Report Title	# Drainage Report
Property Address	Proposed Warehouse Joe McBain Ave Moresby Parks Whitehaven CA28 8EA
Client	O'Connor Fencing Ltd
Our Reference	22-485r002B
Date	December 2022
Prepared by	Colin Aimers BEng Hons CEng MICE CEnv **Kingoor Consulting Ltd** Suite 4, Atlantic House Parkhouse Business Park Carlisle CA3 0LJ

Contents

Introduction

The purpose of this report is to provide support for a planning application associated with the proposed development on land adjacent at Joe McBain Ave, Moresby Parks, Whitehaven, CA28 8EA.

Research has been undertaken on the site and observations made regarding the existing site and the drainage servicing the site.

Calculations associated with the drainage have been performed by software packages from a recognised resource. Where appropriate copies of calculations are provided in the Appendices of this report.

The Site

Historic Usage

The area of the proposed development has historically been undeveloped and is part of a larger site developed in the 1990's by the North West Development Agency for industrial use. Infrastructure and some limited developments took place during the intervening years, and the site proposed for development has remained fallow with limited maintenance being undertaken on the site.

Existing Foul Network

A private sewer system is located on the site servicing the properties which discharges to the United Utilities foul drainage system located on the site boundary.

Existing Site Drainage

The site has no natural drainage and all surface water is collected and managed via a site wide surface water drainage system which leaves the site and discharges to a watercourse on the site boundary. The drainage system installed as part of the development during the 1990's has no flow controls or attenuation and the condition is to be inspected as part of this development to ensure that it is suitable for future demands on the site.

Geology

The superficial geology indicates that the site is overlain by the Diamicton Till generally consisting of clays, and silts.

The solid geology of the site is Coal Measures.

A copy of the geological mapping is appended to this report.

Drainage Strategy

Foul Drainage

It is proposed that the development shall have a connection to the adjacent foul drainage network present on the site boundary.

Surface Water Drainage

Outline Strategy

It is proposed to discharge the surface water from the development to the existing surface water drainage present on the site boundary.

At present, drainage located on the site discharges any surface water from the area of the development into the surface water system unattenuated. It would be proposed to attenuate via a small pond and release the surface water discharge at greenfield runoff rates.

The rate of discharge has been calculated as Qbar = 13 litres per second.

Hydraulic Design

Surface Water Drainage

Principally the surface water drainage has been calculated on the impermeable areas of the development.

Modelling has been conducted on the following rainfall events:

- 1 in 10 years
- 1 in 30 years
- 1 in 100 years plus 40 % increase due to climate change over a 6 hour period

An assessment of the proposed network has been undertaken to identify the requirements of each property and requirements for the attenuation of water on the site to ensure that runoff from the site does not exceed the limits of Qbar (approx 1 in 2 year rainfall event).

The following parameters were adopted in the analysis. These were obtained from UK SUDS based on the site location and data held by HR Wallingford.

Simulation Settings

Rainfall Methodology	FSR	Drain Down Time (mins)	240
FSR Region	England and Wales	Additional Storage (m³/ha)	0.0
M5-60 (mm)	20.000	Check Discharge Rate(s)	✓
Ratio-R	0.300	10 year (l/s)	17.9
Summer CV	0.750	30 year (l/s)	22.0
Winter CV	0.840	100 year (l/s)	26.9
Analysis Speed	Normal	Check Discharge Volume	✓
Skip Steady State	x	100 year +40% 360 minute (m³)	1004

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
10	0	0	0
30	0	0	0
100	40	0	0

The following rates and volumes have been calculated for the predevelopment discharge and volumes from the site.

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)	1.876	Betterment (%)	0
SAAR (mm)	950	QBar	13.0
Soil Index	4	Q 1 year (l/s)	
SPR	0.47	Q 30 year (l/s)	
Region	10	Q 100 year (l/s)	
Growth Factor 1 year	0.85		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	40
Positively Drained Area (ha)	1.876	Storm Duration (mins)	360
Soil Index	4	Betterment (%)	0
SPR	0.47	PR	0.547
CWI	124.875	Runoff Volume (m^3)	1004

Detailed Engineering

The detailed model presented in this report adopts the following engineering aspects specific to the site.

Attenuation

Attenuation in the form of an attenuation pond downstream of the site shall accommodate all peak flows from the development and , prevent flooding occuring within and outside the site.

Node 12 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	30.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	124.750	Main Channel Slope (1:X)	1000.0
Safety Factor	1.0	Time to half empty (mins)	45	Main Channel n	0.030

Flow Control

A hydrobrake is to be installed downstream of the attenuation pond and shall control flows from the site to the existing drainage network. The following summary is presented for the flow control device.

