JNP GROUP
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Flood Risk Assessment and Drainage Strategy

Project: Land South of Hamsland, Horsted Keynes

Client: Rydon Homes

Reference: C86274-JNP-XX-XX-RP-C-1000

Date: November 2020

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EXECUTIVE SUMMARY

JNP Group has been commissioned by Rydon Homes to prepare a flood risk assessment and drainage strategy for the proposed development at Hamsland, Horsted Keynes.

The development comprises the construction of 30 residential properties with associated access roads, footpaths, driveways and private parking courts. The site is accessed via Hamsland road to the north of the site. The site's topography falls to the south at an average gradient of 1:14.

The site has been assessed against all forms of flood risk.

The site is considered at low risk from fluvial flood risk as there are no rivers near the site with the closest watercourses more than 800m away from the site.

An overland surface water flow path passes the site 30m east of the site boundary however it does shown to enter the site, the site is therefore considered at low risk surface water flows.

As there are no sewers or mains crossing the site and no canals or reservoirs nearby, the site is considered at low risk from flooding from infrastructure and sewer failure.

The closest public borehole records to the site are approximately 850m away however these are located on land 12m above the site and within the same bedrock geology and should therefore hold some relevance in determining the site's groundwater flood risk. The borehole records indicate groundwater at depths of 50m below ground level. Based on the available information the site is considered to be at low risk of groundwater flooding.

As of writing no ground investigations have been carried out for the site however the SFRA discusses the bedrock geology in regards to infiltration, stating that the bedrock underlying the area is not a feasible outfall for surface water flows due to its Impermeability. Based on this the proposed drainage strategy does not rely on infiltration.

A drainage ditch runs along the western boundary of the development site receiving overland flows from the site during storm events. This ditch flows south into a network of ditches that ultimately discharges into the Danehill Brook, 835m south of the site. The proposed drainage strategy maintains the existing regime by discharging run-off into the drainage ditch.

Run-off from roofs and driveways will be collected via gullies and then conveyed to below ground tanks which will attenuate the run-off before it is discharged. Run-off will be treated for all expected pollution indices via a vortex separator downstream of the Hydrobrake flow-control device. The run-off will be limited to QBAR greenfield rates and discharged to the ditch via Hydrobrake flow controls.

As the public foul sewer is located north of the development in Hamsland road, the development will require foul water be pumped-up the access road to meet the public foul sewer. An adoptable pump station has been located in the southern corner of the site and a 15m odour buffer integrated into the layout.

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1 INTRODUCTION

1.1 Terms of Reference

i) JNP Group has been commissioned by Rydon Homes to prepare a flood risk assessment and drainage strategy for the proposed development at Hamsland, Horsted Keynes.

ii) This report assesses flood risk at the development site from all potential sources and describes the measures adopted in the master planning process to manage such risks. It has been prepared in compliance with current policies and best practices.

iii) This report proposes a drainage strategy for the development that manages surface water run-off post-development, emulating the existing drainage regime as close as possible.

1.2 Policy Framework and Key Stakeholders

i) The *National Planning Policy Framework* (NPPF) (February 2019) sets strict tests to protect people and property from flooding which all local planning authorities are expected to follow. Where these tests are not met, national policy is clear that new development should not be allowed.

ii) In areas at risk of flooding or for sites of one hectare (ha) or more, developers must undertake a site-specific flood risk assessment to accompany applications for planning permission (or prior approval for certain types of permitted development).

iii) In decision-taking, local planning authorities must ensure a sequential approach to site selection and master planning is followed so that development is, as far as reasonably possible, located where the risk of flooding (from all sources) is lowest, taking account of climate change and the vulnerability of future uses to flood risk.

iv) The Environment Agency (EA) is a statutory consultee on applications where there is a risk of flooding from the sea or main rivers.

v) Lead local flood authorities (unitary authorities or county councils) are responsible for managing local flood risk from ordinary watercourses, surface water or groundwater, and for preparing local flood risk management strategies. Local planning authorities work with lead local flood authorities to ensure local planning policies are compatible with the local flood risk management strategy.

vi) West Sussex County Council (WSCC) is the lead local flood authority (LLFA) and it's strategy for managing local flood risk is set out in 2018 West Sussex Local Flood Risk Management Strategy.

vii) Mid-Sussex District Council (MSDC) is the local planning authority (LPA) and its policies on flood risk management are set out in Mid-Sussex District Plan 2014-2031 (March 2018).

viii) Where relevant, local planning authorities and developers must also take advice from:

- Internal drainage boards; to identify the scope of their interests.
- Sewerage undertakers; to ensure they can assess the impact of new development on their assets and plan any required improvements. Southern Water (SW) is the local sewerage undertaker.
- Reservoir undertakers; to avoid an intensification of development within areas at risk from reservoir failure and ensure they can assess the cost implications of any reservoir safety improvements required due to change in land use downstream of their assets.

- Navigation authorities; in relation to developments adjacent to, or which discharge into, canals (especially where these are impounded above natural ground level).

1.3 Sources of Information

i) This flood risk assessment has been based on the following sources of information:

- Bespoke topographic survey undertaken by Aston Land Surveys September 2018
- British Geological Survey's *Geoindex Tool*; *(http://mapapps2.bgs.ac.uk/geoindex/home.html)*
- DEFRA / EA's aquifer and source protection data *(https://magic.defra.gov.uk/MagicMap.aspx)*
- British Geological Survey's borehole scans; *(http://mapapps.bgs.ac.uk/geologyofbritain/home.html)*
- FEH's catchment data *(https://fehweb.ceh.ac.uk/)*
- EA's *Flood Map for Planning*; *(https://flood-map-for-planning.service.gov.uk/)*
- EA's *Long Term Flood Risk Information*; *(https://flood-warning-information.service.gov.uk/long-term-flood-risk/map)*
- WSCC's Strategic Flood Risk Assessment (May 2011);
- MSDC's Strategic Flood Risk Assessment (June 2015);

2 DEVELOPMENT SITE

2.1 Location

i) The development site is located to the south of Hamsland in Horsted Keynes, West Sussex (Figure 2.1) The site is accessed from Hamsland to the north.

ii) The 1.1 ha Greenfield site is bounded by residential area to the north, Milford Place to the east and further greenfield land to the south and west.

Table 2.1: Site Location

OS X	OS Y	Nearest Postcode
538429	127854	RH17 7DZ

Figure 2.1: Site Location

2.2 Topography

i) The available topographic information (Appendix AA) shows that ground levels within the development site range between 91.5 m AOD and 84.45 m AOD, falling with an average slope of 1:14 towards the southern corner of the site.

2.3 Hydrology

i) The closest watercourse is a stream 650m to the south-west of the development site and approximately 10m lower in altitude. This stream is a tributary to the Cockhaise Brook.

ii) A drainage ditch runs along the western boundary of the site. The ditch flows offsite into a network of ditches which ultimately discharges into the Danehill Brook approximately 835m south of the development site.

iii) No other watercourses or waterbodies are within the vicinity of the development site.

2.4 Geology and Hydrogeology

i) In accordance with BGS' *Geoindex*, the development site lies on two bedrocks. The Ashdown Formation in the northern half of the site and the Upper Tunbridge Wells Sand in the southern half.

ii) The Ashdown Formation and the Upper Tunbridge Wells Sand are both sedimentary bedrock geology consisting of interbedded Sandstone and Siltstone strata. Both geologies are considered to be relatively impermeable.

iii) DEFRA MAGiC maps classify the site's bedrock geology as a Secondary A Aquifer. A Secondary A Aquifer is defined as "*permeable layers capable of supporting water supplies at a local rather than strategic scale, in some cases forming an important source of base flow to rivers*".

iv) In accordance with DEFRA MAGiC maps, the site is identified as being in a groundwater vulnerability zone with high vulnerability. This is discussed in the Mid-Sussex County Council Strategic Flood Risk Assessment which states that any SuDS design for this site must address the high groundwater vulnerability for the site.

