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OLDLANDS FARM PHASE 2 – DRAINAGE & MAINTENANCE STRATEGY

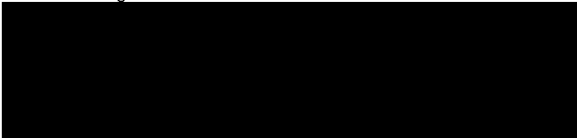


OLDLANDS FARM
PHASE 2 – DRAINAGE & MAINTENANCE STRATEGY

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1. INTRODUCTION

Ramboll UK has been commissioned by Hanbury Properties Ltd to undertake a Drainage Strategy to facilitate Phase 2 Commercial Development at Oldlands Farm, Bognor Regis, West Sussex.

The site lies to the north-east of the approved Phase 1 commercial area and is bounded by the Bognor Northern Relief Road and the main Bognor Regis railway line. The commercial development area covers approximately 6.00ha of undeveloped agricultural farmland that has been subdivided into plots for 4 no. Units (3 no. B2 usage 1 no. B8).

The purpose of this report is to confirm that a satisfactory strategy for the disposal of storm and foul water within the proposed commercial development is achievable.

2. SITE CONDITIONS

The Phase 2 commercial development is accessed through the Phase 1 development from the A29 Trunk Road and lies to the north east of the Phase 1 development area. The approximate National Grid Reference of the site is OSGB 101787N 494435E.



Figure 1 - Existing Site Layout

The topographical survey of the site shows the existing ground generally falling from the Bognor Northern Relief Road in a typically south easterly direction towards the field ditches and the Oldlands Farm Ditch. The existing site levels range from 2.32m AOD to approximately 0.33m AOD at the watercourse and ditches.

The site has been agriculturally farmed over several years. The natural drainage regime is for surface water to run directly off the surface clay soil and directly to the local ditches on the south west boundary. The Oldlands Farm Ditch flows in a north west to south easterly direction along the boundary of the site and forms part of the Internal Drainage Board system. Two small field ditch or drainage channels which take runoff from the existing fields run under the railway and discharge to the Lidsey Rife.

The Phase 2 development comprises of 4 separate plots and estate road with the following catchment areas:

Unit 1 (B2) = 7,490m²
Unit 2 (B2) = 6,495m²
Unit 3 (B8) = 20,700m²
Unit 4 (B2) = 4,505m²
Estate Roads = 4,500m² (1,100m² side road, 3,400m² main access)

The entire site is to be raised above the required 2.0m AOD flood level as part of the flood compensation works outlined within 'Flood Risk and Drainage Assessment' (FRA) document within Appendix 2. Cut and fill volumes required for flood compensation remain as per section 5.8.5 of the FRA document ensuring the site balances flood plain volumes before and after development, as per the strategy outlined in Appendix 2. The Drainage and SuDS strategy for the Phase 2 development outlined in this report supersedes the strategy within the FRA.

3. STORM WATER MANAGEMENT DESIGN PHILOSOPHY

3.1 Proposed Design

National Planning Policy Framework requires new developments to not exacerbate flood risk elsewhere and as such surface water drainage from the site is to be via controlled release. This will be achieved via the use of Sustainable Drainage Systems (SuDS) with the aim of mimicking as close as possible the natural drainage regime of the site.

Building Regulations Document Part H (2002) details the following hierarchy for disposal of surface water flows:

1. To soakaway/infiltration systems
2. To watercourse
3. To sewer

Site investigations have shown the site to be underlain by brickearth clay soils with a high groundwater content. Additionally, the site is being raised via made ground and as such infiltration is not a suitable solution for the site. The Oldlands Farm Ditch runs adjacent to the site and is therefore the best option for disposal of surface water under the aforementioned hierarchy for discharge.

The proposed development has 4 no. units of varying size from 1,042m² up to 10,610m² each unit includes service yard for deliveries, car parking facilities and associated hard standing infrastructure for pedestrian and vehicular access. Surface water will be generated because of replacing the existing farmland with an impermeable road construction.

It is proposed that collection of surface water run-off from external hard standing areas will be via permeable tanked pavement systems and traditional kerb and gully or linear channels within service yard or access points.

Roof drainage will be collected via standard rain water down pipes that will be connected into the surface water drainage networks.

Due to the large catchment areas, underground storage tanks will be required with an appropriate flow control device to hold back surface water flows to allow for gradual release back into the natural surface water regime at the Oldlands Farm ditch.

To attenuate flows within the access roads an oversized pipe network will be utilised prior to outfall to the ditch.

See Appendix 1 for Proposed Drainage Layout.

3.2 Catchment Characteristics

The storm water runoff generated from the site will be managed using appropriate SUDS techniques up to the 1 in 100 year + 40% storm event. This will ensure that the peak rate of storm water leaving the developed site is controlled and accounted for in the design.

As the intention is to discharge to a watercourse, the requirement specified is for the proposed peak storm water runoff rate (1 in 100 year, 6 hour rainfall event) and runoff volume not to exceed pre-development rates (DEFRA, 2015). The Greenfield runoff rate has been calculated using the Interim Code of Practice for Sustainable Drainage Systems (ICP SUDS) methodology using Micro Drainage software (Micro Drainage Limited., 2017). The input variables for the ICP SUDS methodology are the same as for the Institute of Hydrology Report 124 (IH124) method. Results are summarised below, full details are within Appendix 3.

ICP SUDS mean annual flood flow rate equation:

$$QBAR_{RURAL} = 0.00108 \times AREA_{0.89} \times SAAR_{1.17} \times SOIL_{2.17}$$

Unit No.	Q _{bar} (l/ s)
Unit 1	2.7
Unit 2	2.4
Unit 3	7.5
Unit 4	1.6
Estate Roads	1.6

Based on the above, the runoff limitation should be based on a maximum discharge of Q_{bar} of 1.6 to 7.5l/s. The aspiration for the discharge of surface water runoff to be limited to Greenfield equivalent rates from the site provides a very onerous flow restriction, however, and would result in an elevated risk of blockage to a flow restriction device, increasing the maintenance burden. As such, Environment Agency (EA) guidance (Kellagher, 2013) stating a minimum value of **5.0l/ s** for flow devices will be adopted in this design.

To achieve flow rate above the 5.0l/s minimum outflow rate, it is proposed to split the Phase 2 site into 2 no. surface water drainage networks as follows:

Network 1

Unit 1 + Unit 2 + Estate Side Road. Q_{bar} = 2.7 + 2.4 + 0.4 = 5.5l/s

Network 2

Unit 3 + Unit 4. + Estate Main Access. Q_{bar} = 7.5 + 1.6 + 1.2 = 10.3l/s

3.3 Output Summary

It is intended that flows will be restricted by a combination of orifices and ultimately vortex flow control units at the final discharge points in both drainage networks.

Both networks have been designed to contain water below ground to prevent flooding of the plots across the range of storm durations. This will be achieved through a combination of storage within attenuation tanks and permeable paving subbase.

Table 1 below sets out the contributing catchment summary for both networks which is taken as the impermeable surface only: carriageway, footway, building footprint, car parks and service yards.

Table 1 – Drainage Network Summary

Network Reference	Catchment Area (ha)	Outfall Discharge Limit (l/s)	Proposed Flow Restriction	Proposed Peak Discharge (l/s)	Estimated Required Storage Volume (m ³)
1	1.51	5.5	Vortex	5.5	1,500
2	2.86	10.3	Vortex	10.3	2,900
Total	4.37	15.8			

Due to the low-lying area and adjacent flood plain, all surface water outfalls discharging below the 2.0m AOD flood level will utilise non-return valves on the outfall pipes to prevent backflow from the watercourse into the drainage network. A freeboard above ditch invert level is to be provided where falls allow whilst maintaining minimum cover depths to pipework.

3.4 Outfall Flow Restricting Device – Vortex Flow Control

The flow control at the outflow locations will be controlled using a vortex flow control device. This device is self-activated and delivers effective flow control to mitigate against adverse downstream affects. Under low flow conditions, the flow control behaves like an oversized orifice. As the water depth increases, a vortex begins to form within the unit which creates a back pressure and chokes the flow through the aperture restricting the flow during higher flow conditions.

The device will require periodic inspection and maintenance to ensure any build-up of blockage material is removed but has a lower risk of blockage than a traditional orifice.

3.5 Pollution Control

The car parks and services yards are considered as moderate risk in regard to fuel spillages and therefore oil/petrol interceptors will be employed prior to outfall to the natural watercourse. This will be in the form of a Class 1 Full Retention Separator.

4. FOUL WATER MANAGEMENT DESIGN PHILOSOPHY

The foul water discharge from each unit will be managed via standard gravity fed systems. Each network will culminate at a centralised private foul pumping station serving the Phase 2 site. This will discharge into the Enabling Works foul drainage network and ultimately to the existing foul network installed as part of the Phase 1 development.

The existing foul system drains via gravity within the access road to a public pumping station located at the entrance to the Oldlands Farm Estate adjacent to the A259, A29 roundabout. Acceptance of foul flows is subject to agreement with the sewer authority who have adopted the pumping station.

5. MAINTENANCE MANUAL

A key consideration of the drainage design is to ensure a minimum requirement level for maintenance to minimise the risk of the system failing and the cost and disruption associated with rectifying any issues caused by defects. The main issues associated with maintenance of drainage systems are sedimentation, root ingress and associated blockage of pipes, manholes and SUDS features.

The design incorporates measures to mitigate these issues through the use of sumps and trapped gullies to reduce sediment flows through the system. The correct installation of the specified pipe surround material will mitigate the risk of root infiltration into the underground drainage. Whilst these measures will reduce the risk of a reduction in performance, the access road drainage systems across will nevertheless require regular maintenance which should be incorporated within the maintenance regime for the development as a whole.

The table below provides details of the recommended maintenance measures for the access road drainage system:

Table 2 – Maintenance summary: Drainage pipes

Maintenance schedule	Required Action	Frequency
Regular Maintenance	Remove sediment and debris from inspection chambers and flow control chambers	Annually
	Cleaning of any filters and swales as below	Annually
	Remove any root ingress	As required
Occasional Maintenance	CCTV survey of drains to check alignment, cracking and joint displacement	10 year intervals
	Jetting of drains	5 year intervals or as required
	Reconstruct cracked pipes or lengths of pipework with joint displacement	As required
Remedial Actions	Filter drains - replacement of clogged geotextile	10 years or as required
	Replace damaged gully and inspection chamber covers	As required
	Inspect silt traps and note rate of sedimentation accumulation	Monthly in the first year and then annually.
Monitoring	Check gullies and remove silt or debris	Quarterly and after leaf fall

Maintenance and phasing arrangements for the Oldlands Farm Ditch are to be dictated by the Lead Local Flood Authority (LLFA), Arun District Council. Access to the ditch has been provided for the LLFA.

