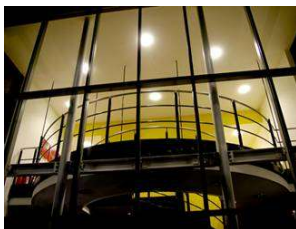


williamsaunders

architecture : engineering : building consultancy



PROPOSED PHASE 1 RESIDENTIAL DEVELOPMENT

**CROSSROADS NURSERIES, QUADRING
DRAINAGE STATEMENT**

11849-WMS-ZZ-XX-RP-C-39210-S8-P1

AUGUST 2020

Contract: Proposed Phase 1 Residential Development, Crossroads Nurseries, Quadring**Document Title:** Drainage Statement**Our Ref:** 11849-WMS-ZZ-XX-RP-C-39210-S8-P1-DRAINAGE_STATEMENT**Prepared by:** P.A. Eagles BEng MIHT**Date:** August 2020**RECORD OF AMENDMENTS TO DOCUMENT**

Ref	Description	Date
P1	Initial issue for Planning Submission	07/08/2020

Verified by: A.C. Gibson BEng CEng MICE MCIHT
MIRSE**Date:** August 2020

C O N T E N T S

- 1.0 INTRODUCTION**
- 2.0 PROPOSED DEVELOPMENT**
- 3.0 DRAINAGE STRATEGY**
- 4.0 CONCLUSIONS**

APPENDICES

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| Appendix A | Location Plan |
| Appendix B | Topographical Survey |
| Appendix C | EA Flood Risk Map |
| Appendix D | Proposed Site Layout |
| Appendix E | Anglian Water Sewer Records |
| Appendix F | Proposed Drainage Strategy Layout |
| Appendix G | Drainage Calculations |
| Appendix H | IDB Watercourse Plan |

PHASE 1 CROSSROADS NURSERIES, QUADRING

DRAINAGE STATEMENT

1.0 INTRODUCTION

William Saunders have been commissioned by Mr. H. Bingham to prepare a Drainage Statement for a proposed residential development at Crossroads Nurseries, Main Road, Quadring. The document is to be submitted as evidence to support a detailed planning application for the residential development.

2.0 PROPOSED DEVELOPMENT

2.1 SITE LOCATION AND DESCRIPTION

The site is located in the centre of Quadring, north of Water Gate and east of Main Road (A152) in the village of Quadring. The National Grid Reference for the site is E522450, N333320.

Access to the site is gained off Main Road and Water Gate. A location plan is given in Appendix A.

The site is surrounded by farmland to the North. East of the site, the land use is residential off Water Gate. Additionally land to the south of the site is residential in the centre of Quadring. Beyond the residential properties is farmland further to the south of the site. West of the site the land use is also residential, off Town Drove.

The Phase 1 site area is approximately 0.69 ha but forms part of a much larger site being 3.7 ha. The topography of the site is generally flat. A topographical survey is given in Appendix B.

The site is currently used for a commercial plant nursery operation with greenhouses and polytunnels with associated areas of hardstanding.

The Environment Agency (EA) flood risk map for planning (GOV.UK) indicates that the site lies within flood zones 1, 2 and 3. A Flood Risk Assessment is required to be undertaken and submitted to the Local Planning Authority as part of a planning submission for the development of the site. This has been prepared by others and will not form part of this report, however a copy of the flood risk map is included within Appendix C. It should be noted that the FRA recommends minimum floor levels of 3.40m AOD within the proposed development.

2.2 DEVELOPMENT PROPOSALS

The proposals are for a residential development consisting of 9 no. dwellings as Phase 1 with the remainder of the site increasing this to a total of 60. The proposed indicative site layout is shown at Appendix D.

3.0 DRAINAGE STRATEGY

3.1 FOUL DRAINAGE

An existing Anglian Water 150mm dia. foul sewer is located within Main Road (A152) is which runs towards the north west to an Anglian Water Pumping Station adjacent 143 Main Road. Within the footway to the east of Main Road is a rising main flowing south east. Copies of the Anglian Water sewer records are included within Appendix E.

To dispose of foul sewage from the site it is proposed to provide a gravity private foul drainage network and an adoptable gravity foul sewer which will discharge to the existing Anglian Water foul sewer system.

A connection will be made into the existing Anglian Water foul sewer in Main Road adjacent to the proposed site entrance. However, this will require the level of the site to be raised to enable a gravity discharge. The levels required are above the recommended minimum floor level set by the FRA as noted in 2.1. As an alternative a pumping station could be utilised to pump foul sewage to the existing Anglian Water sewer.

The foul water connection from the development to the public sewer will require approval by Anglian Water under a Section 106 agreement and the proposed foul sewer approved and adopted under a Section 104 Agreement with Anglian Water.

3.2 SURFACE WATER DRAINAGE

In accordance with requirement H3 of the Building Regulations 2000 all possible options for disposal of surface water have been considered using the preferred hierarchy i.e.

- Soakaways
- Infiltration
- Watercourse
- Sewer

Site Investigations have not been carried out on the development site. However, the Client has provided a Site Investigation report for an adjacent site within Quadring for nearby ground conditions to be examined. The report states that ground conditions are considered as having a 'poor' drainage potential, according to BS8004:1986, with infiltration rates of 1.53×10^{-6} m/s and 1.70×10^{-6} m/s being recorded. It should be noted that due to the very slow rate of infiltration only

PHASE 1 CROSSROADS NURSERIES, QUADRING

DRAINAGE STATEMENT

one refill test could be undertaken on the day of testing rather than the three required by BRE Digest 365. Groundwater levels ranged from 0.83m to 1.06m below ground level. Infiltration is therefore not thought to be a viable method of discharge of surface water from the development for the adoptable areas due to the high groundwater table and poor infiltration rates, but shallow partial infiltration features such as permeable paving may be feasible for the private driveways with an overflow connection to the below ground drainage system.

