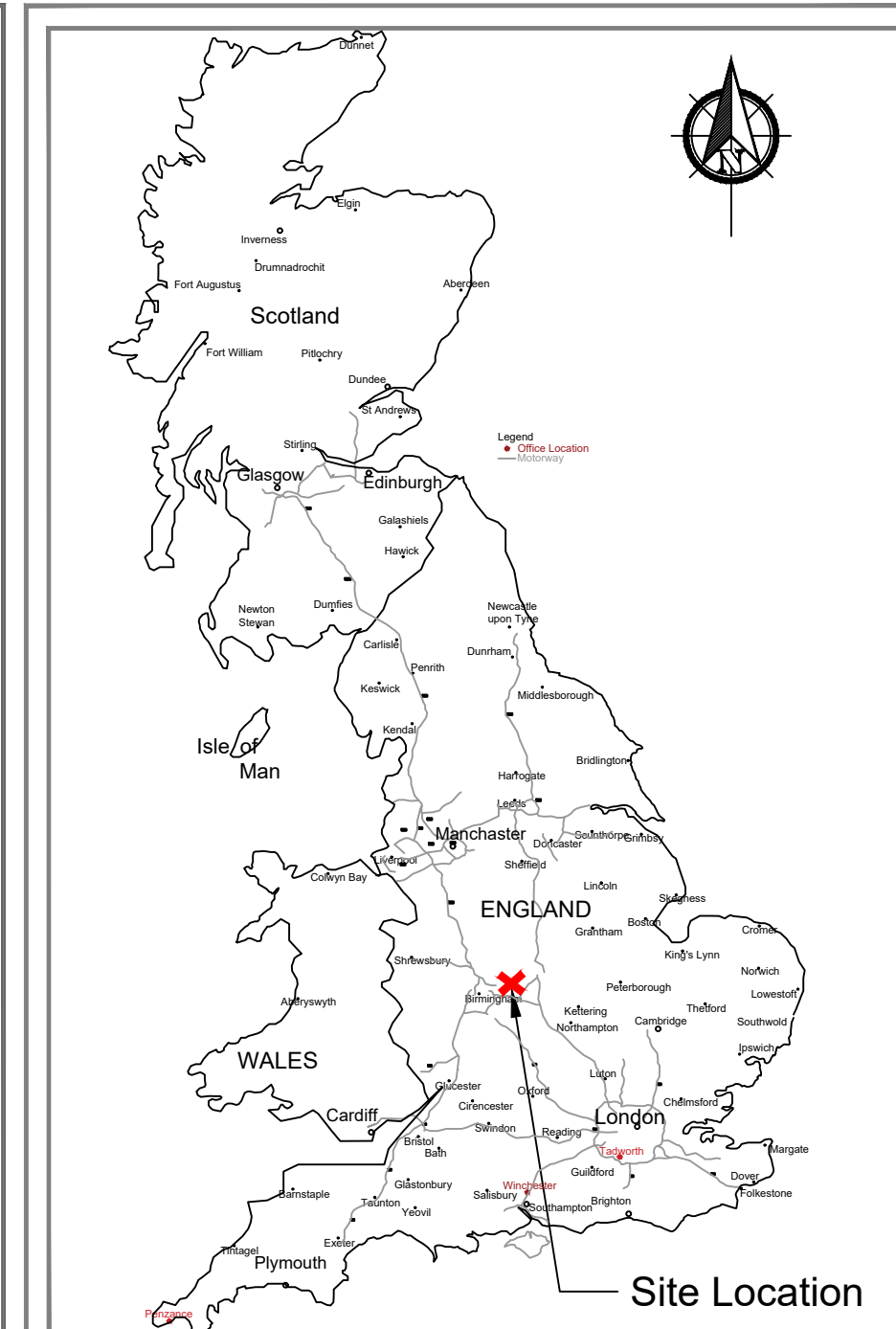
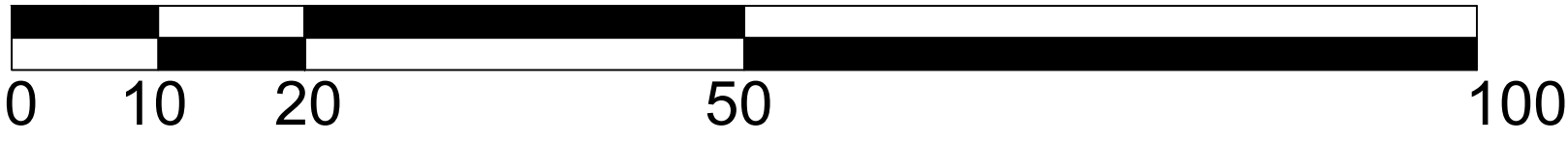
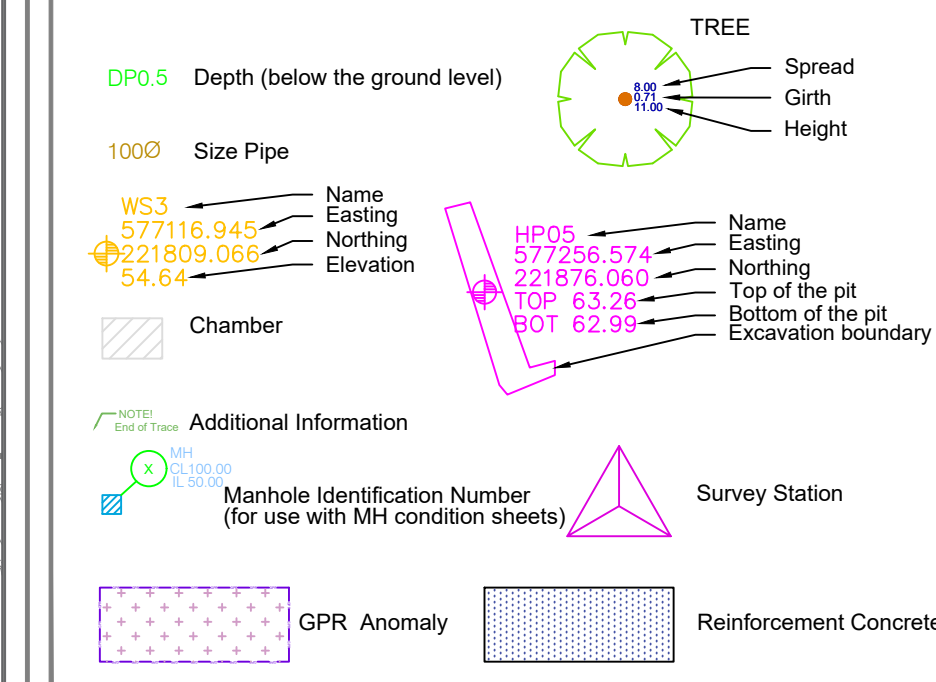




LEGEND	
ELECTRICITY TRACE (UNDEFINED)	— EL — EL —
HIGH VOLTAGE CABLE	— HV — HV —
LOW VOLTAGE CABLE	— LV — LV —
EMPTY DUCT	— ED —
BT CABLE	— BT — BT —
FIBRE OPTIC	— FO —
CATV	— CATV —
TRAFFIC SENSOR	— TS — TS —
OVERHEAD TELECOM LINES	— TS — TS —
SURFACE WATER DRAINAGE	— SWD —
FOUL WATER DRAINAGE	— FWD —
COMBINED DRAINAGE	— CW —
WATER PIPE	— W — W —
GAS PIPE	— GAS —
GPR Target (Unknown)	— GPR —
UNDEFINED LINE	— UN —
UNKNOWN UTILITY-METALIC	— UN-KN-MET —
SURVEY BOUNDARY	— BVD —
END OF TRACE	— f001
UNABLE TO TRACE	— f011

[illegible][illegible]

soils
LIMITED

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Southern Office – Winchester
Contact: Craig Morrison
Winnall Close, SO23 0LB
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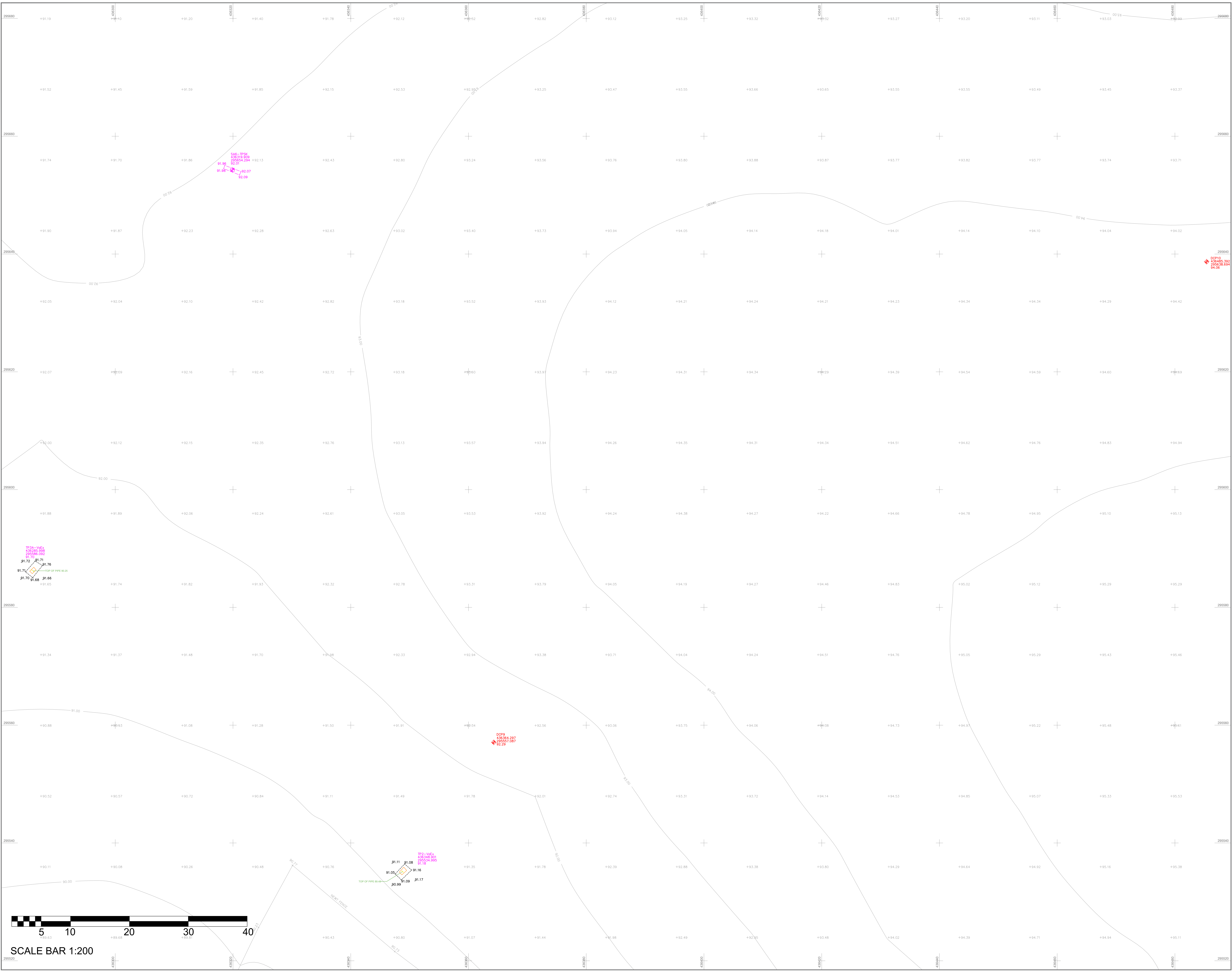
Web: soilslimited.co.uk

Site details	
Address MIRA, Watling Street	
Postcode CV10 0TU	City Nuneaton, Leicestershire

Client:
HORIBA MIRA Ltd

Site Location Plan
based on Topographical, CCTV & PAS
128:2014 Utility Survey, by MK Surveys
project no. 30838 and 29084

Scale 1:500	Sheet Size: A0		Sheet Number: Site plan	Date: 09.06.2023
Project Number: 20188	Rev: 1.0	Surveyed By: BW/PO	Drawn By: PO/BW	Approved By: LW



LEGEND

ELECTRICITY TRACE (UNDEFINED)

- EL
- EL

HIGH VOLTAGE CABLE

- HV
- HV

LOW VOLTAGE CABLE

- LV
- LV

EMPTY DUCT

- ED
- ED

BT CABLE

- BT
- BT

FIBRE OPTIC

- FO
- FO

CATV

- CATV
- CATV

TRAFFIC SENSOR

- TS
- TS

OVERHEAD TELECOM LINES

- TEL
- TEL

SURFACE WATER DRAINAGE

- SWD
- SWD

FOUL WATER DRAINAGE

- FWD
- FWD

COMBINED DRAINAGE

- CD
- CD

WATER PIPE

- W
- W

GAS PIPE

- GAS
- GAS

GPR TARGET (Unknown)

- GPR
- GPR

UNDEFINED LINE

- UNDEF
- UNDEF

UNKNOWN UTILITY-METALIC

- UM
- UM

SURVEY BOUNDARY

- SVY-BO
- SVY-BO

END OF TRACE

- EOT
- EOT

UNABLE TO TRACE

- UT
- UT

TREE

- Spread
- Canopy
- Height

DP0.3 Depth (below the ground level)

1000 Size Pipe

Additional Information

Manhole Identification Number
for use with M1 condition sheets

Survey Station

GPR Anomaly

Reinforcement Concrete

Abbreviations			
AC	ASSUMED CONNECTION	AS	ASSUMED ROUTE
BH	BORER HOLE	BT	BTISH TELECOM COVER
BOX	UNDERFIELD BOX	BOX	BOX
BP	BOUNDARY POST	BS	BUS STOP
CI	CAST IRON	CL	COVER LEVEL
CATV	CABLE TV COVER	CP	CONCRETE POST
CP	DEPTH	ED	ELECTRICITY PIT
ER	END OF TRACE	FB	FLOWER BED
FR	FIRE HYDRANT	GB	GATE POST
FP	FOOTPATH	GP	GAS POST
GV	G.V. TRANCE	IC	INSPECTION CHAMBER
GV	G.V. TRANCE	IC	INSPECTION CHAMBER
HV	HIGH VOLTAGE	LA	LAMP COLUMN
LV	LOW VOLTAGE	MD	MANHOLE
MW	MONITORING WELL	ND	NO DEPTH
OH	OVERHEAD	CL	COVER LEVEL
OHV	OVERHEAD WIRES	PM	PARKING METER
PS	POST BOX	RE	RODGING EYE
RS	ROAD SIGN	RWP	RAIN WATER PIPE
SP	SIGN POST	SV	SOIL VENT PIPE
TCB	TELEPHONE CALL BOX	TH	TRIAL HOLE
TOP	TOP OF FENCE LEVEL	TOW	TOP OF WALL LEVEL
TL	TRAFFIC LIGHT	TS	TOP OF KERB
UT	UNIDENTIFIED	UTS	UNABLE TO SURVEY
UTT	UNABLE TO TRACE	UTL	UNABLE TO LIFT
VP	VENT PIPE	WM	WATER METER
WS	WEAK SIGNAL	WP	WATER PIPE

SOILS LIMITED - Underground Services Disclaimer

The survey aims to map all existing utilities and subsurface structures and provide information on pipe type, material type, and drainage connectivity. However, GPR surveying is limited by the following guidelines, and it may not be possible to accurately survey, define and locate all services and subsurface features.

Existing record information showing underground services is often incomplete and unknown accuracy. Therefore it should be regarded only as an indication.

In ideal conditions, these spatial accuracies for the underground utilities located and mapped are only 150mm for the 600000 and +/-10% of depth for the GPR System. Variations within the subsurface may, however, alter this estimated accuracy.

It is not always possible to trace the entire length of each underground service. Everything depends on ground conditions.

Although all reasonable steps have been taken to locate all underground utilities, there is no guarantee that all will be shown in the drawing, as some above ground features may have obstructed the survey.

Due to the limitation of the radar signal with depth, locating is restricted, making identification of the depth penetration and quality of the data depend on the ground conditions on site. These data may be a result of areas with high conductivity. Also, highly reflective materials close to the surface. (e.g. Rebar may hide deeper anomalies).

Unless otherwise stated, all services and subsurface structures shown in these drawings have been surveyed using approved detectors and the connection between manholes, if not traced, are assumed to be direct.

Where supplied before survey commencement, we will use utility provider's information as a guide for location purposes. However, should we not be able to locate those guided services, we shall not be held responsible for the accuracy, or otherwise, of the location of that service, as issued by the utility provider. These will be shown as "Taken From Records" on the drawing and we are not liable for any loss that may arise due to the lack of accuracy in the guided information.

Plan accuracies of the order of +/- or +/- 150mm may be achieved, but this figure will depend on the depth of the service below ground level. Where similar services run in proximity, separation may be impossible. Successful tracking of non-metallic pipes may be limited.

No guarantee can be given that all services have been shown. During locating underground service, errors and omissions can occur, due to electrical fields and localized ground conditions. The Contractor shall not rely on this information and shall take necessary steps to verify this information as required. It is the Contractor's responsibility to verify the location and presence on site of all existing underground services and whether free or isolated.

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Site details

Address
MIRA, Watling Street

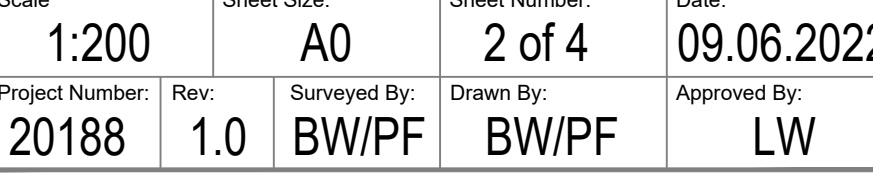
Postcode
CV10 0TU

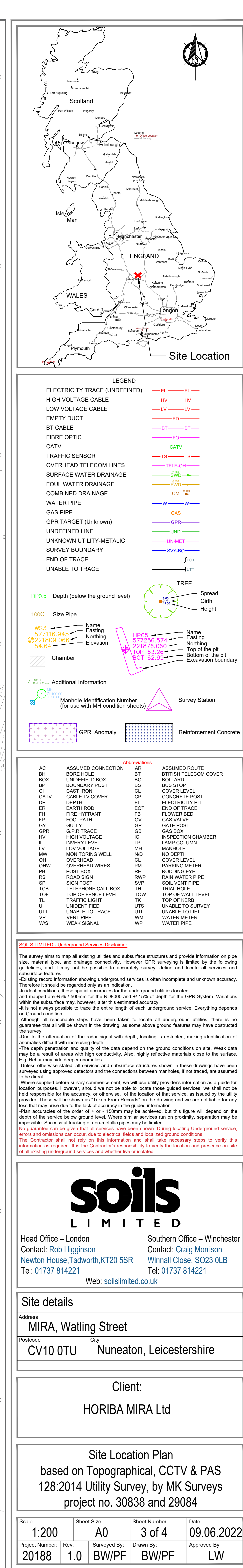
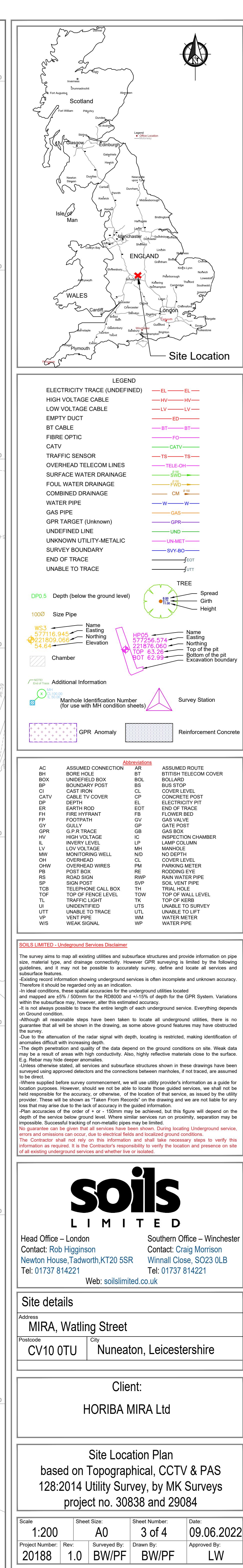
City
Nuneaton, Leicestershire

Client:
HORIBA MIRA Ltd

Site Location Plan
based on Topographical, CCTV & PAS
128:2014 Utility Survey, by MK Surveys
project no. 30838 and 29084

Scale	1:200	Sheet Size	A0	Sheet Number	1 of 4	Date	09.06.2022
Project Number	20188	Rev	1.0	Surveyed By	BW/PF	Drawn By	BW/PF
				Approved By	LW		







LEGEND

ELECTRICITY TRACE (UNDEFINED)

HIGH VOLTAGE CABLE

LOW VOLTAGE CABLE

EMPTY DUCT

BT CABLE

FIBRE OPTIC

DATA

TRAFFIC SENSOR

OVERHEAD TELECOM LINES

SURFACE WATER DRAINAGE

FOUL WATER DRAINAGE

COMBINED DRAINAGE

WATER PIPE

GAS PIPE

GPR TARGET (Unknown)

UNDEFINED LINE

UNKNOWN UTILITY/METALIC

SURVEY BOUNDARY

END OF TRACE

UNABLE TO TRACE

TREE

Depth (below the ground level)

Size Pipe

Additional Information

Manhole Identification Number

GPR Anomaly

Reinforcement Concrete

AC	ASSUMED CONNECTION	AR	ASSUMED ROUTE
BH	BORE HOLE	BT	BTISH TELECOM COVER
BOX	UNDERGROUND BOX	BOX	BOX
BP	BOUNDARY POST	BS	BUS STOP
CI	CAST IRON	CL	COVER LEVEL
CATV	CABLE TV COVER	CP	CONCRETE POST
DI	DEPTH	ECT	ELECTRICITY HT
EN	END OF TRACE	FB	FLOWER BED
FR	FIRE HYDRANT	GP	GATE POST
GA	GAS VALVE	GS	GAS BOX
GY	GUY	IC	INSPECTION CHAMBER
GPR	GPR TRACE	IP	LAND COLUMN
HV	HIGH VOLTAGE	LV	LOW VOLTAGE
LV	LOW VOLTAGE	MD	MANHOLE
MW	MONITORING WELL	ND	NO DEPTH
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OHV	OVERHEAD WIRES	PM	PARKING METER
PS	POST BOX	RE	ROADSIDE
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Plan accuracies of the order of +/- or +/- 100mm may be achieved, but this figure will depend on the depth of the service below ground level. Where services are run in proximity, separation may be impossible. Successful tracking of non-metallic pipes may be limited.

No guarantee can be given that all services have been shown. During locating underground service, errors and omissions can occur, due to electrical fields and localized ground conditions.

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128:2014 Utility Survey, by MK Surveys

project no. 30838 and 29084

Scale	Sheet Size	Sheet Number	Date
1:200	A0	4 of 4	09.06.2022
Project Number	Rev	Surveyed By	Drawn By
20188	1.0	BW/PF	BW/PF
			Approved By
			LW

Appendix C Geotechnical In-situ and Laboratory Testing

Appendix C.1 DCP Testing

DCP Layer Strength Analysis Report

Project Name: 20188 DCPs 1-11

Location No.: DCP1

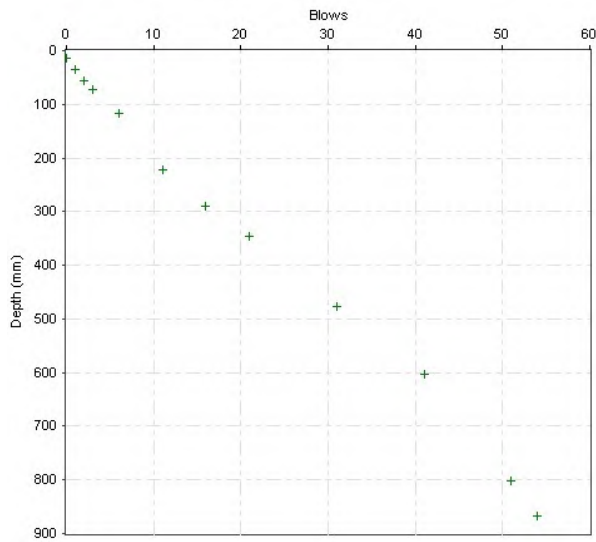
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Cone Angle: 60 degrees

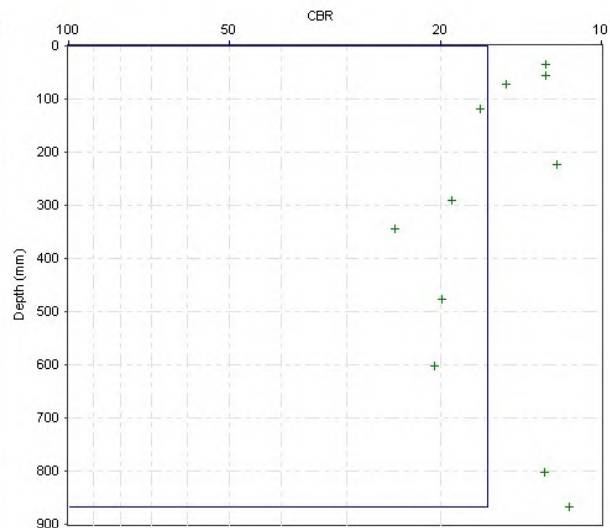
Zero Error (mm): 82

Test Date: 25/05/2022

Layer Boundaries: Chainage 1.000



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	15.80	16	868	868

CBR Relationship:

TRL equation: $\log_{10}(\text{CBR}) = 2.48 - 1.057 \times \log_{10}(\text{Strength})$

Report produced by

DCP Layer Strength Analysis Report

Project Name: 20188 DCPs 1-11

Location No.: DCP2

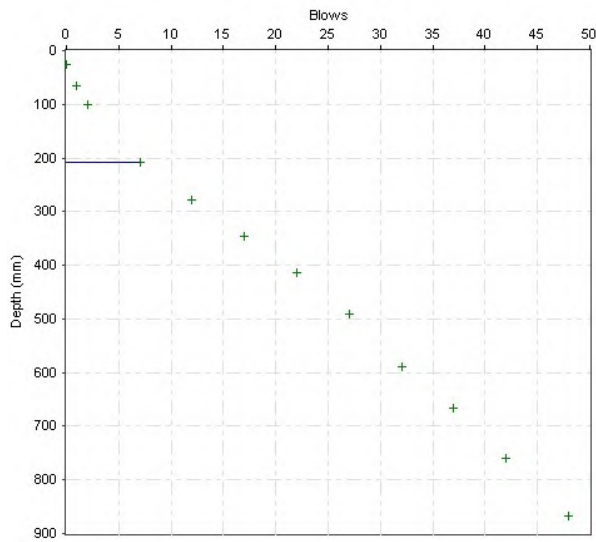
Location/Offset: Lay-by / other

Cone Angle: 60 degrees

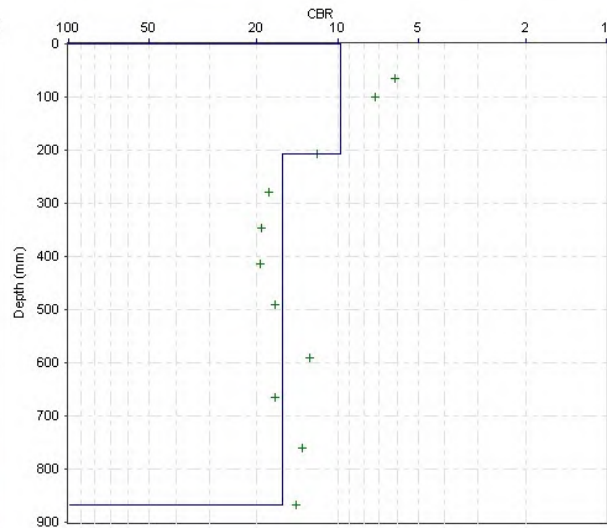
Zero Error (mm): 82

Test Date: 25/05/2022

Layer Boundaries: Chainage 2.000



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	25.86	10	207	207
2	16.12	16	661	868

CBR Relationship:

TRL equation: $\log_{10}(\text{CBR}) = 2.48 - 1.057 \times \log_{10}(\text{Strength})$

Report produced by

DCP Layer Strength Analysis Report

Project Name: 20188 DCPs 1-11

Location No.: DCP3

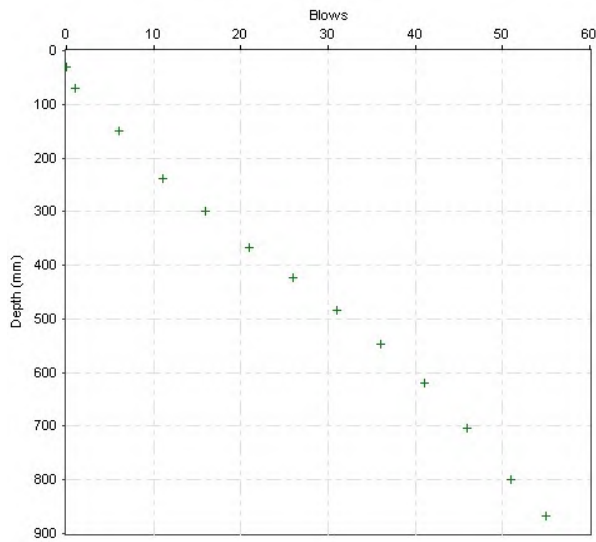
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Cone Angle: 60 degrees

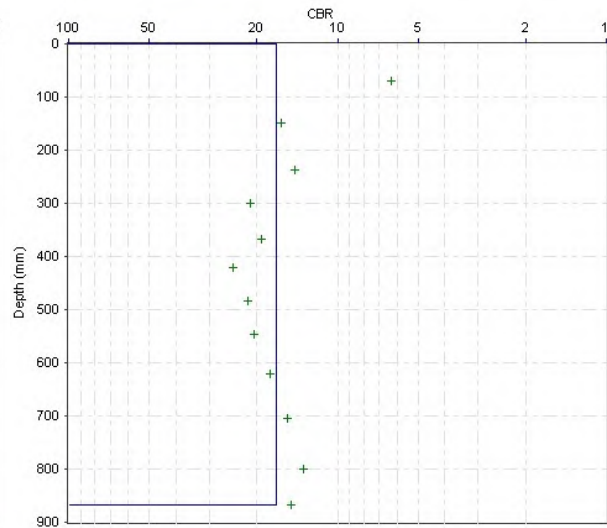
Zero Error (mm): 82

Test Date: 25/05/2022

Layer Boundaries: Chainage 3.000



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	15.24	17	868	868

CBR Relationship:

TRL equation: $\log_{10}(\text{CBR}) = 2.48 - 1.057 \times \log_{10}(\text{Strength})$

Report produced by

DCP Layer Strength Analysis Report

Project Name: 20188 DCPs 1-11

Location No.: DCP4

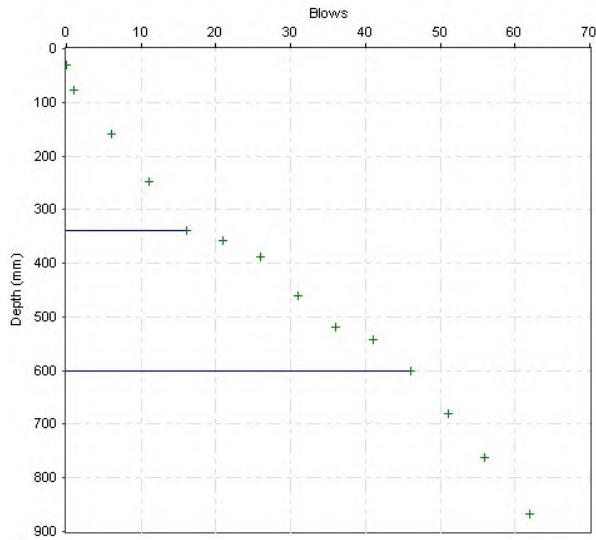
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Cone Angle: 60 degrees

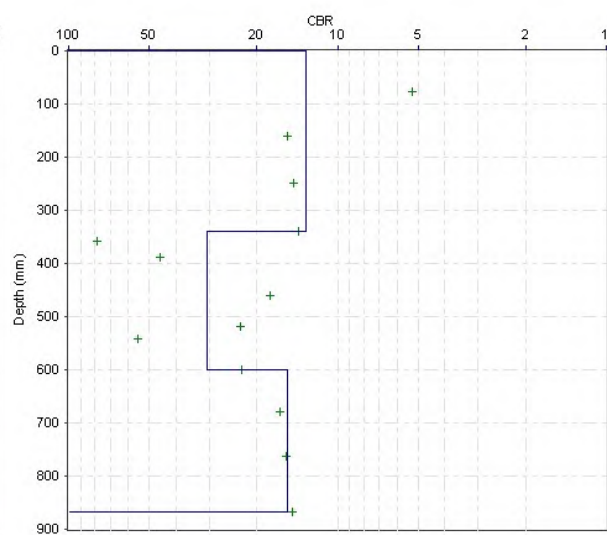
Zero Error (mm): 82

Test Date: 25/05/2022

Layer Boundaries: Chainage 4.000



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	19.38	13	340	340
2	8.70	31	261	601
3	16.69	15	267	868

CBR Relationship:

TRL equation: $\log_{10}(\text{CBR}) = 2.48 - 1.057 \times \log_{10}(\text{Strength})$

Report produced by

DCP Layer Strength Analysis Report

Project Name: 20188 DCPs 1-11

Location No.: DCP5

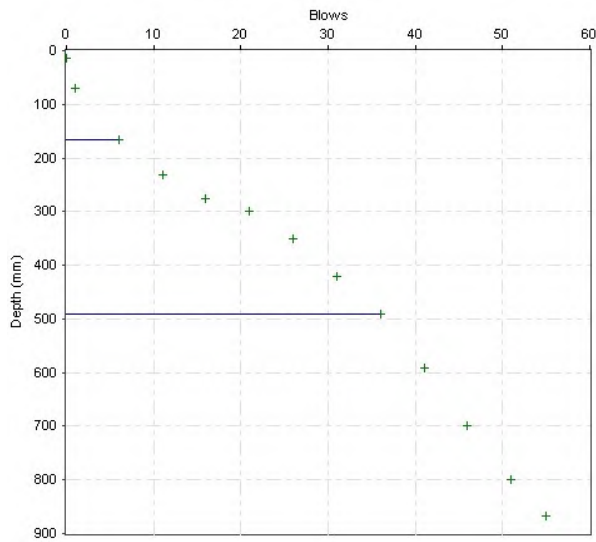
Location/Offset: Lay-by / other

Cone Angle: 60 degrees

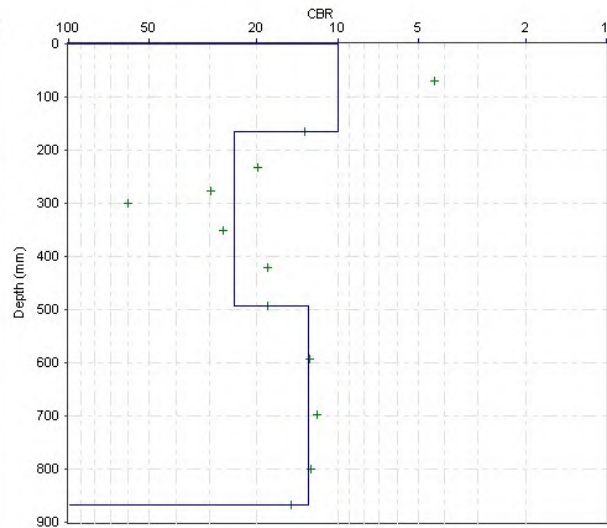
Zero Error (mm): 82

Test Date: 25/05/2022

Layer Boundaries: Chainage 5.000



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	25.17	10	166	166
2	10.87	24	326	492
3	19.79	13	376	868

CBR Relationship:

TRL equation: $\log_{10}(\text{CBR}) = 2.48 - 1.057 \times \log_{10}(\text{Strength})$

Report produced by

DCP Layer Strength Analysis Report

Project Name: 20188 DCPs 1-11

Location No.: DCP6

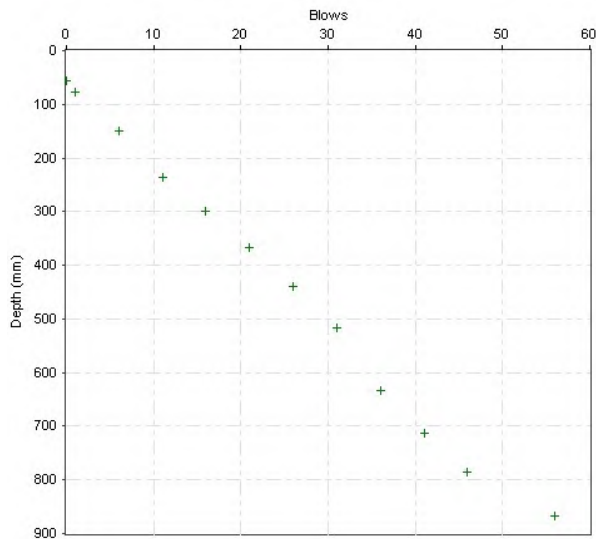
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Cone Angle: 60 degrees

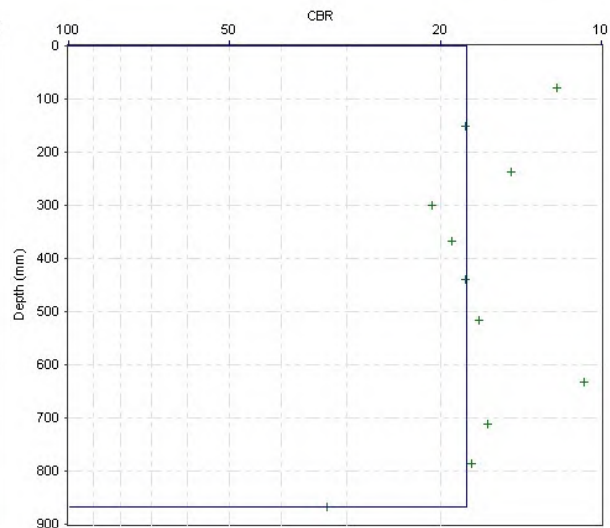
Zero Error (mm): 82

Test Date: 25/05/2022

Layer Boundaries: Chainage 6.000



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	14.48	18	868	868

CBR Relationship:

TRL equation: $\log_{10}(\text{CBR}) = 2.48 - 1.057 \times \log_{10}(\text{Strength})$

Report produced by

DCP Layer Strength Analysis Report

Project Name: 20188 DCPs 1-11

Location No.: DCP7

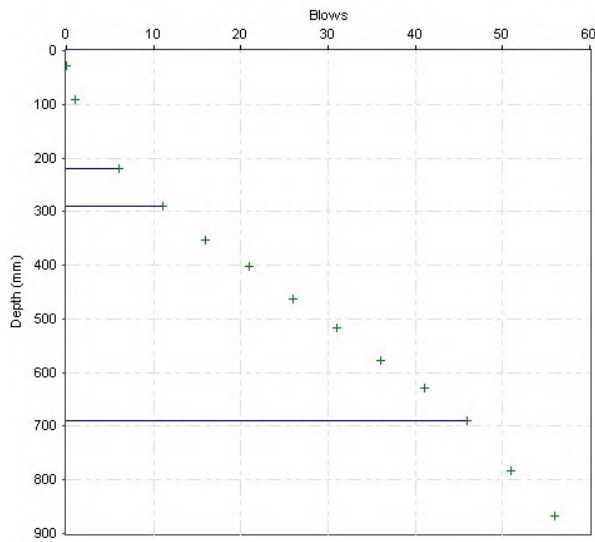
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Cone Angle: 60 degrees

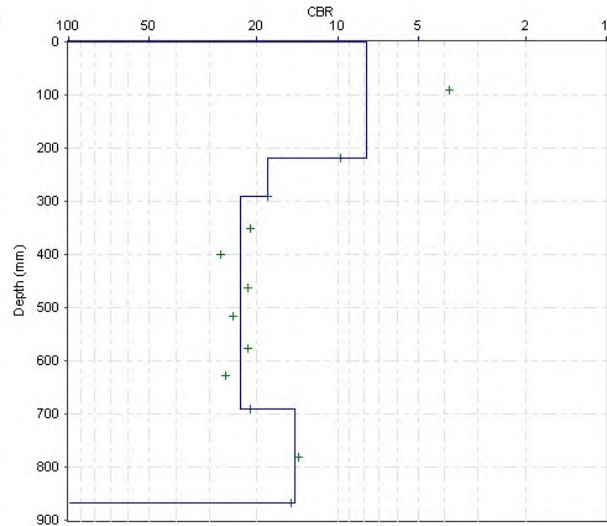
Zero Error (mm): 82

Test Date: 25/05/2022

Layer Boundaries: Chainage 7.000



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	31.83	8	219	219
2	14.20	18	71	290
3	11.43	23	400	690
4	17.80	14	178	868

CBR Relationship:

TRL equation: $\log_{10}(\text{CBR}) = 2.48 - 1.057 \times \log_{10}(\text{Strength})$

Report produced by

DCP Layer Strength Analysis Report

Project Name: 20188 DCPs 1-11

Location No.: DCP8

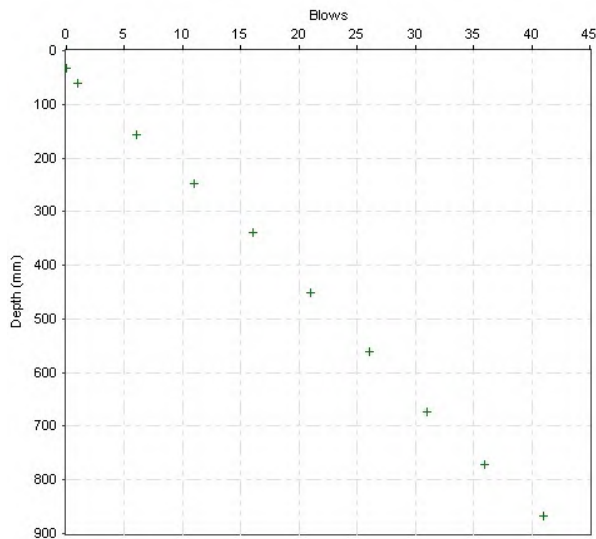
Location/Offset: Lay-by / other

Cone Angle: 60 degrees

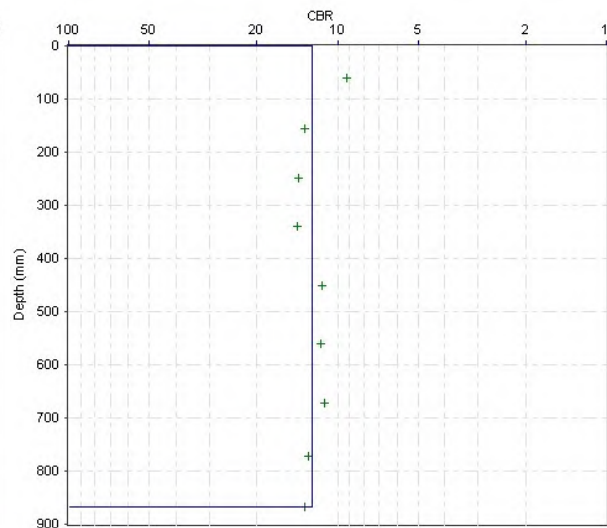
Zero Error (mm): 82

Test Date: 25/05/2022

Layer Boundaries: Chainage 8.000



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	20.37	12	868	868

CBR Relationship:

