



Unit 2, Moroside
Greenbank Road
Eden Business Park
Gillwilly, Penrith
Cumbria, CA11 9FB

DRAINAGE STRATEGY FOR PROPOSED RESIDENTIAL DEVELOPMENT AT MORESBY PARKS, CA28 8UX

Introduction

This drainage strategy has been prepared for the proposed residential development at Moresby Parks, Cumbria, consisting of approximately 54 dwellings across a 2.88 hectare greenfield site. Infiltration tests have confirmed that the ground conditions are unsuitable for soakaway systems. Therefore, an alternative surface water management strategy has been developed in accordance with National Planning Policy.

Surface Water Drainage

Existing Site Drainage

- The existing greenfield site drains primarily to ground with overland flow directed towards an unnamed tributary of Lowca Beck to the northeast.
- Flood risk maps identify the site as **Flood Zone 1** and at very low risk from surface water flooding.
- **Greenfield** runoff rates are calculated as:
 - o Qbar: 25.57 l/s
 - o 1 in 1-year event: 22.24 l/s
 - o 1 in 30-year event: 43.46 l/s
 - o 1 in 100-year event: 53.18 l/s

MANAGING DIRECTOR
R. J. Gibson BEng (Hons) CEng MStructE

Tel 01768 865400
Email info@tweddell.co.uk
www.tweddell.co.uk

Proposed Drainage Design

Impermeable Area and Runoff Management

- The development introduces impermeable surfaces from roof areas, drives and roadways.
- Surface water runoff will be positively drained to an off-site detention basin located northeast of the development, as agreed with the landowner.

Detention Basin and Outfall System

- Surface water will be attenuated in a basin with flow restricted by a **Hydro-Brake** set to the Qbar rate of **25.6 l/s**.
- Discharge will be directed into the unnamed watercourse to the northeast, aligning with drainage hierarchy guidance.

Climate Change and Urban Creep Allowances

- Design accommodates:
 - **No flooding in a 1 in 30-year storm + 45% climate change + 10% urban creep.**
 - **No flooding in a 1 in 100-year storm + 50% climate change + 10% urban creep.**
- Calculations have used the upper-end climate change allowances for the South West Lakes Management Catchment Area.

Peak Flows

- The system is designed to limit surface water discharge to greenfield rates.
- The attenuation system mitigates the effects of peak flows and reduces downstream flood risk.

Exceedance Flow Management

- In the event of an exceedance, flows will follow designated overland routes toward the detention basin, towards the unnamed tributary of Lowca Beck.
- Development layout ensures no property is at risk of flooding during exceedance events.

Betterment Over Greenfield Runoff

- The proposed drainage system offers significant improvements over the natural greenfield runoff condition.
- The attenuation system stores and releases water in a controlled manner, rather than allowing immediate, uncontrolled discharge.
- This results in less frequent and lower intensity peak flows, reducing downstream flooding risks and environmental impact.

- The use of a Hydro-Brake ensures that discharge rates remain controlled and consistent, in contrast to natural storm events, which can cause sudden and severe surges in water volume.
- Overall, the proposed strategy provides a more resilient and sustainable drainage solution compared to unrestricted runoff from a greenfield site.

Foul Water Drainage

Foul Water Management

- Foul drainage will connect to an existing United Utilities foul sewer located in the highway, School Brow. Approximately 75m southeast of the site.
- Gravity discharge is achievable despite topographical constraints.
- The ground is unsuitable for foul drainage fields, so mains connection is necessary and in line with foul drainage hierarchy.

Proposed Solution

- A gravity-fed foul water system will be installed to connect to the public sewer.
- The system will comply with Building Regulations and adoptable standards for structural integrity and long-term durability.

Mitigation and Compliance Measures

- The drainage strategy is designed to comply with **national and local drainage policies**.
- A **maintenance and management plan** will be implemented to ensure the long-term efficiency of the system.
- The attenuation basin will be **monitored and maintained** to prevent failure and ensure environmental protection.

Conclusion

The proposed drainage strategy at Moresby Parks is sustainable and robust, ensuring that surface and foul water are managed effectively. Through **attenuation, flow control**, and compliance with current policy, the development will not increase flood risk and offers measurable improvements over existing greenfield conditions.

For Tweddell & Slater Ltd

April 2025

APPENDIX

APPENDIX A	ARCHITECTS / PROPOSED SITE LAYOUTS
APPENDIX B	EXISTING SITE PLAN
APPENDIX C	PROPOSED DRAINAGE STRATEGY, EXCEEDANCE ROUTES & CONTRIBUTING AREA PLAN
APPENDIX D	GREEN FIELD RUN OFF CALCULATIONS /DRAINAGE STRATEGY CALCULATIONS
APPENDIX E	OPERATION AND MAINTENANCE PLAN
APPENDIX F	SEWER RECORDS
APPENDIX G	GROUND INVESTIGATION REPORT (Permeability Section 5.4)

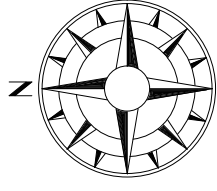
APPENDIX A

ARCHITECTS / PROPOSED SITE LAYOUTS

NOTES AND AMENDMENTS

This drawing is copyright ©. Figured dimensions are to be followed in preference to scaled dimensions and particulars are to be taken from the actual work where possible. Any discrepancy must be reported to the architect immediately and before proceeding.

REVISIONS		
Rev	Description	Date



ASHWOOD

DESIGN ASSOCIATES LTD

01228 510616

adm@ashwooddesign.co.uk

www.ashwooddesign.co.uk

Solway House Business Centre,

Perth House Road,

C66 4BY

Purpose

Project

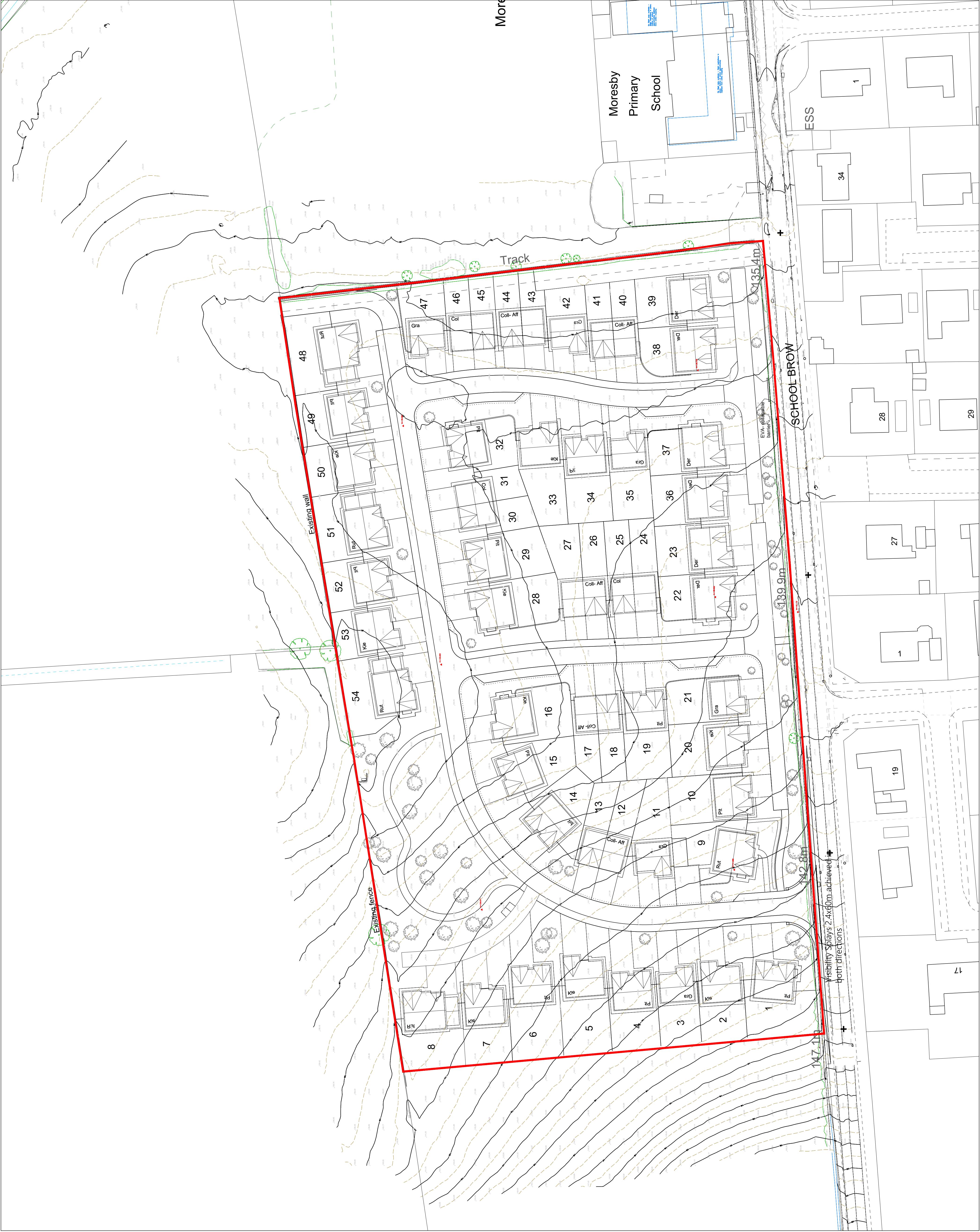
Planning

Proposed Development,
Moresby

Title

Site Layout

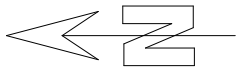
Scale:	Sheet Size:	Drawn:	Date:
1/500	A1	hrh	05-24
Project No:	Drawing No:	Revision:	
2095	102	Y	



APPENDIX B

EXISTING SITE PLAN

This drawing remains the property of Tweddell & Slater Limited and is confidential to our client and may not be reproduced or passed on without the written prior permission of both Tweddell & Slater Limited and the client.



PROPOSED SITE
BOUNDARY 2.88Ha

Issues

Playing Field

Moresby
School

Miners W
Institu

Suitability

PRELIMINARY

Project
West Site
Moresby Parks
Client

Drawing
Existing Site layout

Project no Drawing no Date Drawn by Rev Scale Sheet
7584 C-P-00-03 FEB 25 AJ - 1:500 A1

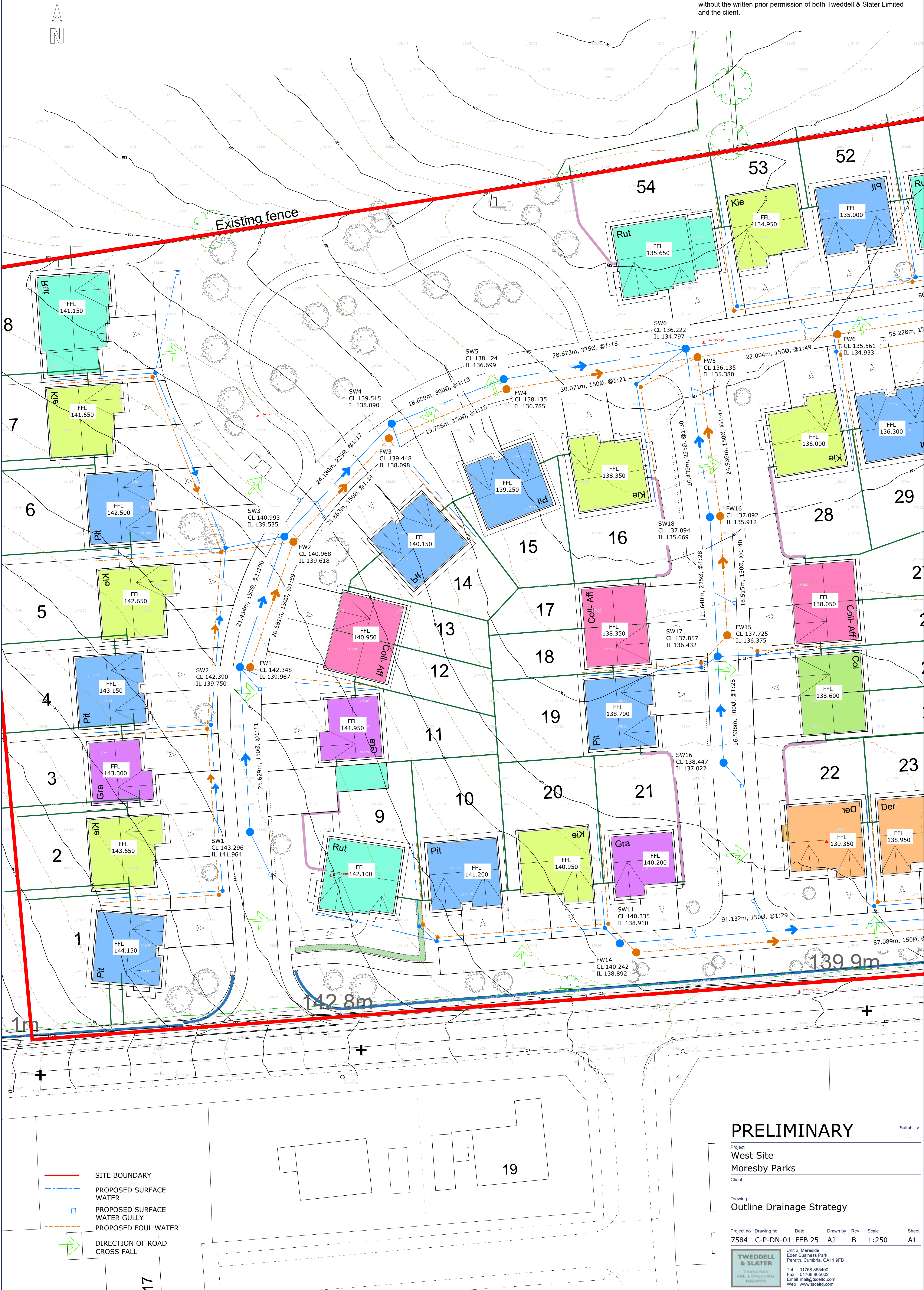


Unit 2, Moreside
Eden Business Park
Penrith, Cumbria, CA11 9PB
Tel 01768 865400
Fax 01768 865402
Email info@tseltd.com
Web www.tseltd.com

