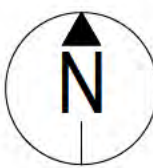




rev	details	by	date
00	FIRST ISSUE - STAGE 02 MASTERPLAN	JM	21.11.2022
01	REVISED ISSUE - FOLLOWING STAGE 02 DTM (24.11.22)	JM	25.11.2022
02	REVISED ISSUE - FOR STAGE 02	JM	06.12.2022
03	REVISED FOLLOWING CLIENT REVIEW - FOR STAGE 02	JM	08.12.2022
04	STAGE 03 - REVISED LAYOUT - FOR COMMENT	JM	18.01.2023
05	STAGE 03 - REVISED LAYOUT - ADDITIONAL SPECIES ADDED	JM	30.08.2023
06	STAGE 03 - REVISED LAYOUT FOR PLANNING	JM	07.09.2023
07	STAGE 03 - ISSUE FOR CONSULTANT REVIEW AND COORDINATION	JM	15.09.2023

rev	details	by	date

- Notes
1. Do not scale from drawing, use figured dimensions only.
 2. All dimensions to be checked onsite.
 3. This drawing to be read in conjunction with all other drawings and specifications.



Project title
NSCC ORANGUTAN FACILITY

Drawing title
**LANDSCAPE MASTERPLAN
GROUND LEVEL**

Drawing number
P22009-00-001-DZ-0100-05

Revision
STAGE 03

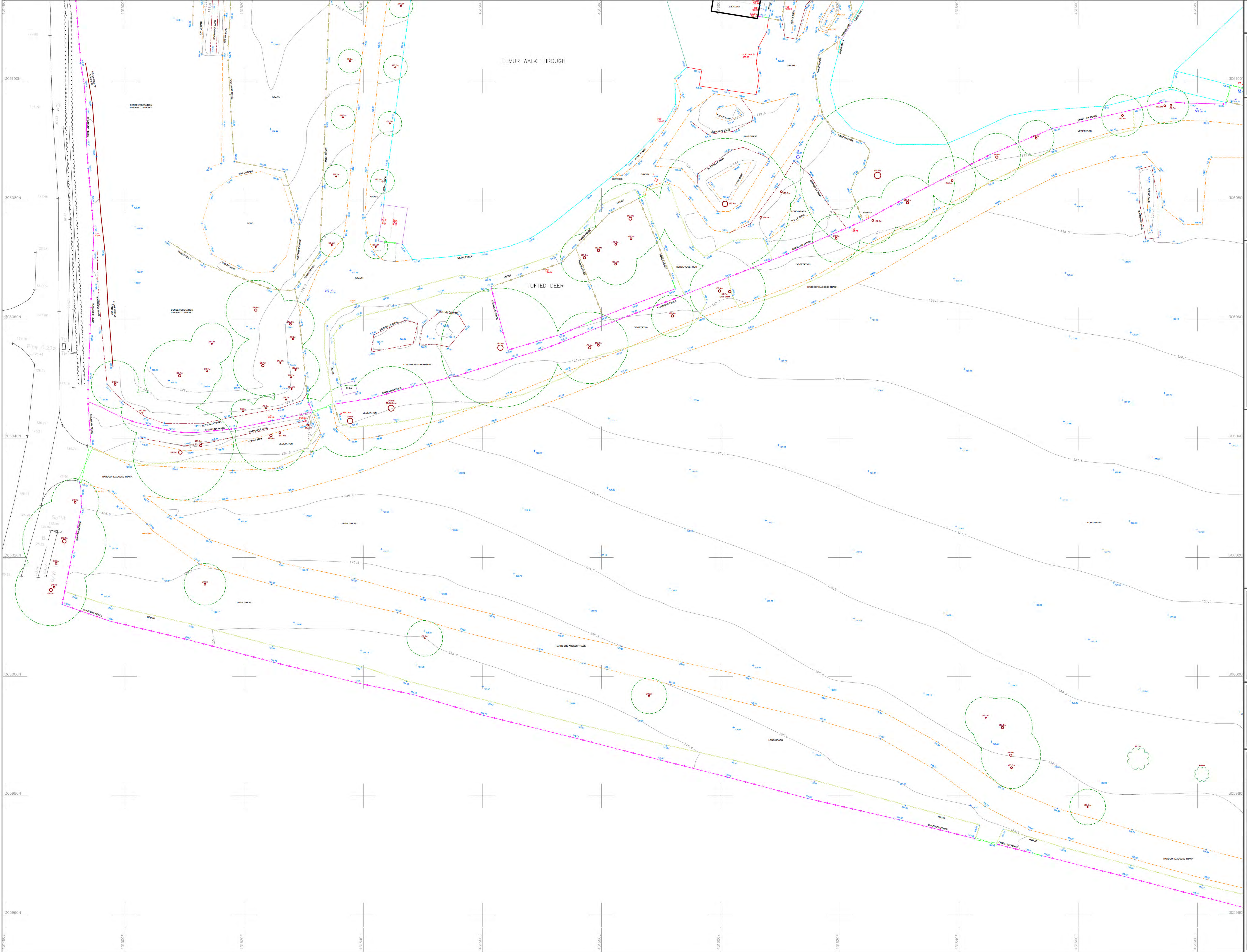
Drawing Status

Date	Scale	Drawn	Checked
21.11.2022	1:250 @ A1	TL	JM

tz Twycross Zoo
IN THE HEART OF CONSERVATION



Appendix B – Topographical Survey.



Notes
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GRID
OS NATIONAL GRID.
Using the OS CPN Network and applying
OSM15 transformation and then removing the
scale factor for true distances.

DATUM
OS LEVEL DATUM
Using the OS CPN Network and applying
OSM15 National Geoid Model to obtain local
area corrections.

Direction of North
NORTH

STATION LISTING

Station	Eastings	Northing	Level
A1	431701.524	306435.444	129.333
A2	431664.498	306442.891	128.308
A3	431614.454	306407.332	128.852
C1	431679.463	306292.843	129.827
C2	431702.447	306262.456	129.627
C3	431817.741	306325.024	128.077
C4	431761.166	306317.812	129.782
C5	431698.570	306382.298	129.184
C6	431704.525	306388.116	128.405
G2	432001.223	306122.337	127.433
G3	432369.477	306300.530	122.034
S2	431764.597	306414.894	129.671
S3	431625.514	306285.589	127.507
S201	431798.939	306208.529	126.182
S2	431696.667	306233.036	130.428
S4	431602.825	306173.930	130.812
S5	431544.269	306177.465	130.268
S6	431532.205	306050.165	127.424
S7	431609.073	306094.266	129.177
S8	431668.928	306160.951	130.359
S9	431737.009	306166.774	129.535
S10	431730.782	306114.519	126.194
S11	431854.330	306117.075	125.741
S12	431904.446	306126.418	126.589
S13	431871.480	306089.120	127.716
U2	431908.852	306283.714	127.575
U3	432016.302	306216.874	127.896
U4	431821.718	306227.802	130.173
U5	432051.851	306157.517	127.319

TOPOGRAPHICAL SURVEY KEY

DRAINAGE & WATER SERVICES

- 100 Drain/Gully
- 101 Kerb Outlet
- 102 Circular Manhole
- 103 Square Manhole
- 104 Triangular Manhole
- 105 Roadside Eye
- 106 Fire Hydrant
- 107 Stop Tap
- 108 Stop Valve
- 109 Tap
- 110 Wash Out
- 111 Water Meter
- 112 Water Valve
- 113 Air Valve

STREET FURNITURE & GEOTEC

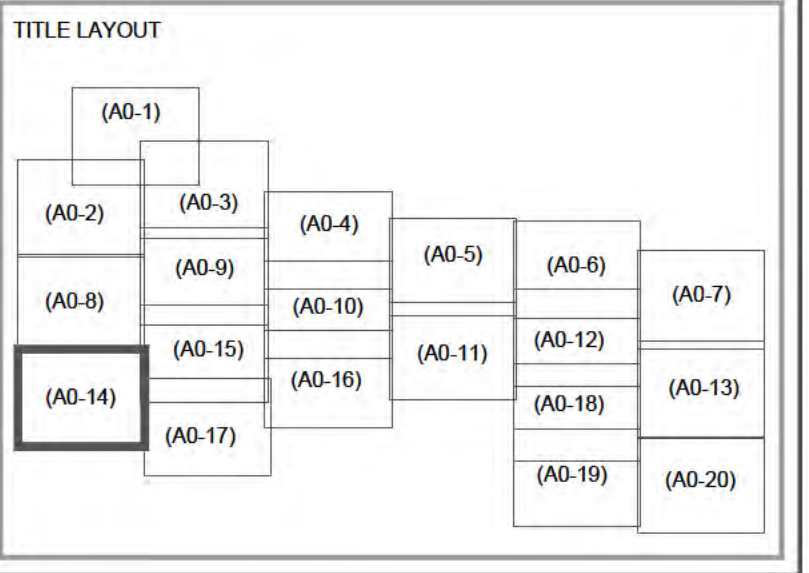
- 114 Ped Box
- 115 Bus Stop
- 116 Bollard
- 117 Sign
- 118 Traffic Light
- 119 Camera
- 120 Lamp Post
- 121 Light
- 122 Column
- 123 Vest
- 124 Bench Mark
- 125 Marker Post
- 126 Tied Pit
- 127 Bollards

SERVICES

- 128 Gas Valve
- 129 Inspection Cover
- 130 Cable TV Cover
- 131 Cable TV Supply
- 132 Electric Cover
- 133 Electricity Pole
- 134 Earth Rod
- 135 Telecoms Cover
- 136 Telegraph Pole
- 137 Gas Riser Pipe
- 138 Rainwater Pipe
- 139 Soil Vent Pipe

ABBREVIATIONS

- 140 Combined Sewer Manhole
- 141 Foot Water Manhole
- 142 Surface Water Manhole
- 143 Cover Level
- 144 Invert Level
- 145 Threshold Level
- 146 Top Of Fence
- 147 Top Of Hedge
- 148 Top Of Wall
- 149 Underside
- 150 Unable To Raise



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MT Surveys Ltd
Unit 8
Parkview Court
Shipley
BD18 3DZ

CLIENT
Baker Mallett LLP / Twycross Zoo

SITE
Twycross Zoo

DRAWING TITLE
2D Topographical Survey

DRAWING REF (LAYOUT TAB)
1301-108_2D (A0-14)

SCALE
1/200

PROJECT REF
1301-108

SURVEYED
CC, AT, HR

DRAWN
CC, AT

CHECKED
MT

DATE
11 / 12 / 2020

REV
DATE DRAWN DESCRIPTION CHECKED



Notes

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Direction of North

GRID

OS NATIONAL GRID

Using the OS CPN Network and applying OSN15 transformation and then removing the scale factor for true distances.