TRL equation: $\log_{10}(\text{CBR}) = 2.48 - 1.057 \times \log_{10}(\text{Strength})$

Report produced by

DCP Layer Strength Analysis Report

Project Name: 20188 DCPs 1-11

Location No.: DCP9

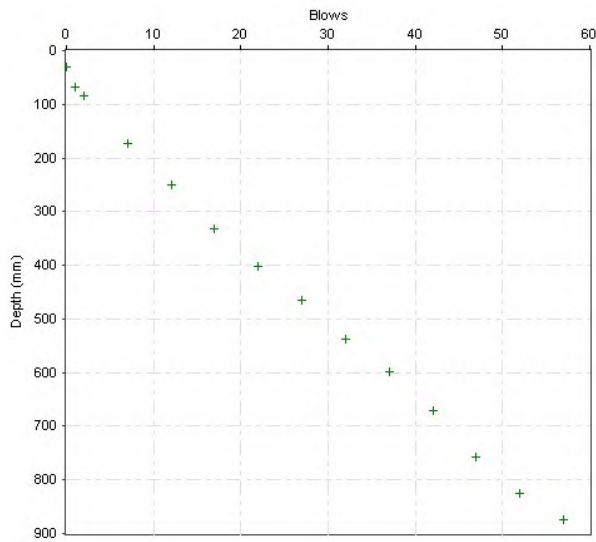
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Cone Angle: 60 degrees

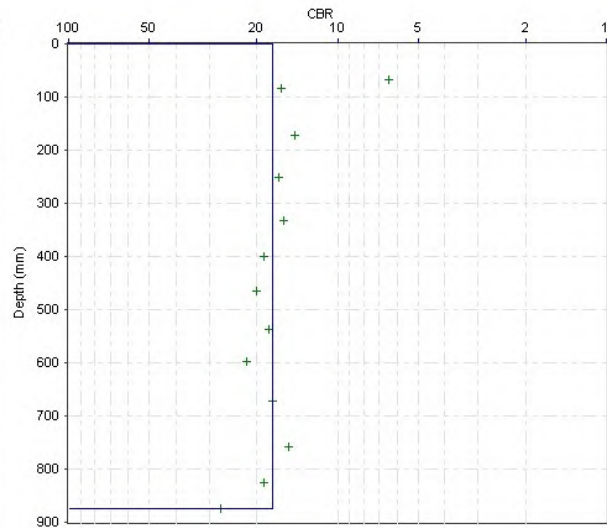
Zero Error (mm): 82

Test Date: 25/05/2022

Layer Boundaries: Chainage 9.000



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	14.82	17	875	875

CBR Relationship:

TRL equation: $\log_{10}(\text{CBR}) = 2.48 - 1.057 \times \log_{10}(\text{Strength})$

Report produced by

DCP Layer Strength Analysis Report

Project Name: 20188 DCPs 1-11

Location No.: DCP10

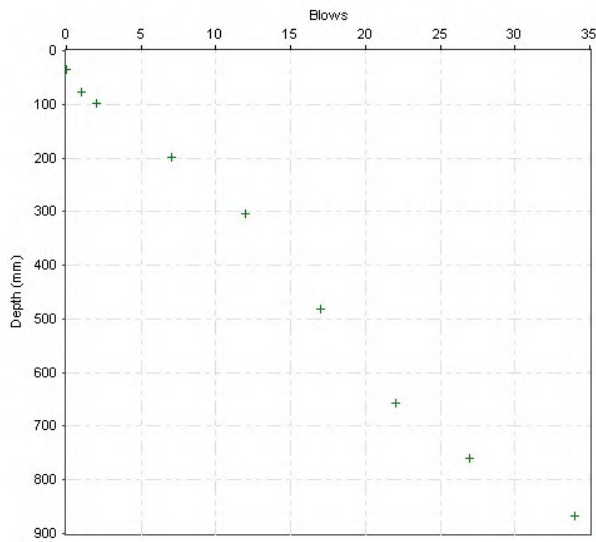
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Cone Angle: 60 degrees

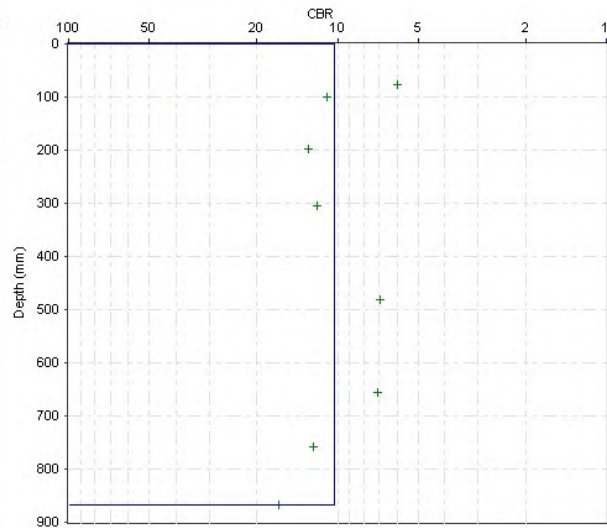
Zero Error (mm): 82

Test Date: 25/05/2022

Layer Boundaries: Chainage 10.000



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	24.50	10	868	868

CBR Relationship:

TRL equation: $\log_{10}(\text{CBR}) = 2.48 - 1.057 \times \log_{10}(\text{Strength})$

Report produced by

DCP Layer Strength Analysis Report

Project Name: 20188 DCPs 1-11

Location No.: 11

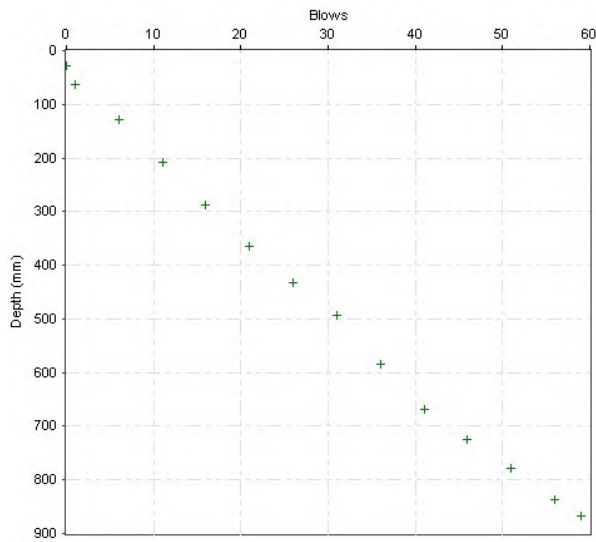
Location/Offset: Lay-by / other

Cone Angle: 60 degrees

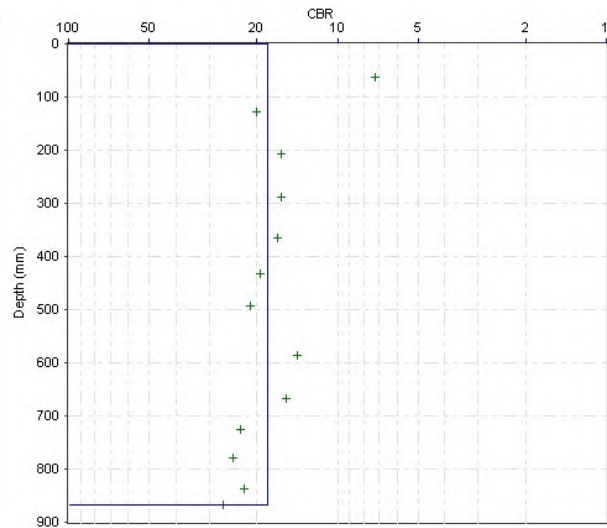
Zero Error (mm): 82

Test Date: 25/05/2022

Layer Boundaries: Chainage 11.000



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	14.22	18	868	868

CBR Relationship:

TRL equation: $\log_{10}(\text{CBR}) = 2.48 - 1.057 \times \log_{10}(\text{Strength})$

Report produced by

DCP Layer Strength Analysis Report

Project Name: 20188 DCPs - Road Cores

Location No.: RC01

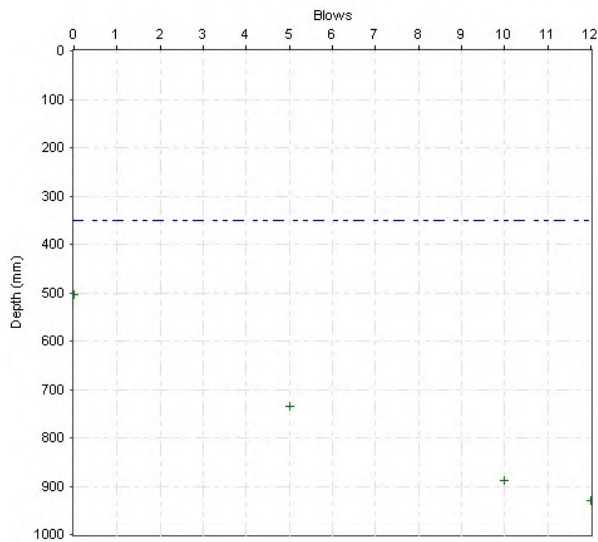
Location/Offset: Carriageway

Cone Angle: 60 degrees

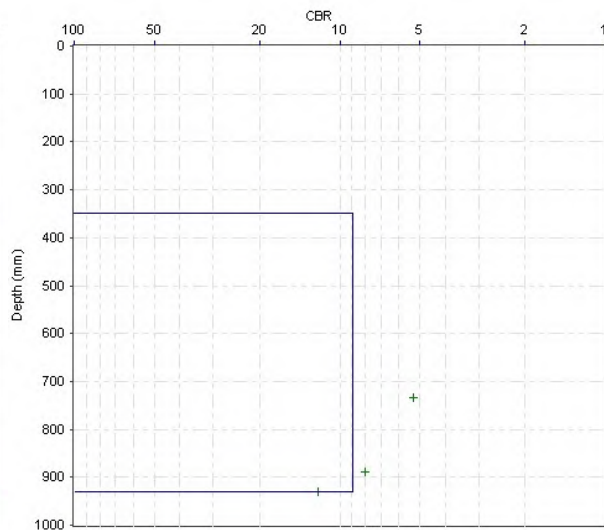
Zero Error (mm): 20

Test Date: 25/05/2022

Layer Boundaries: Chainage 1.000



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	28.00	9	580	930

CBR Relationship:

TRL equation: $\log_{10}(\text{CBR}) = 2.48 - 1.057 \times \log_{10}(\text{Strength})$

Report produced by

DCP Layer Strength Analysis Report

Project Name: 20188 DCPs

Location No.: RC02

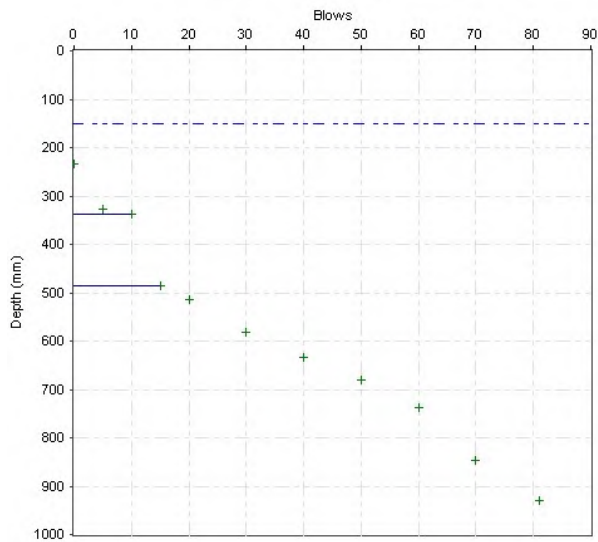
Location/Offset: Carriageway

Cone Angle: 60 degrees

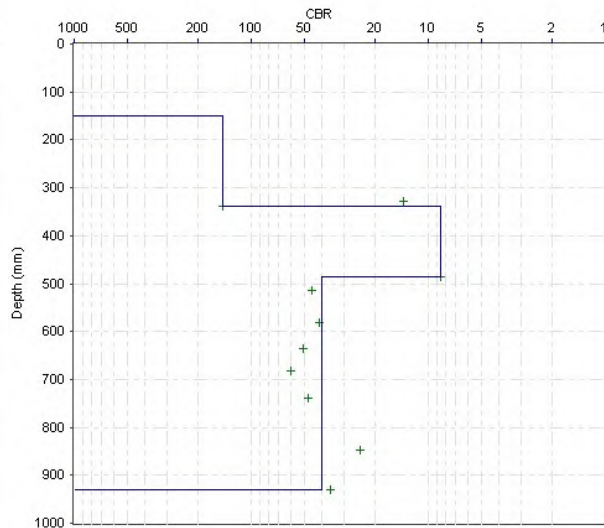
Zero Error (mm): 20

Test Date: 25/05/2022

Layer Boundaries: Chainage 2.000



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	2.00	145	188	338
2	29.40	8	147	485
3	6.74	40	445	930

CBR Relationship:

TRL equation: $\log_{10}(\text{CBR}) = 2.48 - 1.057 \times \log_{10}(\text{Strength})$

Report produced by

DCP Layer Strength Analysis Report

Project Name: 20188 DCPs

Location No.: RC03

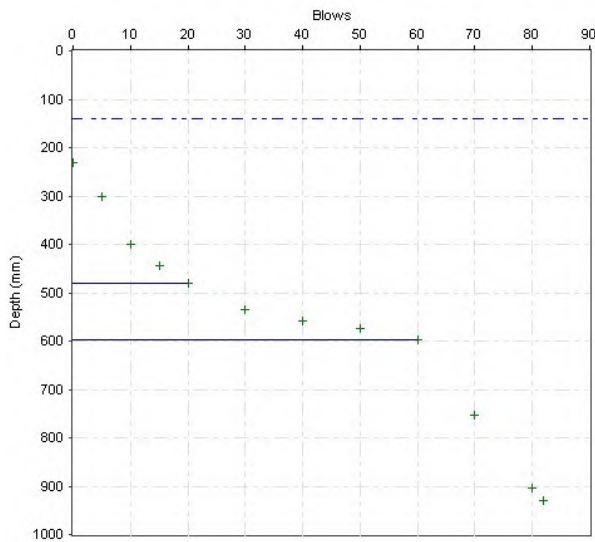
Location/Offset: Carriageway

Cone Angle: 60 degrees

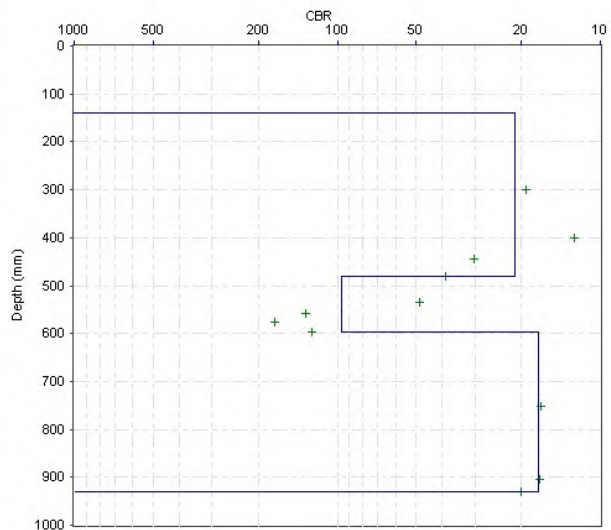
Zero Error (mm): 20

Test Date: 25/05/2022

Layer Boundaries: Chainage 3.000



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	12.40	21	340	480
2	2.95	96	118	598
3	15.09	17	332	930

CBR Relationship:

TRL equation: $\log_{10}(\text{CBR}) = 2.48 - 1.057 \times \log_{10}(\text{Strength})$

Report produced by

DCP Layer Strength Analysis Report

Project Name: 20188 DCPs

Location No.: RC04

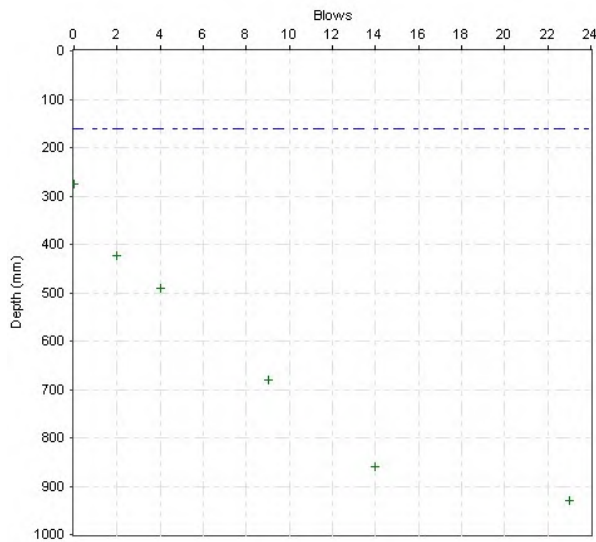
Location/Offset: Carriageway

Cone Angle: 60 degrees

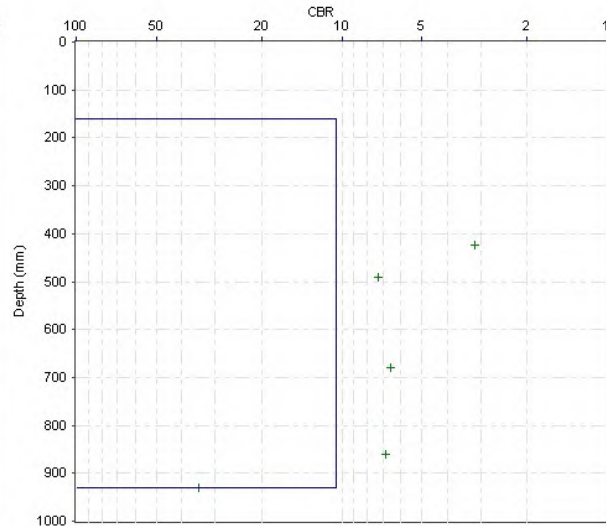
Zero Error (mm): 20

Test Date: 25/05/2022

Layer Boundaries: Chainage 4.000



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	24.10	10	770	930

CBR Relationship:

TRL equation: $\log_{10}(\text{CBR}) = 2.48 - 1.057 \times \log_{10}(\text{Strength})$

Report produced by

Appendix C.2 Infiltration Testing

Soakaway Calculations

Soakaway Test No.	SA1
Site Name.	MIRA, Watling Street, Nuneaton
Job No.	20188

Field Test

Trial Pit Log (include details of groundwater):
See trial Pit

Depth of Pit	1.50 m bgl
Width of Pit	0.60 m
Length of Pit Top	2.40 m
Length of Pit Base	2.00 m
Depth of First Reading	0.31 m bgl

Calculations for Area of Trapezoid Side

Length at top of soak	2.3173
Length at 75% of soak	2.24
Length at 25% of soak	2.08

Area of middle 50% of one trapezoid side 1.2844

Calculations of length of one angled short side

Length of angled short side	1.2316
-----------------------------	--------

Depth of Pit Soaked	1.19 m
ap50	4.748 m2
Vp75-25	0.770644 m3
t75-25	N/A min
Amount of water used total	1.5413 m3
Flow rate	Insufficient Soakage

Field Data

Depth to Water (m)	Elapsed Time (min)	Head of Water (% of Ho)
0.31	0	100
0.32	3.0	99
0.32	12.0	99
0.33	36.0	98
0.34	54.0	97
0.36	69.0	96
0.37	73.0	95
0.37	117.0	95
0.37	172.0	96
0.37	232.0	96
0.50	1266.0	85
0.51	1341.0	84

Total drainage:	0.20	
T75	3.000	0.6075 75% effective storage depth
T25	17.000	1.2025 25% effective storage depth
T75-25	N/A	Derived from Best Fit

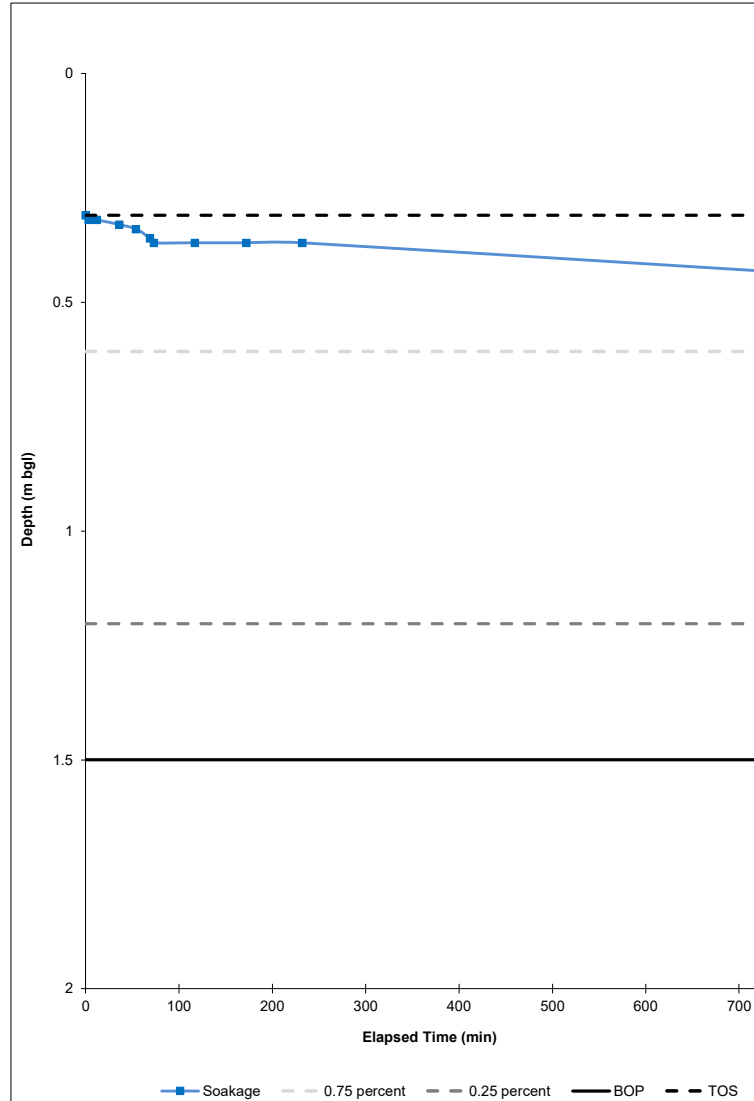
Comments

BRE Digest 365:2016

SOILS LIMITED

Newton House, Cross Road, Tadworth
Surrey, KT20 5SR

Telephone: 01737 814 221



Notes: The horizontal dashed black line represents the top of the water i.e. first reading

The light grey dashed represents 75% of the effective storage depth, The dark grey represents 25% of the effective storage depth. The blue line is the depth to water with time. Where a red line is present it is extrapolated data.

Soakaway Calculations

Soakaway Test No.	SA2
Site Name.	MIRA, Watling Street, Nuneaton
Job No.	20188

Field Test

Trial Pit Log (include details of groundwater):
See trial Pit

Depth of Pit	1.50 m bgl
Width of Pit	0.60 m
Length of Pit Top	2.30 m
Length of Pit Base	1.80 m
Depth of First Reading	0.63 m bgl

Calculations for Area of Trapezoid Side

Length at top of soak	2.09
Length at 75% of soak	2.02
Length at 25% of soak	1.87

Area of middle 50% of one trapezoid side 0.8461

Calculations of length of one angled short side

Length of angled short side	0.9171
-----------------------------	--------

Depth of Pit Soaked	0.87 m
ap50	3.622 m2
Vp75-25	0.507645 m3
t75-25	N/A min
Amount of water used total	1.0153 m3
Flow rate	Insufficient Soakage

Field Data

Depth to Water (m)	Elapsed Time (min)	Head of Water (% of Ho)
0.63	0	100
0.64	6.0	99
0.68	12.0	94
0.72	16.0	90
0.75	27.0	86
0.79	36.0	82
0.81	41.0	79
0.82	44.0	78
0.82	67.0	79
0.82	105.0	79
0.82	151.0	79
0.83	208.0	78
0.83	265.0	78
0.85	1301.0	76
0.85	1375.0	76
0.85	1510.0	76

Total drainage:	0.22	
T75	3.000	0.8475 75% effective storage depth
T25	17.000	1.2825 25% effective storage depth
T75-25	N/A	Derived from Best Fit

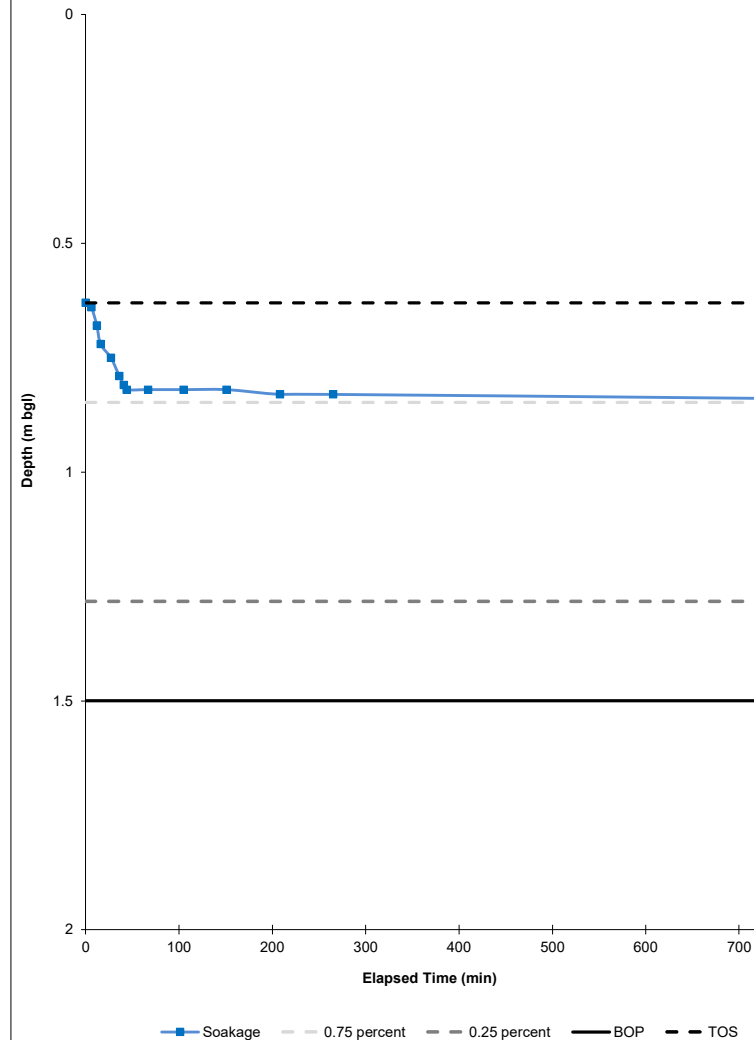
Comments

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Notes: The horizontal dashed black line represents the top of the water i.e. first reading

The light grey dashed represents 75% of the effective storage depth, The dark grey represents 25% of the effective storage depth.
The blue line is the depth to water with time. Where a red line is present it is extrapolated data.

Soakaway Calculations

Soakaway Test No.	SA4
Site Name.	MIRA, Watling Street, Nuneaton
Job No.	20188

Field Test

Trial Pit Log (include details of groundwater):
See trial Pit

Depth of Pit	1.50 m bgl
Width of Pit	0.60 m
Length of Pit Top	2.00 m
Length of Pit Base	1.80 m
Depth of First Reading	0.87 m bgl

Calculations for Area of Trapezoid Side

Length at top of soak	1.884
Length at 75% of soak	1.86
Length at 25% of soak	1.82

Area of middle 50% of one trapezoid side 0.5802

Calculations of length of one angled short side

Length of angled short side	0.6356
-----------------------------	--------

Depth of Pit Soaked	0.63 m
ap50	2.742 m2
Vp75-25	0.348138 m3
t75-25	N/A min
Amount of water used total	0.6963 m3
Flow rate	Insufficient Soakage

Field Data

Depth to Water (m)	Elapsed Time (min)	Head of Water (% of Ho)
0.87	0	100
0.88	1.0	98
0.88	4.0	98
0.88	9.0	98
0.88	46.0	98
0.88	90.0	98
0.88	109.0	98
0.88	147.0	98
0.88	196.0	100
0.88	246.0	100
0.88	307.0	100
0.91	1347.0	95
0.91	1422.0	95
0.91	1542.0	95

Total drainage:	0.04	
T75	3.000	1.0275 75% effective storage depth
T25	17.000	1.3425 25% effective storage depth
T75-25	N/A	Derived from Best Fit

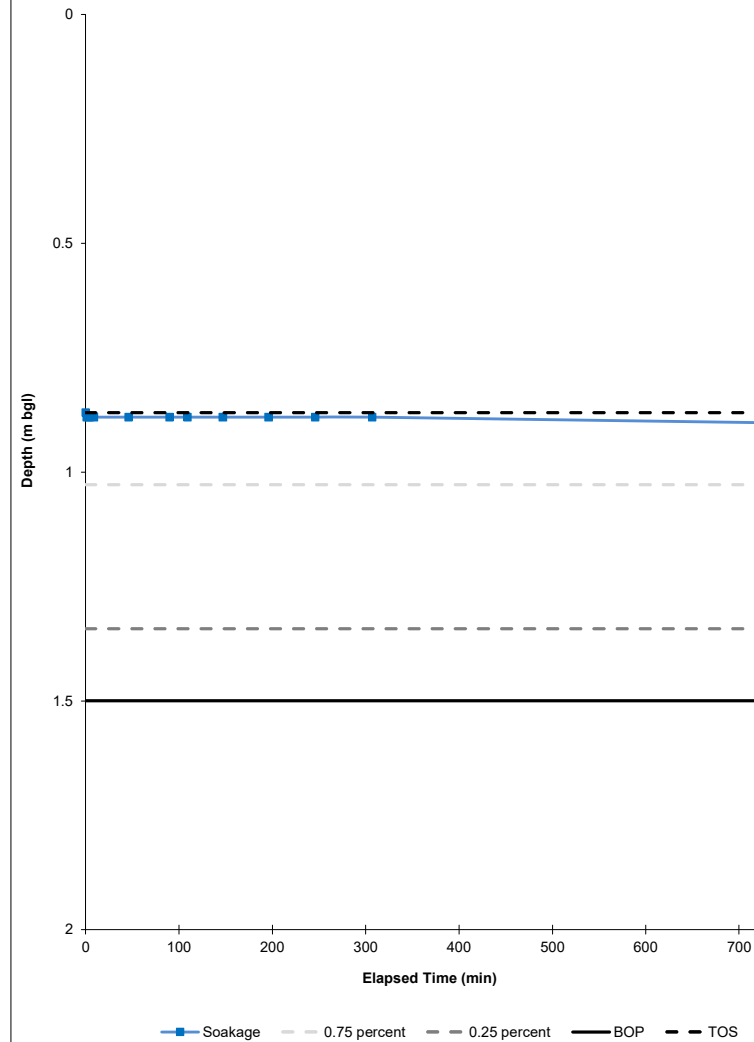
Comments

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Notes: The horizontal dashed black line represents the top of the water i.e. first reading

The light grey dashed represents 75% of the effective storage depth, The dark grey represents 25% of the effective storage depth. The blue line is the depth to water with time. Where a red line is present it is extrapolated data.

Soakaway Calculations

Soakaway Test No.	SA6
Site Name.	MIRA, Watling Street, Nuneaton
Job No.	20188

Field Test

Trial Pit Log (include details of groundwater):
See trial Pit

Depth of Pit	1.50 m bgl
Width of Pit	0.60 m
Length of Pit Top	2.60 m
Length of Pit Base	1.80 m
Depth of First Reading	0.63 m bgl

Calculations for Area of Trapezoid Side

Length at top of soak	2.264
Length at 75% of soak	2.15
Length at 25% of soak	1.92

Area of middle 50% of one trapezoid side 0.8839

Calculations of length of one angled short side

Length of angled short side	0.986
-----------------------------	-------

Depth of Pit Soaked	0.87 m
ap50	3.919 m2
Vp75-25	0.530352 m3
t75-25	N/A min
Amount of water used total	1.0607 m3
Flow rate	Insufficient Soakage

Field Data

Depth to Water (m)	Elapsed Time (min)	Head of Water (% of Ho)
0.63	0	100
0.63	14.0	100
0.63	29.0	100
0.63	60.0	100
0.64	102.0	99
0.64	130.0	99
0.64	163.0	99
0.64	221.0	99
0.64	461.0	99

Total drainage:	0.01	
T75	3.000	0.8475 75% effective storage depth
T25	17.000	1.2825 25% effective storage depth
T75-25	N/A	Derived from Best Fit

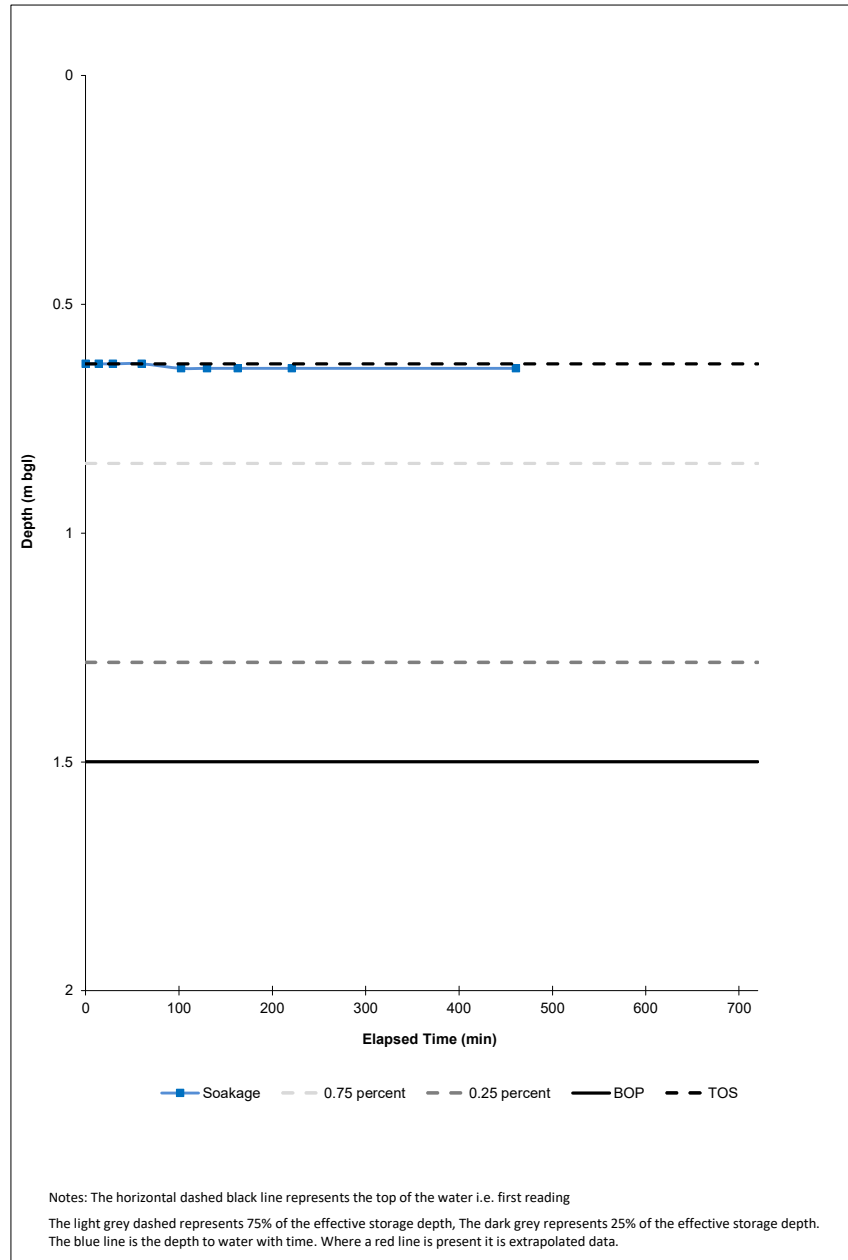
Comments

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Telephone: 01737 814 221



Appendix C.3 Geotechnical Laboratory Results



Laboratory Report



Contract Number: 59882

Client Ref: **20188**

Client PO: **20188**

Date Received: **08-06-2022**

Date Completed: **27-06-2022**

Report Date: **27-06-2022**

Client: **Soils Limited**
Newton House
Cross Road
Tadworth
Surrey
KT20 5SR

This report has been checked and approved by:

Wayne Honey

Health and Safety Coordinator/ Quality Assistant

Contract Title: **MIRA, Watling Street, Nuneaton, CV10 0TU**

For the attention of: **Luke Wilkinson**

Test Description	Qty
Moisture Content of Soil BS1377 : Part 2 : Clause 3.2 : 1990 - * UKAS	11
1 Point Liquid & Plastic Limit BS 1377:1990 - Part 2 : 4.4 & 5.3 - * UKAS	11
PSD Wet & Dry Sieve method BS 1377:1990 - Part 2 : 9.2 - * UKAS	1
Disposal of samples for job	1

Notes: **Observations and Interpretations are outside the UKAS Accreditation**

* - denotes test included in laboratory scope of accreditation

- denotes test carried out by approved contractor

@ - denotes non accredited tests

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved Signatories:

Brendan Evans (Office Administrator) - Emma Sharp (Business Support Manager) - Paul Evans (Director)

Richard John (Quality/Technical Manager) - Shaun Jones (Laboratory manager) - Shaun Thomas (Site Manager)

Wayne Honey (Health and Safety Coordinator/ Quality Assistant)

GEO Site & Testing Services Ltd

Units 3-4, Heol Aur, Dafen, Llanelli, Carmarthenshire, Wales SA14 8QN

Tel: 01554 784040 Fax: 01554 784041 info@gstl.co.uk gstl.co.uk



**PARTICLE SIZE DISTRIBUTION
BS 1377 Part 2:1990
Wet Sieve, Clause 9.2**

Contract Number 59882

Borehole/Pit No. WS6

Site Name MIRA, Watling Street, Nuneaton, CV10 0TU

Sample No.

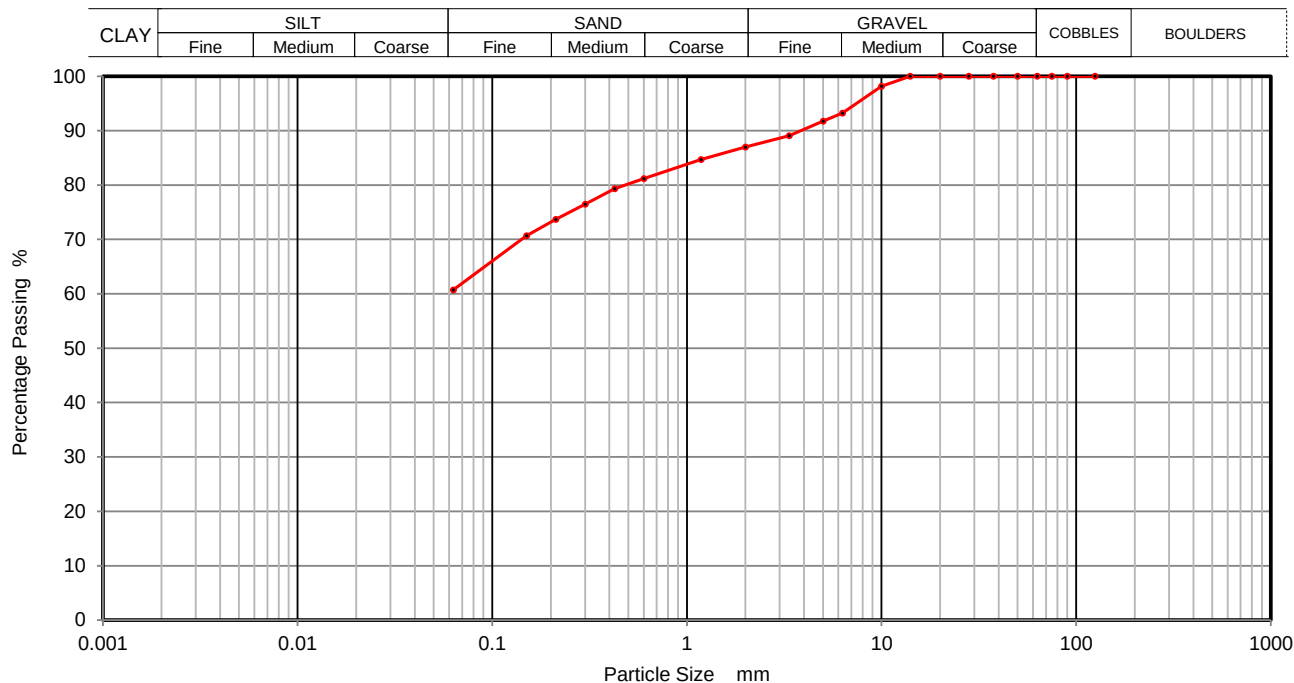
Soil Description *See sample description sheet

Depth Top 2.40

Depth Base

Date Tested 24/06/2022

Sample Type D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	98		
6.3	93		
5	92		
3.35	89		
2	87		
1.18	85		
0.6	81		
0.425	79		
0.3	76		
0.212	74		
0.15	71		
0.063	61		

Sample Proportions	% dry mass
Cobbles	0
Gravel	13
Sand	26
Silt and Clay	61

Remarks
Preparation and testing in accordance with BS1377 unless noted below

Operator				
David Edwards				

Soils Limited
Geotechnical & Environmental Consultants

Newton House
Cross Road, Tadworth
Surrey KT20 5SR

T 01737 814221
W soilslimited.co.uk

Waterman Civils Specification

MIRA Plot 8 & 9 Development

Civils Specification

Project No: WIE13833-120

October 2022

MIRA Plot 8 & 9 Civils Specification

Client Name: HORIBA MIRA Ltd
Reference: WIE13833-120-TC-SP-01
Issue: Stage 3 Issue

Waterman Infrastructure & Environment Ltd
PICKFORDS WHARF, CLINK STREET, LONDON, SE1 9DG
TEL NO: 020 7928 7888, FAX NO: 020 7902 0992, email: chris.hounsell@watermangroup.com

A01	07/10/22	Tender Issue	KS		
Rev.	Date	Description	Prep.	Check.	Appr.

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0. PREAMBLE

0.1 HOW TO USE THE SPECIFICATION

Although each section is generally stand-alone, there is a need to also refer to the general and specific section as appropriate. Any clauses that are not relevant are deemed not to apply.

Users of this specification are advised that alternative environmentally advantageous, reclaimed materials may be available for substitution for some of the naturally occurring materials envisaged in this specification.

Website www.resus-engineer.co.uk is one guide to some materials that might be considered. This site does not provide info on suppliers, only types/categories of replacement materials. Any such proposed substitution may need to be agreed by the Project Manager as acceptable and suitable for application in the chosen location, before use.

