

BARTON ROAD DEVELOPMENT HAVANT

Surface Water Drainage Statement

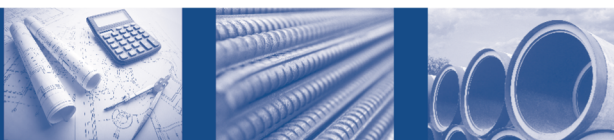
AMc/21/0154/6368: Rev C
12th November 2021

MJA Consulting have been appointed by Redrow Homes Southern to undertake the Reserved Matters engineering design for the proposed residential development to the north of Barton Road, Havant. The site consists of circa 72 residential units with associated infrastructure and landscaping. The following statement provides the surface water drainage proposals for the development.

Approved Drainage Strategy:

Development surface water designs follow the principles outlined in the approved Flood Risk & Drainage Assessment undertaken by Charles & Associates. A summary of points from the report are highlighted below:

- The site lies within Flood Zone 1 and is not at risk of fluvial or surface water flooding. All potential sources of flood risk were considered, the site was assessed as a low risk.
- Ground conditions were described as head deposits consisting of clays, silts and sands overlying London Clay formation. Groundwater was encountered in one trial pit at approximately 2.0m below ground, no other strikes were found during investigations.
- Infiltration testing the underlying geology had low permeability; conservative rates of 2.8×10^{-5} were found. Some infiltration is likely from small areas of permeable type paving.
- Due to the low sub soil permeability the proposed development surface water system will use a combination of SUDs features including permeable type paving and sub-base together with a cellular attenuation tank and open basin features.
- The attenuated flows will discharge to the adjacent watercourse at the equivalent greenfield runoff rate of 12.5 l/sec QBar.



Greenfield Runoff Rate:

The FRA by Charles & Associates Consulting Ltd assessed the Greenfield Runoff as part of the outline planning application, the surface water discharge rate was assessed as follows:

The Greenfield runoff has been reassessed and agreed with the LLFA.

	I/sec
QBar	12.50
1 year	10.60
30 year	28.30
100 year	39.80

Development Surface Water Design:

The development surface water design follows the principles set at outline planning stage, utilizing several SUDs features throughout the system. These include:

- Permeable paving
- Attenuation Basin
- Cellular Attenuation
- Vortex Separator
- Swale

The development surface water drainage strategy for the development is described below:

Roof Runoff:-

Roof runoff will typically be collected by a conventional system of guttering, downpipes and private storm drainage discharged to the main piped network. Where possible downpipes fronting the drive will discharge to the driveway sub base.

Water Butts are to be provided per plot where feasible on a rainwater downpipe to collect roof runoff for re-use.

Private Drives & Parking Bays:-

All private drives and parking bays will typically drain via either permeable block paving or yard gullies / aco drains discharging to permeable sub-base. Links to the main pipe drainage network will ensure the shallow systems will outfall during higher storm events.

Development Roads & Private Drives:-

The development roads will typically drain via deep trapped road gullies connecting directly to the main piped storm drain, flows discharge directly via the piped network.

Attenuation & Outfall:-

Due to the available area and gradient of the existing ground the development attenuation is provided by both an open above ground basin and below ground cellular tank. Storm runoff discharges to the attenuation basin, flows are then controlled via an orifice to maximise storage before outfalling to a lower cellular tank. The final development flows are then controlled before to the 12.5 l/sec before discharging to the adjacent watercourse. The combined storage has been designed to accommodate the necessary storage volumes to manage the 1:100 year storm event, plus an extra allowance of 40% for the predicted potential increase in peak rainfall up to 2115.

To ensure the water quality to the downstream watercourse network is maintained further pollution prevention has been included on the final outfall in the form of a vortex separator/interceptor to remove any oil, silts, and debris.

The development micro drainage network calculations also include a 10% increase in impermeable areas to allow for urban creep from the housing areas.

Total Area:	15,021m ²
Development Road	4,995m ²
Housing, driveways & parking courts	9,115m ²
10%	911m ²

The surface water system has been tested for the designed extreme storm event of 100 year + 40% climate change. Any limited flooding during storms in excess of these or in the event of overloading the drainage network due to failure or blockage the flood water will follow the development road alignments with any exceedance discharging to the lower POS or attenuation basin

Water Quality Risk Management:-

The SUDs features and water quality elements follow the recommendations of the CIRIA Guide “The SUDs Manual” and incorporate the requirements of adoption, construction and the need to install utilities and drainage to the site. A water quality assessment has been undertaken using Chapter 26 of the CIRIA Guide “The SUDs Manual” C753. As the development site is residential the most appropriate method of assessment is the Simple Index Approach.

The SUDs treatment type varies depending on location within the development, SUDs elements throughout the development are:

- Sealed permeable driveway
- Deep Trapped Gullies
- Attenuation Basin
- Vortex Separator
- Outfall Swale

Typically, driveways and parking areas drain via the permeable paving system, main pipe system and the attenuation basin and vortex separator. Road areas will drain via deep trapped gullies, attenuation basin and vortex separator.

The following tables 26.2 & 26.3 from the CIRIA SuDS Manual C753 for the Simple Index Approach and highlight the Pollution hazard indices & SUDs Mitigation Indices for the development.

Pollution hazard indices (Table 26.2):

Land Use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very low	0.2	0.2	0.05
Individual driveways, low traffic roads and non-residential car parking.	Low	0.5	0.4	0.4

SUDs Mitigation Indices (Table 26.3):

Type of SUDs component (Within development)	Mitigation indices		
	TSS	Metals	Hydrocarbons
Permeable Paving	0.7	0.6	0.7
Attenuation Basin/Pond	0.7	0.7	0.5
Vortex Separator (SDS Type)	0.8	0.5	0.7

Where the mitigation index of an individual component is insufficient, two components (or more) in series will be required.

Total SUDs mitigation index = mitigation index + 0.5 (mitigation index)

A factor of 0.5 is used to account for the reduced performance of a secondary or tertiary component associated with already reduced inflow concentrations.

As noted, runoff from the site is from a mix of areas, the roof areas would be considered a very low hazard rating, the majority of the roads & driveways within the development parcel would be considered low.

The tables below provides an assessment and comparison of pollution hazards for the two storm outfalls and the available SUDs mitigation.

		Total suspended solids (TSS)	Metals	Hydrocarbons
Land Use	Residential Areas	0.7	0.6	0.45
SUDs Mitigation	Permeable paving, Attenuation Basin & Vortex Separator	$0.7 + (0.5 \times 0.8) + (0.5 \times 0.5)$ 1.35	$0.6 + (0.5 \times 0.5) + (0.5 \times 0.5)$ 1.10	$0.7 + (0.5 \times 0.7) + (0.5 \times 0.6)$ 1.35
		Acceptable	Acceptable	Acceptable

		Total suspended solids (TSS)	Metals	Hydrocarbons
Land Use	Residential Areas (Roads only)	0.5	0.4	0.4
SUDs Mitigation	Attenuation Basin & Vortex Separator	$0.5 + (0.5 \times 0.8)$ 0.9	$0.5 + (0.5 \times 0.5)$ 0.75	$0.6 + (0.5 \times 0.7)$ 0.95
		Acceptable	Acceptable	Acceptable

The water quality assessment has been carried out in accordance with Chapter 26 of The SUDs Manual based on the available site SUDs elements and has been shown to comply.

Alistair McShane
MJA Consulting

Appendices:
Engineering Layouts & Sections
Surface Water Micro Drainage Calculations
SUDs Maintenance Plan



Engineering Layouts

KEY:

Proposed Adoptable Sewers:

Foul sewer

Storm sewer

Highway Gully

Highway Gully –
Cycle Friendly Gully Grating
HCC Series 11 Notes for Guidance
HCC11/D/015 paragraph 5

Proposed Private Drainage:

Foul drain

Storm drain

Rodding eye

Yard gully

Aco drain

Permeavoid diffuser

All private inspection chambers shall be polypropylene non-access chambers in accordance with The Building Regulations, Part H. Chamber sizes:
SVP
Depth to invert <0.6m DN300
Depth to invert >0.6m DN475

Invert levels shown thus: F10.00 S10.00

Permeable paving

Externals:

Finished floor levels shown thus: FFL 10.00

Carriageway Fall Arrows

Proposed Levels

Primary Access

**THE BUILDING REGULATIONS: PART M
APPROACH ROUTE SCHEMATIC**

M4-A: A LEVEL APPROACH (MAX 1.60 GRADE)

M4-B: B GENTLY SLOPING (MAX 1.20 GRADE)

M4-C: C RAMPED APPROACH (MAX 1.12 OR 1.15 GRADE)

M4-D: D STEPPED APPROACH

M4-E: E SINGLE STEP @ THRESHOLD

Secondary Access

*In accordance with Part-M of the Building Regulations –
Every flight of steps with three or more risers (approach to primary access point to have a suitable grippable HANDEDrail on one side of the flight (or both sides where the flight is wider than 1000mm). This grippable HANDEDrail – is 850–1000mm above the pitch line of the flight and extends at least 300mm beyond the top and bottom nosings.

Stepped Cavity Tray or Raised DPC to architects specification.

External Brickwork

Tanking

Concrete Gravel Board
Max. Height 600mm

Retaining Wall

Embankment Tackle

Existing Tree Root Protection Area

LIGHTING KEY:

Proposed Residential Lighting Column
Column – 6m Straight Column (no outreach bracket & 0° tilt).

Lantern – Philips Luma Micro BGP615
DN50-1400, 6LED, 5.15°CLO L90, Lamp Flux 1,40, 6 x LED, Natural White, S/P Ratio 1.61, wired for Dali control and fitted with Mayflower six pin NEMA socket, post-top mounted, maximum tilt 5 degrees. Lanterns are to be supplied with manufacturers 25 year warranty.

Internal Wiring: DNO supply cables to be terminated in single-phase double pole isolator with HRC fuses to BS EN 60269 (Eg Lucy Titan 2). Internal wiring to lantern to be multi-core PVC flexible 2.5mm². Earthing conductor to be 2.5mm² PVC insulated coloured green/yellow; connections to be by bolted crimped terminations.

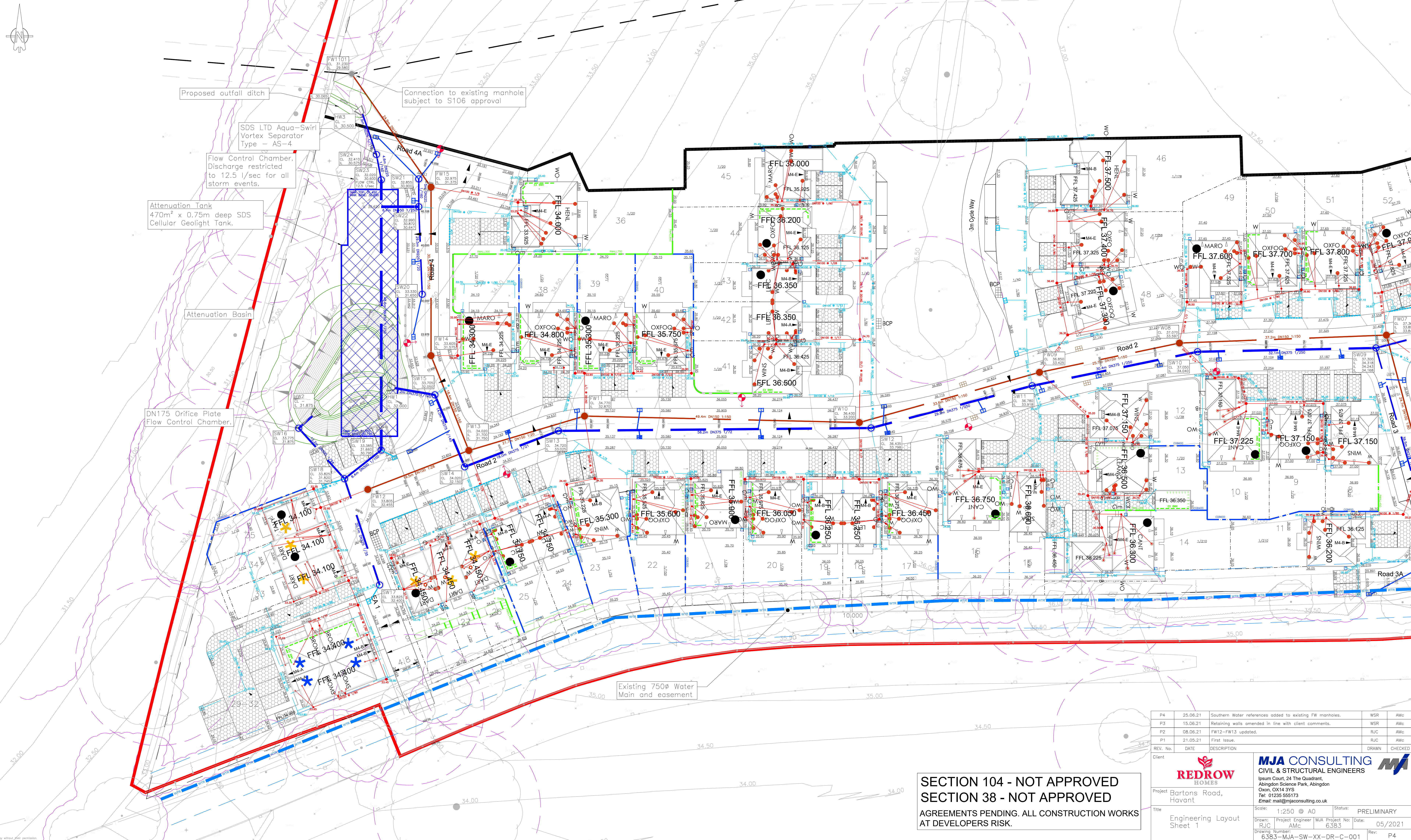
Note:
Lighting design is indicative for tender purposes only. Detailed lighting design to be carried out by SSE.

Construction Notes:

- Do not scale from this drawing.
- All dimensions in metres.
- All levels relate to ordnance datum.
- This drawing is based on the latest Architectural planning layout and shall be read in conjunction with all other relevant document technical drawings & details.
- Any discrepancies with any of the drawings shall be reported to MJA Consulting Engineers.
- The level and location of all existing services shall be verified on site by the Contractor before commencing any construction work.
- All finished floor levels are shown on the drawing for guidance only and may need to be adjusted on site. However there is to be no deviation without prior approval.
- All foul & surface water drainage being offered for adoption by the Water Authority are to be constructed in accordance with the Water UK document, Design and Construction Guidance (DSG) "Code for Adoption" along with the Water Authority specification and addendums.
- Gullies, gully connections, drains, manholes, catchpits, soakways, headwalls and other drainage structures intended to convey highway water are to be constructed in accordance with the specification issued by Hampshire County Council.
- All foul and storm water drains which are not being adopted as public sewers shall be constructed using uPVC pipes or similar approved, bedded and backfilled in accordance with the manufacturers instructions and to the Building Regulations Part H, BS EN 752 & B.R.E. SD1.

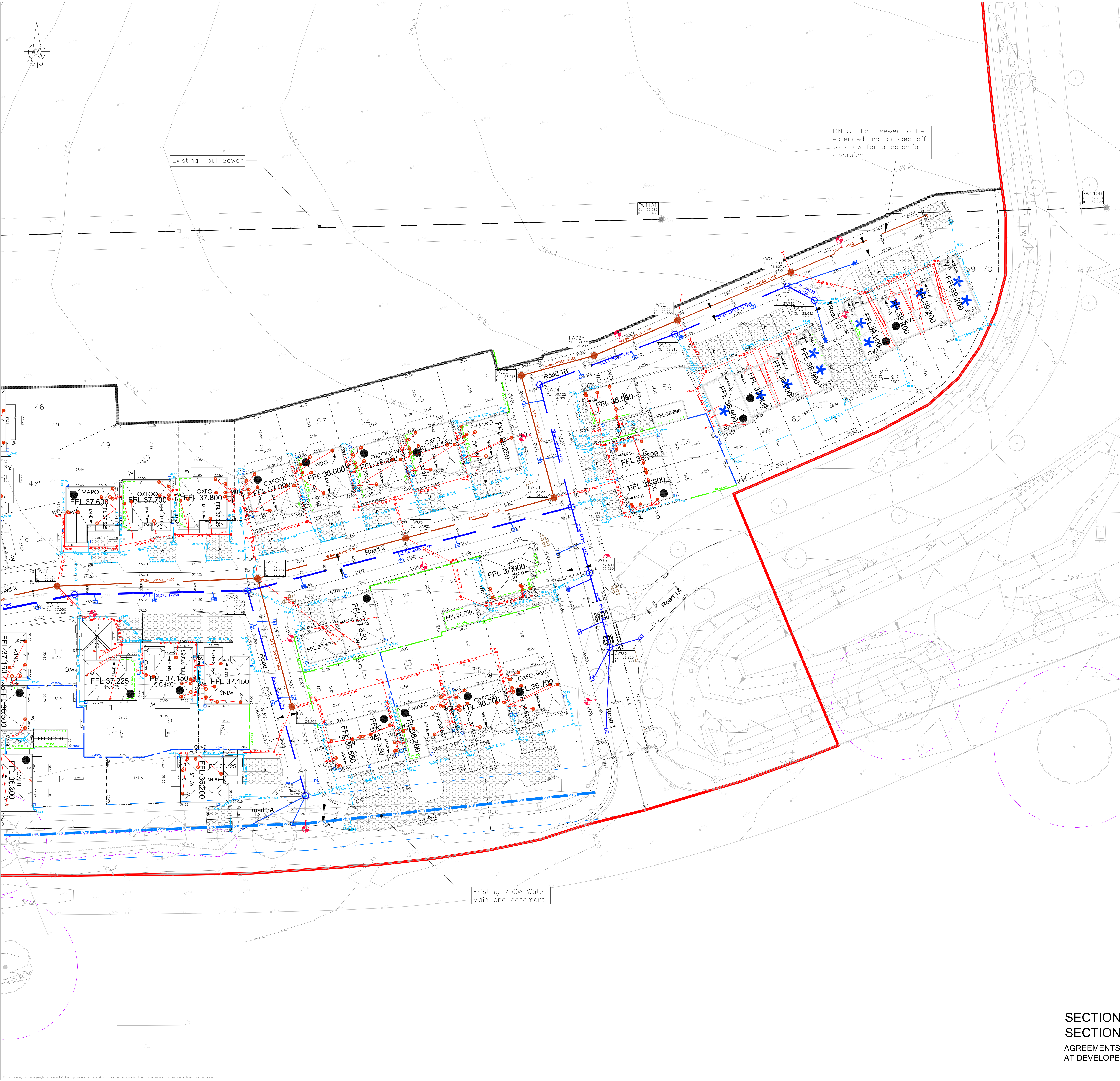
- All building drainage to be 100mm dia. laid at a minimum gradient of 1 in 60 (FW) and 1 in 80 (SW) unless otherwise shown.
- Sewers and drains of different diameters should be laid soffit to soffit unless otherwise specified.
- Inspection chambers on private drains shall be non-access preformed polypropylene.
Depth to invert Minimum size
< 1.2m DN450
> 1.2m DN600
In accordance with the Building Regulations Part H & BS EN 752.
- Position of soil pipes, stubstacks, WC outlets rainwater downpipes etc positions shall be checked against architects house type drawings to ensure compatibility.
- Where back inlet gullies are used they should be roddable.
- All stub stacks to be fitted with air admittance valve where branch drain exceeds 12m except at head of run.
- Rainwater downpipes to be connected directly to drains via removable adapter to permit access for rodding.
- Positions of yard and house gullies are nominal and may be adjusted on site, aco drains to be installed at the end of all drives falling towards the public highway. All gully gratings in drives and parking areas should be of sufficient strength to withstand vehicular loading.
- Lintels or sleeves are to be provided for drains passing through foundation brickwork.
- All gully connections to be 150 dia. uPVC ultrarib or similar.
- All gully connections other than at manholes to be "Y" junctions.
- All drain runs are to be flushed through and building materials removed where necessary at the time of final test by Building Inspector and prior to occupation.

- Where applicable all soakways to be positioned a minimum of 5.0m from buildings (where utilised)
- Where applicable The construction of all pond embankments including selection of fill material, placing, compaction and use of stabilization membranes is to be carried out in accordance with an engineering earthworks specification approved by a specialist Geotechnical Engineer and in accordance with BS EN 1997-1 and BRE 363 to ensure safe and stable slopes during all phases of construction and operation.
- All traffic management shall comply with the requirements as set out in Chapter 8 of the Traffic Signs Manual. Warning signs may be erected outside the indicated boundaries. Any obstructions to traffic or pedestrians shall be properly signed and protected with barriers, cones, signs, and lamps.
- All traffic signs and road markings are to be in accordance with the Traffic Signs Regulations and General Directions 2016.



SECTION 104 - NOT APPROVED
SECTION 38 - NOT APPROVED
AGREEMENTS PENDING. ALL CONSTRUCTION WORKS
AT DEVELOPERS RISK.

