

BARTON ROAD DEVELOPMENT HAVANT

Surface Water Drainage Statement

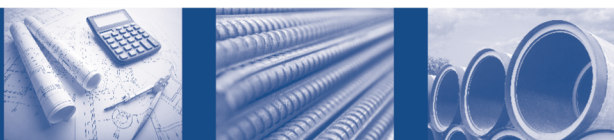
AMc/21/0154/6368: Rev D
14th February 2022

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

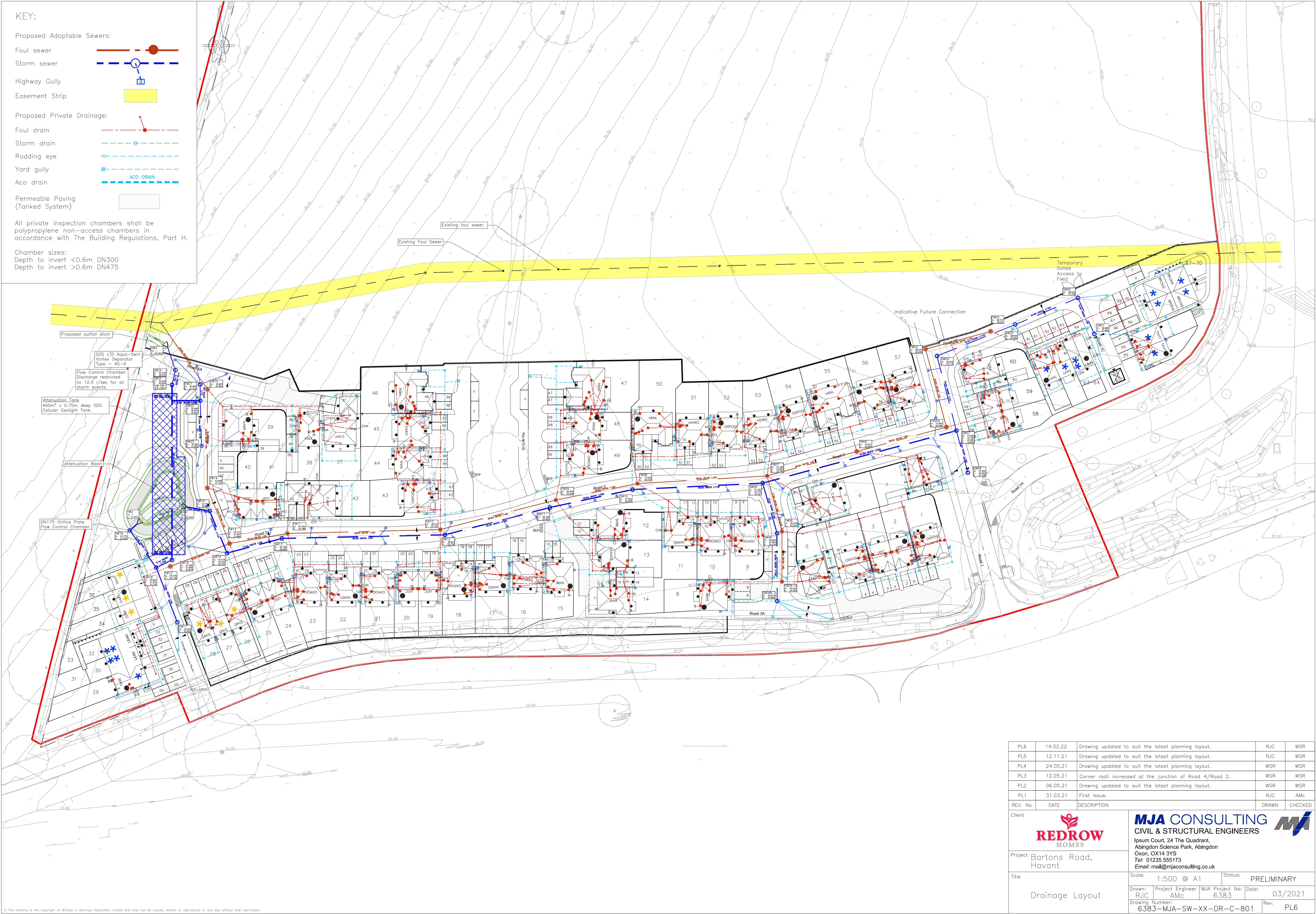
The water quality assessment has been carried out in accordance with Chapter 26 of The SUDs Manual based on the available site SUDs elements and has been shown to comply.

Alistair McShane
MJA Consulting

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



Engineering Layouts



PL6	14.02.22	Drawing updated to suit the latest planning layout.	RJC	WSR
PL5	12.11.21	Drawing updated to suit the latest planning layout.	RJC	WSR
PL4	24.05.21	Drawing updated to suit the latest planning layout.	WSR	WSR
PL3	12.05.21	Corner radii increased at the junction of Road 4/Road 2.	WSR	WSR
PL2	06.05.21	Drawing updated to suit the latest planning layout.	WSR	WSR
PL1	31.03.21	First Issue.	RJC	AMc
REV. No.	DATE	DESCRIPTION	DRAWN	CHECKED
Client				
Project		Bartons Road, Havant		
Title		Drainage Layout		
Scale:		1:500 @ A1	Status:	PRELIMINARY
Drawn:		RJC	Project Engineer	MJA Project No: 6383
Drawing Number:		6383-MJA-SW-XX-DR-C-801	Date:	03/2021
			Rev:	PL6