1. INTRODUCTION

1.1 GENERAL CLAUSES

Each section of this specification has a sub-section covering general clauses that are only pertinent to each different section. However, there are general clauses that are relevant to all sections, and they are consequently included in this introductory section.

1.2 GENERAL CLAUSES COMMON TO ALL SECTIONS

- (i) The term "Engineer" in this Specification refers to Waterman Infrastructure and Environment.
- (ii) The term "Architect" in this Specification refers to Geddes Architects.
- (iii) The term "Landscape Architect" in this Specification refers to Terrafirma Architects.
- (iv) The term "Authority" refers to "Local Planning and/or Highway Authority and/or Water Authority".
- (v) The term "Contractor" refers to the Trade Contractor appointed for a particular section of the works.
- (vi) The term "he" refers to the Contractor and should be read as he or she as appropriate.
- (vii) The term Contract Document refers to the contract agreement document which may be in the form of conditions of contract or a lump sum agreement.
- (vi) The specification is based on:
 - a) Highways Agency's "Specification for Highway Works" and/or "Sewers for Adoption – A Design and Construction Guide for Developers" / "Design and Construction Guidance (DCG)" published by WRc plc and Building Regulations;
 - b) Local Authority Requirements.
- (vii) The Engineer will produce most or all of his drawings by computer. The Contractor must ensure that all his personnel can view the latest version of Acrobat.
- (viii) Where any item of this Specification is subject to the Engineer's or Project Manager's comment, the Contractor may proceed with this item only after all matters arising from such comment have been fully taken into account by the Contractor, or as authorised in writing by the Project Manager.
- (ix) The Project Manager's approval of a sample of materials and/or workmanship does not constitute approval of the actual materials and/or workmanship employed in the works, but only approval of the particular sample.
- (x) The Contractor shall be responsible for co-ordinating the works to ensure all interface details are in accordance with the specifications for the contract.

1.3 SCOPE OF WORKS

The outline scope of works is as follows:

The scope of Plot 8 & 9 works comprises the building and contributing infrastructure works that are to be built to feed Plot 8 & 9 located on the wider MIRA site. This includes building of a new Plot 8 & 9 building and contributing roads, utilities, and necessary infrastructure within the Plot 8 & 9 site boundary. This includes attenuation tank construction, underground drainage, permeable paving, concrete slab installation and connecting road construction. The site will connect into the existing road to the southeast of the site – Mira Drive and connect into the LIF 2 infrastructure works that will be built in parallel to the Plot 8 & 9 development.

All on site sewers are to be constructed under this specification but are not going to be offered for adoption. The site will have a series of SUDs systems and details of these are on the drainage details drawings. The hard standing areas will drain into SuDS system via either a swale, infiltration trench, rain gardens and permeable paving and then drain into attenuation tanks downstream before draining into the LIF 2 drainage infrastructure to the northwest of Plot 8 & 9 site.

Contractor to obtain indirect consent for the foul water system from Severn Trent Water to connect into their system and pumping station downstream.

The proposed foul water sewers are to connect into the existing Severn Trent sewers south of the site to drain all of the new plots and the new gatehouse structure. This is shown on the detailed drainage drawings.

The allowable discharge rate of the Plot 8 & 9 site is ~~8.0 l/s~~ **6.0 l/s**. A hydrobrake will be required to restrict runoff from the site then connect into the LIF 2 drainage system.

All manhole and access chambers in the paved external areas shall be fitted with inset covers to suit the finishes with FACTA B class recessed covers, service yard finishes to be FACTA class D. Grades are as specified on the manhole schedule. All manholes and access chambers in the service yard and car parking areas shall be fitted with D400 grade ironwork. All sewers in the infrastructure works areas are to be vitrified clay or concrete pipes, based on proposed diameter size.

The new foul and surface water sewers are to be jetted and CCTV surveyed on completion. The contractor is to provide a full report for inclusion in the O and M manuals covering all sewers within the site and their connections to the existing external system.

See each section for the detailed scope of works relating to that section.

~~1.4 CONTRACT DOCUMENT~~

~~If there is a conflict between the Contract Document and the Clauses, including General Clauses, in this specification then the Contract Document shall prevail. If there is a conflict between the specification and the drawings, then the Contractor shall give seven days' notice in writing to the Project Manager who will clarify each case.~~

1.5 STANDARDS

Where a British Standard incorporated in the Contract has been superseded by a Harmonised European Standard, or a European Standard, issued prior to the date stated in the Contract

then such Harmonised European Standard or European Standard shall be substituted for the British Standard and any amendments thereto contained in the Specification.

If any other relevant standards become updated, then the new standard shall be referred to.

1.6 MATERIALS

Each section of this specification has its own sub-clauses describing the requirements for the relevant materials. The requirements common to all sections are described in the General Section 3.1

Where a Clause in the Specification relates to work goods or materials that are not required for the Works, it shall be deemed not to apply.

7 STANDARD OF WORK

The whole of the Works shall be carried out in a proper and thoroughly workmanlike manner ~~to the satisfaction of the Project Manager~~ and in accordance with the latest available editions at the time of construction of the various relevant British and European Standards and Codes of Practice.

1.8 SETTING OUT

Each section of this specification has its own sub-clauses describing the additional requirements for the relevant setting out.

The general requirements are as set out below.

- (i) The Contractor shall be responsible for all setting out, that shall be checked and approved by the Project Manager, before commencement of works. Setting out of the buildings and external hardstanding areas to be provided by the Architect and setting out of the internal downpoints to be provided by M & E/Architect. Such approval shall not relieve the Contractor of his responsibility. The Contractor shall provide all instruments and labour for this purpose and also for assisting the Project Manager in checking the setting out should he so desire.
- (ii) The lines, positions and levels of the new works may be amended only at the discretion of the Project Manager.
- (iii) The setting out shall be carried out in accordance with the overall setting out specification. The Contractor shall agree with the Project Manager the actual levels across the site before any excavation works are commenced.
- (iv) The lines and levels of the proposed Works shall be set out by the Contractor in accordance with the Contract Drawings. The Contractor shall keep updated schedules and drawings of all bench marks (that shall be based on Ordnance Datum at Newlyn) used in the setting out and shall make these available to the Project Manager when required.
- (v) The Contractor shall ensure that where necessary, in order to maintain his programme, lines and levels are set out in such time as to enable Statutory Undertakers' plant and other publicly or privately owned services or supplies to be installed, altered or removed.

GMI have deleted this section as it is subjective and is an increase to the Employer's Requirements. GMI to install to objective Standards. PM has the chance to snag as part of the ER's

- (vi) The Contractor shall survey and record existing details of items that he is required to remove and subsequently replace. The level of survey information to be recorded is to be agreed with the Project Manager.

1.9 INSPECTION

The Project Manager will liaise with the adopting authority on inspections required for the proposed adoption of the works.

The Contractor shall give ~~24 hours~~ notice upon completion of each stage of the works for the Project Manager to carry out an inspection. Work shall not proceed with the next stage until this inspection has been made and approval of the works given in writing.

7 days

Refer to each section for the detailed inspections relating to that section.

These inspections shall be in addition to all routine day to day checks and inspections.

1.10 VARIATION TO THE DESIGN

The Contractor shall set all the Works in the positions and for the materials as shown on the drawings or described in this specification.

Before the Contractor varies any material, component or detail of construction he shall notify the Project Manager and the Engineer of the total effect that these variations will have on the design and performance of the installation and all other services.

Permanent works constructed in the wrong position or with incorrect material or to incorrect levels according to the drawings shall be demolished and new works installed correctly unless otherwise approved by the Project Manager.

1.11 PROGRESS DRAWINGS

- (i) The Contractor shall retain on site at all times one complete set of progress drawings marked up in colour to indicate the current progress and variation to the works. These progress drawings shall be available throughout the Project duration for inspection by the Project Manager, Engineer or others. Immediately upon completion of the installation, the Contractor shall prepare a set of "as constructed" drawings of the Works and deliver them to the Project Manager.
- (ii) The Contractor shall provide record drawings on magnetic media in the latest AutoCAD .dwg format that shall indicate all revisions to the detailed design. The record drawings shall be issued ~~within 21 days of issue of the Completion Certificate.~~ with the Operating and Maintenance Manuals
- (iii) The Contractor should note that the provision of the above drawings forms part of the information to be included in the Health and Safety File required under the CDM regulations.

1.12 PROTECTION OF EXISTING TREES AND HEDGES

Trees, hedges, walls and fences shall not be removed except as agreed by the Landscape Architect and the Local Authority and the Project Manager.

Every precaution shall be taken to avoid damage during operations and particular care shall be exercised at all times to safeguard all trees, vegetation and the features required to be preserved.

Branches to be dealt with only as agreed by the Landscape Architect and by approved tree surgeons.

Should the roots of any tree project into an excavation, great care shall be taken to avoid damage to the root. If the cutting of any roots be deemed necessary, the approval of the Landscape Architect and the Project Manager must be sought.

1.13 DIVERSION AND CONTROL OF TRAFFIC

- (i) The Contractor shall, in cases where new sewers, drains or other new works cross roads railways or footpaths, co-operate fully with Police, Local Authorities and Railways as appropriate, regarding the control and diversion of vehicular and/or pedestrian traffic. An appropriate Traffic Management Plan must be employed.
- (ii) Access to properties shall always be maintained. The written consent of the relevant Local Authorities and Railways as appropriate shall be obtained prior to the Contractor breaking up or tunnelling under any road, pavement, railway or grassed surfaces.

1.14 REINSTATEMENT OF SURFACES

The Contractor shall ascertain the Authority's requirements where any new sewer or drain passes under a road or pavement area and include for the provision and maintenance of a temporary surface, if required, and for the permanent reinstatement of the surface in accordance with the Authority's requirements to the satisfaction of the Authority and the Project Manager and the Engineer.

1.15 TEMPORARY WORKS

The Contractor shall provide, and be fully responsible for, all temporary works, including their design and the adequacy of their construction for the purpose intended.

The Contractor shall, if required by the Contract or the Project Manager, prepare and submit in ample time for reviewing by the Project Manager before the execution of the works, detail drawings and calculations of any temporary works he may wish to use that shall also show the location of such temporary works and their order of construction, but this shall not relieve him of his responsibilities in any way.

All temporary works are to be removed on completion and all necessary repairs and reinstatements carried out unless the Project Manager approves otherwise.

~~1.16 WORK NOT TO BE COVERED~~

~~The Contractor shall not backfill nor cover any works until they have been inspected and, if necessary, measured by the Project Manager and he must give reasonable notice when the work is ready for inspection and measurement. Should the Contractor cover up any work contrary to this stipulation, he shall uncover the same and in the case of refusal, the Project Manager may cause such work to be uncovered and may charge the cost to the Contractor.~~

GMI and CS2 had agreed a timing / clause in the employer's requirements that contradicts this. 2.03 in ERs - GMI have deleted

1.17 PROTECTION OF THE WORKS

All works shall be properly and adequately protected from the detrimental effect of any type of weather.

1.18 SURVEY OR INSPECTION OF HIGHWAYS, PROPERTIES AND LANDS

- (i) Where appropriate, the Project Manager shall arrange for surveys or inspections to be carried out in conjunction with the Contractor, owners or occupiers, of the condition of highways, properties, construction works and lands that may be affected by the Works.
- (ii) Before any work affecting such highways, properties or lands is commenced, the Contractor shall confirm in writing to the Project Manager that the relevant survey is a true and accurate record of their condition.

1.19 SITE FENCING

Where temporary site fencing is required the Contractor shall erect such fencing as soon as he is given possession of the relevant portion of the Site. The Contractor shall regularly inspect and maintain all such fencing, any defects being made good without delay. Access shall be provided in temporary site fencing as necessary for the use of the occupiers of adjacent lands. Temporary site fencing shall be of appropriate height and rigidity and shall remain in position until either it is replaced by permanent fencing or the Works are sufficiently completed to enable that portion of the Site to be brought into use.

1.20 SITE SECURITY

The Contractor is to provide the Project Manager with 24-hour contact details. The emergency contact details are to be posted at the site gate.

The Contractor must take all reasonable measures to ensure that no unauthorised persons, especially children, are able to enter the work areas.

All the works are to be adequately fenced or barriered off. Hoardings are to be provided to segregate the contractors and other users of the site.

Fencing and barriers are required to protect against theft and damage, and to protect against accidents to anyone entering the site with and without authority, including children.

1.21 WELFARE FACILITIES

The Contractor is to provide welfare facilities in accordance with the Workplace (Health, Safety and Welfare) Regulations 1992 Approved Code of Practice L24 for all personnel working on site. No other facilities are to be used unless provided by the Client and of a sufficient standard.

The Contractor shall be responsible for ensuring the good upkeep and servicing of the facilities provided.

1.22 LEVELS AND REFERENCE POINTS

- (i) The Contractor shall supply and agree with the Project Manager details of the value and location of the temporary bench marks and reference points that he proposes to use.
- (ii) The Contractor shall satisfy himself that the existing levels as indicated on the drawings are correct. Should the Contractor wish to dispute any levels he shall submit to the Project Manager a schedule of the position of the levels considered to be in error and a set of revised levels. The existing ground relevant to the disputed levels shall not be disturbed before the Project Manager's decision as to the levels to be used.
- (iii) The Contractor shall check the locations, invert levels and sizes of existing drains, sewers, catchpits and manholes before the commencement of any works and shall notify the Project Manager immediately if the declared invert levels or pipe sizes are found to be at variance with the drawings or documents.

1.23 PROTECTION AGAINST DAMAGE

- (i) The Contractor shall take all necessary and reasonable precautions to avoid causing any unwarranted damage to roads, lands, properties, trees and other features and, during the currency of the Contract, shall deal promptly with any complaints by the Authority, owners or occupiers to the satisfaction of the Project Manager if it is proven that the Contractor or the Contractor's subcontractor's are at fault for the damage.
- (ii) Where any portion of the Works is close to, across or under any existing apparatus of Public Utilities or other parties, the Contractor shall temporarily support and work round, under or adjacent to all apparatus in a manner designed to avoid damage, leakage or danger and to ensure uninterrupted operation.
- (iii) Should any leakages or damage be discovered, the Contractor shall at once notify the Project Manager and the relevant authorities or owner concerned, and the Contractor shall afford every facility for the repair or replacement of the item or apparatus affected.

1.24 PUBLIC UTILITY AND OTHER SERVICES

- (i) The Contractor shall consult all relevant Statutory Authorities, Public Utility Companies and service owners before commencing any excavations and shall satisfy himself as to the exact position of existing services that may affect or be affected by the construction of the Works.
- (ii) Outfalls for drainage are to be agreed with the Authority by the Project Manager or the Drainage Engineer.
- (iii) The Project Manager shall make his own arrangements for any diversion or removal of services that he may require for his own convenience or because of his proposed method of working.
- (iv) Should any service be found to exist that is not indicated by the Statutory Authority and Service owners, the Project Manager shall be given written notification immediately.
- (v) The Contractor shall examine such documents as are available at the offices of the Engineer, Utilities and Local Authorities showing the positions, size and levels of all Public Utility Services.

- (vi) The Contractor shall determine the location, level and number of existing drains or other services within the boundary of the site and shall include in his price for their removal, diversion, reinstatement or associated works as required or directed by and to the satisfaction of the Project Manager and the Engineer and the Public Utility Authority.
- (vii) The Contractor shall, in all cases where new works pass under or near to existing pipes or cables, temporarily support them in a manner such that leakage or damage will not occur.
- (viii) The Contractor shall provide, install, maintain and remove when no longer required, such temporary supports or precautions as the relevant authorities may consider necessary. The Contractor shall be responsible for the protection of all existing services and any damage that may be caused to these services during the duration of the contract.
- (ix) Should any leakage or damage occur, notice in writing shall at once be given to the relevant Utility Authority concerned the Project Manager and the Engineer. The Contractor shall provide for properly accredited agents of such an authority, all available facilities and access to their services situated on, over or under the site as may be necessary for inspection, repair, maintaining, removing or renewing of these services or for any other purpose.
- (x) The Contractor shall give the Authority and Utility Authority one month's written notice in advance for the works and shall give no less than seven days' notice for the exact start date. The Contractor shall co-operate fully with them at all times during the Contract.

1.25 PROTECTION TO EXISTING SEWERS, DRAINS DUCTS AND SERVICES

- (i) Protection to any existing sewers, drains, ducts and services shall be to the requirements as described in the Contract.
- (ii) Before protection works are carried out the existing sewer, drain or service shall be located by means of hand dug trial holes except where otherwise permitted by the Project Manager.
- (iii) Excavation and backfilling for the protection work shall be carried out in accordance with the requirements stated in the Contract. Where excavation is required around an existing sewer, drain, duct or service then this shall be carried out carefully by hand to avoid damage to the sewer, drain, duct or service.
- (iv) The Contractor shall ensure that the sewer, drain, duct or service is adequately supported during the carrying out of the protection works.
- (v) Any damage to the sewer, drain, duct or service occurring during the protection works shall be made good by the Contractor.
- (vi) Protection to the sewer, drain duct or service shall be carried out in accordance with the appropriate Specification Clauses and as agreed with the Project Manager and relevant Authority.

1.26 TIDINESS OF SITE

- (i) The Contractor shall be responsible for maintaining the Site and the Works in as clean and tidy a condition as possible and shall remove from the Site rubbish, other waste and surplus

material as it accumulates. Materials and equipment shall be positioned, stored and stacked in an orderly manner.

- (ii) Watercourses, channels and gullies must at all times be kept free of all materials that would impede their efficiency.
- (iii) On completion of the works, the Contractor shall leave the site in a clean and tidy condition to the satisfaction of the Project Manager and the Engineer.
- (iv) A Site Waste Management Plan shall be required under the "The Site Waste Management Plans Regulations 2008" if the contract value exceeds £300,000.

1.27 WHEEL WASHING

No vehicles shall leave the site with earth, mud etc. adhering to the wheels in a quantity which may result in it being deposited on the public highway or footpath, and creating nuisance or hazard to vehicles and pedestrians. The Contractor shall liaise with the Project Manager on the provision, operation and maintenance of this requirement.

1.28 NOISE CONTROL

The Contractor shall comply with the recommendations set out in BS 5228 Parts 1 and 2: 2009 Code of Practice for Noise and Vibration Control on Construction and Open Sites.

The Contractor shall ascertain the requirements prior to commencing work and shall advise the Project Manager of such requirements in writing.

1.29 INFORMATION REGARDING SOIL CONDITIONS

- (i) Information regarding soil conditions in the area of the Contract may be available for inspection at the Engineer's offices, but it should not be assumed that such information covers all soil conditions that may be encountered in the Works.
- (ii) The Contractor may undertake such additional investigation as he deems necessary at no expense to the contract, should he so desire.
- (iii) Refer to The Soil Investigation Report: no. WIE13833-100.R.10.1.1-RJM

1.30 DEALING WITH WATER

The Contractor shall, unless specifically stated elsewhere, keep the whole of the Works free from water and/or sewage during the course of construction. Water shall not be discharged into existing drainage systems, including ditches, without the prior written consent of the Project Manager, and such consent, if given, will be conditional upon the Contractor taking precautions to prevent solid or suspended material entering such drainage systems, as well as the subsequent clearing of these systems from deposits of silt.

1.31 USE OF EXPLOSIVES

The Contractor shall not use any explosives without permission in writing from the Project Manager, who will require evidence that the Contractor has complied with the requirements of the Explosives Acts 1875 and 1923, and “The Health and Safety (Miscellaneous Amendments and Revocations) Regulations 2009”. The Project Manager may refuse to permit the use of explosives for any other reason and this shall not constitute grounds for a claim.

1.32 DESTRUCTION OF WEEDS

The Contractor shall take all necessary precautions against the growth of weeds on the site of the works from the date of commencement until the termination of the maintenance period. Particular attention in this respect shall be paid to the sub grade footways and verges. Perennial weeds shall be destroyed by an application of a non-toxic translocatable, non-residual herbicide approved for total weed control and shall be applied in accordance with the manufacturer’s instructions, at the required locations and frequency. Care shall be taken not to apply weedkiller in close proximity to vegetation, trees, etc., and only an approved non-toxic selective weedkiller shall be used on verges.

1.33 SPECIFIC ITEMS

The Contractor should particularly note the following specific items that are more fully listed in the specification.

- ~~(a) Tolerances on road works for permeable paving are enhanced above the tolerances used for other areas.~~
- (b) Surfacing material is a specialised application available from approved suppliers and a three year performance guarantee is required by the Project Manager.
- (c) At the point of handing over, the polished stone value (psv) must be shown to meet the specified requirements. Surface treatment may be needed to expose the polished stone value of the aggregate to achieve the required skid resistance.
- (d) All layers and surfaces of roads shall require a rigorous NAMAS testing regime with written results to be included in the Project Health and Safety File that will be produced by the CDM Co-ordinator prior to opening of the road.
- (e) Any changes by the Contractor (as built) must be fully notified and detailed for inclusion in the Health and Safety File.
- (f) Some ductile iron kerb drainage units require special manufacture.
- (g) Some manhole covers and drainage channels are of a higher strength grading than usually used on road areas. The full details are included in the drainage specification.
- (h) The testing regime specified that includes test certificates shall be required as these will be needed at hand over.

1.34 WORKMANSHIP

Each section of this specification has its own sub-clauses describing the requirements for workmanship. The requirements common to all sections are described in the General Section 3.2.

1.35 TESTING

Each section of this specification has its own sub-clauses describing the requirements for testing. The requirements common to all sections are described in the General Section 3.3.

3. GENERAL

3.1 MATERIALS

3.1.1 STANDARDS AND SUBMISSION OF MATERIALS

Wherever, in respect of any British Standard, a BSI Scheme of Supervision and Control is available, all goods and materials required are to comply with that Standard, or the containers of such materials, shall be marked with the BSI Certification Trade Mark (The Kitemark). This requirement shall not apply where the Project Manager is satisfied and confirms to the Contractor in writing that Kitemarked materials are not readily available. In such a case and where materials are required to comply with other British Standards, the Contractor shall submit to the Engineer or Authority, test certificates furnished by the supplier or manufacturer of the materials, indicating compliance with the relevant British Standard.

GMI have deleted. GMI will provide details of any item used in the Construction if asked for, but will not be providing a list of all suppliers of all materials.

~~As soon as possible after the Contract has been awarded, the Contractor shall submit to the Project Manager for his approval a list of his proposed suppliers and sources of materials required for the execution of the Works.~~

Samples shall be taken in accordance with the appropriate British Standard where applicable.

The materials subsequently supplied shall conform to the quality of samples that have been approved by the Project Manager.

~~Names of additional suppliers and sources may be submitted by the Contractor during the execution of the Contract, but no source of supply shall be changed without the Project Manager's approval. The Contractor shall maintain a record of the suppliers from whom he proposes to purchase the goods and materials necessary for the execution of the Works. Where a choice of goods or materials is listed in the Contract, the Contractor shall inform the Project Manager of the goods or materials he proposes to use.~~

All materials, workmanship and tests (where required) shall comply with the appropriate British Standard, the National Building Regulations, the Bye-Laws of the Authority, the requirements of the National House Builders Association (as appropriate) and be in accordance with the drawings and the Specification.

Materials required for performance of work shall be new, the best of their respective kind and shall be of uniform pattern throughout the work.

Items of materials and equipment not specifically mentioned on the contract drawings but that are necessary to make a complete and operating installation shall be included.

3.1.2 STORAGE OF MATERIALS

Materials and components shall be stored neatly in such a manner as to preserve their quality and condition to the standards required by the Contract. Materials shall be supported appropriately so that no contamination by natural ground material occurs.

All materials and equipment including manhole covers, pipes and fittings required to complete the construction shall be thoroughly inspected by the Contractor upon arrival at the site.

Those that are inferior in quality or those that have been damaged in transit shall be set aside and removed from the site.

Materials and equipment found to be sound in all respects shall be stored in accordance with the manufacturer's recommendations where applicable. They shall be protected at all times from damage or deterioration whilst in storage. A final inspection shall be made prior to use or installation.

The quantity of materials and components stored on the site shall be consistent with that necessary for efficient working.

3.1.3 HANDLING AND USE OF MATERIALS

Goods and materials shall be handled in such a manner as to avoid any damage or contamination, and in accordance with all applicable recommendations of the manufacturers.

Unless otherwise described in the Contract, the use, installation, application or fixing of materials and components shall be in accordance with all applicable recommendations of the manufacturers. Where appropriate, the Contractor shall make use of any technical advisory services offered by manufacturers.

3.1.4 WATER

Water for use with cement or bituminous materials shall be potable.

3.1.5 RECYCLED AGGREGATES

Source of Recycled Aggregates

- (i) Where recycled concrete aggregate is used as constituent materials for concrete pavement layers, only crushed concrete resulting from reclamation or processing of concrete previously used in construction which originates from appropriately identified structures with a known history of use shall be used.

In order to detect substances and chemicals harmful to the durability of concrete, appropriate tests based on current relevant advice shall be carried out on recycled coarse aggregate and recycled concrete aggregate, and the results reported to the Project Manager.

- (ii) Where recycled concrete aggregate is used as constituent materials for earthworks, the material shall be aggregate resulting from the processing of material used in a construction process.
- (iii) Where recycled aggregate is used as constituent materials for drainage pipe and bedding combinations, the material shall consist of recycled coarse aggregate or recycled concrete aggregate.
- (iv) Where recycled concrete aggregate is used as constituent materials for road pavements containing unbound, cement and other hydraulically bound mixtures, the material shall consist of recycled coarse aggregate or recycled concrete aggregate.

3.1.6 AGGREGATES FOR CONCRETE

- (i) Aggregates for concrete shall comply with the relevant provisions of BS EN 12620:2002.

- (ii) Sea dredged aggregates shall not be used unless they comply with BS 882.
- (iii) The nominal size of aggregate shall be 20 mm.
- (iv) Aggregate for granolithic concrete shall be crushed granite complying with BS EN 12620.

3.1.7 SAND

- (i) Sands for mortar and grout shall be washed sand complying with BS EN 13139:2002 and graded in accordance with Table 1 of that Standard.
- (ii) Bedding sand shall comply with Table D.3, Category II [change to category I if no heavy vehicles] of BS 7533-3 and shall be certified Sterilised. The stockpile of sand shall be protected by covering with polythene sheeting or tarpaulin and allowed to drain down so that sand for use from the top of the pile shall be dry. Similarly the sand is to be kept free of contaminants, weeds and their seeds so that it remains sterilised.

3.1.8 CEMENT

- (i) Cement shall comply with the provisions of the appropriate British Standard, as set out below:

TYPE	BS
Ordinary Portland	12
Sulphate-resisting Portland	4027

- (ii) Except for concrete having an equivalent compressive strength less than 20 N/mm², sulphate-resisting Portland cement shall be used in all cases (including precast concrete products), unless the Contractor can satisfy the Project Manager that any attack from soils or groundwater will adequately be resisted by the use of cement to BS 12.

3.1.9 CONCRETE MIXES

- (i) Formwork, reinforcement and concrete materials are to comply with the requirements of BS 5328 – Methods of specifying concrete, including ready-mixed concrete for the standard and designated mixes and grades of concrete detailed are:

(ii) Class of Concrete

- (a) ST4 (C20) - Uses as below.
 - i. Precast pipe setting blocks.
 - ii. Protection to pipes.
 - iii. Surround to manholes.
 - iv. Manhole inverts and benching.
 - v. Thrust blocks.
- (b) ST5 (C25) - Uses as below.
 - i. Bedding and backing to kerbs.
 - ii. Bedding and backing to drainage channels.

-
- (c) PAV 1 - Class Pav1 shall have air-entraining and be brush finished. The total air voids shall not be more than 5.5% for 20mm aggregate.
- An air-entraining admixture complying with BS 5025 shall be used in at least the top 50mm.
- (d) Class 32/40 - Surface slabs in accordance with BS EN 13877-2.
- (i) Unreinforced concrete (URC).
 - (ii) Jointed reinforced concrete (JRC).
 - (iii) Continuously reinforced concrete pavement (CRCP).
 - (iv) Continuously reinforced concrete base (CRCB).
- (e) Granolithic - Granolithic Concrete shall be strength class C32/40 with maximum aggregate size 4/10mm.

3.1.10 MORTAR

Mortar shall be 3:1 Sharp sand; Ordinary Portland Cement or Sulphate Resisting Cement.

Mortar for bedding and jointing clay pavers shall be strength class M12 to BS EN 998-2.

3.1.11 LEAN MIX CONCRETE

Wet lean concrete for bases and sub bases shall comply with BS EN 13877-1 and as follows:

Grades and Constituents

The strength for wet lean concrete shall be as shown on the drawings with the following constituents:

- (i) ST4 and ST5 to BS EN 197-1 (cement), BS EN 15167-1 (blast furnace, BS EN 450-1 and BS EN 450-2 (pulverised fuel ash) as appropriate.
- (i) the maximum free water/cement ratio shall be 0.60 for strength classes C16/20 and C12/15 or as directed by the Project Manager;
- (ii) aggregate shall comply with BS EN 12620 and BS EN13877-1.

The aggregate shall consist of either coarse and fine aggregate batched separately or an all-in one aggregate, having a maximum nominal size not exceeding 40mm, nor less than 20mm.

Mix Proportions:

The ratio of cement to aggregate by weight (including any absorbed moisture but excluding free water in the aggregate) shall be sufficient to produce an average crushing strength to the requirements of this clause. The ratio of cement to aggregate by weight shall not, however, be more than 1:15 nor less than 1:20 except with the approval of the Project Manager.

Crushing Strength Requirements:

Test cubes shall be made and tested in accordance with BS EN 12390 and shall conform to the minimum characteristic cube strength given for 150 mm cubes in BS EN 206-1:2000, Table 7.

If the test cubes do not attain the minimum compressive strength the Contractor may without expense to the Contract elect to cut cores from locations selected by the Project Manager to determine the equivalent 28 days cube strength and density of the concrete in the Works. Concrete represented by these cores that fails to meet the minimum requirements of the Specification shall be broken out and replaced with further material.

Core holes for sampling that remain in the Works shall be reinstated in concrete Grade ST4.

Consistence (Workability)

- (i) The consistence shall be determined by the Degree of Compactibility (Compaction Index) test in accordance with BS EN 12350-4, or the Vebe test in accordance with BS EN 12350-3. Alternatively for concrete class C16/20 or below, consistence may be determined by the slump test in accordance with BS EN 12350-2. The sampling for all concrete classes shall be undertaken in accordance with BS EN 12350-1 and the rate of testing in accordance with Table 12 of BS EN 206-1. Consistence shall be carried out at the point of placing, in conjunction with tests for strength and any tests for air content. The consistence shall be maintained at the optimum within the limits specified in BS EN 206-1.
- (ii) If any determination of consistence gives a result outside the tolerance, a further test shall be made immediately on the next available load of concrete. The average of the two consecutive results and the difference between them shall be calculated. If the average is not within the tolerance or the difference is greater than 0.1 for CI or 20 mm for slump, or 6 seconds for Vebe, subsequent samples shall be taken from the delivery vehicles, which shall not be allowed to discharge into the Works until compliance with the Specification has been established.

3.1.12 CONCRETE

- (i) Concrete shall either be a designed mix in accordance with the Specification or a Designated or Standard Mix in accordance with BS 5328, all as indicated on the Drawings.
- (ii) Aggregates for the concrete shall comply with the requirements of BS 882 and the fine aggregate shall be limited to grading zones 1 to 3. The source of the aggregate shall not be varied without the Project Manager's consent. Certificates of aggregate quality and source shall be provided to the Project Manager.
- (iii) Air entrainment or the use of admixtures or other similar chemicals is not generally permitted except for usage on road slabs to achieve an exposed aggregate finish if required. The Project Manager may consider proposals for the use of admixtures, chemicals, etc., but there is no guarantee that such proposals will receive approval. Admixtures, chemicals, etc. shall be submitted for the Project Manager's approval at least 2 weeks before they are intended to be used.
- (iv) Drying shrinkage of the concrete tested in accordance with BS 1881 shall not exceed 0.04%.
- (v) Ready mixed concrete shall be in accordance with BS 5328. The Contractor shall provide details of the supplier and mixes on the attached Form 17/1. For fair faced concrete the use of concrete from different suppliers is not permitted within discrete areas.
- (vi) The Contractor shall give **24 hours' notice** to the Project Manager when reinforcement is ready to receive concrete unless otherwise agreed by the Project Manager.

- (vii) All formwork and its supports shall be sufficiently strong and rigid to carry and maintain the concrete for construction traffic, so that the shape and finish of the completed structure is as shown on the Drawings.

All formwork and its supports shall be sufficiently rigid and tight to prevent loss of grout or mortar from the concrete. The type of formwork used shall produce concrete surfaces suitable for the application of the particular type of finish specified.

Surfaces of formwork in contact with concrete shall be well wetted or treated with a release agent, that is subject to the Project Manager's approval.

- (viii) All Contractor's Equipment and formwork shall be clean and contamination of the concrete shall be avoided at all stages.

Concrete shall be discharged from the delivery vehicle within the periods stated in BS 8500 Part 2:2002. Any concrete that has commenced to set before being finally placed shall be rejected.

Unless otherwise directed, concrete shall be compacted by mechanical vibration so as to ensure a dense and homogeneous mass throughout every part of the works and to produce a good surface finish.

- (ix) Concrete used below ground shall utilise sulphate-resisting cement unless otherwise approved by the Project Manager

3.1.13 READY MIXED CONCRETE

INFORMATION TO BE PROVIDED BY THE CONTRACTOR

- a) Proposed ready mixed concrete supplier.
 - i. Name
 - ii. Address.....
 - iii. Postcode
 - iv. Telephone No.
- b) Location of depot.....
- c) If supplier is a BRMCA member (yes / no).....
 - i. Category of depot.....
- d) Name of cement manufacturer
- e) Name of aggregate supplier
- f) Detail of design mixes proportions proposed by the Contractor to comply with the Specification. Qualities of cement and aggregate to be given must be totally dry and relate to one cubic metre of fully compacted fresh concrete:

Concrete grade	C20	C30	C35	C40	C45	C50
Cement content (Kg)						
20mm max. aggregate (Kg)						
Fine aggregate (Kg)						

Water (Kg)						
Slump (mm)						

3.1.14 AIR ENTRAINMENT

(i) ROAD PAVEMENTS - CONCRETE MATERIALS

Admixtures

Concrete in at least the top 50 mm of surface slabs shall incorporate an air-entraining admixture complying with BS EN 934-2 where specified on the drawings.

Air Content

- a) The concrete shall meet the requirement for exposure class XF4 in BS EN 206-1. This shall be achieved by the use of an air-entraining agent. The minimum quantity of air in air-entrained concrete as a percentage of the volume of the concrete shall be as in the following table:

Table - Minimum air contents

Maximum aggregate size mm	Minimum air content %
20	3.5
40	3

- b) The air content shall be determined at the point of delivery to the paving plant by the pressure gauge method in accordance with BS EN 12350-7, at the rate of one determination per 300 m² of slab or at least 6 times per day, whichever is the greater, in conjunction with tests for consistence and strength. For areas less than 300 m² the rate shall be at least one determination to each 20 m length of slab or less constructed at any one time or at least 3 times per day. If the air content is outside the specified limits in BS EN 206-1 the Contractor shall remove the concrete from the Works.
- c) The air-entraining agent shall be added at the mixer, by an apparatus capable of dispensing the correct dose within the tolerance for admixtures given in BS EN 206-1, to ensure uniform distribution of the agent throughout the batch during mixing.

(ii) THIN BONDED REPAIRS

For thin bonded repairs using high early strength concrete less than 30 mm depth, air entrainment is not required.

(iii) FREESTANDING IN-SITU CONCRETE KERBS, CHANNELS AND EDGE DETAILS

The concrete shall be a strength class C28/35 to BS 8500-2 and air-entrained in accordance with BS 5931.

(iv) BRICKWORK, BLOCKWORK AND STONEWORK**Mortar Work Other Than Unreinforced Masonry Arch Bridges**

If the work is to be carried out in frosty weather and the bricks are wet when laid, then a cement sand mortar with an air entraining plasticiser shall be used. Admixtures shall conform to BS EN 934-3 and shall not contain calcium chloride.

3.1.15 P.C.C. KERBING

P.C.C. kerbing shall comply with BS 7533 Part 6 and BS EN 1340:2003 for granite aggregate, hydraulically pressed, pre-cast concrete to the dimensions and types as indicated on the drawings. Radius kerbs shall be purpose-made where the radius is 12 metres or less with taper kerbs and crossing kerbs to match the straight kerbs.

3.1.16 NATURAL STONE KERBING

Natural stone kerbing shall comply with the following:

- (i) BS 7533 Part 6 and BS EN 1343:2001 for natural granite to the dimensions and types as indicated on the drawings. Radius kerbs shall be purpose-made where the radius is 12 metres or less with taper kerbs and crossing kerbs to match the straight kerbs.
- (ii) Granite setts shall be as indicated on the drawings.

3.1.17 EDGING

- (i) PC Edging shall comply with BS 7533 Part 6 and BS EN 1340:2003 to the types and sizes shown on the drawings.
- (ii) PC Dished channel blocks shall comply with BS 7263 to the types and sizes shown on the drawings.

3.1.18 P.C.C. PAVING SLABS

P.C.C. paving slabs shall comply with BS 7533 Part 12 and BS EN 1339:2003 to the types and sizes indicated on the drawings.

3.1.19 RECONSTITUTED STONE PAVING SLABS

Reconstituted stone slabs shall comply with the specification shown on the drawings.

3.1.20 NATURAL STONE PAVING SLABS

Natural stone slabs and jointing materials shall comply with BS 7533 Part 12 to the types and sizes indicated on the drawings.

3.1.21 P.C.C. BLOCK PAVING

Precast concrete paving blocks shall comply with BS EN 1338 and as shown on the drawings.

3.1.22 CLAY BLOCK PAVERS

Clay pavers shall conform to BS EN 1344 and as shown on the drawings.

3.1.23 BEDDING FOR PAVING SLABS. BLOCK PAVING AND PAVERS

(i) Mortar

Where shown on the drawings P.C.C. paving and blocks shall be bedded on mortar in accordance with this Section.

Mortar for bedding and jointing pavers shall be strength class M12 to BS EN 998-2.

(ii) Sand

Where shown on the drawings P.C.C. paving and blocks shall be bedded on mortar in accordance with this Section.

(iii) Waterproof Membrane

Where specified on the drawings, a waterproof membrane is required to prevent ingress of water to the underlying structure.

3.1.24 ROAD LIGHTING COLUMNS AND BRACKETS

The details of road lighting items are to be provided by the MEP engineer.

3.2 WORKMANSHIP

3.2.1 CONCRETE

- (i) All structural concrete and workmanship shall be in accordance with BS EN 13670:2009 and this Specification.
- (ii) In the interests of health and safety to site personnel, the Contractor is to ensure that the ends of reinforcing bars left temporarily protruding from all concrete elements have suitable safety covers to prevent impalement. In the case of bars 12mm diameter or greater, this protection may take the form of a purpose made plastic cap or by other similar effective means of shielding. All bars of 10mm diameter or less where hooked ends have not been provided are to be temporarily protected with boarding or similar protection placed over the ends of the bars and fixed securely in position together with a clear warning notice where a hazard is not obvious.
- (i) Granolithic concrete shall be laid on base concrete that has been prepared in the following manner. The laitance on the base concrete shall be removed by wire brushing

and by hosing with water. This shall be done after the initial set of the base concrete but before hardening and without disturbing the aggregate. Granolithic concrete shall be laid not later than three days after placing the base concrete. After compaction the surface of the render or screed shall be trowelled to a smooth finish to the required levels, profiles and contours and shall present a surface finish Class U3.

3.2.2 MORTAR

- (i) Mortar shall be mixed mechanically until its colour and consistency are uniform. The constituent material shall be accurately measured.
- (ii) Where ready mixed mortars are specified, their use shall be in accordance with the manufacturer's instructions and BS EN 998-1 and BS EN 998-2.
- (iii) Mortar shall be made in small quantities only as and when required. Mortar which has begun to set or which has been mixed for a period of more than one hour shall be discarded.
- (iv) When additives or admixtures are specified, their use shall strictly follow the manufacturer's instructions and shall be demonstrated in the trial panel.

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3.2.3 TURF AND TOPSOIL

Turf or other material, as directed, over the area of the Works and those areas affected by the Contractor's plant shall be stripped, removed separately and stacked in stockpiles to a height not greater than 1.5 m as directed by the Project Manager before construction commences.

Topsoil stockpiles may be allowed to exceed the maximum height for short periods but in no case for longer than one season. Existing turf and topsoil shall remain the property of the Client and shall either remain stacked or be used on the Site as directed by the Project Manager.

3.2.4 GENERAL EXCAVATION

- (i) The Contractor shall excavate for the Works in any material encountered to the net lines, widths, lengths and levels indicated on the Drawings or to such other dimensions as may be directed by the Project Manager.
- (ii) No excavated acceptable material other than that surplus to the requirements of the Works shall be removed from the Site except on the direction or with the permission of the Project Manager, who may require material which is unacceptable, only by reasons of being frozen, to be retained on site when in that condition. Should the Contractor be permitted to remove acceptable material from the Site to suit his operational procedure, then he shall make good at his own expense any consequent deficit of filling arising there from.
- (iii) If any acceptable material excavated from within the Site is, with the permission of the Project Manager taken by the Contractor for purposes other than the forming of embankments and other areas of fill, sufficient acceptable filling material to occupy after full compaction, a volume corresponding to that which the excavated material occupied

shall, unless otherwise directed by the Project Manager, be provided by the Contractor from his own resources.

- (iv) Acceptable material surplus to the total requirements of the Works and all unacceptable material shall, unless the Project Manager directs otherwise, be run to spoil in tips provided by the Contractor. Where the excavation reveals a combination of acceptable and unacceptable materials the Contractor shall, unless otherwise agreed by the Project Manager, carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the Works without contamination by the unacceptable material.
- (v) The Contractor shall make his own arrangements for stockpiling of acceptable or unacceptable material, and for the provision of sites for the purposes where his method of working requires.

3.2.5 P.C.C. KERBS & CHANNEL BLOCKS

- (i) Precast concrete kerbs, channels and quadrants shall be laid true to line and level within a tolerance of + 3mm or - 3mm. Any unit out of tolerance shall be re-laid. The kerbs shall be laid directly onto a 150mm thick bed of grade ST5 concrete and backed with 150mm wide grade ST4 concrete to within 50 mm of the top of the kerb, or as indicated on the Drawings. The kerbs shall be haunched with 150mm wide grade ST5 concrete as indicated on the Drawings.

A 2 mm joint shall be left between all units. Specially cast radius kerbs and channels shall be used for work on curves where the radius is 12.0 m or less. Work of radius between 12.0 m and 30.0 m shall be laid in kerbs and channels which are 0.60 m straight units. Where the joint is in excess of 3 mm it must be mortared with a granolithic cement sand mortar.