APPENDIX C

PROPOSED DRAINAGE STRATEGY, EXCEEDANCE ROUTES & CONTRIBUTING AREA PLAN

This drawing remains the property of Tweddell & Slater Limited and is confidential to our client and may not be reproduced or passed on without the written prior permission of both Tweddell & Slater Limited and the client.



- SITE BOUNDARY
- PROPOSED SURFACE WATER
- PROPOSED SURFACE WATER GULLY
- PROPOSED FOUL WATER
- DIRECTION OF ROAD CROSS FALL

PRELIMINARY

Project
West Site
Moresby Parks
Client

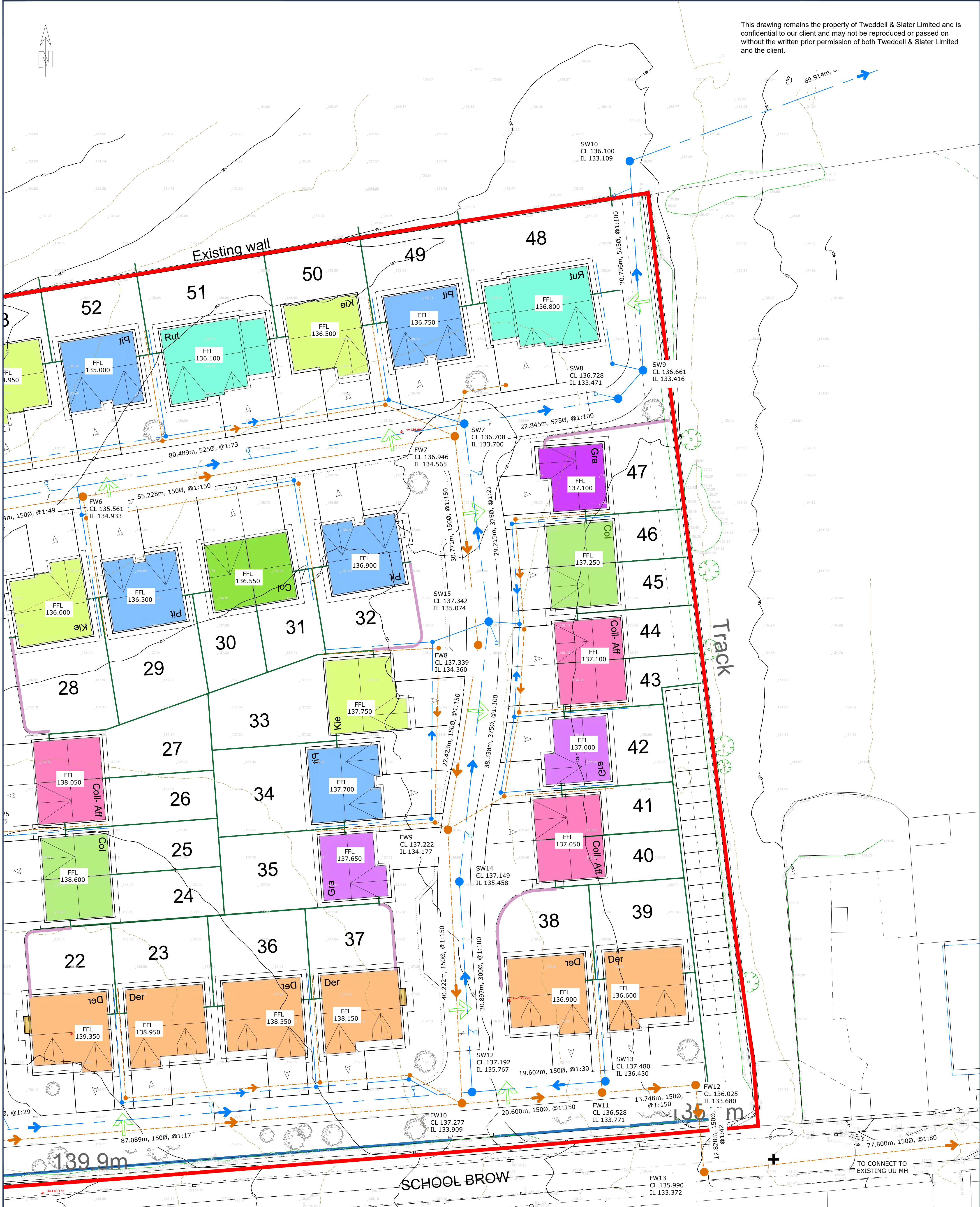
Drawing
Outline Drainage Strategy

Project no	Drawing no	Date	Drawn by	Rev	Scale	Sheet
7584	C-P-DN-01	FEB 25	AJ	B	1:250	A1



Unit 2, Mereside
Eden Business Park
Penrith, Cumbria, CA11 9FB
Tel 01768 865400
Fax 01768 865002
Email mail@tscltd.com
Web www.tscltd.com

This drawing remains the property of Tweddell & Slater Limited and is confidential to our client and may not be reproduced or passed on without the written prior permission of both Tweddell & Slater Limited and the client.



- SITE BOUNDARY
- PROPOSED SURFACE WATER
- PROPOSED SURFACE WATER GULLY
- PROPOSED FOUL WATER
- DIRECTION OF ROAD CROSS FALL

PRELIMINARY

Project
West Site
Moresby Parks
Client

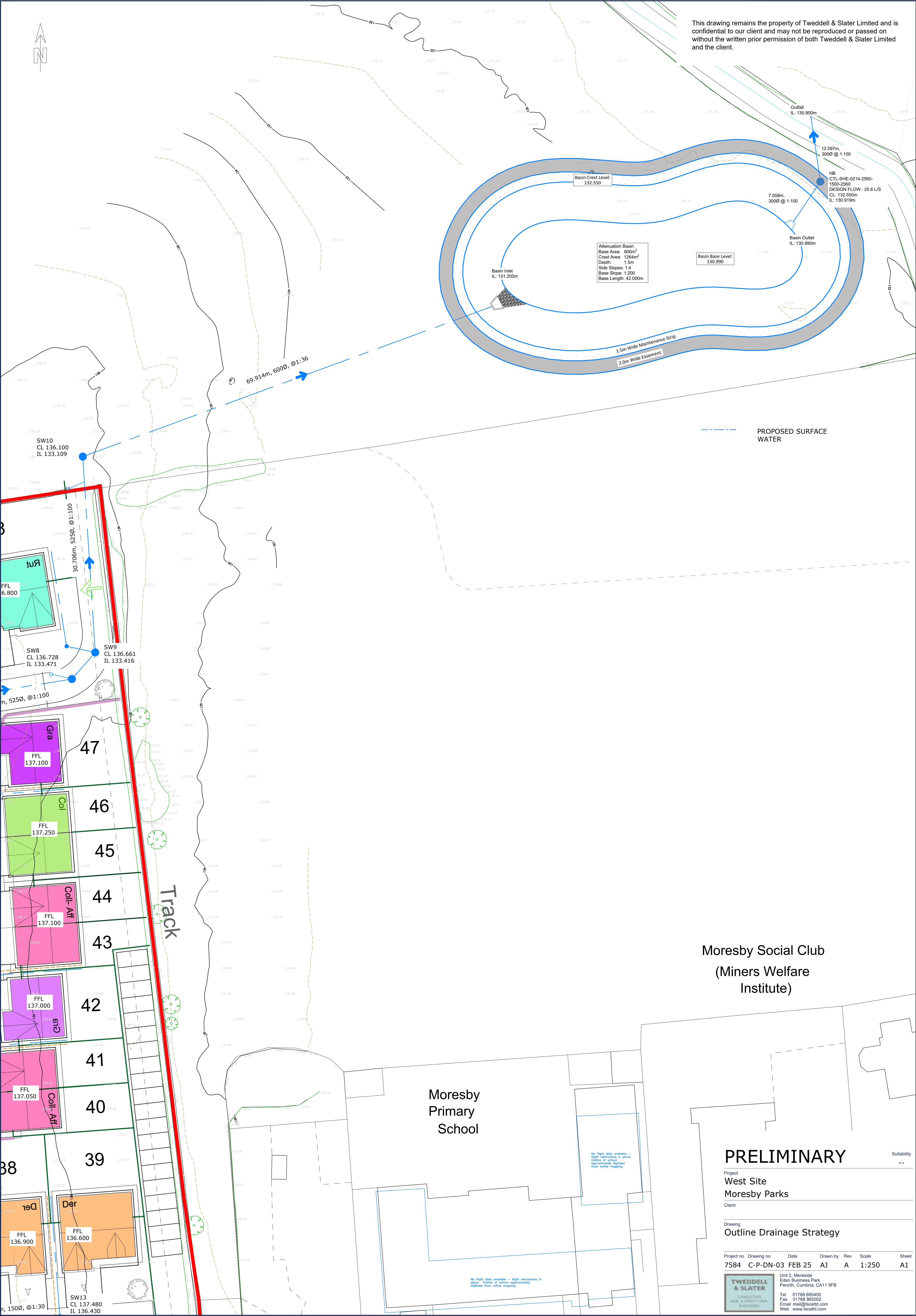
Drawing
Outline Drainage Strategy

Project no	Drawing no	Date	Drawn by	Rev	Scale	Sheet
7584	C-P-DN-02	FEB 25	AJ	B	1:250	A1

TWEDDELL & SLATER
CONSULTING
CIVIL & STRUCTURAL
ENGINEERS

Unit 2, Mereside
Eden Business Park
Penrith, Cumbria, CA11 9FB
Tel 01768 865400
Fax 01768 865002
Email mail@tscedtd.com
Web www.tscedtd.com

This drawing remains the property of Tweddell & Slater Limited and is confidential to our client and may not be reproduced or passed on without the written prior permission of both Tweddell & Slater Limited and the client.



Moresby Social Club
(Miners Welfare
Institute)

Moresby
Primary
School

PRELIMINARY

Project
West Site
Moresby Parks
Client

Drawing
Outline Drainage Strategy

Project no Drawing no Date Drawn by Rev Scale Sheet
7584 C-P-DN-03 FEB 25 AJ A 1:250 A1



Unit 2, Mereside
Eden Business Park
Penrith, Cumbria, CA11 9FB
Tel 01768 865400
Fax 01768 865002
Email mail@tsceltd.com
Web www.tsceltd.com

This drawing remains the property of Tweddell & Slater Limited and is confidential to our client and may not be reproduced or passed on without the written prior permission of both Tweddell & Slater Limited and the client.