3 PROPOSED DEVELOPMENT

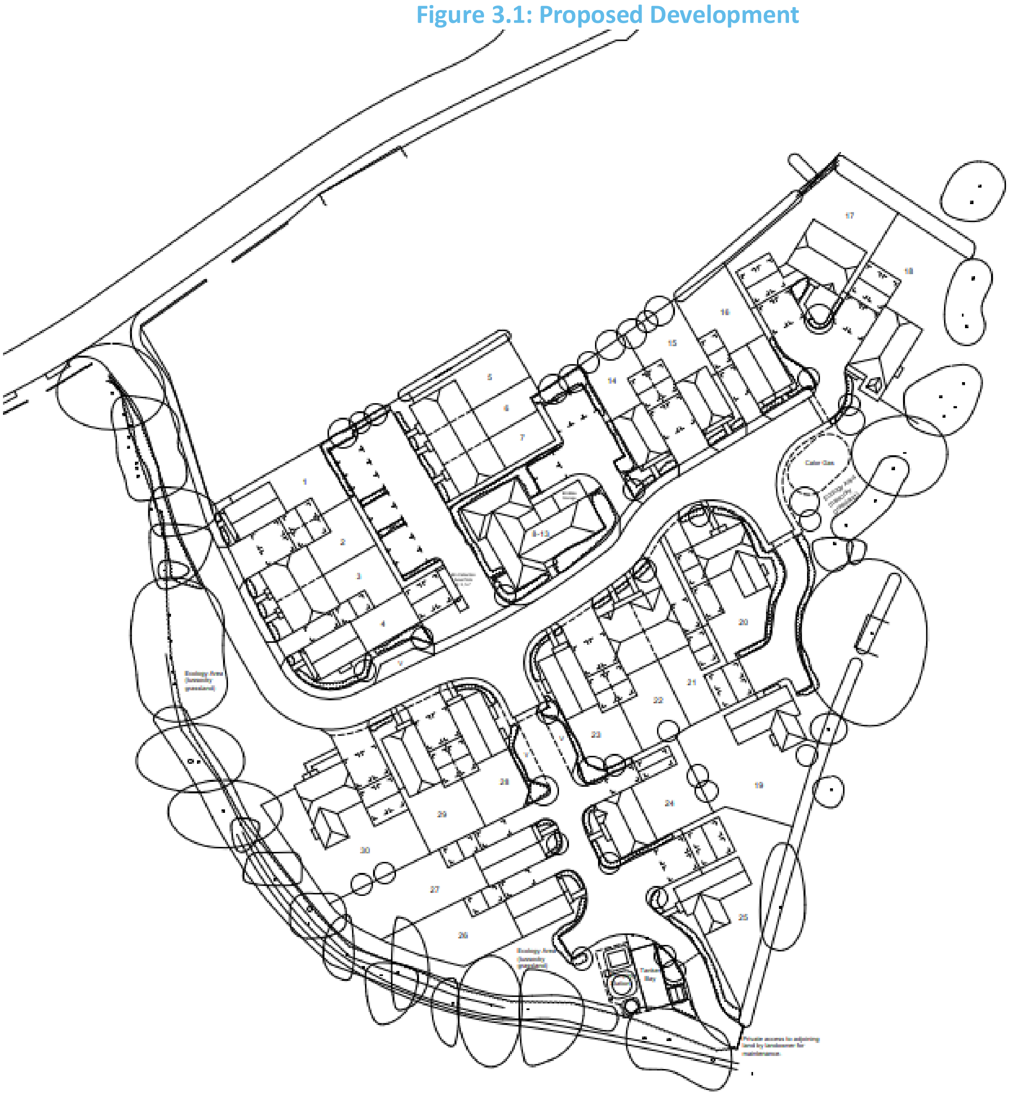
i) The proposed development entails the construction of 30 residential units with associated access roads, driveways, private parking areas and footpaths.

ii) The proposed development introduces 0.642 ha of impermeable surfaces to the site in the form of buildings roofs and paved surfaces.

iii) Under *Table 2* of the *Flood Risk and Coastal Change Guidance* (March 2014), the proposed residential development is classified as more vulnerable.

iv) The proposed site layout has been included in Appendix B for review.

Figure 3.1: Proposed Development



4 FLOOD RISK ASSESSMENT

4.1 Overview

i) All potential sources of flood risk at the development site have been assessed based on the information listed in Section 1.3 and are summarised in Table 4.1. The key sources of flood risk to the proposed development are further described in the ensuing sections.

Table 4.1: Potential Sources of Flood Risk

Source	Flood Risk
Coastal	The site is 25km from the coast and is therefore considered to be safe from coastal flooding.
Fluvial	The site is considered to be at low risk of fluvial flooding. The closest watercourse is 650m away to the west.
Surface Water	The site is at low risk of surface water flooding with flood maps showing no flood risk on site. An overland flow path has been identified flowing south, 30m east of the site boundary.
Groundwater	Based on the available information, Groundwater flood risk is considered low.
Infrastructure Failure	Very low risk as there are no canals or reservoirs within the local area and no sewers crossing or immediately adjacent to the site.

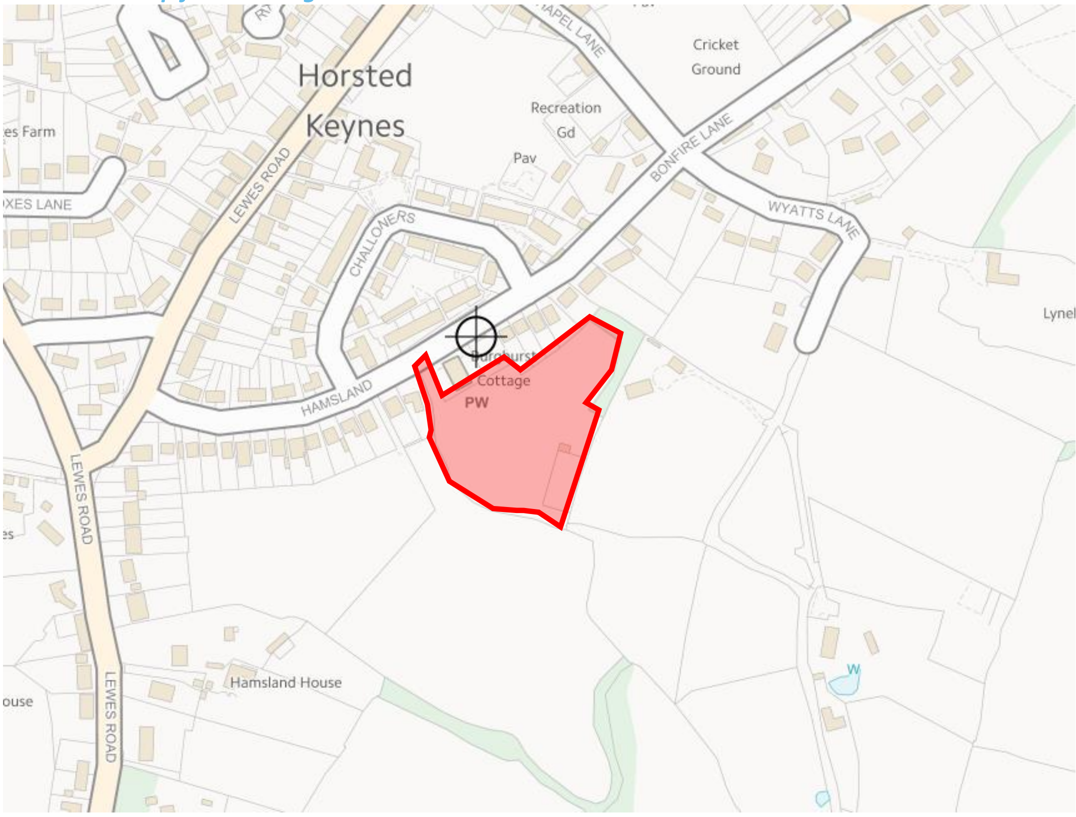
4.2 Climate Change

i) The NPPF sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. This includes demonstrating how flood risk will be managed now and over the development's lifetime, taking climate change into account.

ii) In accordance with the EA's guidance *Flood Risk Assessment: Climate Change Allowances* (February 2016), the proposed development with anticipated life span into the 2080's (2070 to 2115) must take account of the following allowances:

- Peak River Flows (South-East river basin district)
  - Central 120%
  - Higher Central 105%
  - Upper End 45%
- Peak Rainfall Intensity
  - Central 20%
  - Upper End 40%

Figure 4.1: *Flood Map for Planning*



4.3 Fluvial Flood Risk

i) Fluvial flooding occurs when a catchment area receives greater than usual amounts of water (e.g. rainfall or snow melt). Fluvial flooding usually occurs hours or days after heavy and / or prolonged rainfall and its effects often last several hours or days.

