



Flood Risk Assessment

Land West of New Barn Lane, North Bersted,
Bognor Regis
West Sussex

London 100 St John Street, London, EC1M 4EH

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The conclusions reached are those which can be reasonably be determined from sources of information referred to in the report and from which our knowledge of current and professional practice and standards. Any limitations resulting from the data are identified where possible but both these and our conclusions may require amendment should additional information become available. The report is only intended for use in the stated context and should not be used otherwise.

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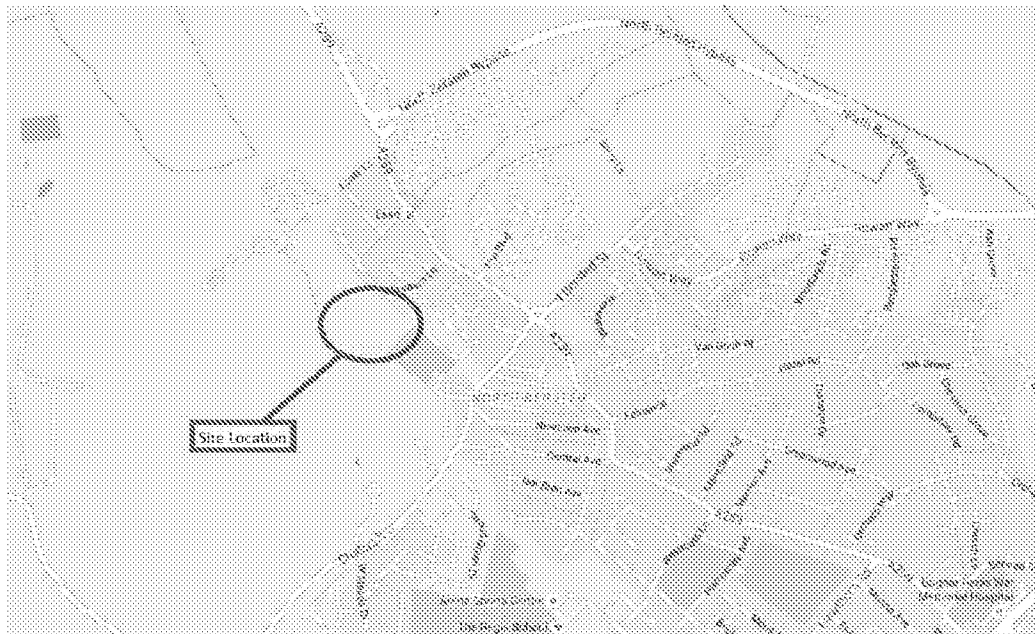


Executive Summary

Flood Risk Appraisal	The site is located within Flood Zone 1 and meets the Sequential development requirements of the National Planning Policy Framework. This site is at LOW RISK from all sources of flooding.
Existing Drainage	Runoff from the site discharges into the surrounding ditches. These line the site on three sides. There is no existing foul water drainage on the site.
Proposed Surface Water Drainage	Existing drainage ditches will be utilized for drainage of the new development, discharge rates will be controlled to less than the current one year storm discharge rate hence delivering a nett gain in reduced flood risk to the local area. Attenuation will be provided to meet SuDs criteria in two ponds. These ponds will provide attenuation storage for flooding up to the 100 year storm event plus 30% allowance for climate change storm event.
Proposed Foul Drainage	Foul water drainage for the new development will outfall into the existing foul water sewer located in New Barn Lane. On-site sewers will be offered for adoption to Southern Water (being the incumbent sewerage provider in the area).
This Executive Summary contains an overview of the key findings and conclusions in this report. No reliance should be placed on any part of the Executive Summary until the whole of this report has been read. Other section of the report may contain information which puts into context the findings summarized in the Executive Summary.	

1 Introduction

- 1.1 WYG Group Ltd has been retained by the Church Commissioners for England (Client) to undertake a Flood Risk Assessment (FRA) in accordance with the National Planning Policy Framework. This FRA is being prepared in support of an outline planning application for up to 50 residential dwellings. This assessment has been undertaken to ascertain the constraints to the redevelopment of the site, and to assess the impact of the proposals, with respect to flood risk.
- 1.2 This FRA has been prepared to assess the increase in surface water run-off and the disposal of foul water from the developed site.
- 1.3 **Site Location and Features**
The Ordnance Survey National Grid Reference (NGR) for the centre of the site is 491697, 100935. The site location is shown below.



- 1.4 The site is located in land off New Barn Lane, North Bersted, Bognor Regis. The site is roughly rectangular in shape and is 1.89ha in size. The site is accessed off New Barn Lane
- 1.5 The site is currently used as a horse paddock. To the east of the site is North Bersted and Bognor Regis. To the south, west and north of the site is arable farmland.
- 1.6 The site is quite flat with a gentle fall from west to east. The high point of the site is 4.62m AOD located in the west of the site. The low point is 4.10m AOD and is found in the south eastern corner of the site. The topographical survey can be found in Appendix A.
- 1.7 **Development Proposals**
It is proposed to develop up to 50 dwellings with an access road off New Barn Lane. Parking, internal roads, footpath links, SuDS and landscaping will also be provided.
- 1.8 Approximately 0.65ha of the site will be developed impermeable areas. The architects layout can be found in Appendix B.

1.9 Flood Zone Allocation

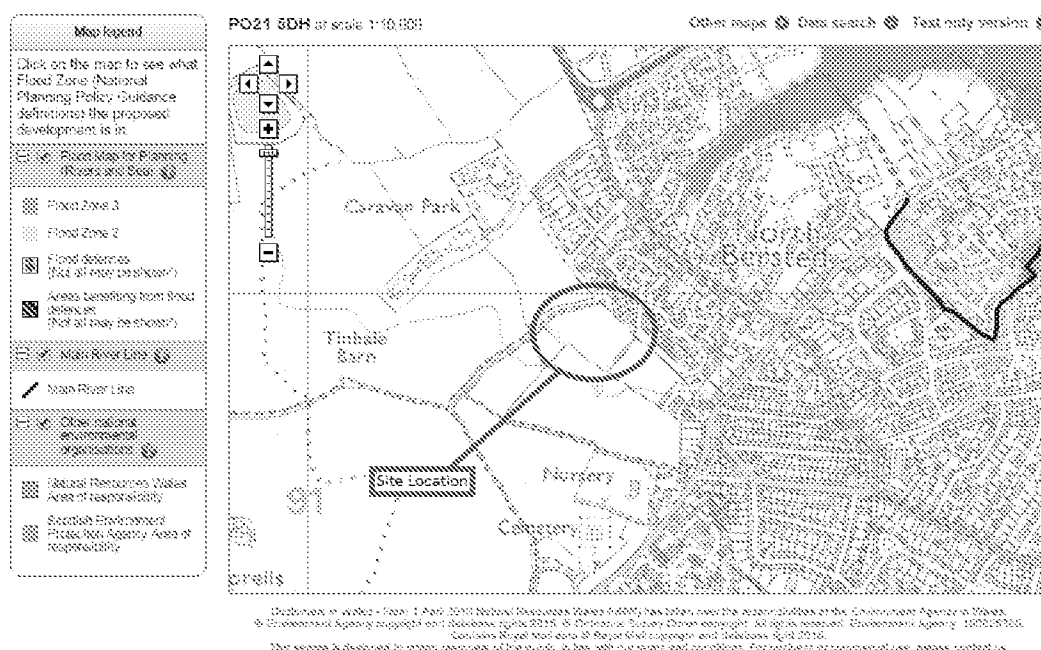
The site is wholly within Flood Zone 1. This means the risk from flooding from river and sea sources is less than 1 in 1000. This makes the site suitable for residential development. The Environment Agency mapping this information has been sourced from can be found below.