Moresby Social Club
(Miners Welfare
Institute)

Moresby
Primary
School

ESS

PRELIMINARY

Project
West Site
Moresby Parks

Drawing

Outline Drainage Strategy

Project no	Drawing no	Date	Drawn by	Rev	Scale	Sheet
7584	C-P-DN-04	FEB 25	AJ	-	1:250	A1

**TWEDDELL
& SLATER**
CONSULTING
CIVIL & STRUCTURAL
ENGINEERS

Unit 2, Mereside
Eden Business Park
Penrith, Cumbria, CA11 9FB

Tel 01768 865400
Fax 01768 865002
Email mail@tsceltid.com
Web www.tsceltid.com

PROPOSED SURFACE
WATER

Track

SES

4

4

**TWEDDELL
& SLATER**
CONSULTING
CIVIL & STRUCTURAL
ENGINEERS

Unit 2, Mereside
Eden Business Park
Penrith, Cumbria, CA11 9FB

Tel 01768 865400
Fax 01768 865002
Email mail@tscltd.com
Web www.tscltd.com

Project no	Drawing no	Date	Drawn by	Rev	Scale	Sheet
7584	C-P-00-04	FEB 25	AJ	-	1:500	A1

Project

Moresby Parks

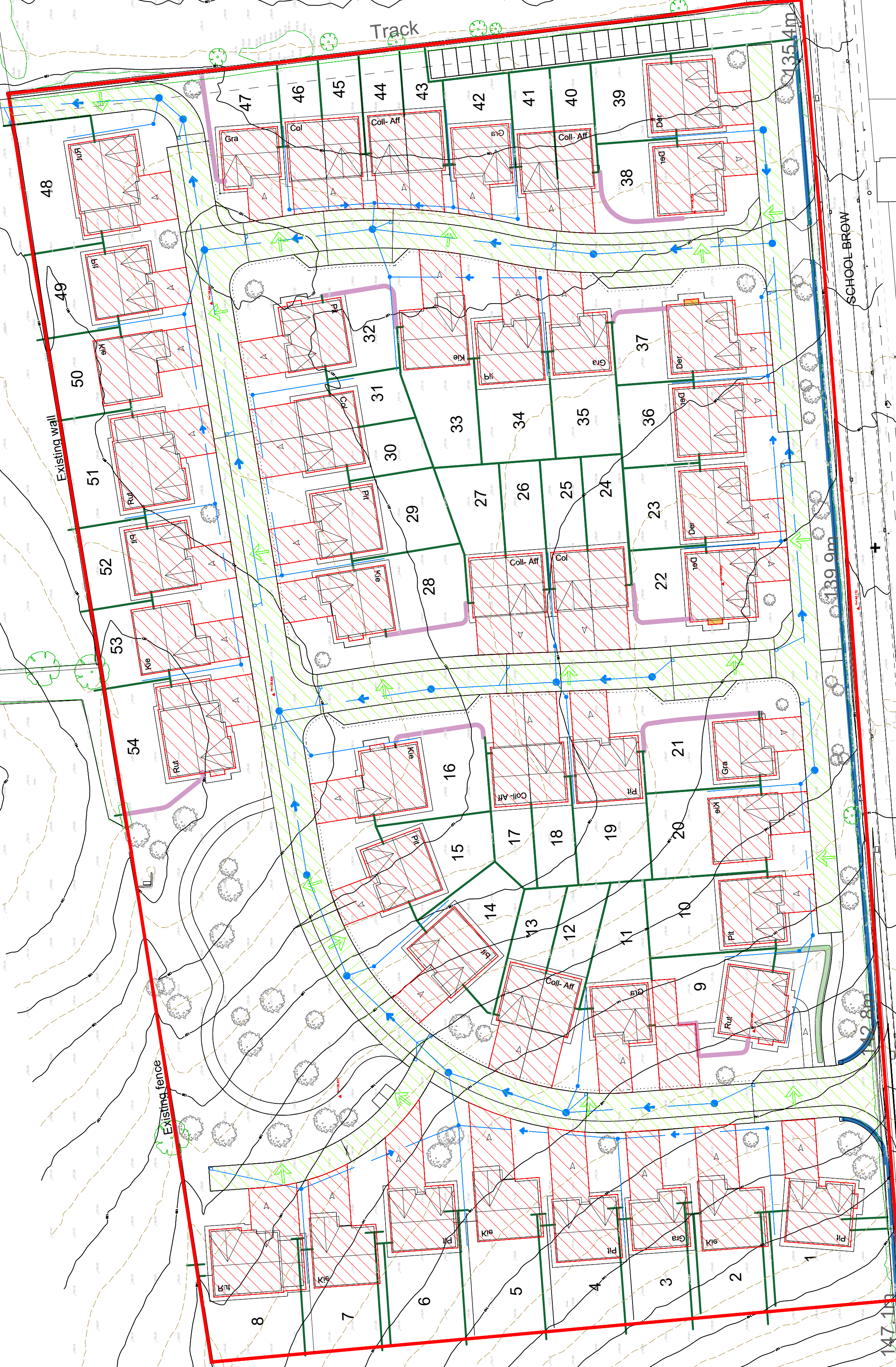
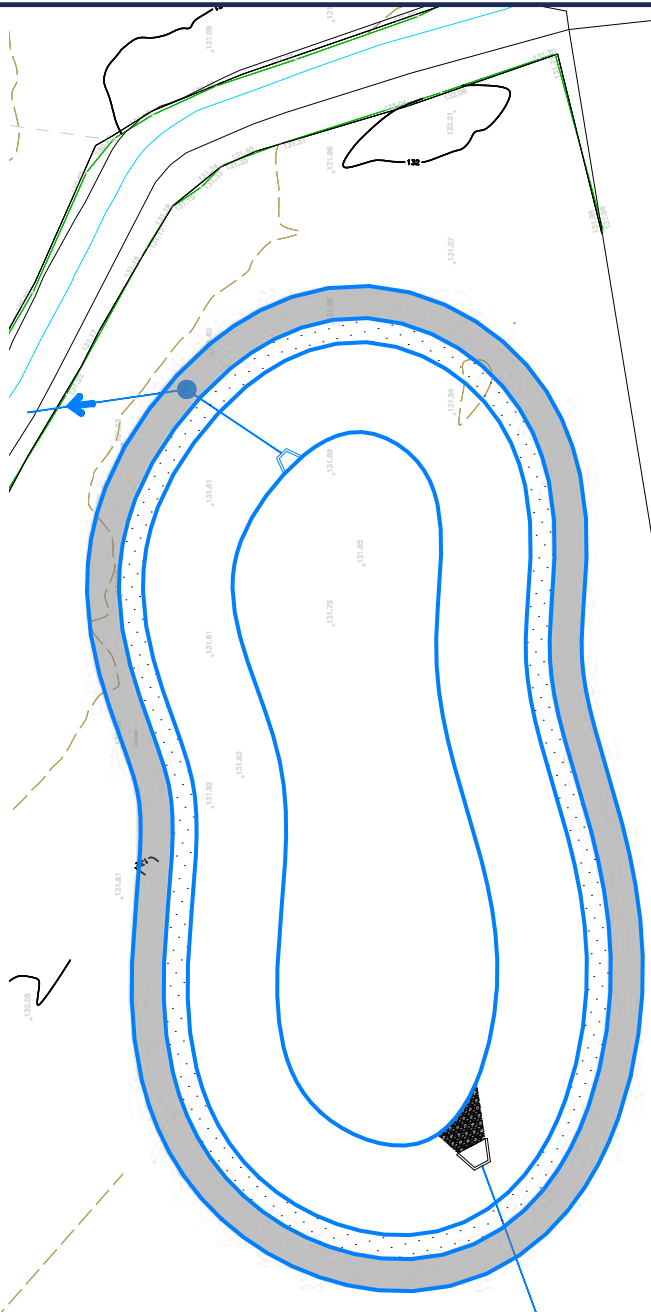
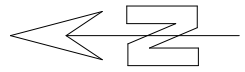
Drawing

Exceedance Routes

This drawing remains the property of Tweddell & Slater Limited and is confidential to our client and may not be reproduced or passed on without the written prior permission of both Tweddell & Slater Limited and the client.

TOTAL SITE AREA:	2.89ha
CONTRIBUTING AREAS:	
ROOF / DRIVE AREAS	0.83ha
ROAD AREAS	0.44ha

—	SITE BOUNDARY
- - -	PROPOSED SURFACE
—	WATER
▨	ROOF / DRIVE AREAS
▨	ROAD AREAS



Moresby Social Club
(Miners Welfare
Institute)

Moresby
Primary
School

ESS

SCHOOL BROW

PRELIMINARY

Project
West Site
Moresby Parks

Client

Drawing

Contributing Area Plan

Project no	Drawing no	Date	Drawn by	Rev	Scale	Sheet
7584	C-P-00-05	FEB 25	AJ	-	1:500	A1



Unit 2, Moreside
Eden Business Park
Penrith, Cumbria, CA11 9PB
Tel: 01768 865400
Fax: 01768 865402
Email: info@tsltd.com
Web: www.tslltd.com

APPENDIX D

GREEN FIELD RUN OFF CALCULATIONS
/DRAINAGE STRATEGY CALCULATIONS

Calculated by:	Andy Johnston
Site name:	West Site
Site location:	Moresby Parks

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:	54.56208° N
Longitude:	3.55669° W
Reference:	4112540344
Date:	Mar 05 2025 16:10

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):	2.88
-----------------------	------

Methodology

Q _{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Notes

(1) Is $Q_{\text{BAR}} < 2.0$ 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

(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.

Hydrological characteristics

	Default	Edited
SAAR (mm):	1178	1178
Hydrological region:	10	10
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	1.7	1.7
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

(3) Is $\text{SPR}/\text{SPRHOST} \leq 0.3$?

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):	25.56	25.56
1 in 1 year (l/s):	22.24	22.24
1 in 30 years (l/s):	43.46	43.46
1 in 100 year (l/s):	53.17	53.17
1 in 200 years (l/s):	60.59	60.59

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	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	50	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	17.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.300	Preferred Cover Depth (m)	1.200
CV	1.000	Include Intermediate Ground	x
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
SW1	0.021	5.00	143.296	1200	1.332
SW2	0.068	5.00	142.390	1200	2.640
SW3	0.160	5.00	140.993	1200	1.458
SW4	0.063	5.00	139.515	1200	1.425
SW5	0.035	5.00	138.124	1350	1.425
SW6	0.073	5.00	136.222	1800	1.425
SW7	0.271	5.00	136.708	1500	3.008
SW8	0.011	5.00	136.728	1500	3.257
SW9	0.000		136.661	1500	3.245
SW10	0.017	5.00	136.100	1500	2.991
SW11	0.063	5.00	140.335	1200	1.425
SW12	0.119	5.00	137.192	1200	1.425
SW13	0.052	5.00	137.480	1200	1.050
SW14	0.029	5.00	137.149	1350	1.691
SW15	0.169	5.00	137.342	1350	2.268
SW16	0.014	5.00	138.447	1200	1.425
SW17	0.083	5.00	137.857	1200	1.425
SW18	0.020	5.00	137.094	1350	1.425
BASIN INLET			132.550	1500	1.350
BASIN OUTLET		5.00	132.550	1200	1.560
HB			132.550	1800	1.631
OUTFALL			131.200	1200	0.400

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	SW1	SW2	25.629	0.600	141.964	139.750	2.214	11.6	150	5.14	50.0
1.001	SW2	SW3	21.434	0.600	139.750	139.535	0.215	99.7	150	5.50	50.0
1.002	SW3	SW4	24.180	0.600	139.535	138.090	1.445	16.7	225	5.62	50.0
1.003	SW4	SW5	18.689	0.600	138.090	136.699	1.391	13.4	300	5.70	50.0
1.004	SW5	SW6	28.673	0.600	136.699	134.797	1.902	15.1	375	5.80	50.0
1.005	SW6	SW7	80.489	0.600	134.797	133.700	1.097	73.4	525	6.31	50.0
1.006	SW7	SW8	22.845	0.600	133.700	133.471	0.229	99.8	525	6.78	50.0
1.007	SW8	SW9	5.539	0.600	133.471	133.416	0.055	100.7	525	6.82	50.0
1.008	SW9	SW10	30.706	0.600	133.416	133.109	0.307	100.0	525	7.05	50.0
1.009	SW10	BASIN INLET	69.914	0.600	133.109	131.200	1.909	36.6	600	7.34	50.0
1.010	BASIN OUTLET	HB	7.058	0.600	130.990	130.919	0.071	99.4	300	5.07	50.0
1.011	HB	OUTFALL	12.097	0.600	130.919	130.800	0.119	101.7	300	5.20	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	2.977	52.6	5.7	1.182	2.490	0.021	0.0	33	1.953
1.001	1.006	17.8	24.1	2.490	1.308	0.089	0.0	150	1.025
1.002	3.214	127.8	67.5	1.233	1.200	0.249	0.0	116	3.259
1.003	4.311	304.7	84.6	1.125	1.125	0.312	0.0	108	3.705
1.004	4.686	517.6	94.1	1.050	1.050	0.347	0.0	107	3.591
1.005	2.617	566.5	145.6	0.900	2.483	0.537	0.0	181	2.209
1.006	2.242	485.4	336.1	2.483	2.732	1.240	0.0	322	2.411
1.007	2.232	483.1	339.1	2.732	2.720	1.251	0.0	325	2.407
1.008	2.239	484.8	339.1	2.720	2.466	1.251	0.0	325	2.414
1.009	4.032	1140.0	343.7	2.391	0.750	1.268	0.0	225	3.549
1.010	1.577	111.4	0.0	1.260	1.331	0.000	0.0	0	0.000
1.011	1.559	110.2	0.0	1.331	0.100	0.000	0.0	0	0.000

