

North Littlehampton: Phase 2

Flood Management in Parcel C1 and Part Parcels B2, B4 and C2

On behalf of Persimmon Homes

Project Ref: 39878/4001 | Rev: AA | Date: March 2017

Office Address: Caversham Bridge House, Waterman Place, Reading, Berkshire RG1 8DN



North Littlehampton: Phase 2
Flood Management in Parcel C1 and Part Parcel B2, B4 and C2



Document Control Sheet

Project Name: North Littlehampton: Phase 2

Project Ref: 39878/4001

Report Title: Flood Management in Parcel C1 and Part Parcels B2, B4 and C2

Doc Ref: 001

Date: 29/03/17

	Name	Position	Signature	Date
Prepared by:	Alex Wray	Assistant Engineer		29/03/17
Reviewed by:	Robert Riddington	Senior Associate		29/03/17
Approved by:	Paul Jenkin	Partner		29/3/17
For and on behalf of Peter Brett Associates LLP				

Revision	Date	Description	Prepared	Reviewed	Approved
-	29/03/17	Final Report	AEW	RWR	

This report has been prepared by Peter Brett Associates LLP ('PBA') on behalf of its client to whom this report is addressed ('Client') in connection with the project described in this report and takes into account the Client's particular instructions and requirements. This report was prepared in accordance with the professional services appointment under which PBA was appointed by its Client. This report is not intended for and should not be relied on by any third party (i.e. parties other than the Client). PBA accepts no duty or responsibility (including in negligence) to any party other than the Client and disclaims all liability of any nature whatsoever to any such party in respect of this report.

© Peter Brett Associates LLP 2017

Contents

1	Introduction	1
2	Parcel C1 and Part Parcels B2, B4 and C2	2
	2.1 Site Location	2
	2.2 Plot & Finished Floor Levels.....	2
	2.3 Flood Compensation	3
3	Conclusion	4

Figures

Figure 1: Phase 2 Residential Development Location Plan	2
---	---

Tables

Table 1 – Flood Compensation Analysis for Phase 2	3
---	---

Appendices

Appendix A	Location Plan
Appendix B	Post Development Proposals
Appendix C	Flood Risk Assessment

This page is intentionally blank

1 Introduction

- 1.1.1 This report and accompanying drawings provides evidence to facilitate the discharging of relevant planning conditions pertaining to the compensatory flood storage and design of plot levels for this second phase of the North Littlehampton residential development.
- 1.1.2 The Phase 2 residential development on the eastern side of the North Littlehampton development site by Persimmon Homes, comprises of Parcel C1 and part Parcels B2, B4 and C2.
- 1.1.3 This phase is brought forward under the original outline consent (LU/47/11) to ensure continuity of build on site and to allow the delivery of wider infrastructure obligations.
- 1.1.4 The relevant outline planning conditions relating to flood risk, design of plot levels and flood compensation are 7(vii) and 9, as follows:

Condition 7 (vii)

The appearance, landscaping and layout particulars to be submitted in accordance with Condition 1 for any phase or sub phase shall include (insofar as they are relevant to that phase or sub phase):

- vii. The detailed design of the flood compensation measures including the wetland, including levels and profiles and a programme for construction;*

Condition 9

The development permitted by this planning permission shall only be carried out in accordance with the approved Flood Risk Assessment (FRA) dated February 2011 and the following mitigation measures detailed within the FRA:

- Compensatory flood storage shall be provided on/or in the vicinity of the site to the design flood levels specified within the approved FRA;*
- Finished floor levels shall be set no lower than 500mm above the design flood level within the approved FRA.*

- 1.1.5 This note details the total volume of flood storage lost due to the proposed earthworks required to enable the construction of Parcel C1 and part Parcels B2, B4 and C2 and the flood storage gained through the demolition of the existing buildings.
- 1.1.6 It demonstrates how the delivery of this phase accords with the approved Flood Risk Assessment (FRA), February 2011, and that the proposals for this phase can be delivered and provide betterment within the development.

2 Parcel C1 and Part Parcels B2, B4 and C2

2.1 Site Location

2.1.1 The Phase 2 Location Plan is included in Appendix A and is shown in the Figure 1, below.



Figure 1. Phase 2 Residential Development Location Plan

- 2.1.2 The Parcels are located to the west of the Central Wetland Area (CWA) and encompass residential development plots and associated highway/public space infrastructure.
- 2.1.3 The eastern edge of the Phase 2 development is offset from the CWA by approximately 35m. The positioning of this development parcels will therefore not instigate the delivery of the CWA and the associated works.

2.2 Plot & Finished Floor Levels

- 2.2.1 To ensure compliance with the approved FRA (February, 2011), the plot platform levels have been set at a minimum level 300mm above the 1 in 100-year (1% annual probability) flood level with a 20% allowance for climate change.
- 2.2.2 The minimum levels for each parcel plot platform are identified in Drawing 39878/4001/001/B, Appendix B.
- 2.2.3 The finished floor levels are to be set a minimum of 200mm above the platform level to ensure the minimum 500mm freeboard to the design flood level.
- 2.2.4 The final proposed finished floor levels and plot levels are identified in Drawings A/PHLITTLE-INT.1/19-1 P2 and A/PHLITTLE-INT.1/19-2 P2, Appendix B.
- 2.2.5 This drawing demonstrate that finished floor levels are set no lower than 500mm above the approved FRA design flood level.

- 2.2.6 The FRA, February 2011, excluding Appendices has been included in Appendix C for completeness.

2.3 Flood Compensation

- 2.3.1 To facilitate the implementation of the Phase 2 development the plots which lie within the design flood extent will be raised out of the flood plain.
- 2.3.2 The total plan area being raised out of the flood plain, as shown on Drawing 39878/4001/001, equals 8,452m².
- 2.3.3 To offset the impact of the raising of the plots several existing impermeable buildings are being demolished as part of the works. These are shown on Drawing 39878/4001/001, and equate to a total plan area of 10,071m².
- 2.3.4 The northern and eastern extents of the parcels will be graded down to existing ground levels with a minimum 1:3 gradient. The resultant impact to the flood compensation has been assessed based on localised level for level approach.
- 2.3.5 The design flood level from the approved FRA, the 1 in 100-year (1% annual average probability) flood event with a 20% allowance for climate change, has been used to assess the impact on flood storage for the Phase 2 works.
- 2.3.6 An overview of the areas analysed are outlined on Drawing 39878/4001/001, Appendix B, and are reproduced below:

FLOOD COMPENSATION ANALYSIS				
DEPTH OF BAND BELOW FLOOD LEVEL (mm)	EXISTING STORAGE (m ³)	PROPOSED STORAGE (m ³)	STORAGE GAINED FROM BUILDINGS DEMOLISHED (m ³)	NET GAIN/LOSS (m ³)
-200	1855	417	1977	+539
-400	1576	359	1949	+732
-600	1340	303	1905	+868
-800	1146	249	1461	+564
-1000	1008	197	992	+182
-1200	880	148	582	-150
-1400	768	102	115	-551
-1600	622	62	7	-553
-1800	423	31	0	-392
-2000	198	10	0	-187
-2200	46	1	0	-45
-2400	20	0	0	-20
-2600	3	0	0	-3
			TOTAL GAIN:	+984

Table 1 – Flood Compensation Analysis for Phase 2

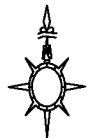
- 2.3.7 The above table demonstrates that the proposed works, together with the removal of buildings, provides a net gain to the flood storage of the site. Whilst there are some losses in level bands from 1.2m below the flood level there is an overall net increase in flood storage of 984m³.
- 2.3.8 It is noted that Phase 2 is an interim stage and the full scheme, once built out, will include further full level-for-level compensation and include flood compensation within the CWA.
- 2.3.9 This will provide an additional betterment in flood compensation, however the current phase meets the requirements of the FRA and the associated planning condition.

3 Conclusion

- 3.1.1 This report has demonstrated that the proposals for Phase 2 comply with the conditions relating to flood risk and compensation, namely condition 7 (vii) and 9.
- 3.1.2 The proposals are therefore compliant with the existing FRA and the associated conditions.