Kerbs shall be backed with concrete Grade ST5 to within 75 mm of the top of the kerb as shown on the Drawings, and not less than 24 hours after completion, the space between the back of the kerb and the face of the excavation shall be filled and rammed. No cut length of kerb or channel shall be less than 0.60 m long.

- (ii) Where a concrete kerb race has been previously constructed, onto a 12mm thick cement mortar bed and haunched with concrete to within 75 mm of the top of the kerb to the lines and levels shown on the drawings. Purpose made radius kerbs, taper kerbs, crossing kerbs and quadrants complying with the BS shall be used wherever appropriate. Straight kerbs shall be laid to radii above 12m.
- (iii) Channel blocks shall be laid directly onto 200 thick bed of ST5 concrete 200 wider than the block and haunched.

3.2.6 PAVING SLABS

- (i) Sub-Base

The sub-base for paving slabs shall be laid and compacted in accordance with this section and BS 7533 Part 4 on the previously approved formation to give a compacted thickness of the material to the dimensions shown on the drawings.

- (ii) Laying Course

The laying course for paving slabs shall be laid and compacted in accordance with BS 7533 Part 4 on the previously approved formation to give a compacted thickness of the material to the dimensions shown on the drawings.

- (iii) Natural stone or concrete paving slabs shall be laid in accordance with BS 7533 Part 4 in the pattern as indicated on the drawing. They shall be placed firmly together without disturbance to the laying course and the order of placing blocks shall ensure this.

3.2.7 BLOCK PAVING

- (i) Sub-Base

The sub-base for block pavements shall be laid and compacted in accordance with this section and BS 7533 Part 3. At the time of laying the sand, the sub-base shall be structurally sound and free from contamination.

- (ii) Sand Laying Course

Precast block pavers shall be laid on a specified thickness of compacted sterilised sand which should be struck off with sufficient surcharge to ensure the laying course thickness so that when the blocks have been vibrated the upper face of the blocks shall be true to the finished levels of the Contract drawings. Before the blocks are laid the laying course shall not be subjected to any form of traffic movements, before, after, or during screeding. Generally the surcharge to achieve a 50mm compacted nominal thickness shall be about 15mm but this should be checked by vibrating some of the blocks as soon as a sufficiently large area is available.

If the levels are not achieved the laid paving blocks are to be taken up. The sand laying course shall then be raked, additional sterilised sand being then placed, the whole then re-screeded to a revised thickness. The process being repeated as necessary until the surcharge is found that produces the required finished levels.

- (iii) Laying Blocks

Blocks shall be laid in the pattern as indicated on the Architect's or Landscape Architect's drawing. They shall be placed firmly together without disturbance to the laying course and the order of placing blocks shall ensure this. The proposed layout, if different coloured blocks are to be used, is to be approved by the Project Manager.

At edges or obstructions such as gully or manhole covers and frames, blocks shall generally be cut to fit. Cutting may be carried out with a hydraulic splitter, a hammer and bolster, or by sawing. Where it is not possible to cut blocks to fit neatly to an obstruction, the obstruction shall be surrounded by concrete ST4. The concrete must be placed after the blocks have been brought as close to the obstruction as possible, to fill the irregular space, which is left. Pigment in accordance with BS EN 12878 shall be used in the concrete to match the colouring of blocks.

- (iv) Vibration

The surface course shall be subjected to passes of a vibrating plate compactor which shall have a centrifugal force of approximately 15-20kN and a frequency of 75-100Hz and a plate area of between 0.2 and 0.5 square metres. Sufficient passes shall be made to compact the laying course and produce an even surface. Vibration shall not be carried out within one metre of an unrestrained edge.

After initial vibration appropriate dry sand shall be brushed into joints and further passes of the vibrating plate compactor made to fill the joints, more sand being spread over the surface if required.

Wet sand shall not be used for vibrating into joints.

(v) Edges

Small gaps left at the edges of block paving, including against obstructions within a paved area which cannot be filled and compacted to the full depth of the paving block with a sand cement mortar not leaner than 3:1. Pigment in accordance with BS EN 12878 shall be used in the mortar to match the colouring of the blocks.

3.2.8 FOOTWAY/FOOTPATH EDGING

Pre-cast concrete edging is to be laid flush with the finished surfacing level on a bed and haunch of 100mm thick ST4 concrete. Where the edging is to be laid to a radius it may be cut with a disc cutter to half lengths or exceptionally 1/3rd lengths. No broken or edging of irregular lengths will be accepted.

3.2.9 FOOTWAY/FOOTPATH LEVEL

Before the surface course is laid, all covers, boxes, etc., shall be accurately set to the correct level and crossfalls.

3.2.9 FOOTWAY/FOOTPATH ALIGNMENTS

Horizontal alignments shall be determined from the centre line of the carriageway pavement surface and/or as shown on the drawings.

The levels of pavement courses shall be determined from the true finished road surface calculated from the vertical profile and crossfalls and/or as shown on the drawings. The vertical depth below the true pavement surface of any point on the constructed surface of the formation or pavement courses shall be within the appropriate tolerances stated in Table A.

However the combination of permitted tolerances in different pavement levels shall not result in a reduction of the surface course thickness by more than 5 mm from that specified nor a reduction in the thickness of the whole pavement, excluding the sub-base, by more than 15 mm from the specified thickness.

For checking compliance with Table A, measurements of surface levels shall be taken at points to be selected by the Project Manager at 10 m centres longitudinally and at 2m centres transversely.

In any length of pavement, compliance with the requirements of Table A shall be regarded as met when not more than one measurement in any consecutive ten longitudinally or one in any transverse line, exceeds the tolerances permitted, but this one measurement shall not exceed 5mm more than the tolerance for the layer concerned.

TABLE A: TOLERANCES IN SURFACE LEVELS OF PAVEMENT COURSES AND THE FORMATION

Surface Course	
General	± 6 mm
Adjacent to a surface water channel*	+10mm - 0 mm
Binder Course*	± 6 mm
Base*	±15 mm
Sub-bases other than above	+10mm - 30 mm
Formation	+20 mm - 30 mm

* Where a surface water channel is laid before the adjacent pavement layer the top of that layer, measured from the top of the adjacent edge of the surface water channel, shall be to the tolerances given in Table A

3.2.10 COLD WEATHER WORK

(i) General

No material in a frozen condition shall be incorporated in the works but shall instead be retained on the Site for use if acceptable when unfrozen.

(ii) Concreting in Cold Weather

Concreting at ambient temperatures below 2°C may be carried out only if all of the following conditions are met:

- a) the aggregates and water used in the mix shall be free from snow, ice and frost;
- b) before placing concrete, the formwork, reinforcement and any surface with that the fresh concrete will be in contact shall be free from snow, ice and frost and be at a temperature above 0°C;
- c) the initial temperature of the concrete at the time of placing shall be at least 5°C;
- d) the Contractor shall take precautions to prevent the temperature of any concrete falling to 0°C during the first 5 days after placing.

(iii) Curing

Concrete shall be protected from drying and freezing for at least 5 days by methods that shall ensure that cracking, distortion and efflorescence are minimised.

In cold weather, when the temperature of freshly placed concrete may approach 0°C, water curing shall not be employed.

(iv) Brick-laying & Block-laying in Cold Weather

Materials used in bricklaying or block laying shall be frost-free, and no bricks or blocks shall be laid when the ambient temperature is below 3°C, unless special precautions are taken. Completed work shall be protected adequately during cold weather.

(v) Road Pavements

Material for use in road pavements shall not be laid on any surface which is frozen or covered with ice.

Except for rolled asphalt surface course the laying of materials containing bitumen binders, shall cease if the temperature of the surface to be covered is at or falls below 2°C. However, where the surface is dry, unfrozen and free from ice, laying may proceed at temperatures at or above -1°C on a rising thermometer.

Unless otherwise agreed by the Project Manager the laying of rolled asphalt surface course shall cease when the temperature of the surface to be covered falls below 5°C or the air temperature falls below 8°C.

Laying of roadworks materials containing cement shall cease when descending air temperature in the shade falls below 3°C and shall not be resumed until the ascending air temperature in the shade reaches 3°C.

If material used in the road pavement contains cement and frost occurs during the first 20 days, or 14 days as appropriate to the time of year, after placing concrete slabs or the first 7 days in the case of their cemented materials, one day shall be added to the period which would otherwise be required before running of traffic of any sort on it for each night on which the temperature of the surface of the layer in question falls to 0°C or below..

3.2.11 ELECTRICAL WORK FOR ROAD LIGHTING AND TRAFFIC SIGNS

All street lighting and other electrically supplied street furniture shall be earthed and bonded in compliance with BS 7430.

3.2.12 LOCATION OF LIGHTING UNITS AND FEEDER PILLARS

The position of lighting units and feeder pillars is shown on the drawings. The exact location shall be agreed on site before commencement of any associated ground work. The Contractor shall be responsible for recording the actual location.

In cases where the location of an item has been determined as indicated above and it is impossible because of underground obstruction to install the item then any excavation shall be backfilled and reinstated to its original condition.

3.3 TESTING

3.3.1 AGGREGATE

- (i) Tests shall be carried out on three samples taken at random from the source prior to use. Tests shall also be carried out during stockpiling or paving, once a week, or at a lesser rate when authorised by the Project Manager.
- (ii) Testing for Constituent Materials in Recycled Aggregate and Recycled Concrete Aggregate.

Quality Control Procedure

The quality control procedure shall be in accordance with the 'Quality Protocol for the production of aggregates from inert waste' and the 'Producers' compliance checklist' published by the Waste and Resources Action Programme (WRAP). The results of all

quality control checks carried out by the Contractor shall be compiled in accordance with the procedure set down in the above document and with those in this Clause. These shall be delivered promptly to the Project Manager on request.

Test Method

The constituents of a sample of recycled aggregate shall be classified by hand-sorting the coarse aggregate particles in accordance with BS EN 933-11. The test shall be carried out by a suitably trained laboratory technician who has demonstrated competence in classifying the constituent classes in accordance with the test method.

3.3.2 CONCRETE

- (i) A minimum of four cubes shall be made from each structural concrete pour, two of these shall be crushed at seven days and two crushed at twenty-eight days, all in accordance with BS 1881 and BS 5328.
- (ii) All tests required shall be carried out by an independent laboratory approved by the Project Manager and appointed by the Contractor. The laboratory shall submit test results directly to the Project Manager.
- (iii) A record of all tests shall be kept on site identifying the tests with the corresponding part of the Works.
- (iv) Should the Contractor either fail to carry out any test described in the Specification or fail to produce the relevant test certificate, further tests shall be specified and carried out at the Contractor's expense.
- (v) If the strength of the works cubes fails to comply with the requirements of this Specification, or if the concrete placed in the Works is, in the opinion of the Project Manager, unsatisfactory in any other way, the relevant mix must no longer be used and the concrete work is liable to be rejected. The Contractor shall cut out and re-execute the defective work or take such other measures as directed by the Project Manager.
- (vi) The rubble and all other materials of failed cubes shall be kept by the laboratory for inspection and further instructions by the Project Manager.

3.3.3 MORTAR

Mortars shall be tested in accordance with BS EN 998-2, BS EN 1015-11 and BS 5628-1 as directed by the Project Manager.

- (i) Mortar shall be mixed thoroughly either by hand or mechanically until its colour and consistency are uniform. The constituent materials shall be accurately gauged, allowance being made for bulking of sand. Mortar shall be made in small quantities only as and when required. Mortar which has begun to set or which has been mixed for a period of more than one hour shall be discarded.
- (ii) Mortar shall have a 28-day mean compressive strength in N/mm² within the following limits:
 - Minimum 9.9 N/mm² 11.5
 - Maximum 11.5 N/mm².

4. EARTHWORKS

4.1 GENERAL

This Section of the specification is based on BS 6031 in addition to the standards described in Section 2 above.

4.1.1 SCOPE OF WORKS

- ~~Cut and fill of earthworks as necessary to formation levels for hard landscaping to levels indicated on the drawings.~~
- ~~Removal of unacceptable or contaminated material from the site.~~
- ~~Removal or relocation of excess material.~~
- ~~Back fill of excavations around substructures such as foundations retaining walls, trenches pits etc.~~
- ~~Removal of soft spots and other areas of unacceptable ground and backfilling with acceptable material.~~
- ~~Removal and clearance of obstructions in the ground and existing hard standing surfacing as shown on the drawings and as required.~~

4.1.2 SETTING OUT

~~Site specific settings out requirements for the works are as shown on the drawings. The Contractor shall deliver sufficient information to the Project Manager for carrying out any checks deemed necessary.~~

4.1.3 INSPECTION

~~The Project Manager will inspect the work at the following stages:~~

- ~~(i) when the lines of the proposed Works have been set out by the Contractor;~~
- ~~(ii) when excavation has been completed and prior to the deposit of any material on it;~~
- ~~(iii) at any stage that the Project Manager may have previously instructed.~~

~~The Contractor shall give 24 hours' notice to the Project Manager before his inspection of each of the above stages. Work shall not proceed until this inspection has been made and approval given in writing.~~

~~These inspections shall be in addition to all routine day to day checks and inspections.~~

4.1.4 SITE CLEARANCE

~~Trees, shrubs and hedges shall only be removed as specified on the drawings including the grubbing up of roots. The Contractor shall cut down and remove from the site all branches and foliage, including cutting any useful timber into lengths, loading and transporting, stacking and disposing of, as instructed by the Project Manager.~~

~~The Contractor shall ensure that individual trees, shrubs and other features and areas stated on the Drawings to be preserved, are suitably identified and protected. Should any trees, shrubs and other planting features and planting areas that it is intended to preserve be killed, removed or damaged by the Contractor during the course of the Works, they shall be replaced by the~~

~~Contractor with plants of the same species and equal in size to those killed, removed or damaged, all in accordance with the Architect's, Landscape Architect's or Arboriculturist's specification as appropriate.~~

~~The Contractor shall be responsible for making good any slips, faults, or loose earth, digging out soft spots, grubbing up old drains, for all double handling from and in the formation of temporary soil heaps and for transporting the materials as required.~~

~~The Contractor is to break up and remove old concrete or rock foundations, drains or manholes, old wells and cesspools or obstructions found during the process of excavation, to the depths shown on the drawings, or as indicated by the Project Manager.~~

~~Where old cellars, wells etc., are found to exist on the site, they shall, when instructed, be completely excavated and cleaned out before commencing fill operations. Fill material to be as defined in the contract or as specified by the Project Manager. All walls shall be reduced in height so that the dimensions from the top of the walls to the underside of any over reaching construction are not less than 600mm.~~

~~If any excavation is carried out in excess of the requirements as shown on the drawings or as directed on site, such excess excavation shall be filled in with materials in accordance with this specification at no additional cost to the Contract.~~

~~The Contractor shall allow for stockpiling of acceptable fill materials for future use by the Project Manager. Areas of stockpiling for this purpose shall be as designated in the Contract, or as agreed prior to stockpiling being carried out by the Project Manager.~~

~~The Contractor shall break up and remove all superficial obstructions on the site as described in the Contract and indicated on the drawings.~~

~~The method of filling voids shall be agreed with the Engineer or Project Manager and carried out in accordance with the Specification.~~

~~All disused pipes, culverts etc., over 1m below formation, that are to remain, shall either be sealed or grouted at the direction of the Project Manager.~~

~~Existing drain runs and connections that are not required or become disused by reason of the works shall be 'grubbed out' and removed. Where this is impracticable they shall be water jetted and cleansed, plugged with a purpose made stopper then filled with acceptable material e.g. ST2 concrete, cement grout or similar to prevent their collapse and effectively permanently seal them against ingress of water and vermin. Pipes of 450 mm internal diameter or greater shall be sealed as shown on the drawings or as instructed by the Project manager.~~

~~Materials arising from site clearance that are to be retained shall be as listed in the Contract Documents and / or shown on the drawings.~~

~~Voids left by items that have been removed shall be filled with acceptable material within one week following excavation, unless otherwise directed or otherwise shown on the drawings.~~

4.1.5 TOPSOIL AND SUBSOIL

~~Topsoil shall wherever practicable be used immediately after its stripping and if not shall be stored in stockpiles of heights not exceeding 1.5m or as directed by the Project Manager. Topsoil shall not be stockpiled for more than two years unless directed otherwise by the Project Manager. Topsoil shall not be unnecessarily trafficked either before stripping or when in a stockpile. Stockpiles shall not be surcharged or otherwise loaded and multiple handling shall be kept to a minimum.~~

~~Reference should be made to the Architect's, or Landscape Architect's specification as appropriate.~~

~~Topsoil shall be required within the extent of the new works wherever soft landscaping areas require reinstatement. This includes the reinstatement to the rear of kerbs and edgings, around sign posts and light columns, and wherever soft landscaping has been disturbed during the works.~~

~~Topsoil shall be re-used in new works including soft landscaped areas and verges. Additionally, any site won topsoil shall be reused as reinstatement to the works and site compound.~~

4.2 MATERIALS

4.2.1 DEFINITIONS

~~The following definitions of earthworks materials shall apply to this and other clauses of the Specification where reference is made to the defined materials:~~

~~(i) acceptable material: material excavated from within the Site or imported on to the Site that meets the requirements of this section for acceptability for use in the Permanent Works. It must be in accordance with the Contract for use in the Works and be capable of being compacted in the manner specified to form a stable fill having side slopes as indicated on the Drawings;~~

~~(ii) unacceptable material: material Class U1A shall be:~~

~~(a) material that does not comply with the permitted constituents and material properties of this section of the specification for acceptable material; and~~

~~(b) material, or constituents of materials, composed of the following:~~

- ~~• peat, materials from swamps, marshes and bogs;~~
- ~~• logs, stumps and perishable material;~~
- ~~• materials in a frozen condition (these materials if otherwise acceptable shall be classified as acceptable when unfrozen;~~
- ~~• clay having a liquid limit determined in accordance with BS 1377 : Part 2, exceeding 90 or plasticity index determined in accordance with BS 1377 : Part 2, exceeding 65;~~
- ~~• material susceptible to spontaneous combustion except unburnt colliery spoil complying with this clause;~~

~~(iii) unacceptable material Class U1B shall be:~~

~~contaminated materials, including controlled wastes (as defined in the Environmental Protection Act 1990 Part IIA) whose level of contamination is above that given below, but excluding all hazardous wastes (as defined in the Special Waste Scotland (Amendment) Regulations 2004) and radioactive wastes (as defined in the Radioactive Substances Act 1993).~~

Limiting Values for Pollution of Controlled Waters.

~~For this site, the contractor should refer to Waterman EED with reference to the bio-remediated material in the stockpiles.~~

Limiting Values for Harm to Human Health and the Environment.

See above.

~~(iv) unacceptable material Class U2 shall be:~~

~~hazardous waste (as defined in the Special Waste Scotland (Amendment) Regulations 2004) and radioactive waste (as defined in the Radioactive Substances Act 1993).~~

~~Where required by the Project Manager, unacceptable material (other than Class U2) shall be processed by mechanical, chemical or other means to render the material acceptable for use in the Permanent Works in accordance with the requirements of this section.~~

~~(v) unacceptable material Class U2 as defined in this clause: material excavated from within the Site that shall not be used in the Permanent Works.~~

~~(vi) topsoil shall mean the top layer of soil that can support vegetation.~~

~~(vii) rock shall be defined as stone in solid beds or masses in its original position or artificial hard material, the excavation of which, in the opinion of the Engineer, requires the use of pneumatic tools, explosives or other approved means. Shale, coal, boulders less than 0.1 m³ in size in trenches or headings or under 0.2 m³ in size in general excavation, or loose or laminated rock, which can be removed by pick and shovel, or by mechanical excavation, will not be included under the definition of rock.~~

~~(viii) "Rock fill" shall consist of hard durable inert material of acceptable size for deposition and compaction as given in Clause 4.3.7 and may comprise rock as defined in this Clause, broken stone, hard brick, concrete or other comparable hard inert materials~~

~~(ix) "Soft material" shall mean acceptable material with the exception of rock fill.~~

4.2.2 MATERIALS GROUPING

~~(i) 'Cohesive soil' includes clays and marls with up to 20% of gravel and having a moisture content not less than the value of the plastic limit (determined in accordance with BS 1377 Part 2: 1990) minus 4; also chalk having a saturation moisture content of 20% or greater.~~

~~(ii) 'Well-graded granular and dry cohesive soils' includes clays and marls containing more than 20% of gravel and/or having a moisture content less than the value of the plastic limit (determined in accordance with BS 1377 Part 2: 1990) minus 4, well-graded sands and gravels with a uniformity coefficient exceeding 10, chalk having a saturation moisture content within the range 15-20% and all shales, clinker ash and spent domestic refuse. —~~

~~(iii) 'Uniformly-graded material' includes sands and gravels with a uniformity coefficient of 10 or less, and all silts and pulverised fuel ashes. Any soil containing 80% or more of material in the particle size range 0.06—0.002mm will be regarded as silts for this purpose.~~

4.2.3 REQUIREMENTS FOR TESTING AND ACCEPTABILITY LIMITS

~~The Contractor shall use only the following permitted classes of acceptable material in construction of the works.~~

The following tests are required to classify and determine the acceptability of earthworks materials. Each class shall only comprise material with properties within the acceptability limits prescribed in Table A.

TABLE A						
Class	General Material Description and Typical Use	Permitted Constituents	Material Properties Required for Acceptability (In Addition to Requirements on Use and Testing of Fill Materials in this specification)			
			Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:	
					Lower Upper	Lower Upper
1A	Well graded granular material. General Fill	Any material or combination of materials, other than material designated as Class 3 in the Contract. (Properties (i), (ii) and (iv) in next column, shall not apply to chalk). Recycled aggregate.	(i) grading	BS 1377 : part 2	Table B	Table B
			(ii) uniformity	See Note 2	10	-
			(iii) optimum mc	BS1377:Part 4 (4.5 kg rammer method)	-	-
			(iv) mc	BS 1377: Part 2	Optimum mc -2%	Optimum mc +2%
1B	Uniformly graded granular material. General Fill	Any material or combination of materials, other than chalk. Recycled Aggregate.	(i) grading	BS 1377 : Part 2	Table B	Table B
			(ii) uniformity coefficient	See Note 2	-	10
			(iii) optimum mc	BS1377:Part 4 (2.5 kg rammer method)	-	-
			(iv) mc	BS 1377: Part 2	Optimum mc -2%	Optimum mc +2%
2C	Stony cohesive material. General Fill	Any material, or combination of materials, other than chalk	(i) grading	BS 1377: part 2	Table B	Table B
			(ii) plastic limit (PL)	BS 1377: part 2	-	-
			(iii) MCV	BS 1377: Part 4	8	16
			(iv) Effective angle of internal friction (ϕ') and effective cohesion (c')	BS 1377: Part 8	$\phi' = 33^\circ$ $c' = 0^\circ$	-
5A	Topsoil or turf, existing on site Topsoiling	Topsoil or turf designated as Class 5A in the Contract	(i) grading	See Notes 3 to 5	-	See n Notes 3 to 5
5B	Imported topsoil. Topsoiling	General purpose grade complying with BS 3882	-	-	-	-
6A	Selected well graded granular material. Below water	Natural gravel, natural sand, crushed gravel, crushed rock other than argillaceous rock, crushed concrete, chalk, well	(i) grading	BS 1377 : Part 2 (On-site)	Table B	Table B
				BS EN 933-2 (Off-site)	Table B	Table B
			(ii) uniformity	See Note 2	10	-
			(iii) SMC of chalk index	Clause 634	-	20%

		burnt colliery spoil or any combination thereof. (Properties (i) and (ii) in next column, shall not apply to chalk.) Recycled aggregate.	(iv) plasticity index	BS 1377 : Part 2	Non-plastic	
6F1	Selected granular material (fine grading). Capping	Any material, or combination of materials – including recycled aggregates with not more than 50% by mass of recycled bituminous planings and granulated asphalt, but excluding materials that contain tar and tar-bitumen binders, unburnt colliery spoil, argillaceous rock and chalk. Property (vi) in the next column shall not apply if the Class Ra (asphalt) content of any recycled aggregate is 20% or less.	(i) grading	BS 1377 : Part 2	Table B	Table B
			(ii) optimum mc	BS 1377 : Part 4 (vibrating hammer method)	-	-
			(iii) mc	BS 1377 : Part 2	Optimum mc – 2%	Optimum mc
			(iv) Los Angeles coefficient	BS EN 1097-2	-	60
			(v) Class Ra (asphalt) content	BS EN 933-11 See Note 6	-	50%
			(vi) bitumen content	BS EN 12697-1 or BS EN 12697-39	-	2.0%
6F2	Selected granular material (coarse grading). Capping	Any material, or combination of materials – including recycled aggregates with not more than 50% by mass of recycled bituminous planings and granulated asphalt, but excluding materials that contain tar and tar-bitumen binders, unburnt colliery spoil and argillaceous rock. Property (i) in the next column shall not apply to chalk. Property (vi) in the next column shall not apply if the Class Ra (asphalt) content of any recycled aggregate is 20% or less.	(i) grading	BS 1377 : Part 2	Table B	Table B
			(ii) optimum mc	BS 1377 : Part 4 (vibrating hammer method)	-	-
			(iii) mc	BS 1377 : Part 2	Optimum mc – 2%	Optimum mc
			(iv) Los Angeles coefficient	BS EN 1097-2	-	60
			(v) Class Ra (asphalt) content	BS EN 933-11 See Note 6	-	50%
			(vi) bitumen content	BS EN 12697-1 or BS EN 12697-39	-	2.0%
6N	Selected uniformly graded granular material. Fill to structures	Natural gravel, natural sand, crushed gravel, crushed rock, crushed concrete, slag, well burnt colliery spoil or any combination thereof. None of these constituents shall include any	(i) grading	BS 1377 : Part 2 (On-site)	Table B	Table B
			(ii) uniformity coefficient	BS EN 933-2 See Note 2	Table B 10	Table B -
			(iii) Los Angeles coefficient	BS EN 1097-2	-	40
			(iv) effective angle of	BS 1377 : Part 8	$\phi' = 35^\circ$ $c' = 0^\circ$	-

		argillaceous rock. Recycled aggregate except recycled asphalt.	internal friction (ϕ') and effective cohesion (c')			
			(v) permeability	As directed	10^{-5} m/s	-
			(vi) optimum	BS1377:Part 4 (Vibrating hammer method)	-	-
			(vii) mc	BS1377:Part 2 and Note 1	Optimum mc -2.5%	Optimum mc +2.5%

Notes-

- Where BS 1377: Part 2 is specified for mc, this shall mean BS 1377: Part 2 or BS EN 1097-5 as appropriate.
- Uniformity coefficient is defined as the ratio of the particle diameters D₆₀ to D₁₀ on the particle size distribution curve, where:

D₆₀ – particle diameter at which 60% of the soil by weight is finer.
D₁₀ – particle diameter at which 10% of the soil by weight is finer.
- Topsoil shall have stones and other debris removed and disposed off Site which have:
 - dimensions greater than 100 mm equivalent diameter, unless otherwise permitted by the Project Manager; and
 - dimensions greater than 50 mm equivalent diameter which lie within 50 mm of the surface.
- Topsoil shall be graded to smooth contours, eliminating all mounds and depressions where water may collect.
- Topsoil shall not have stones or other debris protruding above the surface by more than 30 mm.
- The quality control procedure for recycled materials shall be in accordance with the 'Quality Protocol for the production of aggregates from inert waste' and the 'Producers' compliance checklist' published by Waste and Resources Action Programme (WRAP).

(i) Grading Requirements

All fills and embankments shall be constructed of general fill of classes 1A, 1B, 2C and 6A as defined in this clause and Table A of the Specification, except where stated otherwise in the contract.

TABLE B – MATERIAL GRADING REQUIREMENT	
BS SIEVE SIZE	PERCENTAGE BY MASS PASSING
CLASS 1A	
300 mm	100%
125 mm	95-100%
63 microns	<15%
CLASS 1B	
125 mm	100%
63 microns	<15%
CLASS 2C	

125 mm	100%
2 mm	15-80%
63 microns	15-80%
CLASS 6A	
500 mm	100%
10 mm	0-100%
5 mm	0-85%
600 microns	0-45%
63 microns	0-5%
CLASS 6F1	
75 mm	100%
37.5 mm	75-100%
10 mm	40-95%
5 mm	30-85%
600 microns	0-25%
63 microns	<15%
CLASS 6F2	
100 mm	100%
90 mm	80-100%
75 mm	65-100%
37.5 mm	45-100%
10 mm	15-60%
5 mm	10-45%
600 microns	0-25%
63 microns	0-12%
CLASS 6N	
75 mm	100%
63 microns	<15%

For each approved material a sample of at least 3m³ shall be retained on site as a sample against which subsequent loads can be checked.

(ii) Testing Requirements

The Contractor shall, at least 7 working days before commencement of construction of the earthworks material, submit to the Project Manager for approval the following test certificates for both on site and imported materials:

- 1) Grading
- 2) Uniform coefficient
- 3) Moisture content
- 4) Moisture condition value (MCV)

The minimum frequency of testing to be carried out by the contractor is as follows in Table C:

TABLE C – RATE OF TESTING			
Material Class	Type of Test	Relevant Standard	Rate of Testing
1A 1B 2C	Grading	BS 1377	Source approval and two per week per source
	Optimum Mc	BS 1377	Source approval and one per week per source
	Mc	BS 1377	Two per day per source
	10% Fines Value	BS 812	Source approval and one per week per source
	Soundness	BS 812	Source approval and one per week per source
	Plasticity Index	BS 1377	Source approval and one per week per source
	Plate Bearing Test (C.B.R.)	BS 1377	One per 250 sq. m.
	Field Density Test	BS 1377	Insert number.
5A	Grading	-	Source approval and 1 per 400 tonnes
6F1	Grading	BS 1377	Source approval and two per week per source
	Uniformity Coefficient	BS 892	Source approval and one per week per source
	10% Fines Value	BS 812	Source approval and one per week per source
	Mc	BS 1377	Two per day per source
	Plate Bearing Test (C.B.R.)	BS 1377	One per 250 sq. m.

In areas where fill material is placed at least 1m deep, the Contractor shall allow for 1 no. plate loading test to be carried out for each 500m² plan area of such fill. A minimum of 3 no. plate loadings tests shall be carried out. The tests shall be carried out immediately after completion of the fill operation in the positions designated by the Project Manager. The results shall be documented in the form of a load/settlement curve and issued to the Project Manager within 48hours of the completion of the test. A C.B.R. value shall be given for each plate load test performed.

The Contractor shall provide and maintain full details and drawings showing the locations of all samples taken and tests carried out on the site. Copies of these shall be provided for the Project Manager on his request during the Contract.

4.2.4 GEOTEXTILE MATERIAL

The geotextile material shall be manufactured from engineering grade of polyester, polyethylene, polypropylene sheet, or a combination or approved alternative. It must be used strictly in accordance with the manufacturer's recommendations and comply with the strengths and properties specified on the drawings. Any conflict between the manufacturer's guidelines and the drawings shall be resolved by the Project Manager.

— It shall also be subject to the following requirements:-

1. It shall be inert to all chemicals naturally found in soils.

- ~~2. It shall have no solvents at ambient temperature.~~
- ~~3. It shall not be susceptible to hydrolysis.~~
- ~~4. It shall be resistant to aqueous solutions of salts, acids and alkalis.~~
- ~~5. It shall be non-biodegradable.~~
- ~~6. It shall have a life in excess of 120 years.~~

The Contractor shall refer to the drawings for the location and type of material.

Alternative equivalent products may be proposed by the Contractor for the approval of the Engineer or Project Manager.

When requested one sample for each 1000m² plan area shall be taken from the consignment of geotextile to be used in the works. From each sample taken test pieces shall be cut in order to comply with the tests for tensile strength, flow rates of water and pore size distribution. The tests to prove that the geotextile meets the following criteria shall be at the Contractor's expense:

- (i) The geotextile shall sustain a tensile load of not less than that value shown on the drawings, determined in a 'wide strip' tensile test carried out in accordance with BS 6906: Part 1. The characteristic strength shall be taken as the value of the strength of the material below which not more than 5% of the test results may be expected to fall. This represents the strength at 1.64 standard deviations below the mean strength.
- (ii) The geotextile shall allow water to flow through it, at right angles to its principal plane, in either direction, at a rate of not less than 10 litres/m²/s under a constant head of water of 100 mm, determined in accordance with BS 6906: Part 3. The flow rate determined in the test shall be corrected to that applicable to a temperature of 15°C using published data on variation in viscosity of water with temperature.
- (iii) The geotextile shall have a size distribution of pore openings such that the mean 0₉₀ is between 100 microns and 300 microns, determined in accordance with BS 6906: Part 2.

4.2.5 SLOPE STABILISATION

Where existing slopes, or new embankments are to be stabilised using geotextile fabrics or otherwise, the materials to be used must comply with the relevant standards, and be used strictly in accordance with the manufacturer's recommendations and as specified on the drawings.

4.2.6 REQUIREMENTS FOR DEALING WITH UNACCEPTABLE MATERIAL

- ~~1. Should the Contractor encounter any Class U2 unacceptable material during his earthwork operations he shall immediately inform the Project Manager. Class U2 material shall be stored separately at a location determined by the Project Manager. The Contractor shall make all necessary arrangements including licences for the removal of the material in accordance with the requirements of the Environmental Health Officer and any other interested parties if the Project Manager should decide that the material is to be removed from the site.~~
- ~~2. The details of the Environmental Health Officer are:~~

NAME	ADDRESS	CONTACT	TELEPHONE No.

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3. ~~Unacceptable material (by virtue of moisture content) arising from the site may be stored (subject to space being available) until the moisture content is such that the material becomes acceptable.~~
4. ~~Should the Contractor encounter any Class U1 unacceptable material whilst excavating to achieve a formation level then that material (even if meeting the requirements of CBR or bearing capacity defined for the location) shall be removed to a depth instructed by the Project Manager and replaced with approved materials.~~

4.3 WORKMANSHIP

4.3.1 TOPSOIL AND TURF

~~Topsoil and turf shall, wherever practicable, be used immediately after stripping over the area of the works and any areas affected by the Contractor's plant. It shall be stripped, removed separately and stacked in stockpiles to a height not greater than 1.5m as directed by the Project Manager before construction commences. Topsoil stockpiles may be allowed to exceed the maximum height for short periods but in no case for longer than one season. Existing topsoil and turf shall remain the property of the Client and shall either remain stacked or be used on the Site as directed.~~

4.3.2 GENERAL EXCAVATION

~~The Contractor shall excavate for the Works in any material encountered to the net lines, widths, lengths and levels indicated on the Drawings or to such other dimensions as may be directed.~~

~~No excavated material shall be removed from the Site without the approval of the Project Manager.~~

~~Where the excavation reveals a combination of acceptable and unacceptable materials the Contractor shall carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the Works without contamination by the unacceptable material.~~

~~The Contractor shall make his own arrangements for stockpiling of acceptable or unacceptable material, and for the provision of sites for the purposes where his method of working requires.~~

~~The Contractor shall inform the Project Manager, giving 24 hours' notice, as to when foundation formation levels will be ready for inspection.~~

4.3.3 EXCAVATION OF CUTTINGS

~~Hauling of material from cuttings or borrow pits to the embankments or other areas of fill shall proceed only when sufficient compaction plant is operating at the place of deposition to ensure compliance with the requirement of this section.~~

~~Construction traffic shall not use the surface of the bottom of a cutting unless the Contractor maintains the level of the bottom surface at least 300mm above formation level. Any damage to the sub-grade arising from such use of the surface shall be made good by the Contractor, with material having the same characteristics as the material that has been damaged. From the time the Contractor begins to trim the remaining material to formation level on any given~~

~~area, the movement and use of construction plant thereon other than that used to complete this operation shall be in accordance with the requirements of this section for geotextiles.~~

~~4.3.4 BENCHING~~

~~Where an embankment is to be placed on appreciably sloping ground, this surface shall be benched in steps or trenched, as shown on the Drawings, including if necessary any under-draining of the affected part of the Site.~~

~~The benching or trenches shall be kept free of water in accordance with Section 3.2 for cold weather working.~~

~~4.3.5 EXCAVATION BELOW EMBANKMENTS and BELOW FORMATION LEVEL IN CUTTINGS~~

~~Where any material below the natural ground level under embankments or below formation level in cuttings is required to be excavated, it shall be removed to such depth and over such areas as are shown on the Drawings and disposed of in such a manner depending on its nature and condition at the time. The resultant excavation shall be backfilled with acceptable material as defined in this section all material being deposited and compacted as specified for the forming of the embankments. Nevertheless where in these circumstances such backfill has to be deposited below standing water or where shown on the Drawings, the Contractor shall use only an approved free draining granular material of maximum size not greater than 37.5mm and that on analysis by sieving complies with the requirements of Table A or other approved material. Such materials may be deposited below water without the associated use of compaction plant, except as required by Section 2. Where shown the Drawings 'acceptable material' may be deposited below water level.~~

~~If, after the removal of material as specified in the first paragraph of this clause, the Contractor allows the material so exposed to reach a condition where compaction of backfilling is impracticable, he shall make good either by additional excavation and fill in the manner specified in this clause, or by waiting until the condition of the exposed material is fit to receive the approved backfill.~~

~~4.3.6 FORMING OF EMBANKMENTS AND AREAS OF FILL~~

~~Embankments and other areas of fill shall be formed of material defined as 'acceptable material' in Section 4.2.~~

~~All earthworks material placed in or below embankments, below formation level in cuttings or elsewhere in the Works shall be deposited and compacted as soon as practicable after excavation in layers of thickness appropriate to the compaction used as permitted in this section or as a permitted departure therefrom. Embankments shall be built up evenly over the full width and shall be maintained at all times, with a sufficient camber and a surface sufficiently even to enable surface water to drain from the embankments. The Contractor shall control and direct construction traffic uniformly over their full width. Damage to compacted layers by construction traffic shall be made good by the Contractor.~~

~~If the material deposited as fill subsequently reaches a condition such that it cannot be compacted in accordance with the requirements of the Contract, the Contractor shall either:~~

- ~~(i) Make good by removing the material off the embankment until it is in an acceptable physical condition for re-use, and/or replacing it with acceptable material; or~~

(ii) ~~Make good the material by mechanical or approved chemical means to improve the stability; or~~

(iii) ~~Cease work on the material until its physical condition is again such that it can be compacted as described in the Contract.~~

~~Isolated boulders each within the range 0.015 to 0.085m³ in size may be incorporated in embankments provided that the specified compaction requirements are met and no stone exceeding 0.015m³ shall be placed less than 600mm below finished level.~~

~~In areas of shallow fill where after removal of top soil the ground level is within 300mm of formation level, construction traffic shall not use the surface unless the Contractor brings up and maintains the surface level at least 300mm above formation level. Any damage to the sub-grade arising from such use shall be made good by the Contractor with material having the same characteristics as the damaged material.~~

4.3.7 COMPACTION OF EMBANKMENTS AND AREAS OF FILL

~~Compaction for areas indicated on the drawings shall be undertaken to the requirements of this clause and Table D by approved plant, except where the Project Manager directs or permits a departure from the requirements of this Table.~~

~~For confined conditions such as in trenches, compaction plant shall be such that the compacting surface will apply effort up to, or in excess of, the overall width of the item of plant and further be able to compact the fill material against the undisturbed trench wall unrestricted by any trench supports system in use in such location.~~

~~Variations from the methods given in Table D, or the use of plant not included therein, shall be permitted only if the Contractor demonstrates at site trials that a state of compaction is achieved by the alternative method equivalent to that obtained using the approved methods.~~

~~The procedure to be adopted for these site trials shall be agreed with and approved by the Project Manager.~~

~~Earthmoving plant shall not be accepted as compaction equipment under this Clause.~~

~~The Contractor may at any time be required to carry out comparative field density tests determined in accordance with BS 1377 Part 9: 1990 on material that is considered to have been inadequately compacted (refer to Table C). If the test results, when compared with the result of similar tests made on adjacent approved work in similar materials, shows the state of compaction to be inadequate, or if the test results when compared with the density obtained by a single compaction test carried out on the same material at natural moisture content by the method described in BS 1377 Part 4: 1990 is shown to be less than 95%, and this is held to be due to failure of the Contractor to comply with the requirements of the Specification, the Contractor shall carry out such further work as may be required for compliance.~~

TABLE D – COMPACTION REQUIREMENTS for EMBANKMENTS & AREAS OF FILL						
Type of Compaction Plant	Category	CLASS 1A CLASS 2C	CLASS 1B	CLASS 6F1 CLASS 6F2		
		D — N#	D — N#	N for D = 110 mm	N for D = 150 mm	N for D = 250 mm
Smooth-wheeled roller	Mass per metre width of roll: Over 2100kg up to 2700kg Over 2700kg up to 5400kg	125 — 10 125 — 8	125 — 10* 125 — 8*	Unsuitable 16	Unsuitable Unsuitable	Unsuitable Unsuitable

TABLE D – COMPACTION REQUIREMENTS for EMBANKMENTS & AREAS OF FILL						
Type of Compaction Plant	Category	CLASS 1A CLASS 2C	CLASS 1B	CLASS 6F1 CLASS 6F2		
	Over 5400kg	150 — 8	Unsuitable	8	16	Unsuitable
Grid roller	Mass per metre width of roll: over 2700 kg up to 5400 kg over 5400 kg up to 8000 kg over 8000 kg	Unsuitable 125 — 12 150 — 12	150 — 10 Unsuitable Unsuitable	Unsuitable 20 12	Unsuitable Unsuitable 20	Unsuitable Unsuitable Unsuitable
Deadweight tamping roller	Mass per metre width of roll: over 4000 kg up to 6000 kg over 6000 kg	150 — 12 200 — 12	250 — 4 300 — 3	12 8	20 12	unsuitable 20
Pneumatic-tyred roller	Mass per wheel: over 1000 kg up to 1500 kg over 1500 kg up to 2000 kg over 2000 kg up to 2500 kg over 2500 kg up to 4000 kg over 4000 kg up to 6000 kg over 6000 kg up to 8000 kg over 8000 kg up to 12000 kg over 12000 kg	Unsuitable Unsuitable 125 — 12 125 — 10 125 — 10 150 — 8 150 — 8 175 — 6	150 — 10* Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable	Unsuitable Unsuitable Unsuitable Unsuitable 12 12 10 8	Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable 16 12	Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable
Vibratory tamping roller	Mass per metre width of a vibrating roll: over 700 kg up to 1300 kg over 1300 kg up to 1800 kg over 1800 kg up to 2300 kg over 2300 kg up to 2900 kg over 2900 kg up to 3600 kg over 3600 kg up to 4300 kg over 4300 kg up to 5000 kg over 5000 kg	100 — 12 125 — 12 150 — 12 150 — 9	150 — 12 175 — 12* 200 — 12* 250 — 12*			
COMPACTION METHOD						
CLASS 6A	No Compaction					
CLASS 6N	End product 95% of maximum dry density to BS1377:Part 4 (vibrating hammer method)					

Notes:

- (i) The minimum number of passes N is the minimum number of times that each point on the surface of the layer being compacted shall be traversed by the item of compaction plant in its operating mode, or struck by power rammers or falling weight compactors. D is the maximum depth in mm of the compacted layer.
- (ii) In column headed N# the number of passes shown is to be doubled for material Classes 1A, 1B, and 2C when such materials occur within 600 mm of sub formation (if capping is required) or formation. Such extra compaction shall, unless otherwise directed by the Project Manager, either be carried out for the full width of the embankment or, in other areas of fill which are to receive a pavement, between the outer extremities of the verges.
- (iii) The compaction plant in Table D is categorised in terms of static mass. The mass per metre width of roll is the total mass on the roll divided by the total roll width. Where a smooth wheeled roller has more than one axle the category of the machine shall be determined on the basis of the axle giving the highest value of mass per metre width.
- (iv) A grid roller is a machine with a compacting roll or rolls constructed of heavy steel mesh of square pattern.
- (v) A deadweight tamping roller is a machine with a roll or rolls from which 'feet' project and where the projected end area of each 'foot' exceeds 0.01 m² and the sum of the areas of the feet exceeds 15% of the area of the cylinder swept by the ends of the feet. The requirements for tamping rollers apply to machines that have 2 rolls in tandem. If only one tamping roll traverses each point on the surface of the layer on any one pass of the machine, the minimum number of passes shall be twice the number given in Table D plus any further doubling required to satisfy (ii) above.
- (vi) For pneumatic-tyred rollers the mass per wheel is the total mass of the roller divided by the number of wheels. In assessing the number of passes of pneumatic tyred rollers the effective width shall be the sum of the widths of the individual wheel tracks together with the sum of the spacings between the wheel tracks provided that each spacing

does not exceed 230 mm. Where the spacings exceed 230 mm the effective width shall be the sum of the widths of the individual wheel tracks only.