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)
2.000	SW11	SW12	91.132	0.600	138.910	135.767	3.143	29.0	150	5.81	50.0
2.001	SW12	SW14	30.897	0.600	135.767	135.458	0.309	100.0	300	6.14	50.0
2.003	SW14	SW15	38.338	0.600	135.458	135.074	0.384	99.8	375	6.49	50.0
2.004	SW15	SW7	29.215	0.600	135.074	133.700	1.374	21.3	375	6.61	50.0
3.000	SW13	SW12	19.602	0.600	136.430	135.767	0.663	29.6	150	5.18	50.0
4.000	SW16	SW17	16.538	0.600	137.022	136.432	0.590	28.0	100	5.19	50.0
4.001	SW17	SW18	21.640	0.600	136.432	135.669	0.763	28.4	225	5.33	50.0
4.002	SW18	SW6	26.439	0.600	135.669	134.797	0.872	30.3	225	5.52	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)
2.000	1.876	33.2	17.1	1.275	1.275	0.063	0.0	76	1.891
2.001	1.572	111.1	63.4	1.125	1.391	0.234	0.0	163	1.622
2.003	1.813	200.2	71.3	1.316	1.893	0.263	0.0	154	1.665
2.004	3.944	435.6	117.1	1.893	2.633	0.432	0.0	132	3.365
3.000	1.858	32.8	14.1	0.900	1.275	0.052	0.0	69	1.791
4.000	1.463	11.5	3.8	1.325	1.325	0.014	0.0	39	1.311
4.001	2.466	98.0	26.3	1.200	1.200	0.097	0.0	80	2.101
4.002	2.384	94.8	31.7	1.200	1.200	0.117	0.0	89	2.150

Simulation Settings

Rainfall Methodology	FSR	Summer CV	1.000	Additional Storage (m³/ha)	20.0
Rainfall Events	Singular	Winter CV	1.000	Starting Level (m)	
FSR Region	England and Wales	Analysis Speed	Detailed	Check Discharge Rate(s)	x
M5-60 (mm)	17.000	Skip Steady State	x	Check Discharge Volume	x
Ratio-R	0.300	Drain Down Time (mins)	240		

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 %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0	100	50	10	0
30	45	10	0				

Node HB Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	130.990	Product Number	CTL-SHE-0214-2560-1500-2560
Design Depth (m)	1.500	Min Outlet Diameter (m)	0.300
Design Flow (l/s)	25.6	Min Node Diameter (mm)	1800

Node BASIN OUTLET Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	42.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	130.990	Main Channel Slope (1:X)	200.0
Safety Factor	2.0	Time to half empty (mins)		Main Channel n	0.030

Inlets

BASIN INLET

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	600.0	600.0	1.560	1264.2	1284.6

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

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.63%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW1	10	141.988	0.024	2.9	0.0346	0.0000	OK
15 minute summer	SW2	10	139.845	0.095	12.3	0.1563	0.0000	OK
15 minute summer	SW3	10	139.617	0.082	33.9	0.2721	0.0000	OK
15 minute summer	SW4	10	138.169	0.079	42.3	0.1586	0.0000	OK
15 minute summer	SW5	10	136.774	0.075	46.8	0.1446	0.0000	OK
15 minute summer	SW6	11	134.921	0.124	72.3	0.4433	0.0000	OK
15 minute summer	SW7	11	133.937	0.237	165.4	0.8445	0.0000	OK
15 minute summer	SW8	11	133.734	0.263	165.2	0.4825	0.0000	OK
15 minute summer	SW9	11	133.643	0.227	164.3	0.4003	0.0000	OK
15 minute summer	SW10	12	133.303	0.194	165.5	0.3641	0.0000	OK
15 minute summer	SW11	10	138.962	0.052	8.7	0.1041	0.0000	OK
15 minute summer	SW12	11	135.880	0.113	32.0	0.3152	0.0000	OK
15 minute summer	SW13	10	136.478	0.047	7.2	0.1007	0.0000	OK
15 minute summer	SW14	11	135.569	0.111	35.3	0.1974	0.0000	OK
15 minute summer	SW15	11	135.165	0.091	57.6	0.2666	0.0000	OK
15 minute summer	SW16	10	137.049	0.027	1.9	0.0364	0.0000	OK
15 minute summer	SW17	10	136.488	0.056	13.3	0.1286	0.0000	OK
15 minute summer	SW18	10	135.731	0.062	16.0	0.1059	0.0000	OK
180 minute summer	BASIN INLET	120	131.262	0.062	68.9	0.1088	0.0000	OK
180 minute summer	BASIN OUTLET	120	131.261	0.271	68.1	0.3068	0.0000	OK
180 minute summer	HB	120	131.256	0.337	23.8	0.8573	0.0000	SURCHARGED
180 minute summer	OUTFALL	120	130.894	0.094	23.8	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 summer	SW1	1.000	SW2	2.9	0.453	0.055	0.1737	
15 minute summer	SW2	1.001	SW3	11.9	1.117	0.672	0.2312	
15 minute summer	SW3	1.002	SW4	33.6	2.650	0.263	0.3069	
15 minute summer	SW4	1.003	SW5	42.0	2.950	0.138	0.2664	
15 minute summer	SW5	1.004	SW6	46.5	2.021	0.090	0.6811	
15 minute summer	SW6	1.005	SW7	72.1	1.111	0.127	5.3655	
15 minute summer	SW7	1.006	SW8	163.8	1.618	0.338	2.3132	
15 minute summer	SW8	1.007	SW9	164.3	1.666	0.340	0.5463	
15 minute summer	SW9	1.008	SW10	163.7	2.048	0.338	2.4603	
15 minute summer	SW10	1.009	BASIN INLET	166.4	4.266	0.146	3.0471	
15 minute summer	SW11	2.000	SW12	8.4	0.858	0.255	0.8902	
15 minute summer	SW12	2.001	SW14	31.5	1.316	0.283	0.7396	
15 minute summer	SW13	3.000	SW12	7.1	0.749	0.217	0.1853	
15 minute summer	SW14	2.003	SW15	35.4	1.480	0.177	0.9202	
15 minute summer	SW15	2.004	SW7	57.7	1.263	0.133	1.3719	
15 minute summer	SW16	4.000	SW17	1.9	0.606	0.163	0.0517	
15 minute summer	SW17	4.001	SW18	13.2	1.593	0.134	0.1790	
15 minute summer	SW18	4.002	SW6	15.8	1.038	0.166	0.4129	
180 minute summer	BASIN INLET	Flow through Pond	BASIN OUTLET	68.1	0.072	0.001	108.2167	
180 minute summer	BASIN OUTLET	1.010	HB	23.8	0.351	0.214	0.4850	
180 minute summer	HB	1.011	OUTFALL	23.8	1.196	0.216	0.2406	198.2

Results for 30 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 99.63%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW1	10	142.011	0.047	11.2	0.0694	0.0000	OK
15 minute summer	SW2	12	141.017	1.267	47.4	2.1518	0.0000	SURCHARGED
15 minute summer	SW3	11	139.737	0.202	120.9	0.7173	0.0000	OK
15 minute summer	SW4	11	138.258	0.168	152.8	0.3533	0.0000	OK
15 minute summer	SW5	11	136.845	0.146	170.8	0.2888	0.0000	OK
15 minute summer	SW6	12	135.124	0.327	270.3	1.1991	0.0000	OK
15 minute summer	SW7	12	134.945	1.245	611.2	4.6688	0.0000	SURCHARGED
15 minute summer	SW8	12	134.443	0.972	581.0	1.7893	0.0000	SURCHARGED
15 minute summer	SW9	12	134.179	0.763	581.9	1.3476	0.0000	SURCHARGED
15 minute summer	SW10	11	133.523	0.414	590.4	0.7833	0.0000	OK
15 minute summer	SW11	10	139.032	0.122	33.7	0.2571	0.0000	OK
15 minute summer	SW12	11	136.134	0.367	123.3	1.0899	0.0000	SURCHARGED
15 minute summer	SW13	11	136.585	0.155	27.8	0.3433	0.0000	SURCHARGED
15 minute summer	SW14	11	135.700	0.242	134.5	0.4375	0.0000	OK
15 minute summer	SW15	11	135.354	0.280	220.8	0.8586	0.0000	OK
15 minute summer	SW16	10	137.081	0.059	7.5	0.0791	0.0000	OK
15 minute summer	SW17	10	136.553	0.121	51.7	0.2918	0.0000	OK
15 minute summer	SW18	10	135.800	0.131	62.1	0.2285	0.0000	OK
240 minute summer	BASIN INLET	208	131.823	0.623	215.4	1.1005	0.0000	OK
240 minute summer	BASIN OUTLET	208	131.823	0.833	120.3	0.9419	0.0000	SURCHARGED
240 minute summer	HB	208	131.816	0.897	26.2	2.2834	0.0000	SURCHARGED
180 minute summer	OUTFALL	372	130.897	0.097	25.6	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 summer	SW1	1.000	SW2	11.1	0.838	0.212	0.2859	
15 minute summer	SW2	1.001	SW3	40.1	2.277	2.255	0.3773	
15 minute summer	SW3	1.002	SW4	120.7	3.476	0.944	0.8394	
15 minute summer	SW4	1.003	SW5	153.0	4.095	0.502	0.6981	
15 minute summer	SW5	1.004	SW6	171.0	2.897	0.330	1.9901	
15 minute summer	SW6	1.005	SW7	261.2	1.433	0.461	14.3743	
15 minute summer	SW7	1.006	SW8	576.4	2.668	1.187	4.9353	
15 minute summer	SW8	1.007	SW9	581.9	2.694	1.205	1.1966	
15 minute summer	SW9	1.008	SW10	583.3	2.892	1.203	6.1216	
15 minute summer	SW10	1.009	BASIN INLET	605.8	5.292	0.531	8.2774	
15 minute summer	SW11	2.000	SW12	33.0	1.901	0.995	1.5023	
15 minute summer	SW12	2.001	SW14	119.7	1.744	1.077	2.0281	
15 minute summer	SW13	3.000	SW12	27.4	1.574	0.834	0.3451	
15 minute summer	SW14	2.003	SW15	134.8	1.914	0.673	3.1296	
15 minute summer	SW15	2.004	SW7	215.4	2.025	0.494	2.8985	
15 minute summer	SW16	4.000	SW17	7.4	1.055	0.647	0.1042	
15 minute summer	SW17	4.001	SW18	51.4	2.246	0.524	0.4955	
15 minute summer	SW18	4.002	SW6	61.7	1.727	0.651	0.8437	
240 minute summer	BASIN INLET	Flow through Pond	BASIN OUTLET	120.3	0.124	0.002	552.1812	
240 minute summer	BASIN OUTLET	1.010	HB	26.2	0.442	0.235	0.4970	
240 minute summer	HB	1.011	OUTFALL	25.6	1.219	0.232	0.2540	631.7