DATUM

OS LEVEL DATUM

Using the OS CPN Network and applying OSN15 National Geoid Model to obtain local area corrections.

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G6	431544.269	306177.465	130.269
G7	431532.205	306050.165	127.424
G8	431605.073	306094.266	129.177
G9	431668.928	306160.951	130.359
G10	431730.762	306114.519	129.194
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G13	431871.480	306209.120	127.875
G14	431908.822	306289.714	127.575
G15	432016.902	306216.874	127.896
G16	431821.708	306277.802	130.173
G17	432051.851	306157.517	127.319

TOPOGRAPHICAL SURVEY KEY

DRAINAGE & WATER SERVICES

- Drain/Gully
- Kerb Outlet
- Circular Manhole
- Square Manhole
- Triangular Manhole
- Rodding Eye
- Fire Hydrant
- Stop Tap
- Stop Valve
- Wash Out
- Water Meter
- Water Valve
- Air Valve

STREET FURNITURE & GEOTECH

- Pole Box
- Bus Stop
- Bollard
- Sign
- Traffic Light
- Camera
- Lamp Post
- Column
- Post
- Marker Post
- Boundary

SERVICES

- Gas Valve
- Inspection Cover
- Cable TV Supply
- Electric Cover
- Electric Pole
- Earth Rod
- Telecoms Cover
- Telegraph Pole
- Gas Rise Pipe
- Rainwater Pipe
- Soil Vent Pipes

ABBREVIATIONS

- COMI Combined Sewer Manhole
- FWMH Foot Water Manhole
- SWMH Surface Water Manhole
| CL | Cover Level |
| IL | Invert Level |
| THL | Threshold Level |
| TOP | Top Of Fence |
| TOH | Top Of Hedge |
| TOH | Top Of Wall |
| US | Underside |
| UTR | Unable To Raise |

TITLE LAYOUT

(A0-1)	(A0-2)	(A0-3)	(A0-4)	(A0-5)	(A0-6)	(A0-7)
(A0-8)	(A0-9)	(A0-10)	(A0-11)	(A0-12)	(A0-13)	(A0-14)
(A0-15)	(A0-16)	(A0-17)	(A0-18)	(A0-19)	(A0-20)	(A0-21)

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Shipley
BD18 3DZ

CLIENT

Baker Mallett LLP / Twycross Zoo

SITE

Twycross Zoo

DRAWING TITLE

2D Topographical Survey

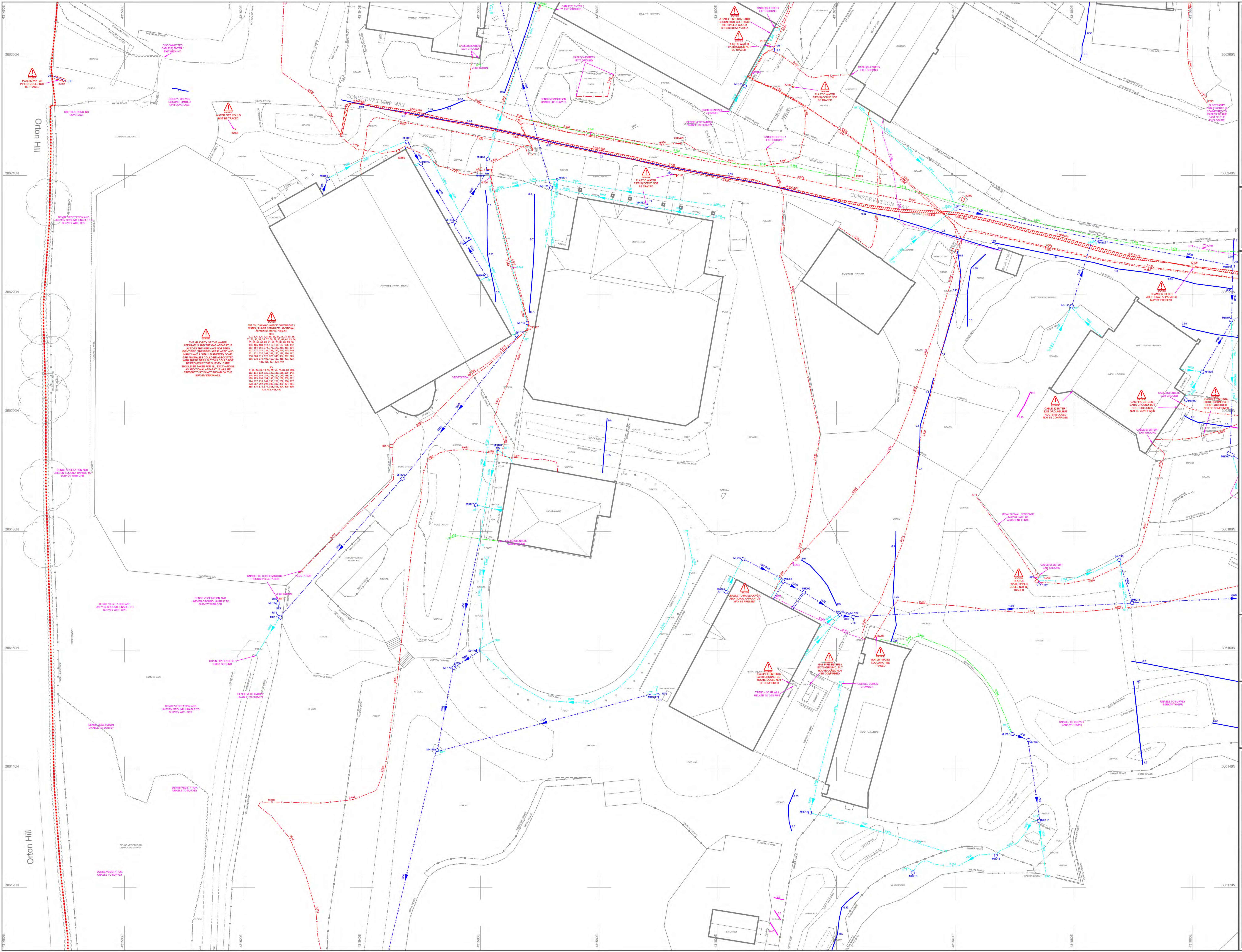
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1301-108_2D (A0-8)	1/200

PROJECT REF	REV
1301-108	0

SURVEYED	CC, AT, HR	DRAWN	CC, AT
CHECKED	MT	DATE	11 / 12 / 2020

REV	DATE	DRAWN	DESCRIPTION	CHECKED

Appendix C – Drainage Records.



NOTES

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- THE RESULTS OF ANY NON INTRUSIVE SURVEY ARE NOT INFALLIBLE. EVERY REASONABLE EFFORT HAS BEEN MADE TO IDENTIFY ALL TYPES OF APPARATUS BUT THE SITE SPECIFIC CONDITIONS, TYPE AND MATERIAL OF THE APPARATUS MAY MEAN THAT IT IS NOT POSSIBLE TO LOCATE ALL SUB-SURFACE UTILITIES AND FEATURES THAT ARE PRESENT ON SITE.
- THIS DRAWING IS BASED UPON DRAWING 1308-108_20.dwg. ALL COVER LEVELS AND INVERT LEVELS ARE IN METRES AND RELATIVE TO THE LEVELS SHOWN IN DRAWING 1308-108_20.dwg.
- THE SURVEY WAS TIED IN USING A GNSS (WITH THE UKOSM15 PROJECTION). IT HAS BEEN OVERLAIN ONTO THE BASE DRAWING USING ORDNANCE SURVEY NATIONAL GRID CO-ORDINATES.
- THE ACCURACY OF TRACED FEATURES IS RELATIVE TO THE DEPTH OF THE FEATURE. IN GOOD CONDITIONS THE ACCURACIES ARE 10% IN PLAN AND 10% IN DEPTH. ALL DEPTHS AND POSITIONS SHOULD BE CONSIDERED AS APPROXIMATE AND SHOULD BE VERIFIED WHERE POSSIBLE BY EXCAVATION.
- DEPTHS ARE GIVEN IN METRES BELOW GROUND LEVEL AND WERE MEASURED AT THE POINT WHERE THE DEPTH IS SHOWN.
- DEPTHS OF PIPES AND CABLES TRACED BY RFL ARE USUALLY TO THE CENTRE OF A FEATURE. DEPTHS OF DRAINS THAT HAVE BEEN SONDED ARE THE DEPTH IN METRES BELOW GROUND LEVEL TO THE SONDE AND ARE NOT NECESSARILY THE DEPTH TO THE BOTTOM OF THE PIPE. DEPTHS OF GPS ANIMALES ARE EITHER TO THE TOP OF A FEATURE OR THE FEATURE LIES WITHIN THE RANGE OF DEPTHS GIVEN.
- MT SURVEYS LTD CANNOT ACCEPT RESPONSIBILITY FOR THE RELIABILITY OR ACCURACY OF ANY INFORMATION PROVIDED BY A THIRD PARTY.

ALWAYS EXERCISE CAUTION WHEN EXCAVATING

Direction of North

GRID
OS NATIONAL GRID.
Using the OS GPS Network and applying OSTED15 transformation and then removing the scale factor for true distances.

DATUM
OS LEVEL DATUM
Using the OS GPS Network and applying OSTED15 National Grid Model to obtain local area corrections.