Flood risk from river and sea sources has been classified by the EA as follows:

Flood Zone 1 (FZ1) – Lower than 1 in 1000 risk of flooding

Flood Zone 2 (FZ2) – Greater than 1 in 100 but lower than 1 in 1000 risk of flooding

Flood Zone 3 (FZ3) – Greater than 1 in 100 chance of flooding



1.10 Surface Water Flood Risk Zones

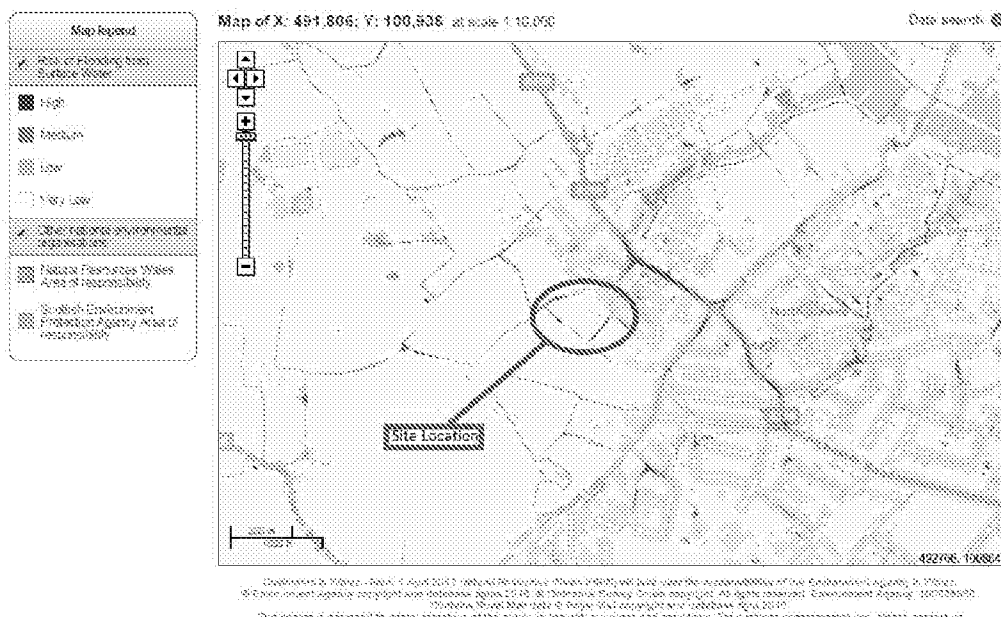
The site is considered to be at very low risk from surface water flooding. This means the site is considered to be at less than 1 in 1000 risk of flooding from surface water. Surrounding the site, there are instances of low and high risk of flooding from surface water. This would suggest the presence of a ditch system surrounding the site for drainage. The presence of these ditches has been confirmed by a site visit and their location denoted on the topographical survey. The EA mapping this information has been sourced from can be found below. Flood risk from surface water has been classified by the EA as follows:

Very Low – Less than 1 in 1000 chance of flooding

Low – Between 1 in 1000 and 1 in 100 chance of flooding

Medium – Between 1 in 100 and 1 in 30 chance of flooding

High – Greater than 1 in 30 chance of flooding



- 100 St John Street, London, EC1M 4EH



2 Sources of Information

2.1 Flood Zone Maps & Flood Defence Data

Information relating to the current flood risk at the application site and local flood defence schemes has been obtained from the EA website. There are no main watercourses in the vicinity of the site. There is a ditch network that surrounds three corners of the site.

2.2 Historic Flooding

There are no records of historic flooding associated with the site.

2.3 Existing Watercourses

The only water courses near the site are the unnamed ditches which are found on 3 sides of the site.

2.4 Hydro geological Data

The Flood Estimation Handbook factors for the catchment show the Standard Percentage Run-off (SPR) factor is 37%. This indicates the soils are not suitable for soakaway drainage as a standalone solution. The soil index map for the area in the Flood Studies Report shows the site to be of Soil Type 3.

2.5 Ground Investigation Data

Ground Investigation testing was carried out on 3rd & 4th March 2016. Soakage tests were attempted but had to be abandoned due to striking groundwater at testing depths. The ground water levels would prohibit the installation and use of infiltration apparatus. The results of the Ground Investigation can be found in Appendix D.

2.6 Public Sewers & Highway Drainage

There are no public surface and foul water sewers within the vicinity of the site. Utility checks are currently being undertaken to locate the nearest publically maintained sewers to the site.

2.7 Land Drainage

There are shallow drainage channels on the site running north to south to assist with the drainage of surface water from the site. These were located on the site visit and photos can be found in Appendix C. There are no plans or information regarding other land drainage within the site.



3 Flood Risk Assessment

3.1 Flood Risk Assessment Methodology & Objectives

It is recognised that developments that are designed without regard to flood risk may endanger lives, damage property, cause disruption to the wider community, damage the environment, be difficult to insure and require additional expense on remedial works. Current guidance on development and flood risk identifies several key aims for a development to ensure that it is sustainable in flood risk terms. These aims are as follows:

- The development should not be at a significant risk of flooding and should not be susceptible to damage due to flooding;
- The development should not be exposed to flood risk such that the health, safety and welfare of the users of the development, or the population elsewhere, are threatened;
- Safe access to and from the developments should be possible during flood events;
- The development should not increase flood risk elsewhere;
- The development should not prevent safe maintenance of watercourses or maintenance and operation of flood defences;
- The developments should not be associated with an onerous or difficult operation and maintenance regime to manage flood risk. The responsibility for any operation and maintenance required should be clearly defined;
- Future users of the development should be made aware of any flood risk issues relating to the development;
- The development design should be such that future users will not have difficulty obtaining insurance or mortgage finance, or in selling all or part of the development, as a result of flood risk issues;
- The development should not lead to degradation of the environment; and
- The development should meet all of the above criteria for its entire lifetime, including consideration of the potential effects of climate change.