P4	25.06.21	Southern Water references added to existing FW manholes.	WSR	AMc
P3	15.06.21	Retaining walls amended in line with client comments.	WSR	AMc
P2	08.06.21	FW12-FW13 updated.	RJC	AMc
P1	21.05.21	First Issue.	RJC	AMc
REV. No.	DATE	DESCRIPTION	DRAWN	CHECKED
Client				
Project				
Title				
Scale: 1:250 @ A0				
Status: PRELIMINARY				
Drawn: Project Engineer MJA Project No: (Date: 05/2021)				
Drawing Number: 6383-MJA-SW-XX-DR-C-001				
Rev: P4				

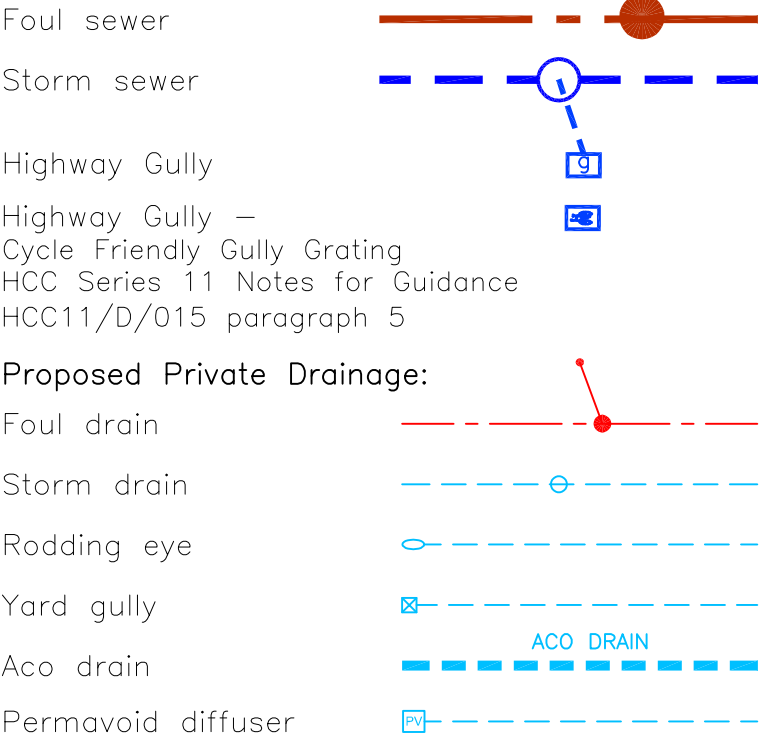


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Depth to invert Minimum size
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> 1.2m DN600
In accordance with the Building Regulations Part H & BS EN 752.
- Position of soil pipes, stubstacks, WC outlets rainwater downpipes etc positions shall be checked against architects house type drawings to ensure compatibility.
- Where back inlet gullies are used they should be raddable.
- All stub stacks to be fitted with air admittance valve where branch drain exceeds 12m except at head of run.
- Rainwater downpipes to be connected directly to drains via removable adapter to permit access for rodding.
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KEY:

Proposed Adoptable Sewers:



All private inspection chambers shall be polypropylene non-access chambers in accordance with The Building Regulations, Part H. Chamber sizes: SVP Depth to invert <0.6m DN300 Depth to invert >0.6m DN475

Invert levels shown thus: F10.00 S10.00

Permeable paving

Externals: Finished floor levels shown thus: FFL 10.00

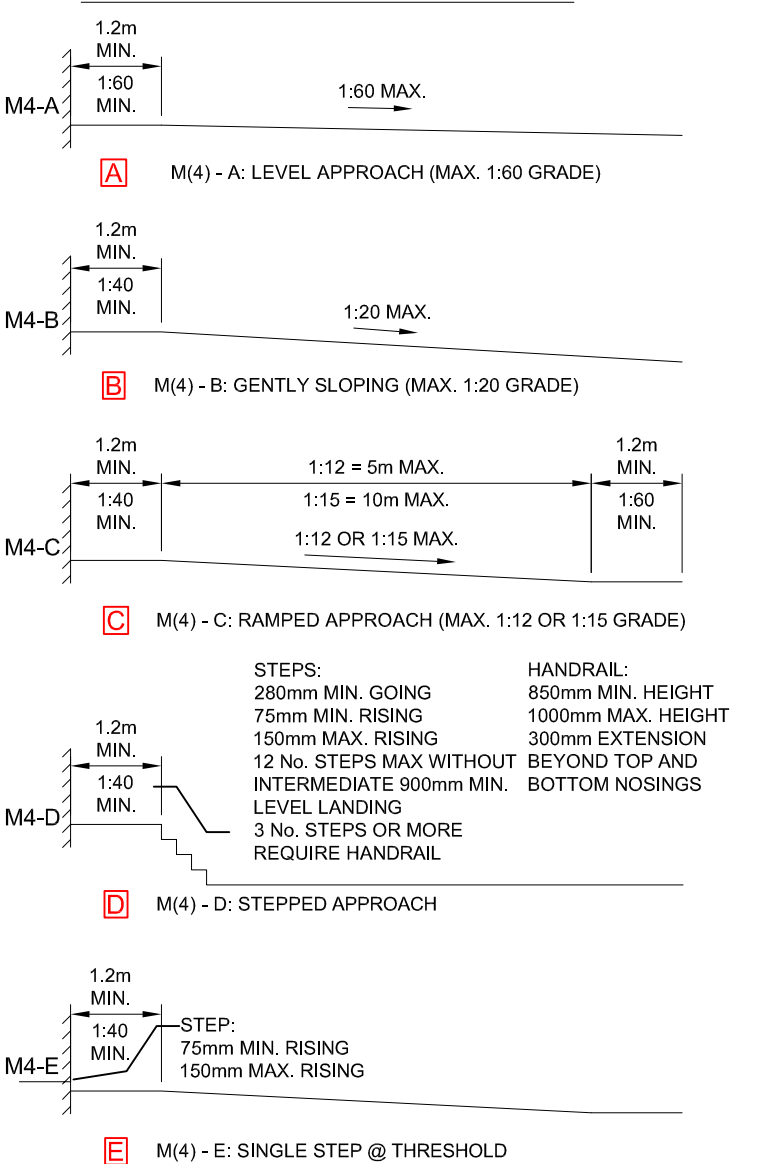
Carriageway Fall Arrows

Proposed Levels

Primary Access

Hierarchical approach to the access & threshold of the principle entrance to comply with M4 Building Regulations as thus:

THE BUILDING REGULATIONS: PART M APPROACH ROUTE SCHEMATIC



Secondary Access
*In accordance with Part-M of the Building Regulations
Every flight of steps with three or more risers (approach to primary access point to have a suitable grippable HANDEDraill on one side of the right (or both sides where the flight is wider than 1000mm). This grippable HANDEDraill is 850-1000mm above the pitch line of the flight and extends at least 300mm beyond the top and bottom nosings.

Stepped Cavity Tray or Raised DPC to architects specification.
External Brickwork
Tanking
Concrete Gravel Board
Max. Height 600mm
Retaining Wall
Embankment Tadopole
Existing Tree Root Protection Area

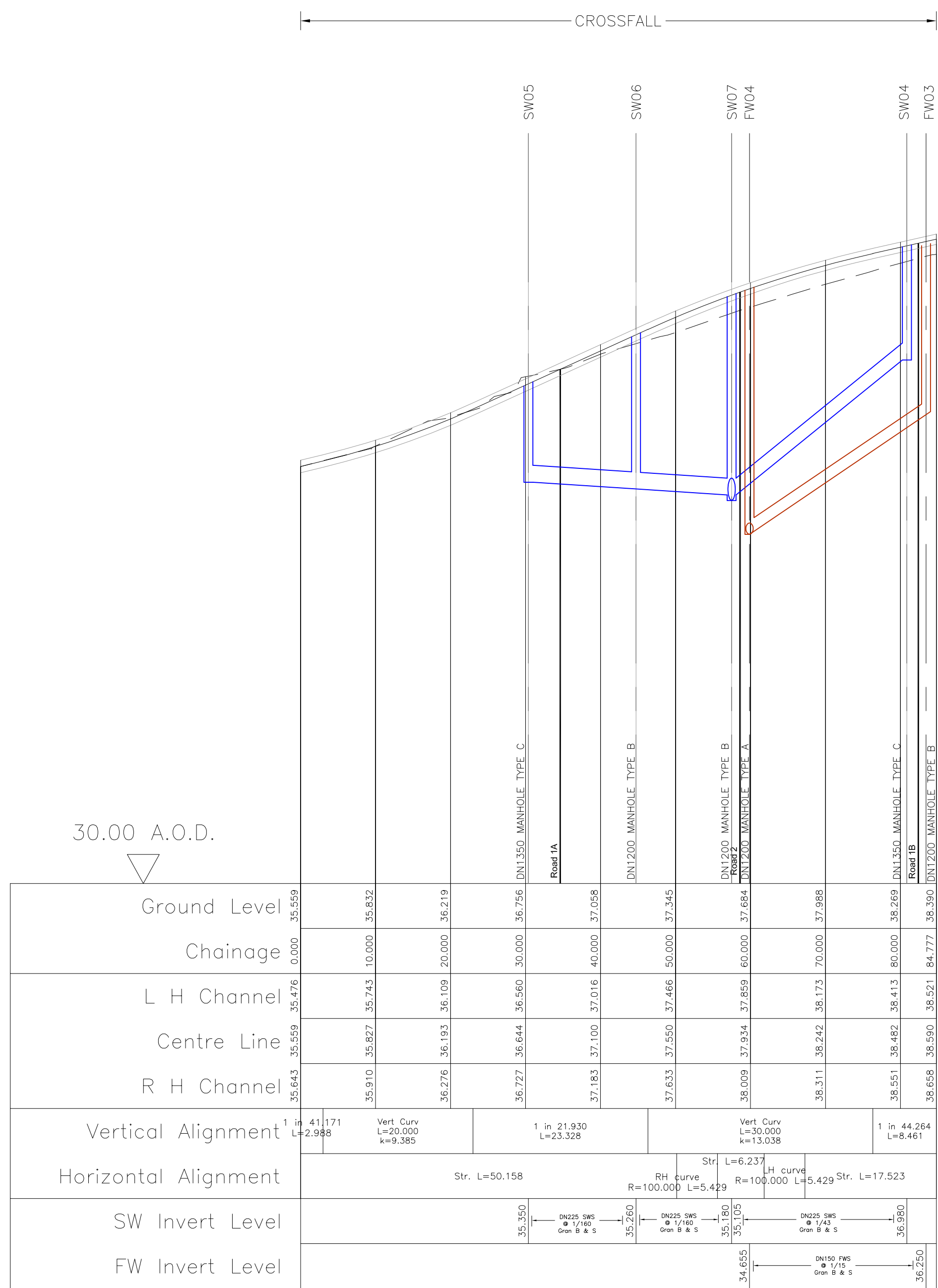
LIGHTING KEY:

Proposed Residential Lighting Column
Column - 6m Straight Column (no outreach bracket & 0° tilt).
Lantern - Phillips Luma Micro BGP615 DM50_1400_6LED_5.15_CLO L90, Lamp Flux 140, 6 x LED, Natural White, S/P Ratio 1:61, wired for Dali control and fitted with Mayflower six pin NEMA socket, post-top mounted, maximum tilt 5 degrees. Lanterns are to be supplied with manufacturers 25 year warranty.
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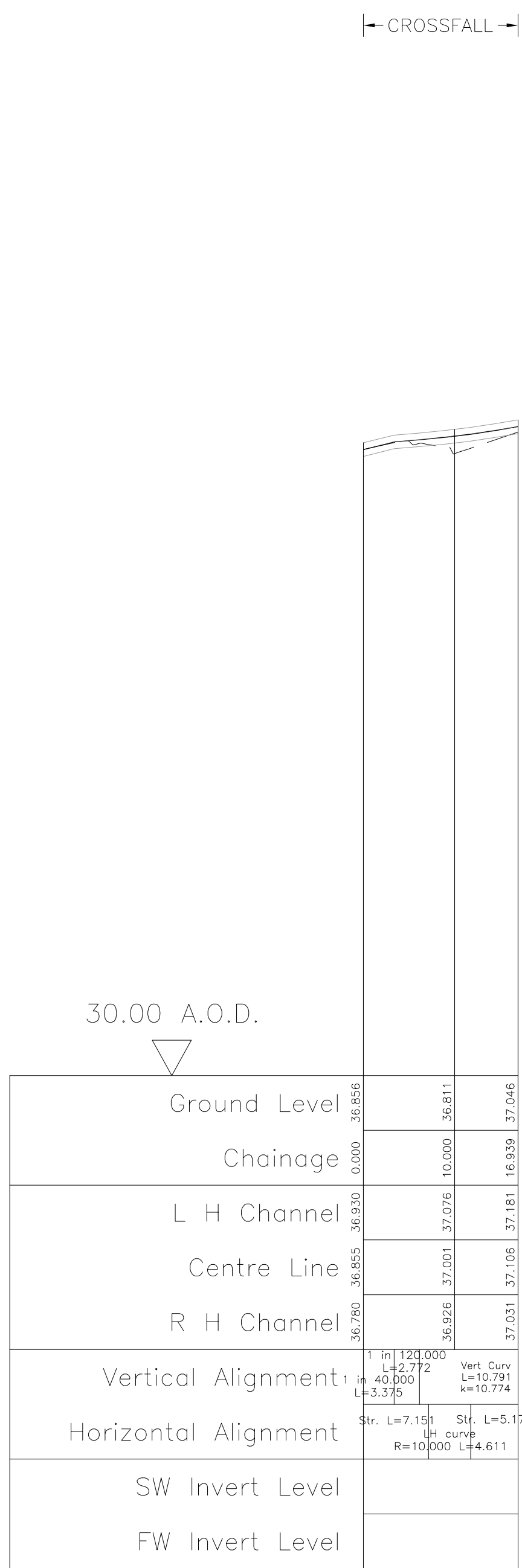
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SECTION 104 - NOT APPROVED
SECTION 38 - NOT APPROVED
AGREEMENTS PENDING. ALL CONSTRUCTION WORKS AT DEVELOPERS RISK.

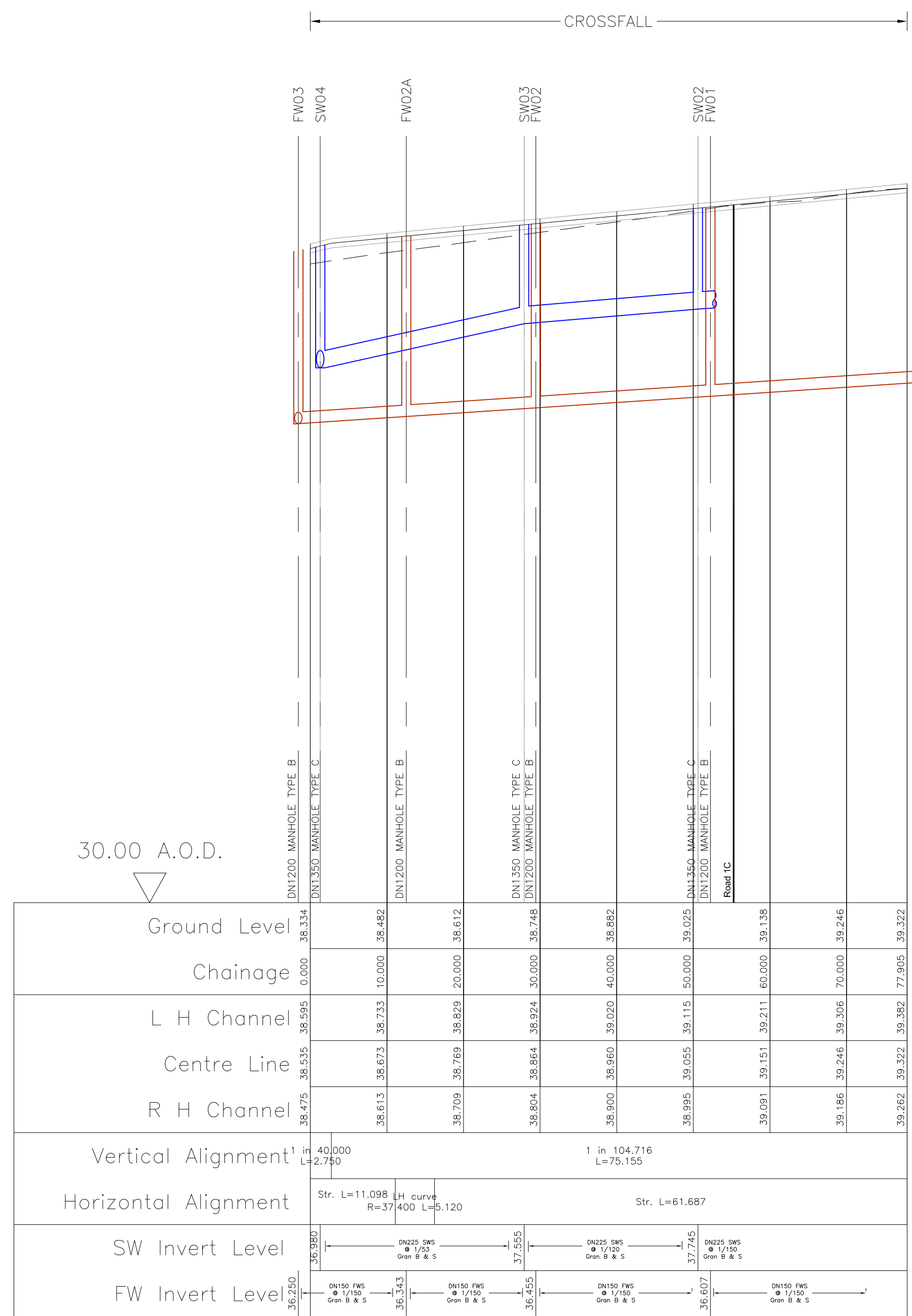
P3	15.06.21	Foul drainage updated to allow for potential sewer diversion. Retaining walls amended in line with client comments.	WSR	AMc
P2	08.06.21	FW06-FW07 and SW08 updated. Gullies updated on Road 3.	RJC	AMc
P1	21.05.21	First Issue.	RJC	AMc
REV. No.	DATE	DESCRIPTION	DRAWN	CHECKED
Client				
REDROW HOMES		MJA CONSULTING CIVIL & STRUCTURAL ENGINEERS		
Project		Bartons Road, Havant		
Title		Engineering Layout Sheet 1		
Scale:		1:250 @ A0	Status:	PRELIMINARY
Drawn:		Project Engineer MJA	Project No:	6383
Drawing Number:		6383-MJA-SW-XX-DR-C-002	Date:	05/2021
			Rev:	P3