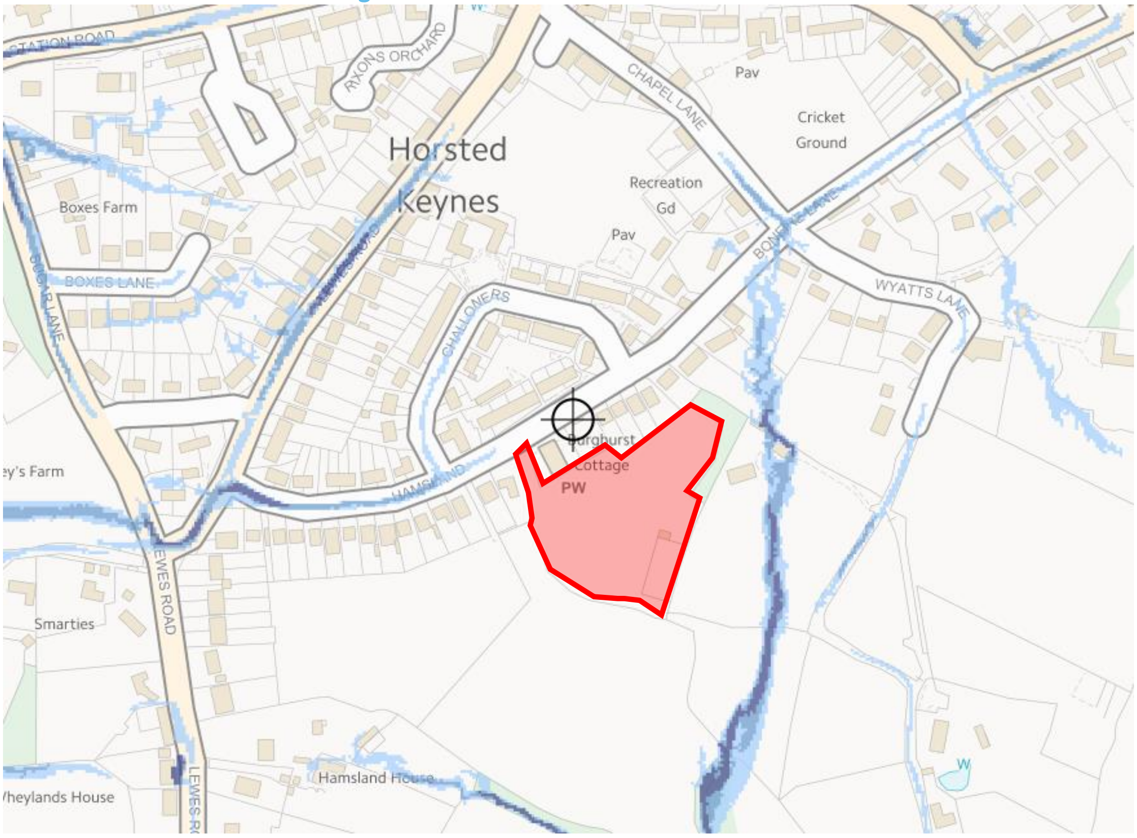
ii) In accordance with the EA's *Flood Map for Planning* (Figure 4.1: *Flood Map for Planning*), the development site is in Flood Zone 1 (0.1% AEP) and is therefore considered to be at low risk from fluvial flooding.

4.4 Surface Water Flood Risk

i) Surface water flooding is usually the result of very intense, short lived rainfall events, but can also occur during milder, longer lived rainfall events, when collecting systems are at capacity or the ground is saturated. It often results in overland flows and/or the inundation of low points in the terrain.

ii) In accordance with the EA's *Long Term Flood Risk Information* (Figure 4.2), the development site is at very low (< 0.1% AEP) risk of surface water flooding. An overland flow path flows south, 30m east of the site boundary. The flow path does not flow towards or into the site during any of the storm events.

Figure 4.2: Flood Risk from Surface Water



iii) The surface water run-off generated as a result of the development site will be managed by the drainage strategy described in Section 5.

4.5 Groundwater Flood Risk

i) Groundwater flooding occurs when the level of water filling the pores and / or cracks in the underlying soil and / or rock (i.e. water table) rises and emerges on the surface. The level of the water table varies seasonally and depends upon long term rainfall, thickness and porosity of the underlying strata and groundwater abstraction.

ii) Groundwater flooding is most common in areas where the underlying bedrock and superficial deposits are very porous, but it can also happen at locations where superficial layers of sand or gravel overlay impermeable bedrock.

iii) BGS maps indicate that the site is underlain by sandstone and siltstone strata. These strata generally have low permeability.

iv) The Mid-Sussex County Council Strategic Flood Risk Assessment elaborates on this stating that due to the underlying bedrock geology the site will have limited infiltration potential. It goes on to recommend that developments overlying this bedrock should not rely solely on infiltration and should rather utilise a combined infiltration or a full attenuation system.

v) According to MSDC's strategic flood risk assessment the majority of the Mid-Sussex district is considered to have medium potential for groundwater flooding. Whilst the development site is in the district the SFRA does not go into how this was determined. This indication is most likely determined by the districts bedrock geology having the potential to be permeable at deeper levels.

vi) British Geological Survey borehole records indicate no borehole records within the immediate vicinity of the site. There are however borehole survey records between 0.8-1km away from the site. BH TQ32NE3 indicates groundwater at 50m below ground level. Whilst this is a distance away from the site the boreholes were dug at ground levels 12m above the site and within the same bedrock geology.

vii) As the surface level at this borehole is approximately 10-20m above the development and within the same bedrock geology the groundwater levels observed provides some indication as to what can be expected if the groundwater is in hydraulic continuity.

viii) Based on the available geologic and hydrogeologic information, a drainage strategy relying solely on infiltration drainage is considered to be unfeasible. The proposed drainage strategy will utilise a fully tanked solution however infiltration testing may prove that partial infiltration may be possible, which will necessitate an updated drainage strategy.

ix) If the groundwater table identified in the borehole 850m to the north is in continuity with the site than groundwater flood risk can be considered low.

x) Based on the available information the site is considered to be at low risk of groundwater flooding.

5 DRAINAGE STRATEGY

5.1 Existing Drainage (Greenfield Runoff)

i) The undeveloped (greenfield) development site does not benefit from a formal surface water drainage system. Runoff generated within the site is expected flow overland towards the southern corner where it will flow into a drainage ditch. This drainage ditch spans the western boundary of the site and continues south into a network of ditches. The ditch network ultimately discharges into Danehill Brook approximately 835m south of the site.

ii) A greenfield rate of 6.3 l/s/ha (QBAR) has been established for the development site using the ADAS methodology with a Soil Index value of 0.45 for the site (The greenfield runoff calcs have been provided in Appendix C). The ADAS method was selected due to the relatively steep gradient of the site, by accounting for the sites topography in the calculations a more accurate greenfield run-off rate can be obtained.

5.2 General Principles for Proposed Site Run-Off

i) The National Standards for Sustainable Drainage Systems (Defra, 2011) state that the following options must be considered for the disposal of surface water run-off in order of preference:

- Discharge to Ground
- Discharge to Surface Water Body
- Discharge to Surface Water Sewer
- Discharge to Combined Sewer

Discharge to Ground

ii) As established in Section 2.4 the site is underlain by a low permeability bedrock geology. Whilst some infiltration may be possible, rates will be too low to rely solely on infiltration. 'Discharge to Ground' is therefore considered feasible with the understanding that a portion of the surface water run-off may be discharged to ground using a partially-infiltrating system.

Discharge to Surface Water Body

iii) The existing drainage regime entails surface water run-off flowing south into the boundary ditch that spans the western boundary. This ditch flows into a ditch network which ultimately discharges into the Danehill Brook approximately 835m south. As the ditch starts within the site boundary the proposed development will emulate the existing drainage regime and discharge surface water run-off into the ditch.

Discharge to Sewers

iv) This is the least desirable option for discharging surface water, the other options must be proven to be unfeasible for the site before this option is considered. As the site can discharge surface water to a watercourse, discharging to sewer is not considered to be appropriate.