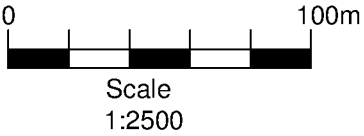
Appendix A Location Plan

Location Plan: Persimmon Homes



LEGEND - LOCATION PLAN

 RMA RED LINE
BOUNDARY



Rev	Date
-	-
-	-
-	-



PERSIMMON
Together, we make a home

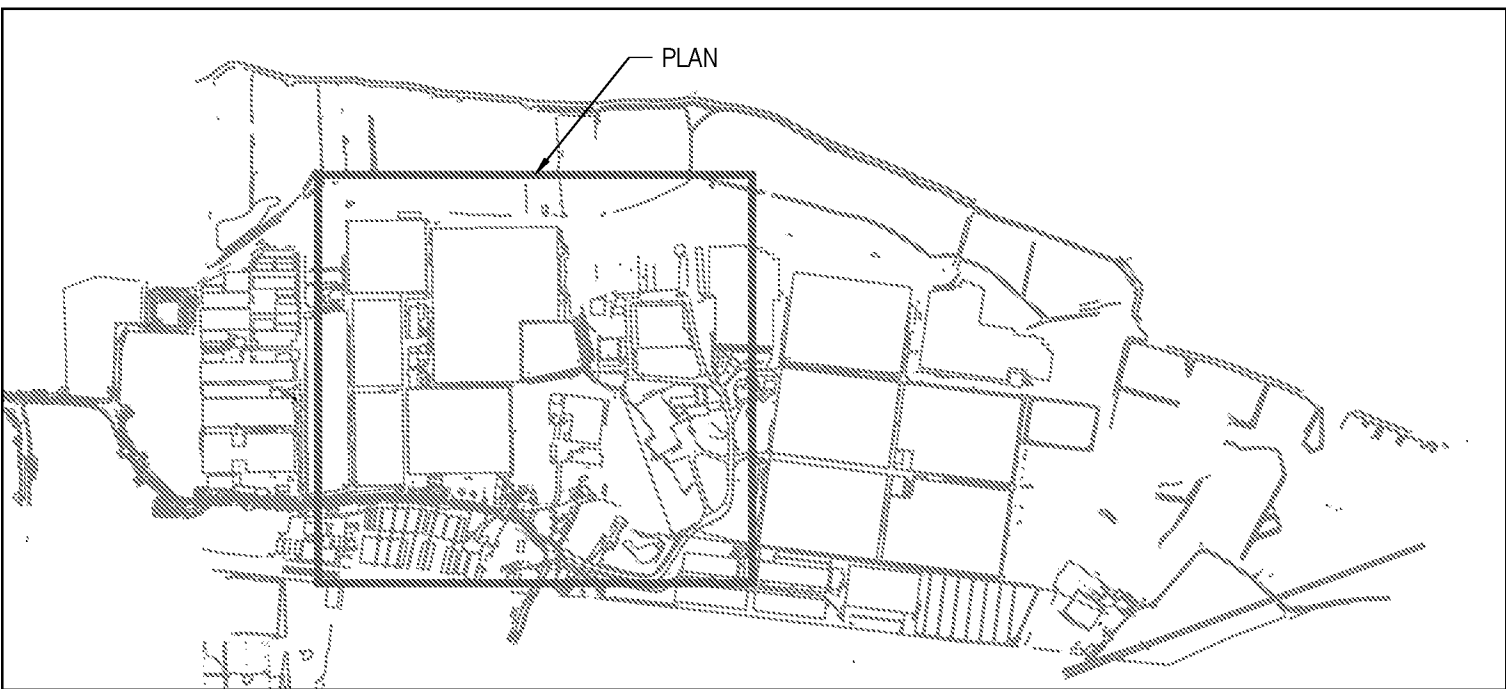
Persimmon Homes Thames Valley
Persimmon House, Knoll Road,
Camberley, Surrey GU15 3TQ
Tel: 01276 808080

Site:	Date:
Phase 2	February 2017
Littlehampton	Scale:
	1:2500 @ A3
Dwg No:	Rev:
S43_PL_SITE LAYOUT_001	-

Drawing Title:	Drawing Status:
LOCATION PLAN	SUBMITTED
Drawn:	Rev:
KJ	-

Appendix B Post Development Proposals

Drawing 39878/4001/001:	Flood Compensation Analysis
Drawing A/PHLITTLE-INT.1/19-1 P2	Contours and Levels Drawing (1 of 2)
Drawing A/PHLITTLE-INT.1/19-2 P2	Contours and Levels Drawing (2 of 2)



- KEY:**
- EXTENT OF BUILDINGS DEMOLISHED
 - PROPOSED BANK REGRAIDING TO EXISTING LEVELS
 - + 3.21 1 in 100 ANNUAL PROBABILITY PLUS 20% ALLOWANCE FOR CLIMATE CHANGE FLOOD LEVEL STATED IN THE APPROVED FRA (Ref. 21491/002 Rev. B)
 - 1 IN 100 ANNUAL PROBABILITY PLUS 20% ALLOWANCE FOR CLIMATE CHANGE FLOOD EXTENT

- NOTES:**
- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, SPECIFICATIONS AND TECHNICAL NOTES.
 - ALL LEVELS ARE IN METRES AND RELATIVE TO ORDNANCE DATUM (NEWLYN). ALL CO-ORDINATES ARE IN METRES AND RELATIVE ORDNANCE SURVEY GRID.
 - THIS DRAWING IS BASED UPON SURVEY INFORMATION SUPPLIED BY WYG ENVIRONMENT PLANNING TRANSPORT LTD DRAWING No. GGP/A044029/LAY/01 DATED 7TH JULY 2008.
 - PARCEL BOUNDARY TAKEN FROM PERSIMMON DRAWING No. 'LITTLEHAMPTON PARCEL C1, B2, B4 - PREAPP' RECEIVED 30.01.2017.
 - DELIVERY OF PARCELS C1, C2, B2 AND B4 AND ASSOCIATED PLATFORM LEVELS TO BE IN ACCORDANCE WITH THE APPROVED FRA (Ref. 21491/002 Rev. B). FLOOD STORAGE ANALYSIS COMPLETED FOR CURRENT PHASE OF WORKS (C1, C2, B2 AND B4) IS SUMMARISED IN TABLE 1.
 - FINAL FLOODPLAIN COMPENSATION FOR WHOLE SCHEME TO BE CONSTRUCTED IN ACCORDANCE WITH THE APPROVED FRA (Ref. 21491/002 Rev. B) AT A FUTURE STAGE.
 - ALL PLATFORM LEVELS TO PROVIDE A MINIMUM OF 300mm FREEBOARD ABOVE THE HIGHEST ADJACENT 1 IN 100 YEAR PLUS 20% ALLOWANCE FOR CLIMATE CHANGE FLOOD LEVEL STATED IN THE APPROVED FRA (Ref. 21491/002 Rev. B).
 - ALL FINISHED FLOOR LEVELS TO PROVIDE A MINIMUM 500mm FREEBOARD ABOVE THE HIGHEST ADJACENT 1 IN 100 YEAR PLUS 20% ALLOWANCE FOR CLIMATE CHANGE FLOOD LEVEL STATED IN THE APPROVED FRA (Ref. 21491/002 Rev. B).
 - ALL BUILDINGS SHOWN ON PLAN HAVE BEEN ASSUMED TO BE DEFENDABLE FOR THE PURPOSES OF THE FLOOD COMPENSATION ANALYSIS.
 - LOCATIONS OF DEMOLISHED BUILDINGS BASED ON LATEST AVAILABLE TOPOGRAPHIC SURVEY AND AERIAL PHOTOGRAPHY.
 - REFER TO MAYER BROWN LEVELS STRATEGY DRAWING FOR FINAL PLOT AND FLOOR LEVELS (DRAWING Ref. MBSK170315-1)

PLAN
1:1000

TABLE 1 - FLOOD COMPENSATION ANALYSIS				
DEPTH OF BAND BELOW FLOOD LEVEL (mm)	EXISTING STORAGE (m³)	PROPOSED STORAGE AFTER EARTHWORKS INSTATED (m³)	STORAGE GAINED FROM BUILDINGS DEMOLISHED (m³)	NET GAIN/LOSS (m³)
0-200	1855	417	1977	+ 539
200-400	1576	359	1949	+ 732
400-600	1340	303	1905	+ 868
600-800	1146	249	1461	+ 564
800-1000	1038	197	952	+ 182
1000-1200	880	148	582	-150
1200-1400	768	102	115	-551
1400-1600	622	62	7	-553
1600-1800	423	31	0	-392
1800-2000	198	10	0	-187
2000-2200	46	1	0	-45
2200-2400	20	0	0	-20
2400-2600	3	0	0	-3

TOTAL GAIN: + 984

B	DRAFT REMOVED	29.03.17	smr	RR	-
A	MINOR AMENDMENTS	17.03.17	AW	RR	-
Mark	Revision	Date	Drawn	Chkd	Appd

SCALING NOTE: Do not scale from this drawing. If in doubt, ask.
UTILITIES NOTE: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other such plant or apparatus may also be present but not shown. The Contractor is therefore advised to undertake his own investigation where the presence of any existing sewers, services, plant or apparatus may affect his operations.