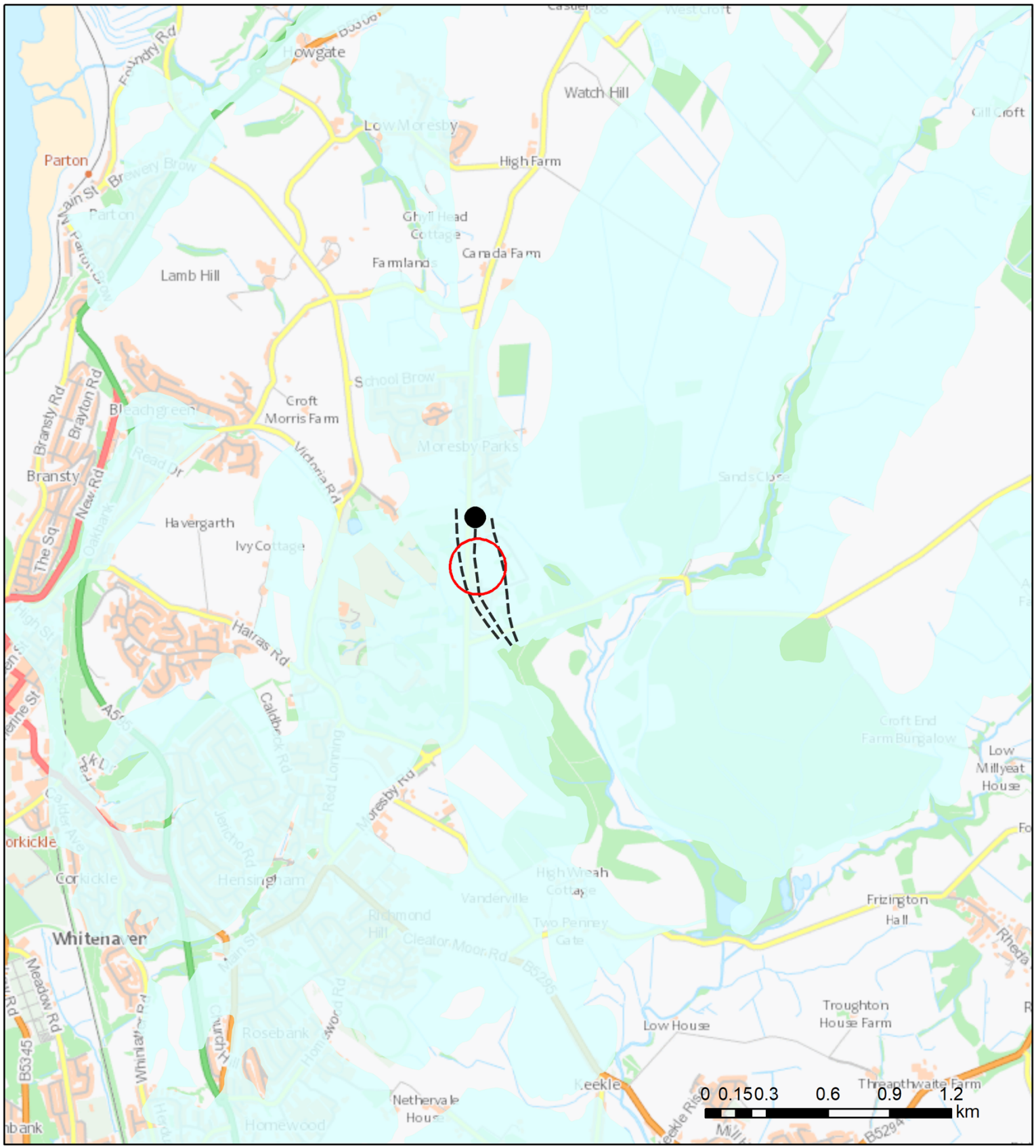
Node 13 Online ACO Q-Brake Control

Flap Valve	x	Design Depth (m)	1.400	Min Node Diameter (mm)	1050
Replaces Downstream Link	✓	Design Flow (l/s)	13.0	Orifice Diameter (mm)	0.145
Invert Level (m)	124.614	Min Outlet Diameter (m)	0.145		

Appendices

BGS Geological Records

Superficial Deposits



Map Key

Superficial deposits 1:50,000 scale

- GLACIOFLUVIAL DEPOSITS, DEVENSIAN - SAND AND GRAVEL
- TILL, DEVENSIAN - DIAMICTON
- ALLUVIUM - CLAY, SILT, SAND AND GRAVEL
- RAISED MARINE DEPOSITS - CLAY AND SILT
- RIVER TERRACE DEPOSITS, 1 - CLAY, SAND AND GRAVEL
- ALLUVIAL FAN DEPOSITS - SAND AND GRAVEL
- MARINE BEACH DEPOSITS - SAND AND GRAVEL
- PEAT - PEAT
- SUPERFICIAL THEME NOT MAPPED [FOR DIGITAL MAP USE ONLY] - UNKNOWN/UNCLASSIFIED ENTRY

Linear features 1:50,000 scale

- Coal_seam_Inf
- Glacial_meltwater_channel_Centre_Undiff
- Marine_band

Selection Results

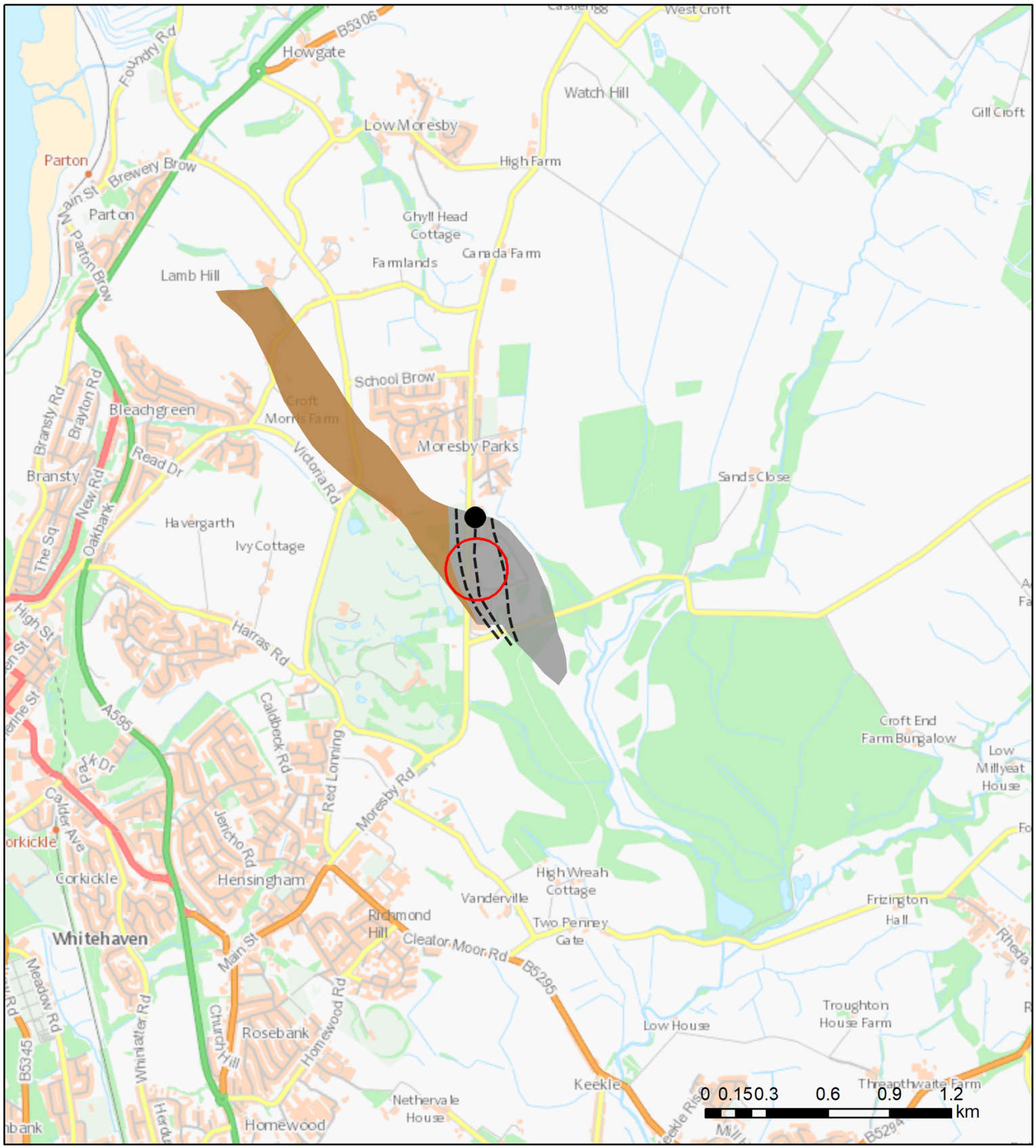
Linear features 1:50,000 scale

Feature
Coal seam, inferred
Coal seam, inferred
Coal seam, inferred

Superficial deposits 1:50,000 scale

Description	Details
TILL, DEVENSIAN - DIAMICTON	More Information

Solid Geology



Map Key

Bedrock geology 1:50,000 scale

- FIRST SHALE MEMBER - SANDSTONE, SILTSTONE AND MUDSTONE
- PENNINE LOWER COAL MEASURES FORMATION - MUDSTONE, SILTSTONE AND SANDSTONE
- FIRST LIMESTONE (CUMBRIA) - LIMESTONE
- MILLYEAT MEMBER - MUDSTONE, SANDSTONE AND LIMESTONE
- BUTTERMERE FORMATION - MUDSTONE AND SANDSTONE
- PENNINE MIDDLE COAL MEASURES FORMATION - MUDSTONE, SILTSTONE AND SANDSTONE
- STAINMORE FORMATION - MUDSTONE, SILTSTONE AND SANDSTONE
- ST BEES SANDSTONE MEMBER - SANDSTONE
- OREBANK SANDSTONE - SANDSTONE
- ST BEES SHALE FORMATION - SILTSTONE AND MUDSTONE, INTERBEDDED
- PENNINE LOWER COAL MEASURES FORMATION - SANDSTONE
- PENNINE MIDDLE COAL MEASURES FORMATION - SANDSTONE
- WHITEHAVEN SANDSTONE FORMATION - SANDSTONE
- ST BEES EVAPORITE FORMATION - DOLOMITIC LIMESTONE, MUDSTONE AND ANHYDRITE-STONE
- HENSINGHAM GRIT - SANDSTONE
- BROCKRAM - BRECCIA