3.2 This FRA is undertaken with due consideration of these sustainability aims, and has been prepared to inform the proposed scheme. A development lifetime of 100 years has been assumed in line with TGNPPF guidance on residential development life cycles.

3.3 Project Scope

In order to achieve the aims outlined above, the Flood Risk Assessment has been undertaken in accordance with current best-practice guidance, including TGNPPF. A scoping study was initially undertaken to identify all potential sources of flooding at the site, which may warrant further consideration. Any potential flooding issues identified in the scoping study have subsequently been considered within this FRA. The aim of the scoping study is to review all available information and provide a qualitative assessment of the flood risk to the site and the impact of the site on flood risk elsewhere. The report has been undertaken with due regard to the EA's National Standing Advice on development and Flood Risk.



3.4 **Level 1 – Scoping Study**

All potential sources of flooding must be considered for any proposed development. Using the EA flood zone mapping, public sewer records and topographical survey, a summary of the potential sources of flooding and a review of the potential risk is posed by each sources on the development area of the application site is presented in Table 1.

Table 1: Potential Risk Posed by Flooding Sources

Potential Source	Potential Flood risk within Site Boundary
Fluvial Flooding	No
Tidal Flooding	No
Flooding from rising/high groundwater	No
Overland flow flooding	No
Flooding from artificial drainage systems	No
Flooding due to infrastructure failure	No
Surface Water Flooding	No
Increase in flood risk due to urbanisation of the catchment	Yes

3.5 Following the Level 1 scoping study a more detailed Level 2 assessment has been undertaken which considers each of the potential flood risks identified above.

3.6 **Level 2 - Technical Assessment of Flood Risk - Increase in surface water run-off due to development**

Based on guidance in TGNPPF, the EA requested that applications for development where the site will increase the amount of surface water run-off include an appropriate drainage strategy to ensure that surface water run-off discharge mimics the existing pre-development regime. This can be via a series of different methods, including infiltration, attenuation and rainwater re-use so that the potential adverse impact, i.e. increase in downstream flood risk on the fluvial system is alleviated. Analysis of the following has been undertaken as part of this process:

- Determination of appropriate discharge rates based on existing Greenfield run-off rates;
- Assessment of the mitigation requirements to ensure that appropriate discharge rates are maintained; and
- An outline surface water drainage strategy that demonstrates no detrimental impact on the existing receiving public sewers, water bodies or property.

3.7 The regulating authorities require that the attenuation storage requirements are based on the critical 1:100 year storm event, including allowance for potential effects of climate change, with run-off not exceeding existing rates. For infiltration the designs should meet the minimum of a 1:30 year storm event, including allowance for potential climate change. Assessment of the run-off regime for the existing and proposed site considers the run-off generated by the site for the 100 year return period event, for a range of durations. Using the effective rainfall and investigation of the existing and proposed site land use characteristics, a range of allowable discharge rates has been estimated at various return period storms should an existing public sewer or watercourse be used to discharge the surface water run-off.



3.8 Existing Greenfield Run-off Rates

Using the land use information, rainfall data FSR Soil Type map, the existing Greenfield Run-off rates have been estimated at the site using the IoH 124 method with regional growth curve factors derived from the Flood Studies Report for the hydrological area 7. The results for the development area of 0.65ha in Table 2 below. The report used to calculate these values is included in Appendix E.

Table 2: Summary of Existing Greenfield Run-off Rates

Return Period (Years)	IoH 124 Method	
	l/s/ha	l/s for 0.65ha
Qbar	2.92	1.90
1 in 1	5.00	5.00
1 in 30	5.00	5.00
1 in 100	9.30	6.05
1 in 100 +30% CC	12.10	7.86

A minimum flow rate of 5l/s applies when calculating Greenfield Run-off Rates

- 3.9 The proposed run-off levels for a 1 in 100 year storm + 30% climate change allowance amounts to 2l/s/ha. This represents a 32% reduction in run-off rates.



4 Drainage Strategy

- 4.1 Development of the site will lead to an increase in impermeable area, which will have a consequential impact on the run-off rates. It is therefore proposed to install a surface water drainage system sized to accommodate an increase in run-off associated with climate change estimates, in accordance with TGNPPF guidance on life cycles for residential development.
- 4.2 The development must however include a surface water drainage scheme based on SuDS principles. This could include soakaways, porous paving, attenuation, rainwater harvesting for toilet flushing and irrigation of landscape areas. Rainwater harvesting is not normally considered to reduce the overall volume of storage required as the tank system may already be close to full when a second rainfall occurs.
- 4.3 Porous paving systems in the private road and parking areas will reduce the overall volume of storage required. This will be designed with an overflow to the main surface water systems.
- 4.4 The strategy for the site will consist of gullies and wet ponds. The outfall for the system will be into the ditches that surround the site.
- 4.5 The outfall of the surface water system will be controlled by a cortex control system. This will ensure the run-off levels are reduced from existing rates. The control system will be housed within a man hole to allow for additional attenuation.
- 4.6 The wet ponds will be designed to have a permanent depth of 0.6m with a storage depth of 1m. The banks of the pond will be designed to have a max gradient of 1:3.
- 4.7 The total attenuation required for the site is 565m³. This will be split into two ponds in opposite corners of the site. Each pond will have an independent outfall with a restricted outfall rate. This rate is still to be agreed with the LLFA but will be lower than the existing run off rate of 2.92l/s/ha. The rate being proposed is 2l/s/ha. This represents a 32% reduction in run-off rate.
- 4.8 The total surface area the ponds will require within the site will be 740m². This will allow for all storage to be contained within the 1m depth storage with 1:3 banked sides of the pond.
- 4.9 An illustrative surface water strategy can be found in Appendix F.
- 4.10 Uksuds.com was used to calculate the required attenuation storage for the site. The report produced is included in Appendix G.
- 4.11 **Disposal of Foul Water Drainage**
Southern Water maintain the public foul water infrastructure for the local area. The nearest public foul sewer is located within New Barn Lane. The site will outfall into this system. Asset record plans can be found in Appendix H.
- 4.12 A foul water capacity check has been carried out by Southern Water (24/08/15) for an adjacent site. This check has shown there is insufficient space within the existing system and approximately 170m of 225mmØ pipe will need to be upgraded to 750mmØ pipe. This upgrade would provide sufficient capacity for the larger site adjacent site.
- 4.13 As part of a Preliminary Infrastructure Assessment currently being carried out for the site, an updated capacity check will be requested from Southern Water. This would confirm whether there is sufficient capacity for this site within the existing network. If the assessment shows a lack of capacity, it will propose works to improve the existing system to allow for the site to



outfall into the network. These improvement works would normally be carried out under a S98 sewer requisition agreement at the developers cost.

- 4.14 The foul water produced from the site will be treated at SW's West Park Wastewater Treatment Works (WwTW) which is located approximately 1.6km south of the site.

