59)

Channel section 1

Wetted perimeter

 $P_1 = 3.059$ m

Area of flow

 $A_1 = 0.450$ m²

Manning roughness factor

 $n_1 = 0.045$

Hydraulic radius

 $R_1 = A_1 / P_1 = 0.147$ m

Discharge

 $Q_1 = A_1 \times (R_1 / 1 \text{ m})^{2/3} \times S_0^{1/2} \times 1 \text{ m/s} / n_1 = 0.362$ m³/s**Compound channel flow**

Total discharge

 $Q_{\text{total}} = Q_1 = 0.362$ m³/s

Appendix G – OJP Drawing J-D0512-101 – SuDS
masterplan



Stone Lined Swale



Bio-retention Area



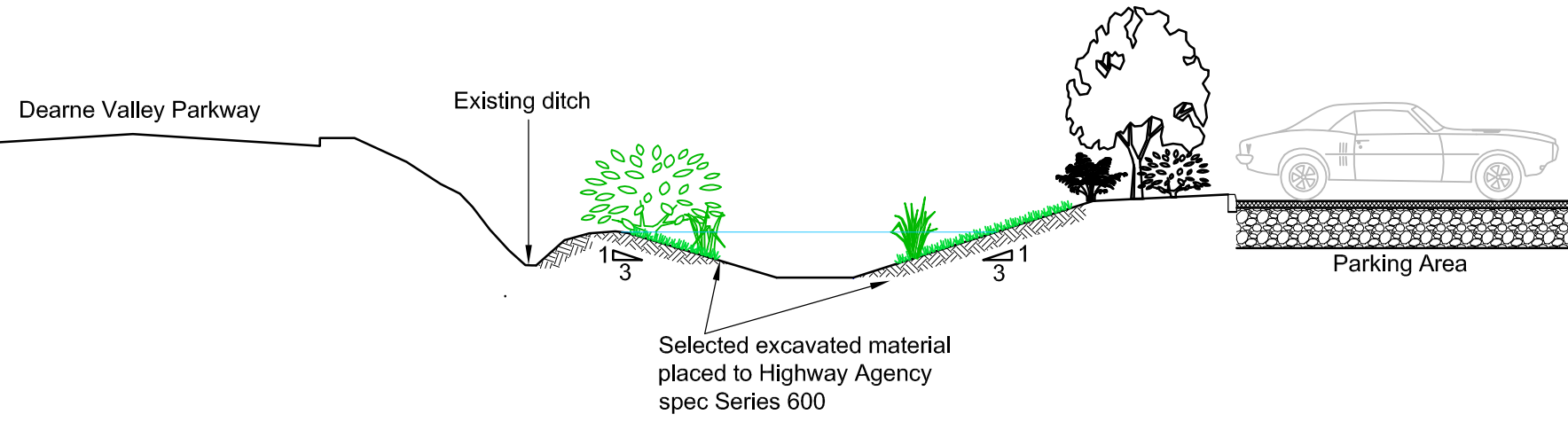
Permeable Paving



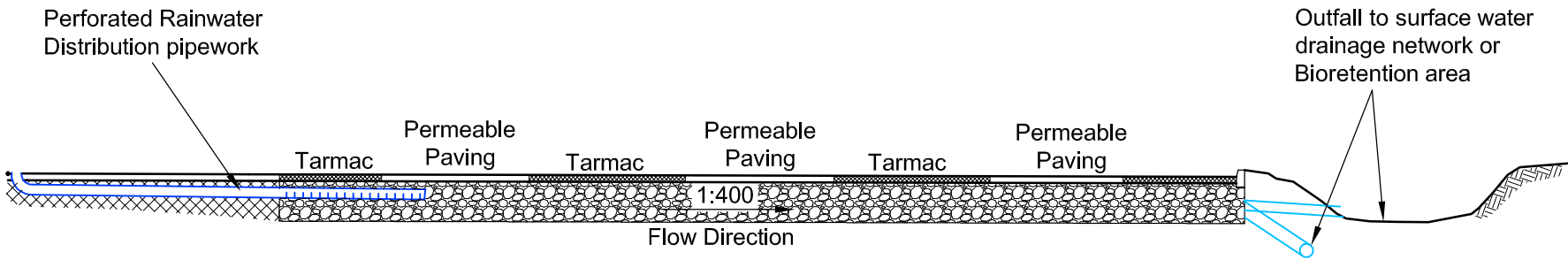
- NOTES**
- DO NOT SCALE.
 - This drawing is to be read in conjunction with all other relevant drawings.
 - Should there be any conflict between the details indicated on this drawing and those indicated on other drawings, the Engineer should be informed PRIOR to construction on site.
 - Until Technical Approval has been obtained from the relevant Authority, it should be understood that all drawings issued are Preliminary and Not for Construction. Should the Contractor commence site work prior to Approval being given, it is entirely at his own risk.
 - All dimensions are in metres U.N.O.
 - Details are shown here for illustration only to demonstrate suitable SuDS drainage measures that may be included as part of the layout evolution.