Drawing Issue Status
FOR COMMENT

NORTH LITTLEHAMPTON PARCELS C1, C2, B2, B4

FLOOD COMPENSATION ANALYSIS

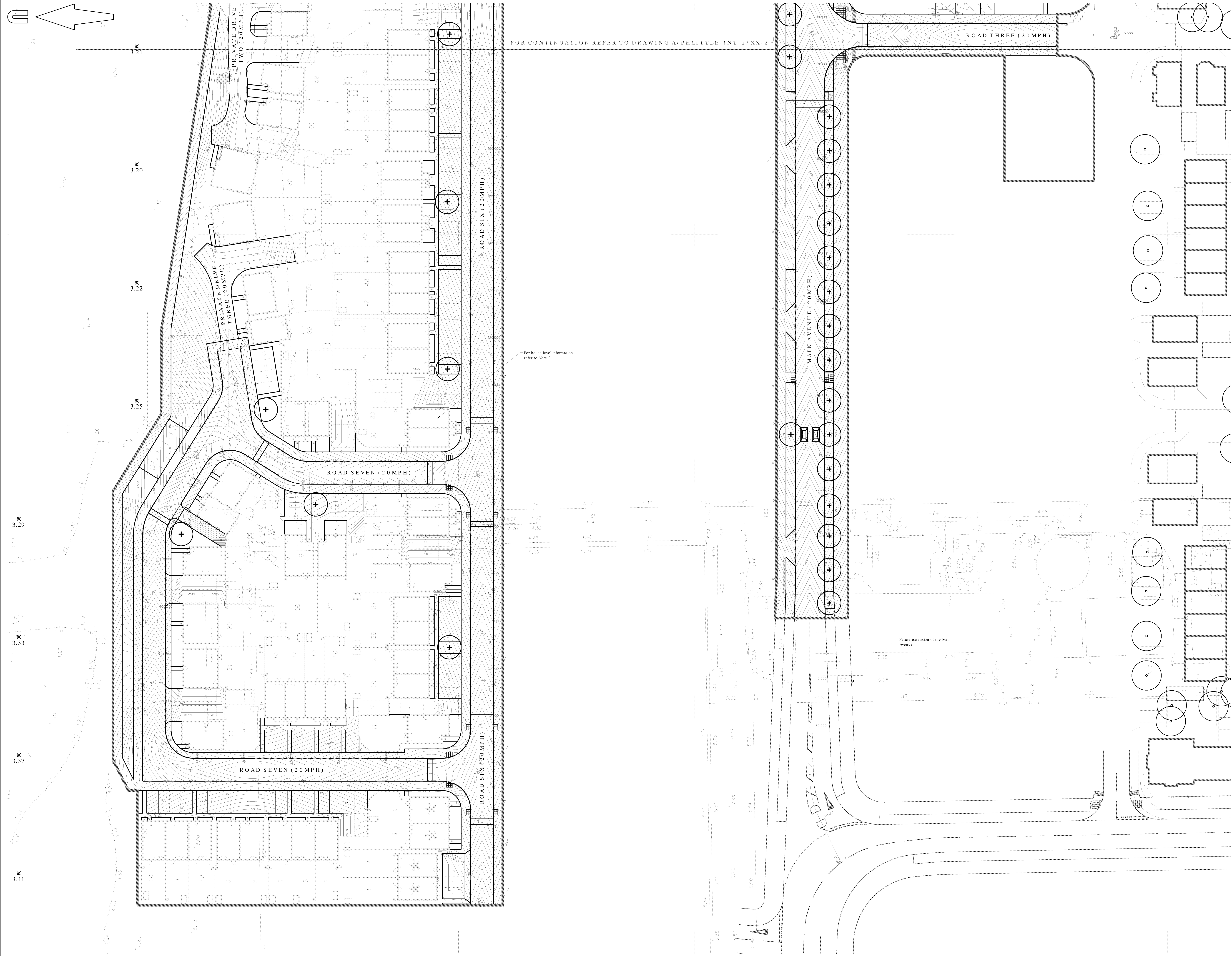
Client

GREENCORE UK
HOLDINGS LTD

Date of 1st Issue 03.03.2017	Designed -	Drawn SMR
A1 Scale AS SHOWN	Checked AW	Approved RR
Drawing Number 39878/4001/001		Revision B



Offices throughout
the UK and Europe
www.peterbrett.com
© Peter Brett Associates LLP
READING
Tel: 0118 950 0761



A0 ORIGINAL

KEY

- EXISTING KERB LINE
- PROPOSED KERB/EDGING LINE
- PROPOSED DROPPED KERB
- PROPOSED BUFF COLOURED TACTILE PAVING
- PROPOSED CORDUROY HAZARD WARNING PAVING
- 1 IN 100 YEAR FLOOD LEVEL TAKEN FROM WYG FLOOD COMPENSATION REPORT
- SITE BOUNDARY

- NOTES:
- This drawing is not to be scaled.
 - The proposed road and footpath levels have been set to ensure they are a minimum of 300mm above the nearest 1in100yr flood level (incl. CO) as described in the WYG flood compensation report. The finished floor levels of the proposed dwellings will be above the adjacent road and footpath levels to ensure they are a minimum of 500mm above the flood level.
 - This drawing is to be read in conjunction with the proposed Surface Treatments drawings A/PHLITTLE-INT.1/11-1 & 11-2
 - This drawing is to be read in conjunction with the latest revision of the Topographic Survey undertaken by WYG in July 2008, drawing numbered CGI/A044029/LAY001
 - Site layout taken from PHTV drawing numbered 543_PL_SITE LAYOUT_100.
 - Dropped kerbs and raised tables have not been modelled.
 - Southern end of Road Three and western end of Road Two tie in levels have been taken from Glaville drawing C8140927615 Rev C1 received from PHTV dated 24/02/2017.
 - Levels Strategy based on flood level information received from FBA dated 07/03/2017.

PRELIMINARY
NOT FOR CONSTRUCTION

P2	Layout updated following Stage 1 Road Safety Audit received 17/03/2017 (ODN)	SF	24/03/2017
P1	Initial Issue (ODN)	AB	17/03/2017

rev.	amendment	checked	date

m3
mayer brown

Mayer Brown Limited
Lime House, General Road, Woking, Surrey GU24 4AB
Telephone: 01483 750 508 Fax: 01483 750 437
wokingoffice@mayerbrown.co.uk www.mayerbrown.co.uk