Linear features 1:50,000 scale

- Coal_seam_Inf
- Glacial_meltwater_channel_Centre_Undiff
- Marine_band

Selection Results

Linear features 1:50,000 scale

Feature
Coal seam, inferred
Coal seam, inferred
Coal seam, inferred

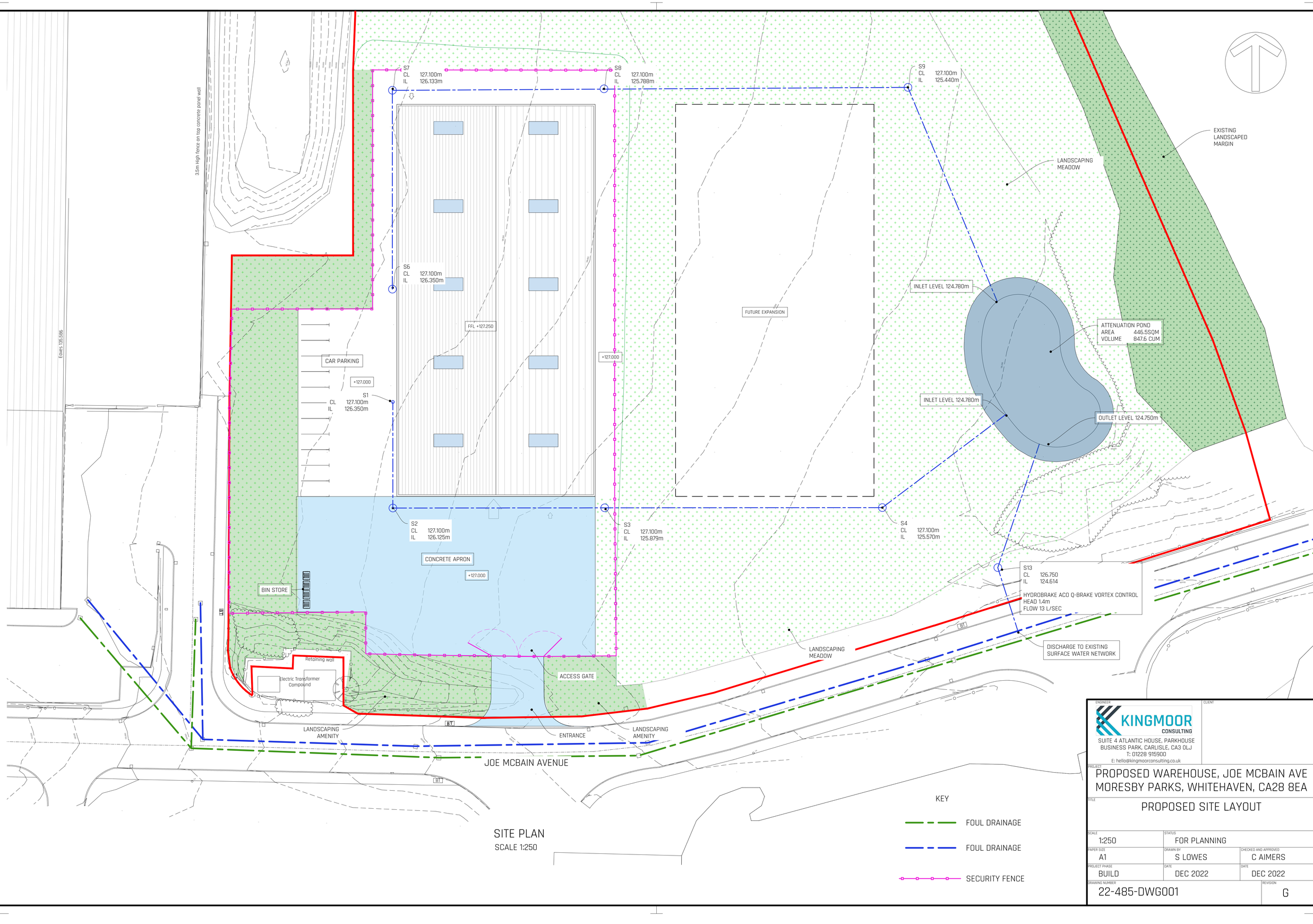
Bedrock geology 1:50,000 scale

Description	Details
PENNINE MIDDLE COAL MEASURES FORMATION - MUDSTONE, SILTSTONE AND SANDSTONE	More Information
WHITEHAVEN SANDSTONE FORMATION - SANDSTONE	More Information

Drawings

22-485 DWG001 - SITE LAYOUT

22-485 DWG006 - DRAINAGE MANHOLE AND PIPE SCHEDULE



SITE PLAN
SCALE 1:250

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PROJECT
PROPOSED WAREHOUSE, JOE MCBAIN AVE MORESBY PARKS, WHITEHAVEN, CA28 8EA

TITLE
PROPOSED SITE LAYOUT

SCALE	STATUS	
1:250	FOR PLANNING	
PAPER SIZE	DRAWN BY	CHECKED AND APPROVED
A1	S LOWES	C AIMERS
PROJECT PHASE	DATE	DATE
BUILD	DEC 2022	DEC 2022

DRAWING NUMBER
22-485-DWG001

REVISION
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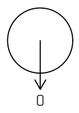
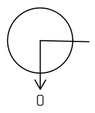
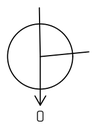
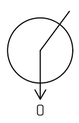
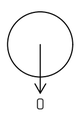
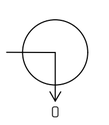
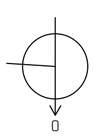
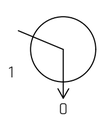
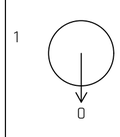
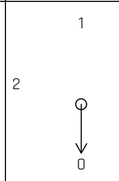
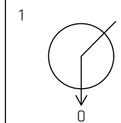
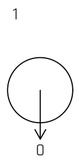
MANHOLE SCHEDULE