- KEY**
- Permeable Paving
 - Landscape basin
 - Bio-retention Area
 - Indicative surface water sewer
 - Indicative existing easement
 - Outfall Manhole
 - Flood Route

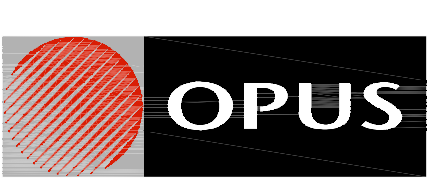
Revision	Amendment	Approved	Revision Date
R0	First Issue		



Typical Section Through Landscaped Basin & Swale
NTS



Typical Section Through Permeable Car Parking Area
NTS



Doncaster Office
1-2 Aire House,
Sidings Court,
Doncaster, DN4 5NL
+44 1302 322295

Drawn	Designed	Approved	Revision Date
CH			
Project No.	Scale		
J-D0512			
Project			
PROPOSED DEVELOPMENT AT HOLLY GROVE FARM ROTHERHAM			
Sheet			
Outline Planning SuDS Masterplan Typical SuDS Details			
Drawing No.	Sheet No.	Revision	
D0 J-D0512-101		R0	

Appendix H – Preliminary WinDES Calculations

Joynes Pike & Associates Ltd		Page 1
1-2 Aire House Richmond Business Park Doncaster, DN4 5NL	Holly Grove Swale Design 1 in 30 year	
Date April 2010	Designed By AJP	
File 1 IN 30 YEAR +CC SWALE.SRC	Checked By	
Micro Drainage	Source Control W.11.1	

Summary of Results for 30 year Return Period (+20%)

Half Drain Time : 276 minutes

Storm Duration (mins)	Maximum Control (l/s)	Maximum Filtration (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	8.3	0.0	8.3	0.7318	0.7318	129.7	O K
30 Summer	8.3	0.0	8.3	0.8133	0.8133	167.3	O K
60 Summer	8.5	0.0	8.5	0.8803	0.8803	201.6	O K
120 Summer	8.7	0.0	8.7	0.9243	0.9243	225.9	O K
180 Summer	8.7	0.0	8.7	0.9323	0.9323	230.4	O K
240 Summer	8.7	0.0	8.7	0.9268	0.9268	227.4	O K
360 Summer	8.7	0.0	8.7	0.9128	0.9128	219.4	O K
480 Summer	8.6	0.0	8.6	0.8998	0.8998	212.2	O K
600 Summer	8.6	0.0	8.6	0.8868	0.8868	205.2	O K
720 Summer	8.5	0.0	8.5	0.8733	0.8733	197.9	O K
960 Summer	8.4	0.0	8.4	0.8453	0.8453	183.2	O K
1440 Summer	8.3	0.0	8.3	0.7858	0.7858	153.9	O K
2160 Summer	8.3	0.0	8.3	0.6928	0.6928	113.4	O K
2880 Summer	8.3	0.0	8.3	0.5983	0.5983	78.6	O K
4320 Summer	8.3	0.0	8.3	0.3817	0.3817	25.7	O K
5760 Summer	8.0	0.0	8.0	0.2202	0.2202	7.0	O K
7200 Summer	6.9	0.0	6.9	0.1742	0.1742	4.1	O K
8640 Summer	6.0	0.0	6.0	0.1513	0.1513	3.0	O K
10080 Summer	5.3	0.0	5.3	0.1338	0.1338	2.3	O K
15 Winter	8.3	0.0	8.3	0.7693	0.7693	146.3	O K
30 Winter	8.4	0.0	8.4	0.8568	0.8568	189.3	O K
60 Winter	8.7	0.0	8.7	0.9308	0.9308	229.7	O K
120 Winter	8.9	0.0	8.9	0.9838	0.9838	261.1	O K
180 Winter	9.0	0.0	9.0	0.9983	0.9983	270.1	O K
240 Winter	9.0	0.0	9.0	0.9978	0.9978	269.8	O K
360 Winter	8.9	0.0	8.9	0.9798	0.9798	258.6	O K
480 Winter	8.9	0.0	8.9	0.9633	0.9633	248.8	O K
600 Winter	8.8	0.0	8.8	0.9458	0.9458	238.4	O K
720 Winter	8.7	0.0	8.7	0.9268	0.9268	227.4	O K
960 Winter	8.6	0.0	8.6	0.8858	0.8858	204.5	O K
1440 Winter	8.3	0.0	8.3	0.7963	0.7963	159.1	O K
2160 Winter	8.3	0.0	8.3	0.6518	0.6518	97.5	O K
2880 Winter	8.3	0.0	8.3	0.4707	0.4707	43.0	O K
4320 Winter	7.4	0.0	7.4	0.1878	0.1878	4.8	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	83.71	18
30 Summer	55.37	33
60 Summer	35.09	62
120 Summer	21.59	122
180 Summer	16.08	180
240 Summer	12.98	220
360 Summer	9.57	280
480 Summer	7.71	346
600 Summer	6.51	414
720 Summer	5.67	484
960 Summer	4.56	618
1440 Summer	3.34	894
2160 Summer	2.45	1276
2880 Summer	1.96	1644
4320 Summer	1.44	2292
5760 Summer	1.15	2936
7200 Summer	0.97	3672
8640 Summer	0.84	4376
10080 Summer	0.74	5088
15 Winter	83.71	18
30 Winter	55.37	33
60 Winter	35.09	62
120 Winter	21.59	118
180 Winter	16.08	176
240 Winter	12.98	230
360 Winter	9.57	298
480 Winter	7.71	370
600 Winter	6.51	448
720 Winter	5.67	524
960 Winter	4.56	674
1440 Winter	3.34	964
2160 Winter	2.45	1360
2880 Winter	1.96	1700
4320 Winter	1.44	2200