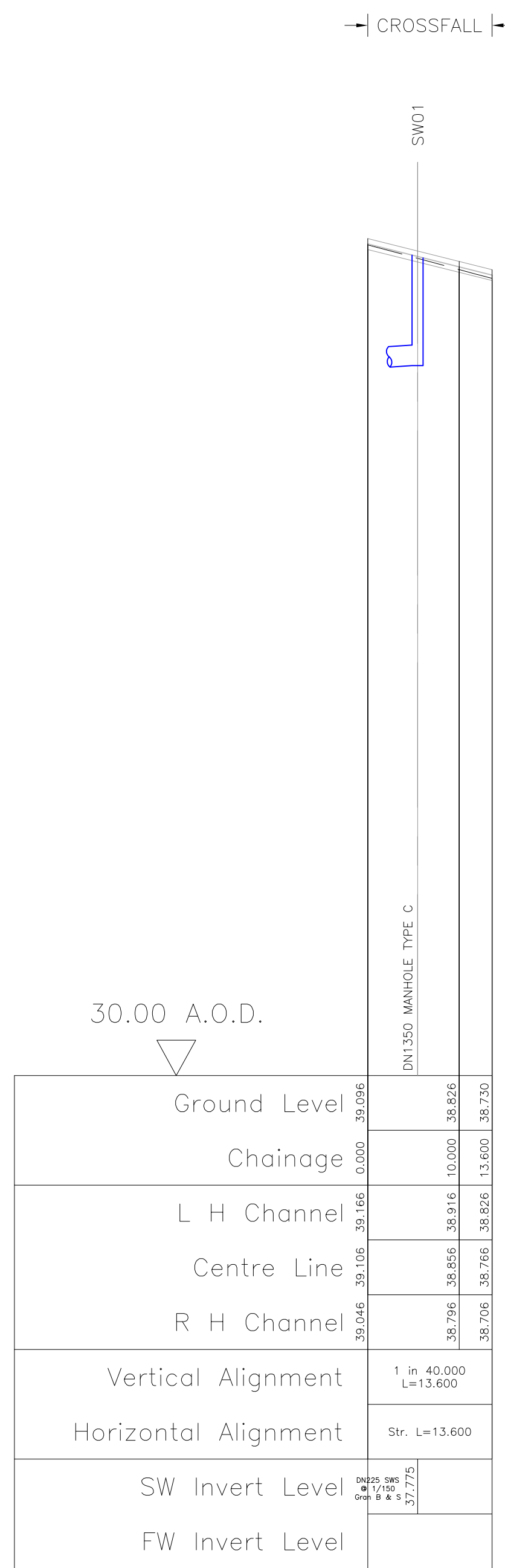
Road1
Horiz. 1:500 Vert. 1:50



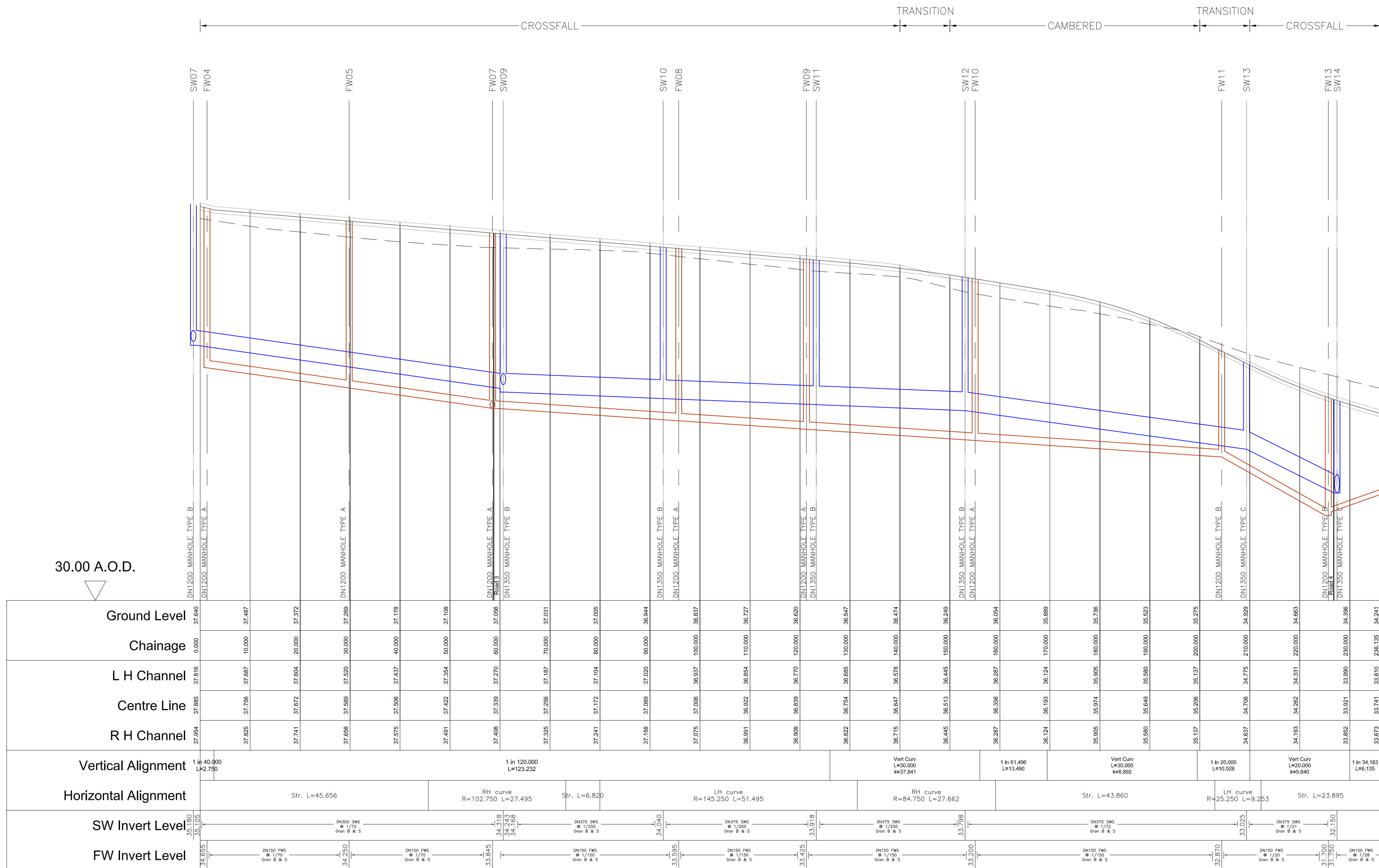
Road1A
Horiz. 1:500 Vert. 1:50



Road1B
Horiz. 1:500 Vert. 1:50



Road1C
Horiz. 1:500 Vert. 1:50



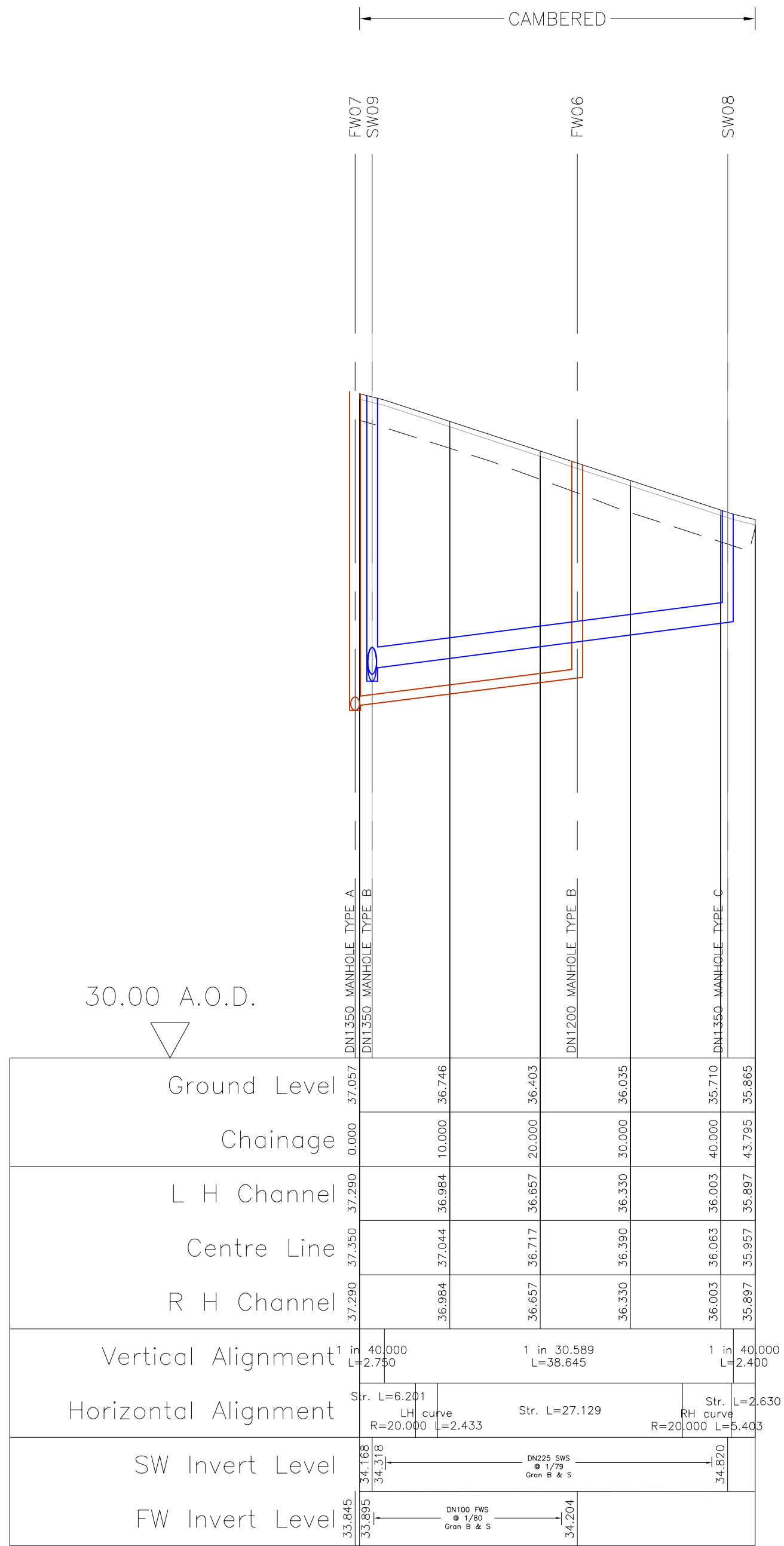
Road2
Horiz. 1:500 Vert. 1:50

Construction Notes:

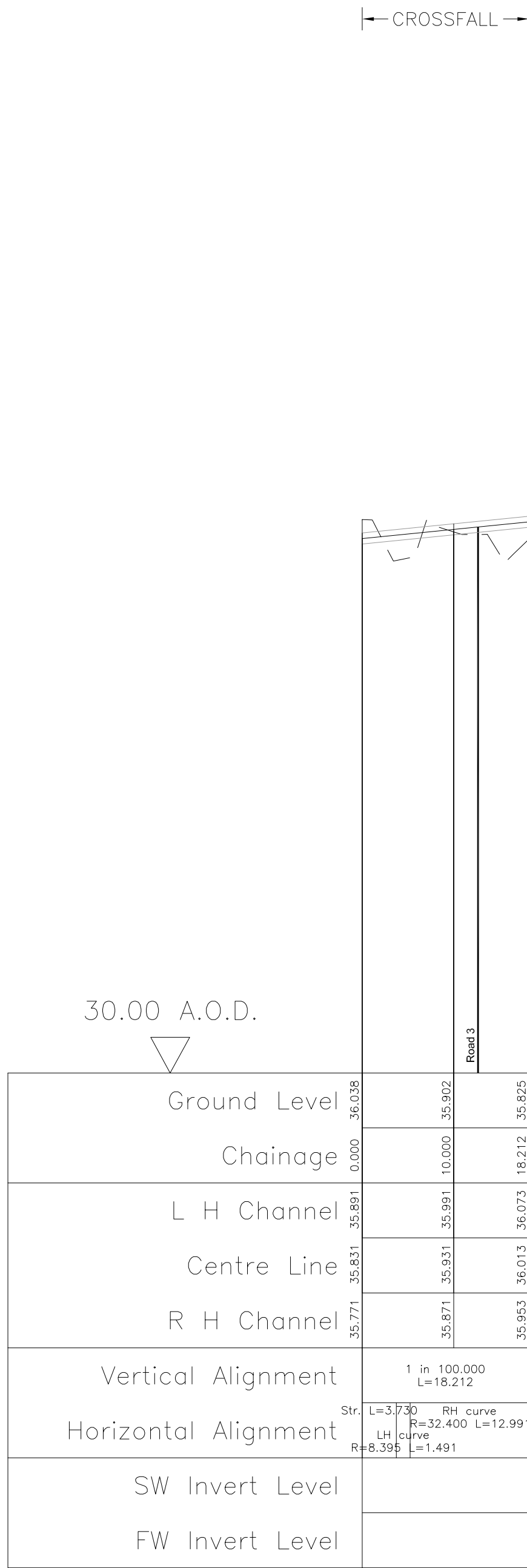
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5. The level and location of all existing services shall be verified on site by the Contractor before commencing any construction work.
6. Manholes, sewers, headwalls and other structures intended to convey surface water or sewerage are to be constructed in accordance with the Water UK document, Design and Construction Guidance (DSG) "Code for Adoption" along with the Water Authority specification and addendums.
7. Contractor must comply with all current legislation relating to CDM, Health and Safety and COSHH.
8. All material in excess of 20kg (i.e. kerbs, manhole units cover etc.) shall be mechanically lifted and laid where possible at all times.
9. ADOPTABLE DRAINAGE SYSTEM:
 - DN150 - DN300 pipework shall be vitrified clay plain ended pipes, joints made with standard flexible couplings.
 - DN375 - DN450 shall be Concrete Class H Pipework or similar approved.

P3	15.06.21	Foul drainage updated on Roads 1, 1B and 2.	WSR	AMc
P2	08.06.21	Manhole types reviewed.	RJC	AMc
P1	21.05.21	First Issue.	RJC	AMc
REV. No.	DATE	DESCRIPTION	DRAWN	CHECKED
Client				
REDROW HOMES				
Project Barton's Road, Havant				
Title				
Scale:	1:500 @ A1	Status:	PRELIMINARY	
Drawn:	Project Engineer	MJA Project No:	Date:	05/2021
Drawing Number:	6383-MJA-SW-XX-DR-C-100	Rev:	P3	

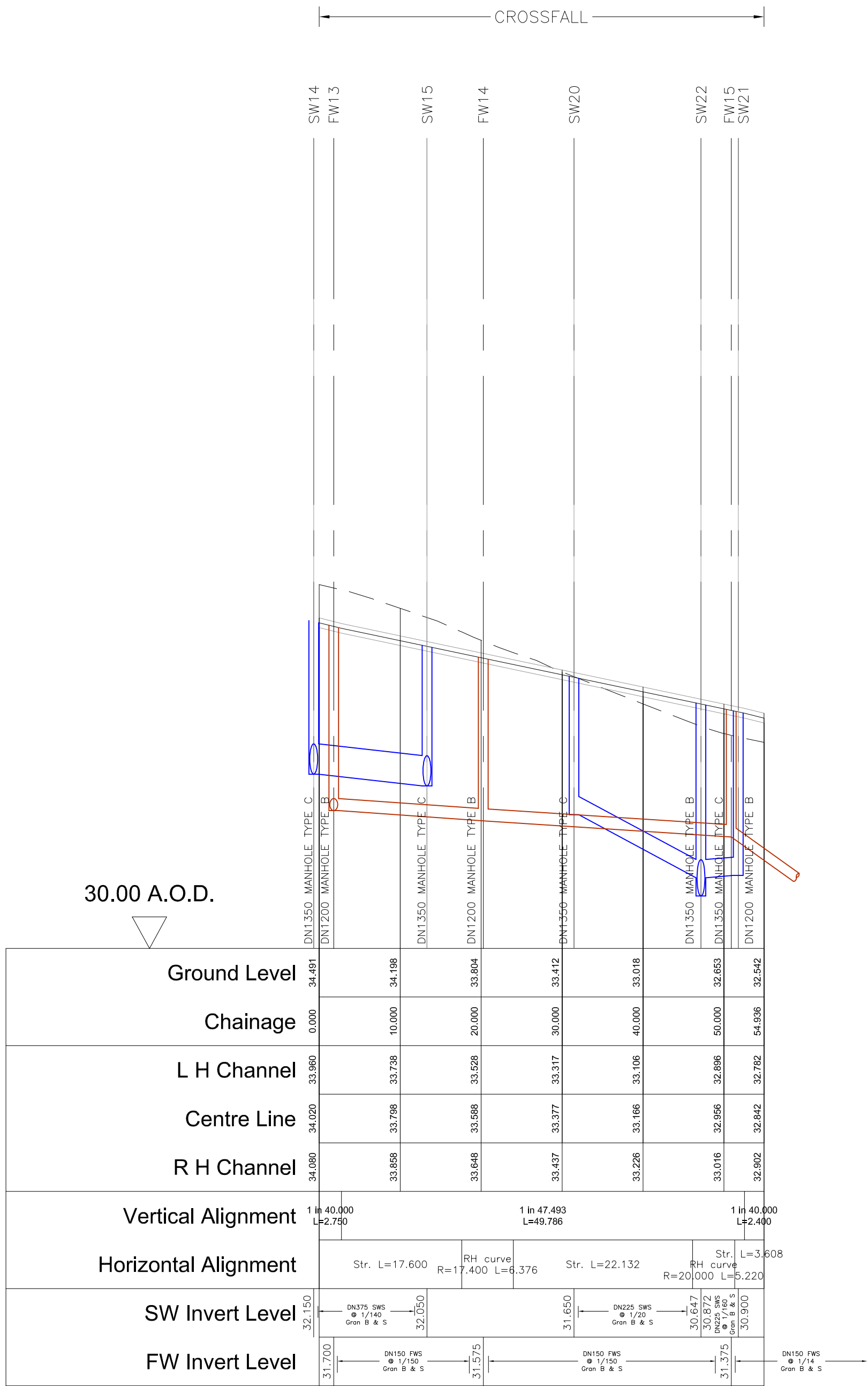
SECTION 104 - NOT APPROVED
SECTION 38 - NOT APPROVED
AGREEMENTS PENDING. ALL CONSTRUCTION WORKS
AT DEVELOPERS RISK.



Road3
Horiz. 1:500 Vert. 1:50



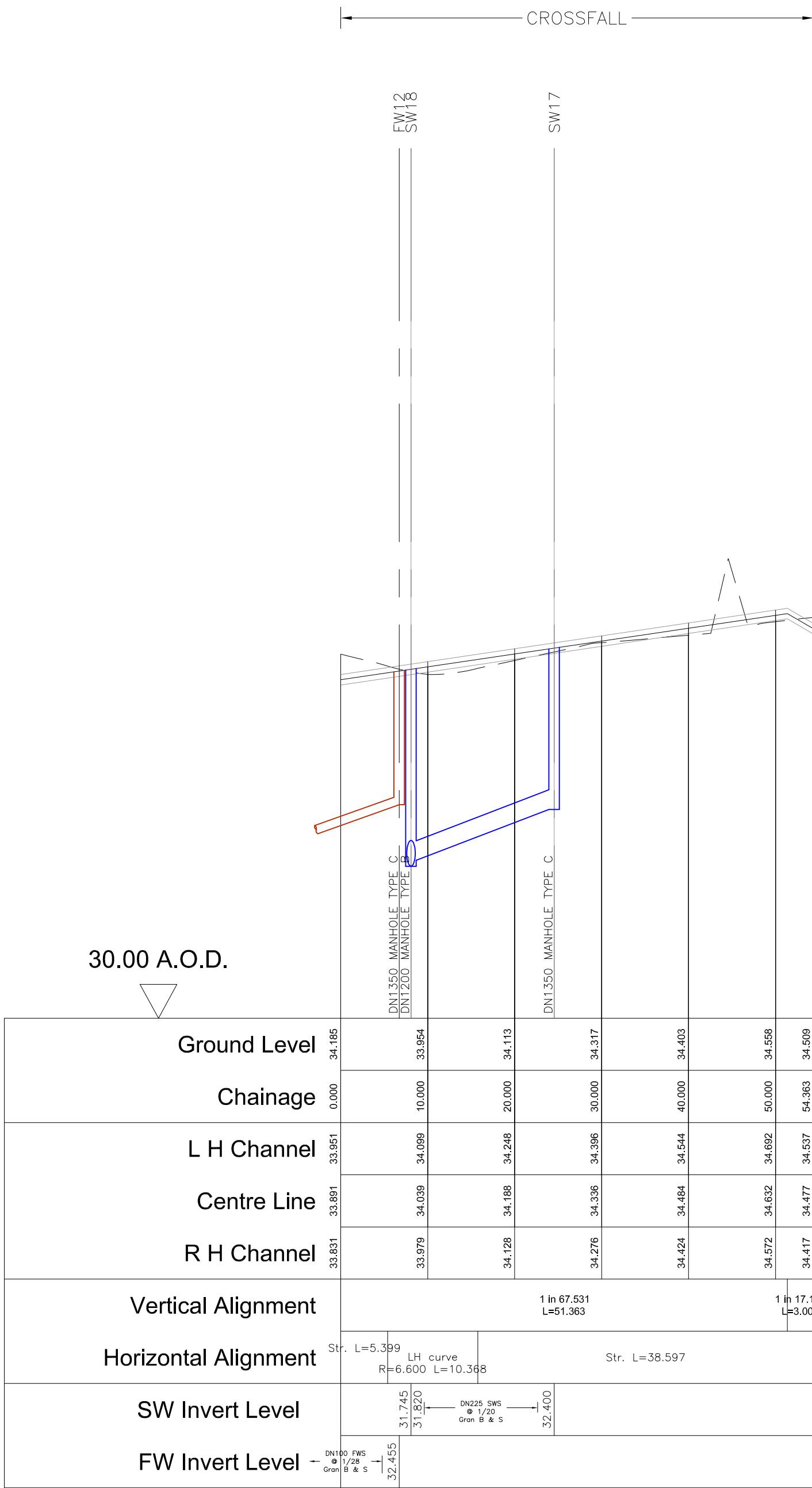
Road3a
Horiz. 1:500 Vert. 1:50



Road4
Horiz. 1:500 Vert. 1:50



Road4a
Horiz. 1:500 Vert. 1:50



EA1
Horiz. 1:500 Vert. 1:50

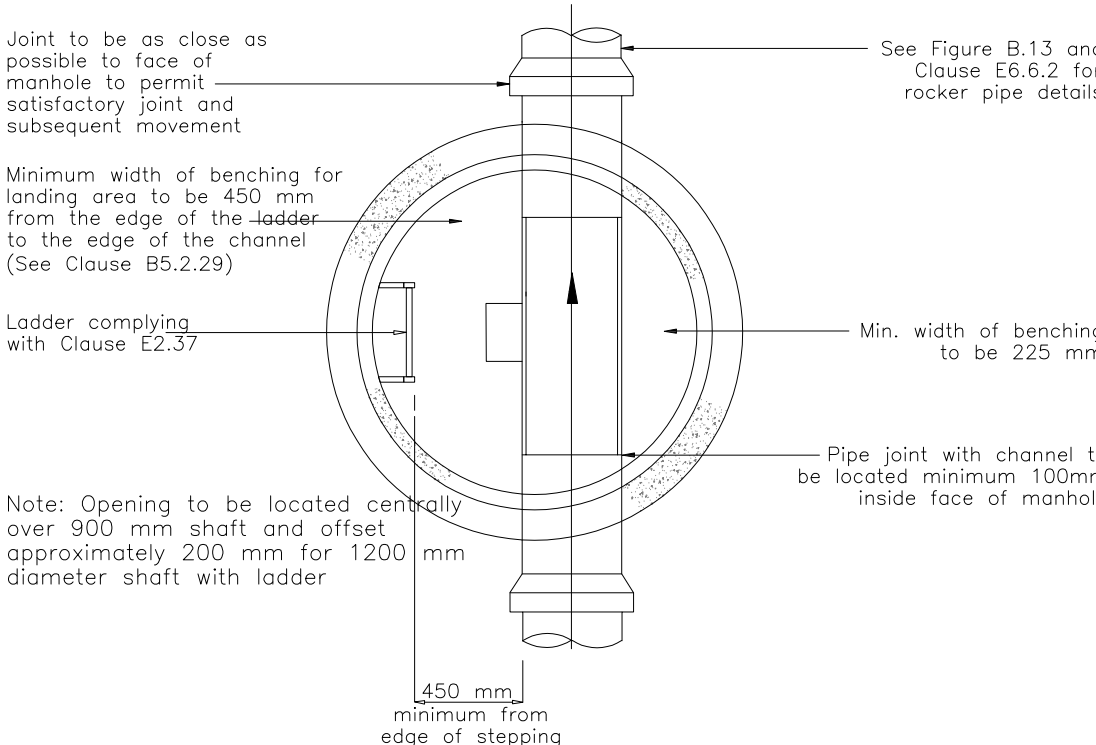
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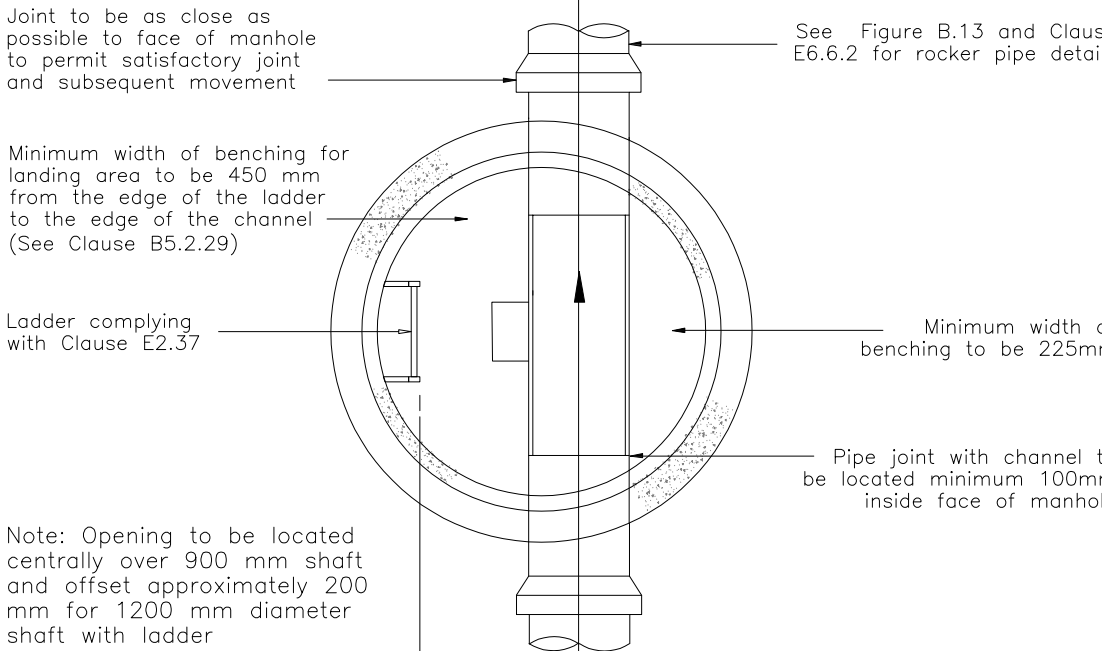
SECTION 104 - NOT APPROVED
SECTION 38 - NOT APPROVED
AGREEMENTS PENDING. ALL CONSTRUCTION WORKS
AT DEVELOPERS RISK.