Results for 100 year +50% CC +10% A Critical Storm Duration. Lowest mass balance: 99.63%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW1	12	142.191	0.227	14.9	0.3352	0.0000	SURCHARGED
15 minute summer	SW2	12	142.108	2.358	62.4	4.0044	0.0000	FLOOD RISK
15 minute summer	SW3	12	140.487	0.952	152.5	3.3744	0.0000	SURCHARGED
15 minute summer	SW4	11	138.277	0.187	182.0	0.3927	0.0000	OK
15 minute summer	SW5	12	136.881	0.182	205.7	0.3587	0.0000	OK
15 minute summer	SW6	12	135.967	1.170	327.5	4.2966	0.0000	FLOOD RISK
15 minute summer	SW7	12	135.595	1.895	695.8	7.1044	0.0000	SURCHARGED
15 minute summer	SW8	12	134.864	1.393	700.8	2.5653	0.0000	SURCHARGED
15 minute summer	SW9	12	134.480	1.064	701.4	1.8804	0.0000	SURCHARGED
15 minute summer	SW10	11	133.576	0.467	711.6	0.8829	0.0000	OK
15 minute summer	SW11	12	140.082	1.172	44.7	2.4662	0.0000	FLOOD RISK
15 minute summer	SW12	12	136.853	1.086	144.7	3.2229	0.0000	SURCHARGED
15 minute summer	SW13	12	137.359	0.929	36.9	2.0618	0.0000	FLOOD RISK
15 minute summer	SW14	12	136.371	0.913	155.3	1.6518	0.0000	SURCHARGED
15 minute summer	SW15	12	136.131	1.057	255.1	3.2469	0.0000	SURCHARGED
15 minute summer	SW16	10	137.095	0.072	9.9	0.0976	0.0000	OK
15 minute summer	SW17	12	136.704	0.272	68.7	0.6555	0.0000	SURCHARGED
15 minute summer	SW18	12	136.429	0.760	82.8	1.3226	0.0000	SURCHARGED
240 minute winter	BASIN INLET	236	132.120	0.920	197.7	1.6254	0.0000	OK
240 minute winter	BASIN OUTLET	236	132.120	1.130	112.7	1.2779	0.0000	SURCHARGED
240 minute winter	HB	236	132.115	1.195	26.0	3.0425	0.0000	SURCHARGED
15 minute summer	OUTFALL	79	130.897	0.097	25.6	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 summer	SW1	1.000	SW2	14.1	1.017	0.268	0.4512	
15 minute summer	SW2	1.001	SW3	46.8	2.660	2.633	0.3773	
15 minute summer	SW3	1.002	SW4	140.2	3.592	1.097	0.9066	
15 minute summer	SW4	1.003	SW5	182.0	4.189	0.597	0.8351	
15 minute summer	SW5	1.004	SW6	202.6	2.926	0.392	2.3405	
15 minute summer	SW6	1.005	SW7	308.2	1.434	0.544	17.3883	
15 minute summer	SW7	1.006	SW8	694.7	3.216	1.431	4.9353	
15 minute summer	SW8	1.007	SW9	701.4	3.247	1.452	1.1966	
15 minute summer	SW9	1.008	SW10	702.1	3.301	1.448	6.4312	
15 minute summer	SW10	1.009	BASIN INLET	734.9	5.294	0.645	10.2106	
15 minute summer	SW11	2.000	SW12	32.9	1.870	0.993	1.6044	
15 minute summer	SW12	2.001	SW14	134.7	1.914	1.213	2.1757	
15 minute summer	SW13	3.000	SW12	31.3	1.779	0.954	0.3451	
15 minute summer	SW14	2.003	SW15	155.0	1.866	0.774	4.2286	
15 minute summer	SW15	2.004	SW7	236.8	2.147	0.544	3.2223	
15 minute summer	SW16	4.000	SW17	9.8	1.307	0.852	0.1149	
15 minute summer	SW17	4.001	SW18	68.6	2.304	0.700	0.8606	
15 minute summer	SW18	4.002	SW6	77.3	1.970	0.815	1.0515	
240 minute winter	BASIN INLET	Flow through Pond	BASIN OUTLET	112.7	0.115	0.002	841.3728	
240 minute winter	BASIN OUTLET	1.010	HB	26.0	0.455	0.234	0.4970	
240 minute winter	HB	1.011	OUTFALL	25.6	1.219	0.232	0.2540	598.8

APPENDIX E

OPERATION AND MAINTENANCE PLAN



Unit 2, Mereside
Greenbank Road
Eden Business Park
Gillwilly, Penrith
Cumbria, CA11 9FB

DRAINAGE STRATEGY FOR PROPOSED RESIDENTIAL DEVELOPMENT AT MORESBY PARKS, CA28 8UX

OPERATION AND MAINTENANCE PLAN

DIRECTOR

R. J. Gibson BEng (Hons) CEng MStructE

Tel 01768 865400

Email mail@tsceltd.com

www.tsceltd.com

CONTENTS

1. INTRODUCTION	pg. 3
2. DESCRIPTION OF THE PROJECT	pg. 3
3. DRAINAGE MAINTENANCE RESPONSIBILITIES.	Pg. 3
4. EMERGENCY CONTACT	pg. 4
5. MAINTENANCE OF DRAINAGE ITEMS	pg. 5
6. INSPECTION CHECK LIST	pg. 9

1.INTRODUCTION

The Operation and Maintenance Plan details all the relevant information required for the operation and maintenance of the private drainage system on site, including the Attenuation Basin.

The operation and maintenance of any public or adoptable drainage is not covered in this report.

2. PROJECT BRIEF

The development includes 54 residential dwellings and development access roads. The site is located at Moresby Parks, near to Moresby Primary School, CA28 8UX

Surface Water Drainage

The roof and drive areas of the dwellings and development access road are positively drained discharged into an attenuation basin with a controlled outfall into a nearby beck.

Foul Water Drainage

The foul water is on a separate drainage system which drains to a public sewer located in School Brow highway

Access

The attenuation basin is the responsibility of the client. The basin is located in an easily accessible areas to the north east of the site.

3. DRAINAGE MAINTENANCE RESPONSIBILITIES

Surface Water Drainage

The surface water system on site will not be offered for adoption by the regional water authority and will therefore be under the maintenance of the client who will be responsible for financing and completion of the ongoing and capital maintenance i.e. replacement of components as required

Foul Water Drainage

The foul water system will be the responsibility of the client who will be responsible for the financing and completion of the ongoing and capital maintenance i.e. replacement of components as required

4. Pollution / Emergency Contact

Contact if pollution is seen on site or if an item of drainage is not working

.....

Emergency action

Most spillages on development sites are of compounds that do not pose a serious risk to the environment if they enter the drainage in a slow and controlled manner with time available for natural breakdown in a treatment system. Therefore, small spillages of oil, milk or other known organic substances should be removed where possible using soak mats as recommended by the Environment Agency, with residual spillage allowed to bioremediate in the drainage system.

In the event of a serious spillage, either by volume or of unknown or toxic compounds, then isolate the spillage with soil, turf or fabric and block outlet pipes from chamber(s) downstream of the spillage with a bung(s). (A bung for blocking pipes may be made by wrapping soil or turf in a plastic sheet or closely woven fabric.)

Contact the Environment Agency immediately

Environment Agency Incident Hotline: **0800 80 70 60**

Safety Precautions

- Always wear appropriate personal protective equipment (PPE) during maintenance.
- Ensure all electrical systems are powered off before inspection or servicing.
- Follow all relevant health and safety regulations, especially when handling waste.

5. MAINTENANCE OF DRAINAGE ITEMS

Detention Basin

Detention basins require routine maintenance to function effectively, including litter removal, selective mowing (especially access routes and storage areas), occasional sediment removal, and vegetation management to support water treatment and prevent invasive species. Maintenance should align with a clear long-term plan, include safe access for machinery, and be assigned to a responsible party. Most tasks can be integrated into standard landscape maintenance with minimal additional cost, and any sediment disposal should follow appropriate environmental guidance

Removal of silt and other pollutants must be in accordance with the appropriate waste management legislation.

Table below taken from Table 22.1 The SUDDS Manual C753

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut grass – for spillways and access routes	Monthly (during growing season)
	Cut grass – meadow grass in and around basin	Half yearly (spring, before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)

	Manage wetland plants in outlet pool – where provided	Annually
Occasional maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

Channel Kerb/ Kerb Drainage System

The maintenance schedule below is to be read in conjunction with the manufacturers detailed specifications and maintenance procedures and frequencies.

Removal of silt and other pollutants must be in accordance with the appropriate waste management legislation.

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris and inspect for sediment accumulation. Empty silt trap buckets replace and jet clean	Annually
Remedial Actions	Repair/rehabilitation of channels and gratings. Replacement of malfunctioning/ damaged parts.	As required

Monitoring	Inspect/check all inlets, outlets, silt traps and gullies to ensure that they are in good condition and operating as designed	Annually and after large storm events
------------	---	---------------------------------------

Surface Water Gullies, Manholes, Inspection Chambers and Silt Traps

Removal of silt and other pollutants must be in accordance with the appropriate waste management legislation.

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspection of Gullies and removal of debris	Six monthly
	Inspection of manholes, inspection chambers, silt traps and removal of debris / sediment build up. Rod pipes if required	Annually
Remedial Actions	Repair/rehabilitation of inlets, outlets, gullies, manholes, silt traps and inspection chambers. Replacement of malfunctioning/ damaged parts.	As required
Monitoring	Inspect/check all inlets, outlets, gullies, manholes, silt traps and inspection chambers to ensure that they are in good condition and operating as designed	Annually and after large storm events

Foul Water Gullies and Manholes

Removal of effluent and other pollutants must be in accordance with the appropriate waste management legislation.

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspection of Gullies and removal of debris	Six monthly
	Inspection of manholes, inspection chambers and removal of debris. Rod pipes if required	Annually
Remedial Actions	Repair/rehabilitation of inlets, outlets, gullies, manholes, and inspection chambers. Replacement of malfunctioning/damaged parts.	As required
Monitoring	Inspect/check all inlets, outlets, gullies, manholes, and inspection chambers to ensure that they are in good condition and operating as designed	Annually and after large storm events

Inspection Check List

Table below taken from Table B.25 The SUDDS Manual C753

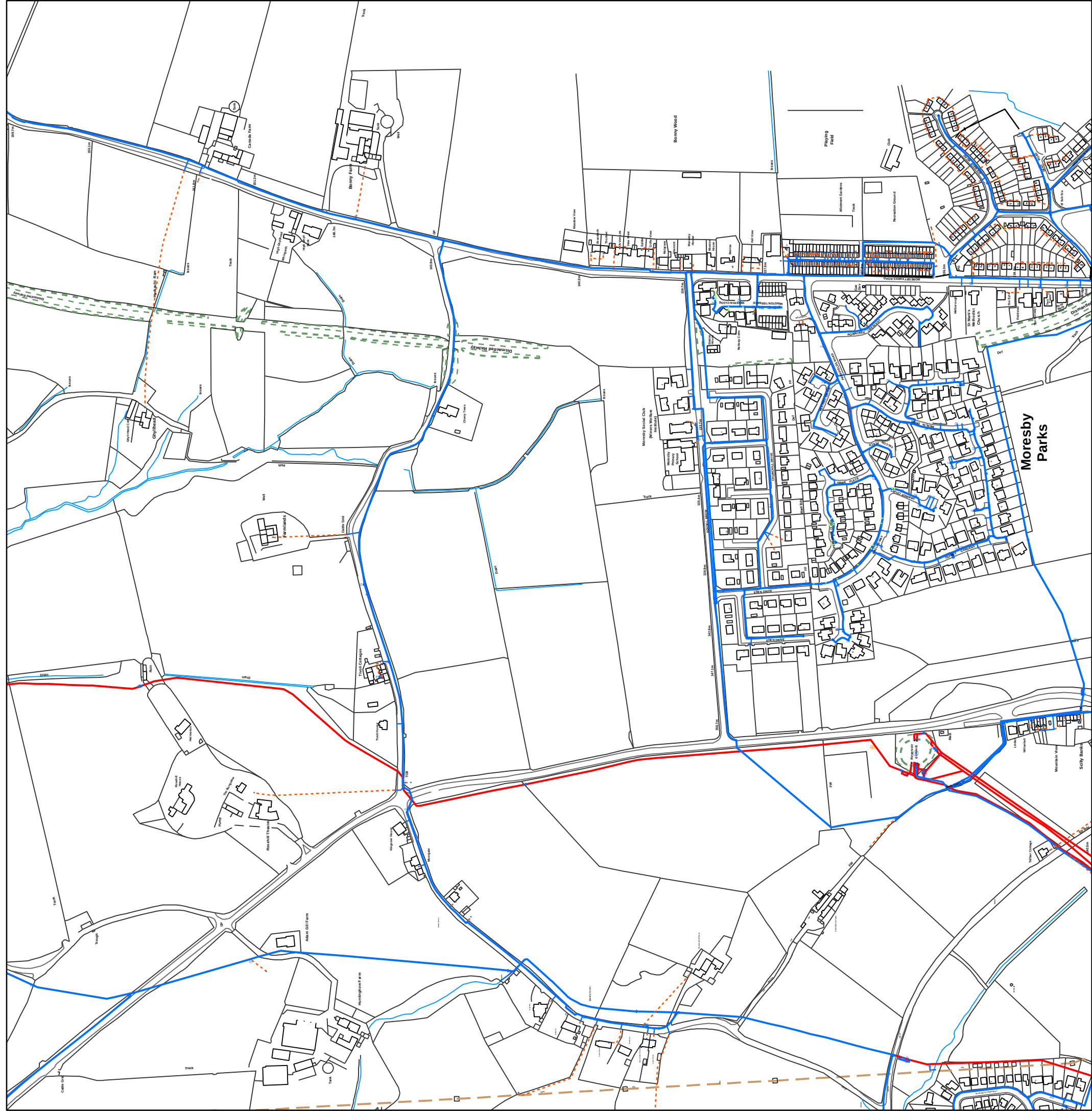
General information				
Site ID				
Site location and co-ordinates (GIS if appropriate)				
Elements forming the SuDS scheme		Approved drawing reference(s)		
Inspection frequency		Approved specification reference		
Type of development		Specific purpose of any parts of the scheme (eg biodiversity, wildlife and visual aspects)		
Inspection date				
	Details	Y/N	Action required	Date completed
General inspection items				
Is there any evidence of erosion, channelling, ponding (where not desirable) or other poor hydraulic performance?				
Is there any evidence of accidental spillages, oils, poor water quality, odours or nuisance insects?				
Have any health and safety risks been identified to either the public or maintenance operatives?				
Is there any deterioration in the surface of permeable or porous surfaces (eg rutting, spreading of blocks or signs of ponding water)?				