KEY

RADIO FREQUENCY LOCATOR (RFL)

- CABLES ROUTE MAY BE FORMULATED BY CABLES (DUCTS)
- EXTENT OF RESPONSES FROM MULTIPLE CABLES
- CABLE DUCT TRACED USING FLEX TRACE
- PROBABLE ELECTRICITY CABLES ROUTE MAY BE FOR MULTIPLE CABLES (DUCTS)
- EXTENT OF BRIDGES ON MULTIPLE POWER RESPONSES ONE CHAMBER CAN BE PRESENT IN THIS AREA
- ROUTE CONTAINS ELECTRICITY CABLES BUT COULD ALSO CONTAIN DATA TELECOMMUNICATIONS CABLES
- STREET / FLOOD LIGHT (ELECTRICITY) CABLES
- PROJECTED DRAINAGE ROUTE
- DRAINAGE ROUTE (BY SONDE)
- WATER
- DUCT TRACED BY FLEX TRACE, CONTAINS SUSPECTED WATER PIPE AND CABLE
- UNIDENTIFIED METALLIC APPARATUS
- METAL PIPE OR METAL DUCT
- PROBABLE ELECTRICITY CABLE BUT DID NOT PRODUCE POWER RESPONSE, COULD BE OTHER TYPE OF APPARATUS
- PROJECTED / INFERRED ROUTE OF APPARATUS BUT THIS COULD NOT BE CONFIRMED ON SITE
- APPROXIMATE DEPTH OF APPARATUS IN METRES BELOW GROUND LEVEL
- DIRECTION OF DRAINAGE FLOW AND PIPE DIAMETER
- APPROXIMATE ROUTE OF APPARATUS TAKEN FROM RECORD (RFL PLANS)
- UNABLE TO TRACE UTILITY SIGNAL LOST, FEATURE MAY CONTINUE IN ANY DIRECTION FROM LAST RECORDED POINT
- UNABLE TO TRACE UTILITY ENTRY TO THE ENCLOSURE, FEATURE MAY CONTINUE IN ANY DIRECTION FROM LAST RECORDED POINT
- UNABLE TO SONDE COVER, APPARATUS MAY BE LOCATED IN CHAMBER WHICH HAS NOT BEEN TRACED
- UNABLE TO SONDE, ROUTE OF DRAIN COULD NOT BE CONFIRMED
- UTILITY CONTINUES OFF SITE
- 7 DENOTES UNCERTAINTY IN POSITION OR DEPTH
- AREA OF POSSIBLE CONCERN RELATING TO APPARATUS THAT MAY NOT HAVE BEEN LOCATED

GROUND PENETRATING RADAR (GPR)

- PROJECTED LINE OF PROBABLE LINEAR FEATURE DERIVED FROM HYPERBOLIC RESPONSES, APPROXIMATE DEPTH BELOW GROUND LEVEL IS GIVEN IN METRES
- PROJECTED LINE OF POSSIBLE LINEAR FEATURE DERIVED FROM HYPERBOLIC RESPONSES, APPROXIMATE DEPTH BELOW GROUND LEVEL IS GIVEN IN METRES
- APPROXIMATE DEPTH OF RFL FEATURE MEASURED ON SITE USING GPR
- WHERE A DEPTH RANGE IS GIVEN THE DEPTHS INDICATED ARE MINIMUM AND MAXIMUM EXTENT OF DEPTH RANGE OF THE SURVEY. THE DEPTHS ARE ESTIMATED BASED ON ASSUMPTIONS OF THE SUB-SURFACE CONDITIONS AND MAY NOT BE ACCURATE.

GENERAL

- APPROXIMATE EXTENT OF SURVEY AREA
- APPROXIMATE POSITION OF POSSIBLE TRENCH SCAR
- INSPECTION CHAMBER (NON-DRAINAGE)
- MANHOLE DRAINAGE CHAMBER

TITLE LAYOUT

(w)	(w)	(w)	(w)	(w)	(w)
(w)	(w)	(w)	(w)	(w)	(w)
(w)	(w)	(w)	(w)	(w)	(w)
(w)	(w)	(w)	(w)	(w)	(w)
(w)	(w)	(w)	(w)	(w)	(w)
(w)	(w)	(w)	(w)	(w)	(w)

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(e) admin@mts-surveys.com
(t) 01274 408352

MT Surveys Ltd
Unit 8
Parkview Court
Shipley
BD18 3DZ

CLIENT
Baker Mallett LLP / Twycross Zoo

SITE
Twycross Zoo

DRAWING TITLE
Utility tracing survey
RFL and GPR scanning results

DRAWINGS REF-LAYOUT TAB	SCALE: 1:200
1301-108_U (A0-8)	1/200
PROJECT REF	REV
1301-108	0
SURVEYED SBC, PH, MW	DRAWN CW, SBC, MW
CHECKED NF	DATE 11 / 12 / 2020

REV	DATE	DRAWN	DESCRIPTION	CHECKED

Appendix D – Infiltration Testing.



Rev	Date	Description	By	Check	App.
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ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
DO NOT TURN ON LAYERS THAT HAVE BEEN TURNED OFF.
DO NOT TURN LAYERS THAT HAVE BEEN FROZEN.

Client	Twycross Zoo
Project	Twycross Zoo
Office	Birmingham
Discipline	Geo-Environmental
Title	Exploratory Hole Location Plan

Scale @ A3	NTS	Status	Draft
------------	-----	--------	-------

Originator	Job Number	Discipline	Building/Zone
SRP	10/2197	Geo	-
Type	Level	Drawing No.	Revision
-	-	002	-



STRUCTURAL SOILS LTD
INSITU TESTING REPORT



1774

Report No. 785456R.01(00)

Date 13-September-2023 Contract Twycross Zoo

Client Clancy Consulting Ltd
Address Dunham Court
2 Dunham Road
Altrincham
Cheshire
WA14 4NX

For the Attention of Robert Phillip

Order received 04-August-2023
Testing Started 11-September-2023
Testing Completed 12-September-2023

Client Reference CCL: 10-2197
Client Order No. 32819
Instruction Type Written

Tests marked 'Not UKAS Accredited' in this report are not included in the UKAS Accreditation Schedule for our Laboratory.

UKAS Accredited Tests

Not UKAS Accredited Tests

* 2 no. Soakaway Testing to BRE Digest 365

Please note that 3 fills in each pit was not achievable due to time constraints/ground conditions

The results represent the ground conditions at the specified locations and depths at the time of testing.

Please Note: Remaining samples will be retained for a period of one month from today and will then be disposed of.

Test were undertaken on samples 'as received' unless otherwise stated.

Opinions and interpretations expressed in this report are outside the scope of accreditation for this laboratory.

Results relate only to items tested

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Structural Soils Ltd, The Potteries, Pottery Street, Castleford, WF10 1NJ Tel.01977552255. e-mail matthew.doran@soils.co.uk

TESTING VERIFICATION CERTIFICATE

The test results included in this report are certified as:-

ISSUE STATUS: **FINAL**

In accordance with the Structural Soils Ltd Laboratory Quality Management System, results sheets and summaries of results issued by the laboratory are checked by an approved signatory. The integrity of the test data and results are ensured by control of the computer system employed by the laboratory as part of the Software Verification Program as detailed in the Laboratory Quality Manual.

This testing verification certificate covers all testing compiled on or before the following datetime: **13/09/2023 08:36:55**.

Testing reported after this date is not covered by this Verification Certificate.



Approved Signatory
Matthew Doran (Site Testing Manager (North))

(Head Office)
Bristol Laboratory
Unit 1A, Princess Street
Bedminster
Bristol
BS3 4AG

Castleford Laboratory
The Potteries, Pottery Street
Castleford
West Yorkshire
WF10 1NJ

Hemel Laboratory
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Tonbridge Laboratory
Anerley Court, Half Moon Lane
Hildenborough
Tonbridge
TN11 9HU



**STRUCTURAL
SOILS LTD**

Contract:

Twycross Zoo

Job No:

785456

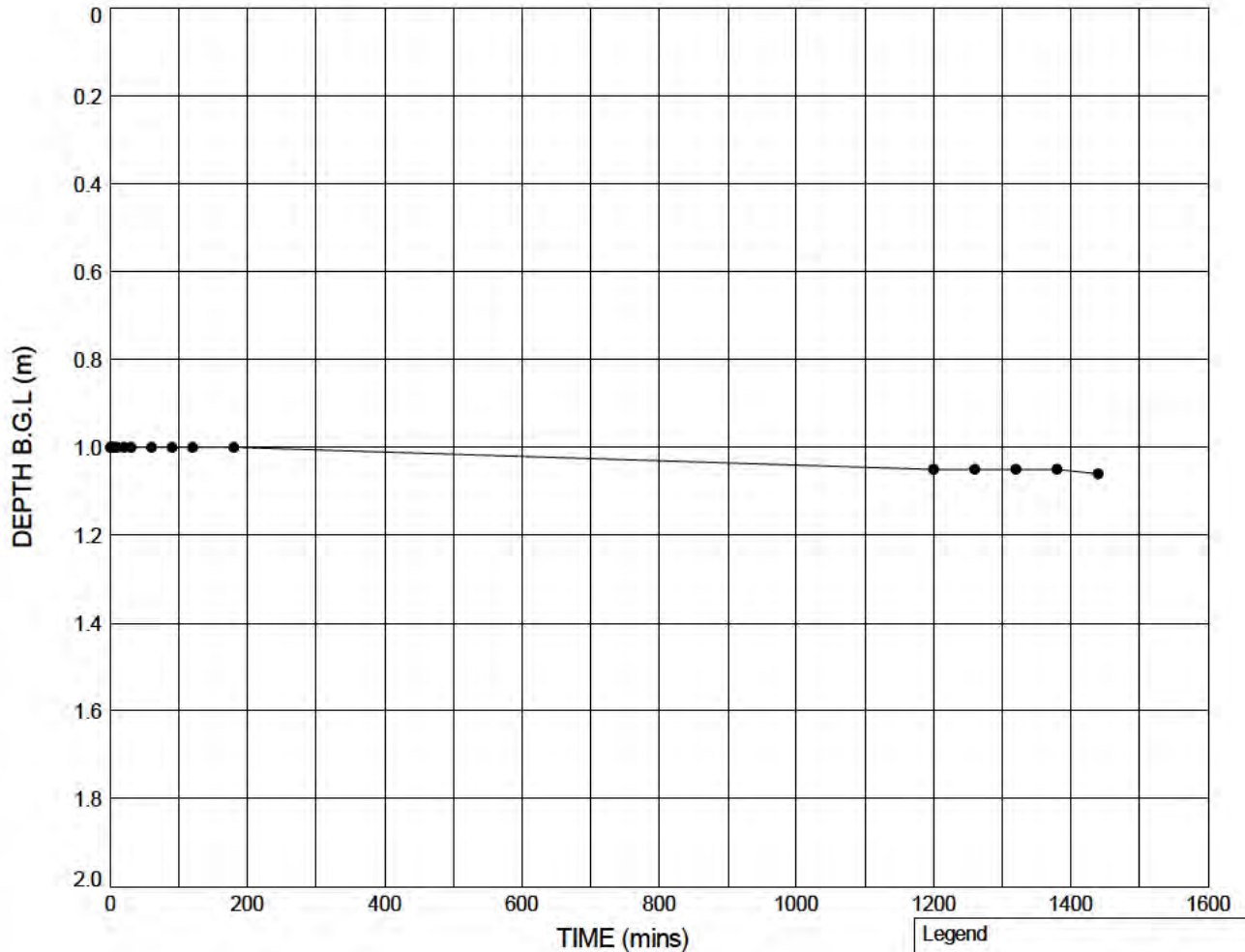


FULL SCALE SOAKAWAY TEST

Non-standard test

Soakaway Test - Position ID : SA01

Plot of Depth of Water Below Ground Level Against Time



Test 1

Pit start depth: = 2.00 m

Pit final depth: = 2.00 m

Effective depth, D_e = 1.00 m

Effective storage volume, V_{p75-25} = 0.4200 m³

Surface area, a_{s50} = 2.8400 m²

Time, t_{p75-25} = N/A secs

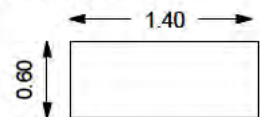
Infiltration rate, f = N/A m/s

Notes: Test 1 - Unable to calculate infiltration rate due to insufficient drop in water level.