5.3 Proposed Drainage Strategy

i) The proposed surface water drainage strategy has been designed in accordance with Sewers for Adoption wherever possible and in compliance with the NPPF, local requirements and current best practices†,to collect, convey and attenuate runoff from all impermeable areas (0.583ha) before discharging into the drainage ditch along the western boundary.

ii) The drainage strategy accounts for additional surface water run-off as a result of Urban Creep and Soft-Landscaping with an allowance of 20% over expected flows. The strategy and calculations therefore account for 0.6998ha of drained area.

iii) Surface Water runoff generated on the development will be captured by gullies and conveyed via one of two, gravity fed pipe networks, each network will attenuate excess run-off in cellular crate tanks. The stored run-off will be discharged into the drainage ditch along the western boundary. Hydrobrake flow control devices will limit discharge to the Qbar greenfield run-off rates . Table outlines the drained area, storage volume and discharge rate for the two areas.

Table 5:1 - Drainage Network Area, Volume, Discharge Rate Summary

Drained Area (ha)	Drained Area + UC + SL	Storage Volume (m3)	Discharge Rate (l/s)
0.4945	0.5935	374	3.7
0.0885	0.1063	90	0.8

iv) Run-off will be discharged to the drainage ditch at the QBAR greenfield rate of 3.7 l/s for the north and 0.8 l/s for the south for all storm events up to and including the 1 in 100 year event (+40% climate change). This complies with local authority guidance which requires new developments be limited to as close to greenfield run-off rates as possible. .

v) A simple MicroDrainage network has been created to model the proposed network, with the key pipe runs, attenuation storage and flow controls. This has been tested for all storm events including the 1 in 1, 1 in 30 and 1 in 100 annual expected probability as well as the 1 in 100 year event with 40% climate change and durations from 15, to 10080 minutes (The proposed surface water drainage network calcs have been provided in Appendix C).

vi) The attenuation tanks have been sized to store surface water run-off during all storm events including the critical 1 in 100 year storm event +40% climate change allowance.

vii) The results of the simulations are included in Appendix C.

5.4 Water Quality Management

i) The suitability of the proposed drainage strategy to manage the development's pollution risk has been assessed using the simple index approach in *The SuDS Manual* (2015), as summarized in Table 5.2.

† e.g. *Non-Statutory Technical Standards for Sustainable Drainage Systems* (March 2015) and *The SuDS Manual* (2015).

Table 5.2: Surface Water Quality Management (Simple Index Approach)

Runoff Route / Treatment Train 1				
Land Use / SuDS	Hazard Level	TSS	Metals	Hydro-Carbons
Pollution Hazard Indices				
Residential Roofs	Very Low	0.20	0.20	0.05
Driveways, residential car parks and low traffic roads	Low	0.50	0.40	0.40
SuDS Mitigation Indices				
Downstream Defender (Vortex Seperator)	-	0.50	0.40	0.80
Mitigation Index Exceeds Each Pollution Hazard Index				

5.5 Exceedance Events

i) Plot levels are set at least 0 mm above external ground levels and external ground levels have been designed to safely route overland flows away from buildings and towards the drainage ditch, using the less vulnerable parts of the proposed development such as parking areas and roads to convey and store overland flows.

ii) Overland flows resulting from exceedance events are expected to leave the developed site via the drainage ditch as currently occurs (i.e. pre-development conditions), without posing any increased flood risk on site or elsewhere.

6 FOUL WATER DRAINAGE STRATEGY

i) Sewerage undertakers have a legal obligation under the Water Industries Act 1991 to provide developers with the right to connect to public (foul) networks. The Water Industries Act 1991 also contains safeguards to ensure that flows resulting from new developments do not cause detriment to the existing public sewerage networks by imposing a duty on sewerage undertakers to carry out works required to accommodate additional flows into their networks.

ii) A Southern Water Foul Sewer flows west down Hamsland road. As Hamsland Road is located more than 10m above the lowest point on the site run-off will have to be pumped uphill to be discharged into the public foul sewer network.

iii) The undeveloped (greenfield) development site does not benefit from a formal foul water drainage system.

iv) The proposed foul water drainage strategy envisages a pumping station (compound sized to adoptable standards, with a cordon sanitaire of 15 m to all dwellings) in the southern part of the site. The proposed foul pumping station will be raised to the public sewer in Hamsland road to the north.

7 CONCLUSIONS AND RECOMMENDATIONS

i) The site was assessed against all sources of flood risk and found to be at low risk from all sources of flooding. Groundwater flood risk at the site is considered to be low.

ii) All methods of discharge were considered in order of preference. Discharge to ground was ruled out due the low permeability bedrock underlying the site. As infiltration cannot be relied upon for discharge of run-off. The proposed drainage strategy emulates the existing drainage regime by discharging surface water run-off to the western boundary ditch at QBAR greenfield run-off rates.

iii) The proposed drainage strategy emulates the existing drainage regime by discharging surface water run-off to the western boundary ditch at QBAR greenfield run-off rates for all storm events including the critical storm event.

iv) Run-off will be collected via gullies and conveyed into attenuation tanks which will store it prior to it being discharged into the drainage ditch via a Hydrobrake flow control device. Run-off will pass through a vortex separator to remove any pollutants generated on the development. The attenuation tanks have been sized to store run-off generated in all storm events including the critical 1 in 100 year storm event (+40% climate change).

v) As the public foul sewer in Hamsland road is higher than the site, foulwater generated on development will require pumping. A pump station has been located at the southern corner with a rising main running within the road into a new foulwater manhole to be constructed on the existing Southern Water public foul sewer.

vi) The proposed development is considered suitable for development, provided the recommendations made in this report are abided by.

8 LIMITATIONS

i) The information, conclusions and recommendations presented within this report are deemed to be current at the time of issue. No guarantee can be given to the status of this information other than at the time of issuing. Where necessary, the user shall confirm the status of any applicable assessments and consents.

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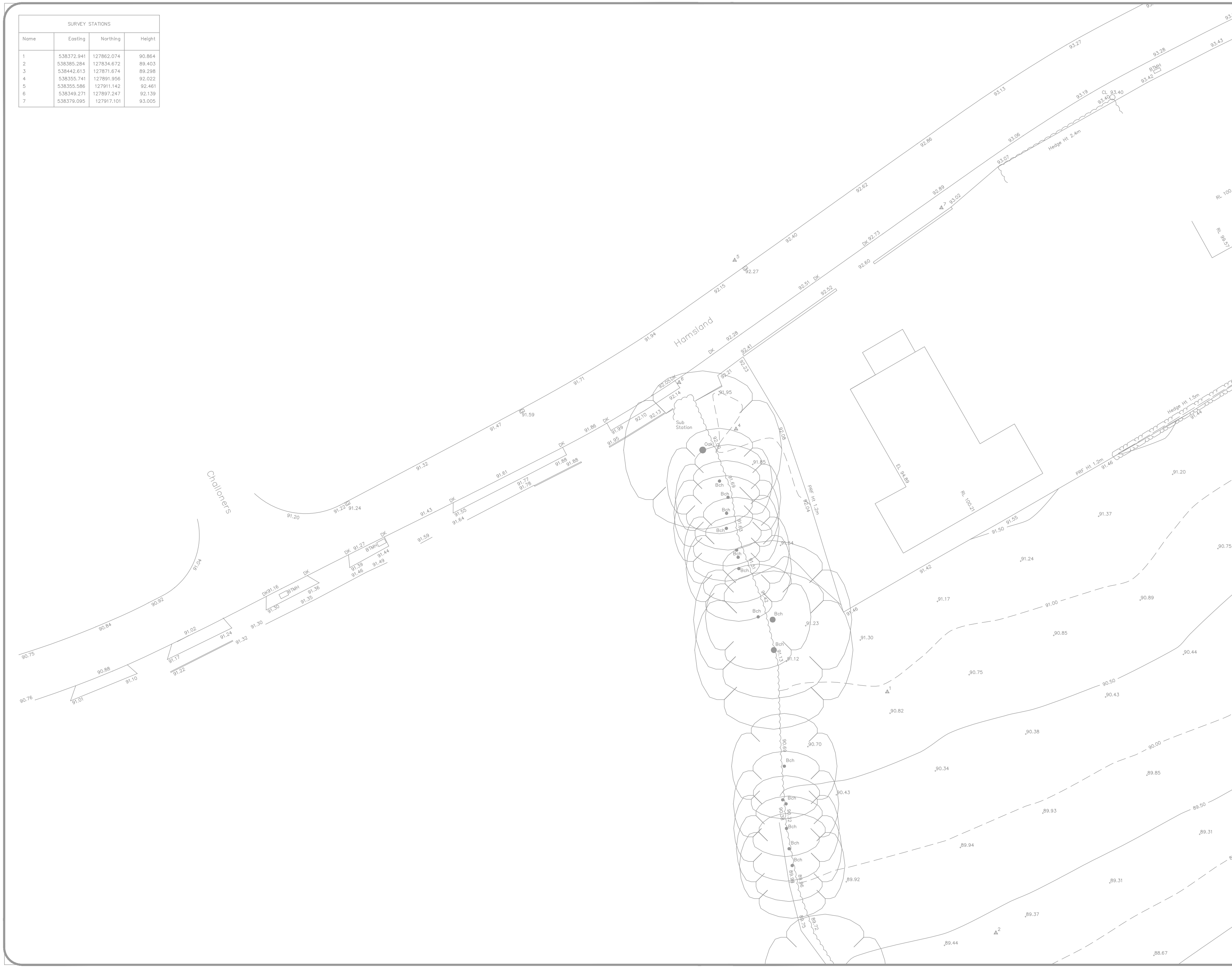
APPENDIX A