Inspection date				
	Details	Y/N	Action required	Date completed
Silt/sediment accumulation				
Is there any sediment accumulation at inlets (or other defined accumulation zones such as the surface of filter drains or infiltration basins and within proprietary devices)? If yes, state depth (mm) and extent. Is removal required? If yes, state waste disposal requirements and confirm that all waste management requirements have been complied with (consult environmental regulator)				
Is surface clogging visible (potentially problematic where water has to soak into the underlying construction or ground (eg underdrained swale or infiltration basin)?				
Does permeable or porous surfacing require sweeping to remove silt?				
System blockages and litter build-up				
Is there evidence of litter accumulation in the system? If yes, is this a blockage risk?				
Is there any evidence of any other clogging or blockage of outlets or drainage paths?				

Inspection date				
	Details	Y/N	Action required	Date completed
Silt/sediment accumulation				
Is there any sediment accumulation at inlets (or other defined accumulation zones such as the surface of filter drains or infiltration basins and within proprietary devices)? If yes, state depth (mm) and extent. Is removal required? If yes, state waste disposal requirements and confirm that all waste management requirements have been complied with (consult environmental regulator)				
Is surface clogging visible (potentially problematic where water has to soak into the underlying construction or ground (eg underdrained swale or infiltration basin)?				
Does permeable or porous surfacing require sweeping to remove silt?				
System blockages and litter build-up				
Is there evidence of litter accumulation in the system? If yes, is this a blockage risk?				
Is there any evidence of any other clogging or blockage of outlets or drainage paths?				

Inspection date				
	Details	Y/N	Action required	Date completed
Infrastructure				
Is there evidence of any accidental damage to the system (eg wheel ruts?)				
Is there any evidence of cross connections or other unauthorised inflows?				
Is there any evidence of tampering with the flow controls?				
Are there any other matters that could affect the performance of the system in relation to the design objectives for hydraulic, water quality, biodiversity and visual aspects? (Specify.)				

APPENDIX F
SEWER RECORDS



**Extract from
Map of Water Mains**

The position of underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available.

The actual positions may be different from those shown on the plan private service pipes may be shown by a broken blue line.

United Utilities will not accept any liability for any damage caused by the actual positions being different from those shown.

United Utilities Water Limited 2014
The plan is based upon the Ordnance Survey Map with the sanction of the Controller of H.M. Stationery Office. Crown and United Utilities copyrights are reserved. Unauthorised reproduction will infringe these copyrights.

LEGEND

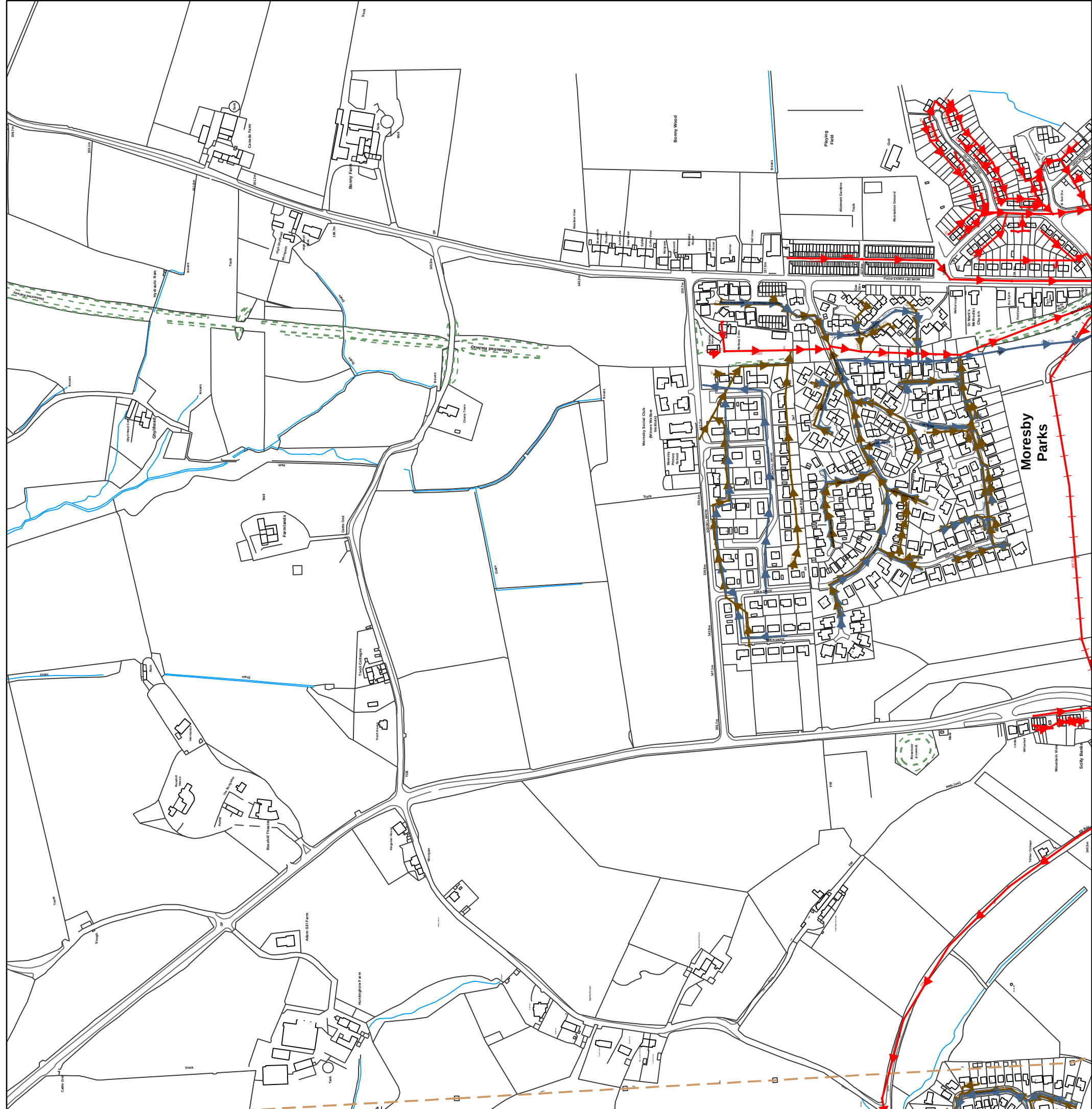
Proposed	Abandoned	Live	
			Distribution Main
			Trunk Main
			Comms Pipe
			Private Pipe
			Raw Water
			LDTM Raw Water
			LDTM Treated Water

MORESBY PARKS, WHITEHAVEN

Printed By : Property Searches Date: 15/08/2016

DO NOT SCALE
Approximate Scale: 1:5000





Extract from
Map of Public Sewers

The position of underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available.

The actual positions may be different from those shown on the plan and private pipes, sewers or drains may not be recorded.

United Utilities will not accept any liability for any damage caused by the actual positions being different from those shown.

United Utilities Water Limited 2014
The plan is based upon the Ordnance Survey Map with the sanction of the Controller of H.M. Stationery Office.Crown and United Utilities copyrights are reserved. Unauthorised reproduction will infringe these copyrights.

LEGEND

	Water Course
	Overflow Pipe
	Sludge Main
	Highway Drain
	Combined
	Surface Water
	Foul
	Abandoned
	Public Sewer
	Private Sewer
	Section 104
	Rising Main

MORESBY PARKS, WHITEHAVEN

Printed By : Property Searches Date: 15/08/2016

DO NOT SCALE
Approximate Scale: 1:5000



WASTE WATER SYMBOLOGY

Legend for Sanitary Sewer System (SSS)

Foul	Surface	Combined	Overflow
Manhole	Manhole	Manhole	Manhole
MainSewer, Public	MainSewer, Public	MainSewer, Public	MainSewer, Public
MainSewer, Private	MainSewer, Private	MainSewer, Private	MainSewer, Private
Rising Main, Public	Rising Main, Public	Rising Main, Public	Rising Main, Public
Rising Main, Private	Rising Main, Private	Rising Main, Private	Rising Main, Private
Rising Main, S104	Rising Main, S104	Rising Main, S104	Rising Main, S104
Highway Drain, Private	Highway Drain, Private	Highway Drain, Private	Highway Drain, Private
Highway Drain, S104	Highway Drain, S104	Highway Drain, S104	Highway Drain, S104
Abandoned Pipe	Abandoned Pipe	Abandoned Pipe	Abandoned Pipe
MainSewer	MainSewer	MainSewer	MainSewer
Rising Main	Rising Main	Rising Main	Rising Main
Highway Drain	Highway Drain	Highway Drain	Highway Drain
Sludge Main	Sludge Main	Sludge Main	Sludge Main
Sludge Main, Public	Sludge Main, Public	Sludge Main, Public	Sludge Main, Public
Sludge Main, Private	Sludge Main, Private	Sludge Main, Private	Sludge Main, Private
Sludge Main, S104	Sludge Main, S104	Sludge Main, S104	Sludge Main, S104
Sludge Pumping Station	Sludge Pumping Station	Sludge Pumping Station	Sludge Pumping Station
Sewer Overflow	Sewer Overflow	Sewer Overflow	Sewer Overflow
T Junction/Saddle	T Junction/Saddle	T Junction/Saddle	T Junction/Saddle
Lamp-hole	Lamp-hole	Lamp-hole	Lamp-hole
Oil Interceptor	Oil Interceptor	Oil Interceptor	Oil Interceptor
Pandstock	Pandstock	Pandstock	Pandstock
Pump	Pump	Pump	Pump
Reedbed	Reedbed	Reedbed	Reedbed
Soakaway	Soakaway	Soakaway	Soakaway
Summit	Summit	Summit	Summit
Valve	Valve	Valve	Valve
Valve Chamber	Valve Chamber	Valve Chamber	Valve Chamber
Washout Chamber	Washout Chamber	Washout Chamber	Washout Chamber
DropShaft	DropShaft	DropShaft	DropShaft
WW Treatment Works	WW Treatment Works	WW Treatment Works	WW Treatment Works

Foul Surface Combined

Foul	Surface	Combined	Overflow
WW Site Termination	WW Site Termination	WW Site Termination	WW Site Termination
Air Valve	Air Valve	Air Valve	Air Valve
Cascade	Cascade	Cascade	Cascade
Non Return Valve	Non Return Valve	Non Return Valve	Non Return Valve
Extent of Survey	Extent of Survey	Extent of Survey	Extent of Survey
Flow Meter	Flow Meter	Flow Meter	Flow Meter
Gully	Gully	Gully	Gully
Hatch Box	Hatch Box	Hatch Box	Hatch Box
Head of System	Head of System	Head of System	Head of System
Hydrobrake / Vortex	Hydrobrake / Vortex	Hydrobrake / Vortex	Hydrobrake / Vortex
Inlet	Inlet	Inlet	Inlet
Inspection Chamber	Inspection Chamber	Inspection Chamber	Inspection Chamber
Bifurcation	Bifurcation	Bifurcation	Bifurcation
Catchpit	Catchpit	Catchpit	Catchpit
WW Pumping Station	WW Pumping Station	WW Pumping Station	WW Pumping Station

CLEAN WATER SYMBOLLOGY

PIPE WORK

PIPE WORK	Live	Proposed
Trunk Main - Pressurised/Main		
Raw Water Aqueduct - Pressurised/Main		
Raw Water Aqueduct - Gravity/Main		
LDIM Raw Water Distribution - Pressurised/Main		
LDIM Raw Water Distribution - Gravity/Main		
LDIM Treated Water Distribution - Pressurised/Main		
LDIM Treated Water Distribution - Gravity/Main		
Private Pipe - Lateral/In		
Distribution Main - Pressurised/Main		
Common Pipe - Lateral/In		
Concessionary Service - Lateral/In		