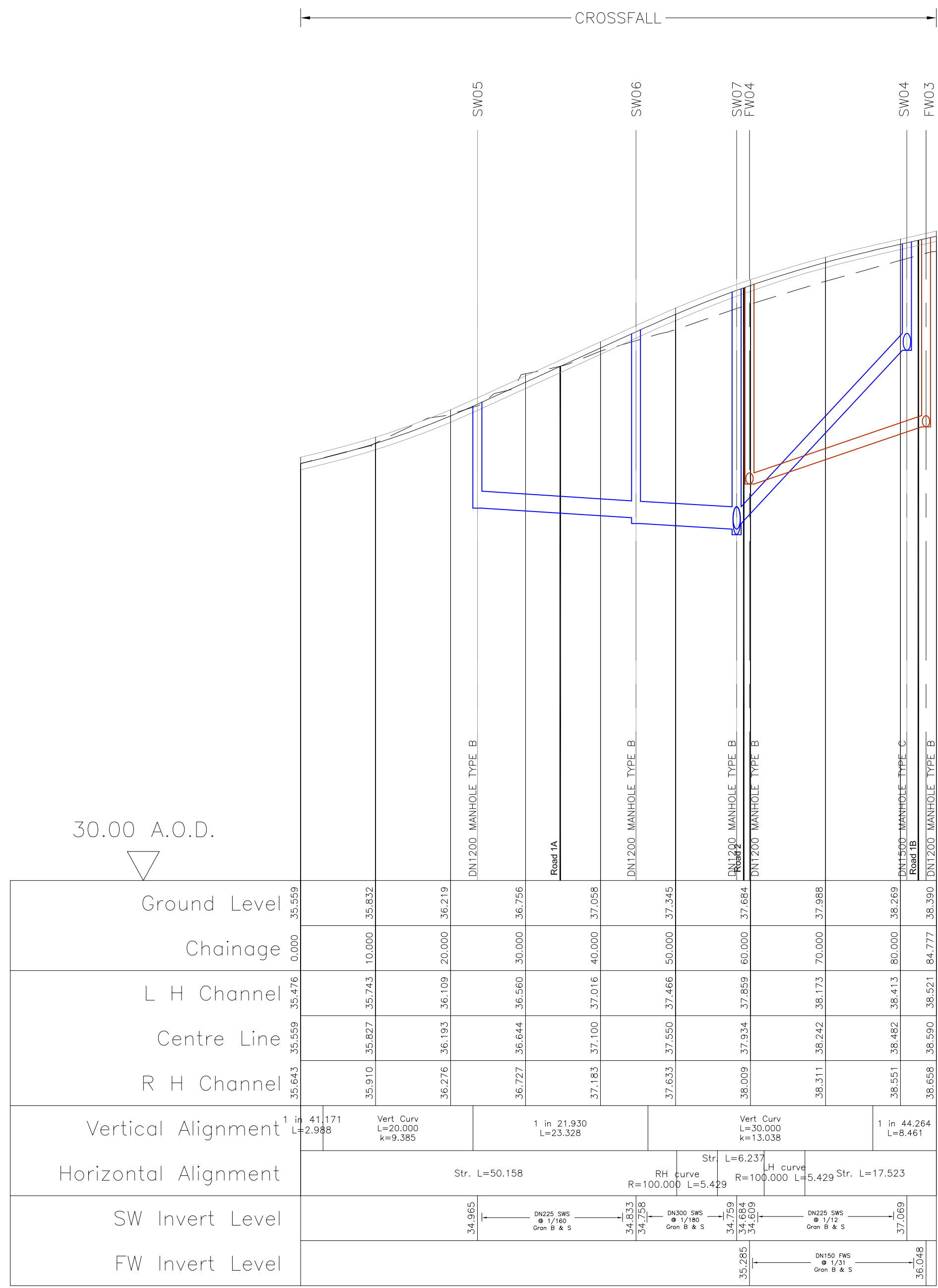
REDROW HOMES

MJA CONSULTING
CIVIL & STRUCTURAL ENGINEERS
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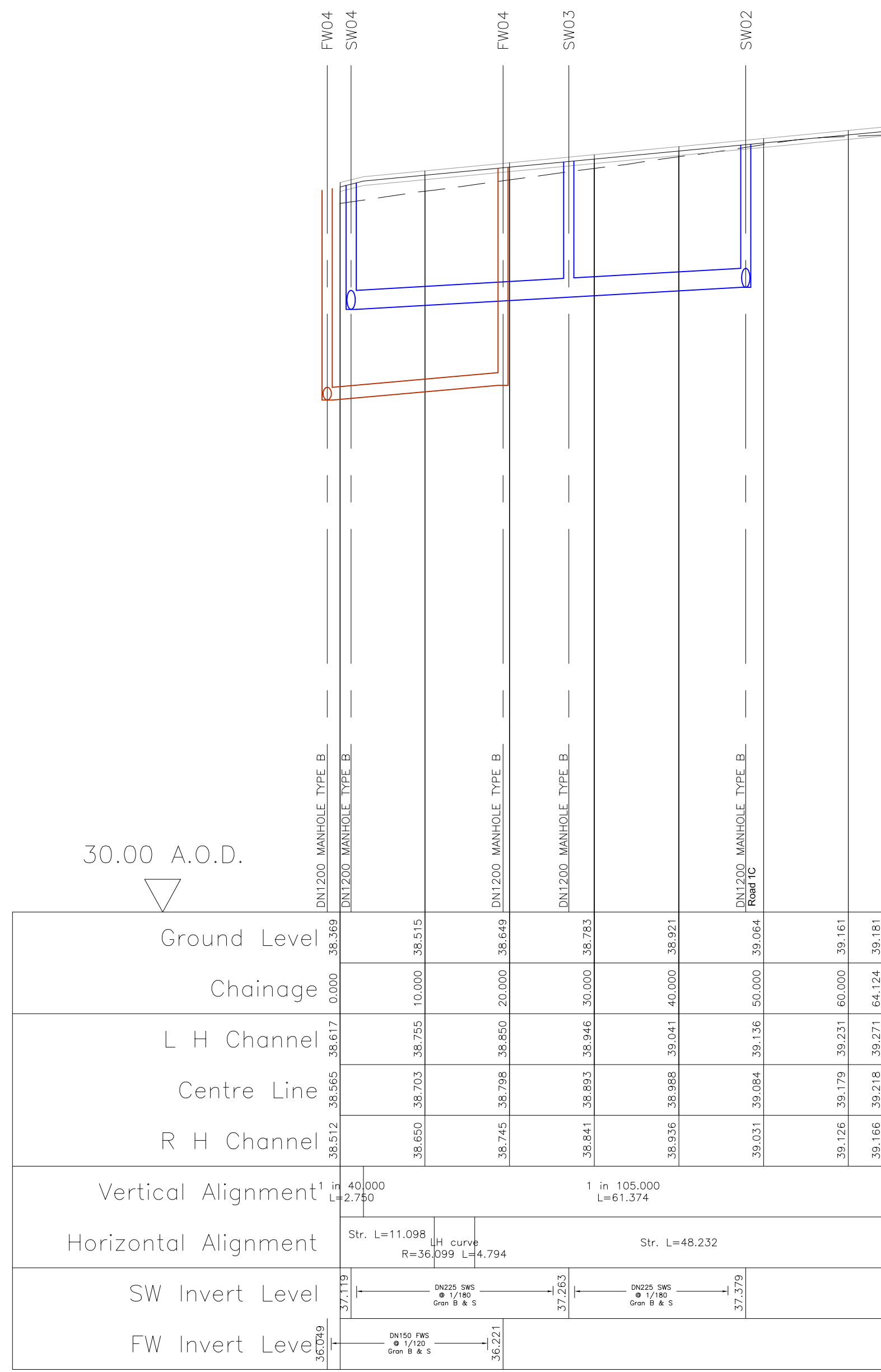


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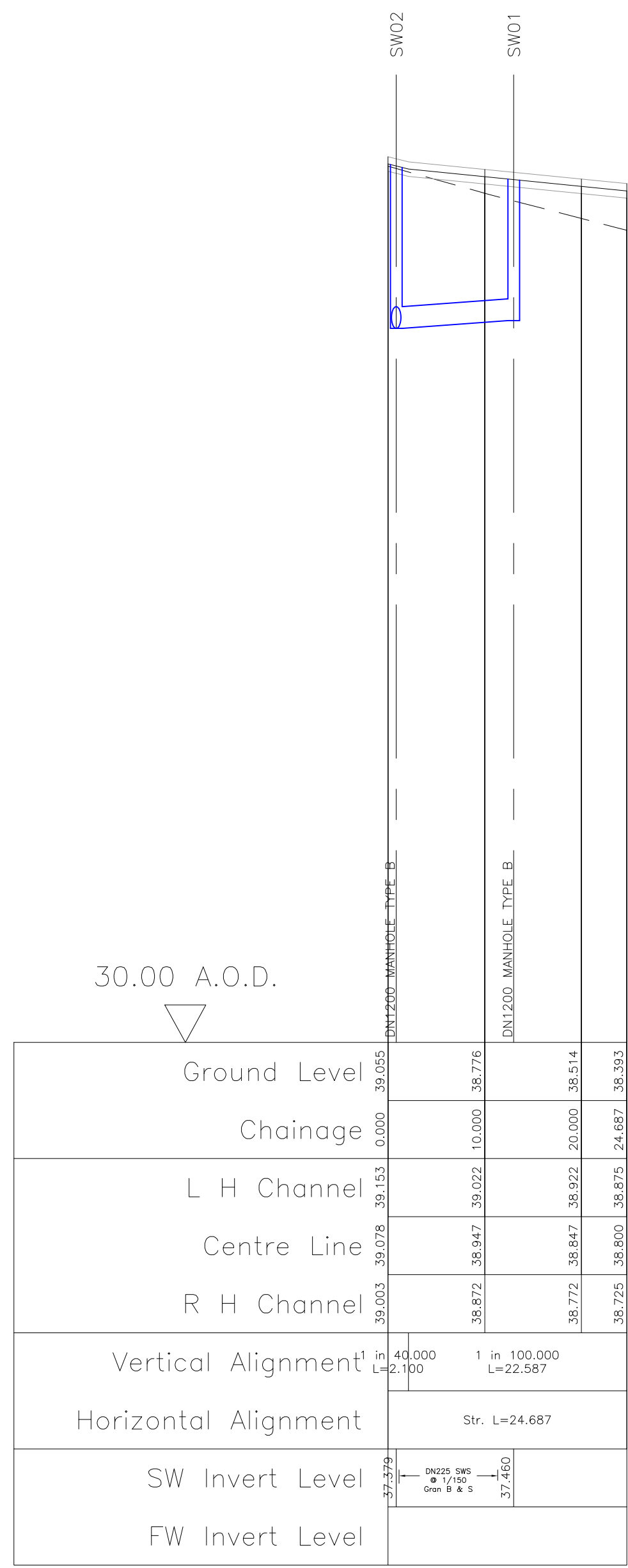
PL3	14.02.22	Drawing updated to suit the latest planning layout.	RJC	WSR
PL2	12.11.21	Drawing updated to suit the latest planning layout.	RJC	WSR
PL1	24.08.21	First Issue.	WSR	AMc
REV. No.	DATE	DESCRIPTION	DRAWN	CHECKED
Client				
		 MJA CONSULTING CIVIL & STRUCTURAL ENGINEERS Ipsium Court, 24 The Quadrant, Abingdon Science Park, Abingdon Oxon, OX14 3YS Tel: 01235 555173 Email: mail@mjaconsulting.co.uk		
Project		Bartons Road, Havant		
Title		Scale: 1:500 @ A1	Status: PRELIMINARY	
Flood Exceedance Plan		Drawn: RJC	Project Engineer: AMc	MJA Project No: 6383 Date: 08/2021
		Drawing Number: 6383-MJA-SW-XX-DR-C-804	Rev: PL3	