4.15 **Off-Site Impact: Sustainable Drainage Design Statement**

It can be demonstrated that with the input of mitigation measures, including porous paving and attenuation storage the proposed development of the site represents no tangible increase in off-site surface water run-off rates.

4.16 **Maintenance and Management**

The continued management and maintenance of the new drainage system will be essential in ensuring the continued protection of the development from surface water flooding. Visual inspection of drainage network and outfalls should be undertaken on a regular basis to identify any siltation/blockage/disrepair of the drainage network and infiltration/attenuation facilities. Siltation of any porous paving infiltration system may lead to a reduction in storage capacity over time and it is important to ensure that any siltation is removed and overall volume of storage is maintained. A surface water management system therefore needs to be drawn up as part of any planning consent that is issued for the site.

- 4.17 It is considered that with these measures, the potential residual risks of the increase in surface water run-off can be managed and lowered to an acceptable level.



5 Summary and Conclusions

- 5.1 WYG Group Ltd has been retained by the Church Commissioners for England to undertake a Flood Risk Assessment in support of a planning application for the residential development of land at New Barn Lane, Bersted, Bognor Regis.
- 5.2 The site lies wholly within Flood Zone 1.
- 5.3 The site does not have to pass a TGNPPF Sequential and Exception Test before planning consent can be issued.
- 5.4 Based on initial assessment the site is not deemed to be at flood risk from ground water or surface water.
- 5.5 The increase in surface water run-off will be discharged via a network of wet ponds. Any run-off storage provided will include 30% uplift in peak rainfall intensity to allow for climate change, in line with TGNPPF and the West Sussex Highway requirements.
- 5.6 Two permanent ponds with a combined storage volume of 564m³ will be used to store the excess surface water.
- 5.7 Separate surface and foul water sewerage systems will be utilised by the proposed development.
- 5.8 The development proposals are duly presented as sustainable in terms of flood risk and in line with the guidance set out in TGNPPF and the requirements of the Environment Agency and Local Lead Flood Authority.



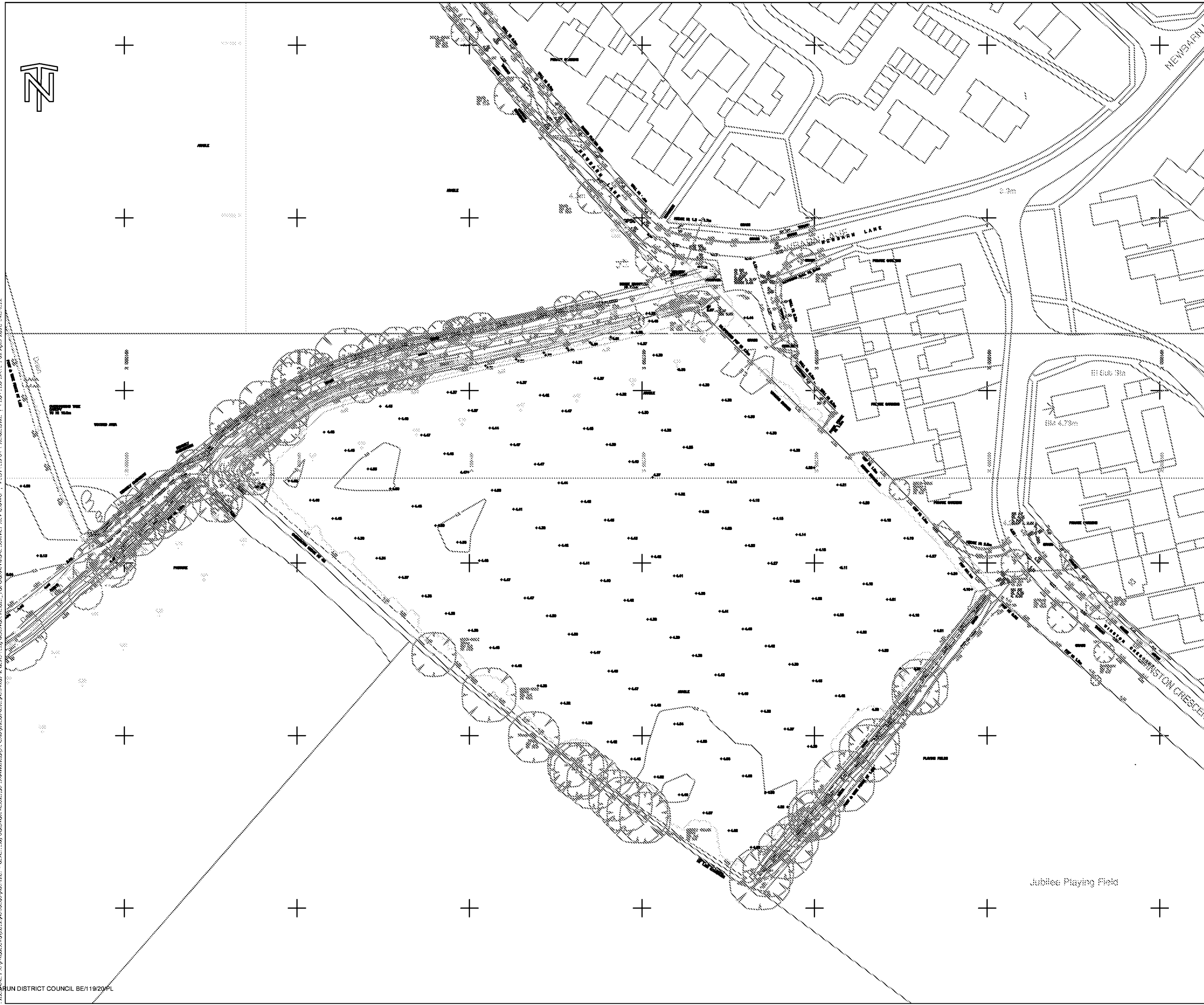
Appendices





Appendix A





SURVEY LEGEND

[illegible]

ALL LEVELS RELATE TO
GPS ORDNANCE DATUM NEWLYN

REV	DESCRIPTION	BY	CHK	APP	DATE
-----	-------------	----	-----	-----	------

ARNDAL COURT
HEADINGLEY
LEEDS
LS6 2UJ

Project:
Bersted,
Bognor Regis

Scale @ A3 1:1000	Drawn RH	Date 04/03/16	Checked DE	Date 04/03/15	Approved DMR	Date 08/03/16
Project No. A094107-2	Office 001	Type	Drawing No. A094107-2	T001	Revision	-





Appendix B

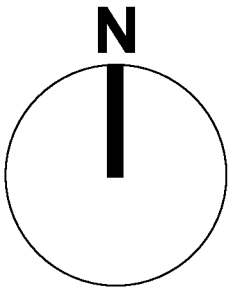




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	Site Boundary	1.94ha
	Potential Development <i>Up to 50 dwellings @ 37dph</i>	1.37ha
	Public Open Space	0.52ha
	Proposed Attenuation	
	Indicative Access	
	Proposed Primary Roads	
	Proposed Secondary Roads	
	Proposed Footpaths	
	Potential Footpath Links	
	Existing Footpaths	
	Proposed Trees	
	Existing Trees	
	Existing Hedgerows	
	Existing Ditch	