- ~~(vii) A vibratory tamping roller, which may be self propelled or towed, is a machine having a means of applying mechanical vibration to one or more rolls. The roll or rolls have projecting feet where the height of each foot exceeds 10% of the radius of the roll drum, the projected end area of each foot exceeds 0.1% of the roll drum surface area, and the sum of the areas of the feet exceeds 10% of the area of the cylinder swept by the ends of the feet. The requirements for the operation of vibratory tamping rollers shall be the same as those stated for vibratory rollers in sub-Clause (viii) except that vibratory tamping rollers operating without vibration shall be classified as deadweight tamping rollers.~~
- ~~(viii) For items marked * in Table D the roller shall be towed by track-laying tractors. Self-propelled rollers are unsuitable.~~
- ~~(ix) Where combinations of different types or categories of plant are used, the following shall apply:
 - ~~(a) the depth of layer shall be that for the type of plant requiring the least depth of layer; and~~
 - ~~(b) the number of passes shall be that for the type of plant requiring the greatest number of passes.~~~~
- ~~(x) The single point compaction comparison test shall not be used to deduce the compaction requirements of Table D.~~
- ~~(xi) When materials of widely divergent characteristics are used in embankments and fill areas, they shall be spread and compacted in separate clearly defined areas in such a manner as to comply with the requirements of Table D.~~
- ~~(xii) If more than one class of material is being used in such a way that it is not practicable to define the areas in that each class occurs, compaction plant shall be operated as if only the material that requires the greatest compactive effort is being compacted.~~
- ~~(xiii) Where the Contractor uses plant to provide assistance in the use of vibro compaction plant, this shall be disregarded in assessing the above requirements.~~

USE OF PLATE COMPACTORS FOR DRAINAGE BACKFILL.

- ~~(a) Vibrating plate compactors are machines having a base plate to which is attached a source of vibration consisting of one or two eccentrically weighted shafts and;~~
- ~~(b) the mass per square metre of the base plate of a vibrating plate compactor is calculated by dividing the total mass of the machine in its working condition by its area in contact with compacted material;~~
- ~~(c) vibrating plate compactors shall be operated at the frequency of vibration recommended by the manufacturers. They shall normally be operated at travelling speeds of less than 4 km/h but if higher speeds are necessary the number of passes shall be increased in proportion to the increase in speed of travel.~~

4.3.8 TOLERANCE

~~The levels shall be determined from the point on the constructed surface of the general fill courses and shall all be within a tolerance of +20mm or -30mm.~~

~~The Contractor shall be required to carry out to ensure 95% compaction, in the ratio of 1 test per 500m² plan area of fill material compacted. Refer to Section 4.2.~~

4.3.9 RECTIFICATION

~~Where any tolerance is exceeded the Contractor shall make good in the manner described below:~~

~~If the surface is too high it shall be re-trimmed and re-compacted in accordance with the specification. If the surface is too low the deficiency shall be corrected by the addition of fresh acceptable material of the same classification laid and compacted to Specification, or as otherwise directed by the Project Manager.~~

~~4.3.10 USE OF SURFACES BY CONSTRUCTION TRAFFIC~~

~~The wheels or tracks of plant moving over the various courses of general fill shall be kept free from deleterious materials.~~

~~Any damage to the subgrade arising from construction traffic shall be made good by the Contractor with material of the same or better quality than the material that has been damaged.~~

~~4.3.11 GEOTEXTILE MATERIAL INSTALLATION~~

~~The Geotextile material shall be located as indicated on the drawings and placed directly on the prepared and approved surface level.~~

- ~~a. Geotextiles shall be laid to the correct orientation and length and shall be installed within 50mm of the levels indicated on the drawings.~~
- ~~b. The placing and positioning of the geotextiles, lap lengths and joint details shall be in full accordance with the manufacturer's details and the contract documents.~~
- ~~c. No traffic or site plant shall be permitted to travel on the geotextile prior to placing a minimum of 150mm of fill on top of the geotextile.~~

5. DRAINAGE

5.1 GENERAL

Outfalls for drainage are to be agreed with the Authority by the Project Manager or the Engineer.

5.1.1 SCOPE OF THE WORKS

The scope of this work within the Contract shall cover the installation of the complete below ground drainage system, consisting of foul and surface water drains, connections to manholes, sumps, gullies and interceptors, etc., together with all necessary excavation supports and reinstatements.

Reference should be made to the subsequent sections of this specification and/or detailed drawings for the description of workmanship, fittings, jointing, supports, trench widths, and beddings for each specified material.

All works shall be carried out strictly in accordance with the recommendations contained within BS EN 12056, BS EN 752, BS 8301, BS 8000 Part 14 and the Building Regulations to the complete satisfaction of the Project Manager, the Engineer and for adopted drainage, the Authority.

5.1.2 LEVELS OF EXISTING DRAINS

The approximate size, location and invert levels of existing drains and associated works are, where applicable and known, indicated on the drawings. The Contractor shall, prior to the commencement of works, check the location, size and invert levels of all existing drains and sewers.

The Contractor shall notify the Project Manager and the Engineer in writing, if the declared position, size and/or level are found to be inaccurate. Should any new drains be laid prior to the Contractor ascertaining this information, they shall be stripped out, re-laid or repositioned as directed by the Project Manager and the Engineer.

5.1.3 CONNECTING TO EXISTING SEWERS AND DRAINS

- (i) Where connections to existing sewers are required, these shall be carried out in accordance with the Authority's specification and as indicated on the relevant drawings. The Contractor shall test for soundness of the existing sewers prior to carrying out the works and confirm in writing his findings to the Project Manager and the Engineer.
- (ii) The Contractor shall allow for and break out such lengths as may be considered necessary by the Authority, provide and install in accordance with the Authority's specification, all branches, saddles, connecting pieces and associated fittings that are required to complete the installation. All works shall be carried out under the direct supervision of the Authority to the satisfaction of the Authority and the Project Manager and the Engineer.

5.1.4 PERMANENT DIVERSION OF SERVICES

- (i) Where the position of any services that require permanent diversion or removal are known, these have been indicated on the drawings. The work of removing or relaying any such services may, where appropriate, be undertaken by the Utility Authority's Contractor. The

Contractor shall provide all facilities for this purpose and shall give the Project Manager and the Engineer not less than one month's written notice before he requires the work of removing or diversion of these services to commence. The Contractor shall, on completion of these services, be at liberty to continue with his operations.

- (ii) The Contractor shall be deemed to have included within his programme of works and contract price, all service diversions within the scope of the Contract Works.
- (iii) During the process of the works, should services be discovered that had previously proved impossible to determine, the Contractor shall on finding them, immediately give notice in writing to the Project Manager and the Engineer. Should the Project Manager and the Engineer require diversionary work to be carried out the Contractor shall provide all available facilities to the relevant Utility Authority to enable them to carry out their work.
- (iv) The Contractor shall not be entitled to make any claim other than as provided for in the Contract.

5.1.5 SEALING OF EXISTING DRAINS

- (i) Existing drain runs and connections that are not required or become disused by reason of the works shall be 'grubbed out' and removed. Where this is impracticable they shall be water jetted and cleansed, plugged with a purpose made stopper then filled with an acceptable material e.g. ST2 concrete, cement grout or similar to prevent their collapse and effectively permanently seal them against ingress of water and vermin. Pipes of 450 mm internal diameter or greater shall be sealed as shown on the drawings or as instructed by the Project manager.
- (ii) Any apparently disused drain that shows signs of flow shall be investigated by the Contractor to establish its origin and authenticity. The results of the investigation shall be delivered to the Project Manager within 24 hours.
- (iii) The Contractor shall ensure that, where appropriate, the sealing of existing drains is to the satisfaction of the Project Manager and of the Authority.
- (iv) Where connections for future site drainage are required they shall be sealed with purpose made removable stoppers and proprietary end caps and referenced.
- (v) The Contractor shall retain on site one complete set of drawings indicating all existing drain points, sealed or retained for future use.

5.1.6 SETTING OUT

The Contractor shall set out the line of drains together with all manholes to the satisfaction of the Project Manager and the Engineer. The exact positions of the manholes shall be determined on site unless detailed or dimensioned on the drawings.

5.1.7 EXCAVATIONS FOR DRAINS, CONNECTIONS AND MANHOLES

- (i) The Contractor shall carry out excavation to the lines and levels shown on the drawings or as varied or directed by the Project Manager and the Engineer. He shall excavate to at least a minimum width sufficient to allow for the lowering and efficient jointing of the pipe and to a minimum depth of 150mm below the barrel of the pipe.

- (ii) Excavations shall be wide enough to allow the timbering of the trenches, where required, but at no time shall the width be permitted to exceed the maximum permissible values as specified on the drawings or where maximum widths are not specified then the manufacture's recommendations shall be followed.
- (iii) Special care shall be taken to ensure a solid and even bed to the required gradients for drain construction.
- (iv) Should a ground slip occur that creates a trench width in excess of the permissible values; the Contractor shall carry out such remedial work as is considered necessary by the Project Manager and the Engineer.
- (v) Soft spots, obstructions etc. shall be cut out and any irregularities in excavation filled with concrete, grade 20N/mm, to the required level.

5.1.8 SUPPORTS FOR TRENCHES AND EXCAVATIONS

The Contractor shall design and include for, where necessary, all supports, timbering and shuttering for supporting the sides of the pits, trenches, headings or other excavations. All such excavations shall be of a sufficient size to enable pipes, bedding, protection, etc. to be laid accurately, backfilled and compacted satisfactorily.

5.1.9 WATER TABLE AND GROUND CONDITIONS

- (i) The Contractor shall take notice of the site investigation report and trial pit details with particular attention being drawn to ground conditions and water table level conditions.

The Contractor should allow for the fact that water table levels are influenced by weather and time and year and therefore site investigation reports can only indicate levels at the time of the investigation and may differ at the date of construction.

Additionally, for works adjacent to river estuaries or coastal areas, the Contractor should allow for the fact that water table levels are influenced by all tides, including spring tides and neap tides. Therefore site investigation reports can only indicate levels at the time of the investigation and may differ at the date of construction

- (ii) The Contractor shall include for all pumps, supporting works, specialised equipment and additional materials that are required to ensure safety of access and the satisfactory excavation bedding, laying, surrounding and backfilling of all pipes, manholes, interceptors, culverts and chambers that may be installed below the water table.

5.1.10 DRAINS AND MANHOLES IN UNACCEPTABLE GROUND

If unacceptable ground conditions are found in any area of the site where drains are to be laid the Project Manager shall be informed before work is commenced. Under these conditions, and also where drains are to be laid in backfilled areas, the following shall apply:

- (i) pipelines are to be supported as detailed separately on the drawings.
- (ii) manholes shall be constructed as detailed separately on the drawings.

5.1.11 CONCRETE BEDS AND SURROUNDS TO DRAINS

Where indicated, pipes shall be surrounded in a minimum of 150mm thick concrete, minimum grade C20 (20N/mm). Concrete shall be in accordance with this specification.

5.1.12 METHOD OF FORMING CONCRETE BEDS AND SURROUNDS

All concrete beds shall be laid to correct falls and formed in the following manner unless directed otherwise:

- (i) A concrete bed 75mm thick shall be laid on the trench bottom. The pipes shall be firmly blocked up and supported in concrete behind each socket/coupling to a height of 75mm above the bed.
- (ii) After passing the test for level and the test for leakage as described in this section, the existing concrete shall be thoroughly cleaned and the remainder of the beds and haunching or casing shall be filled in and properly compacted up to a minimum of 150mm above the pipe barrel.

5.1.13 FLEXIBILITY IN CONCRETE

- (i) Where it is a requirement of this specification and/or where indicated on the drawings that pipes are bedded and surrounded in concrete, flexible jointed pipe systems shall retain their flexibility by the insertion of flexible joints within the concrete.
- (ii) These joints shall occur at every socket or coupling positions. The flexible material shall be pre-cut to pipe diameter and be equal in height and width of the cross-sectional area of the concrete bed surround.

5.1.14 SUPPORTING OF DRAINS

- (i) The Contractor shall ensure that all drains and fittings are adequately supported to correct lines, positions and levels at all times during the construction period.
- (ii) The method of installation and supports shall be as necessary to suit the method of construction and the ground conditions.

5.1.15 FLEXIBLY JOINTED PIPES IN GRANULAR BEDDING

- (i) The trench bottom shall be trimmed true to gradient and inspected and approved by the Project Manager before placing of granular material is commenced. Granular fill, as specified, shall be laid and carefully compacted by plate vibrators or other approved method to give a minimum thickness of 150mm. After thorough compaction, a bed shall be carefully graded so that the whole of the barrel of the pipe is uniformly supported throughout its length.
- (ii) Care shall be taken to ensure that pipe collars do not rest on any hard objects.
- (iii) Pipes shall be laid true to line and gradient, each pipe being accurately laid before the next is laid.

- (iv) After laying and testing the pipe, the granular fill shall be carefully compacted in layers not exceeding 150mm up to 300mm above the pipe barrel. If the granular bed is damaged by water, sewage, or collapse of the trench sides it must be removed from the trench and replaced with new material before any pipes are laid or re-laid.
- (v) Trench formations, bedding, compaction, pipe laying, and jointing must follow consecutively without un-necessary loss of time so as to prevent degradation of the quality of the surrounding surfaces.
- (vi) On completion of the pipe surround backfilling shall be carried out as specified. The first 300mm of selected fill, backfilling being hand rammed in 2no. 150mm layers.
- (vii) In exceptionally wet trenches, the Project Manager may direct the installation of a temporary drain to be incorporated in the granular fill. The Project manager will provide details as appropriate.
- (viii) Where trench slips occur due to the Contractor's action or inaction, the Contractor shall provide concrete protection in lieu of selected fill as instructed by the Project Manager.

5.1.16 PROTECTION OF WORK

- (i) Drains shall be laid to suit the general progress of the building work and at such a time and in such a manner as to be adequately protected against damage and deterioration.
- (ii) Drains laid prior to the completion of heavy earth moving operations and/ or liable to be subjected to abnormal loads shall be suitably protected to the satisfaction of the Project Manager.
- (iii) All works installed shall be maintained throughout the contract period and shall be handed over in a clean and sound condition on completion of the Project.
- (iv) The Project Manager may require any pipes, fittings, gullies, etc. installed to be dismantled for as far as is considered necessary if the above requirements are not complied with. Consequent replacement and/or cleansing shall be to the satisfaction of the Project Manager.

5.1.17 PREVENTION OF INGRESS OF SOIL PARTICLES OR OTHER EXTRANEEOUS MATERIAL INTO THE DRAINAGE WORKS

- (i) The Contractor shall ensure that all pipes, manholes, gullies, etc. are free from corrosion and internal obstruction. Pipes, fittings and covers showing signs of internal or surface corrosion shall not be used.
- (ii) The Contractor shall protect the open ends of all pipes, gullies and fittings. Only proprietary caps or plugs shall be used.
- (iii) Wood, rag or paper plugs shall not be used.
- (iv) Manholes shall be provided with suitable temporary covers, prior to the installation of permanent covers.

- (v) Failure to comply with the above instructions may result in the Project Manager requiring pipes, fittings, gullies, etc. installed to be dismantled for as far as is considered necessary and replaced and/or cleansed manually to the satisfaction of the Project Manager.
- (vi) Upon completion of the whole works or individual discrete portions, the Contractor shall provide a copy of a colour CCTV video and key plan confirming that all sections of the specification have been adhered to and all pipes, gullies, manholes, etc. are clear from internal obstruction and all joints properly made and the pipeline complies with the Contract drawings. The Contractor shall provide records of the survey as detailed in Section 5.3.

5.1.18 TESTS CARRIED OUT ON SITE

- (i) The Contractor shall ensure that testing of completed sections of work is carried out regularly during the process of construction to demonstrate their proper operation to the satisfaction of the Authority and the Project Manager. A minimum of 3 no. tests are required, one before backfill one after backfill and one prior to handover.
- (ii) The Contractor shall ensure that tests carried out meet the standard requirements of the Authority and the requirements of the tests contained within this specification to the satisfaction of the Authority and the Project Manager.
- (iii) The Contractor shall be responsible for verifying the Authority requirements for testing these installations including notification periods.
- (iv) Where it is necessary to test sections of the system before the system is complete, successive tests must overlap so that no joint or section of pipe is missed in the testing.

5.1.19 BACKFILLING

- (i) No backfilling shall commence until the work has been approved and measured by the Project Manager following testing. Any work covered up without such authority shall be uncovered by the Contractor as instructed by the Project Manager. Backfilling shall use acceptable material as defined on the drawings or taken out of the excavation or as directed by the Project Manager in accordance with the specification. Backfilling shall be undertaken immediately after the required operations preceding it have been approved.
- (ii) Against or over the new work, the first 300mm of fill must be granular fill carefully placed by hand in two 150mm thick layers and compacted.
- (iii) Subsequent fill shall be selected fill in layers not exceeding 225mm loose depth each layer shall be thoroughly compacted before subsequent layers are placed.
- (iv) Timber and framing shall be withdrawn ahead of the layer to be compacted, care being taken to keep the sides of the trenches solid and to fill spaces left by the withdrawn timber.
- (v) Under no circumstances, shall the backfilling of trenches or excavations be carried out by the use of bulldozer or similar mechanical device.

5.1.20 BACKFILLING AROUND MANHOLES AND SUMPS

- (i) The method of backfilling around manholes should be generally as for trenches and should be carried out as part of the same operation. Care shall be taken to raise the fill equally all-round the manhole shaft to avoid unbalanced lateral loading.
- (ii) Concrete surround to manholes shall be minimum grade C10-10N/mm 150mm thick minimum poured between ring and curved face of excavation.
- (iii) If the drawings call for a waterproof paint on the outside then this shall be allowed to dry according to manufacturer's instructions before backfilling commences.

5.2 MATERIALS

5.2.1 PROHIBITED MATERIALS

The following materials shall not be specified or employed in the works:

- (i) Material from swamps, marshes or bogs;
- (ii) Peat, logs, stumps and perishable material;
- (iii) Material susceptible to spontaneous combustion;
- (iv) Material in a frozen condition;
- (v) Clay of liquid limit exceeding 90 and/or plasticity index exceeding 65;
- (vi) Material having a moisture content that will not permit compaction in the manner specified.
- (vii) Any materials that are in the opinion of the Project Manager in anyway detrimental to the life or construction of the works or any part of it.

5.2.2 BACKFILLING MATERIALS FOR DRAINS

Backfill material, whether selected from locally excavated material or imported, shall consist of uniform, readily compactable material in compliance with Section 4.2.

Granular Material.

The following materials are permitted for use as backfill within the construction of the works;

Type 1 Granular Material

- a) Type 1 granular material shall comprise crushed rock, crushed slag, crushed concrete or well-burnt non-plastic shale, and may contain up to 12.5% by mass of natural sand, that passes the 5mm BS sieve. The material shall be well graded and lie within the following grading limits:

TABLE A	RANGE OF GRADING
BS SIEVE (mm)	PERCENTAGE % BY MASS PASSING
75 mm	100
37.5 mm	85 – 100
20 mm	60 – 100
10 mm	40 – 70
5 mm	22 – 45
600 microns	8 – 22
75 microns	0 – 10

- b) The material passing the 425 micron BS sieve shall be non-plastic as defined in BS 1377 - Part 2: 1990

- c) The material shall be transported, laid and compacted without drying out or segregation.
- d) The material shall have a ten per cent fines value of 50 kN or more when tested in a soaked condition in compliance with BS 812-III.
- e) The aggregate shall be considered acceptable if, when tested in accordance with BS 812, has a soundness value greater than 65.

Type 2 Granular Material

- a) Type 2 granular material shall comprise natural sands, gravels, crushed rock, crushed slag, crushed concrete or well-burnt non-plastic shale. The material shall be well-graded and lie within the following grading limits:

TABLE B RANGE OF GRADING	
BS SIEVE (mm)	PERCENTAGE % BY MASS PASSING
75 mm	100
37.5 mm	85 – 100
20 mm	60 – 100
10 mm	40 – 100
5 mm	25 – 85
600 microns	8 – 45
75 microns	0 – 10

- b) The particle size shall be determined in accordance with the requirements of BS 1377 - Part 2: 1990.
- c) The material passing the 0.425mm BS sieve when tested in accordance with BS 1377 shall have a plasticity index of less than 6.
- d) The fraction of the material that passes the 20mm sieve shall have a laboratory CBR in excess of 30% unless otherwise stated when tested at the dry density and moisture content likely to be achieved in the field, the moisture content being within the range specified.
- e) With the exception of well-burnt non-plastic shale the ten per cent fines value (TFV) of the material determined in accordance with BS 812 shall not be less than 50 kN. ???

6F1, 6F2 & 6R

General filling material can be selected granular material, 6F1 or 6F2 or a combination of Class 6F1 and 6F2 with a CBR exceeding 15% consisting of any crushed material other than un-burnt colliery material and shall comply with grading in Table C listed below. Choice is subject to the approval of the Project Manager.

Alternatively, a crushed rock or crushed concrete material, 6R may be used that lies within the grading limits in Table D and is subject to the approval of the Project Manager.

TABLE C 6F1 GRADING REQUIREMENT	
BS SIEVE (mm)	PERCENTAGE % BY MASS PASSING
75 mm	100
37.5 mm	75 – 100
10 mm	40 – 95
5 mm	30 – 85
600 microns	10 - 50
63 microns	< 15

TABLE C 6F2 GRADING REQUIREMENT

BS SIEVE (mm)	PERCENTAGE % BY MASS PASSING
125 mm	100
90 mm	80 – 100
75 mm	65 – 100
37.5 mm	45 – 100
10 mm	15 – 60
5 mm	10 - 45
600 microns	0 - 25
63 microns	0 – 12

TABLE D 6R GRADING REQUIREMENT

BS SIEVE (mm)	PERCENTAGE % BY MASS PASSING
125 mm	100
75 mm	85 – 100
20 mm	40 - 70
10 mm	30 - 80
5 mm	20 - 60
0.075 mm	0 – 10

Testing Requirements for Materials

The Contractor shall, at least 7 working days before commencement of placing of the granular material, submit to the Project Manager for approval the following test certificates for both on site and imported materials:

- 1) Grading
- 2) Uniform coefficient
- 3) Moisture content
- 4) Moisture condition value (MCV)
- 5) Plasticity Index

Materials having a soluble sulphate content exceeding 2.5g per litre when tested in accordance with Test 10 of BS 1377 shall be classed as unacceptable materials.

The minimum frequency of testing to be carried out by the Contractor is as follows:-

Material Class	Type of Test	Relevant Standard	Rate of Testing
6F1, 6F2, 6R	Grading	BS 1377	Source approval and two per week per source
	Optimum MC	BS 1377	Source approval and two per week per source
	Uniformity Coefficient (6C)	BS 892	Source approval and one per week per source
	10% Value Fines	BS 812	Source approval and one per week per source
	Mc	BS 1377	Two per day per source

Material Class	Type of Test	Relevant Standard	Rate of Testing
Type 1 Type 2	Grading	BS 1377	Source approval and two per week per source
	Optimum MC	BS 1377	Source approval and one per week per source
	Mc	BS 1377	Two per day per source
	10% Fines Value	BS 812	Source approval and one per week per source
	Soundness	BS 812	Source approval and one per week per source
	Plasticity Index	BS 1377	Source approval and two per week per source

b) Requirements for Testing and Acceptable Limits

The following tests are required to classify and determine the acceptability of filling materials. Each class shall only comprise material with properties within the acceptability limits prescribed below:

Class	Property	Defined and tested in accordance with	Acceptability limits within	
			Lower	Upper
6F1	Grading	BS 1377 Part 2	Table A	Table A
	Optimum mc Moisture content	BS 1377 Part 4 BS 1377 Part 2	- Optimum mc-2%	- Optimum mc
	10% Fines Value	BS 812 Part 3	30 kN	-
6F2 6R	Grading	BS 1377 Part 2	Table A	Table A
	Optimum mc Moisture content	BS 1377 Part 4 BS 1377 Part 2	- Optimum mc-2%	- Optimum mc
	10% Fines Value	BS 812 Part 3	50 kN	-
Type 1	Grading	BS 1377 Part 2	Table B	Table B
	Optimum mc Moisture content	BS 1377 Part 4 BS 1377 Part 2	- Optimum mc-2%	- Optimum mc
	Soundness	BS 812	65	-
	Plasticity Index	BS 1377 Part 2	None plastic(a)	None plastic(a)
	10% Fines Value	BS 812 Part 3	50 kN	-

Backfill to the ST4 Concrete as indicated on the drawings

5.2.3 PRE-FORMED DRAINAGE CHANNELS

- (i) Pre-formed drainage channels are to be polyester concrete as specified on the drawings with gratings, fixings to withstand the required loading conditions.
- (ii) Channels are to be installed as indicated on the drawings and strictly in accordance with the manufacturer's recommendations.

5.2.4 WATER

Water for use with cement shall be of potable quality.

5.2.5 AGGREGATES FOR CONCRETE

- (i) Aggregates for concrete shall comply with the relevant provisions of BS EN 12620:2002.
- (ii) Marine aggregates may not be used.
- (iii) The nominal size of aggregate shall be 20 mm.
- (iv) All sands shall comply with BS EN 12620:2002 or BS EN 13139:2002 and shall be washed sands.

5.2.6 SANDS FOR MORTAR AND GROUT

Sands for mortar and grout shall be washed sand complying with BS 1200 and graded in accordance with Table 1 of that Standard.

5.2.7 CEMENT

Cement shall comply with the provisions of the appropriate British Standard, as set out below:

TYPE	BS
Ordinary Portland	EN 197-1:2000
Sulphate-resisting Portland	4027

Except for concrete having an equivalent compressive strength less than 20 N/mm², sulphate-resisting Portland cement shall be used in all cases (including precast concrete products).

5.2.8 CONCRETE MIXES

- (i) Concrete materials are to comply with the requirements of BS 5328 - Methods of specifying concrete, including ready-mixed concrete for the standard and designated mixes and grades of concrete detailed are:
- (ii) Grade of Concrete
 - (a) ST4 - Precast pipe setting blocks.
Surround to manholes.
Manhole inverts and benching.
 - (b) ST5 - Bedding and backing for drainage channels.
 - (c) Granolithic

Granolithic Concrete shall consist of 1 part Sulphate resisting cement, 1 part natural sharp sand and 2 parts aggregate by mass. The aggregate shall be granite

chips 10 mm nominal size and shall comply with BS EN 12620:2002, graded in accordance with table 6.

5.2.9 MORTAR

Shall be 3:1 – Sand (refer to Section 3): Ordinary Portland Cement (or Sulphate Resisting Cement where sulphates are known or suspected to be present).

5.2.10 PIPE BEDDING

Pipe bedding, haunching and surround shall be as specified on the drawings and as defined below:

- (i) Granular bedding and backfilling material for land drains shall consist of aggregates from natural sources or sintered pulverised fuel ash complying with the relevant provisions of BS EN 12620:2002 and BS EN 13055-1:2002 respectively. The material used shall meet the compaction requirements of BS EN 752:2008. The extent of the fill shall be as shown on the drawings. The grading shall be to BS EN 12620-2002 and as follows:

- Coarse Aggregate shall be in accordance with the table immediately below.

BS EN 13242, Coarse aggregate (Clause 4.3.2)

Category for general grading requirements GC80-20

Category for tolerances at mid-size sieves GTNR (no requirements)

Category for maximum values of fines content

Nominal pipe diameter, mm

Not exceeding 140

Exceeding 140 but not exceeding 400

Exceeding 400

Graded

-

2/14 or 4/20

2/14, 4/20
or 4/40

Gravel - f1.5
Crushed rock, recycled
aggregate - f4

Aggregate size, mm

Single sized

4/10

4/10, 6/10 or 10/20

4/10, 6/14, 10/20 or 20/40

- Fine and all-in aggregates shall be in accordance with the table immediately below.

BS EN 13242, Fine and all-in aggregate (Clause 4.3.3)

Category for general grading requirements

Category for tolerances on manufacturer's declared typical grading

Category for maximum values of fines content

Nominal pipe diameter, mm

Not exceeding 140

Fine

Category GF80

GTfNR

(no requirement)

Fine

0/1, 0/2, 0/4

All-in

Category GA80

GTANR

Gravel - f3
Crushed rock, recycled
aggregate - f11

Aggregate size, mm

All-in

0/10

Exceeding 140 but not exceeding 400	or 0/6	0/10 or 0/20
Exceeding 400		0/10, 0/20 or 0/40

- (ii) Class 'A' bed and surround shall consist of ST4 concrete surround to pipes with flexibility maintained by leaving a gap at each pipe joint filled with 18mm thick soft compressible material. Extent of the bedding shall be as shown on the drawings.
- (iii) Class 'S' bed and surround shall consist of granular material from natural sources to comply with the relevant provisions of BS EN 12620:2002 and BS EN 13055-1:2002 respectively, all in accordance with the table immediately below.

NOMINAL BORE OF PIPE IN MM	AGGREGATE SIZE IN MM
100	Single size 10
Over 100 to 150	14 to 5 graded 10 or 14 single size
Over 150 to 500	14 to 5 or 20 to 5 graded 10, 14 or 20 single size
Over 500	40 to 5 or 20 to 5 or 14 to 5 graded, or 10, 14, 20 or 40 single size

Extent of the bedding shall be as shown on the drawings.

For ductile iron or steel pipelines only aggregates conforming to BS EN 12620:2002 are permitted.

The Contractor shall be required to show, either by Suppliers' Certificate or regular batch sieve testing on site at weekly intervals that the material complies with the grading and that uniformity is maintained.

5.2.11 PRECAST CONCRETE SETTING BLOCKS FOR PIPES

Precast concrete setting blocks for pipes shall have rectangular faces, with sufficient plan area to prevent punching of the blinding concrete or formation and to provide an adequate seating for the pipes. Blocks shall be manufactured from Grade C16/20 concrete using the same type of cement as in the adjacent concrete bed, and be cast in an approved mould. Blocks shall not be used until they have achieved a cube strength of 13.5 N/mm².

5.2.12 CAST IRON PIPES AND FITTINGS

Pipe work and fittings, where shown as cast iron of 100, 150 and 225mm diameter shall be double spigot cast iron to BS 437, and jointed by means of cast iron couplings with stainless steel nuts and bolts to BS 6087 and synthetic rubber gaskets (colour: terracotta) conforming to BS 2494. All as the 'Timesaver 437' drainage system manufactured by Saint Gobain Pipelines or equivalent.

All couplings are to be fitted in accordance with the manufacturer's recommendations and tightened by use of a pre-set torque wrench as item No EF 100 listed in the manufacturer's catalogue.

Under no circumstances is the Timesaver 'Dual Purpose' range of pipe work and fittings to be used underground.

5.2.13 VITRIFIED CLAY PIPES AND PIPELINE FITTINGS

Pipe work and fittings of 100mm, 150mm, 225mm diameter to be of SuperSieve Clay ware to BS EN 295-1:1991, jointed by means of push fit flexible jointed system with Elastomeric Sealing Rings to BS EN 681-1:1996 as Hepworth or similar approved.

5.2.14 CONCRETE PIPES AND FITTINGS

Pipes greater than 400 mm diameter shall be reinforced centrifugally spun concrete cylindrical pipes and fittings to BS EN 1916:2002 and BS 5911-1:2002 and Kite marked, jointed by means of push-fit spigot and socket joint, incorporating a natural rubber ring gasket complying with BS 2494.

5.2.15 POROUS PIPES

Pipes to be used for land drainage shall comply with either BS 5911-Part 114 for porous concrete pipes, BS EN 295-5:1994 and BS 1196:1989 for clay ware pipes or BS 4962:1989 for plastic pipes.

Pipes of other materials than specified but incorporating perforations may also be used, provided they comply in all respects other than water tightness with the relevant specification clauses and subject to the approval of the Project Manager.

5.2.16 UNPLASTICIZED PVC PIPES AND FITTINGS

- (j) Un-plasticized PVC pipes, joints and fittings for gravity sewers and drains shall comply with the relevant provisions of BS 4660: 2000 and BS EN 1401-1:1998.
- (ii) Solvent cements for jointing un-plasticized PVC pipes shall comply with BS 4346 - Part 3, BS EN 1401-1, except for pipes and fittings complying with BS 4660: 2000, where the solvent cement shall comply with BS 6209.
- (iii) Solid wall concentric external rib-reinforced un-plasticized PVC sewer pipe shall comply with the relevant provisions of W.I.C.S. No. 4-31-05.

5.2.17 COMPRESSIBLE FILLER AND PACKING FOR PIPELINES

- (i) Compressible filler for interrupting concrete protection to pipelines shall consist of bitumen impregnated insulating board to BS 1142: Part 3, BS EN 120 and BS EN 317 or other equally compressible material. The thickness of compressible filler shall be as follows:-
 - a) 18 mm for pipes up to 450 mm diameter.
 - b) 36mm for pipes from 450 to 1200 mm diameter.
 - c) 54 mm for pipes exceeding 1200 mm diameter.
- (ii) Compressible packing for use between pipes and precast concrete setting blocks shall consist of bitumen damp proof sheeting complying with BS 743.

5.2.18 PRECAST CONCRETE MANHOLES

Precast concrete manhole units of circular cross-section for manholes and chambers are to be approved by the Project Manager and shall comply with the relevant provisions of BS EN 1917:2002 and BS 5911-3:2002. Units that bed into bases shall be manufactured so that imposed vertical loads are transmitted directly via the full wall thickness of the unit. Horizontal joints between precast sections shall be filled with an approved watertight joint filler.

5.2.19 INSITU CONCRETE AND BRICK MANHOLES

Insitu concrete and brick manholes to be as detailed on the Drawings.

5.2.20 POLYPROPYLENE INSPECTION CHAMBERS

Polypropylene inspection chambers shall be by Hepworth Supersleve or similar approved, 475mm dia to BS EN 295-1:1991 to depths and pipe sizes as shown on the drawings.

5.2.21 PRECAST CONCRETE COVER FRAME SEATING RINGS

Precast concrete cover frame seating rings shall comply with the relevant provisions of BS EN1917 and BS 5911-3:2002

5.2.22 MANHOLE COVERS AND FRAMES

- (i) Manhole covers and frames shall comply with the relevant provisions of BS EN 124. They shall be of a non-rocking design that does not rely on the use of cushion inserts.
- (ii) Class D 400 covers shall be used in carriageways of roads (including pedestrian streets), hard shoulders and parking areas used by all types of road vehicles.
- (iv) Minimum frame depths for NRSWA road categories I to IV shall be 150mm except for residential cul-de-sacs that shall be 100mm.
- (v) Class B125 shall be used in footways, pedestrian areas and comparable locations, unless the area is possible to be over-run by HGVs when Class D400 should be used.
- (iv) All manhole covers shall be vented or non-vented as required by the drawings or by the project Manager and shall have closed keyways.

5.2.23 MANHOLE STEP IRONS AND LADDERS

- (i) Steps irons in manholes shall be in accordance with BS 1247-1:1990 for galvanized ferrous or stainless steel manhole steps, and in accordance with BS 1247-2:1990 for plastic encapsulated manhole steps as shown on the drawings.
- (ii) Access ladders and fittings shall be stainless steel in accordance with BS 4211:2005+A1:2008 unless shown otherwise on the drawings.

5.2.24 GULLIES

- (i) Precast concrete gullies shall comply with the relevant provisions of BS 5911, Part 230.
- (ii) Vitrified gullies shall comply with the relevant provisions of BS EN 295-1:1991
- (iii) Unless specified otherwise gullies shall be 450 mm internal diameter and 900 mm deep with a 150 mm diameter outlet trapped and fitted with a rodding eye, approved stopper and chain.

5.2.25 GULLY GRATES AND FRAMES

Gully grates and frames shall be of one pattern, unless defined otherwise on the drawings, and shall be manufactured from ductile iron or cast iron, and comply with BS EN 124 and be of a type and grade as shown on the Drawings.

5.2.26 BRICKS & BLOCKS

- (i) Concrete bricks or blocks to be used in manholes and chambers shall be precast concrete masonry units manufactured in accordance with BS 6073 containing a minimum of 360 kg/m³ of sulphate resisting cement, having a maximum water cement ratio of 0.45, a minimum compressive strength of 50 N/mm², and a maximum water absorption of 7%.
- (ii) Clay bricks to be used in manholes and chambers shall be Class B engineering complying with the relevant provisions of BS 3921.
- (iii) The shapes and dimensions of special bricks shall comply with the relevant provisions of BS 4729.
- (iv) All bricks shall be frost resistant category F.

5.2.27 PROPRIETARY DRAINAGE SYSTEMS

Where proprietary drainage systems are specified they are to fully conform to the standards and quality specified, and be installed in strict accordance with the drawings and manufacturer's recommendations. Proprietary systems shall only be used with the prior approval of the Project Manager

5.2.28 FULL RETENTION AND BY-PASS SEPARATORS

In situ and package Interceptors shall be as specified on the drawings. Package types shall be surrounded in mass or reinforced concrete, depending upon the location and in accordance with the specialist supplier's instructions.

5.2.29 PUMPING STATIONS

Pumping Stations shall be as specified on the drawing and comply with the requirements of Section 6 of this specification for the pumps and associated equipment, pump and valve chambers, and rising mains.

5.3 WORKMANSHIP

5.3.1 GENERAL EXCAVATION

- (i) The Contractor shall excavate for the Works in any material encountered to the net lines, widths, lengths and levels indicated on the Drawings or to such other dimensions as may be directed by the Project Manager.
- (ii) No excavated acceptable material other than that surplus to the requirements of the Works shall be removed from the Site except on the direction or with the permission of the Project Manager who may require material that is unacceptable only by reasons of being frozen to be retained on site when in that condition. Should the Contractor be permitted to remove acceptable material from the Site to suit his operational procedure, then he shall make good any consequent deficit of filling arising there from.
- (iii) If any acceptable material excavated from within the Site is, with the permission of the Project Manager taken by the Contractor for purposes other than the forming of embankments and other areas of fill, sufficient acceptable filling material to occupy after full compaction, a volume corresponding to that that the excavated material occupied shall, unless otherwise directed by the Project Manager, be provided by the Contractor from his own resources.
- (iv) Acceptable material surplus to the total requirements of the Works and all unacceptable material shall, unless the Project Manager directs otherwise, be run to spoil in tips provided by the Contractor. Where the excavation reveals a combination of acceptable and unacceptable materials the Contractor shall, unless otherwise agreed by the Project Manager, carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the Works without contamination by the unacceptable material.
- (v) The Contractor shall make his own arrangements for stockpiling of acceptable or unacceptable material, and for the provision of sites for the purposes where his method of working requires.

5.3.2 EXCAVATION OF PITS AND TRENCHES

- (i) The sides of pits and trenches shall be adequately supported at all times.
- (ii) Trenches and pits shall be kept free of water.
- (iii) The bottom of all excavations shall be levelled carefully and stepped or benched horizontally including removing unacceptable material as directed by the Project Manager from the bottom of trenches and other excavations that shall then be refilled to formation level with the same material as the layer immediately above the formation. Any void that results from over-excavation below formation level shall be refilled in the same manner.
- (iv) All excavations for pipelines and manholes shall be to the lines and levels shown on the Drawings and with vertical sides or as directed by the Project Manager and trench widths below a level of at least 300 mm above the crown of the pipe shall not be greater than those indicated on the drawings.
- (v) All excavated materials from such excavations not required for refilling shall be disposed of in accordance with the drawings or as instructed by the Project Manager.

- (vi) The Contractor shall make good with acceptable material as defined in Section 4 or concrete as directed by the Project Manager;
 - (a) Any excavation greater than the net volume required for the Works as described in the Contract;
 - (b) Any additional excavation at or below the bottom of foundations to remove material that the Contractor allows to become unacceptable.
- (vii) The Contractor shall carry out his operations in such a manner as to avoid damage to, or deterioration of, the formations of excavations. If after the removal of material as specified in the first paragraph of this clause, the Contractor allows the material so exposed to reach a condition where compaction of backfilling is impracticable, he shall make good either by additional excavation and filling in the manner specified in this clause, or by waiting until the condition of the exposed material is fit to receive the approved backfill.
- (viii) Excavation in Public roads and streets shall be carried out in accordance with the relevant Authority requirements and approvals.

5.3.3 TIMBERING OF EXCAVATIONS

The term 'timbering' shall cover all normal methods of support, including the use of timber, concrete, steel or such other materials. The Contractor shall supply and fix strong and sufficient timbering to support the sides and/or bottom of the excavations when necessary and shall maintain the same until the construction work is sufficiently advanced to permit the timbering to be withdrawn, that shall be conducted only under the personal supervision of a competent foreman.

Should any part of the trenches through insufficient or careless timbering or any other cause, collapse or give way the Contractor shall forthwith remove all the material that has fallen in, and if in the opinion of the Project Manager, there is a possibility of the newly constructed work having been damaged or disturbed by such collapse, the work shall be laid bare, examined and tested. Any damaged work shall be reconstructed to the Project Manager's satisfaction. The Contractor shall be responsible for any damage to the work and any consequential damage caused or arising out of the removal of the timbering and any advice, permission or approval given by the Project Manager relative to the removal of timbering, shall not relieve the Contractor from the responsibility of making good any damage.

Battering the sides of the excavation in order to dispense with the timbering to trenches shall not be allowed without the prior approval of the Project Manager. Every precaution shall be taken by the Contractor to ensure the stability of the Works.