client
PERSIMMON HOMES THAMES VALLEY

project
NORTH LITTLEHAMPTON PHASE 2
PARCEL C1 AND PART PARCELS, B2, B4 & C2

scale
1:250

drawn by
QJN

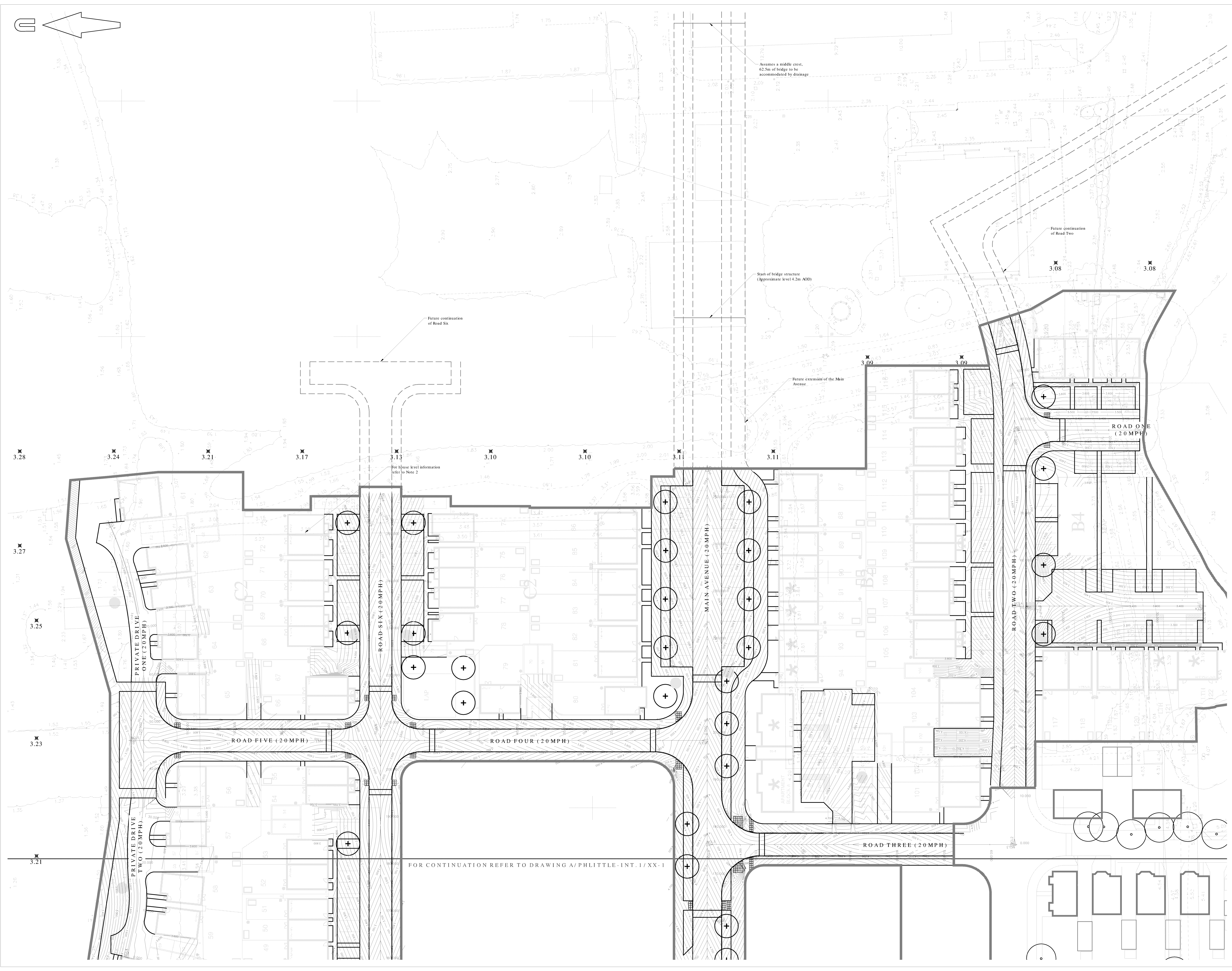
checked by
AB

date
MARCH 2017

cad file
MASTER.DWG

title
CONTOURS AND LEVELS DRAWING (1 OF 2)

drawing number A/PHLITTLE-INT.1/19-1	rev. P2
---	------------



SITE BOUNDARY

Appendix C Flood Risk Assessment

Flood Risk Assessment, PBA, February 2011 (excluding Appendices)

Greencore Group Plc

**North Littlehampton Urban
Extension**

Flood Risk Assessment

Project Ref: 21491/002

Rev B

February 2011

Peter Brett Associates LLP
Caversham Bridge House
Waterman Place
Reading
Berkshire
RG1 8DN
T: 0118 9500761
F: 0118 9597498
E: reading@peterbrett.com



This page is intentionally blank

We print on 100% recycled paper from sustainable suppliers accredited to ISO 14001.



North Littlehampton Urban Extension
Flood Risk Assessment

Document Control Sheet

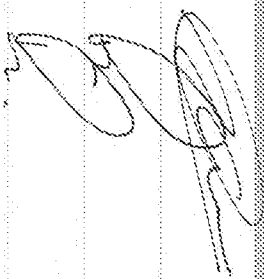
Project Name: North Littlehampton Urban Extension

Project Ref: 21491/002

Report Title: Flood Risk Assessment

Doc Ref: Rev B

Date: February 2011

	Name	Position	Signature	Date
Prepared by:	Adam Clarke	Assistant Hydrologist		11/02/2011
Reviewed by:	Paul Jenkin	Partner		11/02/2011
Approved by:	Paul Jenkin	Partner		11/02/2011

For and on behalf of Peter Brett Associates LLP

Revision	Date	Description	Prepared	Reviewed	Approved
	26/11/2009	Draft Flood Risk Assessment	AC	PJ	PJ
A	01/02/2010	Flood Risk Assessment to accompany planning application	AC	PJ	PJ
B	11/02/2011	Flood Risk Assessment to accompany revised planning application	AC	PJ	PJ

Peter Brett Associates LLP disclaims any responsibility to the Client and others in respect of any matters outside the scope of this report. This report has been prepared with reasonable skill, care and diligence within the terms of the Contract with the Client and generally in accordance with the appropriate ACE Agreement and taking account of the manpower, resources, investigations and testing devoted to it by agreement with the Client. This report is confidential to the Client and Peter Brett Associates LLP accepts no responsibility of whatsoever nature to third parties to whom this report or any part thereof is made known. Any such party relies upon the report at their own risk.

© Peter Brett Associates LLP 2009

This page is intentionally blank

Contents

1	Executive Summary	1
2	Introduction	2
3	Proposed Development Site	3
3.1	Site Location and Plan	3
3.2	Survey Data	3
3.3	Current Land Use	3
3.4	Development Proposals	3
3.5	Existing Flood Defences	4
3.6	Vulnerability	4
3.7	Sequential Test	5
3.8	Exception Test	5
4	Assessment of Risk	7
4.1	Sources of Flooding	7
4.2	Strategic Flood Risk Assessment	8
4.3	Environment Agency Flood Zones	9
4.4	The Sequential Test	12
4.5	Potential Impacts of Flooding	12
4.6	Mitigation Measures	15
4.7	Residual Risk	17
5	Summary	19
6	References	20

Tables

Table 4.1 – Flood Levels at Site	12
Table 4.2 – Summary of Flood Compensation Storage Scheme	16

Figures

Figure 4.1 – Modelled Flood Levels at Site	14
--	----

Appendices

Appendix 1: Site Location Plan
Appendix 2: Topographic Survey
Appendix 3: Development Masterplan
Appendix 4: Arun SFRA “Assessment of Sites of Search” North Littlehampton
Appendix 5: SFRA Flood Zones
Appendix 6: Environment Agency Flood Map
Appendix 7: Detailed Site Flood Extents
Appendix 8: Flood Storage Compensation Scheme
Appendix 9: Flood Storage Compensation Scheme Planimetry

North Littlehampton Urban Extension
Flood Risk Assessment

1 Executive Summary

Peter Brett Associates LLP have been commissioned by Greencore Group Plc to evolve and develop a Flood Risk Assessment (FRA) for the proposed development of the North Littlehampton Strategic Development Area, West Sussex.

The North Littlehampton Strategic Development Area is currently being promoted for development by Greencore through the Arun District Local Development Framework. The proposed mixed use development is expected to include 1,460 units and areas of employment and community facilities, and provide improved and new road infrastructure.

The FRA has been prepared in accordance with the guidance set out in Planning Policy Statement 25 Development and Flood Risk (PPS25), Annex E.

We understand that Arun District Council are undertaking a district wide Sequential Test to support their Core Strategy, and that the site is likely to be found to pass the Sequential Test, and therefore be suitable for the proposed development. The site satisfies the requirements of the Exception Test where necessary.

The Arun District Council Strategic Flood Risk Assessment (SFRA) was released in February 2008, covering the North Littlehampton site. SFRA Flood Zones show land adjacent to the Black Ditch lying within Flood Zone 3, with part of this being functional floodplain (Flood Zone 3b). These areas are not expected to increase significantly with climate change. The land to the south of the site lies within Flood Zone 1, with the lower lying land in the centre of the site forming Flood Zone 2. The extent of the 1.0% annual probability flood is expected to increase in the central area of the site for future scenarios.

The SFRA states that a requirement of any FRA for the site is to: 'revisit flood zones to ensure suitably accurate for land use planning'. This has been done by mapping the modelled SFRA flood levels onto the detailed topographic survey collected for the site. The flood extents produced in this way (Appendix 7) show no significant differences between to the SFRA Flood Zones (Appendix 5), or indeed the Environment Agency's Flood Map (Appendix 6).

The majority of the area proposed for development lies on the higher land to the south of the site. However due to other constraints, it is not possible to locate all proposed development within Flood Zone 1. It is therefore proposed to raise parcels of land locally, such that residential areas are not exposed to an unacceptable level of flood risk, while maintaining a functioning Masterplan vision, and taking account of other important constraints and environmental considerations. All ground floor levels will be set to a minimum level of 300mm above the 1.0% plus climate change annual probability flood level.

A flood storage compensation scheme has been designed, based on the principle of 'level-for-level' compensation storage. Any areas where development encroaches into Flood Zone 3 and therefore causes a loss in floodplain storage volume are fully compensated for. The scheme shows a net increase of 27,000m³ of floodplain volume, which will therefore serve to reduce flood levels at and around the site when implemented.

A separate Drainage Strategy has been produced by WYG, which will be submitted alongside this FRA as part of the Planning Application.

The proposals increase available flood storage and decrease runoff, thus contributing to a reduction in flood risk. The proposals satisfy all of the requirements of the Sequential Test and Exception Test set out in PPS25.