SITE INFORMATION



SURVEY STATIONS			
Name	Easting	Northing	Height
1	538372.941	127862.074	90.864
2	538385.284	127834.672	89.403
3	538442.613	127871.674	89.298
4	538355.741	127891.956	92.022
5	538355.586	127911.142	92.461
6	538349.271	127897.247	92.139
7	538379.095	127917.101	93.005

Aston Land Surveys

27 Davys Place
Gravesend
Kent DA12 4DL
MOBILE 07831 628524

LEGEND

EXTENT OF VEGETATION	
HEDGES	
BUSH	
TREE (Trunk drawn to scale)	
DEAD TREE	
SINGLE GATE	
DOUBLE GATE	
OVERHEAD CABLE	
WALL	
BUILDING	
ORDNANCE SURVEY BENCH MARK	OSBM Value 28.86

BOLLARD	B
BOREHOLE	BH
BUS STOP	BS
BRITISH TELECOM BOX	BT BOX
BRITISH TELECOM MANHOLE	BTMH
CABLE TELEVISION MANHOLE	CATV
FIRE HYDRANT	FH
FOOTPATH	FP
GULLY	G
LAMP POST	LP
MANHOLE	MH
POST BOX	PB
ROAD SIGN	RS
STOP VALVE	SV
SURVEY STATION	
TELEPHONE CALL BOX	TCB
TRAFFIC LIGHT	TL
TELEGRAPH POLE	TP
SPOT LEVEL	+ 28.86
COVER LEVEL	CL 28.86
INVERT LEVEL	IL 28.86
UNABLE TO LIFT	UTL
DITCH	
BANKING	

TREE LEGEND

ALDER	ALD	LIME	LIM
ASH	ASH	LOCUST	LCS
ASPEN	ASP	LONDON PLANE	LPN
BEECH	BCH	MAPLE	MPL
CEDAR	CED	OAK	OAK
CYPRESS	CYP	PINE	PNE
DEAD	DED	POPLAR	POP
ELDER	ELD	RHODODENDRONS	RDN
ELM	ELM	ROWAN	RWN
FIR	FIR	SAPLING	SAP
FRUIT	FRT	SILVER BIRCH	SIB
GOAT WILLOW	GWW	SMOOTH JAPANESE MAPLE	SJM
HAWTHORN	HAW	SPRUCE	SPR
HOLLY	HLY	SWEET CHESTNUT	SCH
HORSE CHESTNUT	HCH	SYCAMORE	SYC
HORNBEAM	HBM	WALNUT	WNT
LABURNUM	LBM	WHITEBEAM	WBM
LARCH	LAR	WILLOW	WLW
LAUREL	LRL	YEW	YEW

FENCE DESCRIPTIONS

BARBED WIRE FENCE	BWF	INTERWOVEN FENCE	IWF
CLOSE BOARD FENCE	CBF	OPEN BOARD FENCE	OBF
CORRUGATED IRON FENCE	CIF	POST AND CHAIN FENCE	PCF
CHAIN LINK FENCE	CLF	POST AND RAIL FENCE	PRF
CHESTNUT PALING	CPF	POST AND WIRE FENCE	PWF
IRON RAILINGS	IRF	WIRE MESH FENCE	WMF

Client
Rydon Homes Ltd
Rydon House
Forest Row
Sussex

Project
Hamsland
Horsted Keynes

Drawing Title
Site Survey

Scale 1:200 | Drawn By T.S.
Date Sept '18 | Checked By A.D.

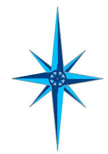
Drawing No HHK/1760/1 of 3a

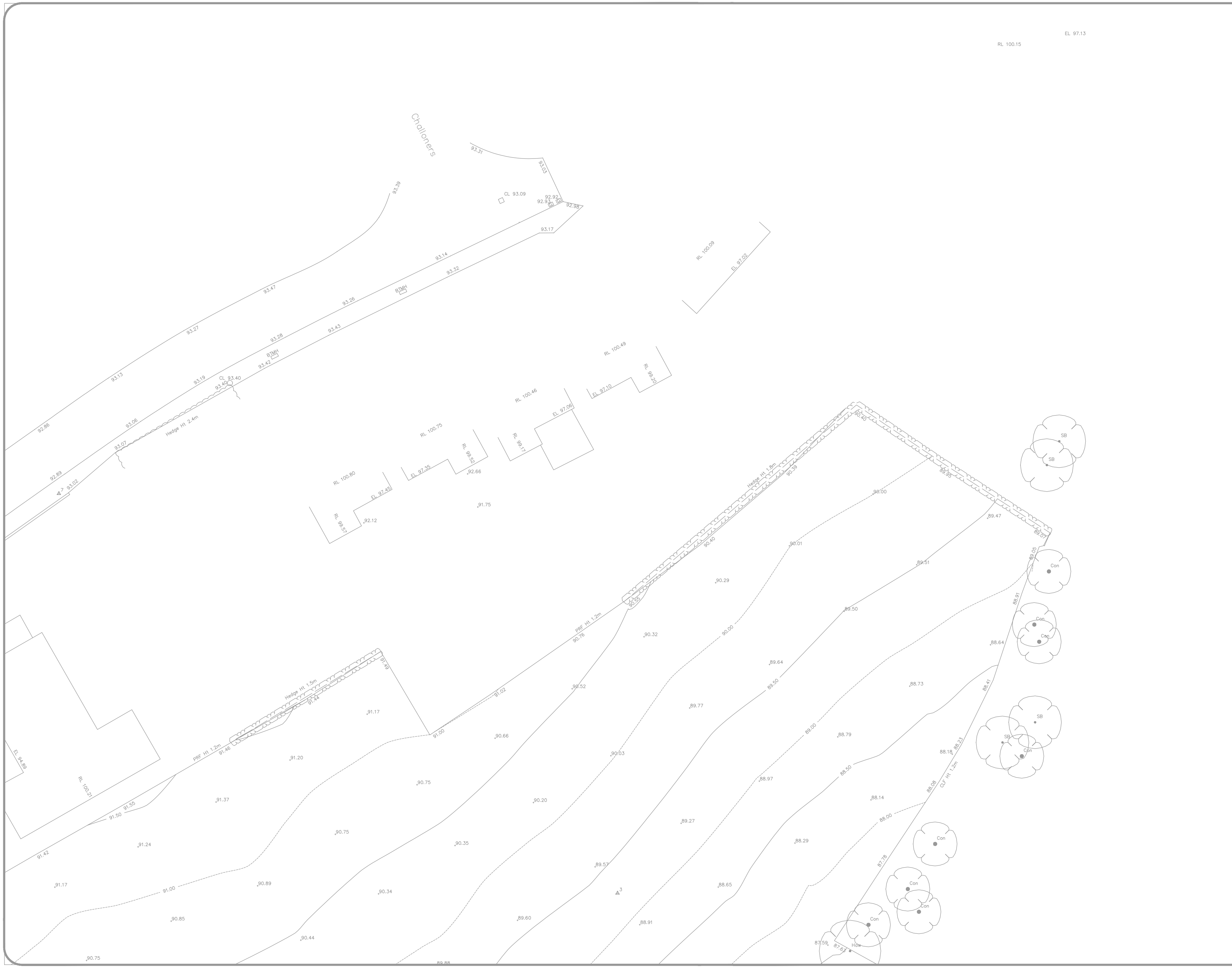
Revisions
A : Ditch along southern boundary added. Sept '20

NOTES

1. TREES – The tree species have been identified to the best of the surveyors knowledge, with the mean spread drawn to scale. Tree heights are approximate.
2. DRAINAGE – All drainage has been surveyed by visual inspection only and should be cross checked in critical areas.
3. FENCES – Fences shown are not necessarily legal boundaries.
4. GRID – The survey grid is based on Ordnance survey co-ordinates derived from GPS.
5. LEVELS – Levels relate to OSBM derived from GPS.