5.3.4 BACKFILLING OF DRAINAGE AND EXCAVATION WORKS

Main backfilling of excavation shall not proceed until pipes and their bedding and construction works have been approved by the Project Manager. Unless otherwise specified on the drawings, backfilling shall normally be carried out to the requirements of BS 8005 with approved acceptable material obtained from the excavation. The compaction equipment and its effects should not produce an overload on the pipes at any stage of the filling.

In the case of manholes, care should be taken to raise the fill equally around the manhole shaft so as to avoid unbalanced lateral loading.

If any filled excavations subside, the depressions so formed shall be filled with approved material and compacted.

The Contractor shall be required to make good any settlement, including road surfacing, arising from his operations that may take place before the expiration of the period of maintenance.

Where the excavation is within one metre of the edge of the carriageway, or proposed carriageway, the fill material shall be such as to permit adequate drainage.

Where the excavations have been supported and the supports are to be removed, these where practicable, shall be withdrawn progressively as backfill proceeds in such a manner as to minimise the danger of collapse and all voids formed behind the supports shall be carefully filled and compacted.

Backfilling and reinstatement in roads and streets shall be carried out in accordance with the relevant Authority requirements and approvals.

Backfilling and reinstatement in existing floor slabs shall be carried out in accordance with the Project Manager's requirements.

Where no precise Specification is provided by others, it shall be carried out to match backfilling and reinstatement in roads and streets in accordance with the Authority requirements and conform to the existing surrounding surfaces both in terms of material selection and level.

5.3.5 GULLIES, GRATES AND FRAMES

Gully frames shall be set in cement mortar over the gully to a tolerance of –5 to –10 from the specified level, and the surface of the surface course shall be rolled down locally around the grating to the lower level.

5.3.6 PIPE BEDDING LAYING AND JOINTING

- (i) Pipe bedding and trench dimensions are to be as shown on the drawings. Before placing pipe bedding material the trench bottom shall be prepared. All loose stones, lumps of clay, rock projections, boulders and other hard spots shall be removed. Where necessary, joint holes shall be neatly cut to permit the barrel of the pipe to be properly supported throughout its length, and shall not be larger than is required for making the joint.
- (ii) Granular bedding material as specified shall be laid over the full width of the trench to such depth that after the pipes have been laid to line and level, the thickness of bed beneath the pipes shall not be less than that specified on the drawings or as directed by the Project Manager. The bedding material shall be evenly spread and carefully compacted and where the bedding beneath the pipe exceeds 200 mm in thickness it shall be placed and compacted in two separate equal layers. Any clay, large stones and other unacceptable material falling on to or into the granular bed from the trench sides or from other source shall be immediately removed.
- (iii) The Contractor shall supply a form of compaction that provides adequate compaction to the satisfaction of the Project Manager and the specification.
- (iv) Timbering or any other form of trench support should be withdrawn as the bedding material is placed so as to avoid disturbance of the bedding by later removal.

- (v) Pipes shall be laid to the line and level as shown on the Drawings with a maximum permitted tolerance + or – 12 mm, provided that no pipe shall have a reverse gradient and with minimum disturbance to the bedding material. Points on either side of a joint shall not err from true line and level by differing amounts.
- (vi) All adjustments to line and level must be made by adding or removing bedding material properly compacted under the body of the pipe and not by wedging and blocking.

Where the pipes are too large to be easily manhandled into position an appropriate mechanical lifting machine must be used. During the pulling operation the pipe shall remain suspended from the crane. If necessary, additional bedding material shall be added to prevent the pipe settling after the release of its weight.

- (viii) The use of pipes produced by different manufacturers shall not be permitted in the same sewer length, and all faulty and damaged pipes shall be rejected and no pipe shall be disturbed after setting and jointing.
- (ix) Pipe jointing surfaces and components shall be kept clean and free from extraneous matter until the joints have been made or assembled. Care should be taken to ensure that there is no ingress of grout or other extraneous material into the joint annulus after the joint has been made.
- (x) Pipes shall be cut by a method that provides a clean square profile, without splitting or fracturing the pipe wall. Where necessary, the cut ends of the pipes shall be formed to the tapers and chamfers acceptable for the type of joint to be used.
- (xi) When pipe laying stops, such as overnight, at a manhole or at junctions, a acceptable stopper must be inserted in the pipe to prevent ingress of foreign matter.
- (xii) After the pipe has been laid, granular bedding material shall be brought up to the level of the horizontal diameter of the pipe, compacted as before. Care shall be taken not to disturb the pipeline from its approved position. The remainder of the pipe bedding shall be as follows until at least 300 mm of material covers the pipe.

(xiii) a) Concrete Bedding:

Grade ST4 concrete shall be placed and compacted to form a surround to the pipe of minimum thickness at the invert of the pipe of not less than one quarter of the external diameter of the pipe, with a minimum of 100 mm. The minimum dimensions of the cradle shall be in accordance with the drawings. The vertical sides of the concrete shall be properly shuttered or the concrete extended across the full width of the trench. The concrete shall be physically separated at each pipe joint by bitumen impregnated board to BS 1142 Part 3 or other suitable compressible material. For thickness required, see Section 5.2. Any space between the concrete and the trench side shall be filled and compacted with specified backfill material.

Backfilling shall not be carried out until the compressive strength of the concrete has reached 14 N/mm².

b) Granular Bedding:

'Granular bedding material' as specified and as used for the bed shall be brought up in layers and compacted by hand until the specified amount of material as shown on drawings covers the pipes. Care must be taken not to disturb the pipeline from its approved position. Remaining backfill is to be carried out in accordance with the materials specified on the drawings.

Pipes shall be laid on setting blocks only where a concrete bed or cradle is used.

5.3.7 JUNCTIONS AND CONNECTIONS

- (i) Where shown on the Drawings or directed by the Project Manager, junction pipes shall be inserted during the construction of the sewers. Junctions on the sewers that are not immediately connected up shall be closed and made watertight with watertight stoppers.
- (ii) Where it is necessary to make a stoneware saddle connection to an existing sewer a hole shall be neatly cut to the shape required as near as practicable such that junctions lead in soffit to soffit and the saddle shall be inserted with its junction pipe leading in the direction of flow of the main pipeline.

The saddle shall be bedded in 1:3 cement mortar, care being taken to clean all surplus mortar from the inside of the junction piece or any that may have fallen into the sewer.

- (iii) Where ordered by the Project Manager, sewers and junction pieces shall be surrounded with Grade ST4 concrete to a thickness of 150 mm.
- (iv) Where it is necessary to make a saddle connection to an asbestos cement pipe or a plastic pipe the saddle junction shall be of the same material as the pipe and shall be fixed and cemented to the pipeline in strict accordance with the manufacturer's instructions. Particular attention should be paid to Health & Safety when dealing with asbestos.
- (v) Saddles when authorised by the relevant Authority shall be of an approved type with flanged seating on to main pipes.
- (v) All saddles and junction pipes shall have flexible joint type sockets.
- (vii) No saddle junctions shall be provided without the prior approval of the Project Manager.

5.3.8 MARKER POSTS

The positions of pipe junctions, saddles and connections shall be indicated at ground level by a 100 mm x 50 mm by 1.25 m timber marker post driven 0.5 m into the ground, the portion above ground being painted white. The type of connection, i.e. foul or surface water, shall be indicated on the post by the letters F.W. or S.W., together with the depth of the top of the pipe. Where directed by the Project Manager, the post shall be securely tied to the pipe.

5.3.9 CROSSING OF PIPELINES

Where pipelines cross at different levels the pipes shall be supported at the point of crossing to the full width of the trench by granular bedding as previously specified. This bedding shall be carefully compacted in 150 mm layers from the lower formation level to half pipe height of the upper pipe.

5.3.10 MANHOLE AND CATCHPIT CONSTRUCTION

- (i) Manholes and chambers shall be built to the dimensions shown in the Schedule and on the detail Drawings and shall be watertight.

- (ii) Base slabs shall be constructed of insitu concrete grade ST4 or as indicated on the Drawings, placed and compacted as specified elsewhere. Where required, bases shall be reinforced as directed by the Project Manager.
- (iii) Invert channels shall be straight or curved special semi-circular channel pipes, tapered, where necessary and constructed from material similar to the main pipeline wherever possible and laid to allow smooth flow.
- (iv) Benching consisting of concrete grade ST4 or as indicated on the Drawings shall be taken up vertically from the springing level to the soffit of the pipes where it shall be rounded at a radius of 25 mm and shaped off to the sides of the chamber at a gradient of 1 in 10. All internal benchings are to be rendered with a 40 mm thick coat of granolithic concrete provided, laid and finished in accordance with the relevant provisions of BS 8204 Part 2 and brought to a smooth trowelled finish.
- (v) Where channels are to be cast insitu the benching shall be cast against the approved formwork to the curves, slopes and levels shown on the Drawings and brought to a smooth finish with a layer of granolithic concrete, to a thickness as stated on the drawings and in accordance with BS 8204 Part 2.
- (vi) Where directed by the Project Manager or as shown on the Drawings, inlet and outlet pipes of the required diameter shall be built into the walls or bases of manholes. Where flexible jointed rigid pipes are used the length of pipe that is built into the manhole shall be restricted in length (by cutting or by obtaining purpose made short lengths) so that first and second joints are provided on the connected pipeline at distances of not more than 150 mm and 750 mm respectively from the outside face of the chamber wall. Where directed by the Project Manager or shown on the Drawings, provision for inlet and outlet pipes shall be boxed out in the concrete surround of the manholes.
- (vii) Manholes that incorporate a backdrop connection shall be constructed as shown on the detail Drawings and generally in accordance with the preceding clauses. The high level pipe shall be continued at its normal gradient to connect with the manhole as a rodding eye. Where possible in concrete ring manholes, suitable lengths of chamber shall be provided so that the position of the rodding eye does not occur at or near a joint between chamber rings.
- (viii) The vertical backdrop pipe shall terminate in a 90° bend built into the manhole base and the whole of the backdrop connection from the upper junction shall be surrounded with concrete grade ST4 or as indicated on the Drawings, not less than 150 mm thick to form a monolithic structure with the manhole chamber.
- (ix) Courses of 230 mm Engineering brickwork jointed in English bond in 1:3 cement mortar shall be built on the cover slab to take the manhole cover and frame. The frame shall be set in 1:3 cement mortar to the required level as directed by the Project Manager, the final adjustment in level being made in this brickwork by using between two and four courses.
- (x) In carriageways and other paved areas, rectangular manholes and all frames shall be placed so that covers are square to the kerb or edging where the line of the sewer is parallel or square to the kerb or edging. Covers should not be located in the wheel tracks of vehicles.

5.3.11 PRECAST CONCRETE MANHOLES

Precast concrete manholes shall be constructed in accordance with the details shown on the Drawings.

The base and benching shall be formed insitu as described previously and the chamber shaft and cover slab formed in purpose-made precast concrete components. Joints on chamber and shaft rings shall be ogee or such other type as approved by the Project Manager.

In jointing the chamber and shaft ring the lower ring or the base slab shall be 'buttered' with 1:3 cement mortar and the next ring lowered in a horizontal position and carefully adjusted to be truly vertical and with the step irons in correct vertical alignment. Excess mortar shall be struck off immediately and a neat flush joint formed on the interior of the rings. No cracked or damaged rings or components shall be used. Lifting holes in chamber and shaft rings shall be made good with trowelled 1:3 cement mortar. Unless otherwise instructed, the whole length of the manhole chamber and shaft shall be surrounded to a depth of 3 m with a minimum thickness of 150 mm and over 3 m deep with a minimum thickness of 225 mm of ST4 concrete or as indicated on the Drawings, properly shuttered where necessary and adequately vibrated to give a dense concrete. Step irons shall be fixed into the concrete rings at the manufacturer's works in accordance with the spacings shown on the detail Drawings. Step irons are not to be used for moving, hoisting or lowering the rings. The cover slab shall be bedded in cement mortar as above on the top shaft ring leaving a clear gap over the concrete surround.

Step irons and access ladders shall be aligned with the edge of the cover opening and with the benching to for ease of access.

5.3.12 INSITU-CONCRETE MANHOLES

Insitu-Concrete Manholes are to be to the dimensions as shown on the drawings.

5.3.13 BRICK MANHOLES

Brick manholes shall be built in English bond at four courses to 300 mm. Bricks shall be as specified previously and they shall be laid on a full bed of 1:3 cement mortar at every course and all vertical joints shall be filled solid with mortar. Brickwork shall be finished with neat flush pointed joints on all exposed surfaces and no cracked, chipped or broken bricks shall be used except for closers. Where directed by the Engineer, bricks shall be soaked in water immediately before use. Brickwork shall be constructed to the dimensions and thicknesses shown on the drawings or directed by the Project Manager. Brick ring relieving arches are to be formed over all pipes, size 225mm diameter or greater that pass through manhole walls.

The arches shall consist of one course of 114 mm brick on edge for pipes less than 914 mm diameter and two courses of 114 mm brick on edge for larger pipes. Brickwork in manhole shafts and in inspection chambers shall be corbelled to receive manhole cover and frame in stages not exceeding 38 mm per course. Step irons as previously specified shall be built into manhole brickwork at the spacings shown on the detail drawing.

Insitu manhole cover slabs shall be constructed in concrete grade ST4 or as otherwise stated to the dimensions shown on the drawings and shall be reinforced as shown in the drawings or directed by the Project Manager.

Formwork for the cover slab shall be in accordance with the drawings.

5.3.14 POLYPROPYLENE INSPECTION CHAMBERS

Polypropylene Inspection Chambers shall be installed strictly in accordance with the manufacturer's requirements and in accordance with the drawings.

5.3.15 BUILDING IN PIPES

- (i) Unless the Project Manager orders in writing to the contrary, pipes are to be built into concrete structures as concreting proceeds.

The pipes shall be rigidly held in position to prevent loss of line or level and the concrete shall be well rammed round the pipe so as to prevent any ingress or egress moisture occurring around the joint.

- (ii) Where flexible jointed rigid pipes are used the length of the pipe that is built into the structure shall be restricted in length (by cutting or by obtaining purpose made short lengths) so that first and second joints are provided on the connected pipeline at distances of not more than 150 mm and 750 mm respectively from the outside face of the wall.
- (vi) The length of the next pipe (rocker pipe) away from the structure shall be in the range 0.5m to 0.75m for pipes up to 450mm nominal diameter and shall not exceed 1m for pipes up to 750mm nominal diameter and shall not exceed 1m for pipes up to 750mm nominal diameter.
- (vii) Where pipes are to pass through the wall of the structure and are not built in as the concreting proceeds, a rebated rectangular or square opening shall be formed in the walls, all in accordance with the drawings. The sides of openings in the concrete shall be well protected from possible subsequent damage during the installation of the pipe by timber battens of adequate size to line and level, the concrete infilling shall be placed in the opening and the concrete well rammed around the pipe and vibrated so as to be completely watertight. Before placing concrete infilling, the faces of the joints shall be scabbled and thoroughly cleaned and washed down with clean water.
- (viii) Where pipes pass through watertight structural walls they shall be fitted with puddle flanges as indicated on the drawings. The Contractor shall ensure that they are fixed in the correct positions at the required levels and also that they are watertight after installation.

5.3.16 SEALING OF DISUSED MANHOLES, SEWERS AND DRAINS

Where pipes are to be filled with grout, they shall be sealed at both ends, leaving suitable holes for the grout filling to escape. Grout shall then be pumped in at sufficient pressure to ensure complete filling.

5.3.17 INTERFERENCE WITH FLOWS

The Contractor shall so organise his work to ensure that the flow of sewage in any existing sewer, channel or drain shall not be obstructed and no sewage or drainage effluent shall be conveyed into new sewers without the Project Manager's authorisation.

5.3.18 EXCLUSION OF WATER FROM SEWERS

The Contractor is to ensure the exclusion of surface water and water from other sources from sewers by providing a stopper at the outfall manhole on the outlet side where possible on the site sewerage system and this stopper shall not be removed until the drainage system has been completed and accepted as watertight by the Project Manager. Any water that collects in the system before acceptance must be pumped out and any deposits in the sewers removed.

5.3.19 WATER TIGHTNESS OF MANHOLES & CHAMBERS

Manholes and chambers shall be inspected to ensure that they are watertight, with no identifiable flow of water penetrating the permanent works.

5.3.20 TESTING AND INSPECTION OF THE DRAINAGE WORKS

The Contractor shall test the drainage works that at the following stages of construction:

- (i) Before backfilling of excavations are commenced.
- (ii) When the lines of the proposed works have been set out by the Contractor.
- (iii) When excavation has been completed and prior to the deposit of any material on it.
- (iv) When drains are laid and jointed.
- (v) When concrete and / or beds are laid, at any stage that the Project Manager may have previously instructed.
- (vi) After cement mortar joints, benching and Concrete works has set and before concrete surround and backfilling external faces are commenced on manhole and inspection chambers.

The Contractor shall locate and remedy all defects found during testing and shall repeat the test to the satisfaction of the Project Manager.

The Contractor shall ensure that all sections of the drainage system are completely clear of any obstructions, debris and superfluous matter before any tests are applied.

After completion of surround, backfilling and surface reinstatement on all pipe work, fittings, manholes and inspection chambers.

Final tests after completion of all contract work and immediately before the Works are finally handed over.

Tests, as necessary, shall be made of sections of pipeline as work proceeds to suit the Contractors programme. Such testing shall not absolve the Contractor from his liability for any defects found during subsequent or final testing.

For drain pipelines up to and including 825mm diameter, an air test shall be applied after construction, but before backfilling, and after backfilling, a water test shall be applied. Manholes can be separately tested by a water test.

All drain pipe lines shall have a water test applied after construction, but before casting in. Manholes can be separately tested by a water test.

All pipe materials shall be effectively sealed against ingress of concrete and other matter, prior to the concreting commencing.

An air test shall be acceptable as an alternative to a water test. If the testing of the pipelines fails, a water test shall be carried out by the Contractor to determine acceptability.

5.3.21 AIR TEST

For an air test expanding plugs shall be moistened and applied to both ends of pipe and lateral connections. Air shall then be pumped by bellows or manual pump into the pipe at the lower end until a pressure equal to 100 mm water gauge is recorded on a U-tube at the upper end. Allow 5 minutes for stabilisation of air temperature.

Adjust the test air pressure to achieve 100 mm water gauge.

Without further pumping, the water gauge should not fall by more than 25 mm in a period of 5 minutes.

After the testing period has elapsed, the pressure shall be released from the lower end and this shall be indicated by a fall of pressure in the manometer, proving continuity throughout the pipe.

5.3.22 WATER TEST

For a water test, all outlets shall be plugged and at the top end a plug shall be inserted into the pipe and a pipe connected to the plug to enable a minimum pressure of 1.5 meters head of water to be exerted on the crown of the pipe at the top end.

The testing head of water should not exceed 6m head at the lower end.

After filling the pipework with testing water and ensuring that there are not pockets of entrapped air, fill the standpipe to the requisite level.

Leave for a minimum of 2 hours to enable the pipe to become saturated, topping up as necessary.

This testing water level shall be maintained for 30 minutes with the standpipe being topped up at regular intervals of 5 minutes.

The rate of loss of water should be less than ½ litre in 30 minutes per metre of pipe run.

The Contractor shall identify the cause of any test failure and then replace the defective work. The tests shall be repeated until soundness is achieved.

5.3.23 DRAINAGE COMMISSIONING

On completion of construction, internal surfaces of Sewers and manholes shall be thoroughly cleansed to remove all deleterious matter, without such matter being passed forward into existing public Sewers or watercourses. The Sewers and manholes shall be maintained in a clean and serviceable condition by the Contractor until completion.

The Contractor shall:

- (i) Thoroughly rod through the whole of the drainage installation with appropriately sized disc type plunger and remove any solid matter contained in the system.
- (ii) Thoroughly clean all manholes including walls, benching, step irons and channels upon completion.
- (iii) Remove sludge and debris from all gullies and separators.

- (iv) Pass through the drainage system an appropriately sized profile to prove that the bore of the pipe is not diminished.
- (v) Check the flow of the drainage by means of water containing sodium fluoresceine (dye) being deposited at the head of each run and the rate of flow being timed by means of a stop watch from manhole to manhole.
- (vi) Check the whole of the drainage system for as installed gradients that shall be carried out by recording the invert and cover levels at each manhole. This information is to be passed to the Project Manager.
- (vii) Pressure jet and flush clean the drainage system in accordance with the Sewer Jetting Code of Practice published by WRc plc.
- (viii) Carry out the final drain testing as specified.

5.3.24 RECORD DRAWINGS

The Contractor shall provide record drawings on magnetic media in AutoCAD .dwg format that shall indicate **all revisions** to the detailed design. The record drawings shall be issued within 21 days of issue of the Completion Certificate.

5.3.25 HANDOVER

Thoroughly clean and flush out the entire drainage installation and clean out silt and debris from drainage gullies, etc. before handover.

5.3.26 CCTV SEWER SURVEY

CCTV sewer surveys shall be recorded in accordance with "the manual of Sewer Condition Classification" published by WRc.

The Contractor, when necessary, shall provide float lines through the sewers and carry out their recovery. The Contractor shall include for provisions of all necessary equipment including cameras, video equipment etc., in order to provide the information required.

The inspection shall be by mobile equipment, details of that shall be submitted to the Project Manager for his approval.

Where directed by The Project Manager, photographs of the interior of each manhole shall be provided. The photographs shall be dated and the manhole reference number stated for easy location on the plan and on site.

Where directed by the Project Manager, photographs of the TV screen showing junctions, pipe joints, faults etc., shall be provided. The photographs shall be dated and numbered with the position of the video camera indicated to provide easy reference to its position on plan and on site.

The record of the survey shall be provided on DVD Discs. The DVD shall be suitably titled to relate the picture to its location on plan and on site, and clearly dated and titled.

The Contractor shall supply two fair bound copies of the complete CCTV Survey Report, inclusive of photographs. The written content of the report is to identify the site, the sewer section between manholes and the precise chainage to locate connections, faults etc., together with a description of the connection and defects as classified in the WRC's "Manual of Sewer Condition Classification". One copy of the DVD shall be supplied.

5.3.27 PRESSURE JET FLUSH CLEAN AND DESCALING EXISTING DRAINS

Prior to the commencement of the drainage works, the entire drainage system is to be descaled and pressure jet clean, by specialist company, to establish whether any remedial works require to be carried out.

Immediately prior to handover, the whole of the drainage system shall be subjected to a pressure jet clean, by an approved specialist company, to remove any debris built up during the construction works.

A certificate of completion shall be issued to the Project Manager. The Contractor shall provide plans of the drainage system for the specialist to work on as his work proceeds.

A final CCTV of the drainage system is to be provided as outlined in this section.

5.3.28 LOCAL AUTHORITY & WATER AUTHORITY SEWERS

All sewers under Local or Water Authority control, that will be affected by the proposed works, shall be surveyed by CCTV at the following points in time and a record provided as item 5.3.27.

- (i) Before any works commence.
- (ii) Upon completion of works.
- (iii) At the end of the maintenance period.

5.3.29 FULL RETENTION AND BY-PASS SEPARATORS

By-pass separators shall be installed in compliance with the manufacturer's instructions and drawing details. The method of installation shall be discussed with the Project Manager, prior to works commencing.

Separators shall be installed to the size and formation indicated on the drawings and details. The vent pipes shall be independently routed to a suitable position located nearby as defined by the Project Manager.

Under no circumstances shall separator vent pipes be interconnected below ground.

The pipes shall be interconnected immediately above ground level and be carried up in a common vent pipe, where upon it shall discharge to the atmosphere by means of a return bend.

Manhole covers shall be to BS EN 124 ductile iron, locking and ventilating pattern.

Separators and Vent Pipes shall be as indicated on the drawings.

5.3.30 SURFACE DRAINAGE CHANNELS WITH GRATINGS

Drainage channels and gratings shall be provided to the sizes and in the positions indicated on the drawings. All channels shall be laid to true and even falls and be bedded in concrete, in accordance with the manufacturer's recommendations and standard drawings.

In asphalt areas, the concrete shall be levelled off as shown on the detail drawings and the asphalt taken up to the channel block.

The channel shall be laid in straight lines, to the gradient shown, with the grating in place during concreting. The grating level shall be located 3mm below finished surface level. The 3mm shall be taken up by an increase in surface gradient, 1.0m either side of grating.

Any grating found to be distorted, twisted, not seated level or showing signs of corrosion shall be rejected.

5.3.31 LAND DRAINAGE

All land drainage shall be installed on the centre line of the previously prepared trench to the sizes, positions and levels indicated on the drawings.

The drains shall be laid on a granular bed and surround. Pipes shall be porous as described elsewhere. Where required, the previously prepared trench shall be lined with a single layer of geotextile similar to Terram Type 1000 geotextile, or similar approved, with a 200mm lap joint.

The geotextile shall be of sufficient width to be returned up the sides of the trench and lapped over the granular surround, so as to prevent the ingress of fines or soil particles, all as indicated on the drawing.

The granular bed and surround shall be laid in full accordance with the appropriate clause of this specification.

5.3.32 REMEDIAL WORKS TO EXISTING PRIVATE DRAINAGE

Where known existing private drainage requires repairs or remedial action under the Contract, all workmanship and materials shall conform with the guidance note / recommendations incorporated within the WRc Publication DUS020X Drain Repair Book – Best Practice Manual for the Inspection and Repair of Domestic and Light Industrial Drains.

Where unknown existing private requires repairs or remedial action it shall be referred to the Project Manager for appropriate instruction checking and approval.

5.3.33 PRIVATE SEWERS

All sewers that are indicated on the drawings and will be affected by the works shall be surveyed by CCTV and a record provided as item 5.3.27:

- (i) Before works commences.
- (ii) Upon completion of the works.
- (iii) At the end of the maintenance period.

5.3.34 PUMPING STATIONS

~~Pumping Stations shall be installed, tested and commissioned in accordance with the requirements of Section 6 of this specification.~~

6. PUMPING STATIONS

6.1 GENERAL

This section of the specification covers works to provide upgrades to existing pumping stations and the provision of new pumping stations.

Pumping Stations shall be installed in strict compliance with the manufacturer's instructions and drawing details. The method of installation shall be agreed with the Project Manager, prior to works commencing. The Contractor shall be responsible for commissioning of the completed pumping stations to the satisfaction of the adopting authority if adoptable, or to the Project Manager if private. The commissioning is to include the provision of power supplies, telemetry and connections as necessary.

6.1.1 GENERAL

The works carried out generally comprise the following:

- (i) Carry out the works according to the drawings, specification, and according to the latest edition of Sewers for Adoption.
- (ii) Carry out any repair works to the existing station required by the Project Manager following the inspections.
- (iii) Provision of cabling, control gear and protective kiosks for pumping stations.
- (iv) Arrange for a suitable electricity supply for the services to the pumping stations.
- (v) Liaise with the appropriate Authority to ensure that the pumping stations are built and commissioned to suit their specification and requirements.
- (vi) Testing and commissioning of the pumping stations and provision of maintenance manuals.

Where ever the text on drawings or documents requires works to be "in accordance with the Sewers for Adoption" it shall be taken to mean as "in accordance with the latest edition of Sewers for Adoption as adapted and amended and modified by the Authority".

In general, pumping stations shall comply with Sewers for Adoption unless alternative specification details are contained herein. Where the Authority has additional adoption requirements and there is a conflict between the specifications, the additional requirements by the Authority shall normally prevail unless the Project Manager instructs otherwise.

6.1.2 SETTING OUT

- (i) The Contractor shall set out the line of drains together with all manholes to the satisfaction of the Project Manager. The exact positions of the manholes shall be determined on site unless detailed or dimensioned on the drawings.
- (ii) The sight rails shall be painted black and white or red and white. The sight rails are to be set up at the ends of each length of pipe and at intermediate points not more than 45m apart, on solid ground clear of the trenches.

~~(iii) They shall be securely fixed to adequate firm posts at the correct levels above the invert in the drain.~~

~~(iv) Adequate boning rods with heads at least 300mm long and a shoe on the toe of sufficient projection to enter the invert of the last pipe shall be provided.~~

~~6.1.3 DRAINAGE AUTHORITIES~~

~~All works are to comply with the Drainage Authority requirements where appropriate and the latest version of Sewers for Adoption as modified by the relevant Water Authority, unless otherwise instructed by the Project Manager.~~

~~6.1.4 GENERAL EXCAVATION~~

~~All earthworks are to be carried out in accordance with Section 3. For works that involve larger scale earthworks also refer to Section 4.~~

~~(i) Benching~~

~~(ii) Excavation below embankments & below formation level in cuttings.~~

~~(iii) Forming of areas of fill~~

~~(iv) Compaction of areas of fill.~~

~~6.2 UPGRADING EXISTING PUMPING STATIONS~~

~~6.2.1 GENERAL~~

~~Upgrading of an existing pumping station shall aim to meet the requirements and standards within Sewers for Adoption unless otherwise specified by the Project Manager for a private pumping station. [Insert the requirement for telemetry as appropriate].~~

~~The upgrading works shall be in accordance with the drawings. The ancillaries shall be sized to fully meet the requirements as shown on the drawings.~~

~~Installation of the pumps, pipes, valves and the like, where necessary, shall fully meet the requirements and standards within Sewers for Adoption.~~

~~Provision of an electrical supply shall be from the nearest suitable statutory undertakers source to adoptable standards or if appropriate, and in suitable condition, by re-use of the existing supply.~~

~~Installation of control gear, electrical supply, electrical works and controls, and a protective kiosk where necessary, shall fully meet the requirements and standards within Sewers for Adoption.~~

~~The pumping station installation and telemetry system (if installed) shall be tested to ensure that the system is fully operational in compliance with Sewers for Adoption. The electrical installation shall be tested in accordance with BS 7671 and an Electrical Installation Certificate, as required by BS 7671 shall be provided to the Project Manager.~~

~~All demolished items shall be removed from site and leaving it neat and tidy.~~

6.2.2 SCOPE OF WORKS

~~Provide over pumping facilities to permit the works to be carried out utilising a minimum of 2 pumping systems to ensure continued operation in the event of failure of one unit.~~

~~Draw down water inside the chamber and jet wash to the satisfaction of the Project Manager.~~

~~Provide suitable safe, lit access for a detailed inspection by the Project Manager.~~

~~Carry out any repairs instructed by the Project Manager following receipt and consideration of information from the inspection.~~

~~Carry out any necessary builders work to the fabric of the chamber and ancillaries according to the details on the drawings and specification.~~

~~Install pumps, pipes, valves and the like to fully meet the requirements and standards within Sewers for Adoption.~~

~~Provide an electrical supply from the nearest suitable private or statutory undertakers source (feeder pillar) to adoptable standards or if appropriate, and in suitable condition, by re-use of the existing supply.~~

~~Install control gear, electrical supply, electrical works and controls and protective kiosk to fully meet the requirements and standards within Sewers for Adoption.~~

~~Remove over pumping on completion of the works and ensure that the system is fully operational to Sewers for Adoption.~~

~~Remove all demolished items from site and leave neat and tidy.~~

~~Details of valve chambers and wet wells are shown on the Drawings.~~

6.3 PROVISION OF NEW PUMPING STATION

6.3.1 GENERAL

~~The installation of a new pumping station shall fully meet the requirements and standards within Sewers for Adoption unless otherwise specified by the Project Manager for a private pumping station.~~

~~The location of the new pumping station shall be as shown on the drawings or as defined by the Project Manager.~~

~~Install pumps, pipes, valves and the like, to fully meet the requirements and standards within Sewers for Adoption.~~

~~Provide an electrical supply from the nearest suitable statutory undertakers source to adoptable standards or if appropriate, and in suitable condition, by re-use of the existing supply.~~

~~Install control gear, electrical supply, electrical works and controls, and protective kiosk to fully meet the requirements and standards within Sewers for Adoption.~~

~~Test pumping station installation and telemetry system (if installed) to ensure that the system is fully operational in compliance with Sewers for Adoption. The electrical installation shall be~~

tested in accordance with BS 7671 and an Electrical Installation Certificate, as required by BS 7671 shall be provided to the Project Manager.

6.3.2 SCOPE OF WORKS

~~Provide over pumping facilities to permit the works to be carried out utilising a minimum of 2 pumping systems to ensure continued operation in the event of failure of one unit.~~

~~Install a new chamber (sized according to the drawings and to an adoptable size).~~

~~Install ancillaries as shown on the Engineer's drawings to meet the requirements and standards within Sewers for Adoption.~~

~~Install pumps, pipes, valves and the like, to fully meet the requirements and standards within Sewers for Adoption.~~

~~Provide an electrical supply from the nearest suitable statutory undertakers source to adoptable standards or if appropriate, and in suitable condition, by re-use of the existing supply.~~

~~Install control gear, electrical supply, electrical works and controls and protective kiosk to fully meet the requirements and standards within Sewers for Adoption.~~

~~Remove over pumping on completion of the works and ensure that the system is fully operational to Sewers for Adoption.~~

~~Remove all demolished items from site and leave neat and tidy.~~

~~Details of valve chambers and wet wells are shown on the Drawings.~~

6.4 PERFORMANCE REQUIREMENTS

~~The pump sets shall comply with all relevant Statutory Regulations and the latest editions of all relevant British and harmonised European Standards.~~

~~The maximum operating speed of the pump sets shall be [1500 rpm].~~

~~Each pump set shall be capable of pumping the design flow rate of [15 litre/sec].~~

~~The pump sets shall be capable of continuous operation within the design operating envelope, including being run on a regular basis for short period of time 'on snore' to keep the wet well free from silt.~~

~~The pump sets shall have stable head versus flow rate characteristics against the system curve shall slope upwards towards closed valve with reducing flow rate in one continuous curve with no points of inflection capable of causing hunting when considered against the system curve(s).~~

~~The pump sets shall be selected such that the design flow rate is between 80% and 105% of the pump set best efficiency point (BEP) flow rate.~~

~~The pump sets shall be capable of discharging into an empty main (i.e. the pump sets shall have non-overloading head versus flow rate characteristics).~~

~~The pump sets shall be capable of operating against a closed valve for short periods of time.~~

~~The pump sets shall be capable of continuous operating with the motor housing uncovered.~~

~~The maximum diameter of solid sphere able to be passed by the pump sets shall generally be in accordance with the guidelines given in the following table. Where the pump sets feature an innovative design, that does not allow compliance with the following table, the Contractor shall provide substantiating information, for approval, to demonstrate that the solids handling performance of the pump sets shall satisfy the Authority or Project Manager requirements (i.e. the pump sets shall be capable of prolonged reliable and trouble free operation):~~

Nominal bore of outlet (mm)

Diameter of solid sphere able to be passed (mm)

~~{Pipe diameter < 100 ————— Sphere diameter 75~~

~~Pipe diameter > 100 but < 125 — Sphere diameter 90~~

~~Pipe diameter > 125 but < 175 — Sphere diameter 120}~~

~~The pump sets shall be reliable, efficient, and capable of operating between the manufacturer's recommended service intervals without attention or inspection.~~

~~Pump sets shall have a specified design life of at least 20 years and a statement confirming this shall be provided from the manufacturer.~~

6.5 INFORMATION REQUIREMENTS

Information Plates

~~Each pump set shall be provided with an information plate permanently fixed to one of the major pump set components. The plate and its fixings shall be manufactured from corrosion resistant, metallic materials. As a minimum, the information plate shall include the following information:~~

- ~~a) Pump set manufacturer;~~
- ~~b) Pump set type;~~
- ~~c) Pump set serial number;~~
- ~~d) Impeller number or diameter;~~
- ~~e) Flow rate at the duty point (l/sec);~~
- ~~f) Head at the duty point;~~
- ~~g) Operating speed (rpm);~~
- ~~h) Motor rating (kW);~~
- ~~i) Operating voltage (V), no of phases and frequency (Hz);~~
- ~~j) Full load current (A);~~
- ~~k) Full load power factor;~~
- ~~l) Insulation class;~~
- ~~m) Enclosure classification (IP rating);~~
- ~~n) Hazardous area classification;~~
- ~~o) Pump set weight.~~

~~Duplicate information plates shall be provided, fixed adjacent to the control panel. Labels, indicating 'Pump No. 1' and 'Pump No. 2' shall be provided in a clearly visible position near the top of the wet well.~~

~~Motors shall be capable of continuous operation under the operating conditions of the pump set. All electrical equipment (motors, cables etc.) shall be selected in accordance with the relevant parts of BS EN 60079-14.~~

~~Appropriate certification shall be included in the O & M manuals to confirm the suitability of the electrical equipment for operation in the specified hazardous area(s).~~

The electrical equipment shall typically comprise:

- ~~(a) A kiosk;~~
- ~~(b) A control panel;~~
- ~~(c) An incoming power supply;~~
- ~~(d) Allowance for future telemetry communications connection (telephone or radio link);~~
- ~~(e) Two pump sets;~~
- ~~(f) All associated interconnecting cabling and wiring;~~
- ~~(g) A level control system.~~

~~The incoming electricity supply to the pumping station shall normally be 400V, 3 phases and neutral, 4 wires, 50 Hz.~~

6.6 TESTING FOR WATER TIGHTNESS

~~A test to check the water tightness of each chamber shall be conducted in the Project Manager's presence once a chamber has reached a suitable stage in its construction.~~

~~The test shall consist of sealing all connection pipes and then filling the chamber with water.~~

~~The water shall not lose height by more than 25mm in 24 hours. The testing period is to commence 6 hours after the chamber has been filled and if necessary topped up.~~

6.7 PRESSURE PIPELINES

6.7.1 DUCTILE IRON PIPES AND FITTINGS

Ductile iron pipes, fittings and joints shall comply with the relevant provisions of BS EN 598.

6.7.2 UNPLASTICISED PVC PIPES AND FITTINGS

1. PVC pressure pipes, joints and fittings for Rising Mains shall be of the mechanical joint type and comply with the relevant provisions of the table immediately below.

Material	Pipe	Joints and fittings
PVC-U	BS EN 1452-2	BS EN 1452-3
PVC-A	PAS 27	PAS 27
PVC-O	WIS 4-31-08	BS EN 1452-3

2. Unplasticised PVC pipes, joints and fittings for gravity sewers shall comply with the relevant provisions of BS 4660 and BS EN 1401-1.

3. Solvent cements for jointing unplasticised PVC pipes shall comply with the relevant revisions of BS 4346: Part 3 or BS EN 1452. For pipes and fittings complying with BS 4660, solvent cement may alternatively comply with BS 6209.
4. Solvent cements for jointing unplasticised PVC pipes shall not be used for below ground use.

6.7.3 JOINT SEALS AND LUBRICANTS

1. Elastomeric joint seals shall be Type WC or WG, complying with the relevant provisions of BS EN 681-1, and shall be obtained from the pipe manufacturer.
2. Joint lubricants for sliding joints shall have no deleterious effect on either the joint rings or pipes, and shall be unaffected by sewage.

6.7.4 PIPE SURROUND MATERIALS

1. Processed granular and 'as-dug' bedding, side fill and surround materials for buried pipelines shall comply with WIS 4- 08-02.
2. Recycled materials shall comply with BS 8500: Part 2.

6.7.5 PRECAST CONCRETE SETTING BLOCKS FOR PIPES

Precast concrete setting blocks for pipes shall have rectangular faces, with sufficient plan area to prevent punching of the blinding concrete or formation and to provide an adequate seating for the pipes. Blocks shall be manufactured from Grade C16/20 concrete using the same type of cement as in the adjacent concrete bed, and be cast in an approved mould. Blocks shall not be used until they have achieved a cube strength of 13.5 N/mm².

6.7.6 COMPRESSIBLE FILLER AND PACKING FOR PIPELINES

1. Compressible filler for interrupting concrete protection to pipes shall consist of bitumen-impregnated insulating board to BS EN 120 and BS EN 317, or other equally compressible material. The thickness of compressible filler shall be as the table immediately below.

Nominal diameter of pipe (mm)	Thickness of compressible filler (mm)
Less than 450	18
450 – 1200	36
Exceeding 1200	54

2. Compressible packing for use between pipes and precast concrete setting blocks shall consist of bitumen damp-proof sheeting complying with BS 743.
3. Bituminous materials shall not be put into contact with plastics pipes.

6.7.7 TESTING OF POLYETHYLENE PRESSURE PIPELINES

1. The entire pipeline shall be pressure tested.
2. Rising Mains shall be tested by the Contractor after they are jointed and before any concreting or backfilling is commenced, other than such as may be necessary for structural stability whilst under test.
3. Gauges used for testing Rising Mains shall either be of the conventional circular type, not less than 300 mm diameter, calibrated in metres of head of water, or shall have a digital indicator capable of reading increments of 0.1 m head. Before any gauge is used, the Contractor shall arrange for it to be checked independently and a dated certificate of its accuracy shall be provided.
4. Before testing valves shall be checked and sealed, the sections of main filled with water and the air released.
5. The pressure in the Rising Main shall then be raised steadily until the specified test pressure is reached in the lowest part of the section. The pressure shall be maintained at this level, by pumping if necessary, for a period of at least 1 hour. The pump shall then be disconnected, and no further water shall be permitted to enter the Rising Main for a further period of 1 hour. At the end of this period the original pressure shall be restored by pumping and the loss measured by drawing off water from the main until the pressure as at the end of the test, is again reached.
6. The permissible loss shall not exceed 2 litres per metre nominal bore per kilometre length per metre head (calculated as the average head applied to the section) per 24 hours.
7. The Contractor shall provide, and subsequently dispose of, the water required for the test. Discharges to Sewers shall not take place without the consent of the Authority.
8. Test pressures for Rising Mains shall be 1.5 times the maximum operating pressure at the lowest point of the main, or the maximum operating pressure plus the maximum calculated surge pressure, whichever is the greater.

7. HIGHWAYS

7.1 GENERAL

Refer to Section 3 for the general items.

7.1.1 SETTING OUT

Site specific settings out requirements are as follows:

Setting out will be provided by Architect.

7.2 MATERIALS

7.2.1 PROHIBITED MATERIALS

The following materials shall not be specified or employed in the works:

- (i) Calcium chloride additives
- (ii) High alumina cement
- (iii) Woodwool permanent formwork
- (iv) Asbestos
- (v) Biodegradable void formers
- (vi) Urea formaldehyde
- (vii) Calcium silicate bricks
- (viii) Any materials that are in anyway detrimental to the life or construction of the works or any part of it.

7.2.2 CAPPING AND SUB-BASE MATERIAL

Capping material shall be 6F1 selected granular material, having a CBR exceeding 15%, consisting of any crushed material other than unburnt colliery material and complying with the BS grading in Table A listed below.

Sub-Base material shall be Type 1 granular material, having a CBR exceeding 30%, comprising crushed rock, crushed slag, crushed concrete or well burnt non-plastic shale and may contain up to 12.5% by mass of natural sand that passes the 5mm BS sieve. The material shall be well graded and lie within the following grading limits as listed in Table B.