Summary of Results for 30 year Return Period (+20%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Filtration (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
5760 winter	6.0	0.0	6.0	0.1493	0.1493	2.9	O K
7200 winter	5.0	0.0	5.0	0.1253	0.1253	2.0	O K
8640 winter	4.4	0.0	4.4	0.1083	0.1083	1.4	O K
10080 winter	3.9	0.0	3.9	0.0958	0.0958	1.1	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
5760 winter	1.15	2936
7200 winter	0.97	3600
8640 winter	0.84	4408
10080 winter	0.74	4984

Swale Details

Infil Coef - Base (m/hr)	0.000000	Length (m)	120.0
Infil Coef - Sides (m/hr)	0.000000	Side Slope (1:x)	3.0
Safety Factor	2.0	Invert Level (m)	0.000
Porosity	1.00	Cover Level (m)	2.000
Base Width (m)	1.0	Slope (1:x)	200.0

Hydro-Brake Outflow Control

Design Head (m)	1.000	Hydro-Brake Type	MD6	Invert Level (m)	0.000
Design Flow (l/s)	9.0	Diameter (mm)	125		

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.10	4.0	0.60	7.7	1.60	11.3	2.60	14.4	5.00	20.0	7.50	24.5
0.20	7.9	0.80	8.2	1.80	12.0	3.00	15.5	5.50	20.9	8.00	25.3
0.30	8.3	1.00	9.0	2.00	12.6	3.50	16.7	6.00	21.9	8.50	26.0
0.40	8.0	1.20	9.8	2.20	13.2	4.00	17.9	6.50	22.8	9.00	26.8
0.50	7.7	1.40	10.6	2.40	13.8	4.50	18.9	7.00	23.6	9.50	27.5