J:\7000\7096\LANDS\Plans\7096-NBL-L-02G ILLUSTRATIVE MASTERPLAN.indd

Church Commissioners
Land off New Barn Lane
Bognor Regis

ILLUSTRATIVE MASTERPLAN

1:500@A1
11 May 2016 DWL / DH
7096-NBL-L-02 rev G

masterplanning
environmental assessment
landscape design
urban design
ecology
architecture
arboriculture

FPCR Environment and Design Ltd
Lockington Hall
Lockington
Derby DE74 2RH

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fpcr



Appendix C





Pipe underneath existing access



Ditch surrounding site



Site from South Eastern corner



Ditch beside existing access



Pipe connection underneath Southern Water



Site from North Eastern Corner. Minor ponding



Existing ditch surrounding site



Natural drainage rill



Grip from rill to existing ditch



Existing site access



Connection to surface water sewer



Appendix D





3 Geology, Hydrogeology, Hydrology and Radon

3.1 Geology

The site is covered by British Geological Survey 1:50,000 (solid and drift) map number 317/332, Chichester and Bognor.

3.1.1 Superficial Geology

The site is recorded as being underlain by undifferentiated River Terrace Deposits of Quaternary Age. These deposits typically comprise of gravel, sand and silt.

No artificial or Made Ground deposits are recorded on the site.

3.1.2 Solid Geology

The BGS geology map indicates that the site is underlain by undifferentiated deposits of the Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation.

3.2 Hydrogeology

3.2.1 Aquifer Classification

The River Terrace Deposits underlying the site are classified as a Secondary A Aquifer – this means the deposit is regarded as permeable and capable of supporting water supplies at a local scale and form an important source of base flow to rivers.

The undifferentiated chalk bedrock underlying the site is classified as a Principal Aquifer – this means that the rock is regarded as having high intergranular and/or fracture permeability, meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

The site is not within a Groundwater Source Protection Zone.



3.3 Hydrology

The closest detailed river network line is recorded 250m north-east of the site and is related to a tertiary river. A surface water offline drainage feature is recorded immediately north and south-west of the site.

3.4 Radon

BRE document 211¹ mapping coverage for the site area was consulted and indicates that the site is located within an area where no radon protection measures are required for new developments.

¹ BRE 211. Radon: Guidance on protective measures for new buildings. Chris Scivyer MCIQB. 2007 edition.



8 Soakaway Investigation

8.1 Site Works

The site investigation work was undertaken on the 3rd March 2016. The scope of the completed investigation is given below:

- 4 No. Machine excavated trial pits excavated to depths between 1.80m – 2.20m bgl.

Figure 3 shows the layout of the trial pits excavated during the site investigation. Trial pit logs including photographic plates of the site investigation work are presented in Appendix D.

8.2 Strata Encountered

The sequence of strata encountered beneath the site was:

- Topsoil;
- River Terrace Deposits; and
- Structureless Chalk (CIRIA Grade Dm).

A summary of depths of each stratum is provided in Table 6 and details of each stratum are discussed in the subsequent sections below. Logs of all exploratory holes can also be seen in Appendix D.

Table 6 - Summary of Strata depths (m bgl) for trail pits

Borehole / Trial Pit	Topsoil	River Terrace Deposits	Chalk
TP01	GL – 0.20	0.20 – 1.30	1.30 – 1.90*
TP02	GL – 0.20	0.20 – 2.10	2.1 – 2.20*
TP03	GL – 0.25	0.25 – 1.60	1.60 – 1.80*
TP05	GL – 0.20	0.20 – 1.30	1.30 – 1.80*

* base of stratum was not proven

Details of each stratum are discussed in the subsequent sections below.

8.2.1 Topsoil

Topsoil was encountered in TP01 – TP04 to the depths indicated in Table 6. The topsoil was generally described as firm brown slightly sandy CLAY with many roots and rootlets.



8.2.2 River Terrace Deposits

River Terrace Deposits were encountered in TP01- TP04 between the depths indicated in Table 6. These were generally described as firm brown slightly mottled grey CLAY with rare fine to medium sub-round flint gravel.

8.2.3 Chalk

Structureless Chalk was encountered in TP01 – TP04 between the depths indicated in Table 6. Two CIRIA Grades of chalk were identified;

- TP01, TP03 and TP04 – structureless chalk was encountered and described as a stiff beige grey mottled orange slightly gravelly CLAY with low sub-angular to rounded flint cobble content. Gravel is fine to medium sub-angular chalk (CIRIA Grade Dm).
- TP02 - structureless chalk was encountered and described as a white very clayey GRAVEL. Gravel is fine to medium sub-angular chalk (CIRIA Grade Dc).



8.3 Groundwater

Groundwater strikes were recorded in TP01 (structureless chalk) and TP02, TP03 and TP04, in the River Terrace Deposits. The groundwater data is summarised in Table 7 below.

Table 7 - Summarised Water Strike Data

Investigation point	Water strike (m bgl)	Strata
TP01	1.70	Structureless Chalk
TP02	1.80	River Terrace Deposits
TP03	0.90	River Terrace Deposits
TP04	0.85	River Terrace Deposits

8.4 Soakaway Considerations

Soakaway testing compliant with BRE365 was not completed at the site. As a result of the ground and groundwater conditions encountered, it was concluded that soakaway drainage would not be suitable for the following reasons:

- Shallow groundwater was encountered across the site (between the depths of 0.85m – 1.80m bgl). BRE Digest 365 for Soakaway Design states that groundwater should not rise to the level of the base of the soakaway during annual variations in the water table.
- The shallow ground conditions have been identified to largely comprise CLAY. The permeability of such deposits are typically low and do not provide good conditions for the soakaway of water.

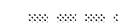


DO NOT SCALE: CONTRACTOR TO CHECK ALL DIMENSIONS AND REPORT ANY OMISSIONS OR ERRORS

KEY



SITE BOUNDARY



DITCH



Soakaway Location



REV	DESCRIPTION	BY	CHK	APP	DATE
-----	-------------	----	-----	-----	------

Client:

ARNDAL COURT
HEADINGLEY
LEEDS
LS6 2UJ

TEL: +44 (0)113 278 7111
FAX: +44 (0)113 275 0623
e-mail: enviro@wyg.com



Project: A094107-2

NEW BARN LANE
BERSTED
BOGNOR REGIS

Drawing Title:

Soakaway Location Plan

0 20 40 60 80 100 m
SCALE 1:2000

Scale @ A3 1:1,000	Drawn CM	Date 21.03.16	Checked Date	Approved Date
Project No. A094107-3	Office CDF	Type N	Drawing No. 02	Revision

WYG ENVIRONMENT

Ground Engineering Services

Longcross Court, 47 Newport Road, Cardiff, CF24 0AD.