Legend

● Test 1 (11.09.23)

Plan (Not to scale)



No Bearing Taken



STRUCTURAL SOILS
The Potteries
Pottery Street
Castleford
W. Yorkshire WF10 1NJ

Compiled By

Date

Checked By

Date

13/09/23

Contract

Twycross Zoo

Contract Ref:

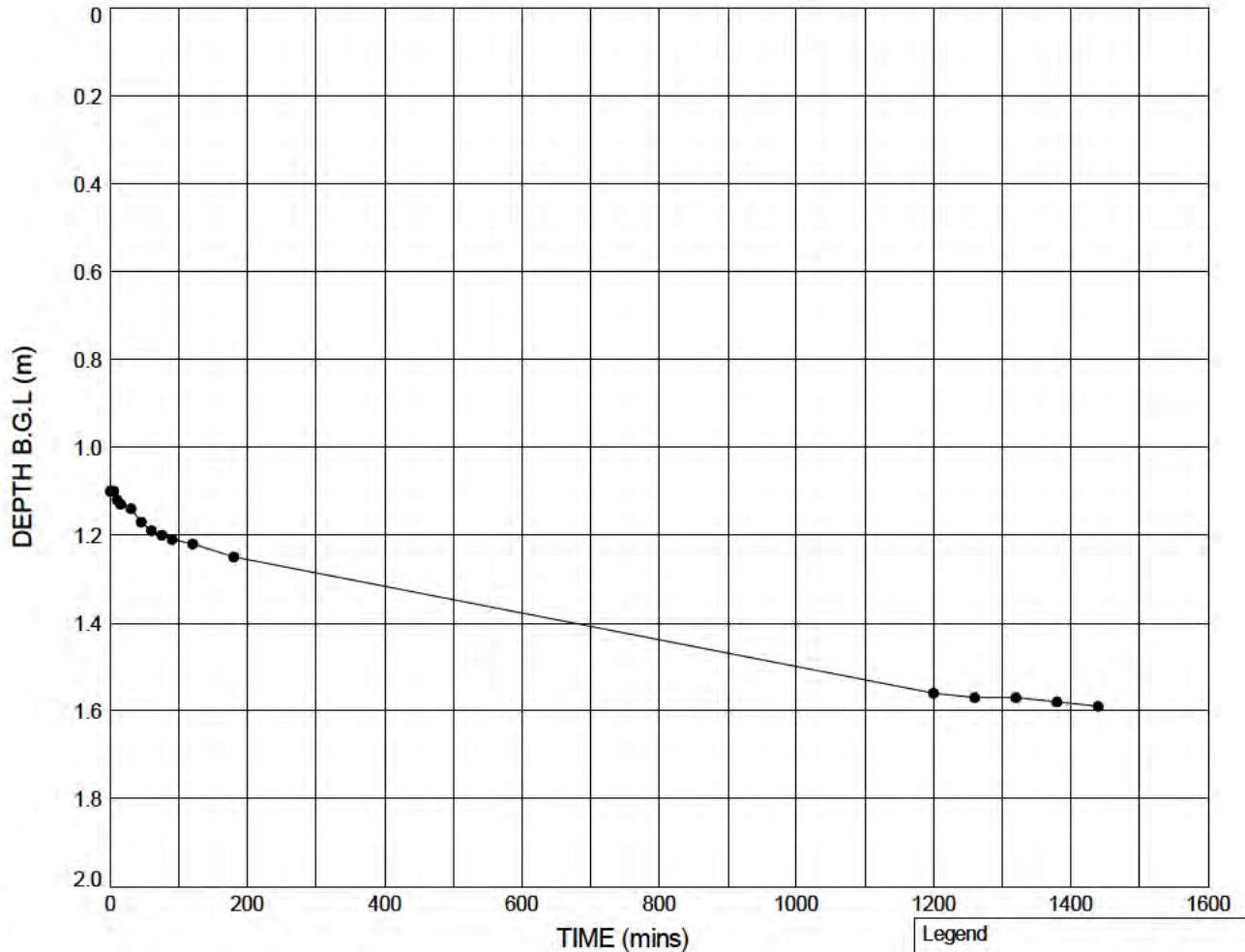
785456

FULL SCALE SOAKAWAY TEST

Non-standard test

Soakaway Test - Position ID : SA02

PLOT OF DEPTH OF WATER BELOW GROUND LEVEL AGAINST TIME



Test 1

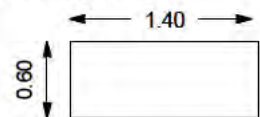
Pit start depth: = 2.00 m
 Pit final depth: = 2.00 m
 Effective depth, D_e = 0.90 m
 Effective storage volume, V_{p75-25} = 0.3780 m³
 Surface area, a_{s50} = 2.6400 m²
 Time, t_{p75-25} = N/A secs
 Infiltration rate, f = N/A m/s

Notes: Test 1 - Unable to calculate infiltration rate due to insufficient drop in water level.

Legend

● Test 1 (11.09.23)

Plan (Not to scale)



No Bearing Taken



STRUCTURAL SOILS
 The Potteries
 Pottery Street
 Castleford
 W. Yorkshire WF10 1NJ

Compiled By

Date

Checked By

Date

13/09/23

Contract

Twycross Zoo

Contract Ref:

785456

Appendix E – Flood Maps for Planning

Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
431556/306080

Created
26 Sep 2023 11:00

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

You will need to do a flood risk assessment if your site is **any of the following:**

- bigger than 1 hectare (ha)
- In an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

Notes

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

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

Flood risk data is covered by the Open Government Licence **which** sets out the terms and conditions for using government data. <https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/>

Use of the address and mapping data is subject to Ordnance Survey public viewing terms under Crown copyright and database rights 2022 OS 100024198. <https://flood-map-for-planning.service.gov.uk/os-terms>

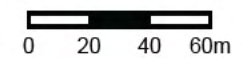


<Unspecified>

431556/306080

1:2500

26 Sep 2023 11:00



Appendix F – Catchments.

EXISTING CATCHMENTS

SITE BOUNDARY		2.18ha
EXISTING HARD STANDING AND ROOF AREAS		0.327ha
EXISTING LANDSCAPING AREAS		1.853ha

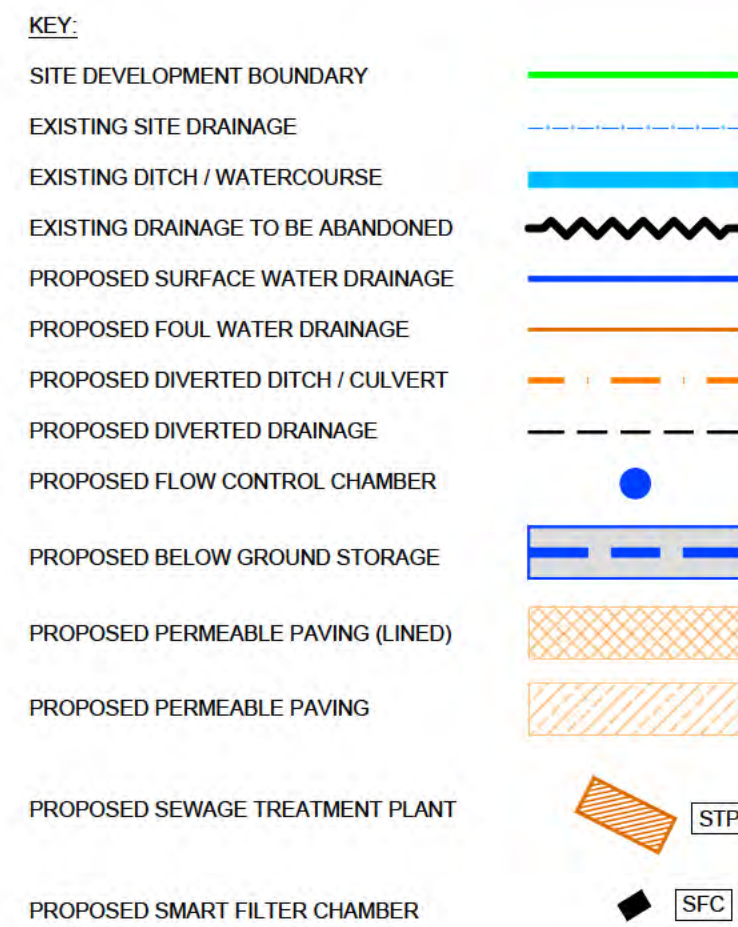


PROPOSED CATCHMENTS

SITE BOUNDARY		2.18ha
HARD STANDING AREA POSITIVELY DRAINED VIA GRAVITY		0.861ha
HARD STANDING AREA POSITIVELY DRAINED VIA PERMEABLE PAVING INFILTRATION SYSTEM		0.126ha
AREA NOT SHOWN HATCHED IS LANDSCAPED		1.193ha



Appendix G – Drainage Drawings.



Job Number 1/21440	Originator CCL	Building/Zone XX	Level XX
Type DR	Discipline C	Drawing No. 001	Revision P01

Appendix H – Correspondence.

Carl Dawson

From: Carl Dawson
Sent: 29 September 2023 08:36
To: Flooding
Subject: RE:[CCL: 1-21440] General Enquiry - Twycross Zoo (CV9 3PX)

Hi Amy.

Thank you for the response.

We are currently undertaking a Flood Risk Assessment for the proposed NSCC Project at Twycross Zoo (CV9 3PX). The proposed development lies to the southwest corner of the existing zoo. See below location bounded red.



Please can you confirm the following.

- Any historical flood to the site.
- Any surface water flooding issues recorded.
- Owner of the existing ditch / watercourse to the southwest corner of the site, adjacent to Orton Hill.
- Any groundwater flooding issues associated with the site.

We look forward to your response.

Kind regards
Carl

From: Amy Jackson [REDACTED] On Behalf Of Flooding
Sent: Wednesday, September 27, 2023 2:13 PM
To: Carl Dawson [REDACTED]
Subject: RE: General Enquiry

Good afternoon Carl,

Twycross sits within Leicestershire County boundary.