6. SUMMARY

Existing surface water runoff from farmland discharges to a number of receiving ditches. Surface water runoff from the new development will be discharged into the existing ditch network via a carrier pipe drainage system located within the carriageways and beneath the proposed hard standing areas.

In order to attenuate surface water discharge to the watercourses in order to mitigate downstream affects, flows will be restricted to greenfield run-off rates (Network 1, 6.7l/s, Network 2, 9.1l/s) by use of vortex flow control device located at the final manhole preceding each outfall position. Attenuation storage has been incorporated into the carrier pipe design as online storage.

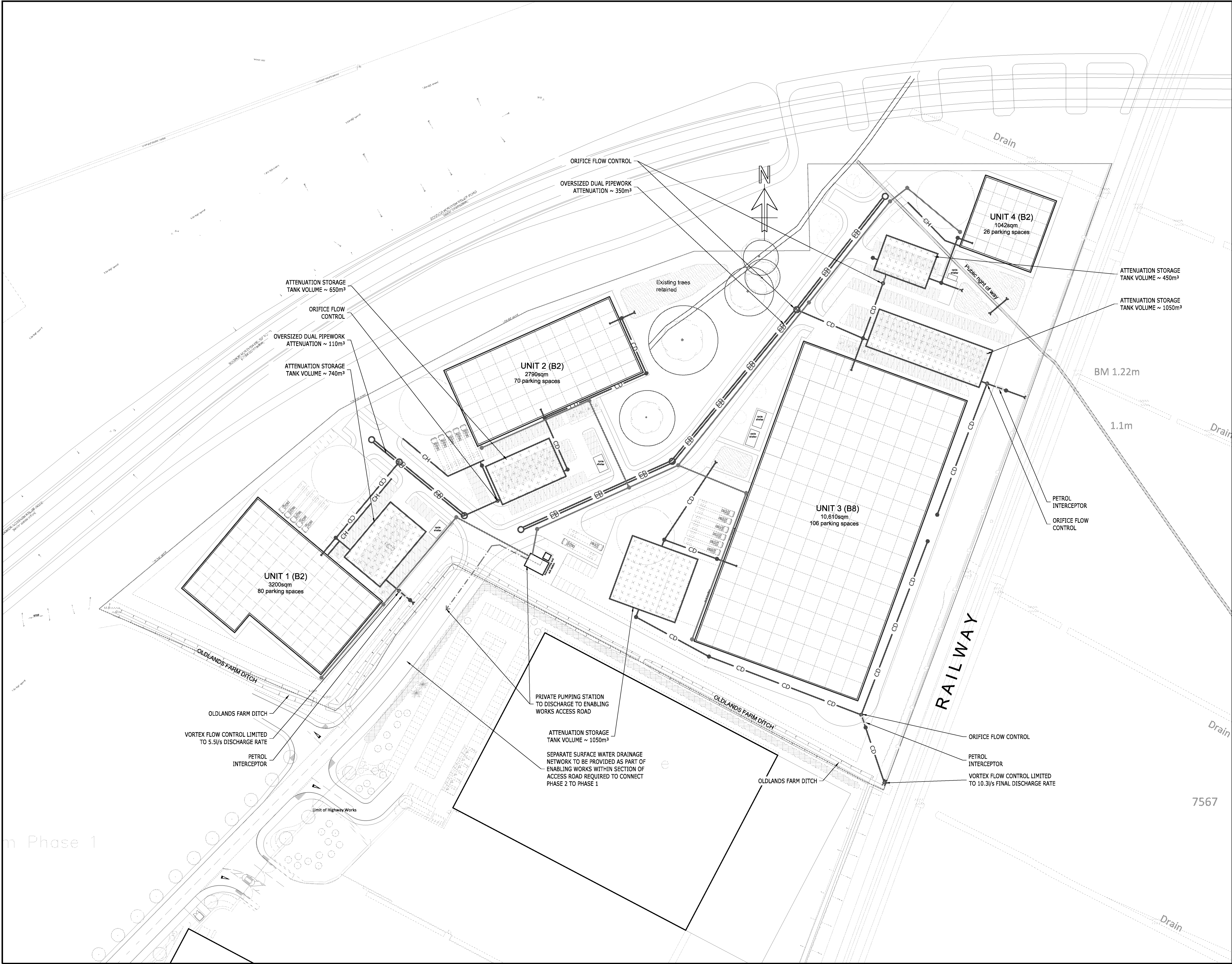
The two drainage networks have been designed to prevent surface flooding for rainfall events up to the 1 in 100 year storm + climate change (applied as a 40% uplift in peak rainfall intensity).

Foul water will be drained via gravity connecting to centralised private pumping station. This will then discharge to the Enabling Works foul network and ultimately the public pumping station located at the entrance to the Oldlands Farm site.

7. WORKS CITED

- DEFRA. (2015). *Sustainable Drainage Systems, Non-statutory technical standards for sustainable drainage systems*. London: Department for Environment, Food and Rural Affairs.
- Kellagher, R. (2013). *Rainfall Runoff Management for Developments - Report SC030219*. Bristol: Environment Agency.
- Micro Drainage Limited. (2017). *Micro Drainage*. UK: XP Solutions.

APPENDIX 1 SURFACE WATER DRAINAGE LAYOUT



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- NOTES
- DO NOT SCALE FROM THIS DRAWING.
 - ALL DIMENSIONS ARE MILLIMETRES U.N.O.
 - ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM U.N.O.
 - THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
 - CONNECTIONS FROM BUILDINGS TO BE INCORPORATED FOLLOWING DETAILED DESIGN OF RAIN WATER AND SEWER DOWN POINT LOCATIONS AND THEREFORE CONNECTIONS SHOWN ARE INDICATIVE ONLY.
 - ADDITIONAL GULLIES, LINEAR CHANNELS AND MANHOLES TO BE ADDED SUBJECT TO COORDINATION WITH DETAILED EXTERNAL LEVELS DESIGN AND ARE OMITTED AT THIS STAGE.

- KEY:
- ATTENUATION TANK/CRATES
 - PERMEABLE PAVING WITH TANKED STORAGE
 - SUDS ATTENUATION POND/OVERFLOW FLOOD STORAGE
 - SURFACE WATER DITCH
 - LINEAR CHANNEL
 - SURFACE WATER CARRIER DRAIN
 - FOUL WATER CARRIER DRAIN
 - FOUL WATER RISING MAIN
 - MANHOLE/CHAMBER
 - FLOW CONTROL CHAMBER
 - PETROL INTERCEPTOR
 - HEADWALL

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Rev	Description	Date	By	App
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PLANNING

PHASE 2
OLDLANDS FARM
BOGNOR REGIS

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APPENDIX 2 FLOOD RISK AND DRAINAGE ASSESSMENT

**PHASE 2 COMMERCIAL DEVELOPMENT
OLDLANDS FARM,
BOGNOR REGIS
WEST SUSSEX**

FLOOD RISK & DRAINAGE ASSESSMENT

HANBURY PROPERTIES LIMITED

Date: May 2015
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Appendix A – Preliminary Site Layout

Appendix B – Topographical Survey

Appendix C – Existing Floodplain Plan

Appendix D – Floodplain Compensation Plans

Appendix E – Runoff calculations

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FIGURES:

Figure 1&2 - Site Location

Figure 3 - Development Site Boundary

Figure 4 - Extract from Environment Agency Flood Zone Map

REFERENCES

Environment Agency Flood Map Information © and database right www.environment-agency.gov.uk

Technical Guidance to the National Planning Policy Framework - NPPF (2012)

Department for Communities and Local Government ISBN: 978-1-4098-3410-6

Contains British Geological Survey materials © NERC (2014)

Arun District Council SFRA – Capita Symonds (February 2008)

Arun District Council Local Plan 2011-2031 Sequential & Exception Tests

1 Executive Summary

SITE INFORMATION	CLIENT	Hanbury Properties
	SITE NAME	Phase 2 Oldlands Farm, Bognor Regis
	SITE LOCATION	SU 94566 01825
	SITE AREA	6.00 ha
	CURRENT LAND USE	Undeveloped arable grazing farmland
	PROPOSED LAND USE	B2 & B8 Commercial Development
	SITE GEOLOGY	Brickearth clay over Raised Beach Deposits (chalk derived sand and gravel) and subsequently the Upper Chalk.
	SOIL INFILTRATION RATE	N/A
	GROUNDWATER LEVELS	TBC
	GROUNDWATER SPZ / AQUIFER	Not in SPZ / Secondary A Aquifer (Superficial Soils)
	GROUND CONTAMINATION	None identified
FLOOD RISK	ENVIRONMENT AGENCY FLOOD ZONE	Flood Zone 2 & 3. Flood compensation used to move site to FZ 1
	FLUVIAL (RIVERS & WATERCOURSES)	Flooding from Oldlands Farm Ditch & Lidsey Rife
	PLUVIAL (SURFACE WATER)	General ponding on existing surface
	GROUNDWATER	Not a risk
	EXISTING/PROPOSED SEWERS & MAINS	Not a risk
	ARTIFICIAL	Not a risk
	TIDAL	Not a risk
FOUL & SURFACE	SURFACE WATER STRATEGY	Outfall to existing watercourse
	PROPOSED SUDS TYPE	Permeable Block Paving with sealed base Attenuation Tanks
	EXISTING SW PEAK FLOW RATE	Greenfield QBar - 21.0 l/s
	PROPOSED SW PEAK FLOW RATE	Max 21.0 l/s (1:100+30%)
	FOUL WATER STRATEGY	Pumped to existing foul network
	EXISTING FW PEAK FLOW RATE	N/A
MISC	PROPOSED FW PEAK FLOW RATE	TBC pumped main
	FURTHER INVESTIGATIONS	

2 Introduction

2.1 Scope

2.1.1 MJA Consulting has been commissioned by Hanbury Properties Ltd to undertake a Flood Risk Assessment and Drainage Strategy to accompany an outline planning application for the Phase 2 Commercial Development at Oldlands Farm, Bognor Regis, West Sussex.