P2	08.06.21	Manhole types reviewed. Drainage updated on Road 3 and EA1.	RJC	AMc
P1	21.05.21	First Issue.	RJC	AMc
REV. No.	DATE	DESCRIPTION	DRAWN	CHECKED
Client				
Project		Bartons Road, Havant		
Title		Longitudinal Sections Sheet 2		
Scale:		1:500 @ A1	Status:	
Drawn:		RJC	Project No:	
Drawing Number:		6383-MJA-SW-XX-DR-C-101	Date:	
			Rev:	
			P2	

Depth from cover level to soffit of pipe 3 m to 6 m with ladder
and reducing slab
Rigid material construction with concrete surround

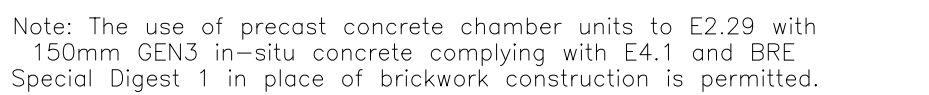


Depth from cover level to soffit of pipe 3 m to 6 m with ladder
Alternative rigid material construction with concrete surround

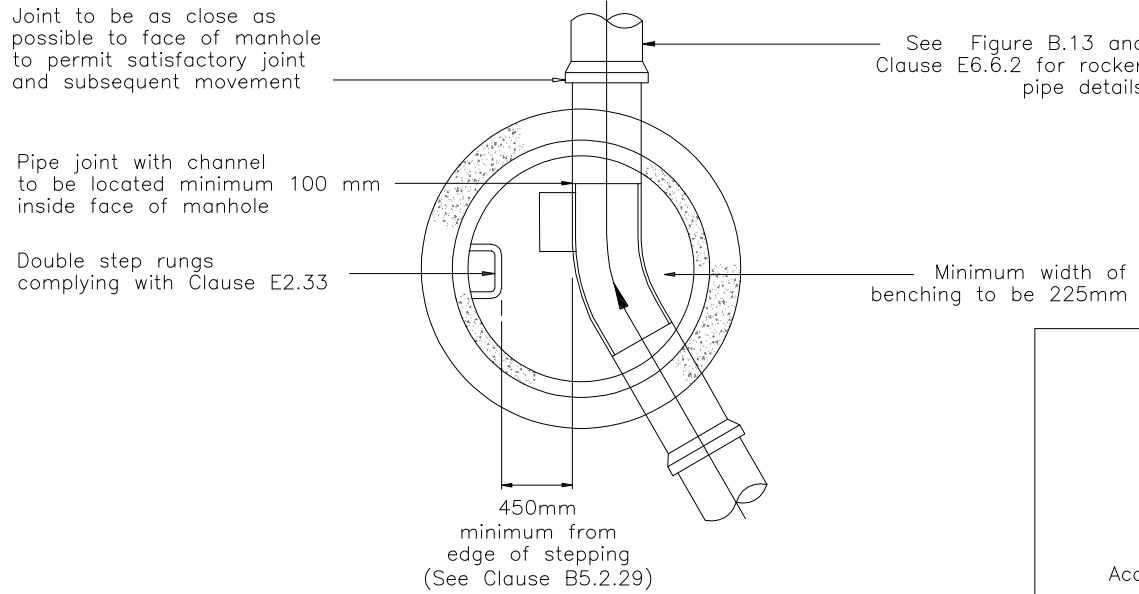


Nominal Internal Diameter of Largest Pipe in Manhole (mm)	Minimum Nominal Internal Dimension of Manhole (mm)
Less than 375	1200
375 – 450	1350
500 – 700	1500
750 – 900	1800
Greater than 900	Pipe diameter + 900

Depth from cover level to soffit of pipe less than 1.5m Maximum pipe size 450mm diameter Rigid material construction



Depth from cover level to soffit of pipe 1.5 m to 3.0 m
Alternative Rigid material construction with concrete surround



Self-cleaning toe holes to be provided where channel exceeds 600mm wide

Inverts to be formed using channel pieces

In-situ GEN3 concrete complying with E4.1 and BRE Special Digest 1

150mm

Construction joint with hydrophobic seal

Distance between top of pipe and underside of precast section to be min. 50mm to max. 300mm

225mm to underside of channel

Joint to be within chamber wall to permit satisfactory joint and subsequent movement

Pipe joint with channel to be located minimum 100 mm inside face of manhole

Double step rungs complying with Clause E2.33

See Figure B.13 and Clause E6.6.2 for rocker pipe details

Minimum width of benching to be 225mm

This diagram illustrates a four-way pipe junction. It features a central vertical pipe with a horizontal pipe crossing it. The junction is shown with preformed swept channels and a rocker pipe required for rigid pipes. Arrows indicate the flow direction, and a note specifies 'No junction leak from outgoing'.

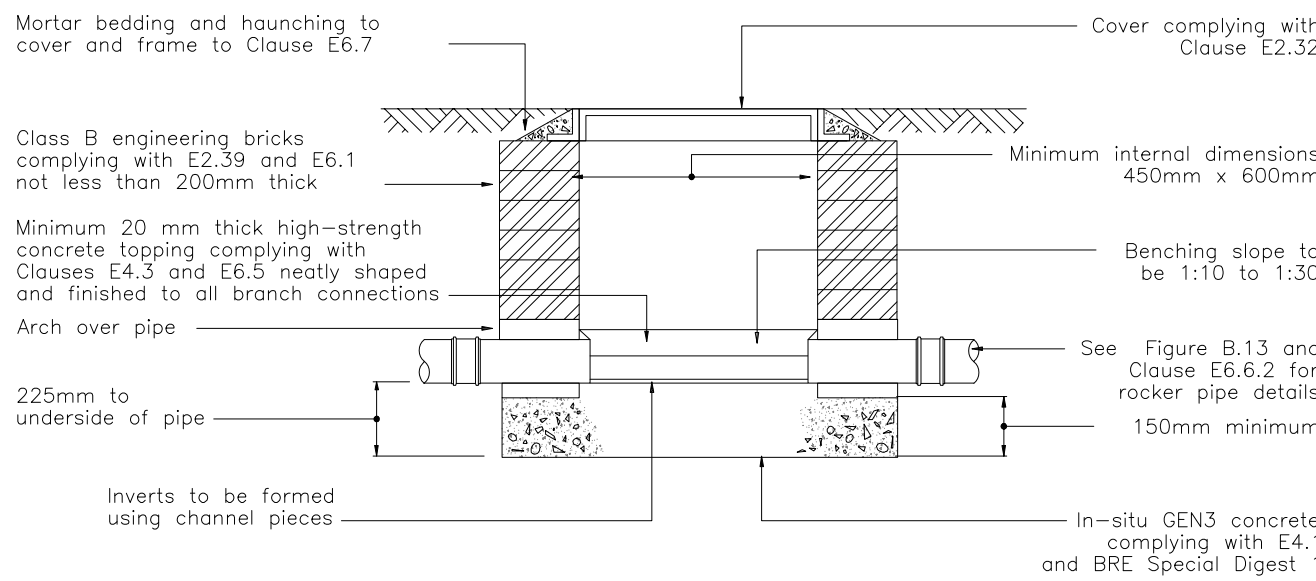
Labels in the diagram include:

- No junction leak from outgoing
- Preformed swept channels
- Rocker pipe required for rigid pipes

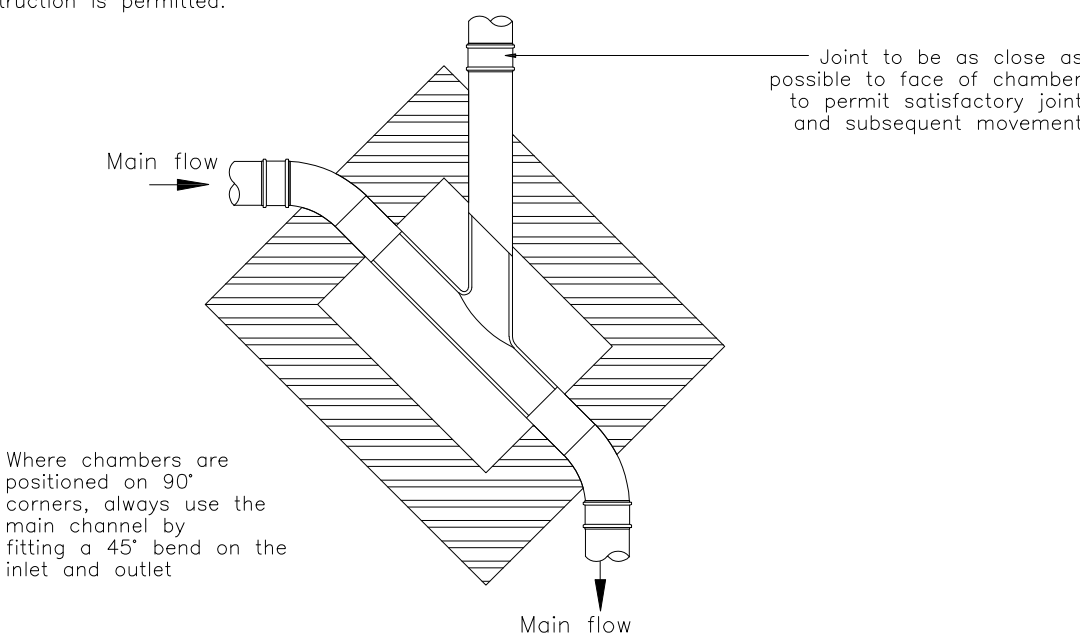
Rigid pipes built into manhole should have a flexible joint as close as feasible to the external face of the structure and the length of the next rocker pipe should be as shown.

Nominal diameter (mm)	Maximum effective length (m)
150 – 600	0.6
601 – 750	1.00
over 750	1.25

Depth from cover level to soffit of pipe up to 1m
Rigid material construction

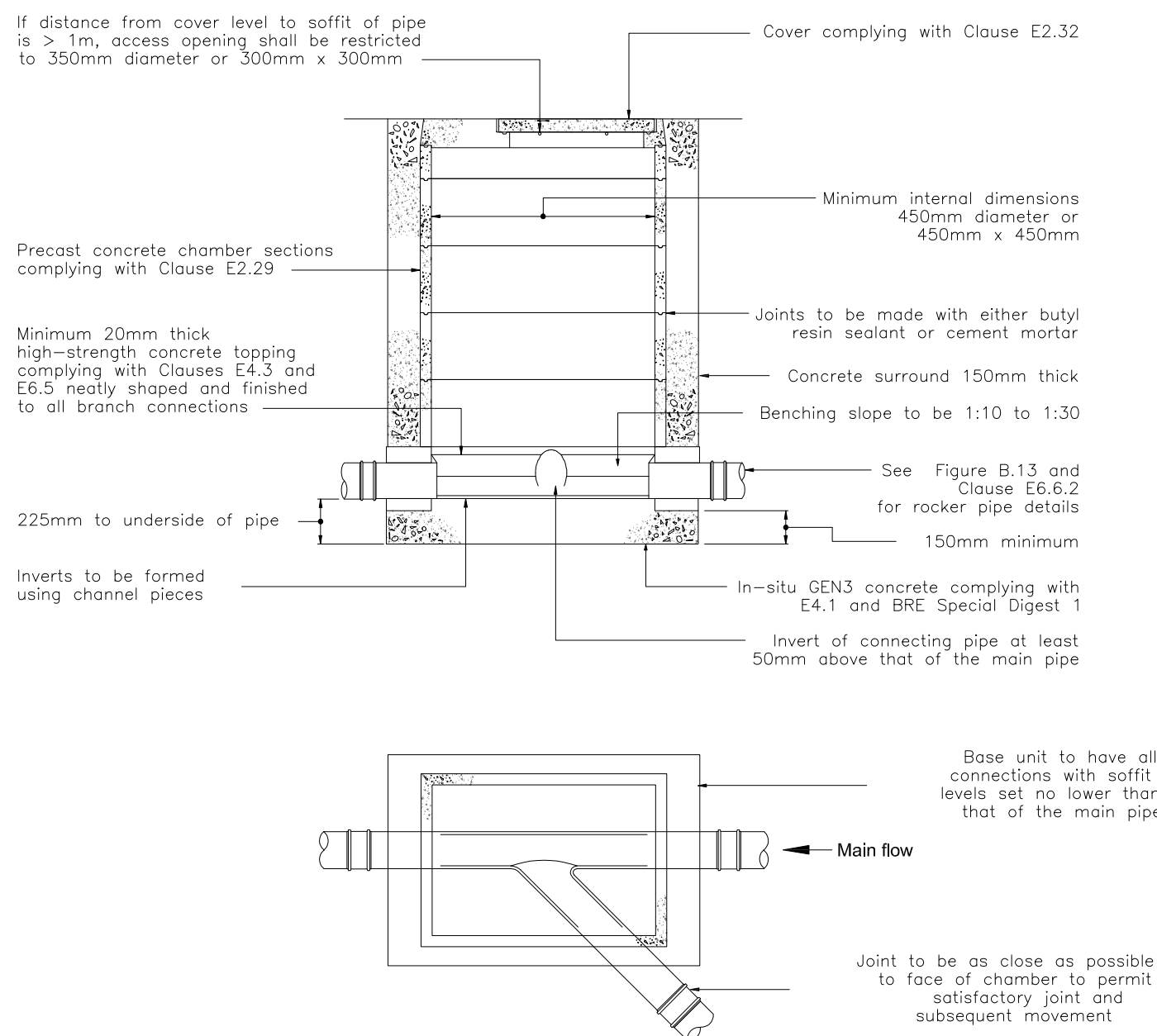


Note: The use of precast concrete chamber units to E2.29 with 150mm GEN3 in-situ concrete surround complying with E4.1 and BRE Special Digest 1 in place of brickwork construction is permitted.



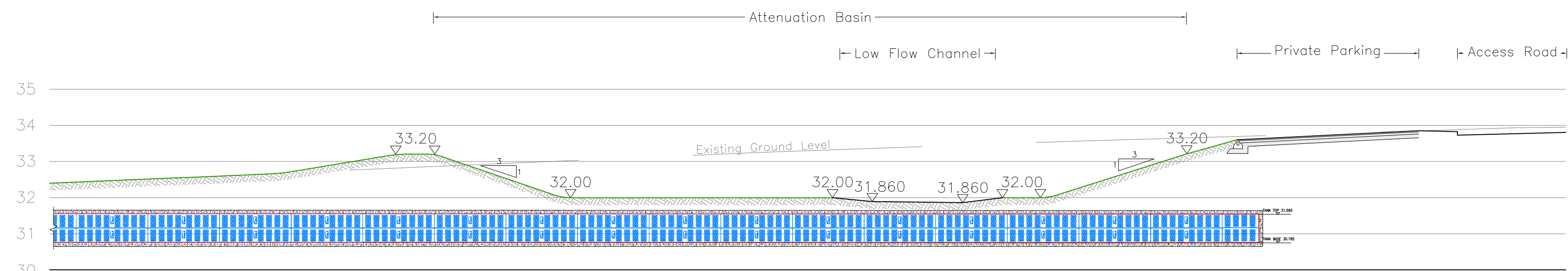
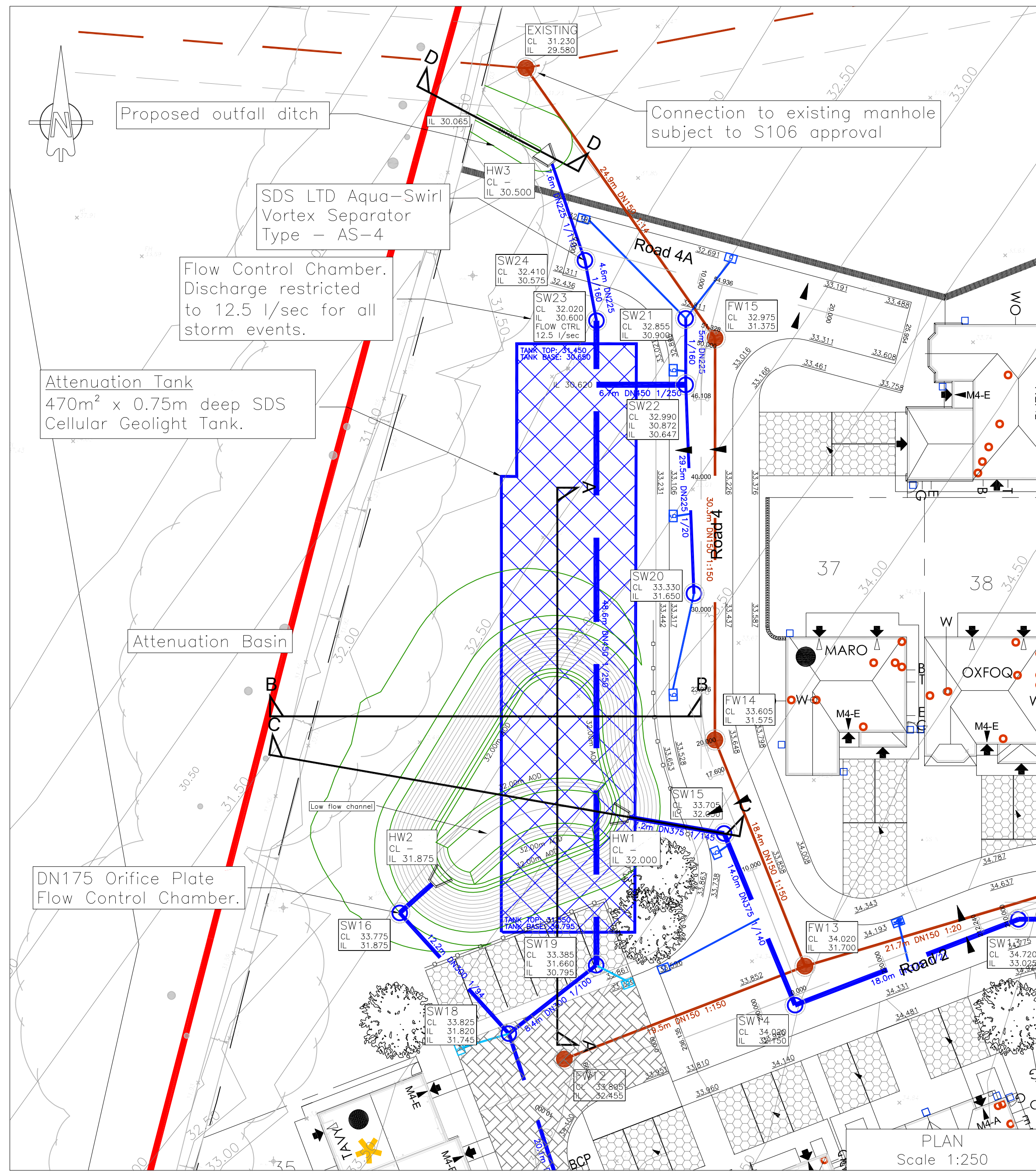
Note: Where the access chamber is in the highway (including any footway), the highway authority can have specific requirements.