N





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MOBILE 07831 628524

LEGEND

EXTENT OF VEGETATION	BOLLARD	B
	BOREHOLE	BH
	BUS STOP	BS
HEDGES	BRITISH TELECOM BOX	BT BOX
	BRITISH TELECOM MANHOLE	BTMH
	CABLE TELEVISION MANHOLE	CATV
	FIRE HYDRANT	FH
BUSH	FOOTPATH	FP
	GULLY	G
TREE (Trunk drawn to scale)	LAMP POST	LP
	MANHOLE	MH
	POST BOX	PB
DEAD TREE	ROAD SIGN	RS
	STOP VALVE	SV
	SURVEY STATION	
SINGLE GATE	TELEPHONE CALL BOX	TCB
	TRAFFIC LIGHT	TL
DOUBLE GATE	TELEGRAPH POLE	TP
	SPOT LEVEL	+ 28.86
OVERHEAD CABLE	COVER LEVEL	CL 28.86
	INVERT LEVEL	IL 28.86
	UNABLE TO LIFT	UTL
WALL	DITCH	
BUILDING	BANKING	
ORDNANCE SURVEY BENCH MARK (OSBM Value 28.86)		

TREE LEGEND

ALDER	ALD	LIME	LIM
ASH	ASH	LOCUST	LCS
ASPEN	ASP	LONDON PLANE	LPN
BEECH	BCH	MAPLE	MPL
CEDAR	CED	OAK	OAK
CYPRESS	CYP	PINE	PNE
DEAD	DED	POPLAR	POP
ELDER	ELD	RHODODENDRONS	RDN
ELM	ELM	ROWAN	RWN
FIR	FIR	SAPLING	SAP
FRUIT	FRT	SILVER BIRCH	SIB
GOAT WILLOW	GWW	SMOOTH JAPANESE MAPLE	SJM
HAWTHORN	HAW	SPRUCE	SPR
HOLLY	HLY	SWEET CHESTNUT	SCH
HORSE CHESTNUT	HCH	SYCAMORE	SYC
HORNBEAM	HBM	WALNUT	WNT
LABURNUM	LBM	WHITEBEAM	WBM
LARCH	LAR	WILLOW	WLW
LAUREL	LRL	YEW	YEW

FENCE DESCRIPTIONS

BARBED WIRE FENCE	BWF	INTERWOVEN FENCE	IWF
CLOSE BOARD FENCE	CBF	OPEN BOARD FENCE	OBF
CORRUGATED IRON FENCE	CIF	POST AND CHAIN FENCE	PCF
CHAIN LINK FENCE	CLF	POST AND RAIL FENCE	PRF
CHESTNUT PALING	CPF	POST AND WIRE FENCE	PWF
IRON RAILINGS	IRF	WIRE MESH FENCE	WMF

Client

Rydon Homes Ltd
Rydon House
Forest Row
Sussex

Project

Hamsland
Horsted Keynes

Drawing Title

Site Survey

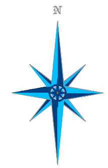
Scale 1:200	Drawn By T.S.
Date Sept '18	Checked By A.D.
Drawing No HHK/1760/2 of 3a	

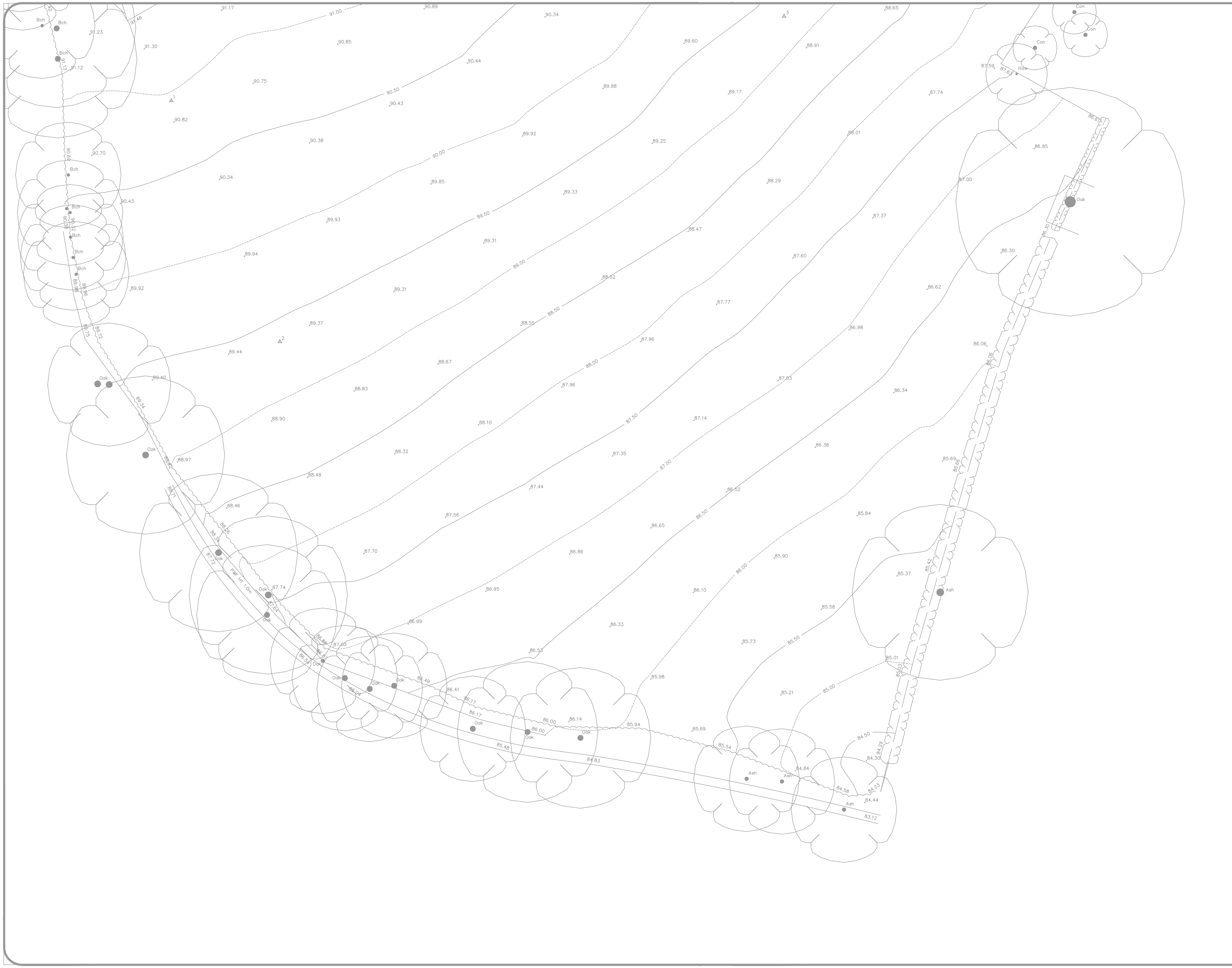
Revisions

A : Ditch along southern boundary added. Sept '20

NOTES

1. TREES – The tree species have been identified to the best of the surveyors knowledge, with the mean spread drawn to scale. Tree heights are approximate.
2. DRAINAGE – All drainage has been surveyed by visual inspection only and should be cross checked in critical areas.
3. FENCES – Fences shown are not necessarily legal boundaries.
4. GRID – The survey grid is based on Ordnance survey co–ordinates derived from GPS.
5. LEVELS – Levels relate to OSBM derived from GPS.