Exploratory Hole Number

TP01**Final**

Scale 1:25 Sheet 1 of 1

Logged By : LK

Checked By : SR

Start Date : 03/03/16

Finish Date : 03/03/16

Project Number : A094107-2

Client : Church Commissioners for England

Method : 8t tracked excavator

Co-ordinates :

Level :

Strata Description	Legend	Reduced Level (mOD)	Depth (m)	Water Strike (m)	Installation/ Backfill	Sample Test		Notes / Remarks
						Depth	Type	
Firm brown slightly sandy CLAY with many roots and rootlets (TOPSOIL)			0.20	 1.70				
Firm brown slightly mottled grey CLAY with rare fine to medium sub-rounded flint gravel (RIVER TERRACE DEPOSITS)						0.40 0.40 0.40	1 2 3	HV = 50kPa HV = 54kPa HV = 52kPa
			1.30			1.00 1.00 1.00	1 2 3	HV = 74kPa HV = 64kPa HV = 60kPa
Structureless CHALK composed of stiff beige grey mottled orange slightly gravelly CLAY with low sub-angular to rounded flint cobble content. Gravel is fine to medium sub-angular chalk. (CIRIA Grade Dm)								
End of Trial Pit at 1.90 m bgl.								
	</							



Logged By : LK
 Checked By: SR
 Start Date : 03/03/16
 Finish Date : 03/03/16



Logged By : LK
 Checked By: SR
 Start Date : 03/03/16
 Finish Date : 03/03/16



Logged By : LK
 Checked By: SR
 Start Date : 03/03/16
 Finish Date : 03/03/16





Appendix E



Site name: Land at Bersted
Site location: New Barn Lane, Bognor Regis

Site coordinates
Latitude: 50.80034° N
Longitude: 0.70052° W

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the CIRIA SUDS Manual (2007). It is not to be used for detailed design of drainage systems. It is recommended that every drainage scheme uses hydraulic modelling software to finalise volume requirements and design details before drawings are produced.

Reference: gcp8bpcvktwr / 1.81
Date: 1 Apr 2016

Site characteristics

Total site area	1.81	ha
Significant public open space	1.16	ha
Area positively drained	0.65	ha

Methodology

Greenfield runoff method	IH124
Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type
SOIL type	3
HOST class	N/A
SPR	0.37

Hydrological characteristics

	Default	Edited	
SAAR	709	709	mm
M5-60 Rainfall Depth	17	17	mm
'r' Ratio M5-60/M5-2 day	0.4	0.4	
FEH/FSR conversion factor	0.85	0.85	
Hydrological region	7	7	
Growth curve factor: 1 year	0.85	0.85	
Growth curve factor: 10 year	1.62	1.62	
Growth curve factor: 30 year	2.3	2.3	
Growth curve factor: 100 year	3.19	3.19	

Greenfield runoff rates

	Default	Edited	
Qbar	1.90	1.90	l/s
1 in 1 year	5.00	5.00	l/s
1 in 30 years	5.00	5.00	l/s
1 in 100 years	6.05	6.05	l/s

Please note that a minimum flow of 5 l/s applies to any site

Greenfield runoff estimation for sites

Site name: Land at Bersted
Site location: New Barn Lane, Bognor Regis

Site coordinates
Latitude: 50.80034° N
Longitude: 0.70052° W

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the CIRIA SUDS Manual (2007). It is not to be used for detailed design of drainage systems. It is recommended that every drainage scheme uses hydraulic modelling software to finalise volume requirements and design details before drawings are produced.

Reference: gcp8bpcvktwr / 1.81
Date: 1 Apr 2016

Site characteristics

Total site area	1.81	ha
Significant public open space	1.16	ha
Area positively drained	0.65	ha

Methodology

Greenfield runoff method	FEH	
Qmed estimation method	Calculate from BFI and SAAR	
BFI and SPR estimation method	Calculate from dominant HOST	
HOST class	N/A	
BFI / BFIHOST	0.00	
Qmed	N/A	I/s
Qbar / Qmed Conversion Factor	N/A	

Hydrological characteristics

	Default	Edited	
SAAR	709	709	mm
M5-60 Rainfall Depth	17	17	mm
'r' Ratio M5-60/M5-2 day	0.4	0.4	
FEH/FSR conversion factor	0.85	0.85	
Hydrological region	7	7	
Growth curve factor: 1 year	0.85	0.85	
Growth curve factor: 10 year	1.62	1.62	
Growth curve factor: 30 year	2.3	2.3	
Growth curve factor: 100 year	3.19	3.19	

Greenfield runoff rates

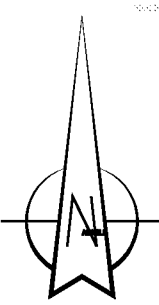
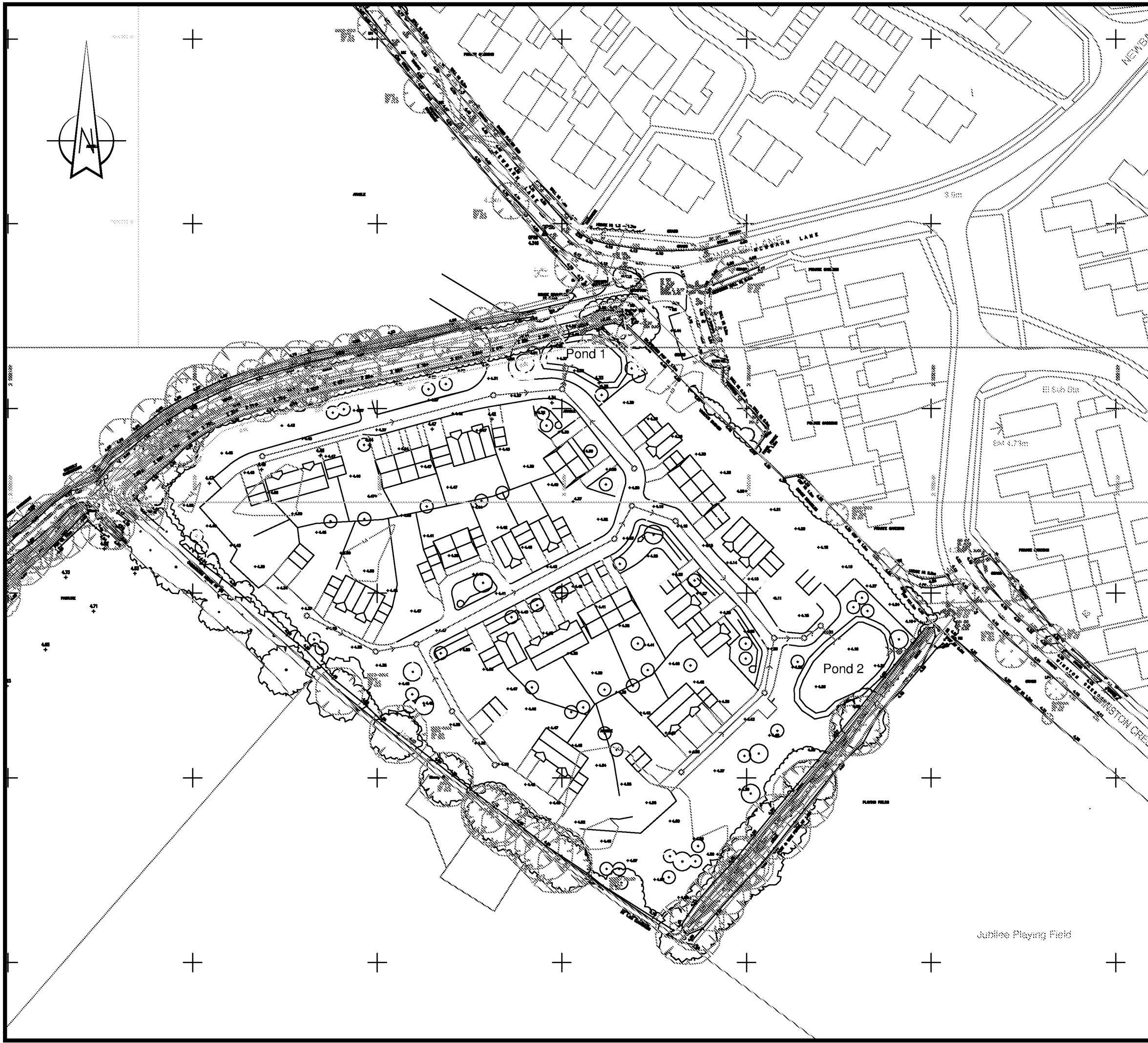
	Default	Edited	
Qbar	---	---	l/s
1 in 1 year	---	---	l/s
1 in 30 years	---	---	l/s
1 in 100 years	---	---	l/s