The development lies within the Welland and Deeping Internal Drainage Board District. There are existing watercourses along the Phase 1 northwest and northeast site boundaries. According to information available on the IDB website these are not maintained by the IDB. However, there is a Welling and Deeping IDB watercourse, the Marlode Drain, further north of the site into which the watercourses around the site flow into.

As infiltration techniques are not considered suitable, discussions have been held with the Welland and Deeping IDB regarding the proposed development and proposals for surface water to be discharged into the adjacent watercourses. Currently an impermeable area of 3512 sqm drains directly into the adjacent watercourses from greenhouses and polytunnels which are to be removed to enable the Phase 1 development. The proposed impermeable area from the Phase 1 site is 3326 sqm resulting in betterment and a reduction in peak flow rates. Welland and Deeping Internal Drainage Board have confirmed that they are acceptable to the principle of an unrestricted discharge from the proposed Phase 1 development subject the required Land Drainage Consent applications being made and approved.

Runoff from roofs and private hard surfaced areas will be collected via a proposed private drainage network and connected to a proposed adoptable surface water sewer into which runoff from the proposed adoptable highway will also be connected before discharging to the adjacent non IDB watercourse along the northern eastern boundary. As the IDB have confirmed acceptance to the principle of an unrestricted discharge it is currently considered that attenuation facilities do not need to be included within the surface water drainage system, but this will be further investigated during the detailed design. The adoptable surface water drainage system will be designed to ensure that a 1 in 30-year flood is contained beneath the ground with no flooding and a 1 in 100-year event (accounting for climate change) is contained within the site with no flooding to the built environment.

The proposed drainage strategy is shown on drawing 11849-WMS-ZZ-XX-DR-C-39210-S8-P2 in Appendix F.

3.3 DRAINAGE STRATEGY REQUIREMENTS

In order to manage the run off from the developed site, and accommodate future climate change, the detailed design of the surface water drainage system will need to include the following: -

- Suitably sized drains and sewers to convey surface water flows to the point of discharge into the adjacent watercourse.
- Flood Flow Routes
To address the residual risks of surface water flows and potential infrastructure failure, flow routes for such waters will be analysed and demonstrated to not present a hazard to the development or adjacent properties.
- Plot Level
Adjacent to flood flow routes and areas at risk from surface water flooding, floor levels will be set above flood level to minimise the flood risk.
- Design/Construction Standard
All on-site foul and surface water drainage will be designed and constructed in accordance with current Building Regulation Standards, Anglian Water adoptable standards, Lincolnshire County Council Highway Drainage Standards, IDB and LLFA requirements

4.0 CONCLUSIONS

- The proposed development is at risk of flooding from fluvial/tidal water (refer to separate Flood Risk Assessment) and floor levels are to be set at a minimum of 3.40m AOD.
- The development will generate quantities of surface water runoff which could pose flood risk to the development itself or to its neighbours unless appropriate design and management measures are taken.
- The surface water runoff generated by the proposed development will be managed in a manner which will ensure no risk of flooding or increased risk to surrounding properties, at present and taking into account allowances for future climate change.
- Ground conditions are not considered suitable for disposal of surface water from the adoptable highway areas and roof and private hard surfaced areas using soakaways/infiltration techniques. However shallow partial infiltration features such as permeable paving may be considered for the private driveways with an overflow connection to the below ground piped drainage system.
- Traditional below ground private and adoptable gravity piped drainage systems will be utilised for the proposed adoptable highway drainage, roof water drainage and private hard surfaced drainage discharging to the adjacent IDB watercourse along the north eastern site boundary.
- The residual risks from surface water and infrastructure failure will be addressed by consideration of flood flow routes through the development.
- Floor levels will be set to minimise the flood risk from adjacent areas at risk from flood flow routes and to enable a gravity drainage system.
- Foul water is proposed to be discharged to the Anglian Water foul sewer in the entrance to the site off Main Road.