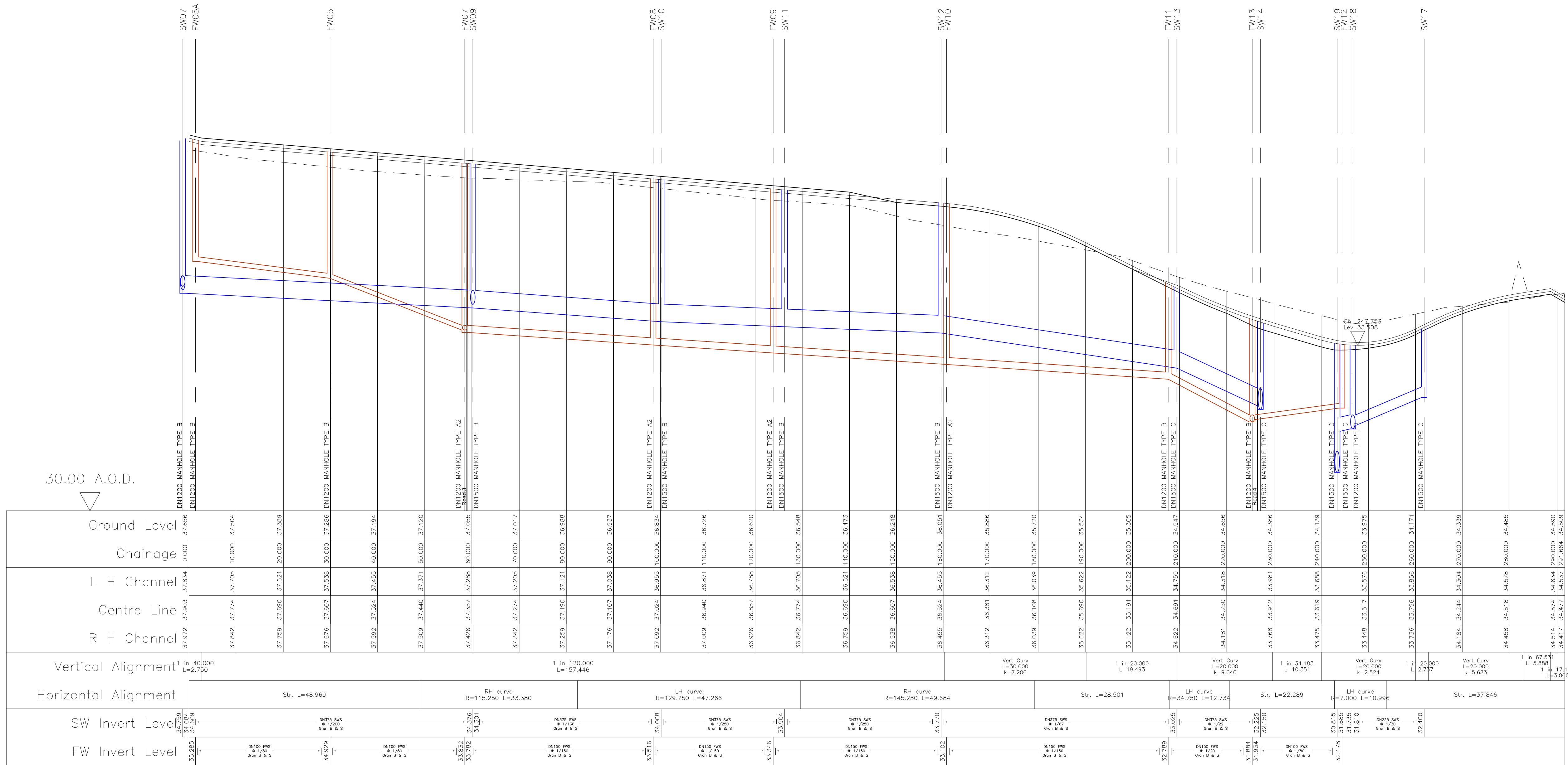
Road1
Horiz. 1:500 Vert. 1:50



Road1B
Horiz. 1:500 Vert. 1:50

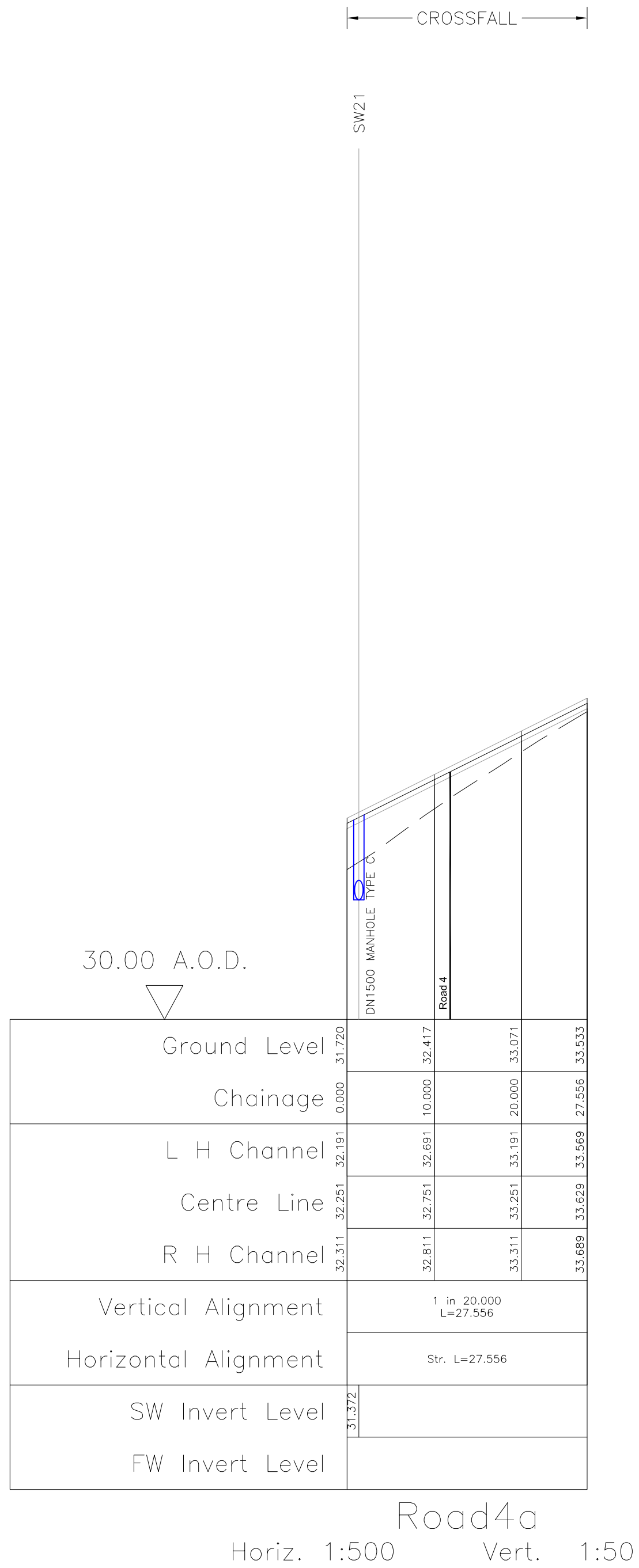