Please note that a minimum flow of 5 l/s applies to any site



Appendix F





Permanent Wet Pond 1
183m³ Storage
Permanent Water Level 2.80m AOD
Rim Level 3.80m AOD
Outfall Level 2.80m AOD
Restricted Outflow 1.12l/s

Permanent Wet Pond 2
387m³ Storage
Permanent Water Level 3.34m AOD
Rim Level 4.34m AOD
Outfall Level 3.34m AOD
Restricted Outflow 2.5l/s

Total Storage Available 570m³
Total Outflow 3.62l/s (2l/s/ha)

- Key**
- Indicative Pipe Layout 225-600mmØ
 - Head Wall
 - Manhole
 - Flow Arrow
 - 'Hydrobrake' manhole or similar approved

REV	DETAILS		DRAWN	CHECKED	DATE
CLIENT: Church Commissioners of England					
PROJECT: Land West of Bersted					
DRAWING TITLE: Illustrative Surface Water Drainage Strategy					
SCALES:		1:500		SHEET SIZE: A3	
DRAWN: RL		CHECKED: RL		DATE: 28.03.16	
WYG Transport part of WYG group  100 St. John Street London EC1M 4EH t: 0207 250 7500 f: 0207 250 7501 e: transport@wyg.com					
DRAWING NUMBER: A094107 - 020					REVISION: -

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Appendix G



Surface water storage requirements for sites

Site name: Land at Bersted
Site location: New Barn Lane, Bognor Regis

Site coordinates
Latitude: 50.80032° N
Longitude: 0.69992° W

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the CIRIA SUDS Manual (2007). It is not to be used for detailed design of drainage systems. It is recommended that every drainage scheme uses hydraulic modelling software to finalise volume requirements and design details before drawings are produced.

Reference: gcp8bpfm6djb / 0.65
Date: 1 Apr 2016

Site characteristics

Total site area	1.81	ha
Significant public open space	1.16	ha
Area positively drained	0.65	ha
Impermeable area	0.65	ha
Percentage of drained area that is impermeable	100	%
Impervious area drained via infiltration	0	ha
Return period for infiltration system design	10	year
Impervious area drained to rainwater harvesting systems	0	ha
Return period for rainwater harvesting system design	10	year
Compliance factor for rainwater harvesting system design	66	%
Net site area for storage volume design	0.65	ha

Methodology

Greenfield runoff method	IH124
Volume control approach	Flow control to max of 2 l/s/ha or
Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type
SOIL type	3
HOST class	N/A
SPR	0.37

Hydrological characteristics

	Default	Edited	
SAAR	709	709	mm
M5-60 Rainfall Depth	17	17	mm
'r' Ratio M5-60/M5-2 day	0.4	0.4	
FEH/FSR conversion factor	0.85	0.85	
Hydrological region	7	7	
Growth curve factor: 1 year	0.85	0.85	
Growth curve factor: 10 year	1.62	1.62	
Growth curve factor: 30 year	2.3	2.3	
Growth curve factor: 100 year	3.19	3.19	

Design criteria

Climate change allowance factor	1.3	
Urban creep allowance factor	1.1	
Interception rainfall depth	5	mm

Greenfield runoff rates

	Default	Edited	
Qbar	1.90	1.90	l/s
1 in 1 year	5.00	5.00	l/s
1 in 30 years	5.00	5.00	l/s
1 in 100 years	5.00	5.00	l/s

Please note that a minimum flow of 5 l/s applies to any site

Estimated storage volumes

	Default	Edited	
Interception storage	26.00	26.00	m³
Attenuation storage	538.98	538.98	m³
Long term storage	0.00	0.00	m³
Treatment storage	78.00	78.00	m³
Total storage	564.98	564.98	m³

HR Wallingford Ltd, the Environment Agency and any local authority are not liable for the performance of a drainage scheme which is based upon the output of this report.

Surface water storage requirements for sites

Site name: Land at Bersted
Site location: New Barn Lane, Bognor Regis

Site coordinates
Latitude: 50.80032° N
Longitude: 0.69992° W

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the CIRIA SUDS Manual (2007). It is not to be used for detailed design of drainage systems. It is recommended that every drainage scheme uses hydraulic modelling software to finalise volume requirements and design details before drawings are produced.