Kind regards,

Flood Risk Management (Infrastructure Planning)
Environment & Transport Department
Leicestershire County Council
[e. flooding@leics.gov.uk](mailto:flooding@leics.gov.uk)
t. 0116 305 0001

a

From: Carl Dawson [REDACTED]
Sent: 26 September 2023 16:07
To: Flooding [REDACTED]
Subject: General Enquiry

CAUTION: This email originated from outside of the organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.

Hi,

I'm currently undertaking a Flood Risk Assessment in the Twycross Area, please can you confirm Leicestershire CC covers this area?

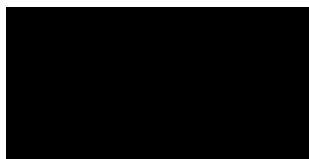
Kind regards
Carl



Carl Dawson
Senior Civil Engineer



Dunham Court, 2 Dunham Road, Altrincham, Cheshire, WA14 4NX.



Low carbon Construction Skills Centre submitted for planning

Plans have been submitted for a £4.4m innovative new
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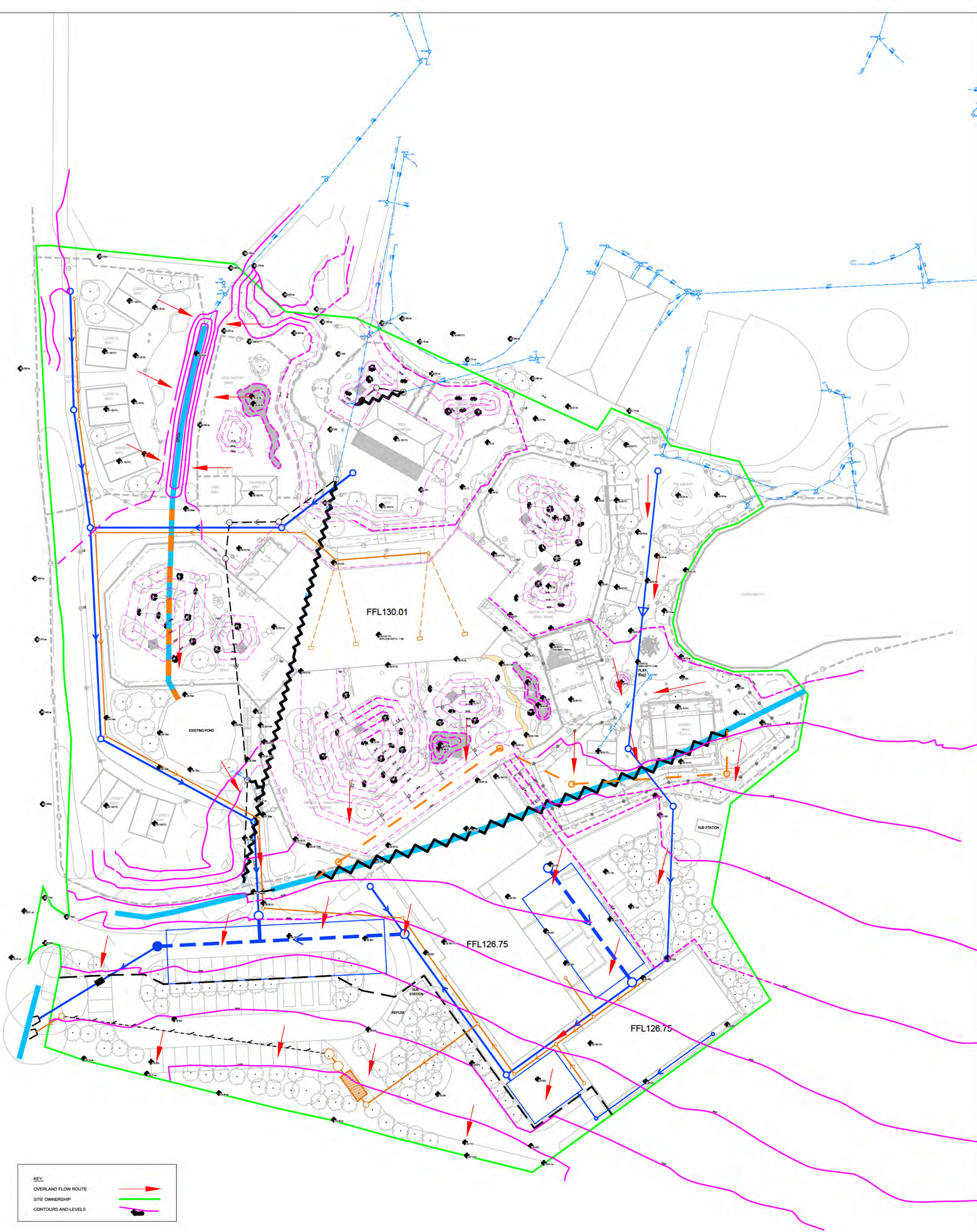
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Appendix I – Flood Exceedance Plan.



GENERAL NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
2. DESIGN BASED ON TOPOGRAPHICAL SURVEY AND INFORMATION AVAILABLE AT THE TIME OF DESIGN.
3. ALL EXISTING SEWERS, CONNECTIONS, PIPE SIZES AND INVERT LEVELS TO BE CONFIRMED BY CONTRACTOR PRIOR TO COMMENCEMENT OF WORKS TO ENSURE CONNECTIVITY. ANY VARIANCE FROM THE INFORMATION SHOWN SHOULD BE REPORTED TO THE ENGINEER FOR REVIEW.
4. DO NOT SCALE THIS DRAWING. ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS SHALL BE BROUGHT TO THE ENGINEERS ATTENTION IMMEDIATELY. ALL DIMENSIONS MUST BE CHECKED / VERIFIED ON SITE.
5. ALL DIMENSIONS ARE IN METRES AND LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS OTHERWISE NOTED.
6. DRAWING SHOWS DIRECTION OF GROUND FALL AND OVERLAND FLOW PATHS OFFSITE SHOULD LOCAL INFRASTRUCTURE FAIL(BECOME BLOCKED).

Rev	Date	Description	CD	CB	DS
P01	29.09.23	ISSUED FOR PLANNING			

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Client	NSCC - TWYXCROSS ZOO
Project	NSCC PROJECT TWYXCROSS ZOO
Office	ALTRINCHAM
Discipline	CIVIL AND STRUCTURAL
Title	OVERLAND FLOW PLAN

Scale @ A1	1:500	Status	PLANNING
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www.clancy.co.uk

Job Number	Originator	Building/Zone	Level
1/21440	CCL	XX	XX
Type	Discipline	Drawing No.	Revision
DR	C	002	P01

Appendix J – Calculations.

Calculated by:

CARL DAWSON

Site name:

NSCC Project

Site location:

Twycross Zoo

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:

52.65180° N

Longitude:

1.53491° W

Reference:

1425271064

Date:

Sep 28 2023 21:30

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):

2.18

Methodology

Q_{BAR} estimation method:

Calculate from SPR and SAAR

SPR estimation method:

Calculate from SOIL type

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	621	621
Hydrological region:	4	4
Growth curve factor 1 year:	0.83	0.83
Growth curve factor 30 years:	2	2
Growth curve factor 100 years:	2.57	2.57
Growth curve factor 200 years:	3.04	3.04

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q _{BAR} (l/s):	9.15	9.15
1 in 1 year (l/s):	7.59	7.59
1 in 30 years (l/s):	18.3	18.3
1 in 100 year (l/s):	23.51	23.51
1 in 200 years (l/s):	27.81	27.81

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
S1	0.116	5.00	130.500	1200	431614.553	306129.464	1.500
S2	0.000		129.000	1200	431608.507	306072.747	1.500
S3	0.000		127.500	1200	431617.666	306060.999	1.500
S4			127.000	1200	431616.486	306029.894	1.500
S5	0.146	5.00	126.700	1800	431592.142	306048.409	1.260
TANK 1			126.500		431600.815	306036.625	1.130
S6	0.059	5.00	126.600	1800	431609.487	306024.842	1.280
S7	0.068	5.00	126.600	1200	431583.599	306006.153	1.410
S8	0.035	5.00	126.600	1200	431555.834	306044.640	0.980
S9			126.600	1800	431562.849	306034.916	1.550
S10	0.073	5.00	132.000	1200	431552.275	306129.089	1.500
S11	0.106	5.00	130.000	1800	431537.756	306117.900	1.410
S12	0.057	5.00	131.000	1200	431494.589	306166.152	1.500
S13	0.057	5.00	131.000	1200	431495.313	306141.959	2.000
S14	0.057	5.00	129.950	1200	431498.687	306117.900	1.700
S15	0.022	5.00	129.150	1200	431500.843	306074.760	1.500
S16	0.037	5.00	127.700	1200	431532.109	306057.844	1.500
S17			126.500	1800	431533.064	306038.651	1.450
TANK 2	0.085	5.00	126.400		431533.323	306033.447	1.400
FCC			126.400	1800	431512.390	306032.405	1.450
OF			125.400		431486.799	306016.750	0.630

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	S1	S2	57.038	0.600	129.000	127.500	1.500	38.0	225	5.45	50.0
1.001	S2	S3	14.896	0.600	127.500	126.075	1.425	10.5	225	5.51	50.0
1.002	S3	S4	31.127	0.600	126.000	125.500	0.500	62.3	225	5.82	50.0
1.003	S4	S6	8.632	0.600	125.500	125.395	0.105	82.2	225	5.92	50.0
2.000	S5	TANK 1	14.632	0.600	125.440	125.370	0.070	209.0	600	5.15	50.0
2.001	TANK 1	S6	14.630	0.600	125.370	125.320	0.050	292.6	600	5.32	50.0
1.004	S6	S7	31.929	0.600	125.320	125.190	0.130	245.6	300	6.45	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	2.128	84.6	15.7	1.275	1.275	0.116	0.0	65	1.637
1.001	4.070	161.8	15.7	1.275	1.200	0.116	0.0	47	2.603
1.002	1.660	66.0	15.7	1.275	1.275	0.116	0.0	74	1.365
1.003	1.443	57.4	15.7	1.275	0.980	0.116	0.0	80	1.236
2.000	1.680	475.1	19.8	0.660	0.530	0.146	0.0	82	0.848
2.001	1.418	401.0	19.8	0.530	0.680	0.146	0.0	89	0.751
1.004	0.999	70.6	43.5	0.980	1.110	0.321	0.0	171	1.049