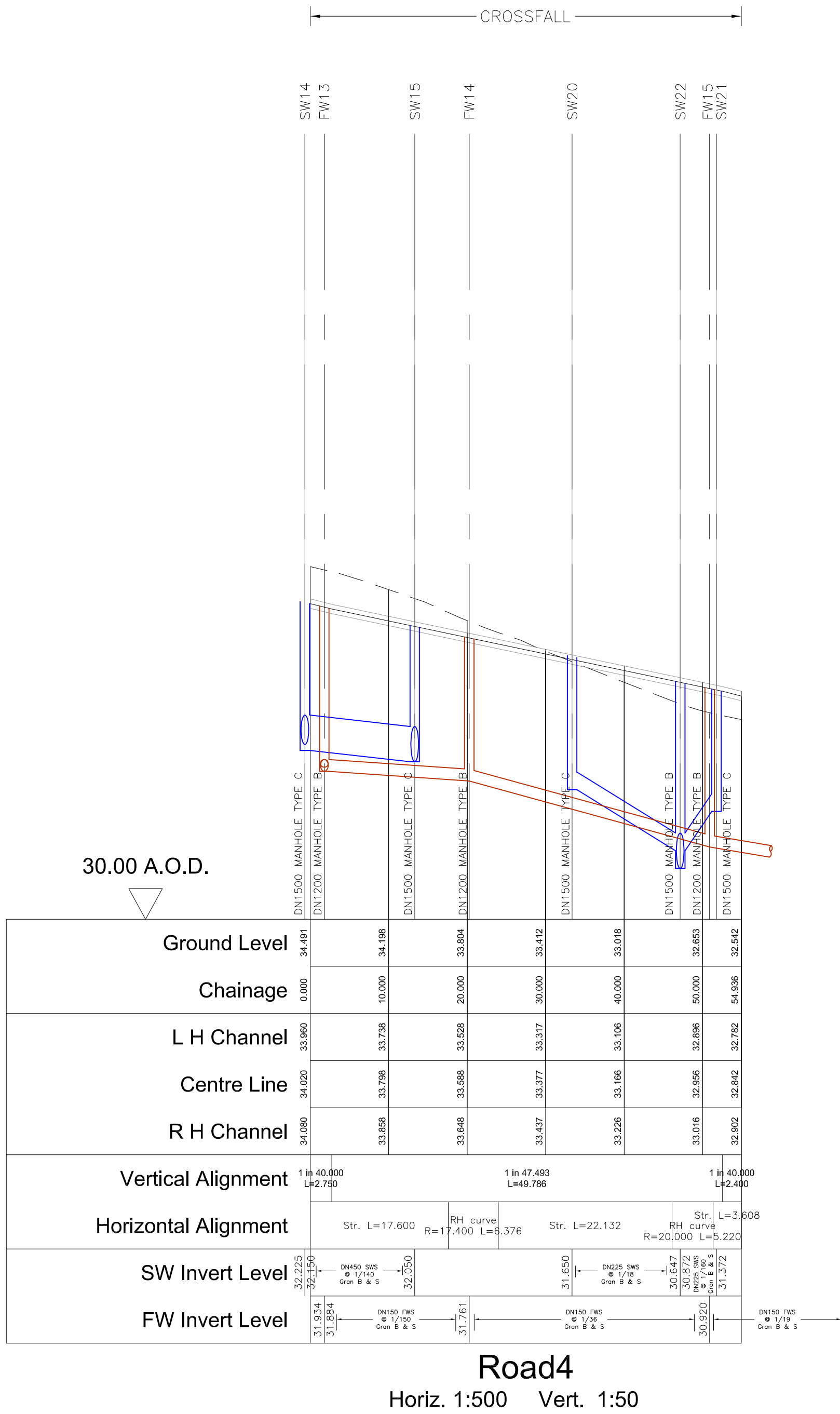
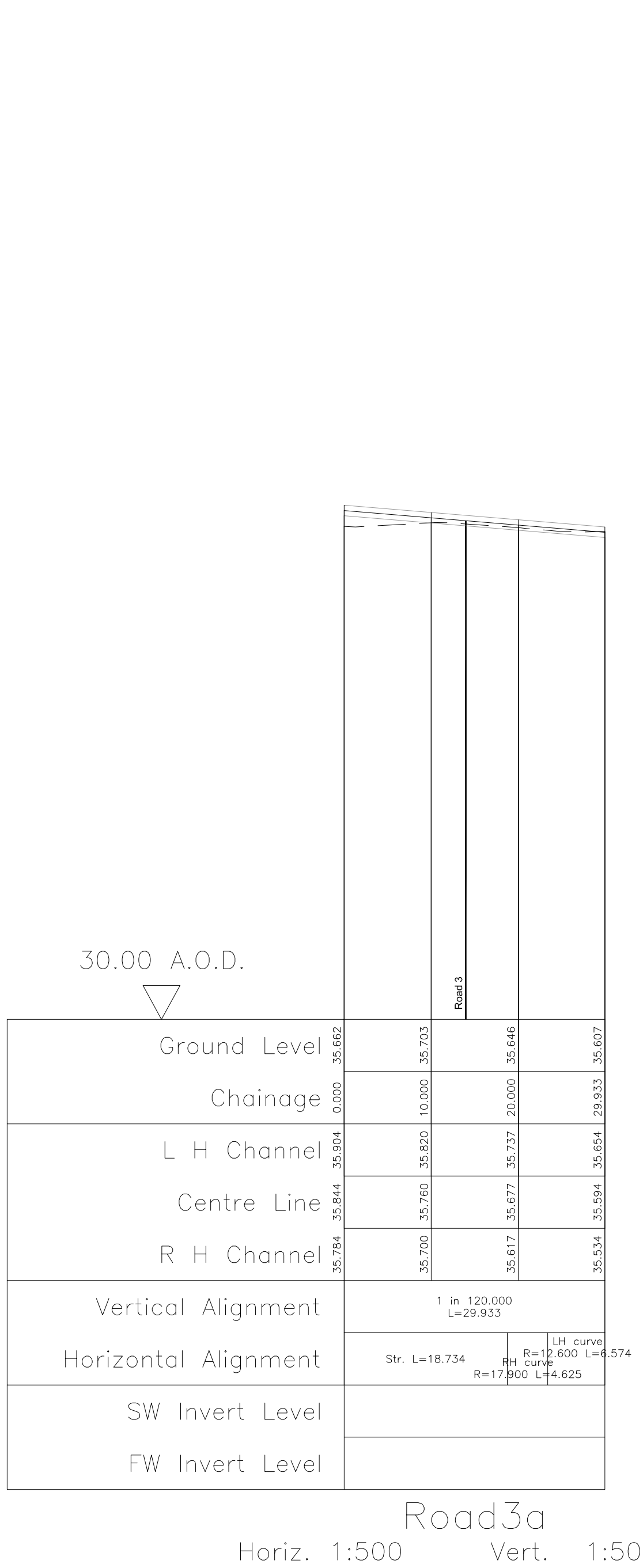
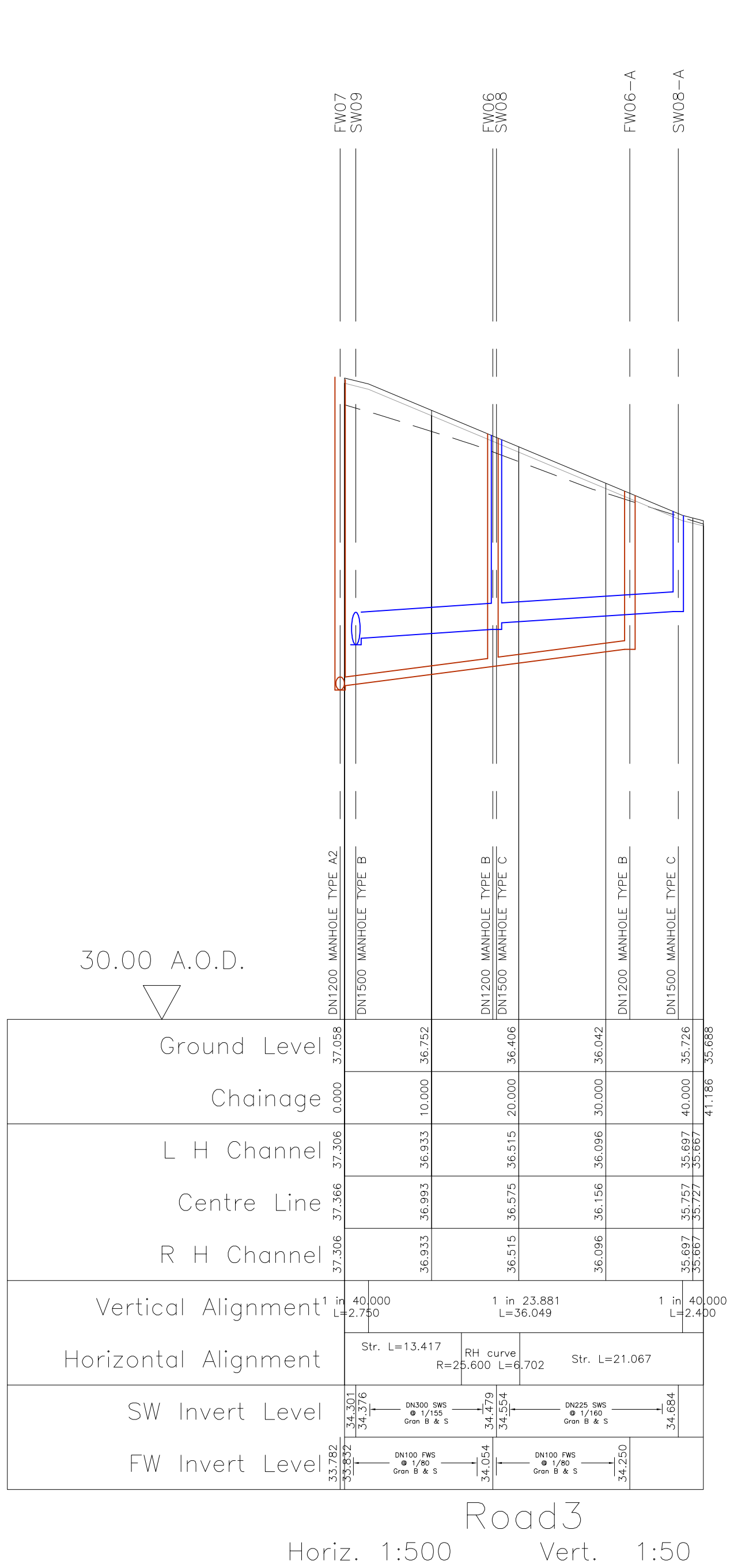