Reference: gcp8bpfm6djb / 0.65
Date: 1 Apr 2016

Site characteristics

Total site area	1.81	ha
Significant public open space	1.16	ha
Area positively drained	0.65	ha
Impermeable area	0.65	ha
Percentage of drained area that is impermeable	100	%
Impervious area drained via infiltration	0	ha
Return period for infiltration system design	10	year
Impervious area drained to rainwater harvesting systems	0	ha
Return period for rainwater harvesting system design	10	year
Compliance factor for rainwater harvesting system design	66	%
Net site area for storage volume design	0.65	ha

Methodology

Greenfield runoff method	FEH	
Volume control approach	Flow control to max of 2 l/s/ha or	
Qmed estimation method	Calculate from BFI and SAAR	
BFI and SPR estimation method	Calculate from dominant HOST	
HOST class	N/A	
BFI / BFIHOST	0.00	
SPR / SPRHOST	0.0	
Qmed	N/A	l/s
Qbar / Qmed Conversion Factor	N/A	

Hydrological characteristics

	Default	Edited	
SAAR	709	709	mm
M5-60 Rainfall Depth	17	17	mm
'r' Ratio M5-60/M5-2 day	0.4	0.4	
FEH/FSR conversion factor	0.85	0.85	
Hydrological region	7	7	
Growth curve factor: 1 year	0.85	0.85	
Growth curve factor: 10 year	1.62	1.62	
Growth curve factor: 30 year	2.3	2.3	
Growth curve factor: 100 year	3.19	3.19	

Design criteria

Climate change allowance factor	1.3	
Urban creep allowance factor	1.1	
Interception rainfall depth	5	mm

Greenfield runoff rates

	Default	Edited	
Qbar	---	---	l/s
1 in 1 year	---	---	l/s
1 in 30 years	---	---	l/s
1 in 100 years	---	---	l/s

Please note that a minimum flow of 5 l/s applies in any site

Estimated storage volumes

	Default	Edited	
Interception storage	---	---	m³
Attenuation storage	---	---	m³
Long term storage	---	---	m³
Treatment storage	---	---	m³
Total storage	---	---	m³

HR Wallingford Ltd, the Environment Agency and any local authority are not liable for the performance of a drainage scheme which is based upon the output of this report.

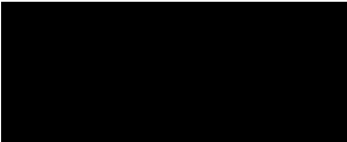


Appendix H





Wyg
5th Floor Longcross Court
47 Newport Road
Cardiff
CF24 0AD

Your Ref WYG
Our Ref 210421
Date 02 March 2016
Contact 

Attention: Luzia Kathriner

Dear Sirs

Provision of Public Sewer Main Record Extracts – VAT Receipt
Newbarn Lane, Bognor Regis PO21 5DH

Further to your recent enquiry regarding the provision of Southern Water apparatus record extracts for the above location.

Please be aware that there are areas within our region in which there are neither sewers nor water mains. Similarly, whilst the enclosed extract may indicate the approximate location of our apparatus in the area of interest, it should not be relied upon as showing that further infrastructure does not exist and may subsequently be found following site investigation. Therefore actual positions of the disclosed (and any undisclosed) infrastructure should be determined on site, because Southern Water does not accept any responsibility for inaccuracy or omission regarding the enclosed plan and accordingly it should not be considered to be a definitive document.

I confirm payment of the appropriate fee in the sum of £ **49.92**

The breakdown of costs is as follows: -

- Provision of record extracts £ 41.60
- VAT @ 20.0% £ 8.32

VAT Registration Number 813 0378 56

Should you require any additional information regarding this matter please contact this office at the address given at the foot of this letter.

Yours faithfully

Land Search Department

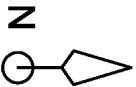
SEWER RECORDS PAGE 1 OF 2

101005



100717

O.S. REF. SU9100NE		Drawn by: wrennl		The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. <i>WATERWORKS, 8245, 1999 are contributors of British Waterways Company WATERWORKS, 1999 are contributors of British Waterways Company</i>		
Scale: 1:1250						
Title: 210421_New Barn Lane	Date: 02/03/2016	Based upon Ordnance Survey Digital Data with the permission of the controller of H.M.S.O. Crown Copyright Reserved Licence No. WU 298530.				



SEWER RECORDS PAGE 2 OF 2

	Node	Cover	Invert	Size	Material	Shape		Node	Cover	Invert	Size	Material	Shape		Node	Cover	Invert	Size	Material	Shape
	7007X	4.5	2.22	225	VC	CIRC														
	7056X	4.47	3.13	150	CP	CIRC														
	7901X	4.52	3.18	150	VC	CIRC														
	7902X	4.5	3.71	100	VC	CIRC														
	7903X			100	PF	CIRC														
	7904X			100	PF	CIRC														
	7951X	4.07	2.29	450	CP	CIRC														
	7952X	4.15	2.4	450	CP	CIRC														
	7953X	4.25	3.27	150	CP	CIRC														
	7954X	4.24	2.74	300	CP	CIRC														
	795K	2.51	2.51	450	CP	CIRC														
	8051Y	3.73		600	CP	CIRC	*													
	8051X	3.73		600	CP	CIRC	*													
	8801X	4.4	2.58	225	VC	CIRC														
	8851X	4.19	2.39	750	CP	CIRC														
	8852X	4.39	3.06	225	CP	CIRC														
	8853X	4.63	2.72	750	CP	CIRC														
	8901X	3.78	2.23	225	VC	CIRC														
	8902X	3.87	2.02	225	VC	CIRC														
	8903X	4.03	1.9	225	VC	CIRC														
	8904X	4.04	2.09	225	VC	CIRC														
	8905X	4.15	2.34	225	VC	CIRC														
	8906X			225	UNIK	CIRC														
	8907X			UNIK	PF	CIRC														
	8908X			UNIK	PF	CIRC														
	8908X			UNIK	UNIK	CIRC														
	890DX			UNIK	UNIK	CIRC														
	891DX			225	VC	CIRC														
	892DX			225	VC	CIRC														
	893DX			225	PF	CIRC														
	8951X	3.87	2.57	300	CP	CIRC														
	8952X	4.04	2.51	225	CP	CIRC														
	8953X	3.75	2.42	375	CP	CIRC														
	8955X	3.86	2.31	900	CP	CIRC														
	8956T	3.86		800	CP	CIRC														
	8956X	3.86		600	CP	CIRC														
	8956X	3.86		300	CP	CIRC														
	8957X	4.23	2.89	300	CP	CIRC														
	8958X	3.77	2.515	300	CP	CIRC														
	9752X	5.26		750	CP	CIRC														
	9852X	4.88	3.4	225	CP	CIRC														
	9903X	3.94	2.29	225	VC	CIRC														
	9904X	3.87	2.78	150	VC	CIRC														
	9905X	5.37	3.87	225	VC	CIRC														
	9905X			225	UNIK	CIRC														
	9908X			UNIK	UNIK	CIRC														
	990DX			UNIK	UNIK	CIRC														
	9953X	3.86	2.82	225	CP	CIRC														
	9954X	3.71	2.71	225	CP	CIRC														
	9954X	4.01	2.93	225	CP	CIRC														
	9955X			225	CP	CIRC														

[illegible]

Drawn by: wrennl	
Title: 210421_New Barn Lane	
Date: 02/03/2016	