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)
1.005	S7	S9	35.467	0.600	125.190	125.050	0.140	253.3	300	7.05	50.0
3.000	S8	S9	11.990	0.600	125.620	125.500	0.120	99.9	150	5.20	50.0
1.006	S9	TANK 2	29.563	0.600	125.050	125.000	0.050	591.3	600	7.55	50.0
4.000	S10	S11	18.330	0.600	130.500	128.790	1.710	10.7	225	5.08	50.0
4.001	S11	S14	39.069	0.600	128.590	128.250	0.340	114.9	375	5.46	50.0
5.000	S12	S13	24.204	0.600	129.500	129.000	0.500	48.4	300	5.18	50.0
5.001	S13	S14	24.294	0.600	129.000	128.525	0.475	51.1	300	5.36	50.0
5.002	S14	S15	43.194	0.600	128.250	127.650	0.600	72.0	300	5.85	50.0
5.003	S15	S16	35.549	0.600	127.650	126.200	1.450	24.5	300	6.04	50.0
5.004	S16	S17	19.217	0.600	126.200	125.375	0.825	23.3	300	6.13	50.0
5.005	S17	TANK 2	5.210	0.600	125.050	125.000	0.050	104.2	600	6.17	50.0
1.007	TANK 2	FCC	20.959	0.600	125.000	124.950	0.050	419.2	600	7.85	50.0
1.008	FCC	OF	30.000	0.600	124.950	124.770	0.180	166.7	225	8.34	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)
1.005	0.983	69.5	52.7	1.110	1.250	0.389	0.0	196	1.078
3.000	1.005	17.8	4.7	0.830	0.950	0.035	0.0	53	0.853
1.006	0.994	281.0	57.5	0.950	0.800	0.424	0.0	183	0.788
4.000	4.019	159.8	9.9	1.275	0.985	0.073	0.0	37	2.242
4.001	1.689	186.6	24.3	1.035	1.325	0.179	0.0	90	1.177
5.000	2.265	160.1	7.7	1.200	1.700	0.057	0.0	44	1.180
5.001	2.203	155.7	15.4	1.700	1.125	0.114	0.0	64	1.424
5.002	1.855	131.1	47.4	1.400	1.200	0.350	0.0	125	1.710
5.003	3.188	225.3	50.4	1.200	1.200	0.372	0.0	96	2.583
5.004	3.271	231.2	55.4	1.200	0.825	0.409	0.0	99	2.700
5.005	2.385	674.3	55.4	0.850	0.800	0.409	0.0	115	1.465
1.007	1.183	334.4	124.4	0.800	0.850	0.918	0.0	253	1.099
1.008	1.010	40.1	124.4	1.225	0.405	0.918	0.0	225	1.028

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	57.038	38.0	225	Circular	130.500	129.000	1.275	129.000	127.500	1.275
1.001	14.896	10.5	225	Circular	129.000	127.500	1.275	127.500	126.075	1.200
1.002	31.127	62.3	225	Circular	127.500	126.000	1.275	127.000	125.500	1.275
1.003	8.632	82.2	225	Circular	127.000	125.500	1.275	126.600	125.395	0.980
2.000	14.632	209.0	600	Circular	126.700	125.440	0.660	126.500	125.370	0.530
2.001	14.630	292.6	600	Circular	126.500	125.370	0.530	126.600	125.320	0.680
1.004	31.929	245.6	300	Circular	126.600	125.320	0.980	126.600	125.190	1.110
1.005	35.467	253.3	300	Circular	126.600	125.190	1.110	126.600	125.050	1.250
3.000	11.990	99.9	150	Circular	126.600	125.620	0.830	126.600	125.500	0.950
1.006	29.563	591.3	600	Circular	126.600	125.050	0.950	126.400	125.000	0.800

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	S1	1200	Manhole	Adoptable	S2	1200	Manhole	Adoptable
1.001	S2	1200	Manhole	Adoptable	S3	1200	Manhole	Adoptable
1.002	S3	1200	Manhole	Adoptable	S4	1200	Manhole	Adoptable
1.003	S4	1200	Manhole	Adoptable	S6	1800	Manhole	Adoptable
2.000	S5	1800	Manhole	Adoptable	TANK 1		Junction	
2.001	TANK 1		Junction		S6	1800	Manhole	Adoptable
1.004	S6	1800	Manhole	Adoptable	S7	1200	Manhole	Adoptable
1.005	S7	1200	Manhole	Adoptable	S9	1800	Manhole	Adoptable
3.000	S8	1200	Manhole	Adoptable	S9	1800	Manhole	Adoptable
1.006	S9	1800	Manhole	Adoptable	TANK 2		Junction	

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)
4.000	18.330	10.7	225	Circular	132.000	130.500	1.275	130.000	128.790	0.985
4.001	39.069	114.9	375	Circular	130.000	128.590	1.035	129.950	128.250	1.325
5.000	24.204	48.4	300	Circular	131.000	129.500	1.200	131.000	129.000	1.700
5.001	24.294	51.1	300	Circular	131.000	129.000	1.700	129.950	128.525	1.125
5.002	43.194	72.0	300	Circular	129.950	128.250	1.400	129.150	127.650	1.200
5.003	35.549	24.5	300	Circular	129.150	127.650	1.200	127.700	126.200	1.200
5.004	19.217	23.3	300	Circular	127.700	126.200	1.200	126.500	125.375	0.825
5.005	5.210	104.2	600	Circular	126.500	125.050	0.850	126.400	125.000	0.800
1.007	20.959	419.2	600	Circular	126.400	125.000	0.800	126.400	124.950	0.850
1.008	30.000	166.7	225	Circular	126.400	124.950	1.225	125.400	124.770	0.405

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
4.000	S10	1200	Manhole	Adoptable	S11	1800	Manhole	Adoptable
4.001	S11	1800	Manhole	Adoptable	S14	1200	Manhole	Adoptable
5.000	S12	1200	Manhole	Adoptable	S13	1200	Manhole	Adoptable
5.001	S13	1200	Manhole	Adoptable	S14	1200	Manhole	Adoptable
5.002	S14	1200	Manhole	Adoptable	S15	1200	Manhole	Adoptable
5.003	S15	1200	Manhole	Adoptable	S16	1200	Manhole	Adoptable
5.004	S16	1200	Manhole	Adoptable	S17	1800	Manhole	Adoptable
5.005	S17	1800	Manhole	Adoptable	TANK 2	Junction		
1.007	TANK 2		Junction		FCC	1800	Manhole	Adoptable
1.008	FCC	1800	Manhole	Adoptable	OF		Junction	

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
S1	431614.553	306129.464	130.500	1.500	1200		0	1.000	129.000	225
S2	431608.507	306072.747	129.000	1.500	1200		1	1.000	127.500	225
S3	431617.666	306060.999	127.500	1.500	1200		0	1.001	127.500	225
S4	431616.486	306029.894	127.000	1.500	1200		1	1.001	126.075	225
S5	431616.486	306029.894	127.000	1.500	1200		0	1.002	126.000	225
S6	431616.486	306029.894	127.000	1.500	1200		1	1.002	125.500	225
S5	431592.142	306048.409	126.700	1.260	1800		0	1.003	125.500	225
TANK 1	431592.142	306048.409	126.700	1.260	1800		0	2.000	125.440	600
TANK 1	431600.815	306036.625	126.500	1.130			1	2.000	125.370	600
S6	431609.487	306024.842	126.600	1.280	1800		0	2.001	125.370	600
S6	431609.487	306024.842	126.600	1.280	1800		1	2.001	125.320	600
S6	431609.487	306024.842	126.600	1.280	1800		2	1.003	125.395	225
S6	431609.487	306024.842	126.600	1.280	1800		0	1.004	125.320	300

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S7	431583.599	306006.153	126.600	1.410	1200		1 1.004	125.190	300
						0	1.005	125.190	300
S8	431555.834	306044.640	126.600	0.980	1200		0 3.000	125.620	150
S9	431562.849	306034.916	126.600	1.550	1800		1 3.000 2 1.005	125.500 125.050	150 300
						0	1.006	125.050	600
S10	431552.275	306129.089	132.000	1.500	1200		0 4.000	130.500	225
S11	431537.756	306117.900	130.000	1.410	1800		1 4.000	128.790	225
						0	4.001	128.590	375
S12	431494.589	306166.152	131.000	1.500	1200		0 5.000	129.500	300
S13	431495.313	306141.959	131.000	2.000	1200		1 5.000	129.000	300
						0	5.001	129.000	300
S14	431498.687	306117.900	129.950	1.700	1200		1 5.001 2 4.001	128.525 128.250	300 375
						0	5.002	128.250	300
S15	431500.843	306074.760	129.150	1.500	1200		1 5.002	127.650	300
						0	5.003	127.650	300
S16	431532.109	306057.844	127.700	1.500	1200		1 5.003	126.200	300
						0	5.004	126.200	300
S17	431533.064	306038.651	126.500	1.450	1800		1 5.004	125.375	300
						0	5.005	125.050	600
TANK 2	431533.323	306033.447	126.400	1.400			1 5.005 2 1.006	125.000 125.000	600 600
						0	1.007	125.000	600
FCC	431512.390	306032.405	126.400	1.450	1800		1 1.007	124.950	600
						0	1.008	124.950	225
OF	431486.799	306016.750	125.400	0.630			1 1.008	124.770	225

Simulation Settings

Rainfall Methodology	FEH-13	Skip Steady State	x	Check Discharge Volume	✓
Summer CV	0.750	Drain Down Time (mins)	240	100 year +45% 360 minute (m³)	912
Winter CV	0.840	Additional Storage (m³/ha)	0.0		
Analysis Speed	Detailed	Check Discharge Rate(s)	x		

Storm Durations

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0	100	40	10	0
30	0	0	0				

Pre-development Discharge Volume

Site Makeup	Greenfield	SPR	0.47	Storm Duration (mins)	360
Greenfield Method	FSR/FEH	CWI	93.482	Betterment (%)	0
Positively Drained Area (ha)	2.180	Return Period (years)	100	PR	0.461
Soil Index	4	Climate Change (%)	45	Runoff Volume (m³)	912

Node FCC Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	124.950	Product Number	CTL-SHE-0140-1000-1400-1000
Design Depth (m)	1.400	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	10.0	Min Node Diameter (mm)	1200

Node TANK 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	125.370
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	
Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	300.0	0.0	0.750	300.0	0.0
			0.751	0.0	0.0

Node TANK 2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	125.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	
Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	500.0	0.0	0.750	500.0	0.0
			0.751	0.0	0.0