2.1.2 The land forms part of the commercial development of the Felpham Site 6 Housing Development. The commercial development area covers approximately 6.00Ha of undeveloped agricultural farmland.

The site lies to the north east of the approved Phase 1 commercial area and is bounded by the Bognor Northern Relief Road (BNRR) and the main Bognor Regis railway. Within the application an area of undeveloped agricultural farmland is included for floodplain compensation works located to the north of the Bognor Northern Relief Road (BNRR).

2.1.3 The proposed commercial development consists of the construction of a number of B2 & B8 units with associated access roads, hardstanding parking areas and soft landscaping. Refer to Appendix A for site preliminary site layouts & options.

2.2 Report Structure

2.2.1 The National Planning Policy Framework - *Department for Communities and Local Government (2012)* is the current guidance on development and flood risk in England and Wales.

The Flood Risk technical guidance for the National Planning Policy Framework requires a Flood Risk Assessment to be carried out to consider all potential forms of flooding including that from river, sea, estuarial, land drainage, groundwater, overland flow, surface water run-off, sewer systems, and artificial water bodies (lakes, reservoirs, canals etc).

A Flood Risk Assessment is required to consider the impact of all these potential forms flooding on both the development site and off site parties and land.

2.2.2 This report will take the structure of a 'Flood Risk Assessment' in accordance with the Environment Agency's Flood Risk Assessment Guidance, the National Planning Policy Framework and CIRIA Report 624 'Development and Flood Risk – Guidance for the Construction Industry.

2.2.3 The purposes of this report are:

- To confirm that the proposed development has a suitable strategy for dealing with potential flood risks.
- To confirm that a satisfactory strategy for the disposal of surface and foul water from the proposed development is achievable.
- This development will not increase the risk of flooding to any offsite parties and land.

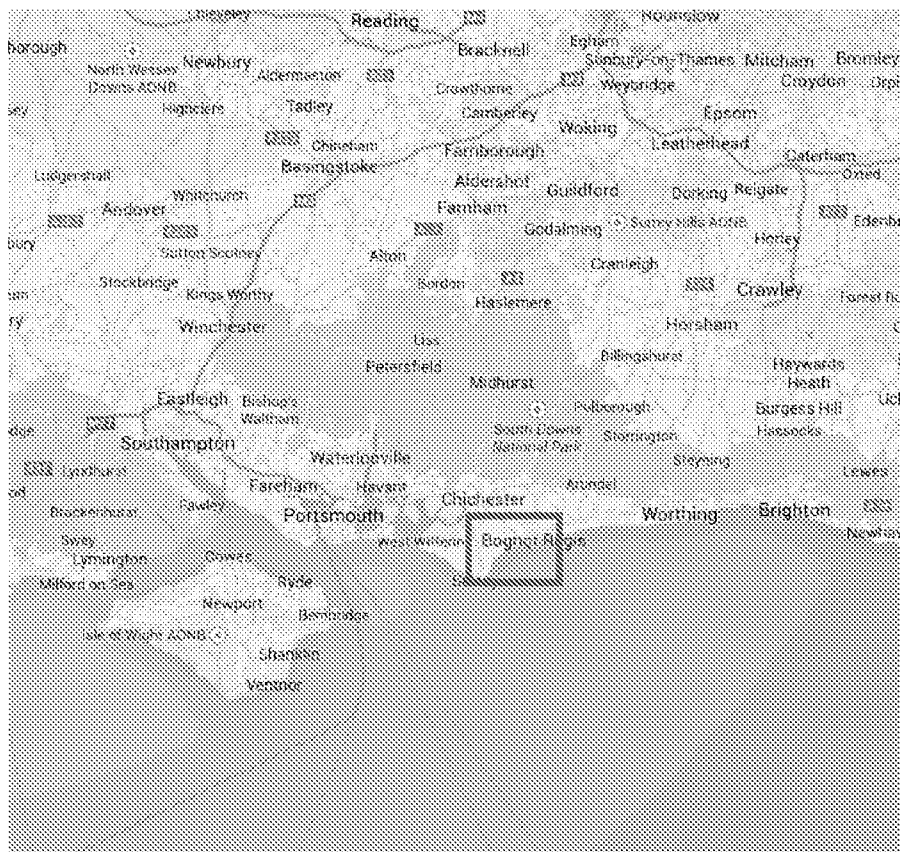
3 Existing Site

3.1 Site Location and Description

- 3.1.1 The proposed development covers an area of approximately 6.0 ha of undeveloped agricultural farmland and lies to the north east of the Phase 1 commercial development area accessed from the A29 Trunk Road and lies between the Bognor Regis Rail line and the Bognor Northern Relief Road, currently under construction.

The approximate National Grid Reference of the site is SU 94566 01825

Figure 1: Site Location



© 2011 Microsoft – Bing Maps



4. Topographical and Geological Information

4.1 Topography

4.1.1 The topographical survey of the site shows the existing ground generally falling from the Bognor Northern Relief Road (BNRR) in a typically south easterly direction towards the field ditches and the Oldlands Farm Ditch.

4.1.2 The site levels range from 2.75m AOD to approximately 0.85m AOD at the watercourse and ditches.

Refer to Appendix B for the existing Topographical Survey.

4.2 Geology & Hydrogeology

4.2.1 The Geological Survey map of the area indicates that the site is underlain by Aeolian Deposits (Brickearth clay) over Raised Beach Deposits (chalk derived sand and gravel) and subsequently the Upper Chalk. The area to the east of the site, in the vicinity of the Lidsey Rife, is shown to be underlain by a tract of Tidal River Deposits comprising silty and sandy clays with sand and gravel.

4.2.2 Ground investigations undertaken on Phase 1 encountered groundwater within a number of trial holes within the clay / silt layers. Consequently soakage testing was not carried out due to the nature of the sub strata.

Infiltration type drainage would not be suitable within this site.

4.2.3 As the existing site has been agriculturally farmed over a number of years the natural drainage regime is for surface water to run directly off the surface impermeable clay soils and directly to the local ditches and Oldlands Farm Ditch on the southern western boundary.

4.3 Catchment Information

Watercourses

4.3.1 The Oldlands Farm Ditch flows in a north west to southern easterly direction along the boundary of the site and forms part of the Internal Drainage Board (IDB) system.

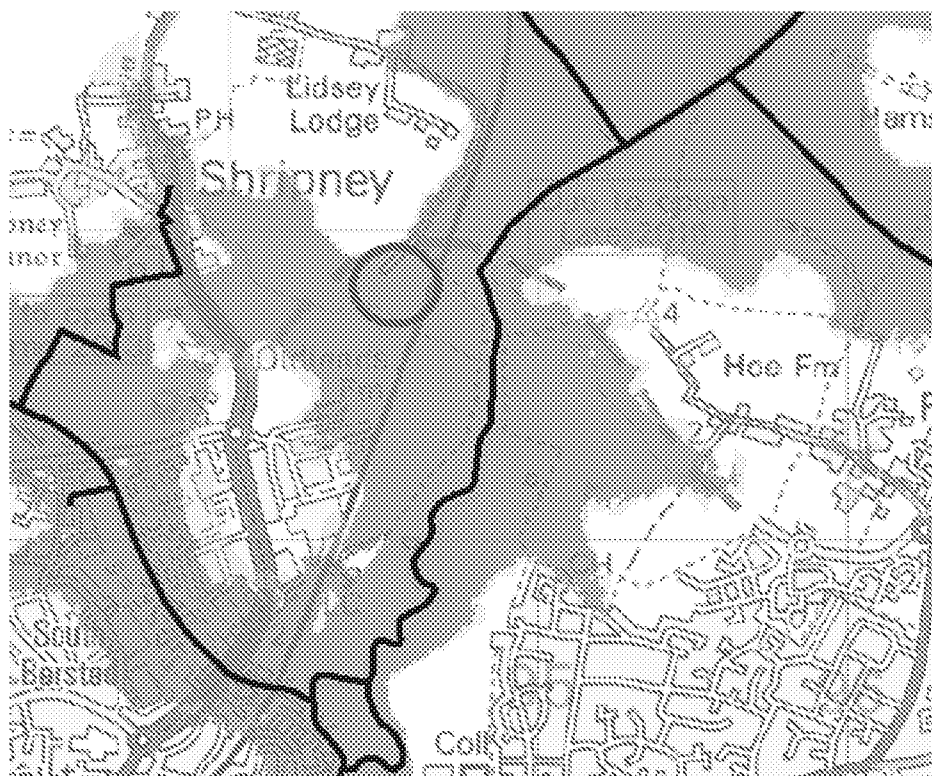
4.3.2 This watercourse takes runoff from an area of the village of Shripney together with direct runoff from the surrounding farmland. At the crossing point with the Bognor Northern Relief Road (BNRR) a new culvert together with flood arches has been installed. The ditch runs in open ditch before discharging to a culvert under the Bognor to Chichester railway line. The Oldlands Farm Ditch ultimately discharges to the Lidsey Rife approximately 300m to the east.

4.3.3 Two small field ditch or drainage channels which take runoff from the existing fields also run under the railway and discharge to the Lidsey Rife.

5 Flood Risk Assessment

5.1 Flood Zone Map

Figure 4: Extract from Environment Agency Flood Zone Map



© Environment Agency 2011

 Main Rivers

 Dark blue shows the area that could be affected by flooding, either from rivers or the sea, if there were no flood defences. This area could be flooded:

- From the sea by a flood that has a 0.5 per cent (1 in 200) or greater chance of happening each year.
- From a river by a flood that has a 1 per cent (1 in 100) or greater chance of happening each year.

 Light blue shows the additional extent of an extreme flood from rivers or the sea. These outlying areas are likely to be affected by a major flood, with up to a 0.1 per cent (1 in 1000) chance of occurring each year.

5.2 The Environment Agency's indicative Flood Map shows the site to be currently located within Flood Zones 2 & 3.

Zone 2 is land assessed as having between a 1 in 100 year and 1 in 1000 annual probability of flooding, while Zone 3 is land assessed as having between a 1 in 100 year or greater annual probability of flooding from a river or stream in any year by the Environment Agency.

5.3 As stated the Environment Agency Flood Map is indicative only and takes no account of actual ground levels or features. These flood maps are derived from coarse scale JFLOW modelling which bases part of the results on assumptions of hydrology and topography. This does lead to inaccuracies in the plans and therefore cannot be used as an accurate guide to flooding. However, they are intended to be an indicative measure to flood risk.