Road1C
Horiz. 1:500 Vert. 1:50

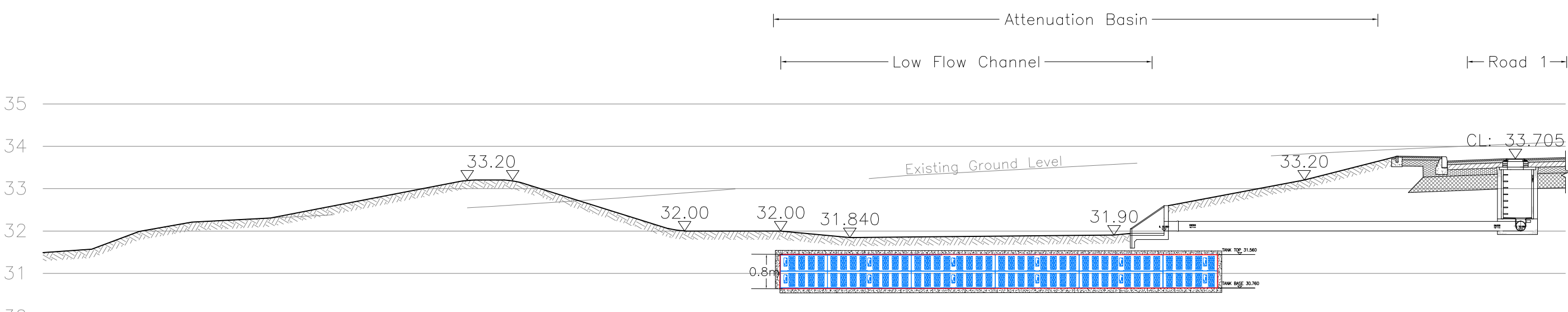
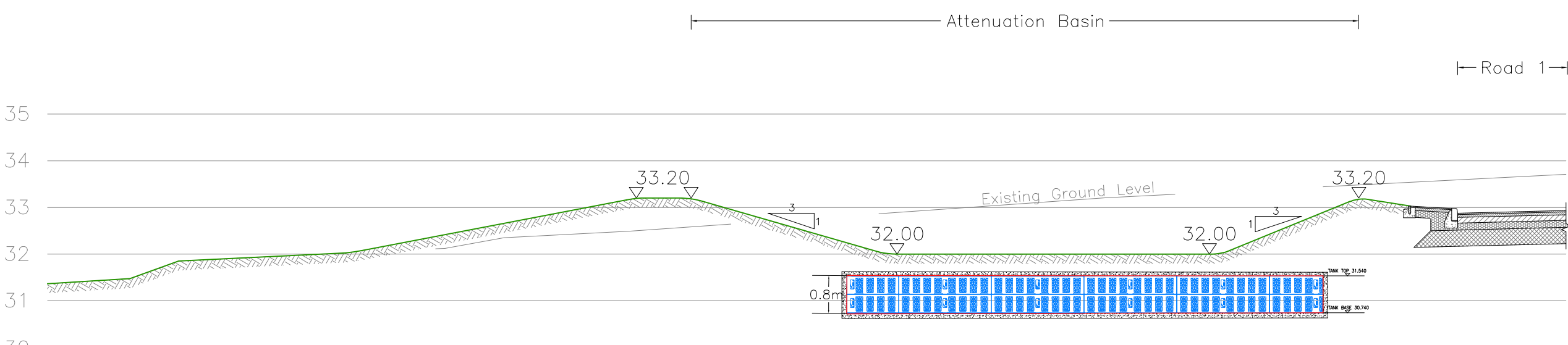
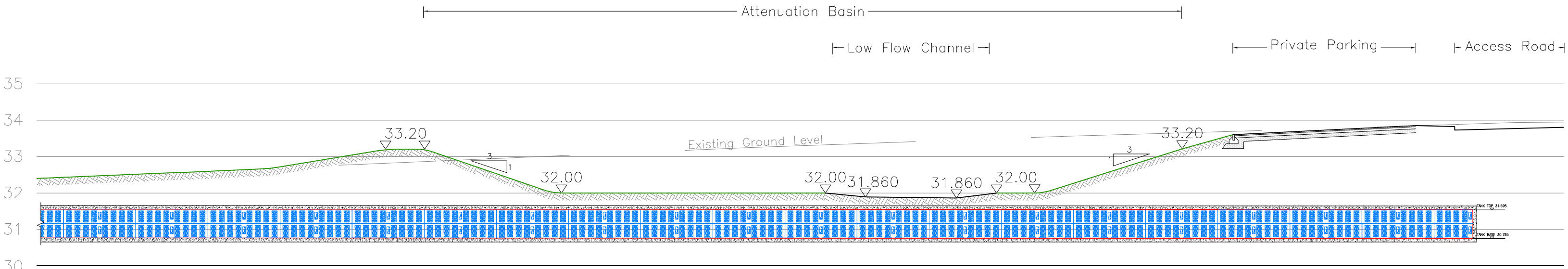
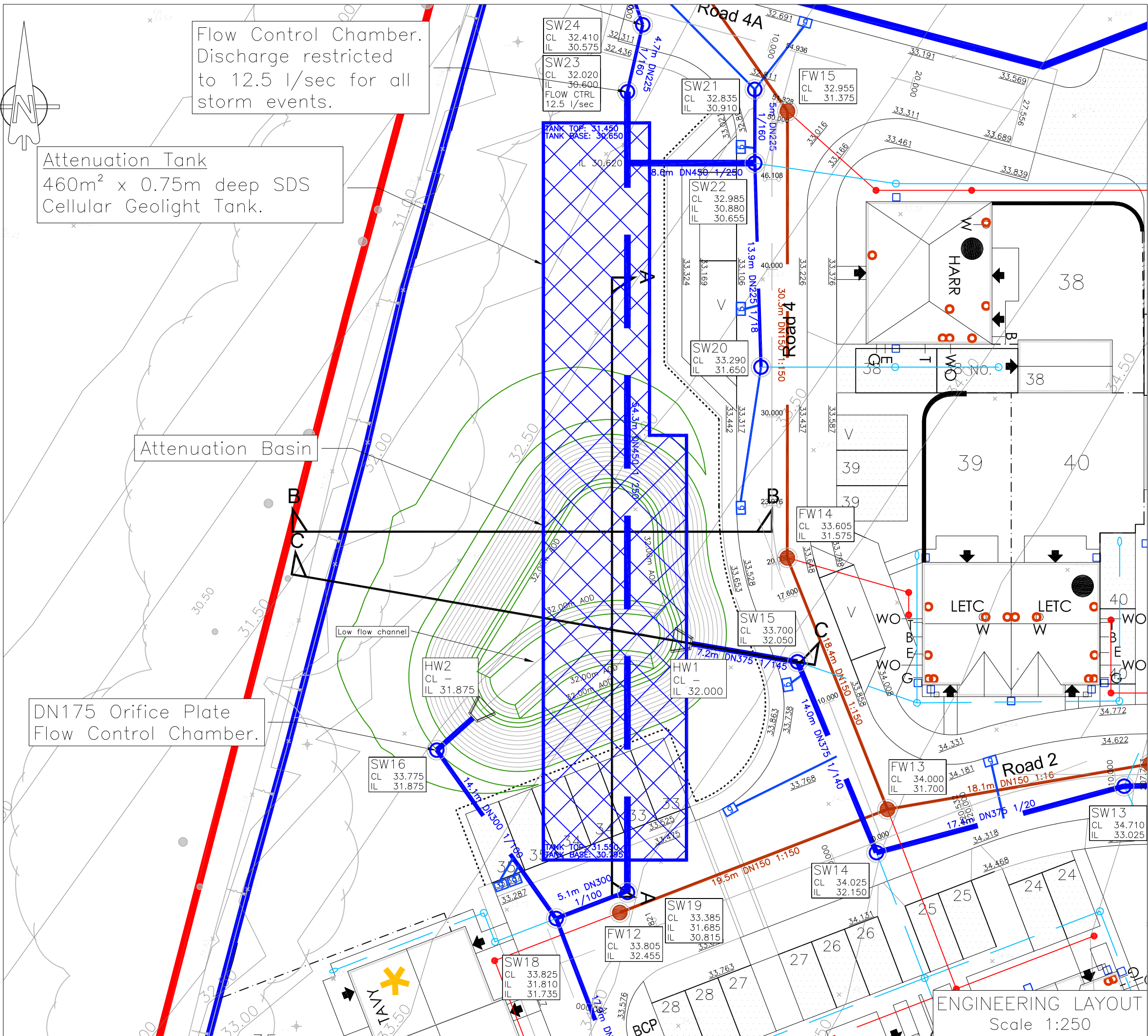


Road2
Horiz. 1:500 Vert. 1:50

PL3	14.02.22	Drawing updated to suit the latest planning layout.	RJC	WSR
PL2	12.11.21	Updated to suit latest planning layout and drainage design.	RJC	WSR
PL1	31.03.21	First Issue.	RJC	AMc
REV. No.	DATE	DESCRIPTION	DRAWN	CHECKED
Client				
REDROW HOMES		MJA CONSULTING CIVIL & STRUCTURAL ENGINEERS		
Project Bartons Road, Havant		Ipsum Court, 24 The Quadrant, Abingdon Science Park, Abingdon Oxon, OX14 3YF Tel: 01235 555173 Email: mail@mjaconsulting.co.uk		
Title		Scale: 1:500 @ A1	Status: PRELIMINARY	
Longitudinal Sections		Drawn: RJC	Project Engineer: MJA	Project No: 6383
Sheet 1		Drawn: AMc	Date: 03/2021	
		Drawing Number: 6383-MJA-SW-XX-DR-C-810	Rev: PL3	



PL3	14.02.22	Drawing updated to suit the latest planning layout.	RJC	WSR
PL2	12.11.21	Updated to suit latest planning layout and drainage design.	RJC	WSR
PL1	31.03.21	First Issue.	RJC	AMc
REV. No.	DATE	DESCRIPTION	DRAWN	CHECKED
Client				
Project		Bartons Road, Havant	Ipsium Court, 24 The Quadrant, Abingdon Science Park, Abingdon, Oxon, OX14 3YU Tel: 01235 555173 Email: mail@mjaconsulting.co.uk	
Title		Longitudinal Sections Sheet 2	Scale: 1:500 @ A1 Drawn: RJC Project Engineer: AMc Drawing Number: 6383-MJA-SW-XX-DR-C-811	Status: PRELIMINARY Project No: 6383 Date: 03/2021 Rev: PL3



PL2	12.11.21	Drawing updated to suit the latest planning layout.	RJC	WSR
PL1	31.03.21	First Issue.	RJC	AMc
REV. No.	DATE	DESCRIPTION	DRAWN	CHECKED
Client				
		 MJA CONSULTING CIVIL & STRUCTURAL ENGINEERS Ipsium Court, 24 The Quadrant, Abingdon Science Park, Abingdon Oxon, OX14 3YS Tel: 01235 555173 Email: mail@mjaconsulting.co.uk		
Project		Bartons Road, Havant		
Title		Attenuation Basin Cross Sections		
Scale:		1:500 @ A1	Status:	PRELIMINARY
Drawn:	Project Engineer	MJA Project No:	Date:	03/2021
RJC	AMc	6383		
Drawing Number:		6383-MJA-SW-XX-DR-C-825		Rev: PL2



Development Surface Water Calculations

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Date 21/01/2022 File 6383 - SWS.MDX	Designed by AMc Checked by	
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

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.387	4-8	0.840	8-12	0.095

Total Area Contributing (ha) = 1.323

Total Pipe Volume (m³) = 56.169

Network Design Table for Storm

« - Indicates pipe capacity < flow

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	20.867	0.482	43.3	0.058	5.00	0.0	0.600	o	225	Pipe/Conduit	
S2.000	8.453	0.057	148.3	0.006	5.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	26.607	0.148	179.8	0.019	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)
S1.000	50.00	5.17	37.847	0.058	0.0	0.0	0.0	1.99	79.3	7.9
S2.000	50.00	5.13	37.422	0.006	0.0	0.0	0.0	1.07	42.6	0.8
S1.001	50.00	5.63	37.365	0.083	0.0	0.0	0.0	0.97	38.6	11.2