TABLE A 6F1 GRADING REQUIREMENT	
BS SIEVE SIZE	PERCENTAGE BY MASS PASSING
75 mm	100
37.5 mm	75-100
10 mm	40-95
5 mm	30-85
600 microns	0-25
63 microns	<15

TABLE B	TYPE 1 RANGE OF GRADING
BS SIEVE SIZE	PERCENTAGE BY MASS PASSING
—63 mm	100
31.5 mm	—75—99
—16 mm	—43—81
—8 mm	—23—66
—4 mm	—12—53
—2 mm	—6—42
—1 mm	—3—32
—63 microns	—0—09

7.2.3 TESTING REQUIREMENTS

A. i. ~~The Contractor shall, at least 7 working days before commencement of importation of the 6F1 and Type 1 material, submit to the Project Manager for approval in accordance with the following.~~

- ~~(a) Grading~~
- ~~(b) Uniform coefficient~~
- ~~(c) Moisture content~~
- ~~(d) Moisture condition value (MCV)~~
- ~~(e) Plasticity Index~~

~~Materials having a soluble sulphate content exceeding 2.5g per litre when tested in accordance with Test 10 of BS 1377 shall be classed as unacceptable materials.~~

ii. ~~The values of maximum dry density and the optimum moisture content for these materials obtained in accordance with BS 1377 Test 12 and 14 as appropriate, for each type and source of material.~~

iii. ~~The Contractor may at any time be required to carry out comparative Field Density Tests determined in accordance with BS 1377 Part 9: 1990 on material that is considered to have been inadequately compacted. If the test results, when compared with the result of similar tests made on adjacent approved work in similar materials, shows the state of compaction to be inadequate, or if the test results when compared with the density obtained by a single compaction test carried out on the same material at natural moisture content by the method described in BS 1377 Part 4: 1990 is shown to be less than 95%, and this is held to be due to failure of the Contractor to comply with the requirements of the Contract, the Contractor shall carry out such further work as may be decided is required to comply with the terms of the Contract.~~

iv. ~~The Contractor may after completion of the fill compaction be required to carry out Plate Bearing Tests. In the positions designated by the Construction Project Manager. The results shall be documented in the form of a load/settlement curve and issued to the Construction Project Manager within 48 hours of the completion of the test. A C.B.R. value shall be given for each test performed.~~

B. ~~The minimum frequency of testing to be carried out by the Contractor is as follows:-~~

Material Class	Type of Test	Relevant Standard	Rate of Testing
6F1	Grading	BS 1377	Source approval and two per week per source
	Uniformity Coefficient	BS 892	Source approval and one per week per source

Type 1	10% Fines Value	BS 812	Source approval and one per week per source
	Mc	BS 1377	Two per day per source
	Plate Bearing Test (C.B.R.)	BS 1377	One per 250 sq. m.
	Grading	BS 1377	Source approval and two per week per source
	Optimum Mc	BS 1377	Source approval and one per week per source
	Mc	BS 1377	Two per day per source
	10% Fines Value	BS 812	Source approval and one per week per source
	Soundness	BS 812	Source approval and one per week per source
Type 1	Plasticity Index	BS 1377	Source approval and one per week per source
	Plate Bearing Test (C.B.R.)	BS 1377	One per 250 sq. m.

C. Requirements for Testing and Acceptable Limits

The following tests are required to classify and determine the acceptability of earthworks materials. Each class shall only comprise material with properties within the acceptability limits prescribed below:-

Class	Property	Defined and tested in accordance with	Acceptable limits within	
			LOWER	UPPER
6F1	Grading	BS 1377 Part 2	Table A	Table A
	Optimum mc	BS 1377 Part 4	-	-
	Moisture Content	BS 1377 Part 2	Optimum mc minus 2%	Optimum mc
	10% Fines Value	BS 812 Part 3*	30 kN	-
TYPE1	Grading	BS 1377 Part 2	Table B	Table B
	Optimum mc	BS 1377 Part 4	-	-
	Moisture Content	BS 1377 Part 2	Optimum mc minus 2%	Optimum mc
	Soundness	BS 812	65	-
	Plasticity Index	BS 1377 Part 2	non-plastic(a)	non-plastic(a)
	10% Fines Value	BS 812 Part 3*	50 kN	-

~~Samples shall be tested in a saturated and surface dried condition. Before testing, the selected test portions shall be soaked in water at room temperature for 24 hours without previously having been oven dried.~~

~~7.2.4 SUB-BASE AND BASE~~

- ~~(i) Material specified within 450 mm of the surface of the road shall not be frost susceptible as determined by the test described in the Transport and Road Research Laboratory LR90 and Supplementary Report No. 318. (The material shall be deemed to be frost susceptible if in the test the heave is greater than 13 mm).~~
- ~~(ii) Temporary thickening. Where the Contractor proposes to use the sub-base for traversing by vehicles or plant he shall increase where necessary the thickness and/or strength of the sub-base to accommodate the method of construction and the type of plant and vehicles that he proposes to use to avoid damage to the sub-base or the subgrade. Any permanent thickening shall be to the approval of the Project Manager and extend across the whole width of the pavement, unless otherwise agreed.~~

~~7.2.5 BASE – DENSE ASPHALT CONCRETE~~

~~The material shall comply with BS EN 13108 Part 1: 2007 for 32mm nominal size crushed rock with 50 pen binder.~~

~~7.2.6 BINDER COURSE – DENSE ASPHALT CONCRETE~~

~~The material shall comply with BS EN 13108 Part 1: 2007 for 20 mm nominal size with 100 pen binder. The aggregate shall consist of hard, clean durable rock, or blast furnace slag.~~

~~7.2.7 SURFACE COURSE~~

~~(i) HOT ROLLED ASPHALT~~

~~Categories for minimum values of resistance to polishing~~

Site category	Site description	Minimum PSV required Traffic (cv/lane/day) at design life									
		0- 250	251- 501-	501- 751-	751- 1001-	1001- 2001-	2001- 3001-	3001- 4001-	4001- 5001-	5001- 6000	Over 6000
C	Single carriageways where traffic is generally free-flowing on a relatively straight line.	60	60	65	65	68+	68+	68+	68+	68+	68+
K	Approaches to pedestrian crossings and other high risk situations	68+	68+	HFS	HFS	HFS	HFS	HFS	HFS	HFS	HFS
Q	Approaches to major and minor junctions on dual carriageways and single carriageways where frequent or sudden braking occurs	68+	68+	HFS	HFS	HFS	HFS	HFS	HFS	HFS	HFS

R	but in a generally straight line.											
	Roundabout circulation areas	68+	68+	68+	HFS	HFS	HFS	HFS	HFS	HFS	HFS	HFS

Where '68+' material is listed in this Table, none of the three most recent results from consecutive PSV tests relating to the aggregate to be supplied must fall below 68.

HFS means specialised high friction surfacing, incorporating calcined bauxite aggregate and conforming to the following requirements.

- 1 High friction surfacing systems shall have current British Board of Agrément HAPAS Roads and Bridges Certificates.
- 2 A high friction surfacing system with a current British Board of Agrément HAPAS Roads and Bridges Certificate shall only be installed by a Contractor approved by the BBA and the Certificate Holder as an Approved Installer for that system.
- 3 The high friction surfacing system BBA/ HAPAS Type Classification required for each location shall be agreed with the Engineer.

Aggregate

- 4 Aggregate used in high friction surfacing systems shall have a minimum declared PSV category specified above in this clause in accordance with BS EN 13043, Clause 4.2.3. The resistance to abrasion of coarse aggregate shall have a maximum AAV [insert value] in accordance with BS EN 13043, Clause 4.2.4. The Contractor shall provide, before work commences, test certificates, issued by an appropriate organisation accredited in accordance with sub-Clauses 105.3 and 105.4 for those tests, not more than six months previously, and showing conformity with the requirements.

Installation and Quality Control Procedures

- 5 The installation and quality control procedures shall be in accordance with the British Board of Agrément Roads and Bridges Certificate for each system and the current method statement agreed by the BBA. The results of all quality control checks carried out on site by the Contractor and quality assurance information compiled in accordance with the requirements of the Certificate, including results from BBA surveillance visits, shall be made available to the Project Manager on request.

System Coverage

- 6 For each location where high friction surfacing is applied, the total quantities of each system component used, the measured area of the surface treated and the calculated coverage rate in kg/m² shall be reported to the Project Manager within three days of completion at that location. For systems in which aggregate is broadcast over a film of binder applied to the surface, the calculated coverage rate shall be that of the binder film and shall not include the mass of the aggregate.

Guarantee

- 7 The Contractor shall guarantee the high friction surfacing materials and workmanship for a period of two years from the date of opening the surfacing to traffic. This guarantee shall exclude defects arising from damage caused by settlement, subsidence or failure of the carriageway on which the surfacing has been applied, but shall cover failure to meet the minimum requirements set out in Table 4 of the BBA/ HAPAS 'Guidelines Document for the Assessment and Certification of High Friction Surfaces for Highways'.

Where HFS is required on the approaches to a hazard, the minimum treatment length must be as defined on the drawings. This may be extended where queueing traffic or sightlines indicate that 50m may not be sufficiently long.

Samples of the aggregate representative of those to be incorporated into the Works must be tested in accordance with BS EN 1097-8 for compliance with the specified PSV and Average Aggregate Value (AAV) properties. Alternatively, except where a PSV of 68+ is specified, the aggregate must be deemed to comply if the mean of the three most recent results from consecutive tests, relating to the material to be supplied, is greater than or equal to the specified PSV and less than the specified AAV.

Traffic (cv/lane/day) at design life:	<250	251-1000	1001-1750	1751-2500	2501-3250	>3250
Max AAV for chippings for hot rolled asphalt and surface dressing, and for aggregate in slurry and micro-surfacing systems:	14	12	12	10	10	10
Max AAV for aggregate in thin surface course systems, exposed aggregate concrete surfacing and coated macadam surface course	16	16	14	14	12	12

- The material shall be manufactured, transported, laid and compacted in accordance with the requirements of BS 594987:2007, and shall comply with Table 3 column 9, laid 40mm thick (14mm size 30% coarse aggregate content, Type F design mix).
- The mix design shall provide a stability in the range 2 to 8KN and a maximum flow of 5mm with a minimum target binder content of 7.1%.
- The coarse aggregate shall have a minimum PSV of 55.

The composition of the coated chipping shall comply with the following table:

BS sieve size	Percentage by mass passing
28mm	100
20mm	95-100
14mm	0-12
10mm	0-4
2.36mm	0-2
75um	0-2

Binder content 1.3 – 2.1%

Maximum percentage of nominal size 80%

Maximum flakiness index 25

(ii) **CLOSE GRADED ASPHALT CONCRETE**

The material shall comply with BS EN 13108 Part1: 2007, for 10mm nominal size crushed rock.

7.2.8 COATED CHIPPINGS

~~Pre-coated chippings shall be 20mm nominal size complying with the relevant requirements of BS EN 13108: Part 4 and shall have a minimum PSV as required in this section. The rate of spread for applied chippings shall be uniform throughout the site and shall be sufficient to achieve a texture depth of 1.0 mm to 1.5 mm as determined by the Volumetric Patch Method BS EN 13036-1: 2002.~~

~~Individual measurements shall not be less than 0.8 mm and not greater than 1.7 mm.~~

7.2.9 CONCRETE PAVEMENTS

- ~~(i) Concrete in rigid or rigid composite pavements shall be to the class shown on the drawings or as directed by the Project Manager.~~
- ~~(ii) The weights of reinforcement used shall be in accordance with the drawings or as directed by the Project Manager. The reinforcement materials shall be obtained from a firm holding a valid CARES (or fully equivalent scheme) certificate of approval. Steel fabric reinforcement shall be in accordance with BS EN 100800 and BS 4483 delivered to site in mats free from any permanent set.~~

7.2.10 DOWEL BARS AND TIE BARS

- ~~(i) Dowel bars for joints in concrete paved roads shall be Grade B500B steel complying with the relevant provisions of Grade B500B steel conforming to BS EN 13877-3 and they shall be free from oil, paint, other than bond breaking compound, dirt, loose rust and scale.~~

~~For expansion joints, dowel bars shall be 25 mm diameter at 300 mm spacing and 600 mm long for slabs up to 239 mm thick and 32 mm diameter for thicker slabs. A closely fitting cap 100 mm long consisting of waterproofed cardboard or suitable synthetic material shall be placed over one end of each dowel bar. An expansion space 10 mm greater than the thickness of the joint filler board shall be formed between the end of the cap and the end of the dowel bar.~~

~~For contraction joints, dowels shall be 20 mm diameter at 300 mm spacing and 400 mm long for slabs up to 239 mm thick, and 25 mm diameter at 300 mm spacing and 600 mm long for thicker slabs.~~

~~Dowel bars shall be covered by a flexible polymeric corrosion resistant coating, bonded onto the previously cleaned bar. The coating shall be smooth and free of indentations. During coating, the bar shall be supported at each end. Minimum thickness shall be 0.3 mm. The coating shall also be able to withstand 250 hours immersion in a salt fog cabinet complying with BS EN ISO 7253, without showing any visible crazing or corrosion of the protected bar.~~

~~For expansion joints, a closely fitting cap 100 mm long consisting of waterproofed cardboard or suitable synthetic material shall be placed over one end of each dowel bar. An expansion space 10 mm greater than the thickness of the joint filler board shall be formed between the end of the cap and the end of the dowel bar.~~

~~Dowel bars for contraction or construction joints shall have half their length painted with bond breaking compound.~~

- (ii) ~~Tie bars for joints in concrete paved roads shall be high Tensile steel complying with the relevant provisions of Grade B500B steel conforming to BS EN 13877-3 and they shall be free from oil, paint, other than bond breaking compound, dirt, loose rust and scale.~~

~~7.2.11 BOND BREAKING COMPOUND FOR DOWEL BARS~~

~~Bond breaking compound for dowel bars shall consist of a bitumen paint containing 66% of 200 pen. bitumen, blended hot with 14 per cent light creosote oil with the addition, when cold, of 20% solvent naphtha. It shall in no way retard or otherwise affect the setting of concrete.~~

~~Concrete shall be clean and prepared according to the manufacturer's recommendations prior to the application of jointing material or as applicable.~~

~~7.2.12 JOINT SEALING COMPOUNDS AND SEALANTS~~

~~Joint sealing compounds shall be impermeable ductile materials of a type suitable for the conditions of exposure in that they are to be placed and capable of providing durable, flexible and watertight seal by adhesion to the concrete through the range of joint movement.~~

~~7.2.13 WATERPROOF MEMBRANE~~

~~The waterproof membrane for use under concrete road slabs shall be 0.125mm gauge polythene.~~

~~7.2.14 JOINT FILLER~~

~~Joint filler for joints in concrete paved roads and paved areas shall be Korkpak by Grace Construction Products or similar approved, to the thicknesses shown on the drawings.~~

~~7.2.15 ROAD MARKING MATERIALS~~

~~Road marking materials shall be:~~

- (i) ~~thermoplastic road marking material in accordance with BS 3262: Part 1 or Part 2 and BS EN 1871;~~
- (ii) ~~paint in accordance with BS EN 1871. It shall be suitable for applying by brush or mechanical means to concrete or bituminous pavement to give a chemically stable film of uniform thickness;~~
- (iii) ~~permanent preformed road markings in accordance with BS EN 1790.~~

~~Where required to be reflectorised, the relevant clauses of BS 3262: Part 1 shall apply.~~

~~The material shall be white or yellow as described in the Contract. Yellow paint shall be standard colour to BS 381C, No. 355.~~

7.2.16 DUCTING

Ducts for cables shall be laid in the positions shown on drawings or where directed by the Project Manager with not less than 600mm cover. Unless otherwise directed, ducts shall be laid to project 1m beyond the edge of the carriageway. Ducts shall be surrounded with 150mm of sharp sand that shall be hydraulically compacted, unless stated otherwise on the drawings.

Ducts shall be constructed using clay or synthetic material pipes complying with the following table and of a diameter indicated on the drawing. They shall be provided with a draw-wire cord of not less than 3mm diameter secured to a toggle or cross piece to prevent accidental withdrawal. All duct ends shall be plugged with a wooden plug.

TYPE	BS
Vitrified Clay	BS 65:1991 or BS EN 295 Parts 1 and 3:1994
Unplasticised	BS 4660:2000, BS EN 1401 1:1998 and BS EN 13598 1:2003 or BS 5481:1977 for Building Regulations.

7.2.17 REGULATING COURSE FOR FLEXIBLE PAVEMENTS

Regulating course material, if required, shall be made from a fine aggregate material in accordance with either BS EN 13108: 2007 Part 1 and laid to a maximum thickness of 40mm in accordance with the requirements for one of the binder course or road course base materials in this Specification as described in the Contract.

7.3 WORKMANSHIP

7.3.1 EXCAVATIONS

When formation/sub-formation level has been reached, the sub-grade shall be inspected and further excavation carried out to remove any soft spots. These shall be filled with General Backfill as Type 6F1 or as directed by the Project Manager and the whole compacted with one pass of a 3000kg vibrating roller.

The capping/extra sub-base required where the ground is weak or frost susceptible, shall be Granular Sub-Base Material, or 6F1 and shall be compacted in layers not exceeding 225 thick with four passes of a 3000kg vibrating roller. The sub-grade shall not be left exposed to the weather.

7.3.2 GRANULAR BASE/SUB-BASE MATERIALS

Granular base and sub-base materials shall be thoroughly compacted in uniform layers to a depth as indicated on the drawings in accordance with the following table.

Type of compaction plant	Category	Number of passes for layers not exceeding the following compacted thicknesses	
		150mm	250mm
Smooth-wheeled roller (or vibratory roller operating without vibration)	Mass per metre width of roll: (or vibratory roller) Over 2100 kg up to 2700 kg Over 2700 kg up to 5400 kg Over 5400 kg	Unsuitable Unsuitable 12	Unsuitable Unsuitable Unsuitable
Pneumatic-tyred roller	Mass per wheel: Over 1000 kg up to 1500 kg Over 1500 kg up to 2000 kg Over 2000 kg up to 2500 kg Over 2500 kg up to 4000 kg Over 4000 kg up to 6000 kg Over 6000 kg up to 8000 kg Over 8000 kg up to 12000 kg Over 12000 kg	Unsuitable 12 6 5 4 Unsuitable Unsuitable Unsuitable	Unsuitable Unsuitable Unsuitable Unsuitable 16 8 4 4
Vibratory roller	Mass per metre width of vibrating roller: Over 270 kg up to 450 kg Over 450 kg up to 700 kg Over 700 kg up to 1300 kg Over 1300 kg up to 1800 Over 1800 kg up to 2300 kg Over 2300 kg up to 2900 kg Over 2900 kg up to 3600 kg Over 3600 kg up to 4300 kg Over 4300 kg up to 5000 kg Over 5000 kg	Unsuitable Unsuitable Unsuitable Unsuitable 12 10 10 8 8 6	Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable 12
Vibrating plate compactor	Mass per square metre of base plate: Over 880 kg up to 1100 kg Over 1100 kg up to 1200 Over 1200 kg up to 1400 kg Over 1400 kg up to 1800 kg Over 1800 kg up to 2100 kg Over 2100 kg	Unsuitable Unsuitable 10 8 6	Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable
Vibro-tamper	Mass: Over 50 kg up to 65 kg Over 65 kg up to 75 kg Over 75 kg up to 100 kg Over 100 kg	Unsuitable Unsuitable Unsuitable 8	Unsuitable Unsuitable Unsuitable Unsuitable
Power rammer	Mass: 100 kg up to 500 kg Over 500 kg	8 6	Unsuitable 10

7.3.3 DENSE ASPHALT CONCRETE BASE

Dense asphalt concrete base shall be laid with a mechanical spreader/compactor at a temperature complying with Table 3 of BS 59487: 2007, and rolled with an 8/10 tonne smooth wheeled roller or a vibrating roller giving the same effective compaction, to the compacted thicknesses, profile and levels shown on the drawings.

7.3.4 DENSE ASPHALT CONCRETE BINDER COURSE

Dense asphalt concrete binder course shall be laid with a mechanical spreader/compactor and rolled with an 8/10 tonne smooth wheeled roller or a vibrating roller achieving the same compaction to a compacted thickness and to the profile and levels shown on the drawings. Hand laying may be permitted by the Project Manager in small and irregular areas of surfacing.

7.3.5 SURFACE COURSE

(i) Close and medium graded asphalt concrete

The binder course shall be thoroughly cleaned and then sprayed with Bitumen Emulsion at a rate of 4.5 l/m². The surface course shall be laid with a mechanical spreader/compactor and rolled with an 8/10 tonne smooth wheeled roller or a vibrating roller giving an equivalent compaction to the compacted thickness on carriageway to the finished levels and profile shown on the approved drawings. Where a vibrating roller is used, the final passes shall be with the roller in non-vibrating mode.

Any joints in the surfacing shall be cut back to a vertical line and the vertical face coated with hot bitumen before the laying proceeds. Hand laying may be permitted by the Project Manager in small and irregular areas of surfacing.

(ii) Hot Rolled Asphalt

The binder course, if it has been used by vehicular traffic or where required by the Project Manager, shall be thoroughly cleaned and then sprayed with Bitumen Emulsion at a rate of 4.5 l/m².

The surface course shall be laid in accordance with BS 594987 Section 9.5.2 and compacted with a 3000kg tandem vibrating roller to the thickness, profile and levels shown on the approved drawings. The final passes of the roller shall be in non-vibrating mode.

7.3.6 CONCRETE PAVEMENTS

(i) Pavements

All reinforcement shall be free from loose rust, scale, oil or other harmful substances and shall be placed so as to have 60mm top cover and 40mm side cover.

All reinforcement shall be lapped to give full strength tension laps. At transverse laps the first transverse wire of one mat shall lie within the last complete mesh of the previous mat. The minimum lap shall be 300mm.

Reinforcement shall be cut and bent in accordance with BS 8666. Re-bending of carbon steel bars and fabric reinforcement on site shall not be permitted.

(ii) Transverse Joints

Details of expansion, contraction and longitudinal joints are shown on the drawing. Transverse joints at road junctions, turning areas, etc., shall be so positioned as to give approximately square corners to all bays, i.e., to avoid acutely pointed corners.

A plan showing the proposed layout of joints shall be submitted for approval by the Project Manager.

~~Transverse joints shall be provided at intervals not exceeding 25m. Every third joint shall be an expansion joint, the remainder being contraction joints.~~

(iii) Longitudinal Joints

~~Longitudinal joints shall be provided in all carriageways of 4.5m or greater width.~~

(iv) Treatment at Manholes and Gullies

- ~~1. Manhole covers, gullies and their frames shall be isolated from the main pavement slab and be housed in separate slabs. The slabs shall be larger than the exterior of the manhole shafts and any concrete surround if the top of the shaft is less than 150mm below the bottom of the concrete pavement.~~
- ~~2. The position of manholes, gullies and joints in the concrete pavement shall be adjusted relative to each other so that the manhole and gully slabs shall be adjacent to a joint or the edge of the slab, or alternatively lie within the middle third of the slab. When this is not possible, reinforcement must be included around the gully or manhole recess.~~
- ~~3. Manholes and gully recesses shall be formed by casting the main slab against formwork boxes placed and fixed accurately and vertically. The formwork shall be removed where the concrete around the manhole or gully cover is to be placed and preformed joint filler 20mm thick fixed to the slab edges so exposed.~~
- ~~4. A groove for a seal shall be made directly above the preformed joint filler and sealed as specified.~~
- ~~5. Reinforcement as may be required shall be placed in the agreed position and concrete shall be placed by hand in the space between the main slab and the manhole or gully frame. This concrete shall meet the strength requirements of this Specification and the mix shall be modified but not by the addition of water alone to permit full compaction by the methods adopted.~~

(v) Sealing Grooves

~~Dirt, grit, dust shall be removed from all grooves before sealing. Joints shall then be dried if necessary and sealed with a cold poured, oil resistant sealant to BS 5212 in accordance with the manufacturer's instructions.~~

(vi) Laying Concrete

~~Construction of reinforced concrete slabs shall be in two layers. The first layer shall be spread, struck off and compacted to a level so that the reinforcement, when placed, shall have the depth of cover specified. Immediately after placing the reinforcement the top layer of the concrete shall be laid and finished.~~

- (vii) The Contractor shall submit a method statement and fully dimensioned drawing describing his method of casting and providing the necessary joints in accordance with this clause and to the requirements of the Project Manager.**

7.3.7 TESTING TO BE CARRIED OUT BY THE CONTRACTOR

MATERIAL	TEST	FREQUENCY OF TESTING	TEST CERTIFICATE	COMMENTS
Aggregate for concrete pavements	British Standard 812 Part 121	Source approval	Testing reports required.	
Concrete for road slabs	Cube compression testing	1 set of 3 cubes for each separately cast concrete road slab	Testing reports required.	
Surface texture	Sand patch	1 per day (set of 10)	Testing reports required.	

7.3.8 CARRIAGEWAY LEVEL

Before the surface course is laid, all covers, boxes, etc., shall be accurately set to the correct level and crossfalls.

7.3.9 ALIGNMENTS

Horizontal alignments shall be determined from the centre line of the carriageway pavement surface as shown on the drawings. The edge of the carriageway as constructed and all other parallel alignments shall be correct within a tolerance of +13 mm therefrom.

Kerbs shall be laid to give a smooth and even line in both plan and elevation within a tolerance of +3 mm. Any unit out of tolerance shall be re-laid.

The levels of pavement courses shall be determined from the true finished road surface calculated from the vertical profile and crossfalls as shown on the Drawings. The vertical depth below the true pavement surface of any point on the constructed surface of the formation or pavement courses shall be within the appropriate tolerances stated in Table A.

The surface level of the pavement at any point shall not deviate vertically from the true finished road surface by more than +6 mm.

However the combination of permitted tolerances in different pavement levels shall not result in a reduction of the surface course thickness by more than 5 mm from that specified for a flexible road nor a reduction in the thickness of the whole pavement, excluding the sub-base, by more than 15 mm from the specified thickness.

For checking compliance with Table A measurements of surface levels shall be taken at points to be selected by the Project Manager at 10 m centres longitudinally and at 2m centres transversely. At junctions the grid point spacings shall be as described in the Contract.

In any length of pavement, compliance with the requirements of Table A shall be regarded as met when not more than one measurement in any consecutive ten longitudinally or one in any transverse line, exceeds the tolerances permitted, but this one measurement shall not exceed 5mm more than the tolerance for the layer concerned.

TABLE A: TOLERANCES IN SURFACE LEVELS OF PAVEMENT COURSES AND THE FORMATION

Surface Course	
General	± 6 mm
Adjacent to a surface water channel*	+10mm - 0 mm
Binder Course*	± 6 mm
Base*	±15 mm
Sub-base under concrete pavement surface slabs laid full thickness in one operation by machines with surface compaction	±10 mm
Sub-bases other than above	+10mm -30 mm
Formation	+20 mm -30 mm

* Where a surface water channel is laid before the adjacent road pavement layer the top of that layer, measured from the top of the adjacent edge of the surface water channel, shall be to the tolerances given in Table A.

7.3.10 SURFACE REGULARITY

The longitudinal regularity of the surface courses, binder courses and concrete slabs shall be within the relevant tolerances stated in Table B.

An irregularity is a variation not less than 4 mm, no more than 7 mm of the profile of the road surface as measured by the rolling straight edge, set at 4 mm or 7 mm as appropriate. No irregularity exceeding 10 mm shall be permitted.

Compliance with Table B shall be tested for all lengths of sub-bases, surface courses and binder courses. The surfaces shall be tested, where necessary, at points decided by the Project Manager, with a straight edge of 3 m length placed parallel with or at right angles to the centre line of the road.

The maximum allowable deviation of the surface below the straight edge shall be:

For pavement surfacing	: 3 mm
For binder course surfacing	: 6 mm

TABLE B: MAXIMUM PERMITTED NUMBER OF SURFACE IRREGULARITIES

	Surfaces of each lane of carriageway, each hard strip and each hard shoulder for each irregularity limit	Surfaces of each lane of bituminous binder courses for carriageway, hard strip and hard shoulder for each irregularity limit	Surfaces of lay-bys, service areas, and associated bituminous binder courses for each irregularity limit
Irregularity Limits	4mm — 7mm	4 mm — 7 mm	4 mm — 7 mm
Length (m)	300 75 — 300 75	300 75 — 300 75	300 75 — 300 75

Pavements 7.3m in width and less	40 — 18 — 4 — 2	60 — 27 — 6 — 3	60 — 27 — 6 — 3
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7.3.11 RECTIFICATION:

Where any tolerance is exceeded the Contractor shall make good the surface of the pavement course or formation in the manner described below:

(i) ~~Formation Level~~

~~If the surface is too high it shall be re-trimmed and re-compacted in accordance with the specification. If the surface is too low the deficiency shall be corrected by the addition of fresh acceptable material of the same classification laid and compacted to Specification, or as otherwise directed by the Project Manager.~~

(ii) ~~Unbound and hydraulically bound materials~~

~~The top 75 mm shall be scarified, reshaped with material added or removed as necessary, and re-compacted. The area treated shall be not less than 20 m long and 2 m wide. For hydraulically bound materials, all rectification shall be completed within 48 hours of the binder being added to the material.~~

(iii) ~~Cement bound sub-bases and bases~~

~~The method of correction shall depend on the period which has elapsed between detection of the error and the time of mixing of the material. If this is less than 4 hours, the surface shall be scarified to a depth of not less than 50 mm, surplus material removed or freshly mixed material added as necessary, and re-compacted in accordance with the Specification. If the period is 4 hours or more the full depth of the layer shall be removed from the pavement and replaced with material in accordance with the Specification. In either case the area treated shall be at least 5 m long and the full width of the paving laid in one operation. If the Contractor proposes rectification within 7 days of laying he shall comply with the following requirement.~~

- ~~• Construction plant and traffic used on pavements under construction shall be suitable in relation to the material, condition and thickness of the courses it traverses so that damage is not caused to the subgrade or the pavement courses already constructed. The wheels or tracks of plant moving over the various pavement courses shall be kept free from deleterious materials.~~

~~Alternatively, for sub-bases under concrete pavements the Contractor may make up low areas to a level within the tolerances of this clause with a 1:4 cement and sand mortar or with an AC4 fine surface course complying with the following:~~

Fine Graded Asphalt Concrete Surface Course

~~1 Fine graded asphalt concrete (formerly macadam) surface course recipe mixes shall be asphalt concrete conforming to BS EN 13108-1, the detailed requirements of BS PD 6691 Annex B. The mixture designation shall be one of the following:~~

- ~~• AC 4 fine surf 160/220.~~
- ~~• AC 4 fine surf 250/330.~~

Coarse Aggregate

~~2 To ensure adequate resistance to polishing and abrasion, the coarse aggregate shall have a minimum declared PSV of 60 and a maximum AAV of 16~~

(iv) ~~Bituminous bases~~

With coated macadam or asphalt bases, the full depth of the top layer as laid shall be removed and be replaced with fresh material laid and compacted in accordance with the Specification. Any area so treated shall be at least 5 m long and the full width of the paving laid in one operation. Alternatively for low areas in bituminous bases, the Contractor may make up the level with additional binder course material.

(v) ~~Surface courses and binder courses~~

~~These shall have the full depth of the course removed and replaced with fresh material laid and compacted in accordance with the Specification. The area rectified shall be the full width of the paving laid in one operation, and at least 5 m long if binder course, or 15 m if surface course. Where the number of surface irregularities exceeds the limits in Table B, the area to be rectified shall be 300 m or 75 m long as appropriate and the full width of the lanes affected, or such lesser length as necessary to make the number of surface irregularities conform with the limits and shall be the full width of the lanes affected.~~

~~Checking of the surface course for compliance with this clause shall be carried out as soon as possible after completion of the surfacing and remedial works completed before the road is opened to traffic.~~

~~Where the macro texture depth requirement is not met remedial works shall be carried out as directed by the Project Manager.~~

(vi) ~~Concrete slabs~~

~~Concrete slabs shall be rectified by planing, grinding or bump cutting. Large depressions, which cannot be dealt with in this way, shall be rectified by cutting out the surface and replacing by a thin bonded surface repair to the following requirements.~~

Thin Bonded Repairs Materials

- ~~1 Cement mortar shall be used for depths less than 20 mm and fine concrete for greater depths. Resin mortar may only be used for small patch repairs less than 4 metre long and less than 30 mm in depth and where insufficient time for adequate curing of a cementitious cement mortar exists.~~
- ~~2 (The cements, aggregates, admixtures and water shall comply with Section 3. The sand (i.e. fine aggregate) for mortars or fine concrete shall be within the limits of 0/4 (CP), 0/4 (MP), 0/2 (MP) or 0/2 (F/P) of BS EN 12620. Coarse aggregate for fine concrete shall be (4/10) single sized aggregate complying with BS EN 12620. All aggregates shall have the same thermal properties as the aggregate in the original concrete, and match other properties as closely as possible. Filler and aggregate for resin mortars shall be pre-packed in the correct proportions and mixed with the resin all in accordance with the manufacturer's instructions.~~
- ~~3 The proportions of cement, admixtures, additives to water and aggregates shall be sufficient to provide high early strength mortar or fine concrete or concrete complying with C32/40. For cement mortar the sand (i.e. fine aggregate) to cement ratio shall not be greater than 3. For resin mortar the sand content shall be in accordance with the manufacturer's requirements in the range between 7 and 11 to 1 of resin. High early strength concrete shall be able to achieve 25 N/mm² in less than 48 hours. For thin bonded repairs using high early strength concrete less than 30 mm depth, air entrainment is not required.~~

Procedure

- ~~4 Mark out the area to be rectified parallel and perpendicular to the axis of the road. Cut a groove around the perimeter at least 10 mm deep without overcutting into the adjacent slab. Carefully cut out the concrete to the required depth, with a vertical face without undercutting the adjacent slab.~~

- ~~5 If a joint is included in the area to be rectified, fix a groove former or corkseal along the line of the joint by chasing out a groove. For joints on the perimeter fix the groove former or corkseal by adhesive to the adjacent slab.~~
- ~~6 For cementitious repairs, wet the area of the patch. Keep it wet until the repair material is ready to be placed. Remove excess water, prime the surfaces with cement grout or bonding agent, spread the repair material immediately before the primed surface is dry, with sufficient surcharge. Thoroughly compact it by vibration ensuring full compaction at the edges and corners.~~
- ~~7 Retexture the surface to match the surrounding concrete and cure in accordance with the following requirements.~~
 - ~~• Immediately after the surface treatment described above, the surface and exposed edges of surface slabs shall be cured for a minimum period of 7 days, by the application of an approved resin based aluminised curing compound, or polythene sheeting or an approved sprayed plastic film which hardens into a peelable plastic sheet and which shall be removed before road marking and opening to traffic. Where the concrete is to receive a thin surfacing overlay, the surface and exposed edges shall be cured for a minimum of 7 days by the application of a curing agent which is compatible with the bond coat specified on the British Board of Agrément HAPAS Roads and Bridges Certificate for the thin surfacing.~~
 - ~~• Resin based aluminised curing compound shall contain sufficient flake aluminium in finely divided dispersion to produce a complete coverage of the sprayed surface with a metallic finish. The compound shall become stable and impervious to evaporation of water from the concrete surface within 60 minutes of application and shall have an efficiency index of 90% when tested as described in BS 7542.~~
 - ~~• The curing compound shall not react chemically with the concrete to be cured and shall not crack, peel or disintegrate within three weeks after application.~~
 - ~~• Prior to application, the contents of any containers shall be thoroughly agitated. The curing compound shall be mechanically applied using a fine spray on to the surface at a rate of at least 0.22 l/m². For the sides of slip formed slabs or when the side forms are removed within 24 hours and for small areas where mechanical application cannot be used, the compound shall be sprayed by hand lance at a rate of at least 0.27 l/m². The rate of spread shall be checked during construction of each trial length and for each 1000 m² of treated slab.~~
 - ~~• The mechanical sprayer shall incorporate an efficient mechanical device for continuous agitation and mixing of the compound in its container during spraying.~~
 - ~~• Continuously reinforced concrete bases shall be cured in accordance with this clause. Immediately prior to laying the bituminous surfacing or upper base, a cationic bituminous tack coat shall be applied in accordance with BS 594987:2010 at a rate between 0.35 l/m² to 0.55 l/m².~~
 - ~~• To achieve high early strength for early use by vehicles, insulation blankets for accelerated curing shall be closed cell polyethylene foam sheets, minimum 40 mm thick with a 'U' value of 4 watts/mC (or K value of 0.04 watts/m Kelvin) or suitable material with an equivalent or lower thermal conductivity. They shall be sufficiently robust and capable of being held in place against variations in wind~~

and weather conditions for the necessary curing time. Strength testing shall be undertaken as directed by the Project Manager.

8. For resin mortar repairs, ensure the area is dry before application of the primer. Place the repair material within the time allowed by the manufacturer for the primer, and compact it well into the edges to the patch. Apply a brush texture to match the original.

Retexturing of hardened concrete shall be carried out by sawing grooves as follows.

- Inadequately textured surface slabs shall be macro textured by sawing grooves in the hardened concrete surface at right angles to the longitudinal axis of the pavement with machines using diamond or other abrasive cutting discs.
- Grooves shall be irregularly spaced and shall be not less than 2 mm and not more than 5 mm wide. The sequence of distances between groove centres in mm shall be: 40, 45, 35, 45, 35, 50, 30, 55, 35, 30, 50, 30, 45, 50, 30, 55, 50, 40, 35, 45, 50, 40, 55, 30, 40, 55, 35, 55. A tolerance of ± 3 mm shall be allowed on each of the spacings. The minimum width of grooving head shall be 500 mm and a head not providing a complete sequence of spacings shall use the number of spacings appropriate to its width commencing at the start of the sequence. Groove depths shall be measured using a tyre tread depth gauge and measurements shall be taken as follows:
 - a. At 10 locations at least 2 m apart along a diagonal line across a lane width between points 50 m apart longitudinally. No measurement shall be taken within 300 mm of the longitudinal edge of a slab.
 - b. At each of the 10 locations the depth of 10 adjacent grooves shall be measured.
 - c. Where a grooved area is less than 50 m in length the locations where measurements are taken shall be as (i) but the number shall be proportional to the requirements for 50 m.
 - d. The average of each set of 10 measurements shall be not less than 3 mm, nor greater than 7 mm.
- Slurry from the sawing process shall be prevented from flowing into joints, drains or into lanes being used by traffic, and all resultant debris from the grooving shall be removed.

Texturing of replaced surfaces shall be by brushing in accordance with the Specification. Where the slab cannot be rectified as above, the full depth of slab shall be removed and replaced with a slab constructed as directed by the Project Manager to the extent required to obtain compliance with the Specification. Remedial works involving the placing of fresh concrete shall be completed in sufficient time for the concrete strength to have developed before that section of pavement is opened to traffic as required immediately below and as directed by the Project Manager.

- Concrete slabs may be used by traffic when the cube compressive strength is assessed to have reached 25 N/mm² for pavement surface slabs, or 20 N/mm² for bases with asphalt surfacing.

- Sampling and testing for, and compliance with the specified characteristic core strength of designed concretes shall be undertaken by compressive strength testing in accordance with BS EN 13877-2 on cores cut from the full depth of the slab. No correction for maturity shall be applied to the 7 day or 28 day strength.
- Concrete cores of the appropriate size shall be taken, cured and tested in accordance with BS EN 12504-1 with the exception that the core shall be cured under water at $20^{\circ}\text{C} \pm 2^{\circ}\text{C}$ from as soon as practically possible. The sampling rate shall be as designated in BS EN 13877-2 for Category 2, three cores shall be taken from areas of concrete of up to 3000 m² and one additional core for every further 1000 m² of concrete laid.

7.3.12 USE OF SURFACES BY CONSTRUCTION TRAFFIC

Construction traffic used on pavements under construction shall be suitable in relation to the thickness of the courses it traverses so that damage is not caused to the sub-grade or the material already constructed. The traffic type is to be agreed by the Project Manager.

The wheels or tracks of plant moving over the various pavement courses shall be kept free from deleterious materials.

Bituminous material shall be kept clean and uncontaminated for so long as it remains uncovered by succeeding layers or surface treatment. The only traffic permitted access to the binder course material shall be that engaged in laying and compacting the surface course or, where the binder course is to be blinded and/or surface dressed that engaged on such surface treatment. Should the binder course become contaminated, the Contractor shall make good by cleaning it to the satisfaction of the Project Manager and if this proves impracticable, by removing the layer and replacing it to specification.

Base material used as a temporary surface shall be cleaned and treated with a tack coat before applying any subsequent layers.

7.3.13 ROAD MARKINGS

Road markings shall be white or yellow continuous or intermittent lines, letters or figures laid to the dimensions laid down in the Contract and consisting of one of the materials specified in Section 7.2.

Thermoplastic material shall be laid to thickness not exceeding 6mm and where it is to be reflectorised the relevant clauses of BS 3262: Part 3:1989, BS 6088 and BS EN 1423:1998 shall apply. A primer shall be used where applied to concrete surfaces.

Paint shall be applied without the use of thinners or additives. Where required to be reflectorised it shall be applied at a rate of not less than 0.55kg/m². All lines shall be applied by approved mechanical means and only on a surface which is clean and dry. The lines shall be laid to a regular alignment.

8. SURFACE CAR PARKS

8.1 GENERAL

Refer to Section 3 for the general items:

8.1.1 SETTING OUT

Site specific settings out requirements are as follows:

Details are to be provided by Architect.

8.2 MATERIALS

8.2.1 PROHIBITED MATERIALS

The following materials shall not be specified or employed in the works:

- (i) Calcium chloride additives
- (ii) High alumina cement
- (iii) Woodwool permanent formwork
- (iv) Asbestos
- (v) Biodegradable void formers
- (vi) Urea formaldehyde
- (vii) Calcium silicate bricks
- (viii) Any materials that are in anyway detrimental to the life or construction of the works or any part of it.

8.2.2 CAPPING AND SUB-BASE MATERIAL

Capping material shall be 6F1 selected granular material, having a CBR exceeding 15%, consisting of any crushed material other than unburnt colliery material and complying with the BS grading in Table A listed below.

Sub-Base material shall be Type 1 granular material, having a CBR exceeding 30%, comprising crushed rock, crushed slag, crushed concrete or well-burnt non-plastic shale and may contain up to 12.5% by mass of natural sand that passes the 5mm BS sieve. The material shall be well graded and lie within the following grading limits as listed in Table B.

TABLE A		6F1 GRADING REQUIREMENT		
BS SIEVE SIZE (mm)		PERCENTAGE PASSING	%	BY MASS
75 mm		100		
37.5 mm		75 – 100		
10 mm		40 – 95		
5 mm		30 – 85		
600 microns		0 – 25		

63 microns	<15
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TABLE B	TYPE 1 RANGE OF GRADING
BS SIEVE SIZE (mm)	PERCENTAGE % BY MASS PASSING
75 mm	100
37.5 mm	85 – 100
20 mm	60 – 100
10 mm	40 – 70
5 mm	25 – 45
600 microns	8 – 22
63 microns	0 – 10

8.2.3 TESTING REQUIREMENTS

- A i. The Contractor shall, at least 7 working days before commencement of importation of the 6F1 and Type 1 material, submit to the Construction or Project Manager for approval in accordance with the following.