5.4 The Environment Agency has confirmed the predicted flood level within this area which does alter the current flood maps.

Flood Levels:

The original 100 year fluvial flood level was 1.82m AOD however this was increased to a level of 2.0m AOD to include for climate change and following the results from the Strategic Flood Risk Assessment.

The Phase 1 Commercial Development land was lifted out of the floodplain by utilising flood compensation. The floodplain was then altered and moved north of the BNRR on existing agricultural land.

Appendix C shows the actual flood zone when based on the topographical survey

5.5 The flood risk technical Guidance to the National Planning Policy Framework Table 2: Flood Risk Vulnerability classification, classifies commercial developments as 'Less Vulnerable'.

NPPF Table 2 of technical Guidance: Flood Risk Vulnerability classification

Less vulnerable
• Police, ambulance and fire stations which are not required to be operational during flooding. • Buildings used for shops, financial, professional and other services, restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non-residential institutions not included in "more vulnerable", and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment works which do not need to remain operational during times of flood. • Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).

NPPF Table 3: Flood Risk Vulnerability and Flood Zone 'compatibility'

Flood risk vulnerability classification (see table 2)		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood zone (see table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	×	Exception Test required	✓
	Zone 3b functional floodplain	Exception Test required	✓	×	×	×

Key: ✓ Development is appropriate.
× Development should not be permitted.

5.6 Table 2 & 3 of the NPPF would indicate that commercial developments 'less vulnerable' can be located within Flood Zone 2 & 3a and are considered appropriate under the National Planning Policy Framework.

5.7 It is the developer's intention to lift the site out of flood zones 2 & 3 and into flood zone 1 above the 2.0m AOD contour. To do this they intend to provide floodplain compensation within the vicinity of the site.

5.8 Floodplain Compensation

5.8.1 As stated previously the proposed development currently lies partially within flood zones 2 & 3 with existing ground levels ranging from 2.75m AOD – circa 0.75m AOD. It is proposed to lift the site within Zones 2 & 3 to above the level of 2.0m AOD by using floodplain compensation and relocating the floodplain to the land to the north which currently lies above the 2.0m AOD contour adjacent to the existing flood compensation area.

5.8.2 The flood compensation has been designed in accordance with the normal Environment Agency policy and Appendix 3 of the CIRIA guide C624 entitled "Development and flood risk - guidance for the construction industry" where compensatory storage is provided on a "volume-for-volume" and "level-for-level" basis (e.g. for each 0.2 m slice of filling there is a slice of excavation at the same level and volume) to ensure no loss of floodplain occurs.

5.8.3 Floodplain compensation has been utilised on both the Bognor Northern Relief Road where the road crosses the Oldlands Farm Ditch and Oldlands Farm Phase 1 Commercial Development. The location of this on existing agricultural land to the north of the Bognor North Relief Road.

5.8.4 The proposed floodplain compensation area is to the north of the new Bognor Northern Relief Road (BNRR) the proposal is to extend the existing compensation area as shown in Appendix D.

5.8.5 Flood Compensation areas & volumes.

Existing site area:

Ex Ground Level m AOD	Area of fill (m ²)	Volume of fill (m ³)
2.00	46,844	4,626
1.90	45,677	4,527
1.80	44,855	4,444
1.70	44,030	4,354
1.60	43,054	4,231
1.50	41,573	4,043
1.40	39,296	3,785
1.30	36,397	3,389
1.20	31,104	2,683
1.10	22,292	1,150
1.00	6,011	301
0.90	712	36
Total fill volume		37,569m ³

Flood compensation areas:

Ex Ground Level m AOD	Area of cut (m ²)	Volume of cut (m ³)
2.00	53,600	5,350
1.90	53,400	5,310
1.80	52,800	5,233
1.70	51,850	5,110
1.60	51,700	4,965
1.50	50,500	4,790
1.40	48,800	4,495
1.30	47,000	3,758
1.20	42,900	1,661
1.10	32,250	1,010
1.00	20,200	48
0.90	960	
Total cut volume		46,906m ³

- 5.8.6 The floodplain compensation will link level for level with the Phase 1 development compensation area to allow a continuous floodplain which is linked by a new flood relief channel adjacent to the site boundary and the Oldlands Farm Ditch.
- 5.8.7 To ensure continuity between the existing flood compensation area to the north, the new compensation area and the Oldlands Farm ditch a new flood channel has been introduced on the south east boundary of the site adjacent to the railway. This will ensure that the flood compensation areas & Oldlands Farm ditch will link both north of the BNRR and south of the development prior to the ditch outfalling under the main rail line.

5.9 Tidal Flood Risk

- 5.9.1 The Tidal Flood Risk to the site is extremely low. Sea defences are well maintained and provide sufficient defence against the predicted 1:200 year tidal level. If a more extreme event or a localised breach occurred the risk to the site is minimal due to the distance to the sea defence.

5.10 Sequential Test

- 5.10.1 The National Planning Policy Framework Guidance states that Planning Authorities should complete a risk based 'Sequential Test' at all stages of the planning process, to steer new development to areas with the lowest probability of flooding.
- 5.10.2 Under the requirements of the 'sequential test' and as the proposed commercial development is to be located within an amended flood zone 1 (lowest risk), there are no more suitable, developable and deliverable alternative sites, better located from a flood risk perspective, which would accommodate the proposed development.

6 Impact of Development on Flood Risk

6.1 This section identifies sources of potential flood risk to the site.

The sources of flooding that could potentially affect the site include flooding from groundwater, rivers (fluvial), overland runoff (pluvial), artificial sources and flooding from overloaded existing and proposed sewer networks.

6.2 History of Flooding

Part of the site is currently within flood zones 2 & 3 and is known to flood from the adjacent watercourse. However, with the proposed flood compensation works the site will move to flood zone 1 with a low risk of flooding.

6.3 Existing Watercourses

6.3.1 Flood water from the watercourse known as the Oldlands Farm Ditch which runs along the south western boundary and is the main cause of the on-site flooding as well as an unnamed field ditch discharging under the rail line.

6.3.2 The Environment Agency have acknowledged that the catchment responds slowly and mirrors the flood levels on the Lidsey Rife.

6.3.3 The Lidsey Rife is located approximately 300m to the east and does not directly present a flood risk.

6.4 Waterbodies

An existing highway drainage pond associated with the Bognor Northern Relief Road lies to the west of the site but does not pose a flood risk to the site.

There are no reservoirs or canals or other artificial sources of flooding within a 500m radius of the development area.

6.5 Groundwater

From the Ground Investigation the Environment Agency has confirmed that they have no recorded incidents of flooding to this development site from groundwater.

6.6 Existing Sewers

Southern Water has indicated that there have been no recorded incidents of flooding from public sewers within a 500m radius of the site.

6.7 Tidal Flood Risk

The Tidal Flood Risk to the site is extremely low. Sea defences are well maintained and provide sufficient defence against the predicted 1:200 year tidal level. If a more extreme event or a localised breach occurred the risk to the site is minimal due to the distance to the sea defence.

6.8 Proposed Site Drainage

Artificial drainage systems and infrastructure within, or in close proximity to, the site may present a risk of flooding through the capacity of the systems being exceeded or the structural, hydraulic, mechanical or operational failure of the system occurring.

In the context of the proposed site there are likely to be installed as part of the development, the following systems which may present a flood risk:

- Piped gravity foul/ surface water sewers and a foul rising main.
- SUDS systems for the collection and conveyance of surface water runoff within the site boundary.

6.9 The surface water runoff generated on the site as a result of the development will be managed using appropriate SUDS techniques up to the 1 in 100 +30% storm event. This will ensure that the peak rate of surface water leaving the developed site

7 Existing and Proposed Site Runoff

- 7.1 This section aims to calculate the estimated peak runoff rate of surface water leaving the site, for the pre development conditions.
These discharge rates have then been used for the preliminary design of the surface water drainage strategy for the proposed development.

7.2 Existing Surface Water Runoff Rate

- 7.2.1 As the intention is to discharge to a watercourse the minimum requirement is for the proposed peak surface water runoff rate and runoff volume not to exceed pre-development rates. The Greenfield runoff rate has been calculated using the Institute of Hydrology Report 124 methodology to determine the level of acceptable rate of discharge from the site to the receiving watercourse.
- 7.3.2 The natural topography of the site is such that all surface runoff typically flows in a south easterly direction from the BNRR boundary towards the Oldlands Farm Ditch and the existing field ditch system.
- 7.3.5 An assessment of the estimated current Greenfield runoff rate has been carried out using the Institute of Hydrology Report 124 methodology using Micro Drainage software. Refer to Appendix E for a summary of results.
- 7.3.6 IH124 mean annual flood flow rate equation:

$$QBAR_{Rural} = 0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$$

Catchment: 6.0ha

1 in 1 year	18.1 l/sec
1 in 30 year	48.3 l/sec
1 in 100 year	68.0 l/sec
QBar	21.3 l/sec

Based on the above all discharge from the site will be restricted to a maximum discharge of 21 l/sec (QBar) for all storm events.

7.4 Proposed Development Surface Water Runoff Rate

- 7.4.1 The estimated peak runoff rate from the proposed site is based on 100% runoff from impermeable areas and 0% runoff from permeable areas, in accordance with CIRIA C697 The SUDS Manual & Preliminary rainfall runoff management for Developments (EA/DEFRA W5-074/A).

7.4.2 A suitable method for the estimation of peak flow is the *Rational method*,
 $Q = 2.78 CIA$.

Where:

Q = flow (l/s)

I = rainfall intensity (mm/hr), return period equal to time of concentration
(to include a 30% increase for predicted climate change)

A = Impermeable area drained (ha)

C = runoff coefficient, assumed to be 1.0

Catchment: 4.30ha

1 in 1 year	204 l/sec
1 in 30 year	495 l/sec
1 in 100 year	656 l/sec
1 in 100 year + 30% CC	853 l/sec

7.4.3 It can be seen that as a result of this development and the increase in impermeable areas, the peak rate and volume at which surface water could potentially runoff the site if not effectively managed, will be greater than in its Greenfield state.

To mitigate this increase in potential additional runoff due to development the discharge will be constrained to Q_{Bar} (mean annual peak rate of runoff for the Greenfield site), calculated for this site at 21 l/s.