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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
S5.000	17.963	0.590	30.4	0.072	5.00	0.0	0.600	o	225	Pipe/Conduit	
S1.015	5.357	0.050	107.1	0.035	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.016	48.862	0.196	249.3	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S6.000	13.846	0.778	17.8	0.028	5.00	0.0	0.600	o	225	Pipe/Conduit	
S7.000	5.000	0.500	10.0	0.037	5.00	0.0	0.600	o	225	Pipe/Conduit	
S6.001	8.644	0.036	240.1	0.035	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.017	4.837	0.011	439.7	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.018	4.664	0.025	186.6	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.019	7.682	0.075	102.4	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)
S5.000	50.00	5.13	32.400	0.072	0.0	0.0	0.0	2.38	94.6	9.7
S1.015	50.00	5.22	31.735	0.107	10.0	0.0	0.0	1.52	107.3	24.5
S1.016	50.00	5.86	30.815	0.107	10.0	0.0	0.0	1.28	204.1	24.5
S6.000	50.00	5.07	31.650	0.028	0.0	0.0	0.0	3.12	123.9	3.8
S7.000	50.00	5.02	31.372	0.037	0.0	0.0	0.0	4.16	165.5	5.0
S6.001	50.00	5.18	30.647	0.100	0.0	0.0	0.0	1.31	208.0	13.5
S1.017	50.00	5.94	30.611	0.207	10.0	0.0	0.0	0.96	153.2	38.0
S1.018	50.00	5.08	30.600	0.000	12.5	0.0	0.0	0.95	37.9	12.5
S1.019	50.00	5.18	30.575	0.000	12.5	0.0	0.0	1.29	51.4	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	S2A	39.272	37.847	1.200	Open Manhole	1200
S2.000	o	225	S1	38.847	37.422	1.200	Open Manhole	1200
S1.001	o	225	S2	39.073	37.365	1.483	Open Manhole	1200
S1.002	o	225	S3	38.819	37.217	1.377	Open Manhole	1200
S1.003	o	225	S4	38.533	37.069	1.239	Open Manhole	1200
S3.000	o	225	S5	36.390	34.965	1.200	Open Manhole	1200
S3.001	o	300	S6	37.355	34.758	2.297	Open Manhole	1200
S1.004	o	375	S7	37.900	34.609	2.916	Open Manhole	1350
S4.000	o	225	S8A	36.109	34.684	1.200	Open Manhole	1200
S4.001	o	300	S8	36.790	34.479	2.011	Open Manhole	1200
S1.005	o	375	S9	37.385	34.301	2.709	Open Manhole	1350
S1.006	o	375	S10	37.000	34.008	2.617	Open Manhole	1350
S1.007	o	375	S11	36.785	33.904	2.506	Open Manhole	1350
S1.008	o	375	S12	36.501	33.770	2.356	Open Manhole	1350
S1.009	o	375	S13	34.738	33.025	1.338	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	20.867	43.3	S2	39.073	37.365	1.483	Open Manhole	1200
S2.000	8.453	148.3	S2	39.073	37.365	1.483	Open Manhole	1200
S1.001	26.607	179.8	S3	38.819	37.217	1.377	Open Manhole	1200
S1.002	26.744	180.7	S4	38.533	37.069	1.239	Open Manhole	1200
S1.003	22.760	9.9	S7	37.900	34.759	2.916	Open Manhole	1350
S3.000	21.150	160.2	S6	37.355	34.833	2.297	Open Manhole	1200
S3.001	13.347	180.4	S7	37.900	34.684	2.916	Open Manhole	1350
S1.004	61.571	199.9	S9	37.385	34.301	2.709	Open Manhole	1350
S4.000	20.783	159.9	S8	36.790	34.554	2.011	Open Manhole	1200
S4.001	16.013	155.5	S9	37.385	34.376	2.709	Open Manhole	1350
S1.005	39.971	136.4	S10	37.000	34.008	2.617	Open Manhole	1350
S1.006	25.944	249.5	S11	36.785	33.904	2.506	Open Manhole	1350
S1.007	33.267	248.3	S12	36.501	33.770	2.356	Open Manhole	1350
S1.008	50.039	67.2	S13	34.738	33.025	1.338	Open Manhole	1350
S1.009	17.392	21.7	S14	34.016	32.225	1.416	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)
S1.010	o	450	S14	34.016	32.150	1.416	Open Manhole	1350
S1.011	o	450	S15	33.705	32.050	1.205	Open Manhole	1350
S1.012	[]	1	SHW1	33.775	32.000	1.175	Open Manhole	3000
S1.013	o	375	SHW2	33.775	31.895	1.505	Open Manhole	3000
S1.014	o	300	S16	33.775	31.875	1.600	Open Manhole	1350
S5.000	o	225	S17	33.825	32.400	1.200	Open Manhole	1200
S1.015	o	300	S18	33.875	31.735	1.840	Open Manhole	1200
S1.016	o	450	S19	33.385	30.815	2.120	Open Manhole	1350
S6.000	o	225	S20	33.290	31.650	1.415	Open Manhole	1200
S7.000	o	225	S21	32.885	31.372	1.288	Open Manhole	1200
S6.001	o	450	S22	32.990	30.647	1.893	Open Manhole	1350
S1.017	o	450	STank	32.450	30.611	1.389	Open Manhole	1350
S1.018	o	225	S23	32.020	30.600	1.195	Open Manhole	1350
S1.019	o	225	S24	31.500	30.575	0.700	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)
S1.010	14.000	140.0	S15	33.705	32.050	1.205	Open Manhole	1350
S1.011	8.006	160.1	SHW1	33.775	32.000	1.325	Open Manhole	3000
S1.012	7.082	236.1	SHW2	33.775	31.970	1.205	Open Manhole	3000
S1.013	12.814	640.7	S16	33.775	31.875	1.525	Open Manhole	1350
S1.014	13.996	121.7	S18	33.875	31.760	1.815	Open Manhole	1200
S5.000	17.963	30.4	S18	33.875	31.810	1.840	Open Manhole	1200
S1.015	5.357	107.1	S19	33.385	31.685	1.400	Open Manhole	1350
S1.016	48.862	249.3	STank	32.450	30.619	1.381	Open Manhole	1350
S6.000	13.846	17.8	S22	32.990	30.872	1.893	Open Manhole	1350
S7.000	5.000	10.0	S22	32.990	30.872	1.893	Open Manhole	1350
S6.001	8.644	240.1	STank	32.450	30.611	1.389	Open Manhole	1350
S1.017	4.837	439.7	S23	32.020	30.600	0.970	Open Manhole	1350
S1.018	4.664	186.6	S24	31.500	30.575	0.700	Open Manhole	1200
S1.019	7.682	102.4	S	31.000	30.500	0.275	Open Manhole	0

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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)
S1.019	S	31.000	30.500	0.000	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 * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1
Number of Input Hydrographs	0	Number of Storage Structures	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	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: S16, DS/PN: S1.014, Volume (m³): 3.9

Diameter (m) 0.175 Discharge Coefficient 0.600 Invert Level (m) 31.875

Hydro-Brake® Optimum Manhole: S23, DS/PN: S1.018, Volume (m³): 2.6

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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<u>Offline Controls for Storm</u> <u>Pipe Manhole: S14, DS/PN: S1.010, Loop to PN: S6.000</u> <table><tr><td>Diameter (m)</td><td>0.150</td><td>Roughness k (mm)</td><td>0.600</td></tr><tr><td>Section Type</td><td>Pipe/Conduit</td><td>Entry Loss Coefficient</td><td>0.500</td></tr><tr><td>Slope (1:X)</td><td>50.0</td><td>Coefficient of Contraction</td><td>0.600</td></tr><tr><td>Length (m)</td><td>20.000</td><td>Upstream Invert Level (m)</td><td>33.525</td></tr></table> <u>Weir Manhole: S23, DS/PN: S1.018, Loop to PN: None</u> Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 31.875			Diameter (m)	0.150	Roughness k (mm)	0.600	Section Type	Pipe/Conduit	Entry Loss Coefficient	0.500	Slope (1:X)	50.0	Coefficient of Contraction	0.600	Length (m)	20.000	Upstream Invert Level (m)	33.525
Diameter (m)	0.150	Roughness k (mm)	0.600															
Section Type	Pipe/Conduit	Entry Loss Coefficient	0.500															
Slope (1:X)	50.0	Coefficient of Contraction	0.600															
Length (m)	20.000	Upstream Invert Level (m)	33.525															
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Storage Structures for Storm

Tank or Pond Manhole: S16, 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	0.500	205.0	1.000	270.0	1.500	390.0
0.100	145.0	0.600	215.0	1.100	290.0	1.600	450.0
0.200	160.0	0.700	230.0	1.200	310.0		
0.300	175.0	0.800	245.0	1.300	330.0		
0.400	190.0	0.900	260.0	1.400	360.0		

Cellular Storage Manhole: S23, DS/PN: S1.018

Invert Level (m) 30.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	460.0	460.0	0.751	0.0	549.6
0.750	460.0	549.6			