Depth from cover level to soffit of pipe up to 2m
Rigid material construction for use in areas
of light vehicle loading or landscaped areas

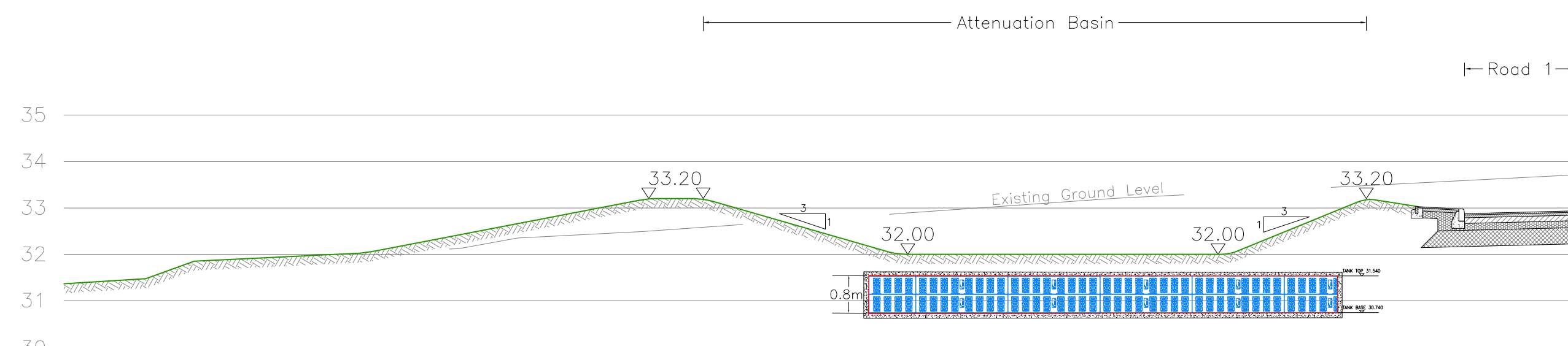


Note: Where the access chamber is in the highway (including any footway), the highway authority can have specific requirements.

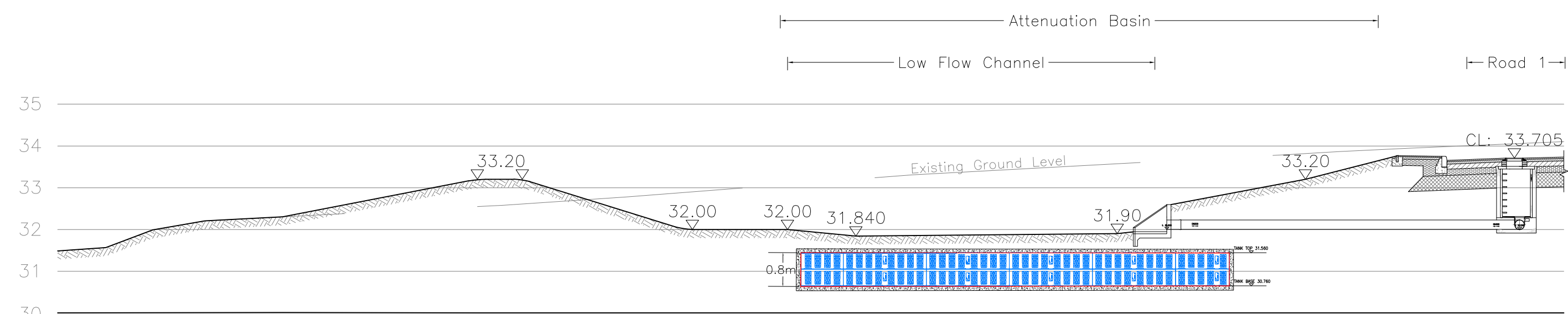
SECTION 104 - NOT APPROVED
SECTION 38 - NOT APPROVED
 AGREEMENTS PENDING. ALL CONSTRUCTION WORK
 AT DEVELOPERS RISK.



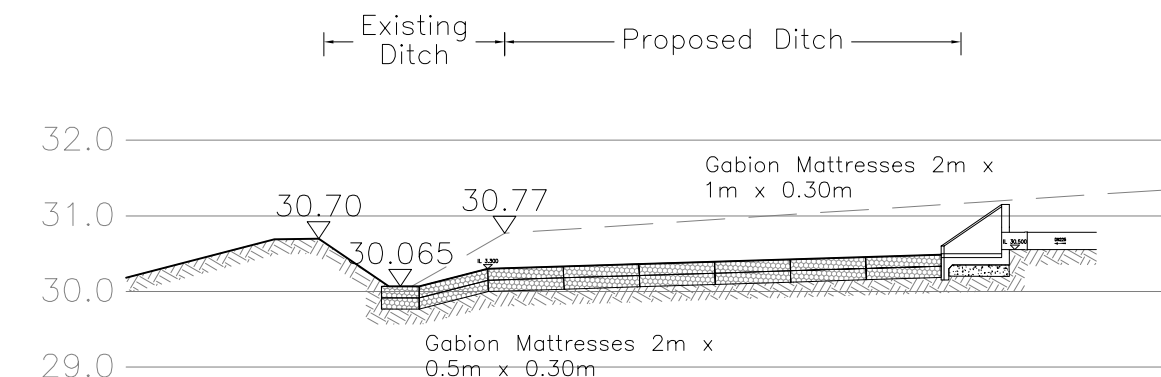
SECTION A-A
THROUGH ATTENUATION BASIN
Scale 1:100



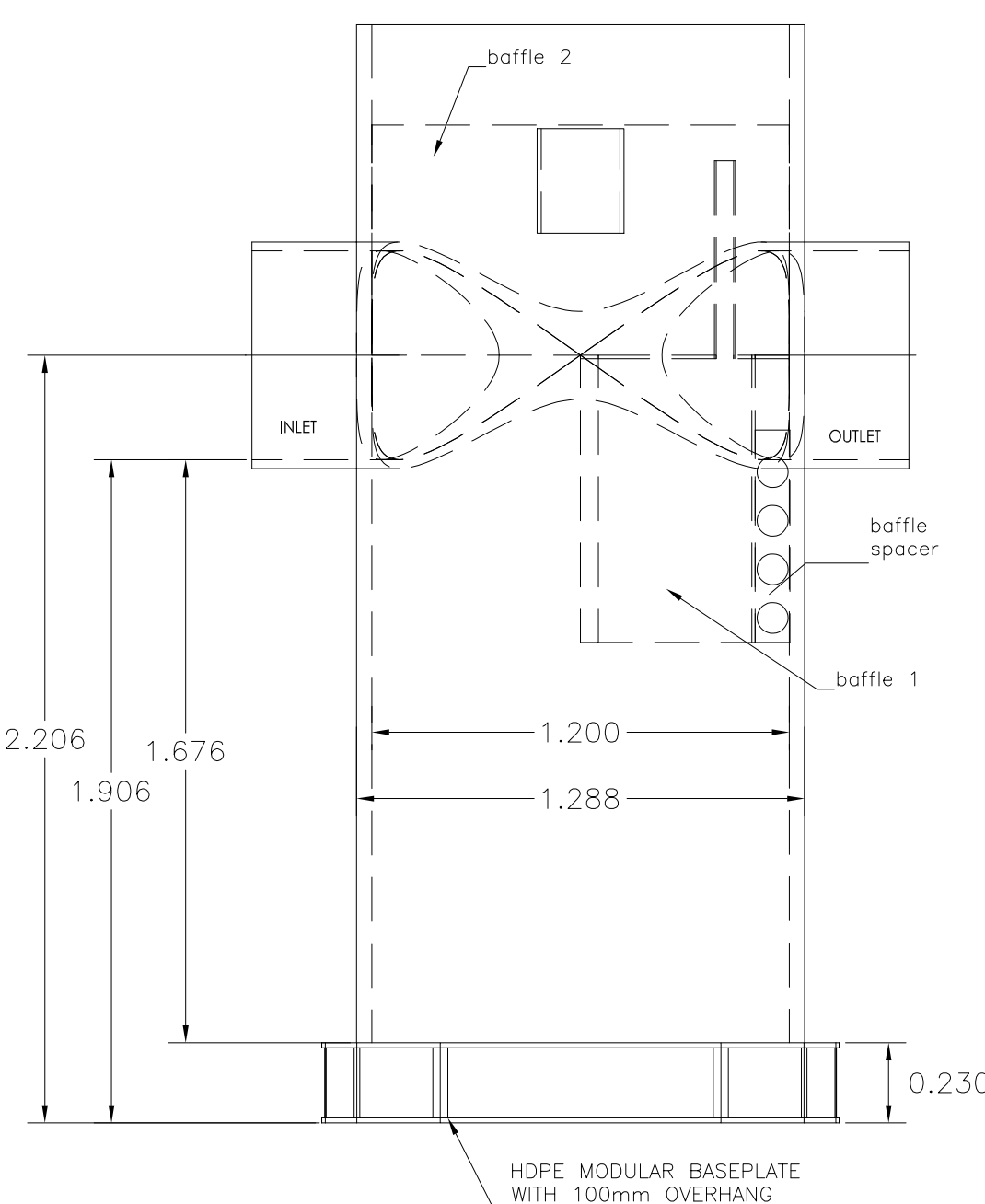
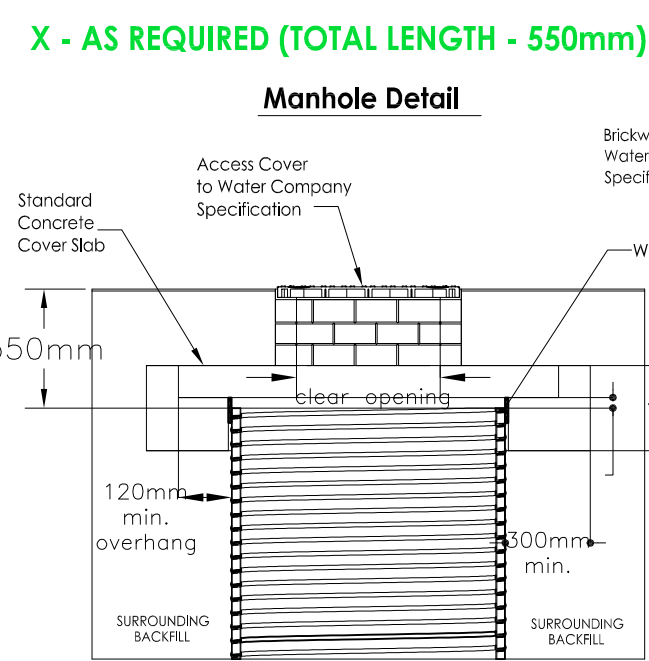
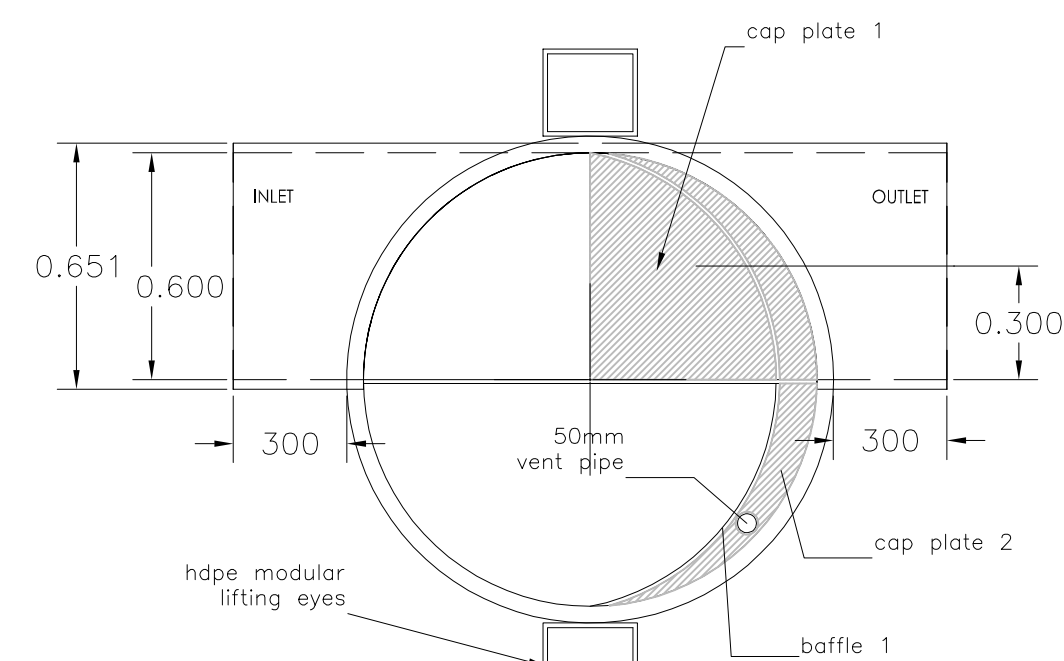
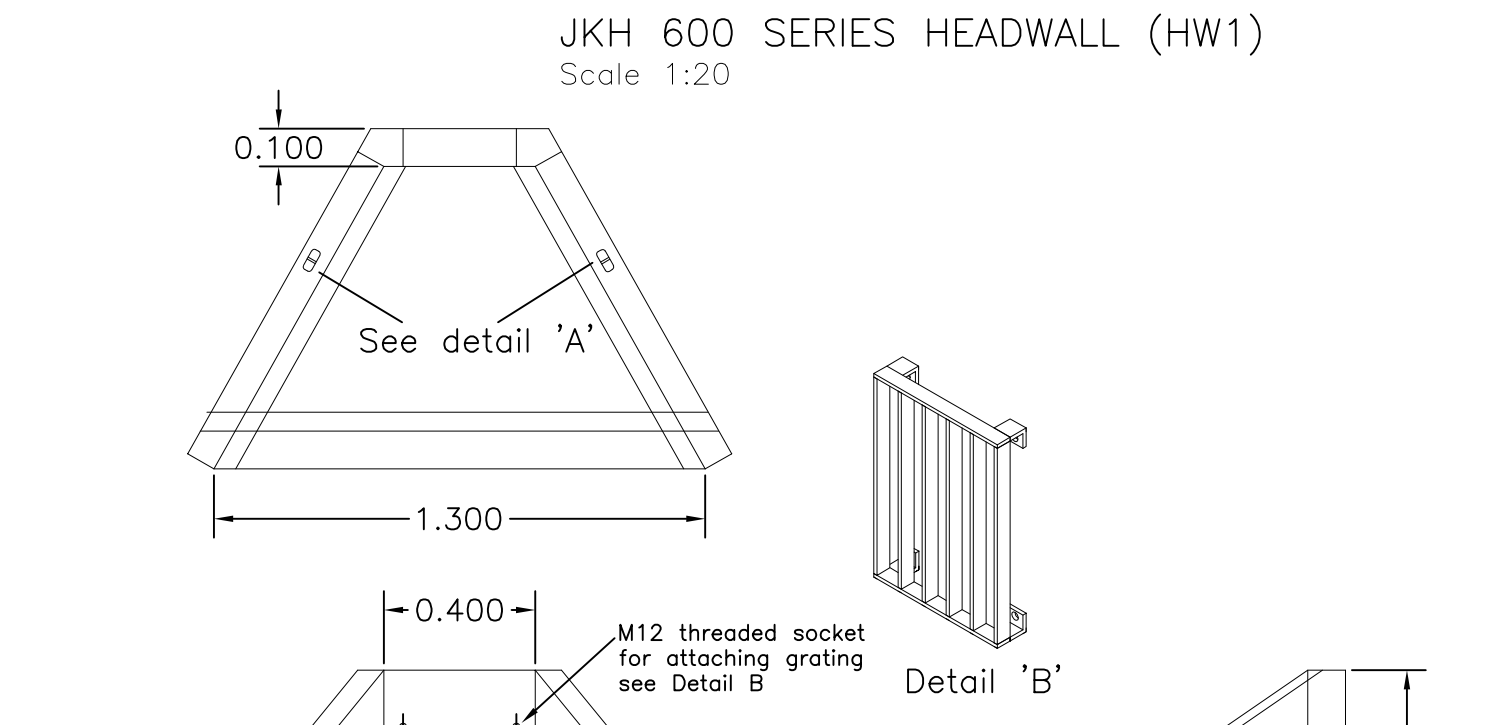
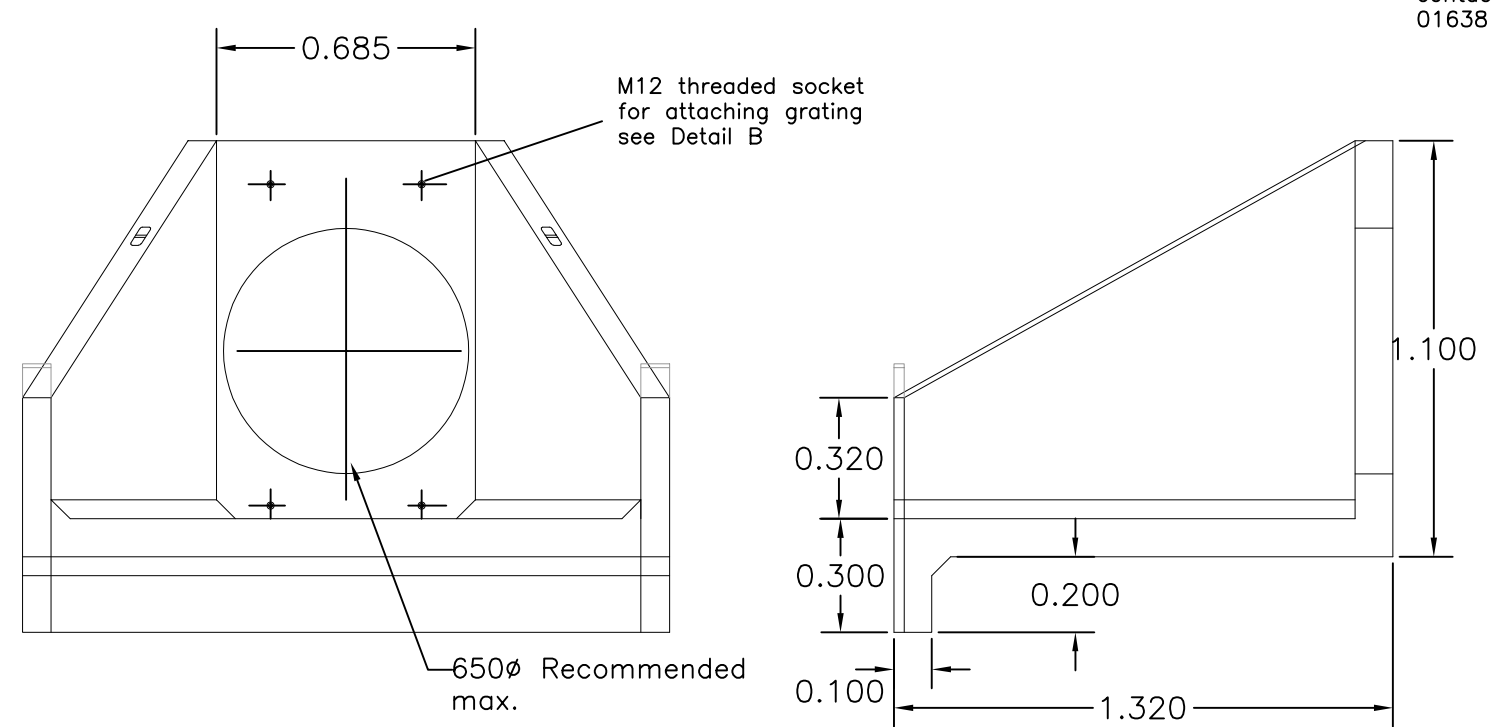
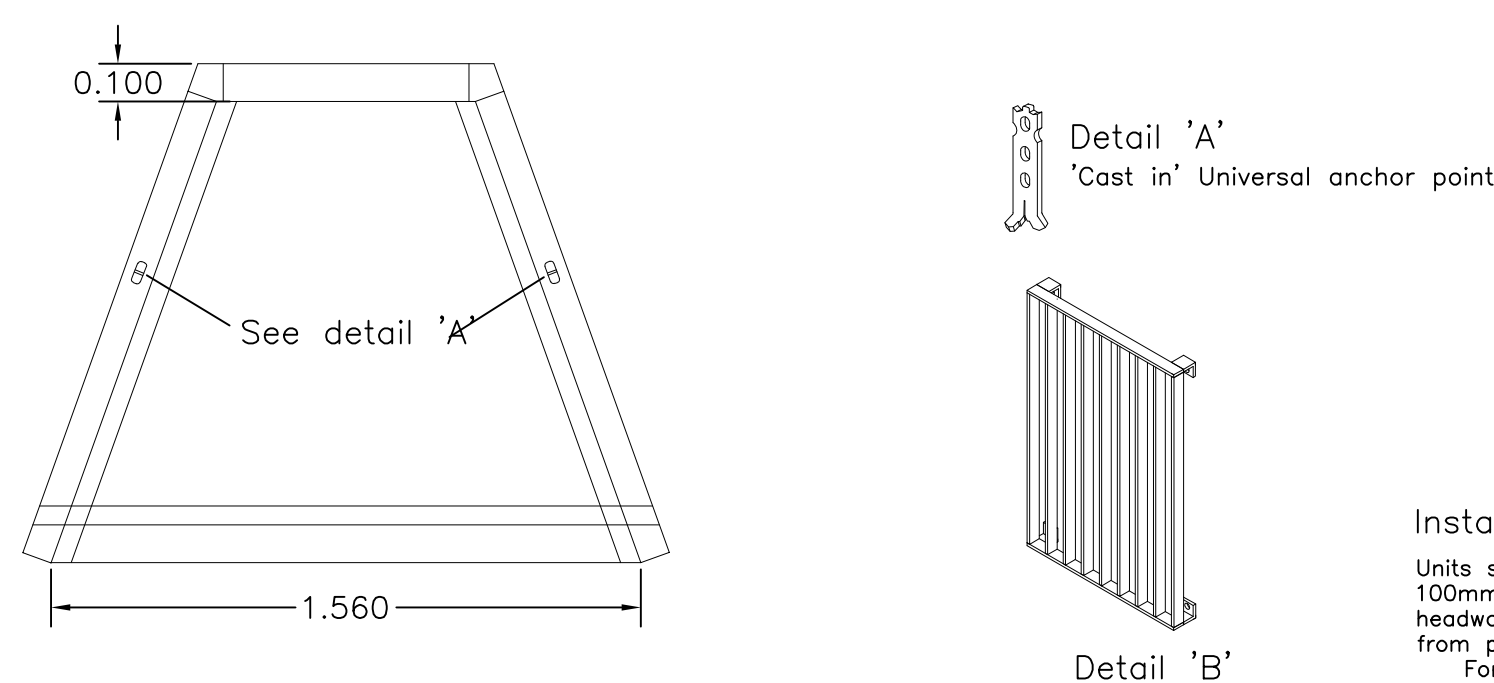
SECTION B-B
THROUGH ATTENUATION BASIN
Scale 1:100