8 Surface Water Drainage Strategy

- 8.1 The National Planning Policy Framework requires that new developments do not exacerbate flood risks elsewhere, which means there is a need to control drainage and runoff to ensure there are no increases in overland flow as a result of the development.

Sustainable Drainage Systems (SuDS) will be incorporated into the surface water drainage strategy to mitigate the additional runoff and reduce flood risk to downstream areas.

The philosophy of the SuDS will be to replicate as closely as possible the natural drainage regime from a site before development, reducing the impact on receiving watercourses.

- 8.2 The Building Regulations Document H (2002) details a hierarchy of potential methods of disposing of surface water from a site:
- An adequate soakaway or some other adequate infiltration system, or where that is not practicable,
 - A watercourse, or where that is not practicable,
 - A sewer
- 8.3 The site investigations on the adjacent site have shown that the site is underlain by Brickearth clay soils with a high groundwater content and would be unsuitable for infiltration type SUDS. Furthermore the site is being raised which would make it also unsuitable for an infiltration drainage solution.
- 8.4 Surface water runoff will be managed in accordance with current requirements to mimic the existing runoff to Oldlands Farm Ditch by incorporating Sustainable Urban Drainage (SUDs) into development. The suitability of various techniques has been assessed using the SUDS management train as stated in the CIRIA Manual C697. The various techniques will be reviewed as to their suitability in consideration of the characteristics of the development to manage runoff at source. The use of SUDS systems will provide an improvement to the biodiversity and water quality and a reduction in runoff peak runoff flows.
- 8.5 The surface water runoff from the development for all storm events including the 1-year, 30-year, 100-year and 100-year +30% climate change storms will be attenuated and discharged into the adjacent watercourses at no greater than the mean annual peak runoff rate QBar from the undeveloped Greenfield site of 21 l/sec.

- 8.6 Appendix F shows the preliminary drainage strategy for the site. Various SUDs features will be used within the storm water system before the attenuated runoff discharges to the watercourse.
- 8.7 Due to the proposed layouts the management of the surface water will be split into typically 3 catchments with the maximum discharge apportioned depending on percentage of site covered.

8.7.1 Access Road:

Due to the nature of the site with heavy traffic movements the road will be constructed as a standard industrial type road with runoff being drained via gullies. To attenuate flows it is intended to attenuate flows within a culvert or oversized pipe system under the access road prior to the ditch.

8.7.2 Employment Areas:

Runoff from the parking areas will drain via a permeable paved surface to the sub base below. Storm water will be stored temporarily within the voids before discharging to an attenuation tank allowing a controlled discharge to the watercourse.

The permeable type sub base will provide a first treatment to runoff and improve the downstream water quality.

Roof runoff will be collected by traditional guttering and downpipe system where it will be discharged to the sub base of the permeable paving structure within the parking areas via permavoid® diffuser cells or to adjacent swales.

Rainwater Harvesting will be considered for all buildings which will provide an opportunity to recycle rainwater for use in toilet flushing. This will be part of any detailed planning application for the proposed units.

- 8.8 Storm water catchments & typical discharge rates:
8.8.1 B2 Uses only (12 units):

Catchment Area	Area (Ha)	Max discharge rate l/sec	Impermeable area Ha (Approx)	Typical storage volume required
1 Units 1 – 5	2.0	7 l/sec	1.60	1350m ³
2 Units 6 – 10	2.5	8 l/sec	2.00	1700m ³
3 Units 11 – 12	1.5	6 l/sec	1.20	900m ³
Total	6.00	21 l/sec		

8.8.2 B2/B8 Uses only (8 units):

Catchment Area	Area (Ha)	Max discharge rate l/sec	Impermeable area Ha (Approx)	Typical storage volume required
1 Units 1 – 5	2.0	7 l/sec	1.60	1350m ³
2 Units 6 – 7	2.65	8 l/sec	2.00	1700m ³
3 Units 7 – 8	1.35	6 l/sec	1.20	900m ³
Total	6.00	21 l/sec		

The discharge from the total site will be restricted to a maximum discharge of 21 l/sec (QBar) to the Oldlands Farm Ditch. The above attenuation volumes have been assessed using the Micro Drainage suite of programs.

- 8.9 As the site is being raised above the fluvial floodplain with imported fill and due to the nature of the existing sub strata all SUDs features will be sealed with an impermeable membrane. This is to prevent site runoff infiltrating to the made ground and creating stability issues. This will also prevent groundwater entering the pond creating less capacity than required.

9 Foul water drainage strategy

- 9.1 It is proposed that the foul water discharge from each unit will drain via gravity through a piped network before discharging to a sewer system within the development road network.

This sewer will convey flow to a pumping station located within the middle of the site. The station will then pump via a rising main to a point on the existing foul sewer system within the Phase 1 development area.

10 Summary & Conclusions

- 10.1 The land forms part of the commercial development area for the Felpham Site 6 Housing Development. The proposed commercial development consists of the construction of a mixture of B2 & B8 units with associated access roads, hardstanding parking areas and soft landscaping.
- 10.2 The Environment Agency's indicative Flood Map shows the site to be currently located within Flood Zones 1, 2 & 3.
Zone 1 is land assessed as having a less than 1 in 1000 (<0.1%) annual probability of flooding, Zone 2 is land assessed as having between a 1 in 100 year and 1 in 1000 annual probability of flooding, while Zone 3 is land assessed as having between a 1 in 100 year or greater annual probability of flooding from a river or stream in any year by the Environment Agency.
- 10.3 No other sources of flooding were identified on or within the vicinity of the site including that from groundwater, tidal, overland runoff (pluvial), artificial sources and flooding from overloaded existing and proposed sewer networks.
- 10.4 The majority of the development area lies within flood zones 2 & 3 however it is intended to be lifted out of the known flood area and into flood zone 1 by using floodplain compensation and relocating the floodplain to adjacent land which currently lies above the 2.0m AOD contour.
- 10.5 The flood compensation has been designed in accordance with the normal Environment Agency policy and Appendix 3 of the CIRIA guide C624 entitled "Development and flood risk - guidance for the construction industry" where compensatory storage is provided on a "volume-for-volume" and "level-for-level" basis (e.g. for each 0.2 m slice of filling there is a slice of excavation at the same level and volume) to ensure no loss of floodplain occurs.
- 10.6 The existing sub strata consists on an impermeable clay with existing runoff discharging to the adjacent Oldlands Farm ditch. With infiltration techniques being unsuitable the runoff from the development will mimic the existing and will be restricted to a maximum Qbar discharge of 21 l/sec for all storm events.

- 10.7 Surface water runoff will be managed in accordance with current requirements to mimic the existing runoff to Oldlands Farm Ditch by incorporating Sustainable Urban Drainage (SUDs) into development. The suitability of various techniques has been assessed using the SUDS management train as stated in the CIRIA Manual C697. The various techniques will be reviewed as to their suitability in consideration of the characteristics of the development to manage runoff at source. The use of SUDS systems will provide an improvement to the biodiversity and water quality and a reduction in runoff peak runoff flows.
- 10.8 The surface water runoff from the development for all storm events including the 1-year, 30-year, 100-year and 100-year +30% climate change storms will be attenuated and discharged into the adjacent watercourse or flood relief channel.
- 10.9 This report concludes that:
- To confirm that the proposed development has a suitable strategy for dealing with potential flood risks.
 - To confirm that a satisfactory strategy for the disposal of surface and foul water from the proposed development is achievable.
 - This development will not increase the risk of flooding to any offsite parties and land.

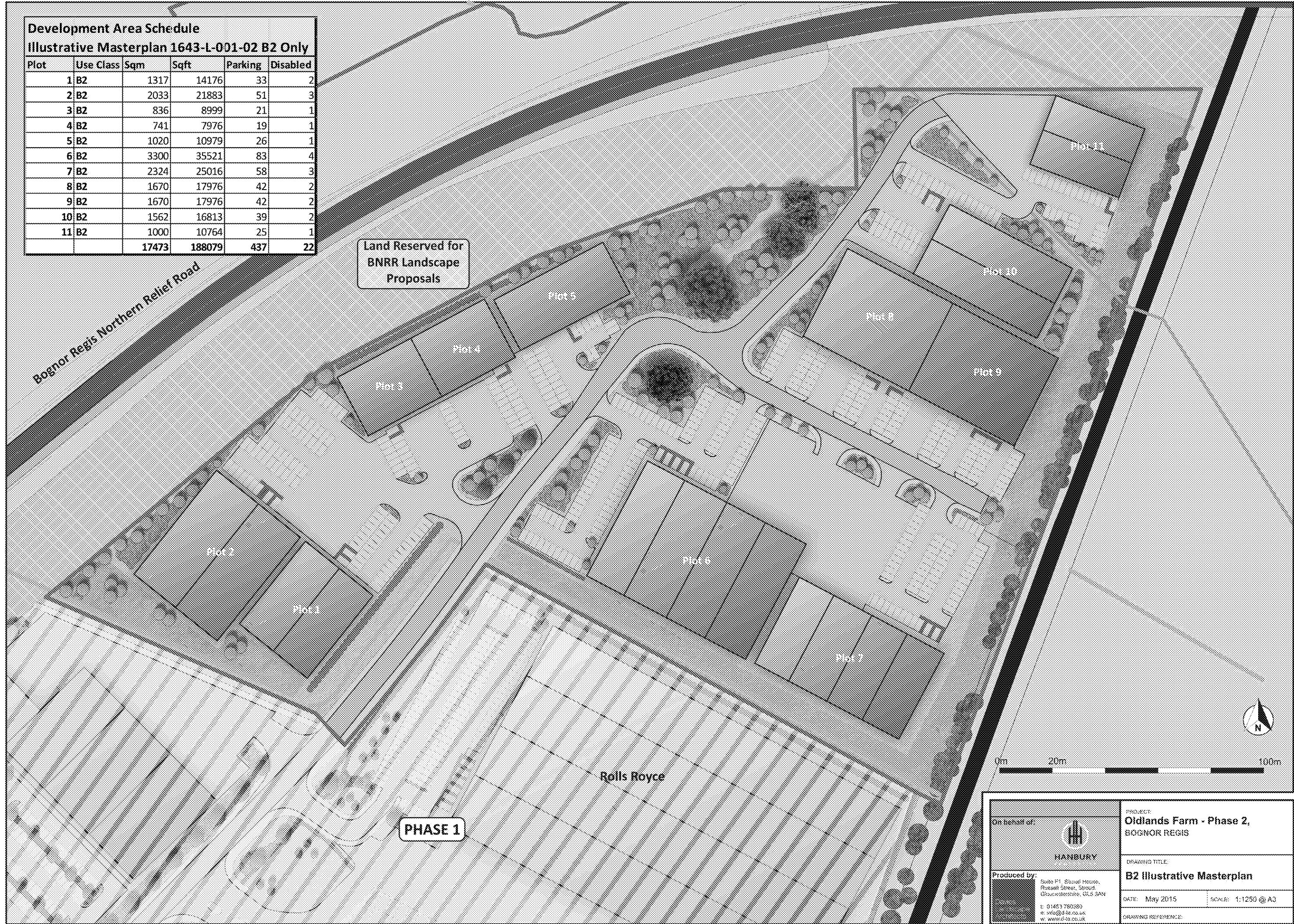


Appendix A

Site Layout Plans

Development Area Schedule
Illustrative Masterplan 1643-L-001-02 B2 Only

Plot	Use Class	Sqm	Sqft	Parking	Disabled
1	B2	1317	14176	33	2
2	B2	2033	21883	51	3
3	B2	836	8999	21	1
4	B2	741	7976	19	1
5	B2	1020	10979	26	1
6	B2	3300	35521	83	4
7	B2	2324	25016	58	3
8	B2	1670	17976	42	2
9	B2	1670	17976	42	2
10	B2	1562	16813	39	2
11	B2	1000	10764	25	1
		17473	188079	437	22