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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 (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
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
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	S2A	30 Winter	1	+0%				
S2.000	S1	15 Winter	1	+0%	100/15 Winter			
S1.001	S2	15 Winter	1	+0%	100/15 Summer			
S1.002	S3	15 Winter	1	+0%	100/15 Summer			
S1.003	S4	15 Winter	1	+0%				
S3.000	S5	15 Winter	1	+0%	100/15 Summer			
S3.001	S6	15 Winter	1	+0%	100/15 Summer			
S1.004	S7	15 Winter	1	+0%	100/15 Summer			
S4.000	S8A	30 Winter	1	+0%	100/15 Summer	100/30 Winter		
S4.001	S8	30 Winter	1	+0%	100/15 Summer			
S1.005	S9	30 Winter	1	+0%	100/15 Summer			
S1.006	S10	30 Winter	1	+0%	30/15 Summer			
S1.007	S11	15 Winter	1	+0%	30/15 Summer			
S1.008	S12	15 Winter	1	+0%	100/15 Summer			
S1.009	S13	15 Winter	1	+0%	100/15 Summer			
S1.010	S14	15 Winter	1	+0%	30/15 Winter		100/30 Winter	4
S1.011	S15	15 Winter	1	+0%	30/15 Summer			
S1.012	SHW1	60 Winter	1	+0%	30/30 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 / Overflow		Half Drain	Pipe	Level	
		US/MH Level (m)	Depth (m)	Volume (m³)			Time (mins)	Flow (l/s)		
S1.000	S2A	37.884	-0.188	0.000	0.06			4.6	OK	
S2.000	S1	37.448	-0.199	0.000	0.02			0.7	OK	
S1.001	S2	37.433	-0.157	0.000	0.20			7.0	OK	
S1.002	S3	37.306	-0.136	0.000	0.33			11.8	OK	
S1.003	S4	37.117	-0.177	0.000	0.10			15.8	OK	
S3.000	S5	35.005	-0.185	0.000	0.07			2.8	OK	
S3.001	S6	34.812	-0.246	0.000	0.08			5.1	OK	
S1.004	S7	34.725	-0.259	0.000	0.21			27.5	OK	
S4.000	S8A	34.747	-0.162	0.000	0.18			6.5	OK	
S4.001	S8	34.543	-0.236	0.000	0.10			7.5	OK	
S1.005	S9	34.433	-0.243	0.000	0.27			42.1	OK	
S1.006	S10	34.184	-0.199	0.000	0.45			49.4	OK	
S1.007	S11	34.102	-0.177	0.000	0.54			61.3	OK	
S1.008	S12	33.916	-0.229	0.000	0.32			72.4	OK	
S1.009	S13	33.144	-0.256	0.000	0.22			76.2	OK	
S1.010	S14	32.360	-0.240	0.000	0.44	0.0		78.8	OK	
S1.011	S15	32.294	-0.206	0.000	0.49			82.0	OK	
S1.012	SHW1	32.283	-0.317	0.000	0.11			68.1	OK	

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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.
S1.013	SHW2	60 Winter	1	+0%	1/15 Winter			
S1.014	S16	60 Winter	1	+0%	1/15 Winter			
S5.000	S17	15 Winter	1	+0%				
S1.015	S18	60 Winter	1	+0%	100/15 Winter			
S1.016	S19	60 Winter	1	+0%	30/120 Winter			
S6.000	S20	15 Winter	1	+0%	30/240 Winter			
S7.000	S21	15 Winter	1	+0%	30/240 Winter			
S6.001	S22	240 Winter	1	+0%	30/60 Winter			
S1.017	STank	240 Winter	1	+0%	30/60 Winter			
S1.018	S23	240 Winter	1	+0%	1/120 Summer		30/240 Winter	27
S1.019	S24	240 Winter	1	+0%				

		Water	Surcharged	Flooded				Half Drain	Pipe	
	US/MH	Level	Depth	Volume	Flow /	Overflow	Time	Flow		
PN	Name	(m)	(m)	(m³)	Cap.	(l/s)	(mins)	(l/s)	Status	
S1.013	SHW2	32.281	0.011	0.000	1.64			68.1	SURCHARGED	
S1.014	S16	32.266	0.091	0.000	0.36			30.4	SURCHARGED	
S5.000	S17	32.438	-0.187	0.000	0.07			5.7	OK	
S1.015	S18	31.890	-0.145	0.000	0.53			32.5	OK	
S1.016	S19	30.941	-0.324	0.000	0.18			32.5	OK	
S6.000	S20	31.677	-0.198	0.000	0.03			3.6	OK	
S7.000	S21	31.404	-0.193	0.000	0.05			4.7	OK	
S6.001	S22	30.893	-0.204	0.000	0.02			2.9	OK	
S1.017	STank	30.893	-0.168	0.000	0.26			29.8	OK	
S1.018	S23	30.892	0.067	0.000	0.44	0.0	160	11.9	SURCHARGED	
S1.019	S24	30.660	-0.140	0.000	0.31			11.9	OK	

PN	US/MH Name	Level Exceeded
S1.013	SHW2	
S1.014	S16	
S5.000	S17	
S1.015	S18	
S1.016	S19	
S6.000	S20	
S7.000	S21	
S6.001	S22	
S1.017	STank	
S1.018	S23	
S1.019	S24	

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Barton Lane

OX14 3NB

Barton Road, Havant

Surface Water Calculations

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Micro Drainage

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

Analysis Timestep 2.5 Second Increment (Extended)

DTS Status OFF

DVD Status OFF

Inertia Status OFF

Profile(s) Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320

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	S2A	30 Winter	30	+0%				
S2.000	S1	15 Winter	30	+0%	100/15 Winter			
S1.001	S2	15 Winter	30	+0%	100/15 Summer			
S1.002	S3	15 Winter	30	+0%	100/15 Summer			
S1.003	S4	15 Winter	30	+0%				
S3.000	S5	15 Winter	30	+0%	100/15 Summer			
S3.001	S6	15 Winter	30	+0%	100/15 Summer			
S1.004	S7	15 Winter	30	+0%	100/15 Summer			
S4.000	S8A	30 Winter	30	+0%	100/15 Summer	100/30 Winter		
S4.001	S8	30 Winter	30	+0%	100/15 Summer			
S1.005	S9	30 Winter	30	+0%	100/15 Summer			
S1.006	S10	30 Winter	30	+0%	30/15 Summer			
S1.007	S11	30 Winter	30	+0%	30/15 Summer			
S1.008	S12	15 Winter	30	+0%	100/15 Summer			
S1.009	S13	15 Winter	30	+0%	100/15 Summer			
S1.010	S14	30 Winter	30	+0%	30/15 Winter		100/30 Winter	4
S1.011	S15	60 Winter	30	+0%	30/15 Summer			
S1.012	SHW1	60 Winter	30	+0%	30/30 Summer			

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

PN	US/MH Name	Water	Surcharged	Flooded	Flow / Cap.	Overflow (l/s)	Half Drain	Pipe	Status
		Level (m)	Depth (m)	Volume (m³)			Time (mins)	Flow (l/s)	
S1.000	S2A	37.907	-0.165	0.000	0.16			11.4	OK
S2.000	S1	37.482	-0.165	0.000	0.05			1.8	OK
S1.001	S2	37.479	-0.111	0.000	0.50			17.9	OK
S1.002	S3	37.371	-0.071	0.000	0.81			28.8	OK
S1.003	S4	37.148	-0.146	0.000	0.26			39.8	OK
S3.000	S5	35.029	-0.161	0.000	0.18			6.7	OK
S3.001	S6	34.845	-0.213	0.000	0.19			12.6	OK
S1.004	S7	34.801	-0.183	0.000	0.51			67.2	OK
S4.000	S8A	34.787	-0.122	0.000	0.43			16.0	OK
S4.001	S8	34.595	-0.184	0.000	0.24			17.7	OK
S1.005	S9	34.567	-0.109	0.000	0.63			97.3	OK
S1.006	S10	34.452	0.069	0.000	1.05			115.0	SURCHARGED
S1.007	S11	34.340	0.061	0.000	1.25			141.6	SURCHARGED
S1.008	S12	34.013	-0.132	0.000	0.74			168.1	OK
S1.009	S13	33.215	-0.185	0.000	0.51			177.6	OK
S1.010	S14	32.849	0.249	0.000	1.01	0.0		180.3	SURCHARGED
S1.011	S15	32.789	0.289	0.000	0.92			154.3	SURCHARGED
S1.012	SHW1	32.763	0.163	0.000	0.23			150.7	SURCHARGED

PN	US/MH Name	Level Exceeded
S1.000	S2A	
S2.000	S1	
S1.001	S2	
S1.002	S3	
S1.003	S4	
S3.000	S5	
S3.001	S6	
S1.004	S7	
S4.000	S8A	
S4.001	S8	
S1.005	S9	
S1.006	S10	
S1.007	S11	
S1.008	S12	
S1.009	S13	
S1.010	S14	
S1.011	S15	
S1.012	SHW1	

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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.
S1.013	SHW2	60 Winter	30	+0%	1/15 Winter			
S1.014	S16	60 Winter	30	+0%	1/15 Winter			
S5.000	S17	15 Winter	30	+0%				
S1.015	S18	60 Winter	30	+0%	100/15 Winter			
S1.016	S19	360 Winter	30	+0%	30/120 Winter			
S6.000	S20	360 Winter	30	+0%	30/240 Winter			
S7.000	S21	360 Winter	30	+0%	30/240 Winter			
S6.001	S22	360 Winter	30	+0%	30/60 Winter			
S1.017	STank	360 Winter	30	+0%	30/60 Winter			
S1.018	S23	360 Winter	30	+0%	1/120 Summer		30/240 Winter	27
S1.019	S24	360 Winter	30	+0%				

		Water	Surcharged	Flooded				Half Drain	Pipe	
	US/MH	Level	Depth	Volume	Flow /	Overflow	Time	Flow		
PN	Name	(m)	(m)	(m³)	Cap.	(l/s)	(mins)	(l/s)	Status	
S1.013	SHW2	32.758	0.488	0.000	3.52			146.5	SURCHARGED	
S1.014	S16	32.731	0.556	0.000	0.63			52.4	SURCHARGED	
S5.000	S17	32.461	-0.164	0.000	0.17			14.1	OK	
S1.015	S18	31.962	-0.073	0.000	0.93			56.9	OK	
S1.016	S19	31.898	0.633	0.000	0.24			43.7	SURCHARGED	
S6.000	S20	31.891	0.016	0.000	0.01			1.4	SURCHARGED	
S7.000	S21	31.891	0.294	0.000	0.02			1.8	SURCHARGED	
S6.001	S22	31.893	0.796	0.000	0.03			4.7	SURCHARGED	
S1.017	STank	31.893	0.832	0.000	0.40			45.8	SURCHARGED	
S1.018	S23	31.891	1.066	0.000	0.46	0.5	324	12.5	FLOOD RISK	
S1.019	S24	30.663	-0.137	0.000	0.32			12.5	OK	