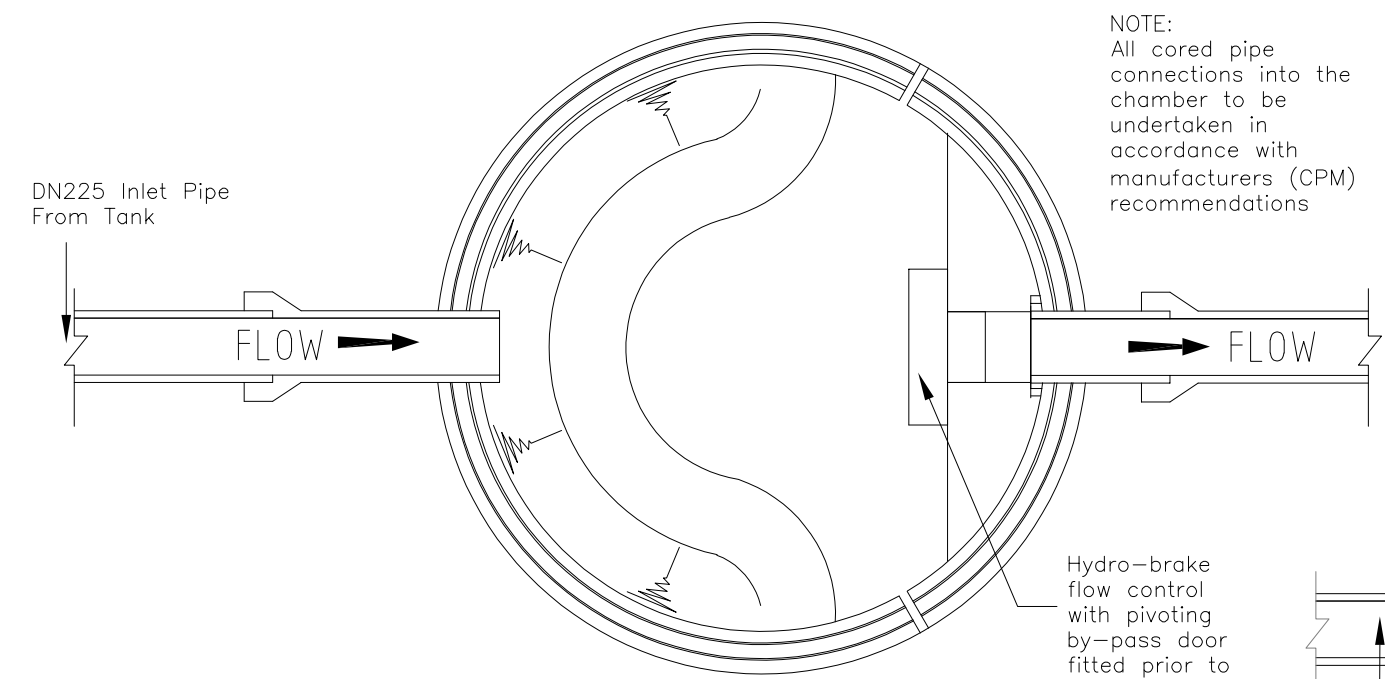
SECTION C-C
THROUGH ATTENUATION BASIN
Scale 1:100



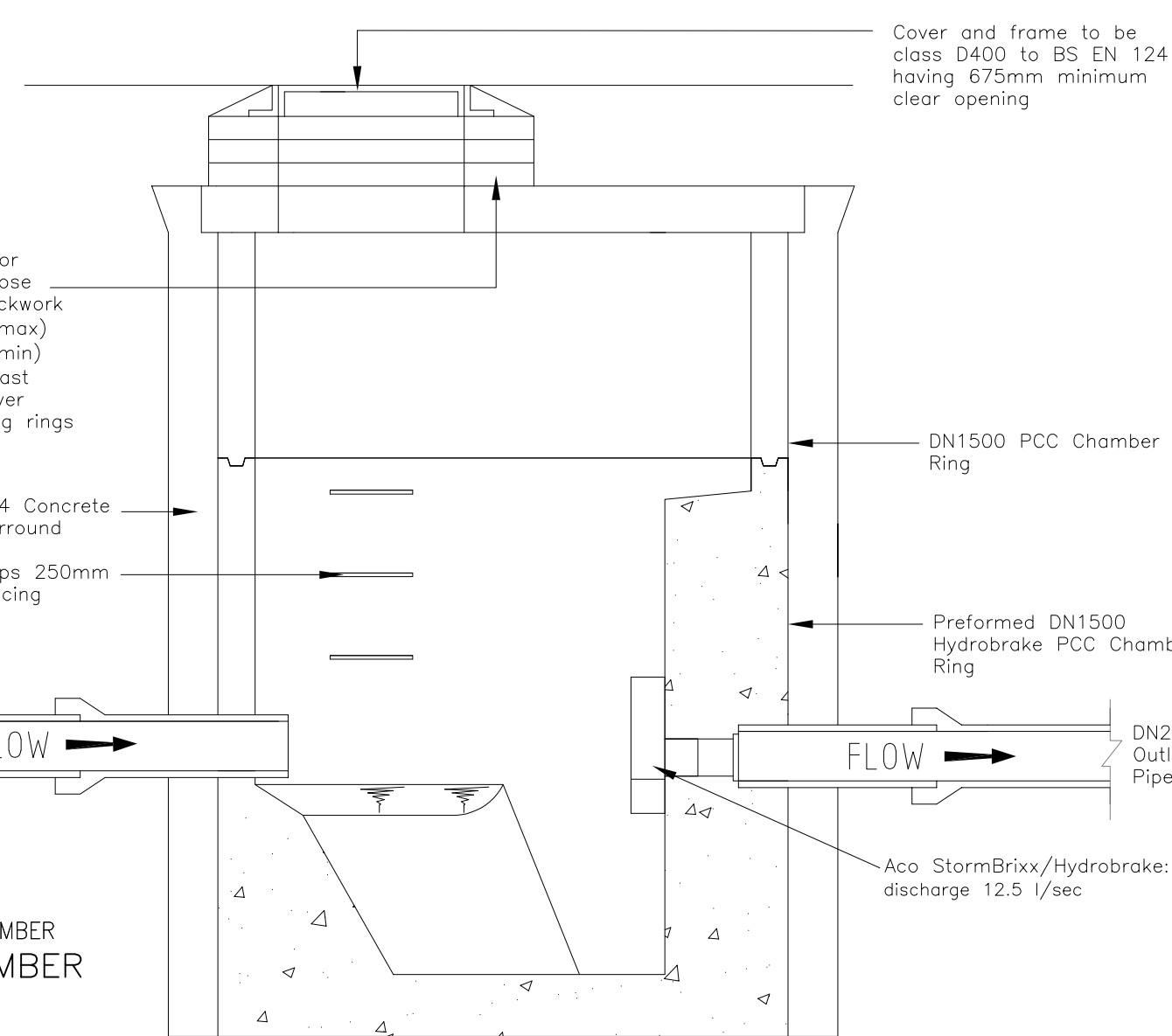
SECTION D-D
THROUGH ATTENUATION DITCH
Scale 1:100



SDS LTD Aqua-Swirl
Hydrodynamic Vortex Separator
1200 Ø - AS-4
Scale 1:20



1500mm INTERNAL DIA HYDRO-BRAKE CHAMBER
HYDROBRAKE CONTROL CHAMBER
BY CPM LTD.



P1	21.05.21	First Issue		RJC	AMc
REV. No.	DATE	DESCRIPTION		DRAWN	CHECKED
Client	REDROW HOMES				
Project	Bartons Road, Havant				
Title	Attenuation Details				
Scale:	As shown @ A0	Status:	PRELIMINARY		
Drawn:	RJC	Project Engineer:	AMc	Project No:	6383
Drawing Number:	6383-MJA-SW-XX-DR-C-210	Date:	03/2021	Rev:	P1



KEY:

Exceedance Flow Direction

Permeable Paving (Tanked System)

PL2	xx.xx.xx	Drawing updated to suit the latest planning layout.	RJC	WSR
PL1	24.08.21	First Issue.	WSR	AMc
REV. No.	DATE	DESCRIPTION	DRAWN	CHECKED
Client				
				
Project Bartons Road, Havant				
Title				
Flood Exceedance Plan				
Client				
				
Project Bartons Road, Havant				
Title				
Flood Exceedance Plan				
Scale: 1:500 @ A1				
Status: PRELIMINARY				
Drawn: RJC				
Project Engineer: AMc				
MJA Project No: 6383				
Date: 08/2021				
Drawing Number: 6383-MJA-SW-XX-DR-C-804				
Rev: PL2				



Development Surface Water Calculations

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Innovyze	Network 2020.1	

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)	19.300	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	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	5.684	0.030	189.5	0.008	5.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	22.700	0.190	119.5	0.032	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.002	26.744	0.575	46.5	0.012	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.003	23.441	0.550	42.6	0.020	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.000	14.351	0.090	159.5	0.040	5.00	0.0	0.600	o	225	Pipe/Conduit	
S2.001	12.665	0.080	158.3	0.008	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.004	62.089	0.862	72.0	0.061	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.000	39.513	0.247	160.0	0.042	5.00	0.0	0.600	o	225	Pipe/Conduit	
S1.005	32.068	0.128	250.5	0.039	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	50.00	5.10	37.775	0.008	0.0	0.0	0.0	0.95	37.6	1.1
S1.001	50.00	5.42	37.745	0.040	0.0	0.0	0.0	1.20	47.5	5.4
S1.002	50.00	5.65	37.555	0.052	0.0	0.0	0.0	1.92	76.5	7.0
S1.003	50.00	5.84	36.980	0.072	0.0	0.0	0.0	2.01	79.9	9.7
S2.000	50.00	5.23	35.350	0.040	0.0	0.0	0.0	1.03	41.1	5.4
S2.001	50.00	5.44	35.260	0.048	0.0	0.0	0.0	1.04	41.2	6.5
S1.004	50.00	6.40	35.105	0.181	0.0	0.0	0.0	1.85	131.1	24.5
S3.000	50.00	5.64	34.565	0.042	0.0	0.0	0.0	1.03	41.0	5.7
S1.005	50.00	6.87	34.168	0.262	0.0	0.0	0.0	1.14	125.9	35.5

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Innovyze	Network 2020.1	

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
S1.006	30.358	0.122	248.8	0.031	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.007	29.926	0.120	249.4	0.027	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.008	56.206	0.773	72.7	0.053	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.009	18.043	0.755	23.9	0.012	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.010	14.000	0.220	63.6	0.021	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.011	8.006	0.050	160.1	0.008	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.012	7.082	0.030	236.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.013	12.814	0.065	197.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.014	12.747	0.070	182.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S4.000	23.194	0.135	171.8	0.038	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.015	8.544	0.050	170.9	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.016	43.756	0.175	250.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S5.000	15.749	0.778	20.2	0.028	5.00	0.0	0.600	o	225	Pipe/Conduit	
S6.000	3.897	0.753	5.2	0.023	5.00	0.0	0.600	o	225	Pipe/Conduit	
S5.001	6.733	0.027	249.4	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.017	4.837	0.020	241.9	0.000	0.00	0.0	0.600	o	450	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)
S1.006	50.00	7.31	34.040	0.293	0.0	0.0	0.0	1.14	126.4	39.7
S1.007	50.00	7.75	33.918	0.320	0.0	0.0	0.0	1.14	126.2	43.3
S1.008	50.00	8.19	33.798	0.373	0.0	0.0	0.0	2.13	234.9	50.5
S1.009	50.00	8.27	33.025	0.385	0.0	0.0	0.0	3.72	410.9	52.1
S1.010	50.00	8.37	32.270	0.406	0.0	0.0	0.0	2.27	251.2	55.0
S1.011	49.97	8.47	32.050	0.414	0.0	0.0	0.0	1.43	157.9	56.0
S1.012	49.71	8.55	31.980	0.414	0.0	0.0	0.0	1.32	209.8	56.0
S1.013	49.29	8.70	31.950	0.414	0.0	0.0	0.0	1.44	229.7	56.0
S1.014	50.00	5.18	31.885	0.000	10.0	0.0	0.0	1.16	82.1	10.0
S4.000	50.00	5.32	32.100	0.038	0.0	0.0	0.0	1.20	84.6	5.1
S1.015	50.00	5.41	31.665	0.038	10.0	0.0	0.0	1.55	246.9	15.1
S1.016	50.00	5.98	30.795	0.038	10.0	0.0	0.0	1.28	203.8	15.1
S5.000	50.00	5.09	31.650	0.028	0.0	0.0	0.0	2.92	116.2	3.8
S6.000	50.00	5.01	31.625	0.023	0.0	0.0	0.0	5.79	230.2	3.1
S5.001	50.00	5.18	30.647	0.051	0.0	0.0	0.0	1.28	204.0	6.9
S1.017	50.00	6.05	30.620	0.089	10.0	0.0	0.0	1.30	207.2	22.1

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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
S1.018	12.933	0.100	129.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.019	6.327	0.050	126.5	0.000	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)
S1.018	50.00	5.19	30.600	0.000	12.5	0.0	0.0	1.15	45.7	12.5
S1.019	50.00	5.28	30.500	0.000	12.5	0.0	0.0	1.16	46.2	12.5

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Innovyze	Network 2020.1	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	225	S1	39.250	37.775	1.250	Open Manhole	1200
S1.001	o	225	S2	39.220	37.745	1.250	Open Manhole	1200
S1.002	o	225	S3	39.005	37.555	1.225	Open Manhole	1200
S1.003	o	225	S4	38.630	36.980	1.425	Open Manhole	1200
S2.000	o	225	S5	36.825	35.350	1.250	Open Manhole	1200
S2.001	o	225	S6	37.400	35.260	1.915	Open Manhole	1200
S1.004	o	300	S5	37.880	35.105	2.475	Open Manhole	1200
S3.000	o	225	S8	36.040	34.565	1.250	Open Manhole	1200
S1.005	o	375	S6	37.300	34.168	2.757	Open Manhole	1350
S1.006	o	375	S7	37.050	34.040	2.635	Open Manhole	1350
S1.007	o	375	S8	36.780	33.918	2.487	Open Manhole	1350
S1.008	o	375	S9	36.435	33.798	2.262	Open Manhole	1350
S1.009	o	375	S10	34.720	33.025	1.320	Open Manhole	1350
S1.010	o	375	S11	34.020	32.270	1.375	Open Manhole	1350
S1.011	o	375	S12	33.915	32.050	1.490	Open Manhole	1350
S1.012	o	450	S16	33.775	31.980	1.345	Open Manhole	1350
S1.013	o	450	S13	33.775	31.950	1.375	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	5.684	189.5	S2	39.220	37.745	1.250	Open Manhole	1200
S1.001	22.700	119.5	S3	39.005	37.555	1.225	Open Manhole	1200
S1.002	26.744	46.5	S4	38.630	36.980	1.425	Open Manhole	1200
S1.003	23.441	42.6	S5	37.880	36.430	1.225	Open Manhole	1200
S2.000	14.351	159.5	S6	37.400	35.260	1.915	Open Manhole	1200
S2.001	12.665	158.3	S5	37.880	35.180	2.475	Open Manhole	1200
S1.004	62.089	72.0	S6	37.300	34.243	2.757	Open Manhole	1350
S3.000	39.513	160.0	S6	37.300	34.318	2.757	Open Manhole	1350
S1.005	32.068	250.5	S7	37.050	34.040	2.635	Open Manhole	1350
S1.006	30.358	248.8	S8	36.780	33.918	2.487	Open Manhole	1350
S1.007	29.926	249.4	S9	36.435	33.798	2.262	Open Manhole	1350
S1.008	56.206	72.7	S10	34.720	33.025	1.320	Open Manhole	1350
S1.009	18.043	23.9	S11	34.020	32.270	1.375	Open Manhole	1350
S1.010	14.000	63.6	S12	33.915	32.050	1.490	Open Manhole	1350
S1.011	8.006	160.1	S16	33.775	32.000	1.400	Open Manhole	1350
S1.012	7.082	236.1	S13	33.775	31.950	1.375	Open Manhole	1350
S1.013	12.814	197.1	S17	33.775	31.885	1.440	Open Manhole	1350

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Innovyze	Network 2020.1	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.014	o	300	S17	33.775	31.885	1.590	Open Manhole	1350
S4.000	o	300	S18	33.800	32.100	1.400	Open Manhole	1200
S1.015	o	450	S17	33.175	31.665	1.060	Open Manhole	1350
S1.016	o	450	S19	32.813	30.795	1.568	Open Manhole	1350
S5.000	o	225	S18	33.300	31.650	1.425	Open Manhole	1200
S6.000	o	225	S18	32.875	31.625	1.025	Open Manhole	1200
S5.001	o	450	S19	32.990	30.647	1.893	Open Manhole	1350
S1.017	o	450	S14	32.450	30.620	1.380	Open Manhole	1350
S1.018	o	225	S15	32.400	30.600	1.575	Open Manhole	1350
S1.019	o	225	S16	31.500	30.500	0.775	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.014	12.747	182.1	S17	33.175	31.815	1.060	Open Manhole	1350
S4.000	23.194	171.8	S17	33.175	31.965	0.910	Open Manhole	1350
S1.015	8.544	170.9	S19	32.813	31.615	0.748	Open Manhole	1350
S1.016	43.756	250.0	S14	32.450	30.620	1.380	Open Manhole	1350
S5.000	15.749	20.2	S19	32.990	30.872	1.893	Open Manhole	1350
S6.000	3.897	5.2	S19	32.990	30.872	1.893	Open Manhole	1350
S5.001	6.733	249.4	S14	32.450	30.620	1.380	Open Manhole	1350
S1.017	4.837	241.9	S15	32.400	30.600	1.350	Open Manhole	1350
S1.018	12.933	129.3	S16	31.500	30.500	0.775	Open Manhole	1200
S1.019	6.327	126.5	S	31.000	30.450	0.325	Open Manhole	0

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.008	0.008	0.008
1.001	-	-	100	0.032	0.032	0.032
1.002	-	-	100	0.012	0.012	0.012
1.003	-	-	100	0.020	0.020	0.020
2.000	-	-	100	0.040	0.040	0.040
2.001	-	-	100	0.008	0.008	0.008
1.004	-	-	100	0.061	0.061	0.061
3.000	-	-	100	0.042	0.042	0.042
1.005	-	-	100	0.039	0.039	0.039
1.006	-	-	100	0.031	0.031	0.031
1.007	-	-	100	0.027	0.027	0.027
1.008	-	-	100	0.053	0.053	0.053
1.009	-	-	100	0.012	0.012	0.012
1.010	-	-	100	0.021	0.021	0.021
1.011	-	-	100	0.008	0.008	0.008
1.012	-	-	100	0.000	0.000	0.000
1.013	-	-	100	0.000	0.000	0.000
1.014	-	-	100	0.000	0.000	0.000
4.000	-	-	100	0.038	0.038	0.038
1.015	-	-	100	0.000	0.000	0.000
1.016	-	-	100	0.000	0.000	0.000
5.000	-	-	100	0.028	0.028	0.028
6.000	-	-	100	0.023	0.023	0.023
5.001	-	-	100	0.000	0.000	0.000
1.017	-	-	100	0.000	0.000	0.000
1.018	-	-	100	0.000	0.000	0.000
1.019	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.503	0.503	0.503

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)
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S1.019	S	31.000	30.450	0.000	0	0
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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 * 10m³/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 Offline Controls	2
Number of Online Controls	2	Number of Storage Structures	2

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Simulation Criteria for Storm

Number of Time/Area Diagrams 16 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)	19.300	Storm Duration (mins) 30
Ratio R	0.350	

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Online Controls for Storm

Orifice Manhole: S17, DS/PN: S1.014, Volume (m³): 4.5

Diameter (m) 0.175 Discharge Coefficient 0.600 Invert Level (m) 31.885

Hydro-Brake® Optimum Manhole: S15, DS/PN: S1.018, Volume (m³): 3.1

Unit Reference	MD-SHE-0158-1250-1250-1250
Design Head (m)	1.250
Design Flow (l/s)	12.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	158
Invert Level (m)	30.600
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.250	12.5
Flush-Flo™	0.375	12.4
Kick-Flo®	0.816	10.2
Mean Flow over Head Range	-	10.8

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	5.7	1.200	12.3	3.000	18.9	7.000	28.5
0.200	11.7	1.400	13.2	3.500	20.4	7.500	29.4
0.300	12.3	1.600	14.0	4.000	21.7	8.000	30.3
0.400	12.4	1.800	14.9	4.500	23.0	8.500	31.3
0.500	12.3	2.000	15.6	5.000	24.2	9.000	32.1
0.600	12.0	2.200	16.3	5.500	25.3	9.500	33.0
0.800	10.5	2.400	17.0	6.000	26.4		
1.000	11.3	2.600	17.7	6.500	27.5		

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Storage Structures for Storm