Manhole Number / Coordinates	Cover Level / Depth To Soffit	Connections	Pipe: Code	Pipe: Inverts	Pipe: Diams	Manhole Size	Types: Manhole	Types: Cover
S1 E. 299847.000 N. 518646.250	127.100 0.650		0	3.000	126.350	100	1010	4	D400
S2 E. 299847.000 N. 518626.000	127.100 0.785		0	3.001	126.165	150	1010	4	D400
S3 E. 299878.600 N. 518626.700	127.100 0.996		1 2 0	4.000 3.001 3.002	126.004 125.954 125.879	100 150 225	1010	4	D400
S4 E. 299925.000 N. 518626.800	127.100 1.305		1 0	3.002 3.003	125.570 125.570	225 225	1010	4	D400
S5 E. 299944.200 N. 518641.100			1	3.003	125.331	225		JUNCTION	
S6 E. 299846.850 N. 518665.875	127.100 0.650		0	1.000	126.350	100	1010	4	D400
S7 E. 299846.850 N. 518690.900	127.100 0.817		1 0	1.000 1.001	126.183 126.133	100 150	1010	4	D400
S8 E. 299878.480 N. 518691.000	127.100 1.097		1 2 0	1.001 2.000 1.002	125.922 125.903 125.778	150 100 225	1010	4	D400
S9 E. 299929.111 N. 518691.000	127.100 1.435		1 0	1.002 1.003	125.440 125.440	225 225	1010	4	D400
S10 E. 299942.864 N. 518658.000			1	1.003	125.082	225		JUNCTION	
S11 E. 299876.792 N. 518664.507	127.100 0.650		0	2.000	126.350	100	1200	4	D400
S12 E. 299949.200 N. 518636.084			0	5.000	124.750	225		JUNCTION	
S13 E. 299942.000 N. 518617.000	126.750 1.911		0	5.001	124.614	225	1200	2	D400
S14 E. 299876.681 N. 518645.658	127.100 0.650		0	4.000	126.350	100	1200	4	D400
S99 E. 299946.000 N. 518608.000			1	5.001	124.556	225		JUNCTION	

STORM Network 1

Pipe Code	Diameter (mm)	Gradient (1:)	Pipe Length	Upstream Manhole: Number	Upstream Manhole: Invert	Upstream Manhole: Cover	Downstream Manhole: Number	Downstream Manhole: Invert	Downstream Manhole: Cover
1.000	100	150	25.025	S6	126.350	127.100	S7	126.183	127.100
1.001	150	150	31.630	S7	126.133	127.100	S8	125.922	127.100
1.002	225	150	50.631	S8	125.778	127.100	S9	125.440	127.100
1.003	225	100	35.751	S9	125.440	127.100	S10	125.082	
2.000	100	59	26.547	S11	126.350	127.100	S8	125.903	127.100
3.000	100	150	20.250	S1	126.350	127.100	S2	126.215	127.100
3.001	150	150	31.608	S2	126.165	127.100	S3	125.954	127.100
3.002	225	150	46.400	S3	125.879	127.100	S4	125.570	127.100
3.003	225	100	23.940	S4	125.570	127.100	S5	125.331	
4.000	100	55	19.055	S14	126.350	127.100	S3	126.004	127.100
5.000	225	150	20.397	S12	124.750		S13	124.614	126.750
5.001	225	170	9.849	S13	124.614	126.750	S99	124.556	

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CLIENT

PROJECT
PROPOSED WAREHOUSE, JOE MCBAIN AVE
MORESBY PARKS, WHITEHAVEN, CA28 8EA

TITLE
DRAINAGE SCHEDULES
MANHOLES AND PIPES

SCALE	STATUS	
AS NOTED	FOR PLANNING	
PAPER SIZE	DRAWN BY	CHECKED AND APPROVED
A1	S LOWES	C AIMERS
PROJECT PHASE	DATE	DATE
BUILD	DEC 2022	DEC 2022
DRAWING NUMBER		REVISION
22-485-DWG006		A

Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	40	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.300	Preferred Cover Depth (m)	0.650
CV	0.750	Include Intermediate Ground	x
Time of Entry (mins)	4.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
6	0.020	4.00	127.100	1010	299846.850	518665.875	0.750
7	0.020	4.00	127.100	1010	299846.850	518690.900	0.967
8	0.020	4.00	127.100	1010	299878.480	518691.000	1.322
9			127.100	1010	299929.111	518691.000	1.660
10			127.100		299942.864	518658.000	2.320
1	0.020	4.00	127.100	1010	299847.000	518646.250	0.750
2	0.020	4.00	127.100	1010	299847.000	518626.000	0.935
3	0.020	4.00	127.100	1010	299878.600	518626.700	1.221
4			127.100	1010	299925.000	518626.800	1.530
5			127.100		299944.200	518641.100	2.320
12		4.00	127.100		299949.200	518636.084	2.350
13			126.750	1200	299942.000	518617.000	2.136
99			125.800		299946.000	518608.000	1.244
11	0.020	4.00	127.100	1200	299876.792	518664.507	0.750
14	0.020	4.00	127.100	1200	299876.681	518645.658	0.750

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	6	7	25.025	0.600	126.350	126.183	0.167	150.0	100	4.67	50.0
1.001	7	8	31.630	0.600	126.133	125.922	0.211	150.0	150	5.31	50.0
1.002	8	9	50.631	0.600	125.778	125.440	0.338	150.0	225	6.10	50.0
1.003	9	10	35.751	0.600	125.440	125.082	0.358	100.0	225	6.56	50.0
3.000_1	1	2	20.250	0.600	126.350	126.215	0.135	150.0	100	4.54	50.0
3.001	2	3	31.608	0.600	126.165	125.954	0.211	150.0	150	5.18	50.0
3.002	3	4	46.400	0.600	125.879	125.570	0.309	150.0	225	5.91	50.0
3.003	4	5	23.940	0.600	125.570	125.331	0.239	100.0	225	6.22	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.625	4.9	3.8	0.650	0.817	0.020	0.0	66	0.690
1.001	0.818	14.5	7.6	0.817	1.028	0.040	0.0	77	0.827
1.002	1.065	42.3	15.2	1.097	1.435	0.080	0.0	93	0.977
1.003	1.307	52.0	15.2	1.435	1.793	0.080	0.0	83	1.137
3.000_1	0.625	4.9	3.8	0.650	0.785	0.020	0.0	66	0.690
3.001	0.818	14.5	7.6	0.785	0.996	0.040	0.0	77	0.827
3.002	1.065	42.3	15.2	0.996	1.305	0.080	0.0	93	0.977
3.003	1.307	52.0	15.2	1.305	1.544	0.080	0.0	83	1.137

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
3.000	12	13	20.397	0.600	124.750	124.614	0.136	150.0	225	4.41	50.0
5.001	13	99	9.849	0.600	124.614	124.556	0.058	169.8	225	4.57	50.0
2.000	11	8	26.547	0.600	126.350	125.903	0.447	59.4	100	4.44	50.0
4.000	14	3	19.055	0.600	126.350	126.004	0.346	55.1	100	4.31	50.0

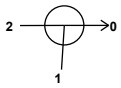
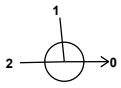
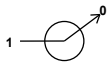
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
3.000	1.065	42.3	0.0	2.125	1.911	0.000	0.0	0	0.000
5.001	1.000	39.8	0.0	1.911	1.019	0.000	0.0	0	0.000
2.000	1.001	7.9	3.8	0.650	1.097	0.020	0.0	49	0.991
4.000	1.040	8.2	3.8	0.650	0.996	0.020	0.0	48	1.022

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	25.025	150.0	100	Circular	127.100	126.350	0.650	127.100	126.183	0.817
1.001	31.630	150.0	150	Circular	127.100	126.133	0.817	127.100	125.922	1.028
1.002	50.631	150.0	225	Circular	127.100	125.778	1.097	127.100	125.440	1.435
1.003	35.751	100.0	225	Circular	127.100	125.440	1.435	127.100	125.082	1.793
3.000_1	20.250	150.0	100	Circular	127.100	126.350	0.650	127.100	126.215	0.785
3.001	31.608	150.0	150	Circular	127.100	126.165	0.785	127.100	125.954	0.996
3.002	46.400	150.0	225	Circular	127.100	125.879	0.996	127.100	125.570	1.305
3.003	23.940	100.0	225	Circular	127.100	125.570	1.305	127.100	125.331	1.544
3.000	20.397	150.0	225	Circular	127.100	124.750	2.125	126.750	124.614	1.911
5.001	9.849	169.8	225	Circular	126.750	124.614	1.911	125.800	124.556	1.019
2.000	26.547	59.4	100	Circular	127.100	126.350	0.650	127.100	125.903	1.097
4.000	19.055	55.1	100	Circular	127.100	126.350	0.650	127.100	126.004	0.996