On behalf of:  HANBURY		PROJECT: Oldlands Farm - Phase 2, BOGNOR REGIS	
Produced by:  Suite P1, Stroud House, Russell Street, Stroud, Gloucestershire, GL5 3AN t: 01453 780389 e: info@h-b.co.uk w: www.h-b.co.uk		DRAWING TITLE: B2 Illustrative Masterplan	
DATE: May 2015		SCALE: 1:1250 @ A3	
DRAWING REFERENCE:			

Development Area Schedule					
Illustrative Masterplan 1643-L-001-02 B2/B8					
Plot	Use Class	Sqm	Sqft	Parking	Disabled
1	B2	1317	14176	33	2
2	B2	2033	21883	51	3
3	B2	836	8999	21	1
4	B2	741	7976	19	1
5	B2	1020	10979	26	1
6	B8	8000	86112	80	4
7	B8	5506	59267	55	3
8	B2	1000	10764	25	1
		20453	220156	309	15

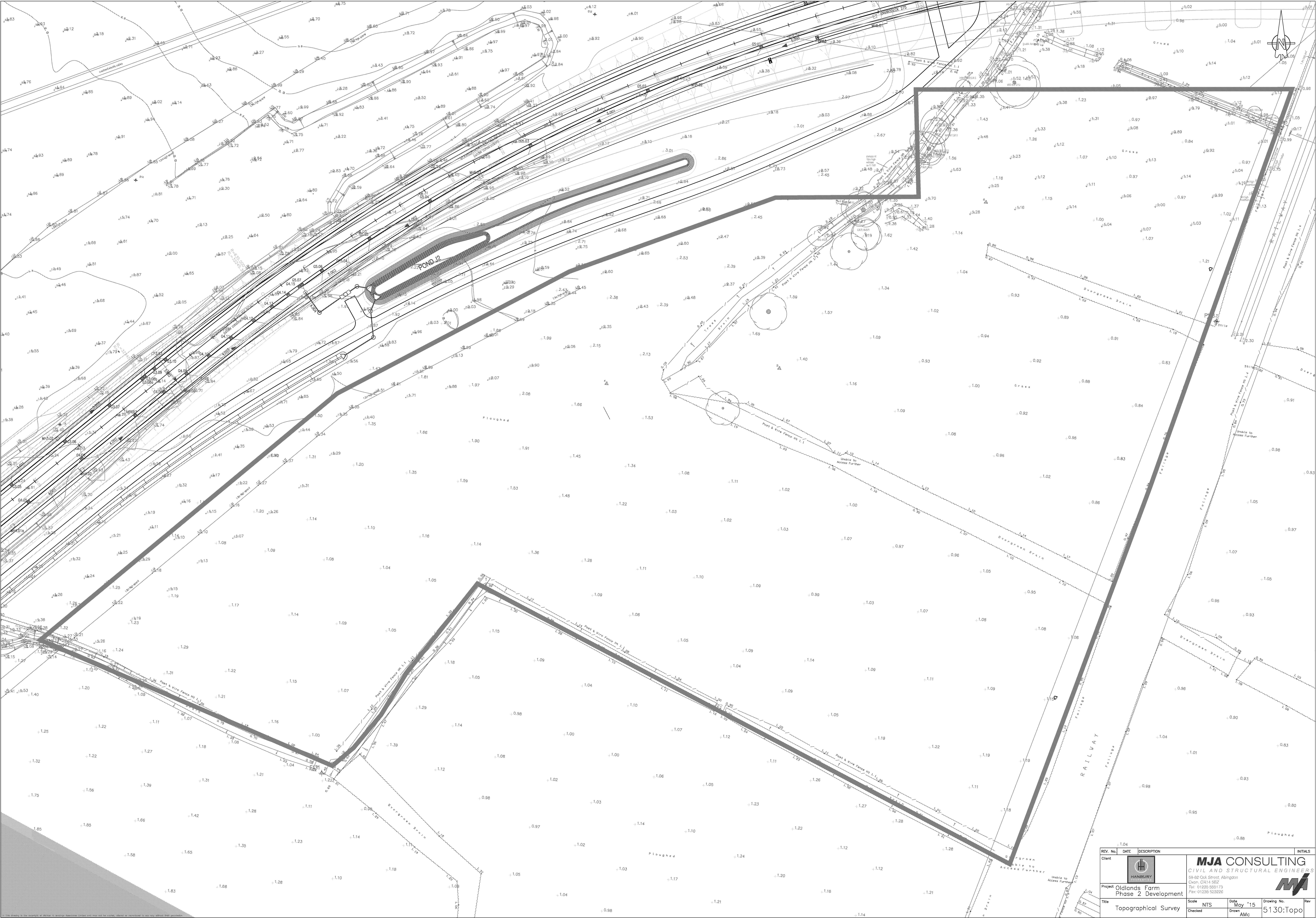


On behalf of:  HANBURY	PROJECT: Oldlands Farm - Phase 2, BOGNOR REGIS
Produced by:  Suite P1, Stroud House, Russell Street, Stroud, Gloucestershire, GL5 3AN t: 01453 780389 e: info@h-b.co.uk w: www.h-b.co.uk	DRAWING TITLE: B2/B8 Illustrative Masterplan
DATE: May 2015	SCALE: 1:1250 @ A3
DRAWING REFERENCE:	



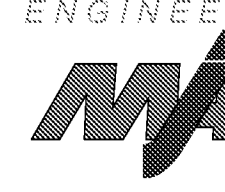
Appendix B

Topographical Survey



REV. No.	DATE	DESCRIPTION	INITIALS
Client 			
Project Oldlands Farm Phase 2 Development			
Title Topographical Survey		Scale NTS	Date May '15
Checked		Drawn AMC	Drawing No. 5130:Topo

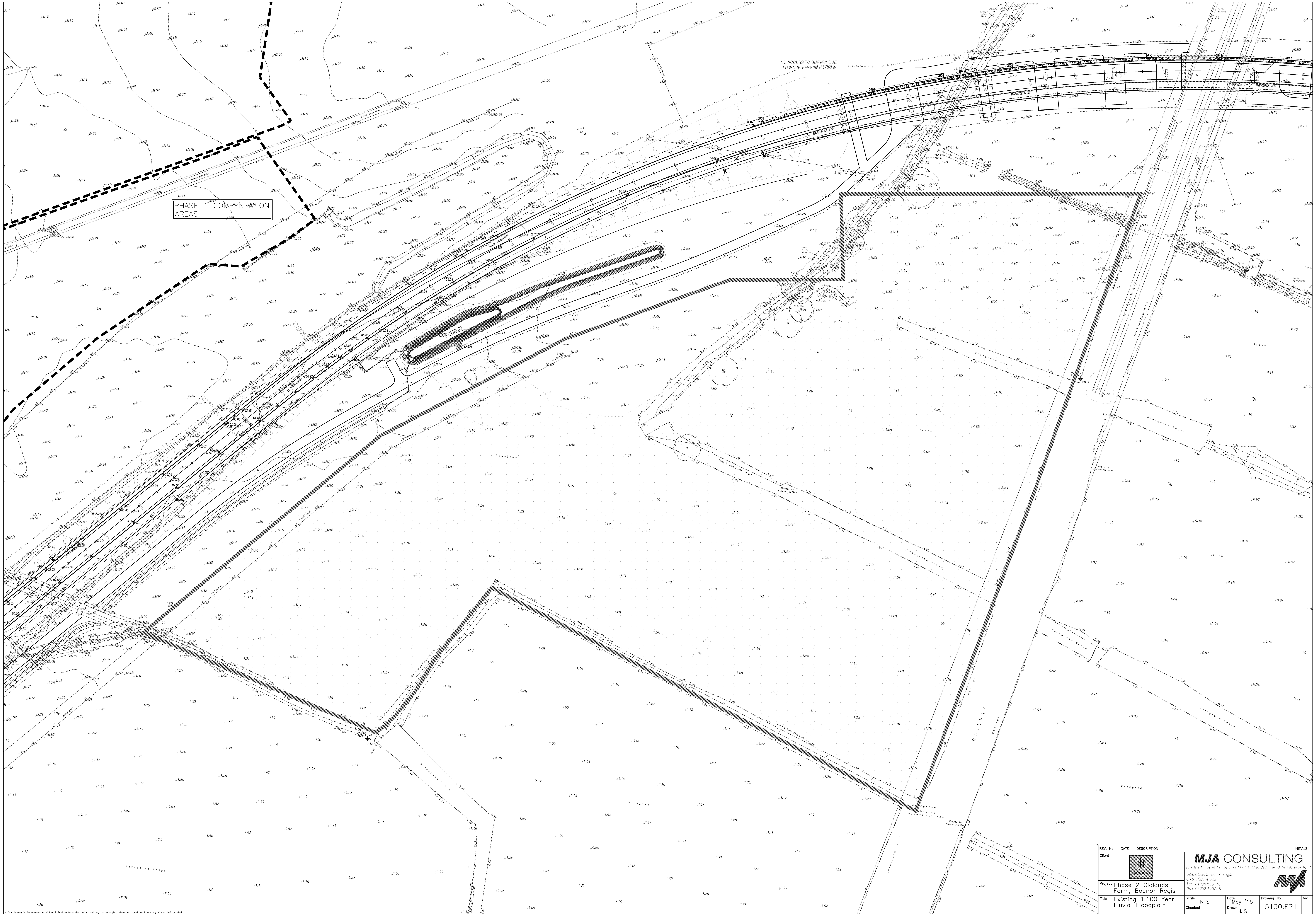
MJA CONSULTING
CIVIL AND STRUCTURAL ENGINEERS
66-68 Oak Street, Abingdon
Oxon, OX14 3BZ
Tel: 01235 555173
Fax: 01235 522925