2 Introduction

This Flood Risk Assessment (FRA) has been prepared by Peter Brett Associates LLP to provide an assessment of flood risk for the 85ha North Littlehampton Strategic Development Area site. The FRA will support a planning application for the proposed development. A separate Drainage Strategy has been prepared for the site, outlining the drainage requirements for the site, and recommending the preferred options for the provision of foul and surface water drainage to the site and means of disposal.

The proposal is for a sustainable urban extension to Littlehampton. A large percentage of the site falls within Flood Zone 1. A Masterplan has been developed to keep development within these areas (provided as Appendix 3). However some development is necessary within Flood Zone 3. These areas are fully compensated for.

Government policy with respect to development in flood risk areas is contained within the Department of Communities and Local Government Planning Policy Statement 25 (PPS25) 'Development and Flood Risk' which was issued on 7th December 2006.

PPS25 builds on the previous guidance contained in the Planning Policy Guidance Note 25 (PPG25) 'Development and Flood Risk' which was issued on July 17, 2001, itself based on the DoE Circular 30/92 (MAFF Circular FD 1/92).

The accompanying 'Development and Flood Risk: A Practice Guide' was updated in December 2009 and the EA's updated National Standing Advice to Local Planning Authorities for Planning Applications – Development and Flood Risk – England, was issued in March 2009.

The Local Planning Authority (LPA), Arun District Council, will make the final decision with regard to any planning application. PPS25, paragraph 26, confirms that 'Following the coming into force, on 1st October 2006, of the amendment to Article 10 of The Town and Country Planning (General Development Procedure) Order 1995 (the "GDPO"), LPAs are required to consult the Environment Agency on all applications for development in flood risk areas except minor development), including those in areas with critical drainage problems and for any development on land exceeding 1 hectare outside flood risk areas.'

Statutory Instrument 2006 No. 2375: The Town and Country Planning (General Development Procedure) (Amendment) (No. 2) (England) Order 2006, on 1st October 2006, made the Environment Agency a statutory consultee for planning applications where flood risk is a key issue.

Peter Brett Associates (PBA), Consulting Engineers are specialists in, amongst other areas, hydrology, flood defence and river engineering.

3 Proposed Development Site

3.1 Site Location and Plan

The site is located adjacent to Toddington Lane in North Littlehampton, West Sussex, immediately north of the main south coast railway line and extends from a recent housing development in Mill Lane in the west to the A259 Rustington Bypass in the east. The watercourse the Black Ditch, a tributary of the River Arun, follows the northern boundary of the site. The approximate National Grid Reference (NGR) of the site is 503300mE, 103900mN (TQ033039). The site is located on Chalk, overlain by sand and freely draining soils. A plan showing the site location is included as Appendix 1.

3.2 Survey Data

A topographic survey of the site to GPS has been provided by (C) D G Yeatman Surveying and Engineering Ltd. A copy of this survey is included as Appendix 2.

Analysis of the topographic survey shows that much of the site is raised significantly above surrounding areas. This is particularly the case for the parts of the site currently in use as industrial glasshouses, where ground levels are typically above 3.50mAOD. The floodplain of the Black Ditch runs along the northern border of the site, where levels are considerably lower (typically around or below 1.50mAOD). This lower lying land protrudes further into the site to the south in two locations; immediately to the east of, and in between, the existing blocks of glasshouses.

3.3 Current Land Use

The proposed development site is currently occupied by a variety of uses including several large nurseries with associated packaging, storage and administration facilities as well as a packaging and distribution business and a number of residential properties. It is estimated from visiting the site that the current level of impervious surfacing is in the order of 26% in the form of roads, buildings and glasshouses.

The developed part of the site lies to the south, while to the north of the site is the floodplain of the Black Ditch, which lies at a lower level. There is detailed topographic information is available for the site, which indicates that the site levels vary from as high as 7.30mAOD around the glasshouses within the southern section of the site, to 1.20mAOD in the lower area to the north.

There are a number of ponds or reservoirs within the site that are currently used as part of the irrigation system for the greenhouses. It is understood that water is abstracted under licence from the Black Ditch and local groundwater boreholes to fill these ponds, as well as collected rainfall.

3.4 Development Proposals

The proposal is for a sustainable urban extension to Littlehampton, West Sussex. A Masterplan has been developed for a significant mixed-use development (Masterplan layout provided as Appendix 3), which envisages the following potential uses:

- ✱ 1460 dwellings (including affordable housing)
- ✱ 1669 jobs created (direct and indirect)
- ✱ Junior School
- ✱ Community, Health, and Youth facilities
- ✱ Commercial and employment

- ✱ Retail
- ✱ On site energy generation
- ✱ Hotel
- ✱ Playing fields and all weather sports pitches
- ✱ Allotments
- ✱ Nature Reserve
- ✱ Surface Water storage ponds
- ✱ Railway bridge and link roads to the Town with cycle and footpath connections

The Masterplan proposes using the higher land to the south for the development of residential properties, while the lower lying areas to the north and centre of the site are maintained as areas of ecology, flood storage and conveyance. A sequential approach has been adopted towards the arrangement of proposed land uses in the Masterplan layout.

3.5 Existing Flood Defences

Littlehampton and the surrounding areas are protected by fluvial and tidal flood defences along the left bank of the River Arun. From the mouth of the River Arun, to the A259 crossing at Littlehampton, these are estimated to have a standard of protection of 1 in 75 years (1.3%). The standard of protection is estimated to be slightly less upstream of the A259 crossing, at approximately 1 in 30 years (3.3%).

The SFRA states the following regarding these defences:

'Earth Embankments along the Lower Arun Left bank. At least four pumping stations used to pump water from the surrounding floodplain into the embanked channel. Unlikely to affect flood extents during a 1 in 100 year event, however may reduce duration of flooding.'

These defences are privately owned, and maintained by the Environment Agency. The recommended action for both of these defence lengths given in the SFRA is to maintain, in order to improve condition.

The Environment Agency has produced a two dimensional hydraulic model of the Lower Arun which considers the residual flood risk allowing for the presence of the defences.

Parts of the proposed development site lie within the Environment Agency flood warning area F3C4.

3.6 Vulnerability

PPS25 Table D.2 confirms the 'Flood Risk Vulnerability Classification' of a site, depending upon the proposed usage. This classification is subsequently applied to PPS25 Table D.3 to determine whether:

- ✱ The proposed development is suitable for the flood zone in which it is located, and;
- ✱ Whether an Exception Test is required for the proposed development.

Due to the mixed use nature of the proposed development, this will include a range of vulnerability classifications.

- More Vulnerable: residential land uses, proposed school, hotel and health facilities;
- Less Vulnerable: non-residential institutions, including commercial and retail units, and indoor leisure facilities;
- Water Compatible: amenity open space, nature conservation, and outdoor sports and recreation with associated facilities.

3.7 Sequential Test

PPS25 follows a sequential risk-based approach in determining the suitability of land for development in flood risk areas, with the intention of steering all new development to the lowest flood risk areas.

PPS25 Annex D confirms that *'The risk-based Sequential Test should be applied at all stages of planning. Its aim is to steer new development to areas at the lowest probability of flooding.....Within each Flood Zone, new development should be directed first to sites at the lowest probability of flooding and the flood vulnerability of the intended use matched to the flood risk of the site, e.g. higher vulnerability uses located on parts of the site at lowest probability of flooding.'*

We understand that Arun District Council are undertaking a district wide Sequential Test to support their Core Strategy, and that the site is likely to be found to pass the Sequential Test, and therefore be suitable for the proposed development.

The suitability of the proposed development at the Site is discussed further in Section 4.4.

3.8 Exception Test

While a significant proportion of the proposed development lies within Flood Zone 1, some development of residential dwellings ('More Vulnerable' according to the classification in Table D.3. of PPS25) is necessary within Flood Zone 3a, and it is therefore necessary to pass the requirements of the Exception Test.

The Exception Test is detailed in PPS25 Annex D paragraph D9, which states the following (PPS25 quoted in *italics*, with the response to the point immediately below in normal text) *'For the Exception Test to be passed:*

- *'It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared. If the DPD has reached the 'submission' stage – see Figure 4 of PPS12: Local Development Frameworks – the benefits of the development should contribute to the Core Strategy's Sustainability Appraisal;'*

The Regional Spatial Strategy for the South East of England, May 2009 ("The South East Plan"), Policy SCT1 : Core Strategy, requires local authorities to "promote the sustainable economic growth and regeneration of the Sussex Coast that will (inter alia): iii) provide for sustainable urban extensions in Arun...."