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	6	1010	Manhole	Adoptable	7	1010	Manhole	Adoptable
1.001	7	1010	Manhole	Adoptable	8	1010	Manhole	Adoptable
1.002	8	1010	Manhole	Adoptable	9	1010	Manhole	Adoptable
1.003	9	1010	Manhole	Adoptable	10		Junction	
3.000_1	1	1010	Manhole	Adoptable	2	1010	Manhole	Adoptable
3.001	2	1010	Manhole	Adoptable	3	1010	Manhole	Adoptable
3.002	3	1010	Manhole	Adoptable	4	1010	Manhole	Adoptable
3.003	4	1010	Manhole	Adoptable	5		Junction	
3.000	12		Junction		13	1200	Manhole	Adoptable
5.001	13	1200	Manhole	Adoptable	99		Junction	
2.000	11	1200	Manhole	Adoptable	8	1010	Manhole	Adoptable
4.000	14	1200	Manhole	Adoptable	3	1010	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
6	299846.850	518665.875	127.100	0.750	1010				
						0	1.000	126.350	100
7	299846.850	518690.900	127.100	0.967	1010	1	1.000	126.183	100
									
						0	1.001	126.133	150
8	299878.480	518691.000	127.100	1.322	1010	1	2.000	125.903	100
						2	1.001	125.922	150
									
						0	1.002	125.778	225
9	299929.111	518691.000	127.100	1.660	1010	1	1.002	125.440	225
									
						0	1.003	125.440	225
10	299942.864	518658.000	127.100	2.320		 1	1.003	125.082	225
1	299847.000	518646.250	127.100	0.750	1010				
						0	3.000_1	126.350	100
2	299847.000	518626.000	127.100	0.935	1010	 1	3.000_1	126.215	100
						0	3.001	126.165	150
3	299878.600	518626.700	127.100	1.221	1010	 1	4.000	126.004	100
						2	3.001	125.954	150
						0	3.002	125.879	225
4	299925.000	518626.800	127.100	1.530	1010	1	3.002	125.570	225
									
						0	3.003	125.570	225
5	299944.200	518641.100	127.100	2.320		1	3.003	125.331	225
									
12	299949.200	518636.084	127.100	2.350					
						0	3.000	124.750	225
13	299942.000	518617.000	126.750	2.136	1200	1	3.000	124.614	225
									
						0	5.001	124.614	225
99	299946.000	518608.000	125.800	1.244		 1	5.001	124.556	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
11	299876.792	518664.507	127.100	0.750	1200				
						0	2.000	126.350	100
14	299876.681	518645.658	127.100	0.750	1200				
						0	4.000	126.350	100

Simulation Settings

Rainfall Methodology	FSR	Drain Down Time (mins)	240
FSR Region	England and Wales	Additional Storage (m³/ha)	0.0
M5-60 (mm)	20.000	Check Discharge Rate(s)	✓
Ratio-R	0.300	10 year (l/s)	17.9
Summer CV	0.750	30 year (l/s)	22.0
Winter CV	0.840	100 year (l/s)	26.9
Analysis Speed	Normal	Check Discharge Volume	✓
Skip Steady State	x	100 year +40% 360 minute (m³)	1004

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
10	0	0	0
30	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)	1.876	Betterment (%)	0
SAAR (mm)	950	QBar	13.0
Soil Index	4	Q 1 year (l/s)	
SPR	0.47	Q 30 year (l/s)	
Region	10	Q 100 year (l/s)	
Growth Factor 1 year	0.85		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	40
Positively Drained Area (ha)	1.876	Storm Duration (mins)	360
Soil Index	4	Betterment (%)	0
SPR	0.47	PR	0.547
CWI	124.875	Runoff Volume (m³)	1004

Node 13 Online ACO Q-Brake Control

Flap Valve	x	Design Depth (m)	1.400	Min Node Diameter (mm)	1050
Replaces Downstream Link	✓	Design Flow (l/s)	13.0	Orifice Diameter (mm)	0.145
Invert Level (m)	124.614	Min Outlet Diameter (m)	0.145		

Node 12 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	30.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	124.750	Main Channel Slope (1:X)	1000.0
Safety Factor	1.0	Time to half empty (mins)	45	Main Channel n	0.030

Inlets

10	5

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	0.0	0.0	0.050	25.0	0.0	1.200	50.0	0.0	1.500	85.0	0.0

Other (defaults)

Entry Loss (manhole)	0.250	Entry Loss (junction)	0.000	Apply Recommended Losses	x
Exit Loss (manhole)	0.250	Exit Loss (junction)	0.000	Flood Risk (m)	0.300

Approval Settings

Node Size	✓	Minimum Full Bore Velocity (m/s)	
Node Losses	✓	Maximum Full Bore Velocity (m/s)	3.000
Link Size	✓	Proportional Velocity	✓
Minimum Diameter (mm)	150	Return Period (years)	
Link Length	✓	Minimum Proportional Velocity (m/s)	0.750
Maximum Length (m)	100.000	Maximum Proportional Velocity (m/s)	3.000
Coordinates	✓	Surcharged Depth	✓
Accuracy (m)	1.000	Return Period (years)	
Crossings	✓	Maximum Surcharged Depth (m)	0.100
Cover Depth	✓	Flooding	✓
Minimum Cover Depth (m)		Return Period (years)	30
Maximum Cover Depth (m)	3.000	Time to Half Empty	x
Backdrops	✓	Discharge Rates	✓
Minimum Backdrop Height (m)		Discharge Volume	✓
Maximum Backdrop Height (m)	1.500	100 year 360 minute (m³)	
Full Bore Velocity	✓		

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
10 year 15 minute summer	192.806	54.557	10 year 180 minute winter	29.245	11.577
10 year 15 minute winter	135.303	54.557	10 year 240 minute summer	35.975	9.507
10 year 30 minute summer	130.321	36.876	10 year 240 minute winter	23.901	9.507
10 year 30 minute winter	91.453	36.876	10 year 360 minute summer	27.947	7.192
10 year 60 minute summer	90.826	24.003	10 year 360 minute winter	18.166	7.192
10 year 60 minute winter	60.342	24.003	10 year 480 minute summer	22.300	5.893
10 year 120 minute summer	57.664	15.239	10 year 480 minute winter	14.816	5.893
10 year 120 minute winter	38.311	15.239	10 year 600 minute summer	18.452	5.047
10 year 180 minute summer	44.990	11.577	10 year 600 minute winter	12.608	5.047