PHASE 1 CROSSROADS NURSERIES, QUADRING

DRAINAGE STATEMENT

APPENDIX A

Location Plan



Crane Bridge

4

Nursery

Judy Cross

3

Mill House

Manor House Farm

Town Drove

3

Barholme Farm

Quadring,
Lincolnshire

Quadring

4

Lane Farm

Sarah G

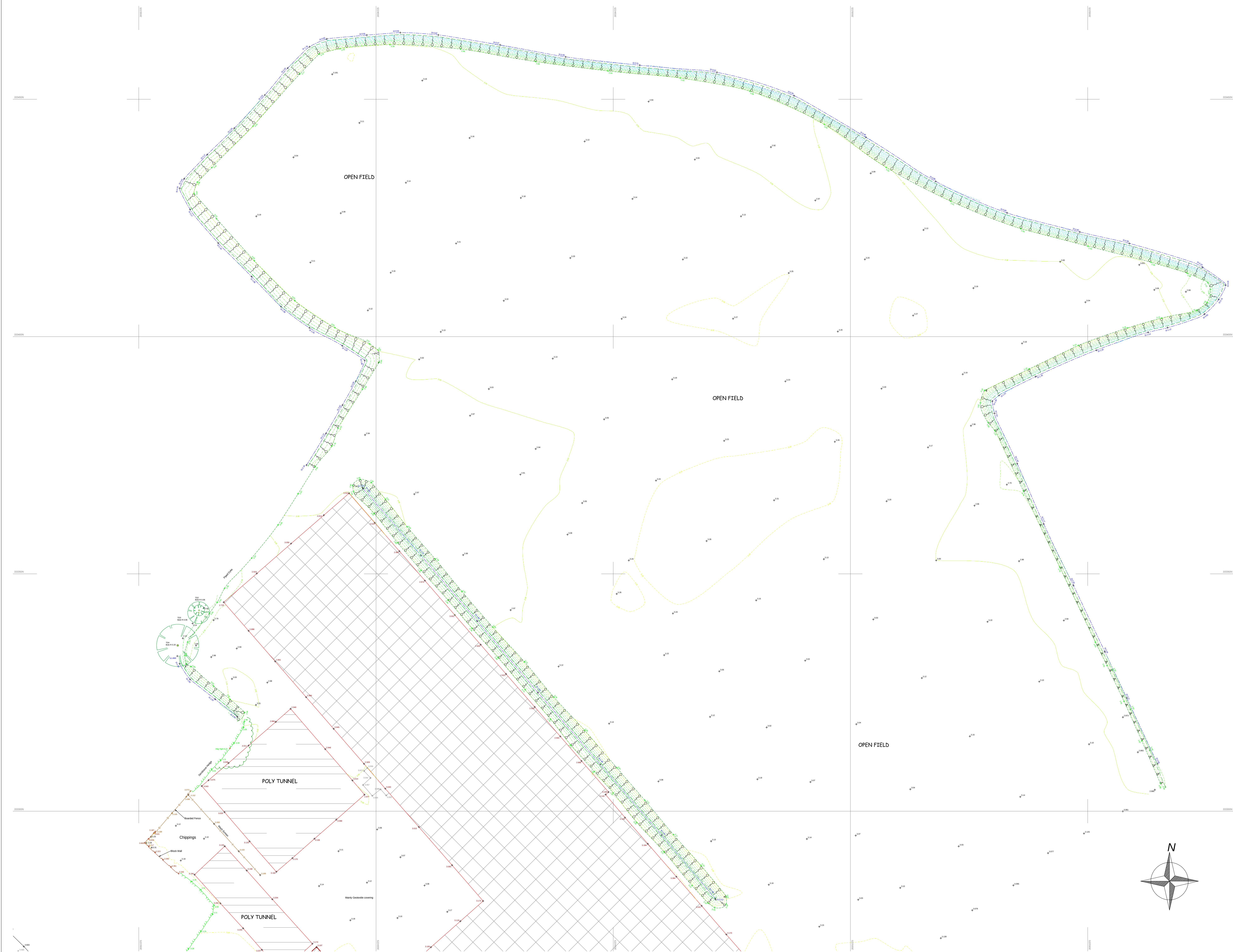
A152

PHASE 1 CROSSROADS NURSERIES, QUADRING

DRAINAGE STATEMENT

APPENDIX B

Topographical Survey



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Key & Notes

SURVEY STATIONS				
Name	Existing	Founding	Height	Remark
STN A1	02000.142	02000.142	2.000	Level NAL
STN A2	02000.142	02000.142	2.000	Level NAL
STN A3	02000.142	02000.142	2.000	Level NAL
STN A4	02000.142	02000.142	2.000	Level NAL

The survey grid is the National Grid obtained from ETRS89 GPS
Coordinates with OSTN15 transformation. Levels shown to Ordnance
Survey datum using ETRS89 GPS with OSGM15 transformation.
Surveyed boundary features are not necessarily legal boundaries.

All utilities have been identified to the best of the surveyors knowledge.
The correct identification can not be 100% guaranteed and should be
independently verified prior to use in any design or building works.
Services may be obscured by parked cars, leaf litter or building materials etc.

Lincolnshire Surveys
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Mobile: 07 840 030 625
john.rowan@lincs-surveys.co.uk
www.lincs-surveys.co.uk

Project
Crossroads Nurseries
Water Gate
Quadrang, Lincolnshire

Client
Moulton Land and Planning

Title
Topographical Survey
Sheet 2 of 3

Surveyor		Client Ref.	
JKR			
Date	March 2018	Drawn By	JKR
Scale	1:250@A0	Checked By	JKR
Contract No.	18016	Revision	
Drawing No.	02		*

ORIGINAL PAPER SIZE A0
Please quote Contract No., Drawing No. & Revision in all Correspondence



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Key & Notes

SURVEY STATIONS				
Name	Existing	Founding	Height	Remark
STN A1	02000.142	02000.142	0.00	Level NAL
STN A2	02000.142	02000.142	0.00	Level NAL
STN A3	02000.142	02000.142	0.00	Level NAL
STN A4	02000.142	02000.142	0.00	Level NAL

The survey grid is the National Grid obtained from ETRIS90 GPS
Coordinates with OSTN15 transformation. Levels shown to Ordnance
Survey datum using ETRIS90 GPS with OSGM15 transformation.
Surveyed boundary features are not necessarily legal boundaries

All utilities have been identified to the best of the surveyors knowledge.
The correct identification can not be 100% guaranteed and should be
independently verified prior to use in any design or building works.
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Project
Crossroads Nurseries
Water Gate
Quadding, Lincolnshire
Client
Moulton Land and Planning

Title
Topographical Survey
Sheet 3 of 3

Surveyor		Client Ref.	
JKR			
Date	March 2018	Drawn By	JKR
Scale	1:250@A0	Checked By	JKR
Contract No.	18016	REVISION	
Drawing No.	03		

ORIGINAL PAPER SIZE A0
Please quote Contract No., Drawing No. & Revision in all Correspondence

PHASE 1 CROSSROADS NURSERIES, QUADRING

DRAINAGE STATEMENT

APPENDIX C

EA Flood Risk Map

Flood map for planning

Your reference
11849

Location (easting/northing)
522459/333377

Created
1 Oct 2018 10:18

Your selected location is in flood zone 1, an area with a low probability of flooding.