The North Littlehampton Urban Extension has been identified by Arun District Council as a potential sustainable urban extension to Littlehampton ("Strategic Development Area") through its Local Development Framework process to date, Littlehampton being one of the two principal coastal towns in the district. Its proposed mixed use redevelopment, including housing, employment, strategic transport infrastructure and community facilities has been assessed as presenting an important regeneration opportunity for the town. This site, together with a smaller site at Courtwick Farm, present the only two opportunities for strategic scale development allocations of land for urban extensions at Littlehampton, given the environmental constraints around the town's periphery including flood risk. *'The development should be on developable previously developed land or, if it is not on previously*

North Littlehampton Urban Extension Flood Risk Assessment

developed land, that there are no reasonable alternative sites on developable previously developed land;

The North Littlehampton site is partly previously developed land, but is substantially greenfield land. That is because the majority of it is developed by extensive glasshouses, warehouses, offices, other ancillary buildings and hardstandings related to intensive horticultural production. As such, it would not be commercially viable to return the land to conventional agricultural use (as previously accepted by the Inspector's report into the Arun District Local Plan Public Inquiry). There are no alternative previously developed sites that have been identified for a sustainable urban extension to Littlehampton. The other, smaller, site that has been identified for an urban extension – Courtwick Farm – is a greenfield, undeveloped site. *'A FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.'*

This FRA demonstrates that the proposed development will be safe, in accordance with current EA guidance, and provides a reduction in flood risk. Section 4 of this FRA describes how this is achieved.

4 Assessment of Risk

The level of detail entered into in any Flood Risk Assessment (FRA) is dependent upon the scale and potential impact of the proposed development (PPS25 Annex E). In this case, a FRA has been developed to support a planning application for a sustainable urban extension to Littlehampton.

4.1 Sources of Flooding

4.1.1 Fluvial Flooding

The Black Ditch, a tributary of the River Arun, runs along the northern boundary of the site. Fluvial flooding from the Black Ditch can result from large flows overtopping the banks of the watercourse during flood events.

4.1.2 Tidal Flooding

The land immediately adjacent to the Black Ditch is potentially at risk of tidal flooding. These areas are protected by tidal flood defences on the River Arun, however if these defences were to fail, there is a risk of flooding from the sea occurring at the lower lying parts of the site.

There is no direct route from the south by which tidal flooding, or a breach in the River Arun fluvial/tidal defences, could reach the site.

4.1.3 Surface Water Flooding

The SFRA states that there is a medium to high probability of flooding from the land surface. The land adjacent to the Black Ditch is relatively flat and crossed by numerous drainage channels, and is therefore at a higher risk of surface water flooding. The higher land towards the south of the site is at a lesser risk.

There have been recorded incidents of surface water flooding in the site and vicinity, for example at the existing entrance to the site. Flooding here is the result of poor existing surface water drainage. A separate Drainage Strategy has been prepared for the site, outlining the drainage requirements for the site, and recommending the preferred options for the provision of foul and surface water drainage to the site and means of disposal.

4.1.4 Groundwater Flooding

The SFRA states that there is high potential for groundwater flooding. The site is located in a groundwater emergence zone (Defra 2004). However no recorded incidents of groundwater flooding have occurred at the site. The SFRA suggests that strategic solutions are unlikely to reduce groundwater flood risk, and that site specific measures would be required.

Groundwater flooding is unlikely to be an issue for the developed site given the raised nature of the majority of the land. While there is high potential for groundwater flooding in the low lying areas adjacent to the Black Ditch, the raised areas where development will be situated are at a much lower risk of flooding from this source.

Groundwater flooding is addressed separately in the Drainage Strategy which has been prepared by White Young Green.

4.1.5 Other Sources of Flooding

No artificial sources of flooding were identified in the Strategic Flood Risk Assessment which covers the site. Historic sewer flooding has been identified in the Old Mead Road area, and is discussed separately in the Drainage Strategy prepared for the site.

4.2 Strategic Flood Risk Assessment

PPS25 confirms that regional planning bodies (RPBs) or local planning authorities (LPAs) should prepare Strategic Flood Risk Assessments (SFRAs) in consultation with the EA. The SFRA will then be used to refine information on areas that may flood, taking into account other sources of flooding and the impacts of climate change, in addition to the information on the EA Flood Zone Map.

PPS25 paragraph 12 states that 'A SFRA should be carried out by the local planning authority to inform the preparation of its LDDs (Local Development Documents), having regard to catchment-wide flooding issues which affect the area. The SFRA will provide the information needed to apply the sequential approach...Policies in LDDs should set out requirements for site-specific Flood Risk Assessments (FRAs) to be carried out by developers and submitted with planning applications in areas of flood risk identified in the plan, under circumstances set out in this PPS.'

The Strategic Flood Risk Assessment prepared by Capita Symonds on behalf of Arun District Council, undertaken in accordance with PPS25 and associated documents, was released in February 2008 and covers the North Littlehampton site.

The proposed development site is identified and assessed within the SFRA in respect of the management of the flood risk associated with any development. The existing flood risk measures confirmed at the site include flood defences against river and sea flooding along the River Arun. These include raised embankments to protect against a flood with a 3.3% Annual Exceedence Probability (AEP).

The specific FRA requirements for the site are as follows:

- ✱ Full FRA required for areas within Flood Zone 3 (adjacent to Black Ditch). FRA will need to consider maintenance of defences and likely standard of protection provided in the future.
- ✱ Revisit flood zones to ensure suitably accurate for land-use planning.
- ✱ Assessment of management of surface water runoff is required for sites larger than 1ha. Surface water runoff will need to be maintained at existing levels.
- ✱ Flooding from land and groundwater flooding requires further investigation.
- ✱ Sequential approach recommended placing "more vulnerable" development on higher ground to the south of the area of search.
- ✱ Exception test will be required for "more vulnerable" development located in areas where probability of river, sea or groundwater flooding is considered "high". Only "water compatible" development is appropriate in Flood Zone 3b (according to PPS25 guidance).

This information was provided in the SFRA 'Assessment of sites of search' for North Littlehampton, which is included in Appendix 4 of this report.

4.2.1 SFRA Flood Zones

The SFRA Flood Zones for Littlehampton are provided here as Appendix 6. The SFRA Flood Zones go further than the Environment Agency Flood Zone Maps, and differentiate between Zone 3a and 3b. Further information on Flood Zones is provided in the SFRA.

The fluvial Flood Zones are slightly larger than the corresponding tidal Flood Zones, and are referred to, hereafter, being a worst case flood outline. The land adjacent to the Black Ditch is classed as high probability (Flood Zone 3) for fluvial flooding, with part of this being functional floodplain (Flood Zone 3b). The SFRA looks at climate change scenarios for 2056 and 2106. The flood extent is not expected to increase significantly in these locations under climate changes scenarios.

The land to the south of the site is mostly low probability (Flood Zone 1), with the lower lying land in the centre of the site medium probability (Flood Zone 2). The extent of the 1.0% annual probability flood is expected to increase in the central area of the site for the 2056 and 2106 scenarios.

4.2.2 Summary of SFRA

- ✱ A Strategic Flood Risk Assessment, covering the area of the site, has been prepared by Capita Symonds on behalf of Arun District Council, and was released in February 2008.
- ✱ The SFRA details the FRA requirements for the North Littlehampton site, and these are addressed in this document.
- ✱ Flood Zones have been produced as part of the SFRA. These show land adjacent to the Black Ditch at high probability (Flood Zone 3) for fluvial/tidal flooding, with part of this being functional floodplain. The land to the south of the site is mostly low probability (Flood Zone 1), with the lower lying land in the centre of the site medium probability (Flood Zone 2).
- ✱ The SFRA includes an assessment of climate change. The flood extent at the site adjacent to the Black Ditch is not expected to increase significantly in the 2056 and 2106 scenarios. The flood extent in the lower lying central area of the site is expected to increase in the 2056 and 2106 scenarios for the 1.0% annual probability flood event.

4.3 Environment Agency Flood Zones

The initial phase in identifying whether a site is potentially at risk of flooding is to consult the EA's Flood Zone maps, available on the EA's website. However, these are (often) based on coarse scale modelling and provide only an initial indication of the flood risk to a site. It should be noted that the Flood Zones produced as part of Arun District Council's SFRA (discussed in Section 4.2 of this FRA) supersede the Environment Agency's Flood Zones.

The Environment Agency Flood Zone map for the site is presented in Appendix 5.

The Flood Zones divide the floodplain into four categories of flood risk, and do not take flood defences into account. PPS25 defines the Flood Zones as:

- ✱ Zone 1: 'Low Probability' - This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).
- ✱ Zone 2: 'Medium Probability' - This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1%) in any year.
- ✱ Zone 3a: 'High Probability' - This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
- ✱ Zone 3b 'The Functional Floodplain' - This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes).