Aston Land Surveys

27 Davys Place
Gravesend
Kent DA12 4DL
MOBILE 07831 628524

LEGEND

EXTENT OF VEGETATION	BOLLARD	B
HEDGES	BOREHOLE	BH
BUSH	BUS STOP	BS
TREE (Trunk drawn to scale)	BRITISH TELECOM BOX	BT BOX
DEAD TREE	BRITISH TELECOM MANHOLE	BTMH
SINGLE GATE	CABLE TELEVISION MANHOLE	CATV
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OVERHEAD CABLE	FOOTPATH	FP
WALL	GULLY	G
BUILDING	LAMP POST	LP
ORDNANCE SURVEY BENCH MARK (OSBM Value 28.86)	MANHOLE	MH
	POST BOX	PB
	ROAD SIGN	RS
	STOP VALVE	SV
	SURVEY STATION	
	TELEPHONE CALL BOX	TCB
	TRAFFIC LIGHT	TL
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	UNABLE TO LIFT	UTL
	DITCH	
	BANKING	

TREE LEGEND

ALDER	ALD	LIME	LIM
ASH	ASH	LOCUST	LCS
ASPEN	ASP	LONDON PLANE	LPN
BEECH	BCH	MAPLE	MPL
CEDAR	CED	OAK	OAK
CYPRESS	CYP	PINE	PNE
DEAD	DED	POPLAR	POP
ELDER	ELD	RHODODENDRONS	RDN
ELM	ELM	ROWAN	RWN
FIR	FIR	SAPLING	SAP
FRUIT	FRT	SILVER BIRCH	SIB
GOAT WILLOW	GWW	SMOOTH JAPANESE MAPLE	SJM
HAWTHORN	HAW	SPRUCE	SPR
HOLLY	HLY	SWEET CHESTNUT	SCH
HORSE CHESTNUT	HCH	SYCAMORE	SYC
HORNBEAM	HBM	WALNUT	WNT
LABURNUM	LBM	WHITEBEAM	WBM
LARCH	LAR	WILLOW	WLW
LAUREL	LRL	YEW	YEW

FENCE DESCRIPTIONS

BARBED WIRE FENCE	BWF	INTERWOVEN FENCE	IWF
CLOSE BOARD FENCE	CBF	OPEN BOARD FENCE	OBF
CORRUGATED IRON FENCE	CIF	POST AND CHAIN FENCE	PCF
CHAIN LINK FENCE	CLF	POST AND RAIL FENCE	PRF
CHESTNUT PALING	CPF	POST AND WIRE FENCE	PWF
IRON RAILINGS	IRF	WIRE MESH FENCE	WMF

Client
Rydon Homes Ltd
Rydon House
Forest Row
Sussex

Project
Hamsland
Horsted Keynes

Drawing Title
Site Survey

Scale 1:200	Drawn By T.S.
Date Sept '18	Checked By A.D.
Drawing No HHK/1760/3 of 3a	

Revisions
A : Ditch along southern boundary added. Sept '20

NOTES

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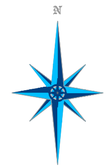


APPENDIX B
PROPOSED DEVELOPMENT

Rydon Homes Ltd
Rydon House
Station Road
Forest Row
East Sussex
RH18 5DW
T 01342 825151
E-mail:design@rydon.co.uk

Land at Hamsland
Horsted Keynes

Site Layout

Drawing No: 1044–SK05

Date: October 2020
Drawn by:
Scale: 1:500 @ A1
Rev:

APPENDIX C

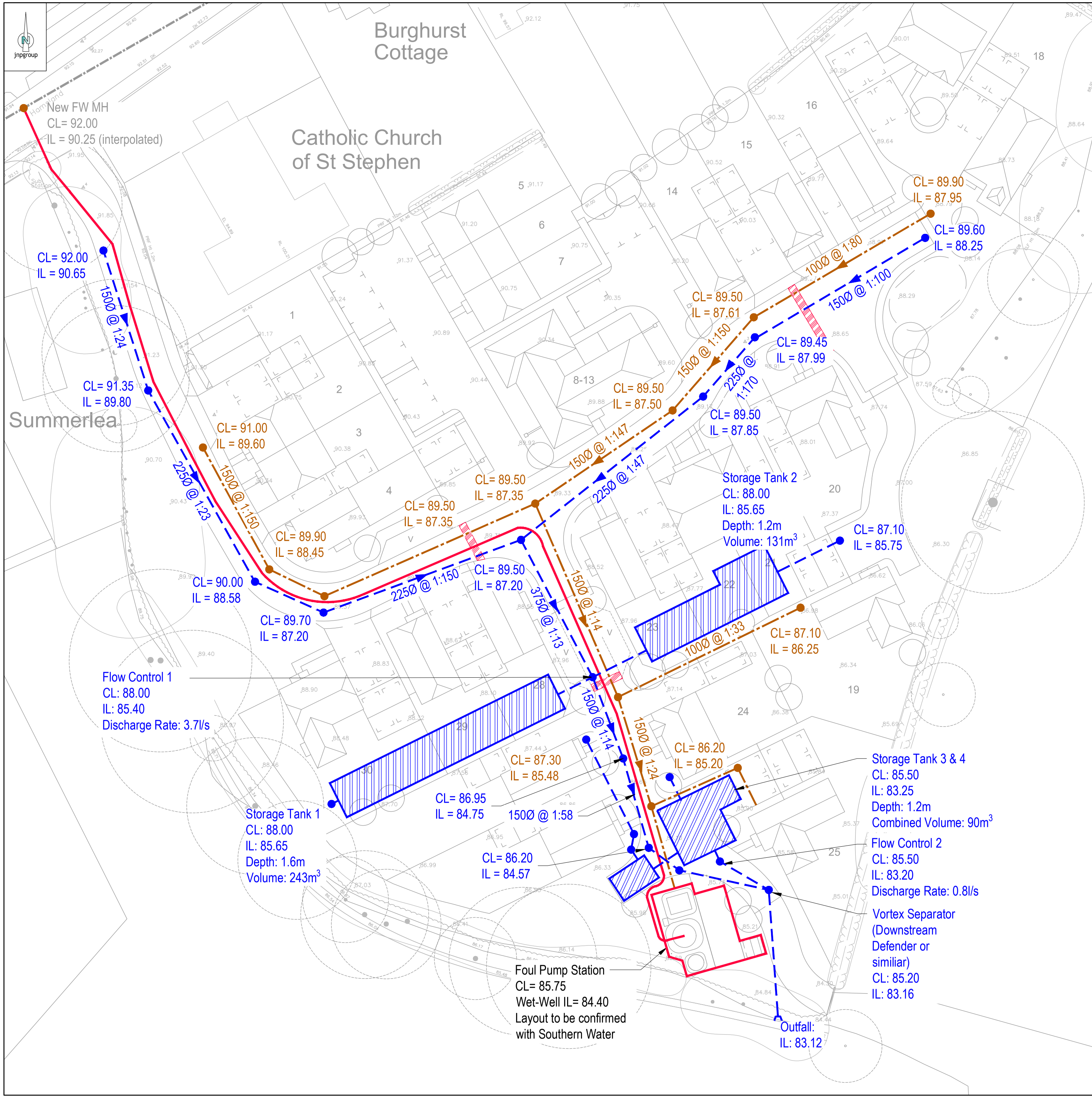
SURFACE WATER DRAINAGE STRATEGY

ADAS 345 Mean Annual Flood

Input

Area (ha)	1.000	AAR (mm)	813	Region Number	Region 7
Length (m)	120.000	Soil Type Factor (St)	0.450		
Average Slope (1:X)	17.0	Paved Area (%)	0.000		

Results	**l/s**
Q0 - Peak Flood Flow	5.5
Total Q0	5.5
QBAR	6.3
Q100 years	20.0
Q1 year	5.3
Q2 years	5.5
Q5 years	8.0
Q10 years	10.2
Q20 years	12.6
Q25 years	13.5
Q30 years	14.2
Q50 years	16.4
Q100 years	20.0
Q200 years	23.5
Q250 years	24.7
Q1000 years	32.4



Key

— ○ — (blue dashed)	Proposed Surface Water
—●— (brown)	Proposed Foul Water
— (red)	Proposed Rising Main
— · — (grey)	Existing Southern Water Public Foul Water Sewer
⌒	Headwall
(blue hatched)	Attenuation Tank
(red hatched)	Service Corridor
(red outline)	Pump Station
(dashed circle)	RPA

Drawing References

- Topographic Survey provided by Aston Land Surveys HHK/1760 September 2018
- Site Layout 1044-FA-02 provided by Rydon Homes 19th November 2020

General Notes

1. Where this drawing has been issued in electronic .dwg format it has been done so in good faith. JNP Group do not take any responsibility for any inaccuracies in the electronic data, which should be checked against the paper (or .pdf) drawing issue. Any apparent discrepancies should be immediately reported to JNP Group. The electronic .dwg file should not be assumed to be to scale and should not be used for 'overlaying', setting out or checking of any third party information. All dimensions should be taken from the paper (or .pdf) version of the drawing. Electronic drawings may contain third party information. JNP Group take no responsibility for this information, which should be checked against the originators paper drawing(s).
2. All dimensions to be checked on site prior to construction/fabrication.
3. Do not scale from this drawing.
4. Any discrepancies between drawings of different scales, and between drawings and specification where appropriate to be notified to JNP Group for decision.
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Health & Safety Note

The details on this drawing have been prepared on the assumption that a competent contractor will be carrying out the works. If the contractor(s) considers that there is insufficient Health and Safety information on this drawing, this should immediately be brought to the attention of the designer.