This means:

- you don't need to do a flood risk assessment if your development is smaller than 1 hectare and not affected by other sources of flooding
- you may need to do a flood risk assessment if your development is larger than 1 hectare or affected by other sources of flooding or in an area with critical drainage problems

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

The Open Government Licence sets out the terms and conditions for using government data.
<https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/>

Flood map for planning

Your reference
11849

Location (easting/northing)
522459/333377

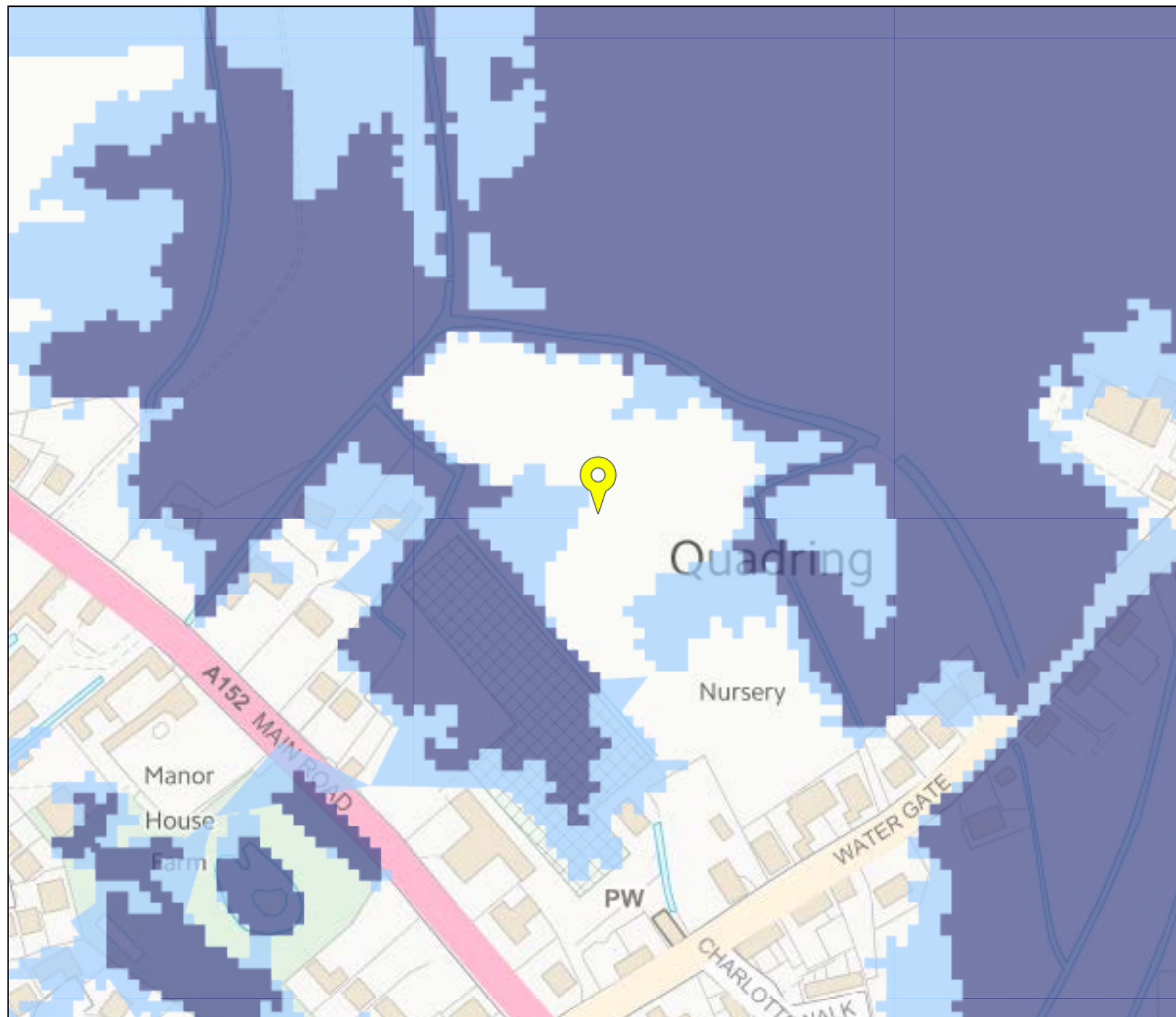
Scale
1:2500

Created
1 Oct 2018 10:18

-  Selected point
-  Flood zone 3
-  Flood zone 3: areas benefitting from flood defences
-  Flood zone 2
-  Flood zone 1
-  Flood defence
-  Main river
-  Flood storage area

0 20 40 60m

Page 2 of 2

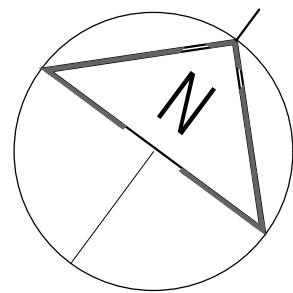


PHASE 1 CROSSROADS NURSERIES, QUADRING

DRAINAGE STATEMENT

APPENDIX D

Proposed Site Layout



INDICATIVE SITE LAYOUT - Phase 1



mlp Moulton Land and Planning

moultonlandandplanning.co.uk 1 Chapel Court Wansford Peterborough PE8 6JF
tel 01780 782306 mob 07484 101655 e-mail alan@moultonland.co.uk