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
10 year 720 minute summer	16.587	4.446
10 year 720 minute winter	11.148	4.446
10 year 960 minute summer	13.811	3.637
10 year 960 minute winter	9.149	3.637
10 year 1440 minute summer	10.216	2.738
10 year 1440 minute winter	6.866	2.738
30 year 15 minute summer	243.818	68.992
30 year 15 minute winter	171.101	68.992
30 year 30 minute summer	166.387	47.082
30 year 30 minute winter	116.763	47.082
30 year 60 minute summer	116.589	30.811
30 year 60 minute winter	77.459	30.811
30 year 120 minute summer	73.902	19.530
30 year 120 minute winter	49.099	19.530
30 year 180 minute summer	57.313	14.749
30 year 180 minute winter	37.255	14.749
30 year 240 minute summer	45.598	12.050
30 year 240 minute winter	30.295	12.050
30 year 360 minute summer	35.178	9.053
30 year 360 minute winter	22.867	9.053
30 year 480 minute summer	27.920	7.379
30 year 480 minute winter	18.550	7.379
30 year 600 minute summer	23.001	6.291
30 year 600 minute winter	15.716	6.291
30 year 720 minute summer	20.598	5.520
30 year 720 minute winter	13.843	5.520
30 year 960 minute summer	17.043	4.488
30 year 960 minute winter	11.289	4.488
30 year 1440 minute summer	12.485	3.346
30 year 1440 minute winter	8.390	3.346
100 year +40% CC 15 minute summer	441.486	124.925
100 year +40% CC 15 minute winter	309.815	124.925
100 year +40% CC 30 minute summer	304.460	86.152
100 year +40% CC 30 minute winter	213.656	86.152
100 year +40% CC 60 minute summer	214.603	56.713
100 year +40% CC 60 minute winter	142.577	56.713
100 year +40% CC 120 minute summer	135.791	35.885
100 year +40% CC 120 minute winter	90.216	35.885
100 year +40% CC 180 minute summer	104.615	26.921
100 year +40% CC 180 minute winter	68.003	26.921
100 year +40% CC 240 minute summer	82.776	21.875
100 year +40% CC 240 minute winter	54.994	21.875
100 year +40% CC 360 minute summer	63.377	16.309
100 year +40% CC 360 minute winter	41.197	16.309
100 year +40% CC 480 minute summer	50.006	13.215
100 year +40% CC 480 minute winter	33.223	13.215
100 year +40% CC 600 minute summer	40.997	11.214
100 year +40% CC 600 minute winter	28.011	11.214
100 year +40% CC 720 minute summer	36.560	9.799
100 year +40% CC 720 minute winter	24.571	9.799
100 year +40% CC 960 minute summer	30.041	7.911
100 year +40% CC 960 minute winter	19.900	7.911
100 year +40% CC 1440 minute summer	21.775	5.836
100 year +40% CC 1440 minute winter	14.634	5.836

Results for 10 year Critical Storm Duration. Lowest mass balance: 99.06%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	6	10	126.441	0.091	5.3	0.0730	0.0000	OK
15 minute winter	7	10	126.228	0.095	10.3	0.0760	0.0000	OK
15 minute winter	8	10	125.892	0.114	20.6	0.0913	0.0000	OK
15 minute winter	9	11	125.538	0.098	20.3	0.0786	0.0000	OK
30 minute winter	10	26	125.101	0.321	15.9	0.0000	0.0000	OK
15 minute winter	1	10	126.443	0.093	5.3	0.0745	0.0000	OK
15 minute winter	2	10	126.260	0.095	10.4	0.0764	0.0000	OK
15 minute winter	3	10	125.993	0.114	20.7	0.0916	0.0000	OK
15 minute winter	4	11	125.669	0.099	20.5	0.0797	0.0000	OK
30 minute winter	5	24	125.091	0.311	16.7	0.0000	0.0000	OK
30 minute winter	12	25	125.091	0.341	24.5	0.0000	0.0000	SURCHARGED
30 minute winter	13	25	125.077	0.463	14.6	0.5238	0.0000	SURCHARGED
15 minute summer	99	1	124.556	0.000	13.0	0.0000	0.0000	OK
15 minute winter	11	10	126.412	0.062	5.3	0.0696	0.0000	OK
15 minute winter	14	10	126.411	0.061	5.3	0.0686	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	6	1.000	7	5.0	0.735	1.021	0.1700	
15 minute winter	7	1.001	8	10.0	0.876	0.693	0.3631	
15 minute winter	8	1.002	9	20.3	1.130	0.479	0.9153	
15 minute winter	9	1.003	10	20.1	1.226	0.388	0.5875	
30 minute winter	10	Flow through pond	12	24.5	0.266	0.008	8.3442	
15 minute winter	1	3.000_1	2	5.1	0.735	1.032	0.1389	
15 minute winter	2	3.001	3	10.1	0.877	0.698	0.3648	
15 minute winter	3	3.002	4	20.5	1.117	0.483	0.8503	
15 minute winter	4	3.003	5	20.4	1.225	0.393	0.3989	
30 minute winter	5	Flow through pond	12	24.5	0.266	0.008	8.3442	
30 minute winter	12	3.000	13	14.6	0.950	0.345	0.8112	
30 minute winter	13	ACO Q-Brake	99	13.0				24.8
15 minute winter	11	2.000	8	5.3	1.060	0.670	0.1320	
15 minute winter	14	4.000	3	5.3	1.087	0.648	0.0927	

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.06%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	6	11	126.506	0.156	6.6	0.1247	0.0000	SURCHARGED
15 minute winter	7	10	126.242	0.109	12.4	0.0874	0.0000	OK
15 minute winter	8	10	125.907	0.129	25.2	0.1033	0.0000	OK
15 minute winter	9	11	125.551	0.111	24.9	0.0887	0.0000	OK
30 minute winter	10	26	125.226	0.446	20.2	0.0000	0.0000	OK
15 minute winter	1	11	126.503	0.153	6.6	0.1225	0.0000	SURCHARGED
15 minute winter	2	10	126.275	0.110	12.6	0.0882	0.0000	OK
15 minute winter	3	10	126.009	0.129	25.4	0.1037	0.0000	OK
15 minute winter	4	11	125.682	0.112	25.1	0.0899	0.0000	OK
30 minute winter	5	26	125.226	0.446	20.3	0.0000	0.0000	OK
30 minute winter	12	26	125.224	0.474	27.0	0.0000	0.0000	SURCHARGED
30 minute winter	13	26	125.211	0.597	15.1	0.6756	0.0000	SURCHARGED
15 minute summer	99	1	124.556	0.000	13.0	0.0000	0.0000	OK
15 minute winter	11	10	126.422	0.072	6.6	0.0816	0.0000	OK
15 minute winter	14	10	126.421	0.071	6.6	0.0803	0.0000	OK