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 358 minutes

Storm Duration (mins)	Maximum Control (l/s)	Maximum Filtration (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	8.3	0.0	8.3	0.8188	0.8188	169.9	O K
30 Summer	8.7	0.0	8.7	0.9183	0.9183	222.6	O K
60 Summer	9.0	0.0	9.0	1.0028	1.0028	272.9	O K
120 Summer	9.3	0.0	9.3	1.0648	1.0648	313.0	O K
180 Summer	9.3	0.0	9.3	1.0823	1.0823	325.1	O K
240 Summer	9.3	0.0	9.3	1.0828	1.0828	325.2	O K
360 Summer	9.3	0.0	9.3	1.0663	1.0663	314.2	O K
480 Summer	9.2	0.0	9.2	1.0513	1.0513	304.0	O K
600 Summer	9.1	0.0	9.1	1.0373	1.0373	294.8	O K
720 Summer	9.1	0.0	9.1	1.0238	1.0238	286.2	O K
960 Summer	9.0	0.0	9.0	0.9968	0.9968	269.2	O K
1440 Summer	8.8	0.0	8.8	0.9418	0.9418	236.1	O K
2160 Summer	8.4	0.0	8.4	0.8573	0.8573	189.5	O K
2880 Summer	8.3	0.0	8.3	0.7723	0.7723	147.7	O K
4320 Summer	8.3	0.0	8.3	0.6023	0.6023	80.0	O K
5760 Summer	8.3	0.0	8.3	0.4047	0.4047	29.7	O K
7200 Summer	8.1	0.0	8.1	0.2452	0.2452	9.0	O K
8640 Summer	7.3	0.0	7.3	0.1842	0.1842	4.6	O K
10080 Summer	6.5	0.0	6.5	0.1623	0.1623	3.5	O K
15 Winter	8.5	0.0	8.5	0.8608	0.8608	191.4	O K
30 Winter	8.9	0.0	8.9	0.9678	0.9678	251.3	O K
60 Winter	9.2	0.0	9.2	1.0598	1.0598	309.8	O K
120 Winter	9.5	0.0	9.5	1.1308	1.1308	358.8	O K
180 Winter	9.6	0.0	9.6	1.1553	1.1553	376.6	O K
240 Winter	9.6	0.0	9.6	1.1608	1.1608	380.9	O K
360 Winter	9.6	0.0	9.6	1.1503	1.1503	373.0	O K
480 Winter	9.5	0.0	9.5	1.1303	1.1303	358.4	O K
600 Winter	9.5	0.0	9.5	1.1123	1.1123	345.8	O K
720 Winter	9.4	0.0	9.4	1.0948	1.0948	333.7	O K
960 Winter	9.2	0.0	9.2	1.0583	1.0583	308.8	O K
1440 Winter	8.9	0.0	8.9	0.9788	0.9788	258.2	O K
2160 Winter	8.4	0.0	8.4	0.8548	0.8548	188.1	O K
2880 Winter	8.3	0.0	8.3	0.7248	0.7248	126.7	O K
4320 Winter	8.3	0.0	8.3	0.3732	0.3732	24.3	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	108.31	19
30 Summer	72.33	33
60 Summer	46.10	62
120 Summer	28.39	122
180 Summer	21.08	182
240 Summer	16.95	240
360 Summer	12.41	306
480 Summer	9.95	370
600 Summer	8.38	434
720 Summer	7.27	502
960 Summer	5.82	638
1440 Summer	4.24	910
2160 Summer	3.08	1316
2880 Summer	2.45	1700
4320 Summer	1.78	2420
5760 Summer	1.41	3056
7200 Summer	1.18	3672
8640 Summer	1.02	4392
10080 Summer	0.90	5136
15 Winter	108.31	18
30 Winter	72.33	33
60 Winter	46.10	62
120 Winter	28.39	120
180 Winter	21.08	176
240 Winter	16.95	234
360 Winter	12.41	340
480 Winter	9.95	390
600 Winter	8.38	464
720 Winter	7.27	542
960 Winter	5.82	694
1440 Winter	4.24	992
2160 Winter	3.08	1408
2880 Winter	2.45	1792
4320 Winter	1.78	2420

Joynes Pike & Associates Ltd		Page 2
1-2 Aire House Richmond Business Park Doncaster, DN4 5NL	Holly Grove Swale Design 1 in 100 year +CC	
Date April 2010	Designed By AJP	
File 1 in 100 year +CC Swale.SRC	Checked By	
Micro Drainage	Source Control W.11.1	

Summary of Results for 100 year Return Period (+20%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Filtration (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
5760 winter	7.3	0.0	7.3	0.1842	0.1842	4.6	O K
7200 winter	6.1	0.0	6.1	0.1538	0.1538	3.1	O K
8640 winter	5.3	0.0	5.3	0.1323	0.1323	2.2	O K
10080 winter	4.7	0.0	4.7	0.1163	0.1163	1.7	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
5760 winter	1.41	2936
7200 winter	1.18	3640
8640 winter	1.02	4320
10080 winter	0.90	5136

Swale Details

Infil Coef - Base (m/hr)	0.000000	Length (m)	120.0
Infil Coef - Sides (m/hr)	0.000000	Side Slope (1:x)	3.0
Safety Factor	2.0	Invert Level (m)	0.000
Porosity	1.00	Cover Level (m)	2.000
Base Width (m)	1.0	Slope (1:x)	200.0

Hydro-Brake Outflow Control

Design Head (m)	1.000	Hydro-Brake Type	MD6	Invert Level (m)	0.000
Design Flow (l/s)	9.0	Diameter (mm)	125		

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.10	4.0	0.60	7.7	1.60	11.3	2.60	14.4	5.00	20.0	7.50	24.5
0.20	7.9	0.80	8.2	1.80	12.0	3.00	15.5	5.50	20.9	8.00	25.3
0.30	8.3	1.00	9.0	2.00	12.6	3.50	16.7	6.00	21.9	8.50	26.0
0.40	8.0	1.20	9.8	2.20	13.2	4.00	17.9	6.50	22.8	9.00	26.8
0.50	7.7	1.40	10.6	2.40	13.8	4.50	18.9	7.00	23.6	9.50	27.5