Project
Main Road Quadring
Phase 1 Draft Plans

Drawing
PRELIM SITE LAYOUT -
BUNGALOW TYPES

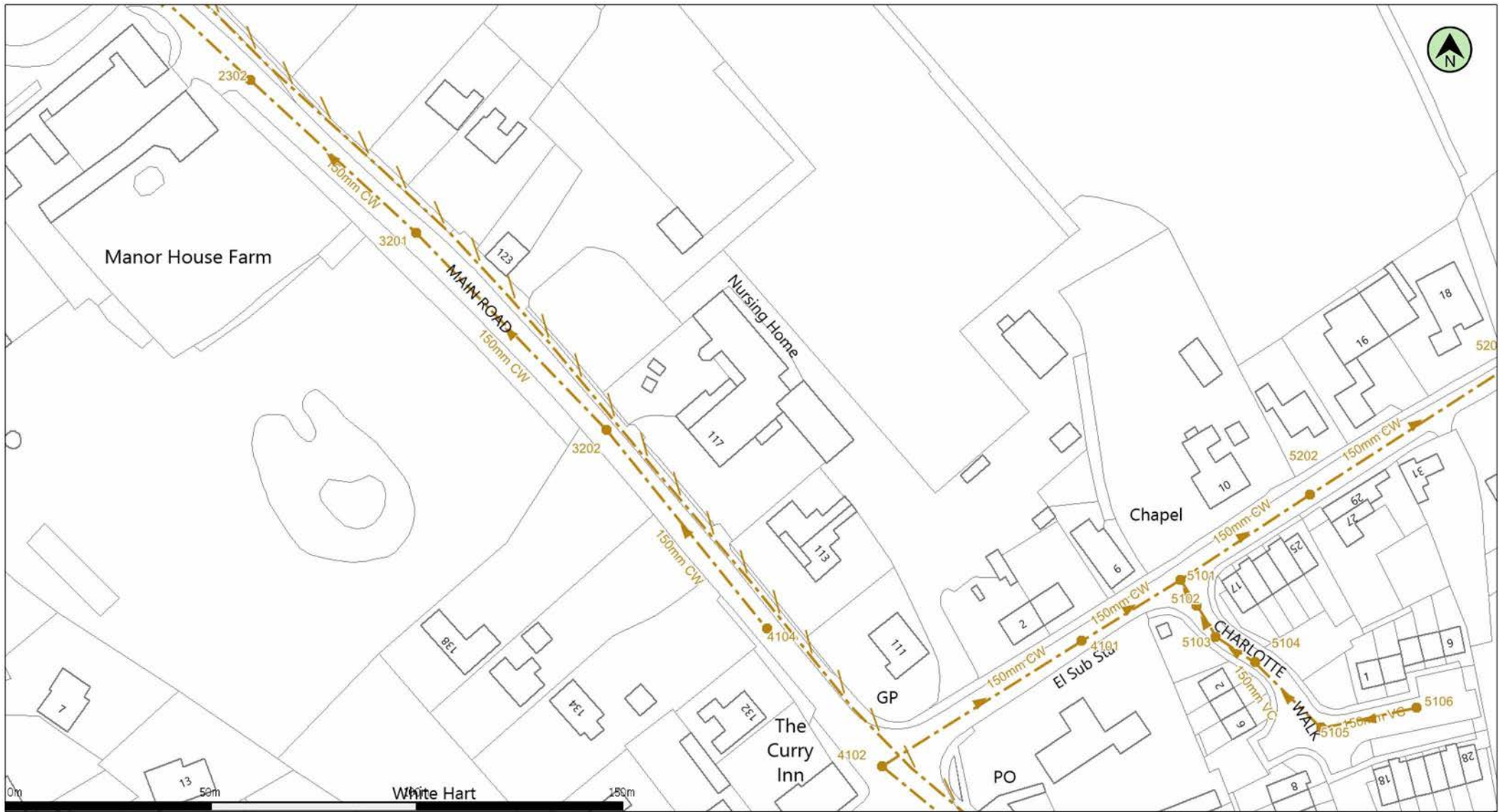
date June 2020
scale(s) 1 : 500 @ A3
DRG. No. -----

PHASE 1 CROSSROADS NURSERIES, QUADRING

DRAINAGE STATEMENT

APPENDIX E

Anglian Water Sewer Records



(c) Crown copyright and database rights 2017 Ordnance Survey 100022432

Date: 15/06/17

Scale: 1:1309

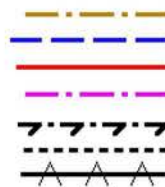
Map Centre: 522406,333223

Data updated: 31/04/17

Wastewater Plan A4

This plan is provided by Anglian Water pursuant to its obligations under the Water Industry Act 1991 sections 198 or 199. It must be used in conjunction with any search results attached. The information on this plan is based on data currently recorded but position must be regarded as approximate. Service pipes, private sewers and drains are generally not shown. Users of this map are strongly advised to commission their own survey of the area shown on the plan before carrying out any works. The actual position of all apparatus MUST be established by trial holes. No liability whatsoever, including liability for negligence, is accepted by Anglian Water for any error or inaccuracy or omission, including the failure to accurately record, or record at all, the location of any water main, discharge pipe, sewer or disposal main or any item of apparatus. This information is valid for the date printed. This plan is produced by Anglian Water Services Limited (c) Crown copyright and database rights 2017 Ordnance Survey 100022432. This map is to be used for the purposes of viewing the location of Anglian Water plant only. Any other uses of the map data or further copies is not permitted. This notice is not intended to exclude or restrict liability for death or personal injury resulting from negligence.