PN	US/MH Name	Level Exceeded
S1.013	SHW2	
S1.014	S16	
S5.000	S17	
S1.015	S18	
S1.016	S19	
S6.000	S20	
S7.000	S21	
S6.001	S22	
S1.017	STank	
S1.018	S23	
S1.019	S24	

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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
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status OFF
 DVD Status OFF
 Inertia Status OFF

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600,
 720, 960, 1440, 2160, 2880, 4320
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S2A 30	Winter	100	+40%				
S2.000	S1 30	Winter	100	+40%	100/15			
S1.001	S2 30	Winter	100	+40%	100/15			
S1.002	S3 30	Winter	100	+40%	100/15			
S1.003	S4 15	Winter	100	+40%				
S3.000	S5 30	Winter	100	+40%	100/15			
S3.001	S6 30	Winter	100	+40%	100/15			
S1.004	S7 30	Winter	100	+40%	100/15			
S4.000	S8A 30	Winter	100	+40%	100/15		100/30	
S4.001	S8 30	Winter	100	+40%	100/15			
S1.005	S9 30	Winter	100	+40%	100/15			
S1.006	S10 30	Winter	100	+40%	30/15			
S1.007	S11 30	Winter	100	+40%	30/15			
S1.008	S12 30	Winter	100	+40%	100/15			
S1.009	S13 30	Winter	100	+40%	100/15			

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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		Half Drain Time (mins)	Pipe Flow (l/s)	Status
		Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)				
S1.000	S2A	37.929	-0.143	0.000	0.29			20.8		OK
S2.000	S1	37.672	0.025	0.000	0.07			2.3		SURCHARGED
S1.001	S2	37.670	0.080	0.000	0.78			28.0		SURCHARGED
S1.002	S3	37.579	0.137	0.000	1.41			50.4		SURCHARGED
S1.003	S4	37.175	-0.119	0.000	0.43			66.3		OK
S3.000	S5	36.178	0.988	0.000	0.29			10.8		FLOOD RISK
S3.001	S6	36.171	1.113	0.000	0.34			23.4		SURCHARGED
S1.004	S7	36.158	1.174	0.000	0.74			98.3		SURCHARGED
S4.000	S8A	36.106	1.197	0.006	1.02			37.9		FLOOD
S4.001	S8	36.033	1.254	0.000	0.58			43.4		SURCHARGED
S1.005	S9	36.007	1.331	0.000	0.96			150.1		SURCHARGED
S1.006	S10	35.744	1.361	0.000	1.63			178.3		SURCHARGED
S1.007	S11	35.480	1.201	0.000	1.89			213.5		SURCHARGED
S1.008	S12	34.999	0.854	0.000	1.13			254.6		SURCHARGED
S1.009	S13	34.061	0.661	0.000	0.76			264.8		SURCHARGED

PN	US/MH Level	
	Name	Exceeded
S1.000	S2A	
S2.000	S1	
S1.001	S2	
S1.002	S3	
S1.003	S4	
S3.000	S5	
S3.001	S6	
S1.004	S7	
S4.000	S8A	
S4.001	S8	
S1.005	S9	
S1.006	S10	
S1.007	S11	
S1.008	S12	
S1.009	S13	

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

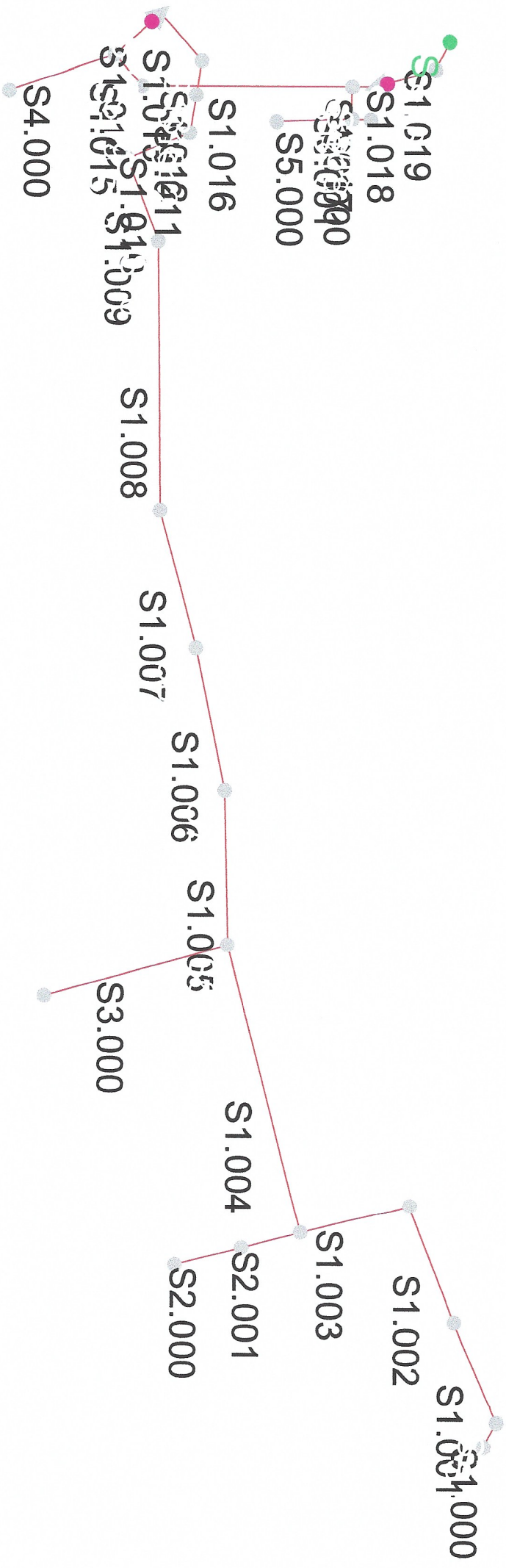
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.010	S14	60 Winter	100	+40%	30/15 Winter		100/30 Winter	4
S1.011	S15	60 Winter	100	+40%	30/15 Summer			
S1.012	SHW1	60 Winter	100	+40%	30/30 Summer			
S1.013	SHW2	60 Winter	100	+40%	1/15 Winter			
S1.014	S16	120 Winter	100	+40%	1/15 Winter			
S5.000	S17	30 Winter	100	+40%				
S1.015	S18	240 Winter	100	+40%	100/15 Winter			
S1.016	S19	240 Winter	100	+40%	30/120 Winter			
S6.000	S20	240 Winter	100	+40%	30/240 Winter			
S7.000	S21	240 Winter	100	+40%	30/240 Winter			
S6.001	S22	240 Winter	100	+40%	30/60 Winter			
S1.017	STank	240 Winter	100	+40%	30/60 Winter			
S1.018	S23	240 Winter	100	+40%	1/120 Summer		30/240 Winter	27
S1.019	S24	240 Winter	100	+40%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.010	S14	33.618	1.018	0.000	1.33	16.4		237.5	SURCHARGED
S1.011	S15	33.496	0.996	0.000	1.47			246.4	FLOOD RISK
S1.012	SHW1	33.430	0.830	0.000	0.37			240.5	SURCHARGED
S1.013	SHW2	33.424	1.154	0.000	5.66			235.7	SURCHARGED
S1.014	S16	33.317	1.142	0.000	0.84			70.0	SURCHARGED
S5.000	S17	32.485	-0.140	0.000	0.30			25.7	OK
S1.015	S18	32.111	0.076	0.000	1.17			71.9	SURCHARGED
S1.016	S19	32.033	0.768	0.000	0.39			71.6	SURCHARGED
S6.000	S20	32.000	0.125	0.000	0.03			3.3	SURCHARGED
S7.000	S21	31.999	0.402	0.000	0.04			4.4	SURCHARGED
S6.001	S22	31.997	0.900	0.000	0.08			11.6	SURCHARGED
S1.017	STank	31.996	0.935	0.000	0.69			79.3	SURCHARGED
S1.018	S23	31.985	1.160	0.000	0.47	61.8		12.9	FLOOD RISK
S1.019	S24	30.664	-0.136	0.000	0.33			12.9	OK

US/MH Level Exceeded

S1.010 S14
 S1.011 S15
 S1.012 SHW1
 S1.013 SHW2
 S1.014 S16
 S5.000 S17
 S1.015 S18
 S1.016 S19

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	<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>S6.000</td><td>S20</td><td></td></tr><tr><td>S7.000</td><td>S21</td><td></td></tr><tr><td>S6.001</td><td>S22</td><td></td></tr><tr><td>S1.017</td><td>STank</td><td></td></tr><tr><td>S1.018</td><td>S23</td><td></td></tr><tr><td>S1.019</td><td>S24</td><td></td></tr></table>		US/MH	Level	PN	Name	Exceeded	S6.000	S20		S7.000	S21		S6.001	S22		S1.017	STank		S1.018	S23		S1.019	S24		
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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
A	31.01.2022	Updated maintenance of watercourse	S. Smith	A. Mcshane

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 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.

Existing Watercourse and New Section

- 3.29 The existing and new sections of ordinary watercourse should be visually inspected at least twice a year and any physical obstructions such as accumulated sediments at the outfall headwall, large rocks, rubble, fallen trees and branches and other waste materials (litter, grass cuttings etc) removed so that water can flow freely.



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