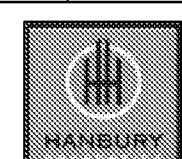


Appendix C

Existing Floodplain Plan



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REV. No.	DATE	DESCRIPTION	INITIALS
Client		MJA CONSULTING CIVIL AND STRUCTURAL ENGINEERS 66-68 Oak Street, Abingdon Oxon. OX14 3BZ Tel: 01235 555173 Fax: 01235 522925	
Project	Phase 2 Oldlands Farm, Bognor Regis		
Title	Existing 1:100 Year Fluvial Floodplain	Scale NTS Checked	Date May '15 Drawn HJS
			Drawing No. 5130:FP1
			Rev

Appendix D

Floodplain Compensation Plans



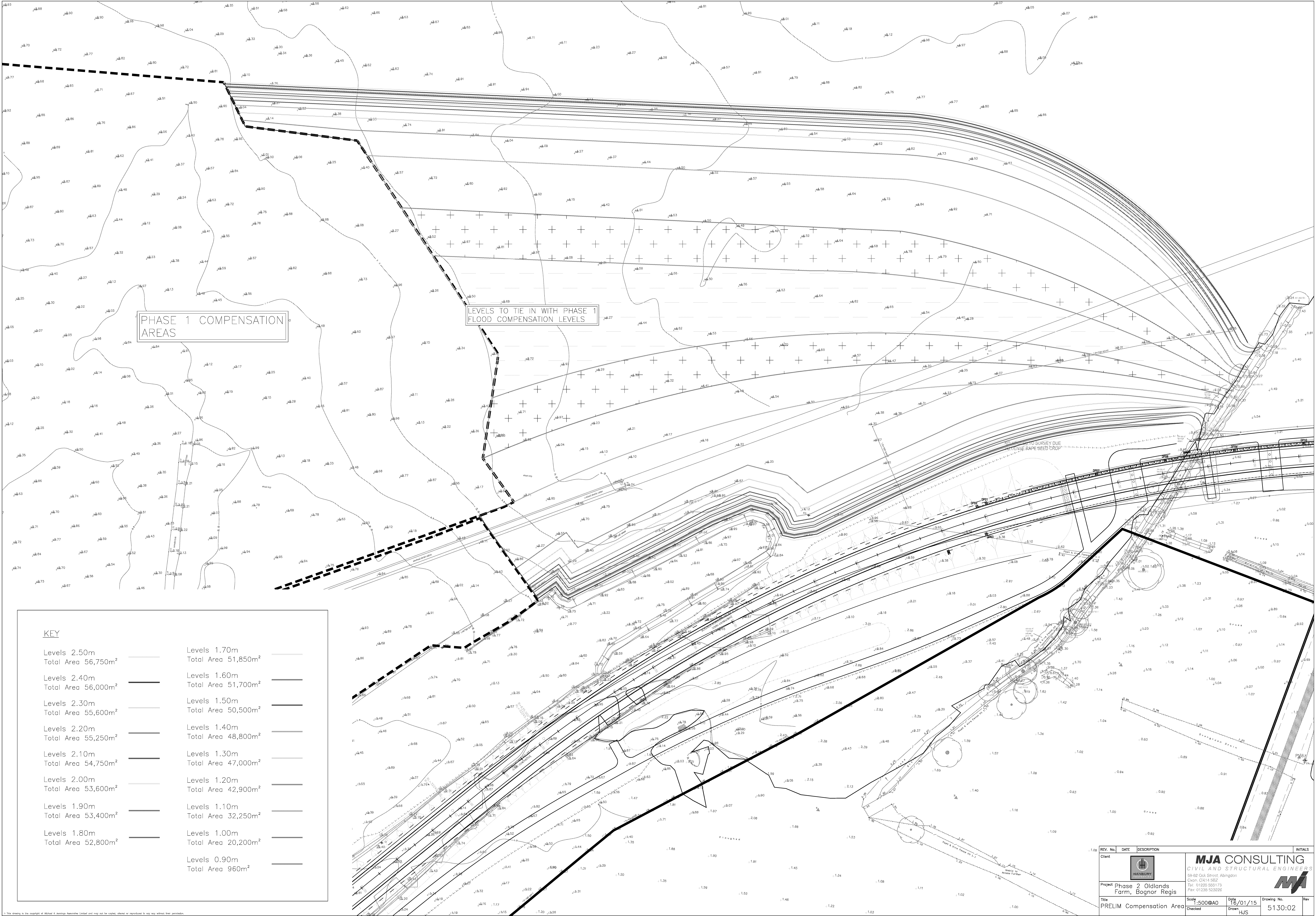
PHASE 1 COMPENSATION
AREAS

KEY

Levels 2.50m Total Area 50,374m ²	Levels 1.70m Total Area 44,030m ²
Levels 2.40m Total Area 49,366m ²	Levels 1.60m Total Area 43,054m ²
Levels 2.30m Total Area 48,583m ²	Levels 1.50m Total Area 41,573m ²
Levels 2.20m Total Area 48,079m ²	Levels 1.40m Total Area 39,296m ²
Levels 2.10m Total Area 47,627m ²	Levels 1.30m Total Area 36,397m ²
Levels 2.00m Total Area 46,844m ²	Levels 1.20m Total Area 31,104m ²
Levels 1.90m Total Area 45,677m ²	Levels 1.10m Total Area 22,292m ²
Levels 1.80m Total Area 44,855m ²	Levels 1.00m Total Area 6,011m ²
	Levels 0.90m Total Area 712m ²

PHASE 2 TOTAL AREA 51,488m²

REV. No.	DATE	DESCRIPTION	INITIALS
Client		MJA CONSULTING CIVIL AND STRUCTURAL ENGINEERS 69-82 Oak Street, Abingdon Oxon, OX14 5BZ Tel: 01235 556173 Fax: 01235 523020	
Project	Phase 2 Oldlands Farm, Bognor Regis	Scale 1:500 Date 16/01/15 Drawing No. 5130:01	Rev
Title	Raised Levels Plan	Checked	



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KEY

Levels 2.50m Total Area 56,750m ²	Levels 1.70m Total Area 51,850m ²
Levels 2.40m Total Area 56,000m ²	Levels 1.60m Total Area 51,700m ²
Levels 2.30m Total Area 55,600m ²	Levels 1.50m Total Area 50,500m ²
Levels 2.20m Total Area 55,250m ²	Levels 1.40m Total Area 48,800m ²
Levels 2.10m Total Area 54,750m ²	Levels 1.30m Total Area 47,000m ²
Levels 2.00m Total Area 53,600m ²	Levels 1.20m Total Area 42,900m ²
Levels 1.90m Total Area 53,400m ²	Levels 1.10m Total Area 32,250m ²
Levels 1.80m Total Area 52,800m ²	Levels 1.00m Total Area 20,200m ²
	Levels 0.90m Total Area 960m ²

REV. No.	DATE	DESCRIPTION	INITIALS
Client		MJA CONSULTING CIVIL AND STRUCTURAL ENGINEERS 66-68 Oak Street, Abington Oxon. OX14 3BZ Tel: 01235 555173 Fax: 01235 522925	
Project	Phase 2 Oldlands Farm, Bognor Regis	Scale 1:500 @ A0	Date 16/01/15
Title	PRELIM Compensation Area	Checked	Drawn HJS
			Drawing No. 5130:02
			Rev

Commercial Development
Area

Flood Relief &
Storm Water
Outfall Channel

SITE BOUNDARY

Railway Land

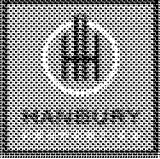
Landscaped finish

Top of Bank
2.750 AOD

Top of Bank
2.250 AOD

Ex. GL
1.20 AOD

TYPICAL SECTION THROUGH FLOOD CHANNEL

REV. No.	DATE	DESCRIPTION	INITIALS
Client		MJA CONSULTING CIVIL AND STRUCTURAL ENGINEERS 58-62 Oak Street, Abingdon Oxon, OX14 5BZ Tel: 01235 555173 Fax: 01235 523226	
Project			
Title	Flood Relief Channel Typical Detail		Rev
	Scale	Date	Drawing No.
Checked	NTS	May '15	5130:FC1
		Drawn	
		AMc	



Appendix E

Runoff Calculations

MJA Consulting		Page 1
58-62 Ock Street Abingdon Oxon OX14 5BZ	Oldlands Farm Ph2	
Date 18/05/2015 16:00 File	Designed by mcshane Checked by	
Micro Drainage Source Control 2015.1		

ICP SUDS Mean Annual Flood

Input

Return Period (years)	1	Soil	0.400
Area (ha)	6.000	Urban	0.000
SAAR (mm)	726	Region Number	Region 7