Foul Sewer
Surface Sewer
Combined Sewer
Final Effluent
Rising Main
(Colour denotes effluent type)
Private Sewer
(Colour denotes effluent type)
Decommissioned Sewer
(Colour denotes effluent type)



Outfall
(Colour denotes effluent type)
Inlet
(Colour denotes effluent type)
Manhole
(Colour denotes effluent type)
Sewage Treatment Works
Pumping Station



jfrancis@sholland.gov.uk

B15-0633-17

love every drop
anglianwater

PHASE 1 CROSSROADS NURSERIES, QUADRING

DRAINAGE STATEMENT

APPENDIX F

Proposed Drainage Strategy Layout

Key:

Proposed Adoptable Surface Water Sewer

Proposed Adoptable Foul Sewer

Proposed Private Surface Water Drain

Proposed Private Foul Drain

Existing riparian owned watercourse

William Saunders is the trading name of Wm Saunders Partnership LLP. Wm Saunders Partnership Limited Liability Partnership is registered in England and Wales with the Registration number OC 308323. The Registered Office is Sheppard Lockton House, Cafferata Way, Newark on Trent, Notts, NG24 2TN.

This drawing & any design thereon is the copyright of Wm Saunders Partnership LLP and must not be reproduced without their written consent.

Contractors must verify all dimensions, levels and co-ordinates at the site before commencing any work or making any shop drawings: no dimensions to be taken from drawing.

P2	Updated following IDB consultation and issued for Regulatory Approval	PAE	PAE	07/08/20
P1	Initial issue for information	PAE	PAE	18/06/20
Rev	Description	Drn	Vf'd	Date

As outlined in section 2.3 of the CITB Industry Guidance to Designers, insignificant risks can usually be ignored, as can risks arising from routine construction activities, unless the design compounds or significantly alters these risks. In accordance with CDM Regulations 8, 9 and 11, any significant risks relating to the design features shown on this drawing have been identified and are annotated thus:

☒ No significant risks have been identified.

☐ Significant risks have been identified - refer to notes on drawing for information on residual risks and any control measures to be employed.

Refer to the current Designer's Risk Assessment sheets for further details.

Designer's Signature	PAE	Date	18/06/20
----------------------	-----	------	----------

Drawing Status

REGULATORY APPROVAL

williamsaunders

architecture: engineering: building consultancy

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Also at Leeds, Lincoln, Wirschworth