ABANDONED PIPE

Trunk Main
Raw Water Aqueduct
LDTM Raw Water Distribution
LDTM Treated Water Distribution
Private Pipe
Distribution Main
Common Pipe
Concessionary Service

PROPERTY TYPES

Live	Proposed	
		Condition Report
		Pipe Bridges
		Tunnels (non carrier)
		Pumping Station
		Water Treatment Works
		Private Treatment Works

NODES/FURNITURES

Live	Proposed	
		End Cap
		CC Valve
		AC Valve
		Air Valve
		Suction Valve
		Non Return Valve
		Pressure Manager
		Change of Character
		Anode
		Chlorination Point
		De Chlorination Point
		Bore Hole
		Intex Point
		Bulk Supply Point
		Fire Hydrant
		Isolation

Live	Proposed	
PH		Private Fire Hydrant
PM		Pump
ST		Site Termination
SE		Service Start
SM		Service End
PM		Process Meter
ST		Stop Tap
ML		Monitor Location
SL		Strainer Point
AP		Access Point
HB		Hatch Box
IP		IP Point
RM		Route Marker
SP		Sampling Station
LB		Logger Box

100

Live

Proposed

Value House
Water Tower
Service Reservoir
Supply Reservoir
Abstraction Point
Domestic meter
Commercial meter
Telemetry CuckooStation

MATERIAL TYPE	LEAK TESTS
12. ACRYLIC CEMENT	2. CEMENT LEAKS
13. CAST IRON	3. VACUUM METHOD
14. COPPER	59. PIPETTE METHOD
15. CEMENT-BINDER	
16. DUCTILE IRON	PERMEATION TESTS
17. GALVANNEAL IRON	60. COBALT
18. INCONEL	61. DYE PENETRANT
19. STEEL	62. HYDROSTATIC LEAKING
20. LEAD	63. MQL-60
21. LPTC	64. PIPING
22. SPERMALLOY	65. SLIP LEAKS
23. IRON	
24. STEEL	
25. POLYETHYLENE	

Foul Surface Combined

Foul Surface Combined Overflow

Screen Chamber
Discharge Point
Outfall

Control Kiosk

Legend

[illegible]

APPENDIX G

GROUND INVESTIGATION REPORT

(Permeability Section 5.4)

TWEDDELL & SLATER

CONSULTING
CIVIL & STRUCTURAL
ENGINEERS

Unit 2, Mereside
Greenbank Road
Eden Business Park
Gilwilly, Penrith
Cumbria, CA11 9FB

School Brow, Moresby Parks, Site A

Ground Investigation Report

Raemore Developments Ltd



DIRECTORS

R. J. Gibson BEng (Hons) CEng MStructE

A. K. Poole BEng (Hons) MSc CEng MICE PCert

Tel 01768 865400

Email mail@tsceltd.com

www www.tsceltd.com

1 Introduction

1.1 Terms of Reference

- 1.1.1 At the request of Raemore Developments Ltd, a ground investigation has been undertaken for a proposed residential development at School Brow, Moresby Parks.
- 1.1.2 The scope of works comprised 6 no. machine excavated trial pits. This report presents the factual results of the trial pit investigation and an interpretation of ground conditions.

2 The Site

2.1 Site Location

- 2.1.1 The site is located 3 km north-east of Whitehaven and lies on the north site of School Brow just to the west of Moresby Primary School (Figures 1 and 2). The national grid reference of the site is NX 993 196 and the postcode is CA28 8XA.

2.2 Site Description

- 2.2.1 The site occupies an approximately rectangular shaped plot of 2.7 hectares (~ 215 m x 125 m). Ground levels stand at about 136 m OD and rise gently westwards becoming steeper across the western third of the site and reaching 144 m along the western side boundary.
- 2.2.2 The site is an unoccupied grass field. The site is bounded to the south by School Brow and to the north and east by field boundaries marked by stone walls. The western boundary is undefined.

2.3 Geology and Hydrology

- 2.3.1 The 1:50,000 scale geological map (British Geological Survey, Sheet 28, Whitehaven, 2004) shows the site to be underlain by sandstones of Carboniferous age belonging to the Whitehaven Sandstone Formation. The rock strata are overlain by glacial deposits, which are mapped at the surface as glacial till.

- 2.3.2 The nearest surface water feature to the site is an unnamed stream which flows north-westwards from a spring which is 140 m east of the site's north-east corner.

2.4 Proposed Development

- 2.4.1 It is proposed to develop the site for residential housing. No detailed plans are currently available, but a framework layout identifies groups of houses with private and adopted site access roads together with a 0.2 hectare area of public open space (POS), see Figure 3. The current drawing supersedes the plan that was available when the trial pits were dug, and shows a revised location for the POS that places it centrally towards the northern site boundary.

3 Ground Investigation

3.1 Trial Pits

- 3.1.1 Six machine-dug trial pits, designated TP 1 to TP 6, were excavated to depths of between 0.75 m and 1.70 m below ground level (bgl) on 24th February 2023 using a 5 tonne tracked excavator. The pit locations were set out in conjunction with Raemore Developments to achieve the following requirements;
- Pits 1 – 4 were excavated along the proposed route of the estate access road to determine formation conditions.
 - Pits 5 - 6 were excavated in the area of public open space to gain a preliminary indication of ground infiltration characteristics.
- 3.1.2 Comprehensive trial pit logs and photographs are provided in Appendix A, together with a drawing showing the trial pit locations. The trial pits were backfilled on completion.

4 Ground Conditions

5.1 Introduction

- 5.1.1 The general sequence of strata comprised topsoil overlying cohesive glacial till.

5.2 Topsoil

- 5.2.1 Topsoil was proved in all six trial pits. The topsoil was between 250 mm and 400 mm thick and was generally described as a dark grey sandy clay topsoil

5.3 Glacial Till

- 5.3.1 Cohesive glacial till was proved beneath the topsoil in all six trial pits. In Trial Pits 1 – 4, which were excavated to depths of between 0.75 m and 0.90 m, the till was weathered and was generally described as a soft becoming firm mottled yellowish brown and grey sandy, occasionally very sandy, clay with some gravel. Trial Pit 3 was taken slightly deeper, and beneath 0.9 m bgl the till was unweathered and was described as a stiff slightly fissured reddish brown mottled grey clay with some gravel. Slightly different ground conditions were encountered in Trial Pits 5 and 6 in the north-eastern quarter of the site. Here the till was a stiff reddish brown sandy clay with some to much gravel and occasional cobbles. In TP 5 the clay till was interbedded with thin beds of clayey sand, and sandstone was encountered in TP 6 at 1.0 m bgl. The sandstone lacked a defined structure and was not thought to be in situ rock, but instead it is conjectured to be a raft of rock within the glacial till.
- 5.3.2 Hand shear vane tests undertaken at depths of between 0.45 m and 0.65 m recorded shear strengths of between 40 kPa and 67 kPa with a median value of 46 kPa. A design shear strength of 45 kPa for this depth range is recommended.

5.4 Permeability

- 5.4.1 A preliminary assessment of ground infiltration characteristics was undertaken in Trial Pits 5 and 6. Fifty litres of water was added to each pit, and the change in water level was recorded over a 30-minute observation period. No drainage was recorded in either pit.

6 Design and Construction Considerations

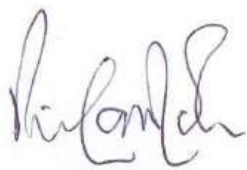
6.1 Road Pavement Design (Trial Pits 1 – 4)

- 6.1.1 Based on the shear vane test results, and using the empirical relationship $CBR = c_u/23$ (Black and Lister, 1978), the short term value of CBR relevant to construction is 2%. However, for equilibrium conditions, which are more relevant to long term performance, the CBR can be estimated from the design charts published in the Transport Research Laboratory report LR 1123 (Powell et.al. 1984) using the plasticity index and construction conditions information. For a plasticity index of 20%, and assuming a high water table and average pavement construction conditions, the CBR is approximately 4.5%. However, for design we would recommend a CBR value of 3%.
- 6.1.2 The low to intermediate plasticity sandy clays that will be exposed at formation level are very sensitive to changes in water content, and every effort must be made to protect exposed formations from rainfall, runoff and seepages.

6.2 Infiltration Characteristics (Trial Pits 5 and 6)

- 6.2.1 The low permeability of the cohesive glacial till makes it an unsuitable drainage medium, and this has been confirmed by test data from percolation tests in Trial Pits 5 and 6.

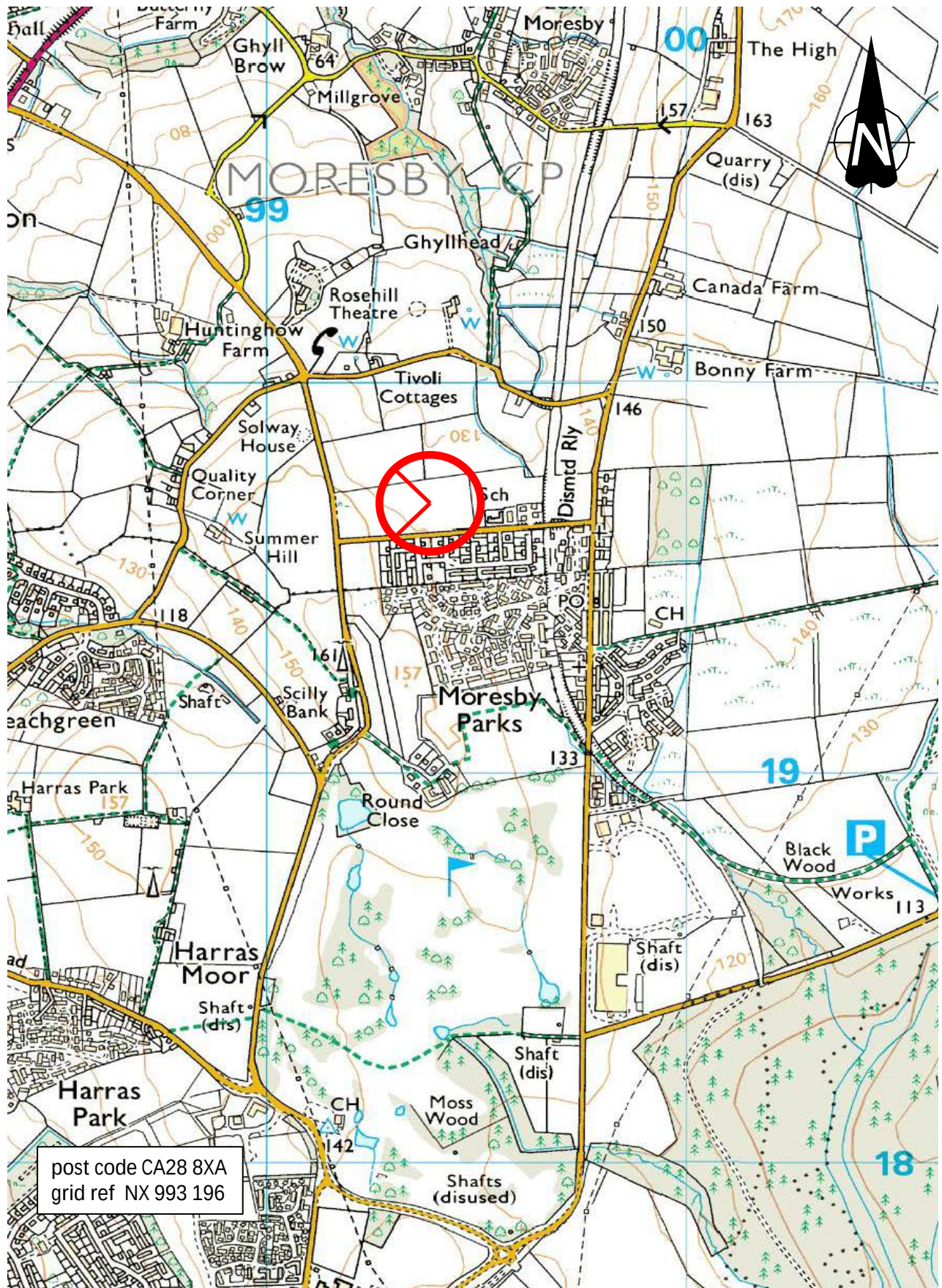
For and on behalf of Tweddell and Slater Ltd