Results 1/s

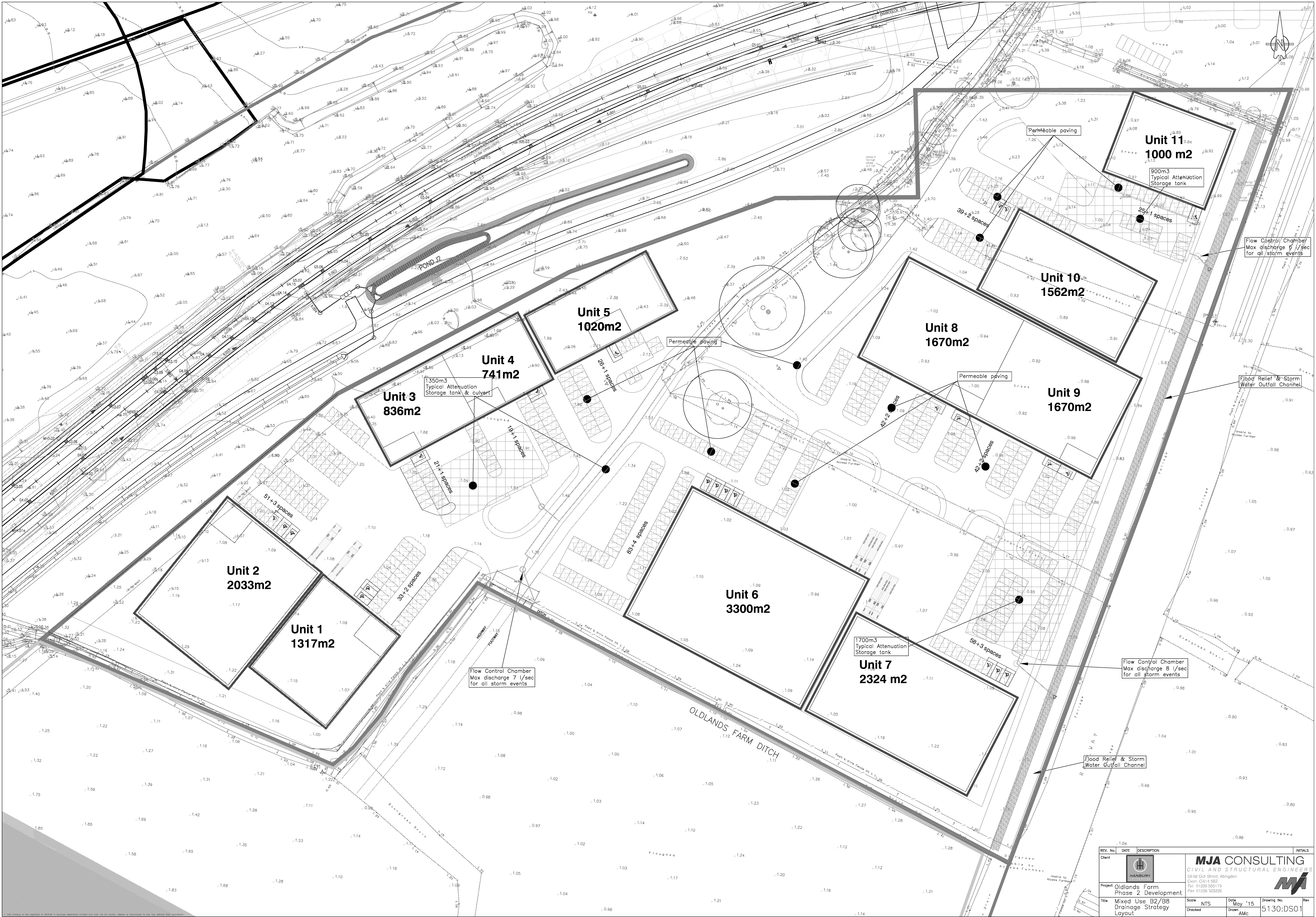
QBAR Rural	21.3
QBAR Urban	21.3
Q1 year	18.1
Q1 year	18.1
Q30 years	48.3
Q100 years	68.0

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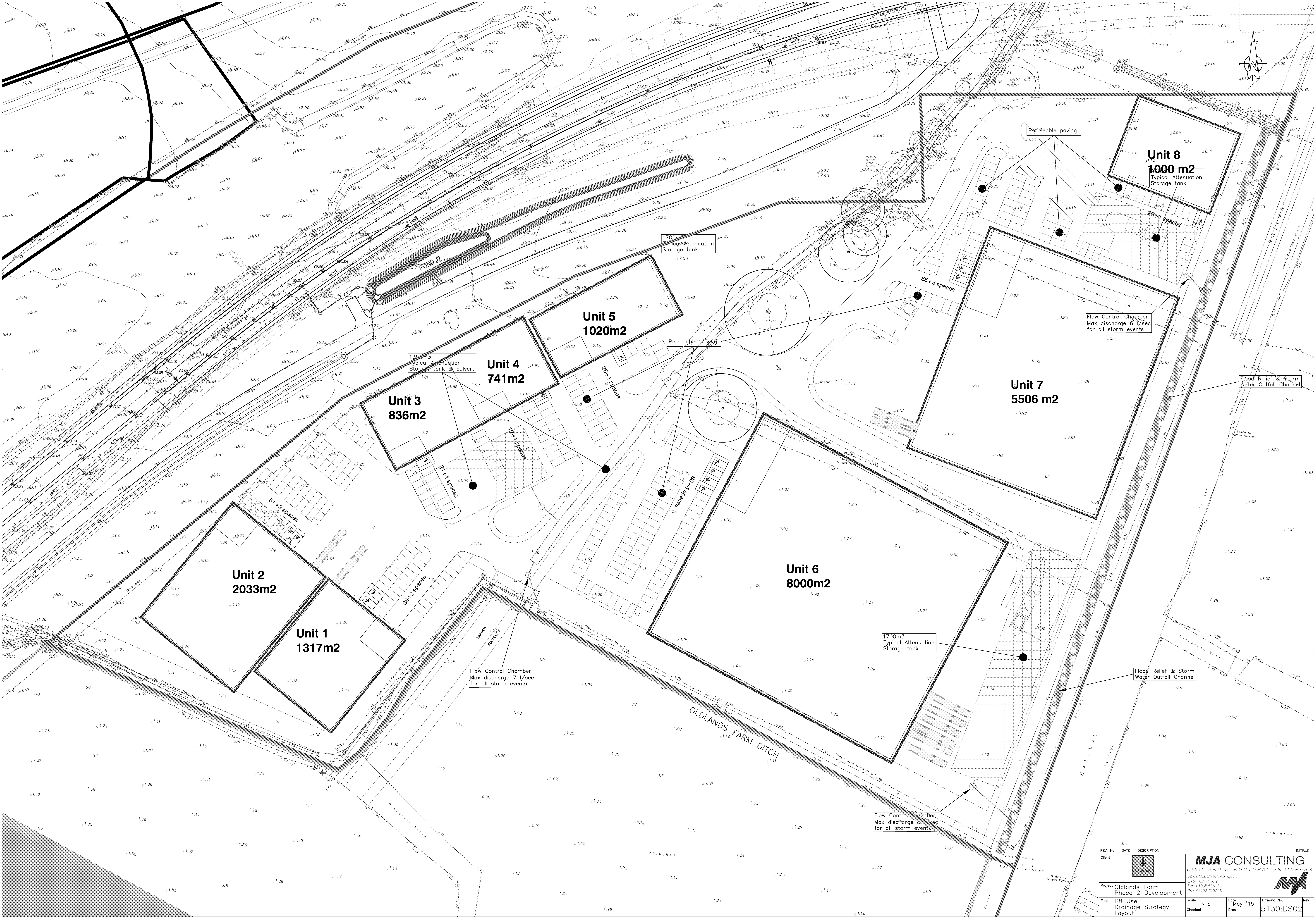


Appendix F

Drainage Strategy



REV. No.	DATE	DESCRIPTION	INITIALS
Client		MJA CONSULTING CIVIL AND STRUCTURAL ENGINEERS 58-62 Oak Street, Abingdon Oxon, OX14 3BZ Tel: 01235 555173 Fax: 01235 562925	
Project	Oldlands Farm Phase 2 Development		
Title	Mixed Use B2/B8 Drainage Strategy Layout	Scale NTS Checked	Date May '15 Drawn AMC
		Drawing No. 5130:DS01	Rev



REV. No.	DATE	DESCRIPTION	INITIALS
Client			
Project	Oldlands Farm Phase 2 Development		
Title	B8 Use Drainage Strategy Layout	Scale NTS	Date May '15
Checked		Drawn	
Drawing No.	5130:DS02	Rev	

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MJA CONSULTING

Civil & Structural Engineers

Monarch House • Abingdon Science Park
Barton Lane • Abingdon • Oxon • OX14 3NB
• www.mjaconsulting.co.uk

APPENDIX 3 GREENFIELD RUNOFF CALCULATIONS

Ramboll UK Ltd		Page 1
240 Blackfriars Road London SE1 8NW		
Date 22/03/2018 10:55 File	Designed by cleig Checked by	
Micro Drainage Source Control 2017.1		

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.400
Area (ha)	0.450	Urban	0.000
SAAR (mm)	741	Region Number	Region 7

Results 1/s

QBAR Rural	1.6
QBAR Urban	1.6
Q100 years	5.2
Q1 year	1.4
Q30 years	3.7
Q100 years	5.2

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Ramboll UK Ltd		Page 1
240 Blackfriars Road London SE1 8NW		
Date 20/03/2018 09:07 File	Designed by cleig Checked by	
Micro Drainage		Source Control 2017.1
<u>ICP SUDS Mean Annual Flood</u> Input Return Period (years) 100 Soil 0.400 Area (ha) 0.749 Urban 0.000 SAAR (mm) 741 Region Number Region 7 Results 1/s QBAR Rural 2.7 QBAR Urban 2.7 Q100 years 8.7 Q1 year 2.3 Q30 years 6.2 Q100 years 8.7		
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Ramboll UK Ltd		Page 1
240 Blackfriars Road London SE1 8NW		
Date 20/03/2018 09:09 File	Designed by cleig Checked by	
Micro Drainage Source Control 2017.1		

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.400
Area (ha)	0.650	Urban	0.000
SAAR (mm)	741	Region Number	Region 7

Results 1/s

QBAR Rural	2.4
QBAR Urban	2.4
Q100 years	7.5
Q1 year	2.0
Q30 years	5.4
Q100 years	7.5

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240 Blackfriars Road London SE1 8NW		
Date 20/03/2018 09:12 File	Designed by cleig Checked by	
Micro Drainage Source Control 2017.1		

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.400
Area (ha)	2.070	Urban	0.000
SAAR (mm)	741	Region Number	Region 7

Results l/s

QBAR Rural	7.5
QBAR Urban	7.5
Q100 years	24.0
Q1 year	6.4
Q30 years	17.1
Q100 years	24.0

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240 Blackfriars Road London SE1 8NW		
Date 20/03/2018 09:14 File	Designed by cleig Checked by	
Micro Drainage Source Control 2017.1		

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.400
Area (ha)	0.451	Urban	0.000
SAAR (mm)	741	Region Number	Region 7

Results 1/s

QBAR Rural	1.6
QBAR Urban	1.6
Q100 years	5.2
Q1 year	1.4
Q30 years	3.7
Q100 years	5.2

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