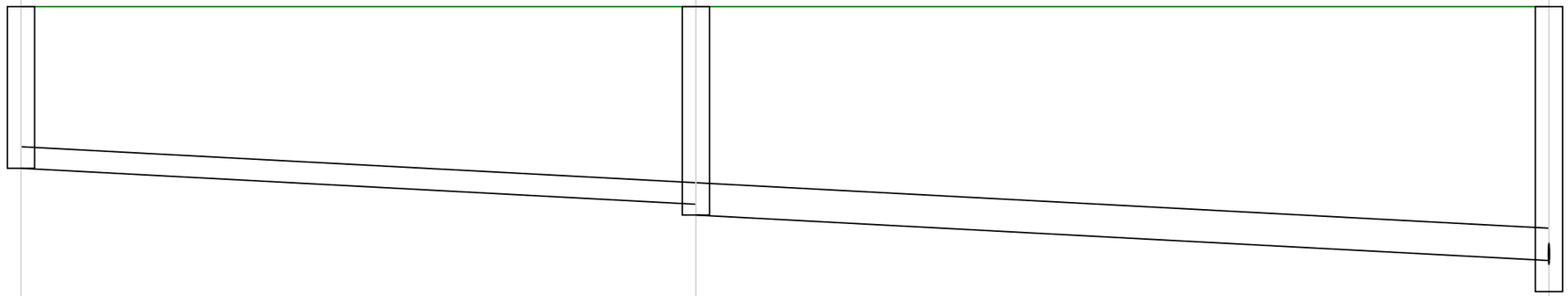
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	6	1.000	7	6.0	0.779	1.215	0.1810	
15 minute winter	7	1.001	8	12.1	0.916	0.836	0.4183	
15 minute winter	8	1.002	9	24.9	1.182	0.589	1.0712	
15 minute winter	9	1.003	10	24.8	1.293	0.477	0.6860	
30 minute winter	10	Flow through pond	12	27.0	0.266	0.009	12.6613	
15 minute winter	1	3.000_1	2	6.1	0.791	1.236	0.1470	
15 minute winter	2	3.001	3	12.2	0.919	0.845	0.4215	
15 minute winter	3	3.002	4	25.1	1.169	0.593	0.9966	
15 minute winter	4	3.003	5	25.1	1.290	0.483	0.4660	
30 minute winter	5	Flow through pond	12	27.0	0.266	0.009	12.6613	
30 minute winter	12	3.000	13	15.1	0.957	0.357	0.8112	
30 minute winter	13	ACO Q-Brake	99	13.0				31.5
15 minute winter	11	2.000	8	6.6	1.104	0.834	0.1577	
15 minute winter	14	4.000	3	6.6	1.133	0.806	0.1107	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.06%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	6	11	127.100	0.750	12.0	0.6008	0.0652	FLOOD
15 minute winter	7	11	126.443	0.310	20.8	0.2484	0.0000	SURCHARGED
15 minute winter	8	11	125.960	0.182	40.4	0.1460	0.0000	OK
60 minute winter	9	49	125.740	0.300	25.8	0.2400	0.0000	SURCHARGED
60 minute winter	10	54	125.730	0.950	25.7	0.0000	0.0000	OK
15 minute winter	1	11	127.098	0.748	12.0	0.5993	0.0000	FLOOD RISK
15 minute winter	2	11	126.491	0.326	21.1	0.2610	0.0000	SURCHARGED
15 minute winter	3	11	126.065	0.186	41.2	0.1492	0.0000	OK
60 minute winter	4	50	125.732	0.162	25.9	0.1298	0.0000	OK
60 minute winter	5	50	125.732	0.952	25.8	0.0000	0.0000	OK
60 minute winter	12	51	125.729	0.979	30.5	0.0000	0.0000	SURCHARGED
60 minute winter	13	50	125.718	1.104	13.9	1.2488	0.0000	SURCHARGED
15 minute summer	99	1	124.556	0.000	13.0	0.0000	0.0000	OK
15 minute winter	11	11	126.800	0.450	12.0	0.5087	0.0000	SURCHARGED
15 minute winter	14	11	126.741	0.391	12.0	0.4424	0.0000	SURCHARGED

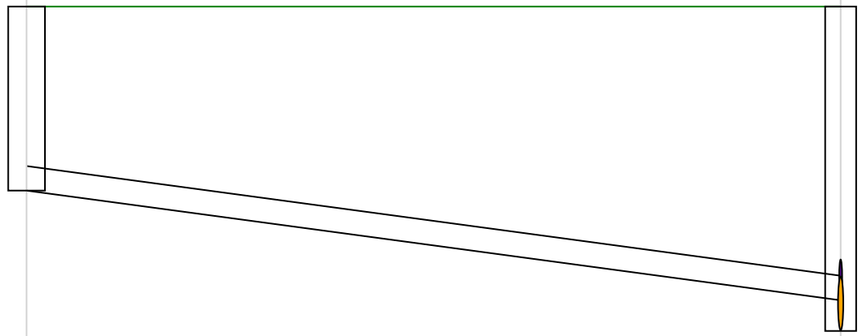
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	6	1.000	7	9.2	1.180	1.879	0.1958	
15 minute winter	7	1.001	8	19.6	1.121	1.357	0.5318	
15 minute winter	8	1.002	9	40.5	1.285	0.955	1.5867	
60 minute winter	9	1.003	10	25.7	1.264	0.495	1.4219	
60 minute winter	10	Flow through pond	12	30.5	0.231	0.010	32.5318	
15 minute winter	1	3.000_1	2	9.7	1.242	1.978	0.1584	
15 minute winter	2	3.001	3	20.0	1.140	1.382	0.5330	
15 minute winter	3	3.002	4	41.3	1.276	0.974	1.4933	
60 minute winter	4	3.003	5	25.8	1.299	0.497	0.8426	
60 minute winter	5	Flow through pond	12	30.5	0.231	0.010	32.5318	
60 minute winter	12	3.000	13	13.9	0.973	0.327	0.8112	
60 minute winter	13	ACO Q-Brake	99	13.0				76.8
15 minute winter	11	2.000	8	10.1	1.293	1.286	0.2055	
15 minute winter	14	4.000	3	10.6	1.351	1.294	0.1476	

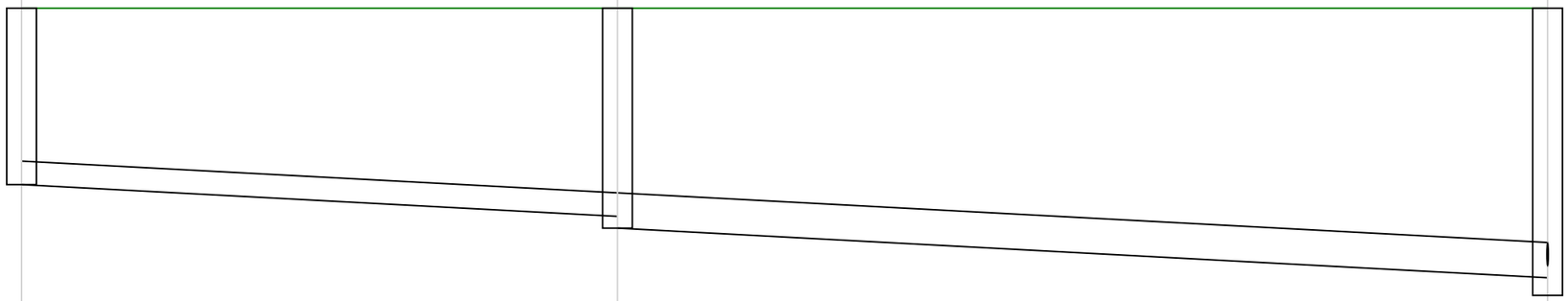
KINGMOOR CONSULTING	Kingmoor Consulting Ltd 6B Clifford Court Parkhouse Carlisle, CA3 0JG	File: COMBINED.pfd Network: Storm Network Colin Aimers 21/12/2022