The online EA Flood Zone maps were developed using a very coarse Digital Elevation Map (DEM), and are superseded by a more detailed analysis of modelled flood levels and topographic survey levels. It should be noted that these Flood Zone maps do not differentiate between Zones 3a and 3b.

PPS25 Annex D Table D.1 defines Flood Zone 1 as follows:

Zone 1 Low Probability

Definition

This zone comprises land assessed as having a less than 1 in 1000 annual probability of river flooding or sea flooding in any year (<0.1%).

Appropriate uses

All uses of land are appropriate in this zone.

FRA requirements

For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a FRA. This need only be brief unless the factors above or other local considerations require particular attention. See Annex E for minimum requirements.

Policy aims

In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage techniques.

PPS25 Annex D Table D.1 defines Flood Zone 2 as follows:

Zone 2 Medium Probability

Definition

This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1%) in any year.

Appropriate uses

The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure in Table D.2 are appropriate in this zone.

Subject to the Sequential Test being applied, the highly vulnerable uses in Table D.2 are only appropriate in this zone if the Exception Test (see para. D.9.) is passed.

FRA requirements

All development proposals in this zone should be accompanied by a FRA. See Annex E for minimum requirements.

Policy aims

In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage techniques.

PPS25 Annex D Table D.1 defines Flood Zone 3a as follows:

Zone 3a High Probability

Definition

This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of sea flooding (>0.5%) in any year.

Appropriate uses

The water-compatible and less vulnerable uses of land and essential infrastructure in Table D.2 are appropriate in this zone.

The highly vulnerable uses in Table D.2 should not be permitted in this zone.

The more vulnerable and essential infrastructure uses in Table D.2 should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood.

FRA requirements

All development proposals in this zone should be accompanied by a FRA. See Annex E for minimum requirements.

Policy aims

In this zone, developers and local authorities should seek opportunities to

- i. reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage techniques;
- ii. relocate existing development to land in zones with a lower probability of flooding; and
- iii. create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.

PPS25 Annex D Table D.1 defines Flood Zone 3b as follows:

Zone 3b The Functional Floodplain

Definition

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

Appropriate uses

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

- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage;
- not impede water flows; and
- not increase flood risk elsewhere.

Essential infrastructure in this zone should pass the Exception Test.

FRA requirements

All development proposals in this zone should be accompanied by a FRA. See Annex E for minimum requirements.

Policy aims

In this zone, developers and local authorities should seek opportunities to:

- i. reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage techniques; and
- ii. relocate existing development to land with a lower probability of flooding.

4.4 The Sequential Test

We understand that Arun District Council are undertaking a district wide Sequential Test to support their Core Strategy, and that the site is likely to be found to pass the Sequential Test, and therefore be suitable for the proposed development.

The site naturally divides into two halves: a development platform which is to be situated on existing raised land (low risk); and lower lying areas which are important for flood storage/conveyance, and of ecological value (higher risk). There is therefore a natural division in terms of flood risk within the site, and a sequential approach has been adopted in developing the site arrangement, placing more vulnerable land uses in areas of the site where flood risk is low. Other than water compatible land uses, all proposed development will be situated on the raised development platform in an area of low flood risk (Zone 1). For development planning purposes, the platform has been extended locally into Flood Zone 3 where necessary. However this loss of floodplain has been fully compensated for.

Water compatible uses are located within Flood Zones 3 and 3b. This is appropriate development, as evidenced by PPS25 Table D.3.

4.5 Potential Impacts of Flooding

4.5.1 Flood Levels at Site

Flood levels from the modelling undertaken as part of the SFRA are provided in Table 4.1 for a selection of points within the site. Figure 4.1 illustrates the location of these points.

Table 4.1 – Flood Levels at Site

Location Point	1 in 20 (5%) annual probability flood level (mAOD)	1 in 100 (1%) annual probability flood level (mAOD)	1 in 100 (1%) annual probability + 20% flood level (mAOD)
A	n/a	2.54	3.29
B	2.00	2.47	3.15
C	1.99	2.52	3.26
D	n/a	2.49	3.23
E	1.99	2.55	3.44
F	n/a	n/a	3.07
G	n/a	n/a	3.03
H	1.97	2.51	3.19
I	1.97	2.49	3.61

4.5.2 Detailed Mapping of Flood Extent at Site

The SFRA states that a requirement of any FRA for the site is to: 'revisit flood zones to ensure suitably accurate for land use planning'.

This has been done by mapping the modelled flood levels produced as part of the SFRA, onto the detailed topographic survey collected for the site. This produces a more highly resolved flood extent for the site, utilising the higher level of accuracy and local variations in topography captured in the detailed site survey.

The SFRA modelling is deemed suitable for use in determining flood levels at the site. While the modelling undertaken for the SFRA is at a relatively coarse scale, the important factors controlling the extent of flooding at the site are the hydrological inflows, and downstream boundary condition, neither of which would be subject to change under more detailed hydraulic modelling.

The flood extents produced by the remapping exercise are presented in Appendix 7. There are no significant differences between this and the flood outlines produced as part of the SFRA (Appendix 5), or indeed the Environment Agency's Flood Map (Appendix 6).

4.5.3 Masterplan

A Masterplan has been produced which enables the development objectives for the site to be met, while addressing important constraints and environmental considerations. The Masterplan is included as Appendix 3 to this report. This has been developed following detailed consideration of Flood Zones at the site, and the development outline closely follows the extent of Flood Zone 1.

The Drainage Strategy has also been developed alongside the Masterplan layout, and has enabled an outline strategy to be developed for the management of foul and surface water drainage. The Drainage Strategy (which forms a separate document) is discussed further in Section 4.6.4 of this FRA.

4.5.4 Potential Impacts of Reprofilling Land

The site Masterplan envisages development to be situated on the higher land in the southern part of the site, which forms Flood Zone 1. However for development planning purposes, it is necessary to locate pockets of development around the edges of this platform, in areas of higher flood risk. It is therefore necessary to reprofile areas of land locally to meet the requirements of PPS25.

Land raising will be undertaken around the fringe of the development platform including the edges of the lower lying central area of the site, to raise areas proposed for residential land use above the 1.0% plus climate change annual probability flood level, and to raise an area to the east of the site proposed for playing fields/leisure facilities above the 5.0% annual probability flood level.

Lowering of areas of land will be undertaken in the eastern area of the site, and along the fringe of the development platform, where higher land extends beyond the edge of the area which will accommodate development. Additional land lowering will be undertaken in the low lying central area of the site, and to form a series of drainage swales running east to west, to join the central area of the site.

The extent of the ground profiling discussed above is illustrated in Appendix 8.



LEGEND

-  Red Line Boundary
-  Land for development not controlled by Greencore Group
-  Land under ownership by others
-  Flood level data point

CLIENT:

**Greencore
Group PLC**

pbd
peterbrett

SCALE: 1:7500

REV: -

DATE: 04/02/2011

FILE: Flood_Levels.wor

Figure 4.1

**North Littlehampton:
Modelled Flood Levels at Site**

4.5.5 Existing Flood Defences

The fluvial and tidal flood defences which protect Littlehampton and surrounding areas are described in Section 3.5 of this FRA. This Section discusses the potential impact of a failure of these defences.

While it is important for the residents of Littlehampton that the fluvial and tidal flood defences on the River Arun are maintained, the impact of a defence breach at the site, which lies further upstream, would be much lower. This is due to the distance upstream any potential failure would have to propagate in order to reach the site; and the elevated nature of the development platform at the site.

A tidal sluice at the confluence between the River Arun and Black Ditch prevents high water levels from the River Arun propagating upstream along the Black Ditch. A failure of this structure would not have a significant impact on water levels at the site. This is due to the duration of the tidal peak water level this far up the system being short; the elevated nature of the development platform, and the fact that there are many other potential barriers to flow passing upstream back through the Black Ditch system, for example the Lyminster Road embankment, and a railway embankment.

4.5.6 Impact of Uncontrolled Discharge

If development were to take place without a suitable drainage and surface water management strategy in place, runoff from the development would quickly exceed the capacity of local drainage systems, and lead to significant surface water flooding issues. A Drainage Strategy has been prepared as a separate report to accompany this FRA, and is summarised in Section 4.6.4 of this document.

4.6 Mitigation Measures

The following section details the mitigation measures to be incorporated into the proposed development to minimise flood risk to both users of the site and third parties.

4.6.1 Proposed Development Ground Floor Level

The majority of the area of the site proposed for development lies on higher land to the south of the site, within Flood Zone 1. However due to other constraints, it is not possible to locate all proposed development within Flood Zone 1. It is therefore proposed to raise parcels of land locally, such that residential areas are not exposed to an unacceptable level of flood risk, while maintaining a functioning Masterplan vision, and taking account of other important constraints and environmental considerations.