Project

PHASE 1 RESIDENTIAL DEVELOPMENT
CROSSROAD NURSERIES
QUADRING
LINCOLNSHIRE

Client

HENRY BINGHAM

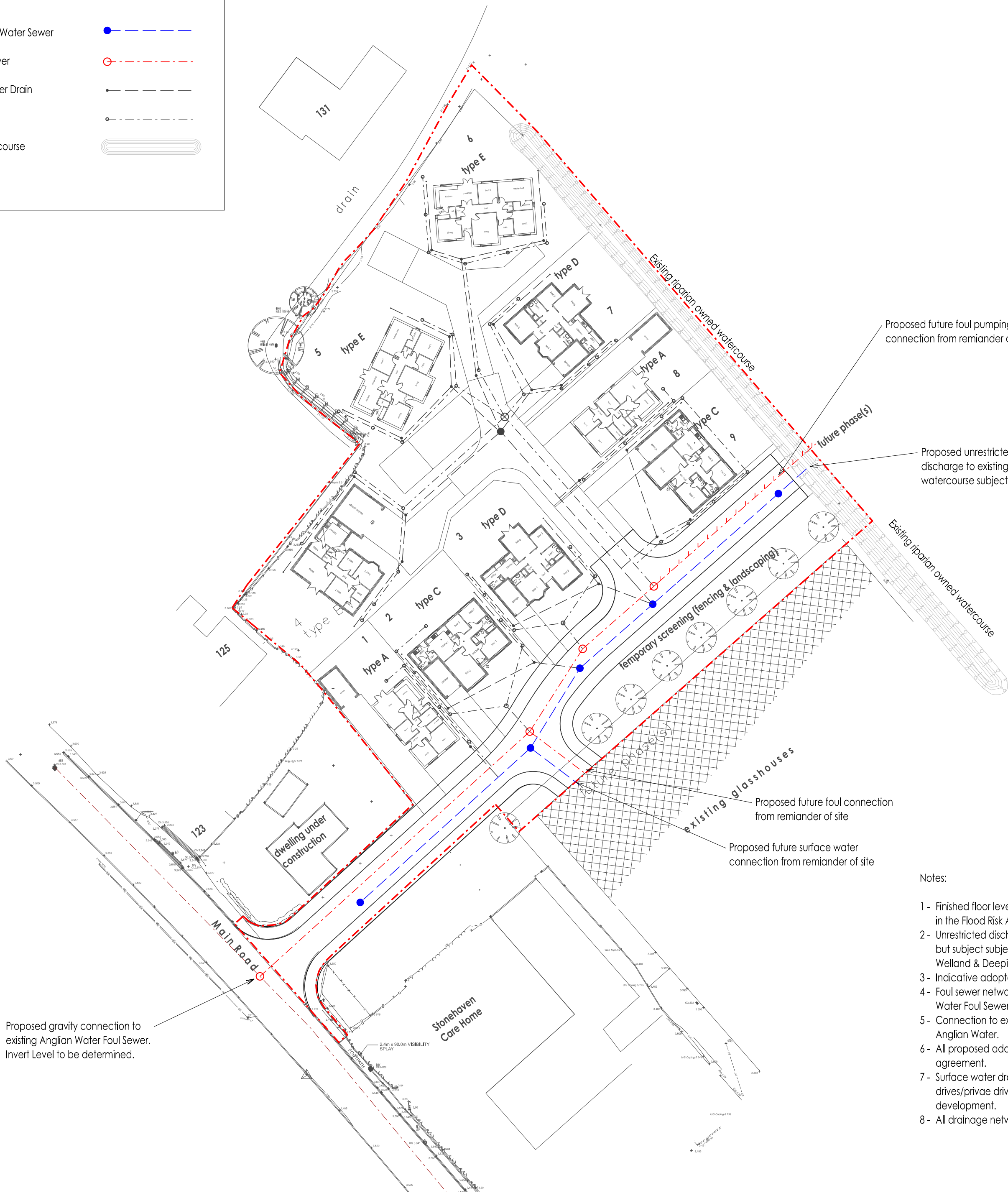
Title

DRAINAGE STRATEGY

WmS Project Ref.	Drawn	Date	Scale	@ A2
11849	PAE	18/06/20	1:500	

Drawing/Document Reference

Project	Originator	Zone	Level	Type	Role	Number	Status	Rev.
11849	- WMS	- ZZ	- XX	- DR	- C	- 39210	- S8	- P2



Proposed future foul pumping main connection from remiander of site

Proposed unrestricted surface water discharge to existing riparian owned watercourse subject to IDB approval

Proposed future foul connection from remiander of site

Proposed future surface water connection from remiander of site

Proposed gravity connection to existing Anglian Water Foul Sewer. Invert Level to be determined.

Notes:

- 1 - Finished floor levels for units assumed at 3.40m AOD. (Recommended in the Flood Risk Assessment)
- 2 - Unrestricted discharge rate into existing ditch approved in principle but subject subject to formal Land Drainage Consent approval from Welland & Deeping Internal Drainage Board.
- 3 - Indicative adoptable sewer network shown only.
- 4 - Foul sewer network subject to gravity outfall into existing Anglian Water Foul Sewer in Main Road.
- 5 - Connection to existing foul sewer subject to S106 approval from Anglian Water.
- 6 - All proposed adoptable sewers subject to Anglian Water Section 104 agreement.
- 7 - Surface water drainage system serves all building roof areas, drives/privae drives and adoptable highway area within the development.
- 8 - All drainage networks subject to final detailed design.

PHASE 1 CROSSROADS NURSERIES, QUADRING

DRAINAGE STATEMENT

APPENDIX G

Drainage Calculations

William Saunders		Page 1
Sheppard Lockton House Cafferata Way Newark, NG24 2TN	11849 - Phase 1 - feh Crossroads Nurseries Quadrang	
Date 07/08/2020 File 20.06.29_feh ;private d...	Designed by PAE Checked by	
Innovyze	Network 2019.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	19.100	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	100	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	100	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	36.380	0.214	170.0	0.048	5.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	14.825	0.060	247.1	0.264	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	15.333	0.062	247.0	0.045	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	36.388	0.162	225.0	0.167	5.00	0.0	0.600	o	225	Pipe/Conduit	
S1.003	26.487	0.085	311.6	0.034	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.004	6.300	0.020	315.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	63.85	5.61	2.650	0.048	0.0	0.0	0.0	1.00	39.8	8.4
S1.001	62.62	5.85	2.361	0.313	0.0	0.0	0.0	1.00	70.4	53.0
S1.002	61.41	6.11	2.301	0.358	0.0	0.0	0.0	1.00	70.4	59.5
S2.000	63.38	5.70	2.935	0.167	0.0	0.0	0.0	0.87	34.5	28.7
S1.003	59.48	6.54	2.164	0.559	0.0	0.0	0.0	1.02	112.8	90.1
S1.004	59.04	6.65	2.079	0.559	0.0	0.0	0.0	1.02	112.2	90.1

William Saunders		Page 2
Sheppard Lockton House Cafferata Way Newark, NG24 2TN	11849 - Phase 1 - feh Crossroads Nurseries Quadrang	
Date 07/08/2020 File 20.06.29_feh ;private d...	Designed by PAE Checked by	
Innovyze	Network 2019.1	

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1
Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.100	Storm Duration (mins)	30
Ratio R	0.400		

William Saunders		Page 3
Sheppard Lockton House Cafferata Way Newark, NG24 2TN	11849 - Phase 1 - feh Crossroads Nurseries Quadrang	
Date 07/08/2020 File 20.06.29_feh ;private d...	Designed by PAE Checked by	
Innovyze	Network 2019.1	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 522850 333500 TF 22850 33500
C (1km)	-0.020
D1 (1km)	0.291
D2 (1km)	0.308
D3 (1km)	0.210
E (1km)	0.304
F (1km)	2.524
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	450.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S1	60 Summer	1	+0%	30/60 Summer			
S1.001	S2	60 Summer	1	+0%	30/60 Summer	100/60 Summer		
S1.002	S3	60 Summer	1	+0%	30/60 Summer			
S2.000	S4	60 Summer	1	+0%	30/60 Summer			
S1.003	S5	60 Summer	1	+0%	30/60 Summer			
S1.004	S6	60 Summer	1	+0%	30/60 Summer			

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Water		Surcharged		Flooded		Pipe		Status	Level Exceeded
		Level (m)	Depth (m)	Volume (m ³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)				
S1.000	S1	2.700	-0.175	0.000	0.11		4.1	OK			
S1.001	S2	2.499	-0.162	0.000	0.43		25.3	OK			2
S1.002	S3	2.449	-0.152	0.000	0.49		28.9	OK			
S2.000	S4	3.040	-0.120	0.000	0.44		14.2	OK			
S1.003	S5	2.357	-0.182	0.000	0.46		45.3	OK			
S1.004	S6	2.297	-0.157	0.000	0.63		45.1	OK			