Node S7 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	125.190
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	
Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	120.0	0.0	0.750	120.0	0.0
			0.751	0.0	0.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 97.59%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1	10	129.068	0.068	15.1	0.0772	0.0000	OK
15 minute winter	S2	10	127.547	0.047	14.9	0.0534	0.0000	OK
15 minute winter	S3	11	126.072	0.072	14.7	0.0814	0.0000	OK
15 minute winter	S4	11	125.585	0.085	14.8	0.0958	0.0000	OK
15 minute winter	S5	10	125.523	0.083	18.9	0.2112	0.0000	OK
180 minute winter	TANK 1	116	125.410	0.040	5.5	11.3953	0.0000	OK
15 minute winter	S6	11	125.426	0.106	22.0	0.2703	0.0000	OK
120 minute summer	S7	72	125.276	0.086	15.0	9.9514	0.0000	OK
15 minute winter	S8	10	125.673	0.053	4.5	0.0602	0.0000	OK
240 minute winter	S9	188	125.171	0.121	11.2	0.3070	0.0000	OK
15 minute winter	S10	10	130.538	0.038	9.5	0.0428	0.0000	OK
15 minute winter	S11	10	128.677	0.087	23.2	0.2223	0.0000	OK
15 minute winter	S12	10	129.544	0.043	7.4	0.0491	0.0000	OK
15 minute winter	S13	10	129.063	0.063	14.7	0.0715	0.0000	OK
15 minute winter	S14	11	128.378	0.128	44.6	0.1446	0.0000	OK
15 minute winter	S15	11	127.744	0.094	47.1	0.1063	0.0000	OK
15 minute winter	S16	11	126.302	0.102	51.8	0.1157	0.0000	OK
360 minute winter	S17	232	125.179	0.129	10.0	0.3292	0.0000	OK
240 minute winter	TANK 2	188	125.170	0.170	29.1	80.8110	0.0000	OK
240 minute winter	FCC	188	125.170	0.220	9.4	0.5593	0.0000	OK
15 minute summer	OF	1	124.770	0.000	5.6	0.0000	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	S1	1.000	S2	14.9	1.852	0.176	0.4615	
15 minute winter	S2	1.001	S3	14.7	2.490	0.091	0.0877	
15 minute winter	S3	1.002	S4	14.8	1.210	0.224	0.3824	
15 minute winter	S4	1.003	S6	14.8	1.153	0.259	0.1112	
15 minute winter	S5	2.000	TANK 1	18.8	1.751	0.039	0.1863	
180 minute winter	TANK 1	2.001	S6	3.6	0.311	0.009	0.1971	
15 minute winter	S6	1.004	S7	17.0	1.254	0.241	0.4840	
120 minute summer	S7	1.005	S9	12.3	0.724	0.177	0.6045	
15 minute winter	S8	3.000	S9	4.4	0.817	0.250	0.0651	
240 minute winter	S9	1.006	TANK 2	10.9	0.414	0.039	1.5657	
15 minute winter	S10	4.000	S11	9.4	2.181	0.059	0.0791	
15 minute winter	S11	4.001	S14	22.8	0.878	0.122	1.0208	
15 minute winter	S12	5.000	S13	7.3	0.869	0.046	0.2063	
15 minute winter	S13	5.001	S14	14.4	1.370	0.092	0.2558	
15 minute winter	S14	5.002	S15	44.4	1.876	0.338	1.0247	
15 minute winter	S15	5.003	S16	47.3	2.365	0.210	0.7117	
15 minute winter	S16	5.004	S17	51.8	2.557	0.224	0.3898	
360 minute winter	S17	5.005	TANK 2	15.1	1.010	0.022	0.2711	
240 minute winter	TANK 2	1.007	FCC	9.4	0.256	0.028	1.6668	
240 minute winter	FCC	Hydro-Brake®	OF	9.4				152.0

Results for 30 year Critical Storm Duration. Lowest mass balance: 97.59%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1	10	129.116	0.116	39.6	0.1314	0.0000	OK
15 minute winter	S2	10	127.579	0.079	39.1	0.0899	0.0000	OK
15 minute winter	S3	10	126.126	0.126	38.6	0.1423	0.0000	OK
15 minute winter	S4	11	125.655	0.155	38.7	0.1754	0.0000	OK
15 minute winter	S5	10	125.568	0.128	49.9	0.3258	0.0000	OK
30 minute winter	TANK 1	24	125.476	0.106	51.5	30.1254	0.0000	OK
15 minute winter	S6	11	125.480	0.160	58.1	0.4083	0.0000	OK
240 minute winter	S7	228	125.429	0.239	24.5	27.5580	0.0000	OK
15 minute winter	S8	10	125.716	0.096	12.0	0.1088	0.0000	OK
240 minute winter	S9	228	125.429	0.379	26.0	0.9644	0.0000	OK
15 minute winter	S10	10	130.562	0.062	24.9	0.0703	0.0000	OK
15 minute winter	S11	10	128.734	0.144	61.0	0.3674	0.0000	OK
15 minute winter	S12	10	129.570	0.070	19.5	0.0791	0.0000	OK
15 minute winter	S13	10	129.106	0.106	38.8	0.1199	0.0000	OK
15 minute winter	S14	11	128.492	0.242	117.8	0.2740	0.0000	OK
15 minute winter	S15	11	127.813	0.163	123.7	0.1845	0.0000	OK
15 minute winter	S16	11	126.386	0.186	136.4	0.2103	0.0000	OK
240 minute winter	S17	228	125.429	0.379	28.4	0.9644	0.0000	OK
240 minute winter	TANK 2	228	125.429	0.429	57.5	203.7426	0.0000	OK
240 minute winter	FCC	228	125.429	0.479	23.8	1.2200	0.0000	SURCHARGED
15 minute summer	OF	1	124.770	0.000	9.6	0.0000	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	S1	1.000	S2	39.1	2.363	0.462	0.9463	
15 minute winter	S2	1.001	S3	38.6	3.223	0.239	0.1786	
15 minute winter	S3	1.002	S4	38.7	1.497	0.587	0.8079	
15 minute winter	S4	1.003	S6	39.1	1.445	0.681	0.2332	
15 minute winter	S5	2.000	TANK 1	49.5	2.160	0.104	0.4220	
30 minute winter	TANK 1	2.001	S6	20.4	0.571	0.051	0.6532	
15 minute winter	S6	1.004	S7	38.5	1.404	0.545	1.0681	
240 minute winter	S7	1.005	S9	23.7	0.735	0.341	2.3176	
15 minute winter	S8	3.000	S9	11.8	1.035	0.665	0.1368	
240 minute winter	S9	1.006	TANK 2	24.5	0.432	0.087	5.9586	
15 minute winter	S10	4.000	S11	24.8	2.861	0.155	0.1586	
15 minute winter	S11	4.001	S14	60.2	1.074	0.323	2.2236	
15 minute winter	S12	5.000	S13	19.3	1.125	0.121	0.4200	
15 minute winter	S13	5.001	S14	38.1	1.779	0.245	0.5207	
15 minute winter	S14	5.002	S15	116.6	2.303	0.890	2.1621	
15 minute winter	S15	5.003	S16	124.5	2.927	0.552	1.5110	
15 minute winter	S16	5.004	S17	136.7	3.202	0.591	0.8201	
240 minute winter	S17	5.005	TANK 2	28.1	1.387	0.042	1.0501	
240 minute winter	TANK 2	1.007	FCC	23.8	0.256	0.071	4.7887	
240 minute winter	FCC	Hydro-Brake®	OF	10.0				242.3

Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 97.59%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1	11	129.263	0.263	83.4	0.2976	0.0000	SURCHARGED
15 minute winter	S2	12	127.621	0.121	80.6	0.1368	0.0000	OK
15 minute winter	S3	12	126.705	0.705	78.8	0.7978	0.0000	SURCHARGED
360 minute winter	S4	352	126.148	0.648	12.8	0.7331	0.0000	SURCHARGED
360 minute winter	S5	352	126.149	0.709	16.2	1.8040	0.0000	SURCHARGED
360 minute winter	TANK 1	352	126.148	0.778	40.3	213.8925	0.0000	SURCHARGED
360 minute winter	S6	352	126.149	0.829	32.5	2.1109	0.0000	SURCHARGED
360 minute winter	S7	352	126.146	0.956	32.8	86.6383	0.0000	SURCHARGED
360 minute winter	S8	352	126.145	0.525	3.9	0.5941	0.0000	SURCHARGED
360 minute winter	S9	352	126.145	1.095	27.8	2.7870	0.0000	SURCHARGED
15 minute winter	S10	11	130.593	0.093	52.5	0.1052	0.0000	OK
15 minute winter	S11	12	129.986	1.396	128.5	3.5518	0.0000	FLOOD RISK
15 minute winter	S12	12	129.980	0.480	41.0	0.5429	0.0000	SURCHARGED
15 minute winter	S13	12	129.962	0.961	81.7	1.0875	0.0000	SURCHARGED
15 minute winter	S14	12	129.863	1.613	211.2	1.8246	0.0000	FLOOD RISK
15 minute winter	S15	12	128.273	0.623	208.7	0.7041	0.0000	SURCHARGED
15 minute winter	S16	12	126.761	0.561	227.9	0.6347	0.0000	SURCHARGED
360 minute winter	S17	352	126.145	1.095	45.0	2.7870	0.0000	SURCHARGED
360 minute winter	TANK 2	352	126.145	1.145	70.7	356.4875	0.0000	FLOOD RISK
360 minute winter	FCC	352	126.145	1.195	11.0	3.0415	0.0000	FLOOD RISK
15 minute summer	OF	1	124.770	0.000	10.0	0.0000	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	S1	1.000	S2	80.6	2.696	0.953	1.7292	
15 minute winter	S2	1.001	S3	78.8	3.533	0.487	0.4580	
15 minute winter	S3	1.002	S4	76.8	1.930	1.163	1.2380	
360 minute winter	S4	1.003	S6	12.9	1.084	0.225	0.3433	
360 minute winter	S5	2.000	TANK 1	15.7	0.874	0.033	4.1215	
360 minute winter	TANK 1	2.001	S6	-31.7	0.318	-0.079	4.1209	
360 minute winter	S6	1.004	S7	25.9	0.799	0.367	2.2484	
360 minute winter	S7	1.005	S9	-26.8	0.652	-0.386	2.4976	
360 minute winter	S8	3.000	S9	3.9	0.790	0.219	0.2111	
360 minute winter	S9	1.006	TANK 2	-25.3	0.437	-0.090	8.3272	
15 minute winter	S10	4.000	S11	52.4	3.237	0.328	0.5064	
15 minute winter	S11	4.001	S14	112.3	1.121	0.602	4.3092	
15 minute winter	S12	5.000	S13	40.8	1.404	0.255	1.7044	
15 minute winter	S13	5.001	S14	74.1	1.804	0.476	1.7108	
15 minute winter	S14	5.002	S15	195.1	2.771	1.488	3.0417	
15 minute winter	S15	5.003	S16	207.1	3.034	0.919	2.5033	
15 minute winter	S16	5.004	S17	228.2	3.427	0.987	1.3532	
360 minute winter	S17	5.005	TANK 2	44.6	1.492	0.066	1.4675	
360 minute winter	TANK 2	1.007	FCC	11.0	0.259	0.033	5.9037	
360 minute winter	FCC	Hydro-Brake®	OF	10.0				286.4

Appendix K – Outline Drainage Maintenance Operations.