Tank or Pond Manhole: S17, DS/PN: S1.014

Invert Level (m) 31.950

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	130.0	0.700	230.0	1.400	360.0	2.100	0.0
0.100	145.0	0.800	245.0	1.500	390.0	2.200	0.0
0.200	160.0	0.900	260.0	1.600	450.0	2.300	0.0
0.300	175.0	1.000	270.0	1.700	0.0	2.400	0.0
0.400	190.0	1.100	290.0	1.800	0.0	2.500	0.0
0.500	205.0	1.200	310.0	1.900	0.0		
0.600	215.0	1.300	330.0	2.000	0.0		

Tank or Pond Manhole: S15, DS/PN: S1.018

Invert Level (m) 30.600

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	460.0	0.700	460.0	1.400	460.0	2.100	460.0
0.100	460.0	0.800	460.0	1.500	460.0	2.200	460.0
0.200	460.0	0.900	460.0	1.600	460.0	2.300	460.0
0.300	460.0	1.000	460.0	1.700	460.0	2.400	460.0
0.400	460.0	1.100	460.0	1.800	460.0	2.500	460.0
0.500	460.0	1.200	460.0	1.900	460.0		
0.600	460.0	1.300	460.0	2.000	460.0		

Time Area Diagram at Pipe Number S1.000 for Storm

Total Area (ha) 0.036

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To: (ha)		From: To: (ha)		From: To: (ha)	
0 4 0.012		4 8 0.016		8 12 0.008	

Time Area Diagram at Pipe Number S1.002 for Storm

Total Area (ha) 0.043

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To: (ha)		From: To: (ha)		From: To: (ha)	
0 4 0.020		4 8 0.016		8 12 0.007	

Time Area Diagram at Pipe Number S2.000 for Storm

Total Area (ha) 0.013

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<u>Time Area Diagram at Pipe Number S2.000 for Storm</u> <table><tr><th>Time (mins)</th><th>Area (ha)</th><th>Time (mins)</th><th>Area (ha)</th></tr><tr><td>From: To:</td><td></td><td>From: To:</td><td></td></tr><tr><td>0 4</td><td>0.003</td><td>4 8</td><td>0.010</td></tr></table> <u>Time Area Diagram at Pipe Number S2.001 for Storm</u> Total Area (ha) 0.017 <table><tr><th>Time (mins)</th><th>Area (ha)</th><th>Time (mins)</th><th>Area (ha)</th></tr><tr><td>From: To:</td><td></td><td>From: To:</td><td></td></tr><tr><td>0 4</td><td>0.007</td><td>4 8</td><td>0.010</td></tr></table> <u>Time Area Diagram at Pipe Number S1.004 for Storm</u> Total Area (ha) 0.046 <table><tr><th>Time (mins)</th><th>Area (ha)</th><th>Time (mins)</th><th>Area (ha)</th></tr><tr><td>From: To:</td><td></td><td>From: To:</td><td></td></tr><tr><td>0 4</td><td>0.020</td><td>4 8</td><td>0.026</td></tr></table> <u>Time Area Diagram at Pipe Number S3.000 for Storm</u> Total Area (ha) 0.086 <table><tr><th>Time (mins)</th><th>Area (ha)</th><th>Time (mins)</th><th>Area (ha)</th><th>Time (mins)</th><th>Area (ha)</th></tr><tr><td>From: To:</td><td></td><td>From: To:</td><td></td><td>From: To:</td><td></td></tr><tr><td>0 4</td><td>0.025</td><td>4 8</td><td>0.035</td><td>8 12</td><td>0.026</td></tr></table> <u>Time Area Diagram at Pipe Number S1.005 for Storm</u> Total Area (ha) 0.086 <table><tr><th>Time (mins)</th><th>Area (ha)</th><th>Time (mins)</th><th>Area (ha)</th><th>Time (mins)</th><th>Area (ha)</th></tr><tr><td>From: To:</td><td></td><td>From: To:</td><td></td><td>From: To:</td><td></td></tr><tr><td>0 4</td><td>0.025</td><td>4 8</td><td>0.035</td><td>8 12</td><td>0.026</td></tr></table> <u>Time Area Diagram at Pipe Number S1.006 for Storm</u> Total Area (ha) 0.083 <table><tr><th>Time (mins)</th><th>Area (ha)</th><th>Time (mins)</th><th>Area (ha)</th><th>Time (mins)</th><th>Area (ha)</th></tr><tr><td>From: To:</td><td></td><td>From: To:</td><td></td><td>From: To:</td><td></td></tr><tr><td>0 4</td><td>0.025</td><td>4 8</td><td>0.035</td><td>8 12</td><td>0.023</td></tr></table>			Time (mins)	Area (ha)	Time (mins)	Area (ha)	From: To:		From: To:		0 4	0.003	4 8	0.010	Time (mins)	Area (ha)	Time (mins)	Area (ha)	From: To:		From: To:		0 4	0.007	4 8	0.010	Time (mins)	Area (ha)	Time (mins)	Area (ha)	From: To:		From: To:		0 4	0.020	4 8	0.026	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	From: To:		From: To:		From: To:		0 4	0.025	4 8	0.035	8 12	0.026	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	From: To:		From: To:		From: To:		0 4	0.025	4 8	0.035	8 12	0.026	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	From: To:		From: To:		From: To:		0 4	0.025	4 8	0.035	8 12	0.023
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<u>Time Area Diagram at Pipe Number S1.007 for Storm</u> Total Area (ha) 0.170 <table><tr><td>Time (mins)</td><td>Area</td><td>Time (mins)</td><td>Area</td><td>Time (mins)</td><td>Area</td></tr><tr><td>From: To: (ha)</td><td></td><td>From: To: (ha)</td><td></td><td>From: To: (ha)</td><td></td></tr><tr><td>0 4 0.050</td><td></td><td>4 8 0.075</td><td></td><td>8 12 0.045</td><td></td></tr></table> <u>Time Area Diagram at Pipe Number S1.008 for Storm</u> Total Area (ha) 0.135 <table><tr><td>Time (mins)</td><td>Area</td><td>Time (mins)</td><td>Area</td><td>Time (mins)</td><td>Area</td></tr><tr><td>From: To: (ha)</td><td></td><td>From: To: (ha)</td><td></td><td>From: To: (ha)</td><td></td></tr><tr><td>0 4 0.050</td><td></td><td>4 8 0.060</td><td></td><td>8 12 0.025</td><td></td></tr></table> <u>Time Area Diagram at Pipe Number S1.009 for Storm</u> Total Area (ha) 0.100 <table><tr><td>Time (mins)</td><td>Area</td><td>Time (mins)</td><td>Area</td><td>Time (mins)</td><td>Area</td></tr><tr><td>From: To: (ha)</td><td></td><td>From: To: (ha)</td><td></td><td>From: To: (ha)</td><td></td></tr><tr><td>0 4 0.025</td><td></td><td>4 8 0.045</td><td></td><td>8 12 0.030</td><td></td></tr></table> <u>Time Area Diagram at Pipe Number S1.010 for Storm</u> Total Area (ha) 0.045 <table><tr><td>Time (mins)</td><td>Area</td><td>Time (mins)</td><td>Area</td></tr><tr><td>From: To: (ha)</td><td></td><td>From: To: (ha)</td><td></td></tr><tr><td>0 4 0.025</td><td></td><td>4 8 0.020</td><td></td></tr></table> <u>Time Area Diagram at Pipe Number S1.011 for Storm</u> Total Area (ha) 0.019 <table><tr><td>Time (mins)</td><td>Area</td><td>Time (mins)</td><td>Area</td></tr><tr><td>From: To: (ha)</td><td></td><td>From: To: (ha)</td><td></td></tr><tr><td>0 4 0.010</td><td></td><td>4 8 0.009</td><td></td></tr></table> <u>Time Area Diagram at Pipe Number S4.000 for Storm</u> Total Area (ha) 0.055 <table><tr><td>Time (mins)</td><td>Area</td><td>Time (mins)</td><td>Area</td></tr><tr><td>From: To: (ha)</td><td></td><td>From: To: (ha)</td><td></td></tr><tr><td>0 4 0.030</td><td></td><td>4 8 0.025</td><td></td></tr></table>						Time (mins)	Area	Time (mins)	Area	Time (mins)	Area	From: To: (ha)		From: To: (ha)		From: To: (ha)		0 4 0.050		4 8 0.075		8 12 0.045		Time (mins)	Area	Time (mins)	Area	Time (mins)	Area	From: To: (ha)		From: To: (ha)		From: To: (ha)		0 4 0.050		4 8 0.060		8 12 0.025		Time (mins)	Area	Time (mins)	Area	Time (mins)	Area	From: To: (ha)		From: To: (ha)		From: To: (ha)		0 4 0.025		4 8 0.045		8 12 0.030		Time (mins)	Area	Time (mins)	Area	From: To: (ha)		From: To: (ha)		0 4 0.025		4 8 0.020		Time (mins)	Area	Time (mins)	Area	From: To: (ha)		From: To: (ha)		0 4 0.010		4 8 0.009		Time (mins)	Area	Time (mins)	Area	From: To: (ha)		From: To: (ha)		0 4 0.030		4 8 0.025	
Time (mins)	Area	Time (mins)	Area	Time (mins)	Area																																																																																										
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<u>Time Area Diagram at Pipe Number S1.015 for Storm</u> Total Area (ha) 0.020 <table><thead><tr><th colspan="2">Time (mins)</th><th>Area</th></tr><tr><th>From:</th><th>To:</th><th>(ha)</th></tr></thead><tbody><tr><td>0</td><td>4</td><td>0.020</td></tr></tbody></table> <u>Time Area Diagram at Pipe Number S5.001 for Storm</u> Total Area (ha) 0.019 <table><thead><tr><th colspan="2">Time (mins)</th><th>Area</th><th colspan="2">Time (mins)</th><th>Area</th></tr><tr><th>From:</th><th>To:</th><th>(ha)</th><th>From:</th><th>To:</th><th>(ha)</th></tr></thead><tbody><tr><td>0</td><td>4</td><td>0.010</td><td>4</td><td>8</td><td>0.009</td></tr></tbody></table>			Time (mins)		Area	From:	To:	(ha)	0	4	0.020	Time (mins)		Area	Time (mins)		Area	From:	To:	(ha)	From:	To:	(ha)	0	4	0.010	4	8	0.009
Time (mins)		Area																											
From:	To:	(ha)																											
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Time (mins)		Area	Time (mins)		Area																								
From:	To:	(ha)	From:	To:	(ha)																								
0	4	0.010	4	8	0.009																								
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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 (1/per/day) 0.000
Foul Sewage per hectare (1/s) 0.000	

Number of Input Hydrographs 0	Number of Storage Structures 2
Number of Online Controls 2	Number of Time/Area Diagrams 16
Number of Offline Controls 2	Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R 0.350
Region England and Wales Cv (Summer)	0.750	
M5-60 (mm)	19.300 Cv (Winter)	0.840

Margin for Flood Risk Warning (mm) 300.0	DVD Status OFF
Analysis Timestep	Fine Inertia Status OFF
DTS Status	ON

Profile(s) Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720	
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	15 Winter	1	+0%				
S1.001	S2	15 Winter	1	+0%				
S1.002	S3	15 Winter	1	+0%				
S1.003	S4	15 Winter	1	+0%				
S2.000	S5	15 Winter	1	+0%	100/15 Winter			
S2.001	S6	15 Winter	1	+0%	100/15 Winter			
S1.004	S5	15 Winter	1	+0%	100/15 Winter			
S3.000	S8	15 Winter	1	+0%	100/15 Summer			
S1.005	S6	15 Winter	1	+0%	100/15 Summer			
S1.006	S7	15 Winter	1	+0%	100/15 Summer			
S1.007	S8	15 Winter	1	+0%	30/15 Winter			
S1.008	S9	15 Winter	1	+0%	100/15 Summer			
S1.009	S10	15 Winter	1	+0%	100/15 Summer			
S1.010	S11	15 Winter	1	+0%	30/15 Summer		100/15 Summer	6
S1.011	S12	15 Winter	1	+0%	30/15 Summer			
S1.012	S16	15 Winter	1	+0%	30/15 Summer			
S1.013	S13	60 Winter	1	+0%	30/15 Summer			
S1.014	S17	60 Winter	1	+0%	1/30 Winter			
S4.000	S18	15 Winter	1	+0%				
S1.015	S17	60 Winter	1	+0%				
S1.016	S19	60 Winter	1	+0%	100/60 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	Flow / Cap.	Overflow (l/s)	Half Drain	Pipe	Status
		Level (m)	Depth (m)	Volume (m³)			Time (mins)	Flow (l/s)	
S1.000	S1	37.825	-0.175	0.000	0.11	0.0		3.2	OK
S1.001	S2	37.802	-0.168	0.000	0.14			6.2	OK
S1.002	S3	37.611	-0.169	0.000	0.14			10.0	OK
S1.003	S4	37.041	-0.164	0.000	0.16			12.0	OK
S2.000	S5	35.380	-0.195	0.000	0.04			1.5	OK
S2.001	S6	35.306	-0.179	0.000	0.09			3.2	OK
S1.004	S5	35.184	-0.221	0.000	0.16			19.6	OK
S3.000	S8	34.631	-0.159	0.000	0.19			7.3	OK
S1.005	S6	34.309	-0.234	0.000	0.30			33.8	OK
S1.006	S7	34.196	-0.219	0.000	0.36			40.6	OK
S1.007	S8	34.104	-0.189	0.000	0.49			54.8	OK
S1.008	S9	33.938	-0.235	0.000	0.30			65.0	OK
S1.009	S10	33.143	-0.257	0.000	0.22			73.4	OK
S1.010	S11	32.439	-0.206	0.000	0.42			76.2	OK
S1.011	S12	32.288	-0.137	0.000	0.72			77.3	OK
S1.012	S16	32.228	-0.202	0.000	0.59			77.6	OK
S1.013	S13	32.220	-0.180	0.000	0.35		59.1	OK	
S1.014	S17	32.210	0.025	0.000	0.47		31.1	SURCHARGED	
S4.000	S18	32.154	-0.246	0.000	0.07		5.6	OK	
S1.015	S17	31.801	-0.314	0.000	0.20		32.7	OK	
S1.016	S19	30.923	-0.322	0.000	0.18		32.7	OK	

PN	US/MH Name	Level Exceeded
S1.000	S1	
S1.001	S2	
S1.002	S3	
S1.003	S4	
S2.000	S5	
S2.001	S6	
S1.004	S5	
S3.000	S8	
S1.005	S6	
S1.006	S7	
S1.007	S8	
S1.008	S9	
S1.009	S10	
S1.010	S11	
S1.011	S12	
S1.012	S16	
S1.013	S13	
S1.014	S17	
S4.000	S18	
S1.015	S17	

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<u>1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)</u> <u>for Storm</u>											
<table><tr><td></td><td>US/MH</td><td>Level</td></tr><tr><td>PN</td><td>Name</td><td>Exceeded</td></tr><tr><td>S1.016</td><td>S19</td><td></td></tr></table>				US/MH	Level	PN	Name	Exceeded	S1.016	S19	
	US/MH	Level									
PN	Name	Exceeded									
S1.016	S19										
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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S5.000	S18	15 Winter	1	+0%					31.677
S6.000	S18	15 Winter	1	+0%	100/360 Winter				31.649
S5.001	S19	240 Winter	1	+0%	30/120 Winter				30.808
S1.017	S14	240 Winter	1	+0%	30/120 Winter				30.808
S1.018	S15	240 Winter	1	+0%	30/30 Summer			0	30.806
S1.019	S16	240 Winter	1	+0%					30.594

Surcharged Flooded					Half Drain		Pipe	Level	
PN	US/MH Name	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)	Status	Exceeded
S5.000	S18	-0.198	0.000	0.03			3.6	OK	
S6.000	S18	-0.201	0.000	0.02			3.0	OK	
S5.001	S19	-0.289	0.000	0.02			2.0	OK	
S1.017	S14	-0.262	0.000	0.23			26.7	OK	
S1.018	S15	-0.019	0.000	0.29	0.0		11.6	OK	
S1.019	S16	-0.131	0.000	0.37			11.6	OK	

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30 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	2
Number of Online Controls	2	Number of Time/Area Diagrams	16
Number of Offline Controls	2	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region England and Wales Cv (Summer)	0.750		
M5-60 (mm)	19.300	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s) Summer and Winter

Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S1	15 Winter	30	+0%				
S1.001	S2	15 Winter	30	+0%				
S1.002	S3	15 Winter	30	+0%				
S1.003	S4	15 Winter	30	+0%				
S2.000	S5	15 Winter	30	+0%	100/15 Winter			
S2.001	S6	15 Winter	30	+0%	100/15 Winter			
S1.004	S5	15 Winter	30	+0%	100/15 Winter			
S3.000	S8	15 Winter	30	+0%	100/15 Summer			
S1.005	S6	15 Winter	30	+0%	100/15 Summer			
S1.006	S7	15 Winter	30	+0%	100/15 Summer			
S1.007	S8	15 Winter	30	+0%	30/15 Winter			
S1.008	S9	15 Winter	30	+0%	100/15 Summer			
S1.009	S10	15 Winter	30	+0%	100/15 Summer			
S1.010	S11	30 Winter	30	+0%	30/15 Summer		100/15 Summer	6
S1.011	S12	30 Winter	30	+0%	30/15 Summer			
S1.012	S16	60 Winter	30	+0%	30/15 Summer			
S1.013	S13	60 Winter	30	+0%	30/15 Summer			
S1.014	S17	60 Winter	30	+0%	1/30 Winter			
S4.000	S18	15 Winter	30	+0%				
S1.015	S17	60 Winter	30	+0%				
S1.016	S19	240 Winter	30	+0%	100/60 Summer			

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PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1	37.856	-0.144	0.000	0.28			7.8	OK
S1.001	S2	37.843	-0.127	0.000	0.38			16.6	OK
S1.002	S3	37.650	-0.130	0.000	0.37			26.2	OK
S1.003	S4	37.085	-0.120	0.000	0.44			32.2	OK
S2.000	S5	35.399	-0.176	0.000	0.10			3.7	OK
S2.001	S6	35.333	-0.152	0.000	0.22			8.0	OK
S1.004	S5	35.236	-0.169	0.000	0.40			49.4	OK
S3.000	S8	34.672	-0.118	0.000	0.46			17.7	OK
S1.005	S6	34.457	-0.086	0.000	0.71			79.6	OK
S1.006	S7	34.397	-0.018	0.000	0.83			93.4	OK
S1.007	S8	34.312	0.019	0.000	1.14			126.7	SURCHARGED
S1.008	S9	34.030	-0.143	0.000	0.69			151.3	OK
S1.009	S10	33.215	-0.185	0.000	0.51			171.6	OK
S1.010	S11	32.928	0.283	0.000	0.93	0.0		170.2	SURCHARGED
S1.011	S12	32.744	0.319	0.000	1.60			171.9	SURCHARGED
S1.012	S16	32.644	0.214	0.000	1.06			140.5	SURCHARGED
S1.013	S13	32.632	0.232	0.000	0.82			139.0	SURCHARGED
S1.014	S17	32.616	0.431	0.000	0.77			51.2	SURCHARGED
S4.000	S18	32.187	-0.213	0.000	0.18			13.8	OK
S1.015	S17	31.843	-0.272	0.000	0.33			54.2	OK
S1.016	S19	31.177	-0.068	0.000	0.25			45.4	OK
PN	US/MH Name	Level Exceeded							
S1.000	S1								
S1.001	S2								
S1.002	S3								
S1.003	S4								
S2.000	S5								
S2.001	S6								
S1.004	S5								
S3.000	S8								
S1.005	S6								
S1.006	S7								
S1.007	S8								
S1.008	S9								
S1.009	S10								
S1.010	S11								
S1.011	S12								
S1.012	S16								
S1.013	S13								
S1.014	S17								
S4.000	S18								
S1.015	S17								
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<u>30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)</u> <u>for Storm</u>											
<table><tr><td></td><td>US/MH</td><td>Level</td></tr><tr><td>PN</td><td>Name</td><td>Exceeded</td></tr><tr><td>S1.016</td><td>S19</td><td></td></tr></table>				US/MH	Level	PN	Name	Exceeded	S1.016	S19	
	US/MH	Level									
PN	Name	Exceeded									
S1.016	S19										
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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S5.000	S18	15 Winter	30	+0%					31.694
S6.000	S18	15 Winter	30	+0%	100/360 Winter				31.660
S5.001	S19	240 Winter	30	+0%	30/120 Winter				31.170
S1.017	S14	240 Winter	30	+0%	30/120 Winter				31.170
S1.018	S15	240 Winter	30	+0%	30/30 Summer			0	31.168
S1.019	S16	60 Winter	30	+0%					30.598

		Surcharged		Flooded		Half Drain		Pipe	
	US/MH	Depth	Volume	Flow /	Overflow	Time	Flow		Level
PN	Name	(m)	(m³)	Cap.	(l/s)	(mins)	(l/s)	Status	Exceeded
S5.000	S18	-0.181	0.000	0.09			8.8		OK
S6.000	S18	-0.190	0.000	0.06			7.2		OK
S5.001	S19	0.073	0.000	0.04			4.5	SURCHARGED	
S1.017	S14	0.100	0.000	0.41			47.0	SURCHARGED	
S1.018	S15	0.343	0.000	0.32	0.0		12.4	SURCHARGED	
S1.019	S16	-0.127	0.000	0.39			12.4		OK