26 April 2023

Richard Lote BSc, MSc, FGS, CGeol

Figures



**TWEDDELL
& SLATER**
CONSULTING
CIVIL & STRUCTURAL
ENGINEERS

project
client
drawing

School Brow, Moresby Parks, Site A
Raemore Developments Ltd
Site Location Map

scheme
scale
figure

6972
nts
1



Promap

Ordnance Survey © Crown Copyright 2016. All rights reserved. Licence number 100022451. Printed Scale - 1:2500

**TWEDDELL
& SLATER**

CONSULTING
CIVIL & STRUCTURAL
ENGINEERS

project School Brow, Moresby Parks, Site A

drawing Site Map

client Raemore Developments Ltd

date March 2023

scheme 6972

scale nts

figure 2



**TWEDDELL
& SLATER**

CONSULTING
CIVIL & STRUCTURAL
ENGINEERS

project School Brow, Moresby Parks, Site A

drawing Development Plan

client Raemore Developments Ltd

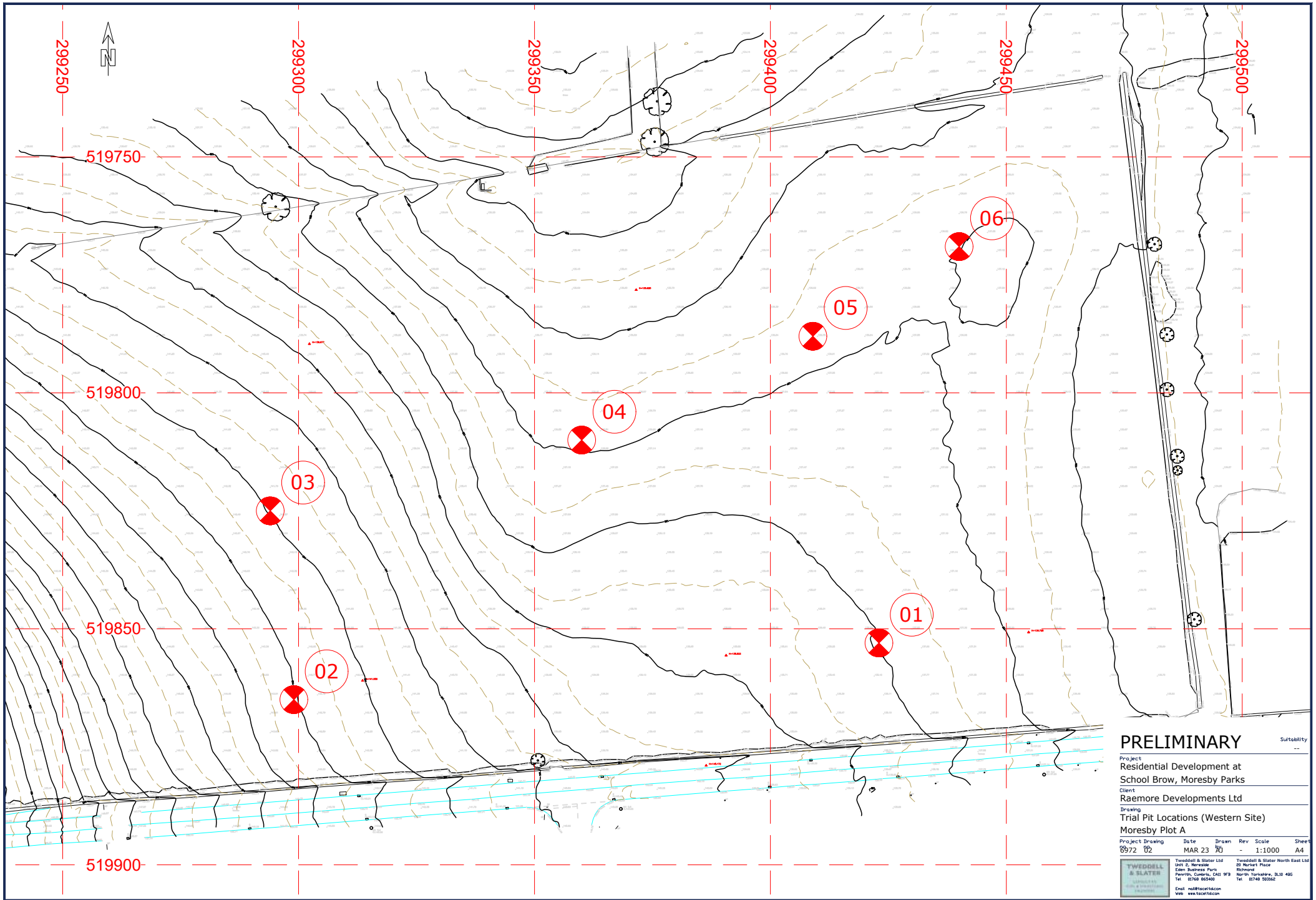
date March 2023

scheme 6972
scale nts

figure 3

Appendix A

Trial Pit Logs and Trial Pit Location Plan



PRELIMINARY

Project:
Residential Development at
School Brow, Moresby Parks
Client:
Raemore Developments Ltd
Drawing:
Trial Pit Locations (Western Site)
Moresby Plot A

Project Drawing	Date	Drawn	Rev	Scale	Sheet
6972 02	MAR 23	RD	-	1:1000	A4

TWEDDELL & SLATER
SURVEYORS
200, 210 & 220, Market Street
Preston, Lancashire, PR1 2QJ
Tel: 0749 853500
Email: info@twedell.com
Web: www.twedell.com

TWEDDELL & SLATER LTD
Unit 2, Riverside
Eden Business Park
Preston, Lancashire, PR1 9TB
Tel: 0749 853500
Tel: 0749 565662
Email: info@twedell.com
Web: www.twedell.com

Key to Symbols on Exploratory Hole Records

All linear dimensions are in metres or millimetres

**	Drillers' description
→	Groundwater strike
▽	Groundwater level after standing period
B	Bulk sample (disturbed)
C	Standard penetration test: solid 60° cone
CBR	California Bearing Ratio mould sample
c_u	Undrained shear strength (kPa)
D	Jar sample (disturbed)
date/water	Date of shift (day/month)/Depth to water at end of previous shift shown above the date and depth to water at beginning of shift given below the date
G	Gas sample and depth of hole at time of sampling
N	Standard penetration test: blows required to drive 300 mm after seating drive
P(F), (P)	Piston sample, F: not recovered, P: partially recovered
S, (NR)	Standard penetration test: split barrel sampler, NR no recovery
S(x) (AJ) or S(x) (V)	Sample number (x), amber jar or vial
U()	Undisturbed 102 mm diameter sample, () denotes number of blows to drive sampler
U()F, U()P	F: not recovered, P: partially recovered
U38	Undisturbed 38 mm diameter sample
V	Vane test
W	Water sample
x/y	denotes x blows for y mm within the standard penetration test
x*/y	denotes x blows for y mm within the seating drive

Field Assessment of Shear Strength and Density

Term	Undrained Shear Strength (kN/m ²)	Term	SPT N Value
very soft	<20	very loose	<4
Soft	20 - 40	loose	4 - 10
soft to firm	40 - 50	medium dense	10 - 30
Firm	50 - 75	dense	30 - 50
firm to stiff	75 - 100	very dense	>50
Stiff	100 - 150		
very stiff	150 - 300		
Hard	>300		

Trial Pit Record

Strata			Samples and Tests		
depth (m)	No.	Description	depth (m)	type	tests
GL - 0.30	1	TOPSOIL (Grass overlying dark grey sandy clay topsoil).			
0.30 - 0.75	2	Soft, becoming firm, yellowish brown and light grey sandy CLAY with some fine to coarse subangular gravel. In places very sandy.	0.45	SV	55, 67, 53



method Doosan Solar 5.5t excavator	groundwater none encountered.	location and level NGR NX 99423 19647* Ground Level not recorded
remarks	Pit excavated 24th February 2023 to investigate pavement formation conditions. Backfilled on completion. * grid reference taken from mobile phone app with estimated +/- 6 m accuracy	
	project	Plot A, School Brow, Moresby Parks
	client	Raemore Developments Ltd
	scheme no.	6972
	trial pit	1

Trial Pit Record

Strata			Samples and Tests		
depth (m)	No.	Description	depth (m)	type	tests
GL - 0.30	1	TOPSOIL (Grass overlying dark grey sandy clay topsoil).			
0.30 - 0.75	2	Soft, becoming firm, yellowish brown and light grey sandy CLAY with some fine to coarse subangular gravel. In places very sandy.	0.50	SV	45, 48, 40



method Doosan Solar 5.5t excavator	groundwater none encountered.	location and level NGR NX 99299 19635* Ground Level not recorded
remarks	Pit excavated 24th February 2023 to investigate pavement formation conditions. Backfilled on completion. * grid reference taken from mobile phone app with estimated +/- 6 m accuracy	
	project	Plot A, School Brow, Moresby Parks
	client	Raemore Developments Ltd
	scheme no.	6972
	trial pit	2

Trial Pit Record

Strata			Samples and Tests		
depth (m)	No.	Description	depth (m)	type	tests
GL - 0.30	1	TOPSOIL (Grass overlying dark grey sandy clay topsoil).			
0.30 - 0.90	2	Soft, becoming firm, yellowish brown and light grey sandy CLAY with some fine to coarse subangular gravel. In places very sandy.	0.50	SV	46, 44, 46
0.90 - 1.30	3	Stiff slightly fissured reddish brown mottled grey CLAY with some gravel.			



method Doosan Solar 5.5t excavator	groundwater none encountered.	location and level NGR NX 99294 19675* Ground Level not recorded
remarks	Pit excavated 24th February 2023 to investigate pavement formation conditions. Backfilled on completion. * grid reference taken from mobile phone app with estimated +/- 6 m accuracy	
	project	Plot A, School Brow, Moresby Parks
	client	Raemore Developments Ltd
	scheme no.	6972
	trial pit	3

Trial Pit Record

Strata			Samples and Tests		
depth (m)	No.	Description	depth (m)	type	tests
GL - 0.40	1	TOPSOIL (Grass overlying dark grey sandy clay topsoil).			
0.40 - 0.60	2	Soft to firm light grey sandy CLAY with some gravel.			
0.60 - 0.90	3	Firm mottled light grey, grey, and orange brown, sandy occasionally very sandy CLAY with some gravel.	0.65	SV	49, 45, 58



method Doosan Solar 5.5t excavator	groundwater water entry from land drain.	location and level NGR NX 99360 19690* Ground Level not recorded
remarks	Pit excavated 24th February 2023 to investigate pavement formation conditions. Backfilled on completion. * grid reference taken from mobile phone app with estimated +/- 6 m accuracy	
	project	Plot A, School Brow, Moresby Parks
	client	Raemore Developments Ltd
	scheme no.	6972
	trial pit	4

Trial Pit Record

Strata			Samples and Tests		
depth (m)	No.	Description	depth (m)	type	tests
GL - 0.30	1	TOPSOIL (Grass overlying dark grey sandy clay topsoil).			
0.30 - 1.20	2	Stiff interbedded very sandy CLAY and clayey SAND. Becoming firm to stiff reddish brown very sandy CLAY with some to much sandstone gravel cobbles and occasional boulders.			



method Doosan Solar 5.5t excavator	groundwater water entry from land drain.	location and level NGR NX 99409 19712* Ground Level not recorded
remarks	Pit excavated 24th February 2023 at proposed detention tank location. Backfilled on completion. * grid reference taken from mobile phone app with estimated +/- 6 m accuracy	
	project	Plot A, School Brow, Moresby Parks
	client	Raemore Developments Ltd
	scheme no.	6972
	trial pit	5

Trial Pit Record

Strata			Samples and Tests		
depth (m)	No.	Description	depth (m)	type	tests
GL - 0.25	1	TOPSOIL (Grass overlying dark grey sandy clay topsoil).			
0.25 - 1.00	2	Stiff reddish brown sandy CLAY with some to much gravel and occasional cobbles.	0.55	SV	100 kPa
1.00 - 1.70	3	Weak to moderately strong pinkish grey coarse SANDSTONE. Recovered as gravel and cobbles of sandstone with matrix of clayey sand. (Possible raft of local rock within glacial deposits)			



method Doosan Solar 5.5t excavator	groundwater water entry from land drain.	location and level NGR NX 99440 19731* Ground Level not recorded
remarks	Pit excavated 24th February 2023 at proposed detention tank location. Backfilled on completion. * grid reference taken from mobile phone app with estimated +/- 6 m accuracy	
	project Plot A, School Brow, Moresby Parks	scheme no. 6972
	client Raemore Developments Ltd	trial pit 6