HAZARD IDENTIFICATION BOX

This table is provided to assist the Principal Contractor to fulfil their obligations under the CDM Regulations 2015

Hazard Ref	Hazard Type (Construction/Maintenance/Cleaning/Demolition/Adaptation)	Hazard Description	Mitigation Measures/ Residual Risk
	Construction	Deep Excavation	Contractor to use appropriate trench support measures for deep excavations

Rev.	Date	Description	Drn / Chk'd / App'd
P2	11/23/2020	Final Issue	MIT/MAH/MAH
P1	10/5/2020	First Draft	MIT/MAH/MAH

Suitability: S2 - Suitable for Information

JNP GROUP
CONSULTING ENGINEERS
Chesham ● Brighouse ● Glasgow ● Hartlepool
Leamington Spa ● Sheffield
www.jnpgroup.co.uk

Client: Rydon Homes

Job: Land South of Hamsland, Horsted Keynes

Title: Preliminary Drainage Strategy

Classification: FI_60_20
Scale @ A1: As Shown

Project - Originator - Volume/System - Level/Location - Type - Discipline - Number
C86724-JNP-XX-XX-DR-C-2000
Document/Drawing Number

Revision: P2

JNP Group Internal Project Number: C86724

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 538850 127150 TQ 38850 27150
Data Type	Catchment
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm at outfall (pipe 1.001)

Time (mins)	**Area (ha)**	**Time (mins)**	**Area (ha)**
0-4	0.191	4-8	0.403

Total Area Contributing (ha) = 0.594

Total Pipe Volume (m³) = 2.997

Time Area Diagram at outfall (pipe 3.001)

Time (mins)	**Area (ha)**	**Time (mins)**	**Area (ha)**
0-4	0.105	4-8	0.029

Total Area Contributing (ha) = 0.134

Total Pipe Volume (m³) = 1.117

Network Design Table for Storm

« - Indicates pipe capacity < flow

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

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)

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
1.000	21.757	0.110	197.8	0.297	5.00	0.0	0.600	o	300	Pipe/Conduit	
2.000	16.627	0.110	151.2	0.297	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	45.176	0.060	752.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.000	7.059	0.247	28.6	0.090	5.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	24.960	0.230	108.5	0.044	0.00	0.0	0.600	o	225	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)
1.000	50.00	5.33	85.650	0.297	0.0	0.0	0.0	1.11	78.8	40.2
2.000	50.00	5.26	85.650	0.297	0.0	0.0	0.0	1.06	42.2	40.2
1.001	50.00	7.42	85.540	0.594	0.0	0.0	0.0	0.36	6.3«	80.4
3.000	50.00	5.06	83.500	0.090	0.0	0.0	0.0	1.89	33.4	12.2
3.001	50.00	5.39	83.178	0.134	0.0	0.0	0.0	1.25	49.9	18.1

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
2	87.500	1.850	Open Manhole	1200	1.000	85.650	300				
4	88.000	2.350	Open Manhole	1200	2.000	85.650	225				
4	89.600	4.060	Open Manhole	1200	1.001	85.540	150	1.000	85.540	300	
								2.000	85.540	225	
	86.000	0.520	Open Manhole	0		OUTFALL		1.001	85.480	150	
4	86.100	2.600	Open Manhole	1200	3.000	83.500	150				
5	85.210	2.032	Open Manhole	1200	3.001	83.178	225	3.000	83.253	150	
	84.500	1.552	Open Manhole	0		OUTFALL		3.001	82.948	225	

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.297	0.297	0.297
2.000	-	-	100	0.297	0.297	0.297
1.001	-	-	100	0.000	0.000	0.000
3.000	-	-	100	0.090	0.090	0.090
3.001	-	-	100	0.044	0.044	0.044
				Total	Total	Total
				0.728	0.728	0.728

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.001		86.000	85.480	84.300	0	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
3.001		84.500	82.948	83.120	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	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	3
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 538850 127150 TQ 38850 27150
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750

Synthetic Rainfall Details

Cv (Winter)	0.840
Storm Duration (mins)	30

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 4, DS/PN: 1.001, Volume (m^3): 6.7

Unit Reference	MD-SCU-0053-3700-1600-3700
Design Head (m)	1.600
Design Flow (l/s)	3.7
Flush-Flo™	Calculated
Objective	Linear discharge profile
Application	Surface
Sump Available	Yes
Diameter (mm)	53
Invert Level (m)	85.540
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.600	3.7	Kick-Flo®	0.080	1.0
Flush-Flo™	0.076	1.0	Mean Flow over Head Range	-	2.5

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	1.1	1.200	3.2	3.000	5.0	7.000	7.4
0.200	1.4	1.400	3.5	3.500	5.3	7.500	7.7
0.300	1.7	1.600	3.7	4.000	5.7	8.000	7.9
0.400	2.0	1.800	3.9	4.500	6.0	8.500	8.1
0.500	2.2	2.000	4.1	5.000	6.3	9.000	8.4
0.600	2.4	2.200	4.3	5.500	6.6	9.500	8.6
0.800	2.7	2.400	4.5	6.000	6.9		
1.000	3.0	2.600	4.6	6.500	7.2		

Hydro-Brake® Optimum Manhole: 5, DS/PN: 3.001, Volume (m^3): 2.4

Unit Reference	MD-SCU-0025-8000-1200-8000
Design Head (m)	1.200
Design Flow (l/s)	0.8
Flush-Flo™	Calculated
Objective	Linear discharge profile
Application	Surface
Sump Available	Yes
Diameter (mm)	25
Invert Level (m)	83.253
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Hydro-Brake® Optimum Manhole: 5, DS/PN: 3.001, Volume (m³): 2.4

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	0.8	Kick-Flo®	0.039	0.2
Flush-Flo™	0.039	0.2	Mean Flow over Head Range	-	0.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.3	1.200	0.8	3.000	1.2	7.000	1.8
0.200	0.4	1.400	0.9	3.500	1.3	7.500	1.9
0.300	0.4	1.600	0.9	4.000	1.4	8.000	1.9
0.400	0.5	1.800	1.0	4.500	1.5	8.500	2.0
0.500	0.5	2.000	1.0	5.000	1.5	9.000	2.0
0.600	0.6	2.200	1.1	5.500	1.6	9.500	2.1
0.800	0.7	2.400	1.1	6.000	1.7		
1.000	0.7	2.600	1.1	6.500	1.7		

Storage Structures for Storm

Cellular Storage Manhole: 2, DS/PN: 1.000

Invert Level (m) 85.650 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	115.0	0.0	1.601	0.0	0.0
1.600	115.0	0.0			

Cellular Storage Manhole: 4, DS/PN: 2.000

Invert Level (m) 85.650 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	211.0	0.0	1.601	0.0	0.0
1.600	211.0	0.0			

Cellular Storage Manhole: 5, DS/PN: 3.001

Invert Level (m) 83.253 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	90.0	0.0	1.201	0.0	0.0
1.200	90.0	0.0			

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 3
Number of Online Controls 2 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	2013
Site Location	GB 538850 127150 TQ 38850 27150
Data Type	Catchment
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	2, 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.	Water Level (m)
1.000	2	1440 Winter	100	+40%	2/180 Winter				87.224
2.000	4	1440 Winter	100	+40%	2/120 Summer				87.083
1.001	4	1440 Winter	100	+40%	2/15 Summer				87.694
3.000	4	1440 Winter	100	+40%	30/15 Summer				84.686
3.001	5	1440 Winter	100	+40%	2/60 Summer				84.685

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	2	1.274	0.000	0.10		7.0	FLOOD RISK	
2.000	4	1.208	0.000	0.14		5.1	SURCHARGED	
1.001	4	2.004	0.000	0.57		3.5	SURCHARGED	
3.000	4	1.036	0.000	0.10		2.9	SURCHARGED	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
3.001	5	1.282	0.000	0.02		0.9	SURCHARGED	

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