DMS 1-21440 (NCSS PROJECT – TWYCROSS ZOO)

Outline Drainage Maintenance Operations

This section is intended to give an overview of the operation and maintenance for the drainage features included with the drainage strategy and in relation to typical details. Where proprietary products are specified, the manufacturer's instructions and recommendations should be followed in priority to this document unless specifically noted otherwise due to project constraints.

The recommended operations and frequencies are typical only and should be more frequent initially to ensure that there are no unforeseen issues with the operation and then adjusted to suit the site requirements.

Drainage components are indicated on Clancy Consulting Ltd Drainage Strategy drawing.

Components

The following components have been included within the drainage design for the proposed development:

- Manhole and Inspection Chambers
- Catchpit Chambers
- Linear Drains
- Gullies
- Pipework
- Permeable Paving – Type to be agreed, follow manufacturer guidance.
- Attenuation Tank – Type to be agreed, follow manufacturer guidance.
- Flow Control Unit – Type to be agreed, follow manufacturer guidance.
- Smart Filter Chamber – Type to be agreed, follow manufacturer guidance.
- Sewage Treatment Plant – Type to be agreed, follow manufacturer guidance.
- Phosphate Chamber – Type to be agreed, follow manufacturer guidance.
- Foul Pumping Chamber - Type to be agreed, follow manufacturer guidance.

A suitable maintenance strategy should be adopted to ensure the drainage network is cleaned regularly and the routine maintenance and cleansing regime should be documented.

It is assumed that the maintenance of the drainage network will be the responsibility of an on-site facilities management team.

A copy of the final construction drainage layout should be provided in the final Operations and Maintenance Manual.

The surface water network has been designed to accommodate the 1 in 100 year storm rainfall event plus an allowance for climate change particular to the requirements of the site. It may be that the exceedance flows above the 1 in 30 year storm rainfall event are stored within the site partially above ground, on non-habitable external landscaping, parking or other space. As the flows are generally being attenuated on site and within SuDS features there will be a period of time after storm events where the network is still partially or fully surcharged and is draining down. Where this surcharging is still present after 48hrs appropriate action should be taken as noted below.

It is recommended that the drainage system is inspected as a minimum twice a year, with the system also being inspected after any major storm event.

Significant sediment deposition is likely in areas used for storage, so a post clean-up operation may be required including the removal of litter, vegetation, sewerage debris and larger objects.

Long-term management practices include monthly sweeping of external paved areas. The sweeping program will remove sand and contaminants directly from paved surfaces before they become mobilised during storm events and transported to the drainage system.

During the winter months, drainage features such as gullies and channels should be cleared of ice, snow, debris or litter.

Sediment/material removal should be undertaken in consultation with the environmental regulator to confirm appropriate protocols; especially where run-off is taken from potentially contaminated areas such as the filter drains and the upstream/downstream chambers.

Should any oil or fuel spillages occur, these are to be cleaned up locally to prevent contaminants being washed into the surface water system by rainfall. Spillages such as these should not be washed into the drainage system.

Manholes and Inspection Chambers

Description

Manholes providing rodding and jetting access to pipe work.

Normally manholes, in similarity to inspection chambers, are designed for access by operatives. Manholes must only be accessed after a risk assessment, and the implementation of a safe system of work, which identifies the specific risk to confined space.

Maintenance Issues

It is not likely that Manholes will present maintenance issues. However, they allow both the access to the drainage infrastructure and allow visual inspection from the surface of any key maintenance issues.

Schedule	Action Required	Frequency
Routine/regular maintenance (inc. inspections and monitoring)	Remove covers and ensure that there are no blockages. Inspect and ascertain any parts that are not operating correctly and resolve.	For 3 months after installation
	Check covers do not need repairing.	Monthly
	Check drainage is running freely by inspecting manholes and inspection chambers.	Every 6 months and following the leaf fall in autumn.
Occasional maintenance	Suction sweeping and cleansing (to Water Jetting Association standards) and CCTV where appropriate.	2 – 4 Years
Remedial maintenance	• Silt removal • Inlet/outlet repair • Erosion repairs • System recovery following a pollution event • Manhole Cover replacement • Repairs to brickwork or concrete • Chanel repair	When required (tasks to repair problems due to wear, damage or vandalism)

Catchpits

Description

Catchpits are similar to manholes, however, they include a sump to the base which is designed to capture silt and prevent it reaching other parts of the drainage network. Catchpits provide a useful location to remove silt for drainage networks. Catchpits must only be accessed after a risk assessment, and the implementation of a safe system of work, which identifies the specific risk to confined space.

Maintenance Issues

If the silt captured in catchpits does not get removed regularly it will cause silt to move downstream to other part of the drainage network, some of which may be difficult to access, or totally inaccessible.

Maintenance Regime

Schedule	Action Required	Frequency
Routine/regular maintenance (inc. inspections and monitoring)	Remove manhole covers and ensure that there are no blockages. Inspect and identify any parts that are not operating correctly and resolve. Inspect silt storage in sump. Remove silt as appropriate using subcontractor with vacuum extraction plant.	For 3 months after installation
	Check covers do not need repairing. Repair/replace as required.	Monthly
	Inspect catchpits to ensure that the drainage is running freely, and free of debris. Inspect silt storage in sump. Remove silt as appropriate using subcontractor with vacuum extraction plant.	Every 6 months and following the leaf fall in autumn.
Occasional maintenance	Suction sweeping and cleansing (to Water Jetting Association standards) and CCTV where appropriate. Resolve any chamber structural defects, or any defects that could reduce the free flow of water.	2 – 4 Years
Remedial maintenance	• Silt removal • Inlet/outlet repair • Erosion repairs • System recovery following a pollution event • Manhole Cover Replacement • Repairs to brickwork or concrete	When required (tasks to repair problems due to wear, damage or vandalism)

Linear Drains

Description

Surface Water is drained over impermeable sections towards grated, or slot-type linear drains at low points and water is carried to below ground pipework.

Maintenance Issues

Linear drains could get blocked by silt or debris, causing flooding.

Linear drains frequently include silt traps at outlets which can cause siltation of downstream drainage infrastructure if the appropriate maintenance is not undertaken.

Maintenance Regime

Schedule	Action Required	Frequency
Routine/regular maintenance (inc. inspections and monitoring)	Inspect linear drains to make sure that there are no blockages at surface level. Remove covers to outflow boxes and check for blockages or siltation. Inspect and identify any parts that are not operating correctly and resolve.	For 3 months after installation
	Inspect linear drains to make sure that there are no blockages at surface level.	Monthly
	Remove covers to outflow boxes and check for blockages or siltation.	Every 6 months and following the leaf fall in autumn.
Occasional maintenance	Jetting of linear drains and suction vacuuming of outlet boxes (to Water Jetting Association standards) and CCTV where appropriate.	1 – 2 Years
Remedial maintenance	• Silt removal • Inlet/outlet repair • Erosion repairs • System rehabilitation following a pollution event • Linear drain cover replacement • Chancel repair • Ensure that impermeable surfaces surrounding linear drains have not settled below top of linear drain level, causing ponding	When required (tasks to repair problems due to wear, damage or vandalism)

Gullies

Description

Surface Water is drained over impermeable areas towards grated gullies at low points and water is carried to below ground pipework.

Maintenance Issues

Gullies can become blocked by silt or debris, causing flooding.

Gullies include integral silt traps which can cause siltation of downstream drainage infrastructure if the appropriate maintenance is not undertaken.

Gullies frequently include a trapped outlet which prevents liquids lighter than water (ie oil and fuel) departing the gully. If silt and light liquids do not get removed regularly silt and oil will move downstream to other areas of the drainage network, some of which may be difficult to access, or totally inaccessible.

Maintenance Regime

Schedule	Action Required	Frequency
Routine/regular maintenance (inc. inspections and monitoring)	Inspect to ensure that there are no blockages at surface level, and that the outfall is operating efficiently.	For 3 months after installation
	Inspect and identify any parts that are not operating correctly and resolve.	
	Check that there are no blockages at surface level.	Monthly
	Remove covers to check for blockages or siltation.	Every 6 months and following the leaf fall in autumn.
Occasional maintenance	Remove oil and silt using specialist vacuum extraction plant.	1 – 2 Years
Remedial maintenance	• Silt removal • Inlet/outlet repair • Erosion repairs • System rehabilitation following a pollution event • Cover replacement • Structural failure of gully pot • Ensure that impermeable surfaces surrounding linear drains have not settled below top of gully cover level, causing ponding	When required (tasks to repair problems due to wear, damage or vandalism)

Pipework

Description

Below ground drainage pipework connects drainage inlets (gullies, linear drains etc) to manholes as well as providing connections between manholes.

Maintenance Issues

Pipes could become blocked by silt, debris fat, grease, or collapse. In addition, it's possible for pipe joints to become displaced or for roots to grow from the surrounding ground into the pipes.

These factors can cause a reduction in, or loss of, the hydraulic capability of the pipes which could cause flooding to land and buildings.

Defects in pipes could cause a reduction in stability to ground underlying foundations, thus, causing settlement and damage to buildings and external surfaces.

The material of pipes and associated couplings can be damaged if aggressive liquids are passed through the pipes.

It is recommended that trees are not planted within 3m of pipes to reduce the risk of root ingress.

Maintenance Regime

Schedule	Action Required	Frequency
Routine/regular maintenance (inc. inspections and monitoring)	Inspect and identify any parts that are not operating correctly and resolve.	For 3 months after installation.
	Monitor working of drainage at ground level. The indications damaged pipework's may include localised flooding or emission of smells.	Monthly
	Remove manholes covers to check for blockages.	Every 6 months
Occasional maintenance	CCTV pipework, clean to WRC Sewer Jetting Code of Practice. Resolve issues as appropriate.	1 – 2 Years
Remedial maintenance	• Silt removal. • Fat and Grease removal. • Erosion repairs. • Joint displacement. • Structural failure, cracking or collapse. • System rehabilitation following a pollution event.	When required (tasks to repair problems due to wear, damage or vandalism)