Node Name		6	7	8
A3 drawing Hor Scale 200 Ver Scale 25 Datum (m) 124.000				
Link Name		1.000	1.001	
Section Type		100mm	150mm	
Slope (1:X)		150.0	150.0	
Cover Level (m)		127.100	127.100	127.100
Invert Level (m)		126.350	126.183 126.133	125.922
Length (m)		25.025	31.630	

Node Name	8	9
A3 drawing Hor Scale 200 Ver Scale 25 Datum (m) 124.000		
Link Name	1.002	
Section Type	225mm	
Slope (1:X)	150.0	
Cover Level (m)	127.100	127.100
Invert Level (m)	125.778	125.440
Length (m)	50.631	

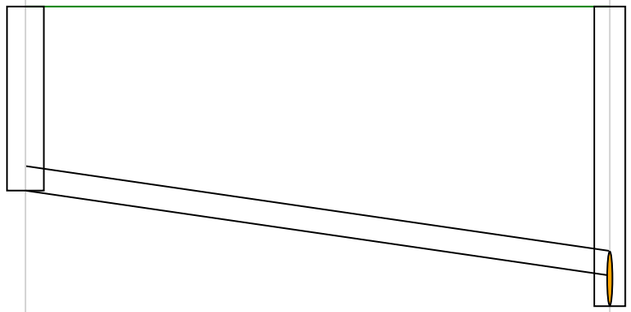
Node Name		9	10
A3 drawing Hor Scale 200 Ver Scale 25 Datum (m) 123.000			
Link Name		1.003	
Section Type		225mm	
Slope (1:X)		100.0	
Cover Level (m)		127.100	127.100
Invert Level (m)		125.440	125.082
Length (m)		35.751	

Node Name		11	8
A3 drawing Hor Scale 200 Ver Scale 25 Datum (m) 124.000			
Link Name		2.000	
Section Type		100mm	
Slope (1:X)		59.4	
Cover Level (m)		127.100	127.100
Invert Level (m)		126.350	125.903
Length (m)		26.547	

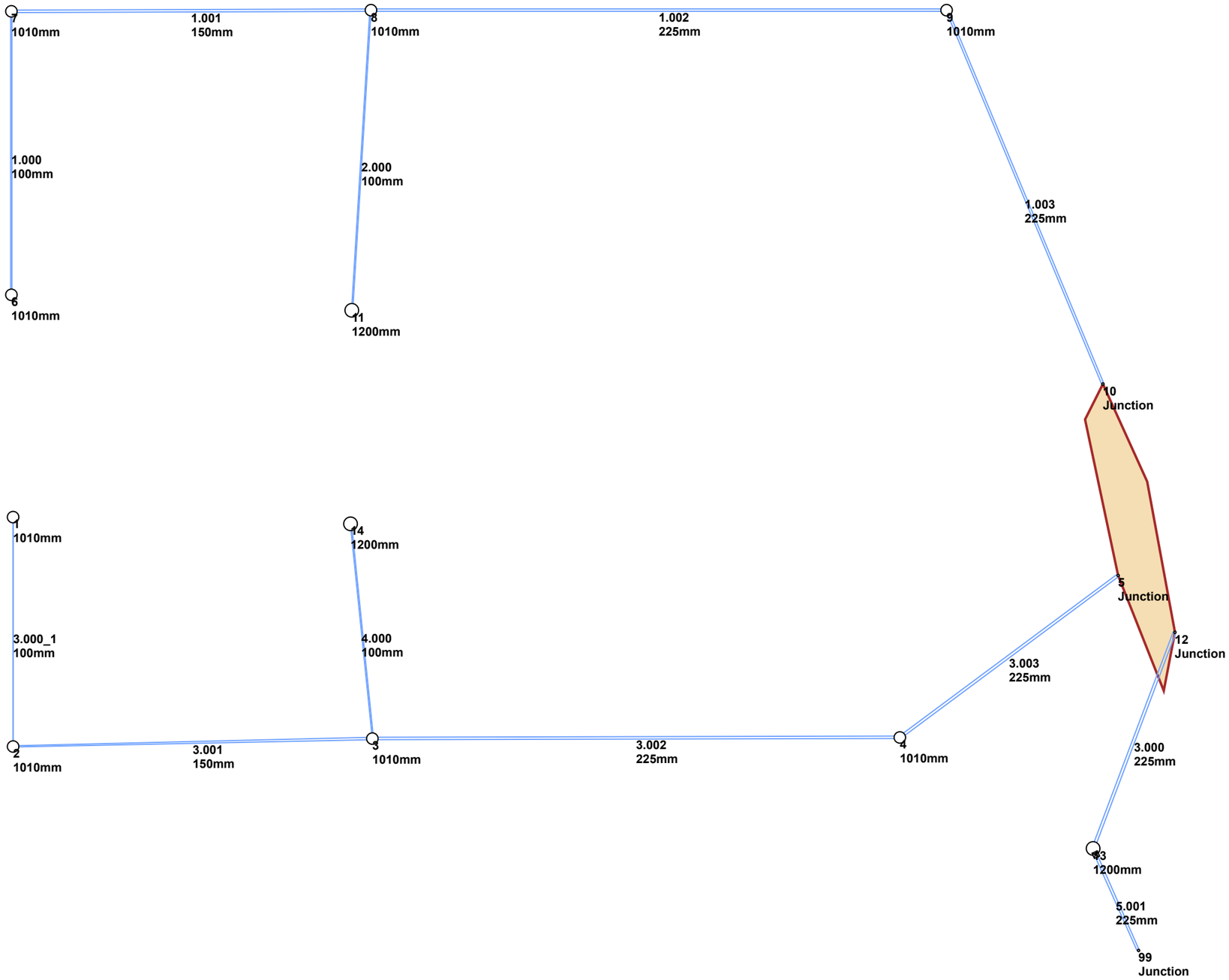
Node Name	1	2	3
A3 drawing Hor Scale 200 Ver Scale 25 Datum (m) 124.000			
Link Name	3.000_1	3.001	
Section Type	100mm	150mm	
Slope (1:X)	150.0	150.0	
Cover Level (m)	127.100	127.100	127.100
Invert Level (m)	126.350	126.215 126.165	125.954
Length (m)	20.250	31.608	

Node Name	3	4
A3 drawing Hor Scale 200 Ver Scale 25 Datum (m) 124.000		
Link Name	3.002	
Section Type	225mm	
Slope (1:X)	150.0	
Cover Level (m)	127.100	127.100
Invert Level (m)	125.879	125.570
Length (m)	46.400	

Node Name		4	5
A3 drawing Hor Scale 200 Ver Scale 25 Datum (m) 123.000			
Link Name		3.003	
Section Type		225mm	
Slope (1:X)		100.0	
Cover Level (m)		127.100	127.100
Invert Level (m)		125.570	125.331
Length (m)		23.940	

Node Name		14	3
A3 drawing Hor Scale 200 Ver Scale 25 Datum (m) 124.000			
Link Name		4.000	
Section Type		100mm	
Slope (1:X)		55.1	
Cover Level (m)		127.100	127.100
Invert Level (m)		126.350	126.004
Length (m)		19.055	

Node Name		12	13	99
A3 drawing Hor Scale 200 Ver Scale 25 Datum (m) 123.000				
Link Name		3.000	5.001	
Section Type		225mm	225mm	
Slope (1:X)		150.0	169.8	
Cover Level (m)		127.100	126.750	125.800
Invert Level (m)		124.750	124.614 124.614	124.556
Length (m)		20.397	9.849	



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