All ground floor levels will be set to a minimum level of 500mm above the 1.0% plus climate change annual probability fluvial flood level, as requested by the Environment Agency (Environment Agency, Ref: HA/2009/108631/01-L01). This will lead to localised losses in floodplain storage volume. A compensation scheme designed to offset these losses is described in Section 4.6.3.

4.6.2 Ground Level Modifications

The client would like to situate the leisure facilities which are proposed for the eastern part of the site (football playing fields and associated facilities) outside of the 5.0% annual probability flood extent. This will be achieved by raising land in this area to 2.0mAOD (the 5.0% annual probability flood level for this part of the site). Existing ground levels in this area are approximately 1.5mAOD.

This will lead to localised losses in floodplain storage volume. A compensation scheme designed to offset these losses is described in Section 4.6.3.

4.6.3 Flood Storage Compensation

Any new development located in the vicinity of a watercourse should be constructed such that it does not reduce the available floodplain storage or act as an obstruction to the flow routes over the area. Reducing floodplain storage capacity would have the effect of increasing flood levels.

The ground raising proposed in Sections 4.6.1 and 4.6.2 above will result in an overall loss in floodplain storage volume of 28,500m³. In order to offset this loss of floodplain volume, a flood storage compensation scheme has been designed which will provide level-for-level compensation, by lowering areas of ground (and through the removal of existing buildings situated within the floodplain). The scheme results in a total net gain in floodplain volume of up to 27,300m³ (up to the 1.0% plus climate change annual probability flood level). The final landscaping of the scheme may vary slightly from that shown here, however this will be expected to still show a significant net increase in floodplain storage volume. When implemented, this significant increase in the volume of floodplain available for attenuation of flood water will serve to reduce water levels at and around the site in times of flood.

The flood storage compensation scheme is presented in Appendix 8, along with supporting calculations. A summary of the scheme is provided in Table 4.2.

Table 4.2 – Summary of Flood Compensation Storage Scheme

Level at Top of Band (mAOD)	Volume Loss due to Ground Level Modifications (m ³)	Volume Gain due to Removal of Existing Building and Ground Lowering (m ³)	Net Change in Floodplain Storage Volume (m ³)
0.9	34.5	0.0	-28.1
1.1	45.2	0.0	-37.6
1.3	59.0	0.0	-50.2
1.5	493.8	536.3	52.6
1.7	2338.1	3907.7	1581.5
1.9	4166.7	5706.9	1546.1
2.1	3996.1	6426.1	2424.6
2.3	1220.3	6509.5	5379.8
2.5	1958.4	5544.5	4033.4
2.7	2565.8	4348.5	2330.3
2.9	3039.4	3902.8	1416.7
3.1	3957.7	3872.4	442.4
3.3	2753.8	3819.2	1567.0
3.5	1293.4	3796.9	2979.8
3.7	556.4	3765.0	3664.9
Total	28478.6	52135.7	27303.1

The proposed flood storage compensation scheme is predicated on the principle of 'level-for-level' storage. The scheme shows a significant increase in flood storage across all elevation bands, ranging from 1.3mAOD, to 3.7mAOD (the highest 1.0% plus climate change annual probability flood level within the site boundary). A negligible reduction in storage volume occurs below 1.3mAOD: these slight losses are inconsequential when compared to the significant net benefits afforded by the scheme.

There are some areas where it is necessary to provide an amount of compensatory floodplain storage within the existing floodplain, in order to meet the Environment Agency's requirement for providing 'level-for-level' flood compensation. While such storage is located planimetrically within the floodplain; volumetrically, it lies outside of the existing floodplain, and therefore acts as additional floodplain storage volume below the level of the existing ground surface. A drawing illustrating this principle is included as Appendix 9.

Flood compensation areas have been designed to be in direct contact with the fluvial floodplain wherever possible. Where any structures are to be constructed across compensation areas, these will be designed such as to provide connectivity between adjacent areas, and to allow the free passage of floodwater.

Generally, the proposed future ground levels remain consistent with the existing ground levels at the site, and tie in sympathetically with surrounding ground surfaces. Post-construction survey information will be provided following implementation of a scheme, for Arun District Council's records.

4.6.4 Surface Water Management

A separate Drainage Strategy has been prepared for the site by WYG, setting out the drainage requirements for the site, and recommending preferred options for the provision of foul and surface water drainage and disposal. The following is a summary of the main points of the Drainage Strategy, however this document should be consulted for further information on these issues.

- ✱ The most suitable option for the development's foul drainage is to connect to the foul public sewer network south of the site. While a connection cannot be made at the immediate boundary, a sewer may be constructed further downstream to a connection point to be confirmed by Southern Water.
- ✱ The recently constructed treatment plant at Ford has been designed to accept flows from new developments such as that proposed for the North Littlehampton Strategic Development Area. It is not expected that upgrades to this facility will be required. However, the pumping station which connects Littlehampton to the plant may need some works to provide additional capacity for the increase in flows from the development. Further technical studies will be required to definitively address this.
- ✱ The site currently drains to the Black Ditch via open channel drains through the site as there are no public sewers immediately adjacent to the site. The surface water drainage strategy has been designed to lead to a reduction in runoff from the site.
- ✱ The Environment Agency has requested that SUDS be implemented within the development for surface water management, and the most suitable solution is to use a combination of infiltration drainage, SUDS techniques and piped systems.

4.7 Residual Risk

It is impossible to completely guard against flooding since extreme events greater than the design standard event are always possible, however it is possible to minimise the risk by allowing an appropriate freeboard (safety margin) and by using suitable construction techniques.

To minimise residual risks to residents, such as climate change and other uncertainties, the ground floor levels are set a suitable freeboard above modelled flood levels.

North Littlehampton Urban Extension Flood Risk Assessment

Flooding can happen for a number of reasons. Flooding generally occurs through a combination of events as set out in Department of Communities and Local Government (DCLG) Document 'Improving the Flood Performance of New Buildings' (Part1/Chapter 2/Flooding Considerations /Section 2.1' *What are the causes of Flooding?*).

Furthermore various measures can be put into place to further reduce the impact of a possible flood using flood resistant construction techniques as detailed below:

- ✱ Raised (on stilts) concrete ground floor.
- ✱ Sealed utility service ducts.
- ✱ The electrical and other plant located at a suitable height above the ground floor level.
- ✱ High level electrical sockets.
- ✱ Security of supplies optimised.

PPS25 and 'Sewers for Adoption' recognise that it is not practicable to fully limit flows during extreme wet weather, the residual risk can be mitigated by design features (i.e. having drainage constructed in areas lower than the ground floor levels) to demonstrate safe above ground flow paths.

In addition, future residents should be made clearly aware of the potential risk of flooding in the area.

5 Summary

- ✱ The site is currently occupied by a variety of uses including several large nurseries. These occupy an elevated southern portion of the site, which falls within Flood Zone 1. The proposed development replaces this existing development, with land uses of a range of flood risk vulnerability classifications.
- ✱ A FRA has been prepared in accordance with PPS25 for a significant mixed use development, which forms a sustainable urban extension to Littlehampton, West Sussex.
- ✱ A separate Drainage Strategy has been produced by WYG, which will be submitted alongside this FRA as part of the Planning Application.
- ✱ Part of the site to the north lies within the floodplain of the Black Ditch, occupying Flood Zones 3 and 3b. No development is proposed for these areas of the site, apart from water compatible development, which is permitted under PPS25. These areas will be retained as public open space, and amenity and ecological areas.
- ✱ For development planning purposes, it is proposed to raise small areas of land where necessary, which will extend the development platform into Flood Zone 3 locally. This loss of floodplain storage attributable to ground raising has been fully compensated for by way of a level-for-level floodplain storage compensation scheme.
- ✱ Subject to the agreement of funders and insurers, floor levels would be to a minimum level of 500mm above the 1.0% plus climate change flood level.
- ✱ The proposals increase available flood storage and decrease runoff, thus contributing to a reduction in flood risk.
- ✱ The proposals satisfy all of the requirements of the Sequential Test and Exception Test set out in PPS25.

6 References

The following documents have been used in the compilation of this Flood Risk Assessment:

- Department of Communities and Local Government, Planning Policy Statement 25: Development and Flood Risk, December 2006 <http://www.communities.gov.uk/index.asp?id=1504640>
- Department of Communities and Local Government, Development and Flood Risk: A Practice Guide Companion to PPS25 'Living Draft', February 2007
<http://www.communities.gov.uk/index.asp?id=1506265>
- Arun District Council: Strategic Flood Risk Assessment, February 2008