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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 2
Number of Online Controls 2 Number of Time/Area Diagrams 16
Number of Offline Controls 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.350
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S1	15 Winter	100	+40%				
S1.001	S2	15 Winter	100	+40%				
S1.002	S3	15 Winter	100	+40%				
S1.003	S4	15 Winter	100	+40%				
S2.000	S5	30 Winter	100	+40%	100/15 Winter			
S2.001	S6	30 Winter	100	+40%	100/15 Winter			
S1.004	S5	30 Winter	100	+40%	100/15 Winter			
S3.000	S8	30 Winter	100	+40%	100/15 Summer			
S1.005	S6	30 Winter	100	+40%	100/15 Summer			
S1.006	S7	30 Winter	100	+40%	100/15 Summer			
S1.007	S8	30 Winter	100	+40%	30/15 Winter			
S1.008	S9	30 Winter	100	+40%	100/15 Summer			
S1.009	S10	30 Winter	100	+40%	100/15 Summer			
S1.010	S11	30 Winter	100	+40%	30/15 Summer		100/15 Summer	6
S1.011	S12	30 Winter	100	+40%	30/15 Summer			
S1.012	S16	60 Winter	100	+40%	30/15 Summer			
S1.013	S13	60 Winter	100	+40%	30/15 Summer			
S1.014	S17	120 Winter	100	+40%	1/30 Winter			
S4.000	S18	15 Winter	100	+40%				
S1.015	S17	120 Winter	100	+40%				
S1.016	S19	360 Winter	100	+40%	100/60 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	Flow / Cap.	Overflow (l/s)	Half Drain	Pipe	Status
		Level (m)	Depth (m)	Volume (m³)			Time (mins)	Flow (l/s)	
S1.000	S1	37.897	-0.103	0.000	0.50	28.3		14.2	OK
S1.001	S2	37.887	-0.083	0.000	0.69			30.2	OK
S1.002	S3	37.690	-0.090	0.000	0.67			47.5	OK
S1.003	S4	37.135	-0.070	0.000	0.80			58.3	OK
S2.000	S5	35.868	0.293	0.000	0.17			6.0	SURCHARGED
S2.001	S6	35.861	0.376	0.000	0.45			16.1	SURCHARGED
S1.004	S5	35.847	0.442	0.000	0.65			81.5	SURCHARGED
S3.000	S8	35.812	1.022	0.000	0.72			28.1	FLOOD RISK
S1.005	S6	35.691	1.148	0.000	1.00			112.3	SURCHARGED
S1.006	S7	35.570	1.155	0.000	1.21			135.5	SURCHARGED
S1.007	S8	35.392	1.099	0.000	1.69			188.7	SURCHARGED
S1.008	S9	35.047	0.874	0.000	1.04			228.2	SURCHARGED
S1.009	S10	34.209	0.809	0.000	0.77		260.1	SURCHARGED	
S1.010	S11	33.774	1.129	0.000	1.33		243.5	FLOOD RISK	
S1.011	S12	33.415	0.990	0.000	2.31		247.7	SURCHARGED	
S1.012	S16	33.204	0.774	0.000	1.65		218.4	SURCHARGED	
S1.013	S13	33.140	0.740	0.000	1.28		217.0	SURCHARGED	
S1.014	S17	33.119	0.934	0.000	0.99		65.6	SURCHARGED	
S4.000	S18	32.219	-0.181	0.000	0.33		24.9	OK	
S1.015	S17	31.877	-0.238	0.000	0.45		73.6	OK	
S1.016	S19	31.868	0.623	0.000	0.33		60.6	SURCHARGED	

PN	US/MH Name	Level Exceeded
S1.000	S1	
S1.001	S2	
S1.002	S3	
S1.003	S4	
S2.000	S5	
S2.001	S6	
S1.004	S5	
S3.000	S8	
S1.005	S6	
S1.006	S7	
S1.007	S8	
S1.008	S9	
S1.009	S10	
S1.010	S11	
S1.011	S12	
S1.012	S16	
S1.013	S13	
S1.014	S17	
S4.000	S18	
S1.015	S17	

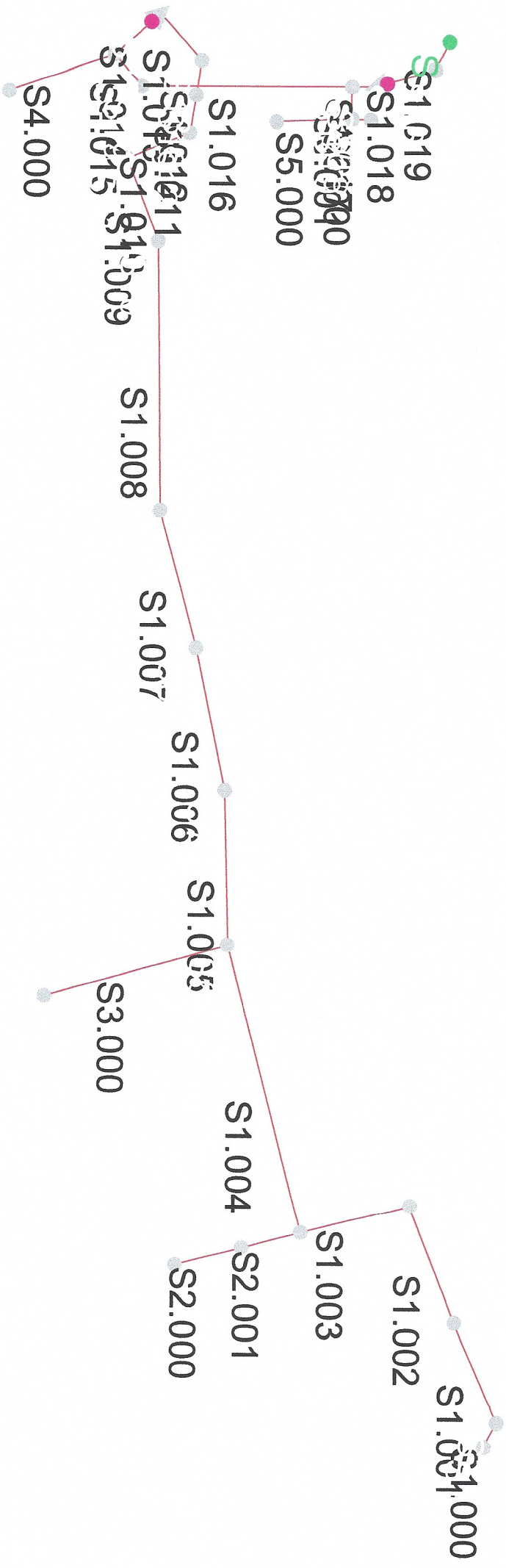
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<u>100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>											
<table><tr><td></td><td>US/MH</td><td>Level</td></tr><tr><td>PN</td><td>Name</td><td>Exceeded</td></tr><tr><td>S1.016</td><td>S19</td><td></td></tr></table>				US/MH	Level	PN	Name	Exceeded	S1.016	S19	
	US/MH	Level									
PN	Name	Exceeded									
S1.016	S19										
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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S5.000	S18	360 Winter	100	+40%					31.861
S6.000	S18	360 Winter	100	+40%	100/360 Winter				31.861
S5.001	S19	360 Winter	100	+40%	30/120 Winter				31.861
S1.017	S14	360 Winter	100	+40%	30/120 Winter				31.861
S1.018	S15	360 Winter	100	+40%	30/30 Summer			0	31.859
S1.019	S16	360 Winter	100	+40%					30.598

Surcharged Flooded					Half Drain		Pipe		
PN	US/MH Name	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)	Status	Level Exceeded
S5.000	S18	-0.014	0.000	0.02			2.4	OK	
S6.000	S18	0.011	0.000	0.02			2.0	SURCHARGED	
S5.001	S19	0.764	0.000	0.05			5.9	SURCHARGED	
S1.017	S14	0.791	0.000	0.56			64.4	SURCHARGED	
S1.018	S15	1.034	0.000	0.32	0.0		12.5	SURCHARGED	
S1.019	S16	-0.127	0.000	0.40			12.5	OK	



BARTON ROAD
HAWAII
SUS

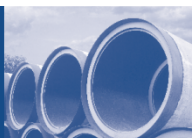
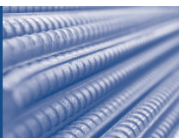


SUDs Maintenance Plan

BARTON ROAD DEVELOPMENT HAVANT

SUDS MANAGEMENT & MAINTENANCE PLAN

Date: March 2021
Ref: AMc/21/Suds Main/**6383**
Rev: -



DOCUMENT CONTROL RECORD

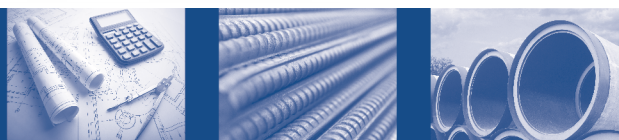
Document Issue:

Rev	Date	Issue Status	Prepared by	Checked by
-	31/03/2021	First Issue	A. Mcshane	C. Pendle

References:

The SUDS manual – CIRIA C753 (2015) ISBN 9780-86017-760-9

National Planning Policy Framework (NPPF) – Communities and Local Government
Technical Guidance - Flood Risk & Coastal Change (March 2012)



1 Introduction

1.1 This document sets out the principles for the long-term management and maintenance of the proposed surface water Sustainable Drainage Systems (SuDS) installed within the Land west of Havant Crematorium, Bartons Road, Havant, Hants.

1.2 The purpose of this document is to ensure that the management company and /or homeowner that will be maintaining the SuDS and ditches is entrusted with an inspection and maintenance programme to ensure the optimum operation of the surface water drainage network is continually maintained for the lifetime of the development and to prevent the increased risk of flooding both on and off site in accordance with the NPPF.

The management company is funded by the development residents with every property paying an apportionment of the overall annual charge according to the size of the property.

1.3 This document details the SuDS structures within the treatment train and their required maintenance processes to ensure that no polluted discharge to the off site network will take place.

1.4 This plan has been directly referenced from the latest technical SuDS guidance within the *CIRIA Report C753 The SuDS Manual* (2015) and other applicable guidance.

1.5 This document is laid out in specific sections applicable to the relevant SuDS type detailing:

- A description of the SUDS component and its use.
- Maintenance requirements and frequencies.
- Inspection requirements and frequencies.

1.6 The activities listed are generic to the relative SuDS types and represent the minimum maintenance and inspection requirements, however additional tasks or varied maintenance frequency may be instructed by the maintenance company as required. Specific maintenance needs of the SuDS elements should be monitored and maintenance schedules adjusted to suit requirements.

2 SuDS Layout & Design

- 2.1 The installed SuDS system at this development are the responsibility of Redrow Homes and their appointed Management Company or the relevant adopting authority.
- 2.2 Following installation and after transfer, all SuDS are to be maintained in perpetuity by the Management Company and shall ensure that it or any contractor employed by it carries out periodic maintenance of all such SuDS in accordance with the schedules listed in this report. Inspection checks shall be carried out by a qualified and competent person, at the minimum intervals listed within the schedules and the appropriate work carried out.
- 2.3 In terms of water quality, the proposed surface water system offers a suitable level of mitigation in accordance with the Environment Agency pollution prevention guidance GP3, NPPF, CIRIA C753 and DEFRA guidance.
- 2.4 There are three categories of maintenance activities referred to in this report:
- **Regular maintenance** (including inspections and monitoring).
Consists of basic tasks done on a frequent and predictable schedule, including vegetation management, litter and debris removal, inspections and sampling.
 - **Occasional maintenance**
Comprises tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the routine tasks (sediment removal is an example).
 - **Remedial maintenance**
Comprises intermittent tasks that may be required to rectify faults associated with the system, although the likelihood of faults can be minimised by good design.
Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, and as such timings are difficult to predict.
- 2.5 There are a number of SuDS components with the surface water drainage system including:
- Deep trap gullies draining to pipework
 - Permeable driveway sub-base
 - Attenuation basin
 - Cellular Tank
 - Vortex Separator
 - Flow controls

3 SUDS Management & Maintenance

3.1 Storm water pipework & Road Gullies

The key maintenance requirement for the surface water drainage system includes the removal of sediments and debris from the system as required. **Note:** If adopted the maintenance of gullies & pipework along the carriageways will fall under the standard maintenance regime of either Hampshire County Highways or Southern Water.

- 3.2 All storm water pipe work should be visually inspected a minimum of monthly for the first three months after installation and then a minimum of once year.
- 3.3 As road gullies are the first on the treatment train and susceptible to higher silt loadings, these will need to be inspected a minimum of monthly for the first three months after installation and then a minimum of every four months.
- 3.4 During this inspection identify any gully pots or pipes that require remedial maintenance such removal of sediment, debris, leaves and litter as required.
This involves the removal all protective covers and grids and the cleaning out of channels or gully pots by hand or with suitable jetting equipment.
- 3.5 During the first year of operation each gully should be inspected every 3 months, and every 6 months thereafter for structural integrity and cleaned out as required.

3.6 Driveways & Parking Bays

Driveways & Parking Bays will either be constructed as either permeable block paving or a macadam surface drained via traditional yard gullies or aco drains discharging into a permeable sub-base layer beneath. This sub-base allows for filtration of pollutants from the runoff which is then discharged via a mix of infiltration and link to the main piped network.

- 3.7 General yard gully and linear channel maintenance involves the removal of dead leaves, soil, litter from the gratings and sediments from the sump within the gully pot or channel.
This involves the removal all protective covers and grids and the cleaning out of channels or gully pots by hand or with suitable jetting equipment.

During the first year of operation each gully and channel should be inspected every 3 months, and every 6 months thereafter for structural integrity and cleaned out as required.

3.8 Attenuation Basin

Key Maintenance Requirements:

- Grass mowing / vegetation management
- Litter / debris removal and sediment monitoring

3.9 Regular inspection and maintenance is important for the effective operation of the basins and swales as designed.

Many of the maintenance activities can be undertaken as part of landscape maintenance and, if landscape management is already required at site, should have marginal cost implications.

3.10 These activities will be carried out at intervals detailed below, and shall comprise of the following operations:

- Collection and removal of all litter/large debris from the attenuation pond, inlets, outflows, and water margins once a month.
- Monthly Inspection of the attenuation ponds to check the following, and repair as necessary:
 - Any failure in the operation of the inlet and outlet headwalls unless adopted by others in which case they will be notified of any observed defect.
 - Any damage or erosion to the perimeter edges and slopes of the attenuation ponds.

3.11 An annual check carried out by a suitably qualified person, to assess the condition and operation of the swale inlets and outflows, and the accumulation of silt/sediment. A record of maintenance visits and remedial operations shall be maintained.

3.12 The above operations shall (where feasible) be in conjunction with routine grounds maintenance operations to the surrounding landscape.

Attenuation Basin & Watercourse Maintenance Requirements

Maintenance schedule	Required action	Frequency
Regular maintenance	Litter and debris removal.	Monthly.
	Grass cutting – for spillways and access routes.	Monthly (during growing season), or as required.
	Grass cutting – meadow grass in and around basin.	Half yearly (spring – before nesting season, and autumn).
	Manage other vegetation and remove nuisance plants.	Monthly (at start, then as required).
	Tidy all dead growth before start of growing season.	Annually.
	Remove sediment from inlets, outlet and forebay.	Annually (or as required).
	Manage wetland plants in outlet pool – where provided.	Annually.
Occasional maintenance	Re-seed areas of poor vegetation growth.	Annually, or as required.
	Prune and trim trees and remove cuttings.	2 years, or as required.
	Remove sediment from forebay, when 50 % full and from micropools if volume reduced by > 25%.	3 – 10 years (or as required).
Remedial actions	Repair of erosion or other damage by re-seeding or re-turfing.	As required.
	Realignment of rip-rap.	As required.
	Repair/rehabilitation of inlets, outlets and overflows.	As required.
	Re-level uneven surfaces and reinstate design levels.	As required.
Monitoring	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly/after large storms.
	Inspect banksides, structures, pipework etc for evidence of physical damage.	Monthly/after large storms.
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Half yearly.
	Check penstocks and other mechanical devices.	Half yearly.

- 3.13 In addition to regular routine items, de-silting of the attenuation basin may be required, usually on a 10 - 15 year cycle depending on the on-going silt level checking.

Cellular Attenuation Tank

- 3.14 The key maintenance requirement for the cellular attenuation tank will be the visual inspection of the internal units via built in access chambers and integral maintenance tunnel for the removal of sediment and jetting as required.

A visual inspection of the impermeable geomembrane that envelopes the structure should also be carried out to check for structural integrity.

- 3.15 The attenuation tank is to be constructed from cellular units that allow internal CCTV and jetting access for inspection and maintenance (Hydro StormBloc, Aco Stormbrixx, Wavin Aquacell or similar approved).

The built in modular inspection unit and maintenance tunnels within the attenuation tank allow almost the entire volume of the structure to be inspected via CCTV camera and flushed through.

A catchpit chamber is to be installed immediately upstream of the attenuation tank to reduce the amount of silt entering the tank and it will generally only be necessary to ensure that the upstream catchpits / silt traps are free from debris such as leaves or sediment.

- 3.16 It is recommended that the attenuation tank system be inspected no less frequently than at monthly intervals for the first 3 months and thereafter at 6 monthly intervals.
In addition, it is suggested that the installation is inspected immediately following the first storm event, whenever this should occur post installation.
- 3.17 It should also be noted that more regular inspections may be required should the catchpit(s) fill more frequently and/or if the initial inspections reveal that maintenance / cleaning will be required more regularly than at six month intervals.
- 3.18 Any silt & debris should be flushed to the inspection or catchpit manhole and removed in accordance with the Management Company policy for waste management.

Cellular Systems - Operation and Maintenance Requirements

Maintenance schedule	Required action	Recommended Frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then six monthly
	Debris removal from catchment surface (where may cause risks to performance)	Monthly
	Where rainfall infiltrates into blocks from above, check surface of filter for blockage by silt, algae or other matter. Remove and replace surface infiltration medium as necessary.	Monthly (and after large storms)
	Remove sediment from pre-treatment structures	Annually, or as required
Remedial actions	Repair/rehabilitation of inlets, outlet , overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually and after large storms

3.19 Hydrodynamic Vortex Separator & Filter

SDS Ltd Aqua Swirl proprietary Hydrodynamic Vortex Separator & Aqua Filter provided on each outfall to the deep bore holes, cellular tank and attenuation basins.

3.20 Maintenance:

Long term performance of the Aqua Swirl or any other device depends on inspection and maintenance program.

Recommended schedule in line with Ciria C753 guidance; upon hand over – 3 months -6 months -12 months and then annually or as deemed necessary from details obtain from previous inspections.

Each site sediment loadings will be different and at its highest just after the build phase, hence why a more frequent visit is required at the start of the programme.

The Aqua-Swirl® has been designed to minimize and simplify the inspection and maintenance process. The single chamber system can be inspected and maintained entirely from the surface thereby eliminating the need for confined space entry. Furthermore, the entire structure (specifically, the floor) is accessible for visual inspection from the surface. There are no areas of the structure that are blocked from visual inspection or periodic cleaning. Inspection of any free- floating oil and floatable debris can be directly observed and maintained through the manhole access provided directly over the swirl chamber. Chamber system can be inspected and maintained entirely from the surface

3.21 Inspection:

To inspect the Aqua-Swirl®, remove the manhole cover. The only tools needed to inspect the Aqua-Swirl® system are a flashlight and a measuring device such as a stadia rod or pole. Given the easy and direct accessibility provided, floating oil and debris can be observed directly from the surface. Sediment depths can easily be determined by lowering a measuring device to the top of the sediment pile and to the surface of the water.

When the sediment pile is within 42 to 48 inches of the water surface (or sediment pile thickness is 18 to 24 inches as measured from the base), the system should be maintained. The maximum Sediment storage capacity of the Aqua-Swirl® is reached when the sediment pile is within 30 inches of the water surface (or sediment accumulation is 36 inches thick as measured from the base).

It should be noted that to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile. Keep in mind that the finer sediment at the top of the pile may offer less resistance to the measuring device than the larger particles which typically occur deeper within the sediment pile.

The Aqua-Swirl® design allows for the sediment to accumulate in a semi-conical fashion as illustrated above. That is, the depth to sediment as measured below the water surface may be less in the center of the swirl chamber; and likewise, may be greater at the edges of the swirl chamber.

3.22 Removal:

Cleaning the Aqua-Swirl® is simple and quick. Free-floating oil and floatable debris can be observed and removed directly through the 750mm service access riser provided. A vacuum truck is typically used to remove the accumulated sediment and debris. An advantage of the Aqua-Swirl® design is that the entire sediment storage area can be reached with a vacuum hose from the surface (reaching all the sides). Since there are no multiple or limited (hidden or “blind”) chambers in the Aqua-Swirl®, there are no restrictions to impede on-site maintenance tasks.

3.23 Disposal:

Sediments excavated from swales that receive runoff from residential or standard road and roof areas are generally not toxic or hazardous material and can be safely disposed of by either land application or landfilling. All removed products should be disposed of in line with local council and environmental requirements

3.24 Flow Control Chamber

The key maintenance requirement for the flow control chambers will be the inspection of the units for blockages of the vortex flow control unit and silt removal from sump of chamber.

3.25 The hydraulic vortex flow control unit has no moving parts and is self-activating, requiring minimal maintenance. After initial installation, it is recommended that the unit be inspected monthly for three months.

3.26 Thereafter the manhole chamber and control device should be inspected at least every six months to verify the condition and operation of the unit and check for blockages within the inlet of the chamber and of the flow control device. During these inspections, accumulated silts should be removed and the sump cleaned out using a conventional sump vacuum cleaner. Flow Controls are fitted with a pivoting by-pass door, which allows the manhole chamber to be drained down should blockages occur.

3.27 Outfall Headwalls

Outfall headwalls should be visually inspected a minimum of monthly for the first three months after installation and then a minimum of once a year. Accumulated sediments, debris and any overgrown vegetative material should be removed from the culvert and margins of the outlet headwalls as necessary.

3.28 During the inspections the general operation, and structural condition of the headwall and any erosion of banks or scour control features should be identified and rehabilitated as required.



MJA CONSULTING

Civil & Structural Engineers

www.mjaconsulting.co.uk

Ipsium Court
24 The Quadrant
Abingdon Science Park
Abingdon
Oxfordshire
OX14 3YS