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Water	Surcharged	Flooded	Pipe		Status	Level Exceeded
		Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)		
S1.000	S1	2.879	0.004	0.000	0.29	11.1	SURCHARGED	
S1.001	S2	2.849	0.188	0.000	1.16	68.4	SURCHARGED	2
S1.002	S3	2.766	0.165	0.000	1.32	78.0	SURCHARGED	
S2.000	S4	3.223	0.063	0.000	1.20	39.0	SURCHARGED	
S1.003	S5	2.655	0.116	0.000	1.26	123.3	SURCHARGED	
S1.004	S6	2.517	0.063	0.000	1.71	122.6	SURCHARGED	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 0
 Number of Online Controls 0 Number of Time/Area Diagrams 0
 Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH
 FEH Rainfall Version 1999
 Site Location GB 522850 333500 TF 22850 33500
 C (1km) -0.020
 D1 (1km) 0.291
 D2 (1km) 0.308
 D3 (1km) 0.210
 E (1km) 0.304
 F (1km) 2.524
 Cv (Summer) 0.750
 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 450.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 60, 120, 180, 240, 360, 480, 600, 720, 960,
 1440, 2160, 2880, 4320, 5760, 7200, 8640,
 10080
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S1	60 Summer	100	+40%	30/60 Summer			
S1.001	S2	60 Summer	100	+40%	30/60 Summer	100/60 Summer		
S1.002	S3	60 Summer	100	+40%	30/60 Summer			
S2.000	S4	60 Summer	100	+40%	30/60 Summer			
S1.003	S5	60 Summer	100	+40%	30/60 Summer			
S1.004	S6	60 Summer	100	+40%	30/60 Summer			

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water	Surcharged	Flooded	Pipe		Status	Level Exceeded
		Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)		
S1.000	S1	3.641	0.766	0.000	0.61	22.9	FLOOD RISK	
S1.001	S2	3.560	0.899	9.823	1.95	114.9	FLOOD	2
S1.002	S3	3.376	0.775	0.000	2.21	130.9	FLOOD RISK	
S2.000	S4	3.799	0.639	0.000	2.11	68.8	FLOOD RISK	
S1.003	S5	3.098	0.559	0.000	2.13	209.6	SURCHARGED	
S1.004	S6	2.705	0.251	0.000	2.93	209.7	SURCHARGED	

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	19.100	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	100	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	100	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	36.380	0.214	170.0	0.048	5.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	14.825	0.060	247.1	0.264	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	15.333	0.062	247.0	0.045	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	36.388	0.162	225.0	0.167	5.00	0.0	0.600	o	225	Pipe/Conduit	
S1.003	26.487	0.085	311.6	0.034	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.004	6.300	0.020	315.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	63.85	5.61	2.650	0.048	0.0	0.0	0.0	1.00	39.8	8.4
S1.001	62.62	5.85	2.361	0.313	0.0	0.0	0.0	1.00	70.4	53.0
S1.002	61.41	6.11	2.301	0.358	0.0	0.0	0.0	1.00	70.4	59.5
S2.000	63.38	5.70	2.935	0.167	0.0	0.0	0.0	0.87	34.5	28.7
S1.003	59.48	6.54	2.164	0.559	0.0	0.0	0.0	1.02	112.8	90.1
S1.004	59.04	6.65	2.079	0.559	0.0	0.0	0.0	1.02	112.2	90.1

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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1
Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.100	Storm Duration (mins)	30
Ratio R	0.400		

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<u>1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)</u> <u>for Storm</u>							
<u>Simulation Criteria</u>							
Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000							
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000							
Hot Start Level (mm) 0 Inlet Coefficient 0.800							
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000							
Foul Sewage per hectare (l/s) 0.000							
Number of Input Hydrographs 0 Number of Storage Structures 0							
Number of Online Controls 0 Number of Time/Area Diagrams 0							
Number of Offline Controls 0 Number of Real Time Controls 0							
<u>Synthetic Rainfall Details</u>							
Rainfall Model FSR Ratio R 0.400							
Region England and Wales Cv (Summer) 0.750							
M5-60 (mm) 19.000 Cv (Winter) 0.840							
Margin for Flood Risk Warning (mm) 450.0 DVD Status OFF							
Analysis Timestep Fine Inertia Status OFF							
DTS Status ON							
Profile(s) Summer and Winter							
Duration(s) (mins) 15, 30, 60							
Return Period(s) (years) 1, 30, 100							
Climate Change (%) 0, 0, 40							

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<u>30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)</u> <u>for Storm</u>					
<u>Simulation Criteria</u>					
Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000					
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000					
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800					
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000					
Foul Sewage per hectare (l/s) 0.000					
Number of Input Hydrographs 0 Number of Storage Structures 0					
Number of Online Controls 0 Number of Time/Area Diagrams 0					
Number of Offline Controls 0 Number of Real Time Controls 0					
<u>Synthetic Rainfall Details</u>					
Rainfall Model FSR Ratio R 0.400					
Region England and Wales Cv (Summer) 0.750					
M5-60 (mm) 19.000 Cv (Winter) 0.840					
Margin for Flood Risk Warning (mm) 450.0 DVD Status OFF					
Analysis Timestep Fine Inertia Status OFF					
DTS Status ON					
Profile(s) Summer and Winter					
Duration(s) (mins) 15, 30, 60					
Return Period(s) (years) 1, 30, 100					
Climate Change (%) 0, 0, 40					
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PHASE 1 CROSSROADS NURSERIES, QUADRING

DRAINAGE STATEMENT

APPENDIX H

IDB Watercourse Plan



Marlode Extension-51

Casswells Dyke-33

Quadring Siding, Drain-61

Bennetts Dyke-31

Watergate Dyke-70

Marlode Drain-50

Cranebit Lane Drain-40

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architecture : engineering : building consultancy

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