- (a) Grading
- (b) Uniform coefficient
- (c) Moisture content
- (d) Moisture condition value (MCV)
- (e) Plasticity Index

Materials having a soluble sulphate content exceeding 2.5g per litre when tested in accordance with Test 10 of BS 1377 shall be classed as unacceptable materials.

- ii. The values of maximum dry density and the optimum moisture content for these materials obtained in accordance with BS 1377 Test 12 and 14 as appropriate, for each type and source of material.
- iii. The Contractor may at any time be required to carry out comparative Field Density Tests determined in accordance with BS 1377 Part 9: 1990 on material that is considered to have been inadequately compacted. If the test results, when compared with the result of similar tests made on adjacent approved work in similar materials, shows the state of compaction to be inadequate, or if the test results when compared with the density obtained by a single compaction test carried out on the same material at natural moisture content by the method described in BS 1377 Part 4: 1990 is shown to be less than 95%, and this is held to be due to failure of the Contractor to comply with the requirements of the Contract, the Contractor shall carry out such further work as may be decided is required to comply with the terms of the Contract.
- iv. The Contractor may after completion of the fill compaction be required to carry out Plate Bearing Tests. In the positions designated by the Construction Project Manager. The results shall be documented in the form of a load/settlement curve and issued to the Construction Project Manager within 48 hours of the completion of the test. A C.B.R. value shall be given for each test performed.

- B The minimum frequency of testing to be carried out by the Contractor is as follows:-

Material Class	Type of Test	Relevant Standard	Rate of Testing
6F1	Grading	BS 1377	Source approval and two per week per source
	Uniformity Coefficient	BS 892	Source approval and one per week per source
	10% Fines Value	BS 812	Source approval and one per week per source
	Mc	BS 1377	Two per day per source
	Plate Bearing Test (C.B.R.)	BS 1377	One per 250 sq. m.
Type 1	Grading	BS 1377	Source approval and two per week per source
	Optimum Mc	BS 1377	Source approval and one per week per source
	Mc	BS 1377	Two per day per source
	10% Fines Value	BS 812	Source approval and one per week per source
	Soundness	BS 812	Source approval and one per week per source
	Plasticity Index	BS 1377	Source approval and one per week per source
	Plate Bearing Test (C.B.R.)	BS 1377	One per 250 sq. m.

C Requirements for Testing and Acceptable Limits

The following tests are required to classify and determine the acceptability of earthworks materials. Each class shall only comprise material with properties within the acceptability limits prescribed below:-

Class	Property	Defined and tested in accordance with	Acceptable limits within	
			LOWER	UPPER
6F1	Grading	BS 1377 Part 2	Table A	Table A
	Optimum mc	BS 1377 Part 4	-	-
	Moisture Content	BS 1377 Part 2	Optimum mc minus 2%	Optimum mc
	10% Fines Value	BS 812 Part 3*	30 kN	-
TYPE1	Grading	BS 1377 Part 2	Table B	Table B
	Optimum mc	BS 1377 Part 4	-	-
	Moisture Content	BS 1377 Part 2	Optimum mc minus 2%	Optimum mc
	Soundness	BS 812	65	-

Class	Property	Defined and tested in accordance with	Acceptable limits within	
			LOWER	UPPER
	Plasticity Index	BS 1377 Part 2	non - plastic(a)	non -plastic(a)
	10% Fines Value	BS 812 Part 3*	50 kN	-

Samples shall be tested in a saturated and surface dried condition. Before testing, the selected test portions shall be soaked in water at room temperature for 24 hours without previously having been oven dried.

8.2.4 SUB-BASE AND BASE

- (i) Material specified within 450 mm of the surface of the road shall not be frost susceptible as determined by the test described in the Transport and Road Research Laboratory LR90 and Supplementary Report No. 318. (The material shall be deemed to be frost susceptible if in the test the heave is greater than 13 mm).
- (ii) Temporary thickening. Where the Contractor proposes to use the sub-base for traversing by vehicles or plant he shall increase where necessary the thickness and/or strength of the sub-base to accommodate the method of construction and the type of plant and vehicles that he proposes to use to avoid damage to the sub-base or the subgrade. Any permanent thickening shall be to the approval of the Project Manager and extend across the whole width of the pavement, unless otherwise agreed.

8.2.5 BASE – DENSE ASPHALT CONCRETE

The material shall comply with BS EN 13108 Part 1: 2007 for 32mm nominal size crushed rock with 50 pen binder.

8.2.6 BINDER COURSE – DENSE ASPHALT CONCRETE

The material shall comply with BS EN 13108 Part 1: 2007 for 20 mm nominal size with 100 pen binder. The aggregate shall consist of hard, clean durable rock, or blast furnace slag.

8.2.7 SURFACE COURSE – CLOSE GRADED ASPHALT CONCRETE

The material shall comply with BS EN 13108 Part1: 2007, for 10mm nominal size crushed rock.

The surface of the material shall have a minimum PSV value of 55 or as instructed by the Project Manager.

8.2.8 BITUMINOUS EMULSION TACK COAT

Bituminous emulsion tack coat shall be in accordance with BS 434 Class A 1-40.

Rate of Application: 4.5 l/m².

8.2.9 ROAD MARKING MATERIALS

Road marking materials shall be:

- (i) Thermoplastic material in accordance with BS 3262: Part 1 or Part 2,
- or
- (ii) Road marking paint. It shall be suitable for applying by brush or mechanical means to concrete or bituminous pavement to give a chemically stable film of uniform thickness.

Where required to be reflectorised, the relevant clauses of BS 3262: Part 1 shall apply.

The material shall be white or yellow as described in the Contract. Yellow paint shall be standard colour to BS 381C No. 355.

8.2.10 DUCTING

Ducts for cables shall be laid in the positions shown on drawings or where directed by the Project Manager with not less than 600mm cover. Unless otherwise directed, ducts shall be laid to project 1m beyond the edge of the carriageway.

Ducts shall be constructed using clay or synthetic material pipes complying with the following table and of a diameter indicated on the drawing. They shall be provided with a draw-wire cord of not less than 3mm diameter secured to a toggle or cross-piece to prevent accidental withdrawal. All duct ends shall be plugged with a wooden plug.

TYPE	BS
Vitrified Clay	BS 65:1991 or BS EN 295 Parts 1 and 3:1991
Unplasticised	BS 4660:2000, BS EN 1401-1:1998 and BS EN 13598-1:2003 or BS 5481:1977 for Building Regulations.

8.2.11 REGULATING COURSE

Regulating course material, if required, shall be made from a fine aggregate material in accordance with either BS EN 13108: 2007 Part 1 and laid to a maximum depth of 40mm in accordance with the requirements for one of the binder course or road course base materials in this Specification as described in the Contract.

8.3 WORKMANSHIP

8.3.1 EXCAVATIONS

When formation/sub-formation level has been reached, the sub-grade shall be inspected and further excavation carried out to remove any soft spots. These shall be filled with General

Backfill Type 6F1 or as directed by the Project Manager and the whole compacted with one pass of a 3000kg vibrating roller.

The capping/extra sub-base required where the ground is weak or frost susceptible, shall be Granular Sub-Base Material, or 6F1 and shall be compacted in layers not exceeding 225 thick with four passes of a 3000kg vibrating roller. The sub-grade shall not be left exposed to the weather.

8.3.2 GRANULAR BASE/SUB-BASE MATERIALS

Granular base and sub-base materials shall be thoroughly compacted in uniform layers to a depth as indicated on the drawings in accordance with the following table.

Type of compaction plant	Category	Number of passes for layers not exceeding the following compacted thicknesses	
		150mm	250mm
Smooth-wheeled roller (or vibratory roller operating without vibration)	Mass per metre width of roll: (or vibratory roller 1 Over 2100 kg up to 2700 kg Over 2700 kg up to 5400 kg Over 5400 kg	Unsuitable Unsuitable 12	Unsuitable Unsuitable Unsuitable
Pneumatic-tyred roller	Mass per wheel: Over 1000 kg up to 1500 kg Over 1500 kg up to 2000 kg Over 2000 kg up to 2500 kg Over 2500 kg up to 4000 kg Over 4000 kg up to 6000 kg Over 6000 kg up to 8000 kg Over 8000 kg up to 12000 kg Over 12000 kg	Unsuitable 12 6 5 4 Unsuitable Unsuitable Unsuitable	Unsuitable Unsuitable Unsuitable Unsuitable 16 8 4 4
Vibratory roller	Mass per metre width of vibrating roller: Over 270 kg up to 450 kg Over 450 kg up to 700 kg Over 700 kg up to 1300 kg Over 1300 kg up to 1800 Over 1800 kg up to 2300 kg 12 Over 2300 kg up to 2900 kg 10 Over 2900 kg up to 3600 kg 10 Over 3600 kg up to 4300 kg Over 4300 kg up to 5000 kg Over 5000 kg	Unsuitable Unsuitable Unsuitable Unsuitable 12 10 10 8 8 6	Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable 12
Vibrating-plate compactor	Mass per square metre of base plate: Over 880 kg up to 1100 kg Over 1100 kg up to 1200 Over 1200 kg up to 1400 kg Over 1400 kg up to 1800 kg Over 1800 kg up to 2100 kg Over 2100 kg	Unsuitable Unsuitable 10 8 6	Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable
Vibro-tamper	Mass: Over 50 kg up to 65 kg Over 65 kg up to 75 kg Over 75 kg up to 100 kg Over 100 kg	Unsuitable Unsuitable Unsuitable 8	Unsuitable Unsuitable Unsuitable Unsuitable

Power rammer	Mass: 100 kg up to 500 kg 8 Over 500 kg	8 6	Unsuitable 10
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8.3.3 DENSE ASPHALT CONCRETE BASE

Shall be laid with a mechanical spreader/compacter at a temperature complying with Table 3 of BS 594987: 2007, and rolled with an 8/10 tonne smooth wheeled roller or a vibrating roller giving the same effective compaction, to the compacted thicknesses, profile and levels shown on the drawings.

8.3.4 DENSE ASPHALT CONCRETE BINDER COURSE

Shall be laid with a mechanical spreader/compacter and rolled with an 8/10 tonne smooth wheeled roller or a vibrating roller achieving the same compaction to a compacted thickness and to the profile and levels shown on the drawings. Hand laying may be permitted by the Project Manager in small and irregular areas of surfacing.

8.3.5 SURFACE COURSE

(i) Close and medium graded asphalt concrete

The binder course, if shall be thoroughly cleaned and then sprayed with Bitumen Emulsion at a rate of 4.5 l/m². The surface course shall be laid with a mechanical spreader/compacter and rolled with an 8/10 tonne smooth wheeled roller or a vibrating roller giving an equivalent compaction to the compacted thickness on carriageway to the finished levels and profile shown on the approved drawings. Where a vibrating roller is used, the final passes shall be with the roller in non-vibrating mode.

Any joints in the surfacing shall be cut back to a vertical line and the vertical face coated with hot bitumen before the laying proceeds. Hand laying may be permitted by the Project Manager in small and irregular areas of surfacing.

(ii) Hot Rolled Asphalt

The binder course, if it has been used by vehicular traffic or where required by the Project Manager, shall be thoroughly cleaned and then sprayed with Bitumen Emulsion at a rate of 4.5 l/m².

The surface course shall be laid in accordance with BS 594987 Section 9.5.2 and compacted with a 3000kg tandem vibrating roller to the thickness, profile and levels shown on the approved drawings. The final passes of the roller shall be in non-vibrating mode.

8.3.6 CARRIAGEWAY LEVEL

Before the surface course is laid, all covers, boxes, etc., shall be accurately set to the correct level and crossfalls.

8.3.7 ALIGNMENTS

Horizontal alignments shall be determined from the centre line of the carriageway pavement surface as shown on the drawings. The edge of the carriageway as constructed and all other parallel alignments shall be correct within a tolerance of +13 mm therefrom.

Kerbs shall be laid to give a smooth and even line in both plan and elevation within a tolerance of +3 mm. Any unit out of tolerance shall be re-laid.

The levels of pavement courses shall be determined from the true finished road surface calculated from the vertical profile and crossfalls as shown on the Drawings. The vertical depth below the true pavement surface of any point on the constructed surface of the formation or pavement courses shall be within the appropriate tolerances stated in Table A.

The surface level of the pavement at any point shall not deviate vertically from the true finished road surface by more than +6 mm.

However the combination of permitted tolerances in different pavement levels shall not result in a reduction of the surface course thickness by more than 5 mm from that specified for a flexible road nor a reduction in the thickness of the whole pavement, excluding the sub-base, by more than 15 mm from the specified thickness.

For checking compliance with Table A measurements of surface levels shall be taken at points to be selected by the Project Manager at 10 m centres longitudinally and at 2m centres transversely. At junctions the grid point spacings shall be as described in the Contract.

In any length of pavement, compliance with the requirements of Table A shall be regarded as met when not more than one measurement in any consecutive ten longitudinally or one in any transverse line, exceeds the tolerances permitted, but this one measurement shall not exceed 5mm more than the tolerance for the layer concerned.

TABLE A: TOLERANCES IN SURFACE LEVELS OF PAVEMENT COURSES AND THE FORMATION

Surface Course	
General	± 6 mm
Adjacent to a surface water channel*	+10mm - 0 mm
Binder Course*	± 6 mm
Base*	±15 mm
Sub-base under concrete pavement surface slabs laid full thickness in one operation by machines with surface compaction	±10 mm
Sub-bases other than above	+10mm - 30 mm
Formation	+20 mm - 30 mm

* Where a surface water channel is laid before the adjacent road pavement layer the top of that layer, measured from the top of the adjacent edge of the surface water channel, shall be to the tolerances given in Table A.

8.3.8 SURFACE REGULARITY:

The longitudinal regularity of the surface courses, binder courses and concrete slabs shall be within the relevant tolerances stated in Table B.

An irregularity is a variation not less than 4 mm, no more than 7 mm of the profile of the road surface as measured by the rolling straight edge, set at 4 mm or 7 mm as appropriate. No irregularity exceeding 10 mm shall be permitted.

Compliance with Table B shall be tested for all lengths of sub-bases, surface courses and binder courses. The surfaces shall be tested, where necessary, at points decided by the Project Manager, with a straight edge of 3 m length placed parallel with or at right angles to the centre line of the road.

The maximum allowable deviation of the surface below the straight edge shall be:

For pavement surfacing: 3 mm
For binder course surfacing: 6 mm

TABLE B: MAXIMUM PERMITTED NUMBER OF SURFACE IRREGULARITIES

	Surfaces of each lane of carriageway for each irregularity limit				Surfaces of each lane of bituminous binder courses for carriageway for each irregularity limit				Surfaces of lay-bys, service areas, and associated bituminous binder courses for each irregularity limit			
Irregularity Limits	4mm	7mm			4 mm	7 mm			4 mm	7 mm		
Length (m)	300	75	300	75	300	75	300	75	300	75	300	75
Pavements 7.3m in width and less	40	18	4	2	60	27	6	3	60	27	6	3

8.3.9 RECTIFICATION:

Where any tolerance is exceeded the Contractor shall make good the surface of the pavement course or formation in the manner described below:

- (i) **Formation Level**
If the surface is too high it shall be re-trimmed and re-compacted in accordance with the specification. If the surface is too low the deficiency shall be corrected by the addition of fresh acceptable material of the same classification laid and compacted to Specification, or as otherwise directed by the Project Manager.
- (ii) **Unbound and hydraulically bound materials**
The top 75 mm shall be scarified, reshaped with material added or removed as necessary, and re-compacted. The area treated shall be not less than 20 m long and 2 m wide. For hydraulically bound materials, all rectification shall be completed within 48 hours of the binder being added to the material.
- (iii) **Cement bound sub-bases and bases**
The method of correction shall depend on the period which has elapsed between detection of the error and the time of mixing of the material. If this is less than 4 hours,

the surface shall be scarified to a depth of not less than 50 mm, surplus material removed or freshly mixed material added as necessary, and re-compacted in accordance with the Specification. If the period is 4 hours or more the full depth of the layer shall be removed from the pavement and replaced with material in accordance with the Specification. In either case the area treated shall be at least 5 m long and the full width of the paving laid in one operation. If the Contractor proposes rectification within 7 days of laying he shall comply with the following requirement.

- Construction plant and traffic used on pavements under construction shall be suitable in relation to the material, condition and thickness of the courses it traverses so that damage is not caused to the subgrade or the pavement courses already constructed. The wheels or tracks of plant moving over the various pavement courses shall be kept free from deleterious materials.

Alternatively, for sub-bases under concrete pavements the Contractor may make up low areas to a level within the tolerances of this clause with a 1:4 cement and sand mortar or with an AC4 fine surface course complying with the following:

Fine Graded Asphalt Concrete Surface Course

- 1 Fine graded asphalt concrete (formerly macadam) surface course recipe mixes shall be asphalt concrete conforming to BS EN 13108-1, the detailed requirements of BSI PD 6691 Annex B. The mixture designation shall be one of the following:
 - AC 4 fine surf 160/220.
 - AC 4 fine surf 250/330.

Coarse Aggregate

- 2 To ensure adequate resistance to polishing and abrasion, the coarse aggregate shall have a minimum declared PSV of 60 and a maximum AAV of 16

(iv) Bituminous bases

With coated macadam or asphalt bases, the full depth of the top layer as laid shall be removed and be replaced with fresh material laid and compacted in accordance with the Specification. Any area so treated shall be at least 5 m long and the full width of the paving laid in one operation. Alternatively for low areas in bituminous bases, the Contractor may make up the level with additional binder course material.

(v) Surface courses and binder courses

These shall have the full depth of the course removed and replaced with fresh material laid and compacted in accordance with the Specification. The area rectified shall be the full width of the paving laid in one operation, and at least 5 m long if binder course, or 15 m if surface course. Where the number of surface irregularities exceeds the limits in Table B, the area to be rectified shall be 300 m or 75 m long as appropriate and the full width of the lanes affected, or such lesser length as necessary to make the number of surface irregularities conform with the limits and shall be the full width of the lanes affected.

Checking of the surface course for compliance with this clause shall be carried out as soon as possible after completion of the surfacing and remedial works completed before the road is opened to traffic.

Where the macro-texture depth requirement is not met remedial works shall be carried out as directed by the Project Manager.

8.3.10 USE OF SURFACES BY CONSTRUCTION TRAFFIC

Construction traffic used on pavements under construction shall be suitable in relation to the thickness of the courses it traverses so that damage is not caused to the sub-grade or the material already constructed. The traffic type is to be agreed by the Project Manager.

The wheels or tracks of plant moving over the various pavement courses shall be kept free from deleterious materials.

Bituminous material shall be kept clean and uncontaminated for so long as it remains uncovered by succeeding layers or surface treatment. The only traffic permitted access to the binder course material shall be that engaged in laying and compacting the surface course or, where the binder course is to be blinded and/or surface dressed that engaged on such surface treatment. Should the binder course become contaminated, the Contractor shall make good by cleaning it to the satisfaction of the Project Manager and if this proves impracticable, by removing the layer and replacing it to specification.

Base material used as a temporary surface shall be cleaned and treated with a tack coat before applying any subsequent layers.

8.3.11 ROAD MARKINGS

Road markings shall be white or yellow continuous or intermittent lines, letters or figures laid to the dimensions laid down in the Contract and consisting of one of the materials specified in Section 8.2 of this specification.

Thermoplastic material shall be laid to thickness not exceeding 6mm and where it is to be reflectorised the relevant clauses of BS 3262: Part 3:1989, BS 6088 and BS EN 1423:1998 shall apply. A primer shall be used where applied to concrete surfaces.

Paint shall be applied without the use of thinners or additives. Where required to be reflectorised it shall be applied at a rate of not less than 0.55kg/m². All lines shall be applied by approved mechanical means and only on a surface which is clean and dry. The lines shall be laid to a regular alignment.

9. SERVICE YARDS

9.1 GENERAL

Refer to Section 3 of this specification for the general items:

9.1.1 SETTING OUT

Site specific settings out requirements are as follows:

Setting Out will be provided by Architect.

The service yard shall provide for heavy goods vehicles to deliver goods to the main store, external garden centre and building yard and should include a 30m diameter turning circle. A minimum of 870m² storage / circulation space shall be provided.

A reinforced concrete slab with falls between 1:80 and 1:60 with a soft brushed finish and trowelled edges designed to carry 30KN/m² over the entire area.

Service Yard

The service yard area providing access to the goods doors is to be reinforced concrete paving in a brush finish with trowelled edges to accept heavy goods vehicles and fork lift trucks, all laid to a maximum gradient of 1:60. The pavement design shall be based on use by the heaviest legal HGV's (44 tonnes). A turning circle of 30m in diameter shall be provided within the confines of the Service Yard and shall be clearly marked in yellow thermoplastic paint.

Access Road

Ducts to suit external lighting and fire alarm cabling as described in the duct layout services drawing are to be incorporated. In addition ducts are required across all full height access gates and also to the utility meters for BMS monitoring.

As far as possible this canopy should have no internal columns, all columns should be sited along the wall line or perimeter fence line. The open side of the canopy is to be enclosed with cladding down stand to match the main building to a depth of 2m to prevent light pollution as well as shielding the area from both wind and rain.

In the Service Yard and Access Road access is to be made available from the service yard area to the external Garden Centre for the loading and unloading of goods, giving a minimum 4m wide access route if not immediately adjacent to one another.

Protection against impact damage to the main building and to the garden centre fence shall be provided using Armco or similar approved type barriers where heavy goods vehicles are manoeuvring. These are to be at both the standard height and at 1.3m. The goods door openings and Fire doors/gates within the service yard are to be protected by concrete filled steel bollards appropriately marked with safety markings (2 no per door).

High containment kerbs are to be provided to all Service Routes, these are to be supplied by Brett Landscaping of Loughborough. The full extent of these kerbs is to be agreed with the Project Manager.

The service yard shall include a ramp to the goods doors with dock levellers, the ramp gradient is to be no greater than 1 in 20 and shall normally be a maximum of 1.2m below floor level with an overall length of 25m.

The facility is to incorporate all necessary builders work including drainage, retaining walls and guard rails. Dock levellers, complete with openings, shall be set as a projection from the main building line in accordance with the site layout. These are to include all equipment such as electrically operated door shutters, dock (inflatable) shelters and bumpers, traffic lights, dock levellers etc. as manufactured by an approved supplier. The clear height to cladding bulkhead over the Dock Leveller doors should be 4m minimum, AFFL to allow clear access for the leading edge of Delivery Vehicles.

Protection against impact damage to the main building and to the garden centre fence shall be provided using Armco type barriers where heavy goods vehicles are manoeuvring. The goods door openings and Fire doors/gates within the service yard are to be protected by concrete filled steel bollards (2 no. per door).

9.2 MATERIALS

9.2.1 PROHIBITED MATERIALS

The following materials shall not be specified or employed in the works:

- (i) Calcium chloride additives
- (ii) High alumina cement
- (iii) Woodwool permanent formwork
- (iv) Asbestos
- (v) Biodegradable void formers
- (vi) Urea formaldehyde
- (vii) Calcium silicate bricks
- (viii) Any materials that are in anyway detrimental to the life or construction of the works or any part of it.

9.2.2 CAPPING AND SUB-BASE MATERIAL

Capping material shall be 6F1 selected granular material, having a CBR exceeding 15%, consisting of any crushed material other than unburnt colliery material and complying with the BS grading in Table A listed below.

Sub-Base material shall be Type 1 granular material, having a CBR exceeding 30%, comprising crushed rock, crushed slag, crushed concrete or well-burnt non-plastic shale and may contain up to 12.5% by mass of natural sand that passes the 5mm BS sieve. The material shall be well graded and lie within the following grading limits as listed in Table B.

TABLE A		6F1 GRADING REQUIREMENT		
BS SIEVE SIZE (mm)		PERCENTAGE PASSING	%	BY MASS
75 mm		100		
37.5 mm		75 – 100		
10 mm		40 – 95		
5 mm		30 – 85		
600 microns		0 – 25		
63 microns		<15		

TABLE B		TYPE 1 RANGE OF GRADING	
BS SIEVE SIZE (mm)		PERCENTAGE PASSING	% BY MASS
75 mm		100	
37.5 mm		85 – 100	
20 mm		60 – 100	
10 mm		40 – 70	
5 mm		25 – 45	
600 microns		8 – 22	
63 microns		0 – 10	

9.2.3 TESTING REQUIREMENTS

- A. i. The Contractor shall, at least 7 working days before commencement of importation of the 6F1 and Type 1 material, submit to the Construction or Project Manager for approval in accordance with the following.

- Grading
- Uniform coefficient
- Moisture content
- Moisture condition value (MCV)
- Plasticity Index

Materials having a soluble sulphate content exceeding 2.5g per litre when tested in accordance with Test 10 of BS 1377 shall be classed as unacceptable materials.

- The values of maximum dry density and the optimum moisture content for these materials obtained in accordance with BS 1377 Test 12 and 14 as appropriate, for each type and source of material.
- The Contractor may at any time be required to carry out comparative Field Density Tests determined in accordance with BS 1377 Part 9: 1990 on material that is considered to have been inadequately compacted. If the test results, when compared with the result of similar tests made on adjacent approved work in similar materials, shows the state of compaction to be inadequate, or if the test results when compared with the density obtained by a single compaction test carried out on the same material at natural moisture content by the method described in BS 1377 Part 4: 1990 is shown to be less than 95%, and this is held to be due to failure of the Contractor to comply with the requirements of the Contract, the Contractor shall carry out such further work as may be decided is required to comply with the terms of the Contract.
- The Contractor may after completion of the fill compaction be required to carry out Plate Bearing Tests. In the positions designated by the Construction Project Manager. The results shall be documented in the form of a load/settlement curve and issued to the Construction Project Manager within 48 hours of the completion of the test. A C.B.R. value shall be given for each test performed.

- B. The minimum frequency of testing to be carried out by the Contractor is as follows:-

Material Class	Type of Test	Relevant Standard	Rate of Testing
6F1	Grading	BS 1377	Source approval and two per week per source
	Uniformity Coefficient	BS 892	Source approval and one per week per source

Type 1	10% Fines Value	BS 812	Source approval and one per week per source
	Mc	BS 1377	Two per day per source
	Plate Bearing Test (C.B.R.)	BS 1377	One per 250 sq. m.
	Grading	BS 1377	Source approval and two per week per source
	Optimum Mc	BS 1377	Source approval and one per week per source
	Mc	BS 1377	Two per day per source
	10% Fines Value	BS 812	Source approval and one per week per source
	Soundness	BS 812	Source approval and one per week per source
Type 1	Plasticity Index	BS 1377	Source approval and one per week per source
	Plate Bearing Test (C.B.R.)	BS 1377	One per 250 sq. m.

C. Requirements for Testing and Acceptable Limits

The following tests are required to classify and determine the acceptability of earthworks materials. Each class shall only comprise material with properties within the acceptability limits prescribed below:-

Class	Property	Defined and tested in accordance with	Acceptable limits within	
			LOWER	UPPER
6F1	Grading	BS 1377 Part 2	Table A	Table A
	Optimum mc	BS 1377 Part 4	-	-
	Moisture Content	BS 1377 Part 2	Optimum mc minus 2%	Optimum mc
	10% Fines Value	BS 812 Part 3*	30 kN	-
TYPE1	Grading	BS 1377 Part 2	Table B	Table B
	Optimum mc	BS 1377 Part 4	-	-
	Moisture Content	BS 1377 Part 2	Optimum mc minus 2%	Optimum mc
	Soundness	BS 812	65	-
	Plasticity Index	BS 1377 Part 2	non - plastic(a)	non -plastic(a)
	10% Fines Value	BS 812 Part 3*	50 kN	-

Samples shall be tested in a saturated and surface dried condition. Before testing, the selected test portions shall be soaked in water at room temperature for 24 hours without previously having been oven dried.

9.2.4 SUB-BASE

- (i) Material specified within 450 mm of the surface of the road shall not be frost susceptible as determined by the test described in the Transport and Road Research Laboratory LR90 and Supplementary Report No. 318. (The material shall be deemed to be frost susceptible if in the test the heave is greater than 13 mm).
- (ii) Temporary thickening. Where the Contractor proposes to use the sub-base for traversing by vehicles or plant he shall increase where necessary the thickness and/or strength of the sub-base to accommodate the method of construction and the type of plant and vehicles that he proposes to use to avoid damage to the sub-base or the subgrade. Any permanent thickening shall be to the approval of the Project Manager and extend across the whole width of the pavement, unless otherwise agreed.

9.2.5 CONCRETE PAVEMENT

- (i) The concrete strength shall be 50 N/mm² with steel reinforcement top and bottom having 50mm cover.
- (ii) The concrete surface texture depth shall be 2 to 3mm. Aggregate shall be a single size of 20mm and of uniform colour.
- (iii) Concrete shall be to the class shown on the drawings or as directed by the Project Manager.
- (iv) The weights of reinforcement used shall be in accordance with the drawings or as directed by the Project Manager. The reinforcement materials shall be obtained from a firm holding a valid CARES (or fully equivalent scheme) certificate of approval. Steel fabric reinforcement shall be in accordance with BS EN 100800 and BS 4483 delivered to site in mats free from any permanent set.

9.2.6 DOWEL BARS AND TIE BARS

- (i) Dowel bars for joints in concrete paved roads shall be Grade B500B steel complying with the relevant provisions of Grade B500B steel conforming to BS EN 13877-3 and they shall be free from oil, paint, other than bond breaking compound, dirt, loose rust and scale.

For expansion joints, dowel bars shall be 25 mm diameter at 300 mm spacing and 600 mm long for slabs up to 239 mm thick and 32 mm diameter for thicker slabs. A closely fitting cap 100 mm long consisting of waterproofed cardboard or suitable synthetic material shall be placed over one end of each dowel bar. An expansion space 10 mm greater than the thickness of the joint filler board shall be formed between the end of the cap and the end of the dowel bar.

For contraction joints, dowels shall be 20 mm diameter at 300 mm spacing and 400 mm long for slabs up to 239 mm thick, and 25 mm diameter at 300 mm spacing and 600 mm long for thicker slabs.

Dowel bars shall be covered by a flexible polymeric corrosion resistant coating, bonded onto the previously cleaned bar. The coating shall be smooth and free of indentations. During coating, the bar shall be supported at each end. Minimum thickness shall be 0.3 mm. The coating shall also be able to withstand 250 hours immersion in a salt fog cabinet complying with BS EN ISO 7253, without showing any visible crazing or corrosion of the protected bar.

For expansion joints, a closely fitting cap 100 mm long consisting of waterproofed cardboard or suitable synthetic material shall be placed over one end of each dowel bar. An expansion space 10 mm greater than the thickness of the joint filler board shall be formed between the end of the cap and the end of the dowel bar.

Dowel bars for contraction or construction joints shall have half their length painted with bond breaking compound.

- (ii) Tie bars for joints in concrete paved roads shall be high Tensile steel complying with the relevant provisions of Grade B500B steel conforming to BS EN 13877-3 and they shall be free from oil, paint, other than bond breaking compound, dirt, loose rust and scale.

9.2.7 BOND BREAKING COMPOUND FOR DOWEL BARS

Bond breaking compound for dowel bars shall consist of a bitumen paint containing 66% of 200 pen. bitumen, blended hot with 14 per cent light creosote oil with the addition, when cold, of 20% solvent naphtha. It shall in no way retard or otherwise affect the setting of concrete.

Concrete shall be clean and prepared according to the manufacturer's recommendations prior to the application of jointing material or as applicable.

9.2.8 JOINT SEALING COMPOUNDS AND SEALANTS

Joint sealing compounds shall be impermeable ductile materials of a type suitable for the conditions of exposure in that they are to be placed and capable of providing durable, flexible and watertight seals by adhesion to the concrete through the range of joint movement.

9.2.9 WATERPROOF MEMBRANE

The waterproof membrane for use under concrete road slabs shall be 0.125mm gauge polythene.

9.2.10 JOINT FILLER

Joint filler for joints in concrete paved roads and paved areas shall be Korkpak by Grace Construction Products or similar approved, to the thicknesses shown on the drawings.

9.2.11 ROAD MARKING MATERIALS

Road marking materials shall be:

- (i) Thermoplastic material in accordance with BS 3262: Part 1 or Part 2,
or
- (ii) Road marking paint. It shall be suitable for applying by brush or mechanical means to concrete or bituminous pavement to give a chemically stable film of uniform thickness.

Where required to be reflectorised, the relevant Clauses of BS 3262: Part 1 shall apply.

The material shall be white or yellow as described in the Contract. Yellow paint shall be standard colour to BS 381C No. 355.

9.2.12 DUCTING

Ducts for cables shall be laid in the positions shown on drawings or where directed by the Project Manager with not less than 600mm cover. Unless otherwise directed, ducts shall be laid to project 1m beyond the edge of the carriageway.

Ducts shall be constructed using clay or synthetic material pipes complying with the following table and of a diameter indicated on the drawing. They shall be provided with a draw-wire cord of not less than 3mm diameter secured to a toggle or cross-piece to prevent accidental withdrawal. All duct ends shall be plugged with a wooden plug.

TYPE	BS
Vitrified Clay	BS 65:1991 or BS EN 295 Parts 1 and 3:1991
Unplasticised	BS 4660:2000, BS EN 1401-1:1998 and BS EN 13598-1:2003 or BS 5481:1977 for Building Regulations.

9.2.13 TRIEF KERBS

Where specified on the drawings, Trief kerbs shall be supplied from Brett Landscaping of Loughborough. Alternative suppliers shall only be approved if the dimensions and profile of the kerbs are identical to those kerbs supplied by Brett Landscaping.

9.2.14 PROTECTION TO COLUMNS

Protection to columns shall be as defined in the Contract or as follows:

- (i) The cosmetic protection of corners of reinforced concrete columns shall be either cast into the concrete or fixed externally as approved by the Project Manager.
- (ii) Overall protection of columns from impact shall be by stand-alone systems which do not use the columns for structural support. Proprietary systems may only be used if approved by the Project Manager.

9.3 WORKMANSHIP

9.3.1 EXCAVATIONS

When formation/sub-formation level has been reached, the sub-grade shall be inspected and further excavation carried out to remove any soft spots. These shall be filled with General Backfill as Clause Type 6F1 or as directed by the Project Manager and the whole compacted with one pass of a 3000kg vibrating roller.

The capping/extra sub-base required where the ground is weak or frost susceptible, shall be Granular Sub-Base Material, or 6F1 and shall be compacted in layers not exceeding 225 thick with four passes of a 3000kg vibrating roller. The sub-grade shall not be left exposed to the weather.

9.3.2 GRANULAR BASE/SUB-BASE MATERIALS

Granular base and sub-base materials shall be thoroughly compacted in uniform layers to a depth as indicated on the drawings in accordance with the following table.

Type of compaction plant	Category	Number of passes for layers not exceeding the following compacted thicknesses	
		150mm	250mm
Smooth-wheeled roller (or vibratory roller operating without vibration)	Mass per metre width of roll: (or vibratory roller 1 Over 2100 kg up to 2700 kg Over 2700 kg up to 5400 kg Over 5400 kg	Unsuitable Unsuitable 12	Unsuitable Unsuitable Unsuitable
Pneumatic-tyred roller	Mass per wheel: Over 1000 kg up to 1500 kg Over 1500 kg up to 2000 kg Over 2000 kg up to 2500 kg Over 2500 kg up to 4000 kg Over 4000 kg up to 6000 kg Over 6000 kg up to 8000 kg Over 8000 kg up to 12000 kg Over 12000 kg	Unsuitable 12 6 5 4 Unsuitable Unsuitable Unsuitable	Unsuitable Unsuitable Unsuitable Unsuitable 16 8 4 4
Vibratory roller	Mass per metre width of vibrating roller: Over 270 kg up to 450 kg Over 450 kg up to 700 kg Over 700 kg up to 1300 kg Over 1300 kg up to 1800 Over 1800 kg up to 2300 kg 12 Over 2300 kg up to 2900 kg 10 Over 2900 kg up to 3600 kg 10 Over 3600 kg up to 4300 kg Over 4300 kg up to 5000 kg Over 5000 kg	Unsuitable Unsuitable Unsuitable Unsuitable 12 10 10 8 8 6	Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable 12
Vibrating-plate compactor	Mass per square metre of base plate: Over 880 kg up to 1100 kg Over 1100 kg up to 1200 Over 1200 kg up to 1400 kg Over 1400 kg up to 1800 kg Over 1800 kg up to 2100 kg Over 2100 kg	Unsuitable Unsuitable 10 8 6	Unsuitable Unsuitable Unsuitable Unsuitable Unsuitable

Vibro-tamper	Mass: Over 50 kg up to 65 kg Over 65 kg up to 75 kg Over 75 kg up to 100 kg Over 100 kg	Unsuitable Unsuitable Unsuitable 8	Unsuitable Unsuitable Unsuitable Unsuitable
Power rammer	Mass: 100 kg up to 500 kg 8 Over 500 kg	8 6	Unsuitable 10

9.3.4 CONCRETE PAVEMENT

(i) Pavements

All reinforcement shall be free from loose rust, scale, oil or other harmful substances and shall be placed so as to have 60mm top cover and 40mm side cover.

All reinforcement shall be lapped to give full strength tension laps. At transverse laps the first transverse wire of one mat shall lie within the last complete mesh of the previous mat. The minimum lap shall be 300mm.

Reinforcement shall be cut and bent in accordance with BS 8666. Re-bending of carbon steel bars and fabric reinforcement on site shall not be permitted.

(ii) Transverse Joints

Details of expansion, contraction and longitudinal joints are shown on the drawing. Transverse joints at road junctions, turning areas, etc., shall be so positioned as to give approximately square corners to all bays, i.e., to avoid acutely pointed corners.

A plan showing the proposed layout of joints shall be submitted for approval by the Project Manager.

Transverse joints shall be provided at intervals not exceeding 25m. Every third joint shall be an expansion joint, the remainder being contraction joints.

(iii) Longitudinal Joints

Longitudinal joints shall be provided in all carriageways of 4.5m or greater width.

(iv) Treatment at Manholes and Gullies

1. Manhole covers, gullies and their frames shall be isolated from the main pavement slab and be housed in separate slabs. The slabs shall be larger than the exterior of the manhole shafts and any concrete surround if the top of the shaft is less than 150mm below the bottom of the concrete pavement.
2. The position of manholes, gullies and joints in the concrete pavement shall be adjusted relative to each other so that the manhole and gully slabs shall be adjacent to a joint or the edge of the slab, or alternatively lie within the middle third of the slab. When this is not possible, reinforcement must be included around the gully or manhole recess.

3. Manholes and gully recesses shall be formed by casting the main slab against formwork boxes placed and fixed accurately and vertically. The formwork shall be removed where the concrete around the manhole or gully cover is to be placed and preformed joint filler 20mm thick fixed to the slab edges so exposed.
4. A groove for a seal shall be made directly above the preformed joint filler and sealed as specified.
5. Reinforcement as may be required shall be placed in the agreed position and concrete shall be placed by hand in the space between the main slab and the manhole or gully frame. This concrete shall meet the strength requirements of this Specification and the mix shall be modified but not by the addition of water alone to permit full compaction by the methods adopted.

(v) Sealing Grooves

Dirt, grit, dust shall be removed from all grooves before sealing. Joints shall then be dried if necessary and sealed with a cold poured, oil resistant sealant to BS 5212 in accordance with the manufacturer's instructions.

(vi) Laying Concrete

Construction of reinforced concrete slabs shall be in two layers. The first layer shall be spread, struck off and compacted to a level so that the reinforcement, when placed, shall have the depth of cover specified. Immediately after placing the reinforcement the top layer of the concrete shall be laid and finished.

- (vii) The Contractor shall submit a method statement and fully-dimensioned drawing describing his method of casting and providing the necessary joints in accordance with this clause and to the requirements of the Project Manager.

9.3.5 TESTING TO BE CARRIED OUT BY THE CONTRACTOR

MATERIAL	TEST	FREQUENCY OF TESTING	TEST CERTIFICATE	COMMENTS
Aggregate for concrete pavements	British Standard 812 Part 121	Source approval	Testing reports required.	
Concrete for road slabs	Cube compression testing	1 set of 3 cubes for each separately cast concrete road slab	Testing reports required.	
Surface texture	Sand patch	1 per day (set of 10)	Testing reports required.	

9.3.6 CARRIAGEWAY

Before the surface course is laid, all covers, boxes, etc., shall be accurately set to the correct level and crossfalls.

9.3.7 ALIGNMENTS

Horizontal alignments shall be determined from the centre line of the carriageway pavement surface as shown on the drawings. The edge of the carriageway as constructed and all other parallel alignments shall be correct within a tolerance of +13 mm therefrom.

Kerbs shall be laid to give a smooth and even line in both plan and elevation within a tolerance of +3 mm. Any unit out of tolerance shall be re-laid.

The levels of pavement courses shall be determined from the true finished road surface calculated from the vertical profile and crossfalls as shown on the Drawings. The vertical depth below the true pavement surface of any point on the constructed surface of the formation or pavement courses shall be within the appropriate tolerances stated in Table A.

The surface level of the pavement at any point shall not deviate vertically from the true finished road surface by more than +6 mm.

However the combination of permitted tolerances in different pavement levels shall not result in a reduction of the surface course thickness by more than 5 mm from that specified for a flexible road nor a reduction in the thickness of the whole pavement, excluding the sub-base, by more than 15 mm from the specified thickness.

For checking compliance with Table A, measurements of surface levels shall be taken at points to be selected by the Project Manager at 10 m centres longitudinally and at 2m centres transversely. At junctions the grid point spacings shall be as described in the Contract.

In any length of pavement, compliance with the requirements of Table A shall be regarded as met when not more than one measurement in any consecutive ten longitudinally or one in any transverse line, exceeds the tolerances permitted, but this one measurement shall not exceed 5mm more than the tolerance for the layer concerned.

TABLE A: TOLERANCES IN SURFACE LEVELS OF PAVEMENT COURSES AND THE FORMATION

Surface Course	
General	± 6 mm
Adjacent to a surface water channel*	+10mm - 0 mm
Binder Course*	± 6 mm
Base*	±15 mm
Sub-base under concrete pavement surface slabs laid full thickness in one operation by machines with surface compaction	±10 mm
Sub-bases other than above	+10mm - 30 mm
Formation	+20 mm - 30 mm

* Where a surface water channel is laid before the adjacent road pavement layer the top of that layer, measured from the top of the adjacent edge of the surface water channel, shall be to the tolerances given in Table A.

9.3.8 SURFACE REGULARITY

The longitudinal regularity of the surface courses, binder courses and concrete slabs shall be within the relevant tolerances stated in Table B.

An irregularity is a variation not less than 4 mm, no more than 7 mm of the profile of the road surface as measured by the rolling straight edge, set at 4 mm or 7 mm as appropriate. No irregularity exceeding 10 mm shall be permitted.

Compliance with Table B shall be tested for all lengths of sub-bases, surface courses and binder courses. The surfaces shall be tested, where necessary, at points decided by the Project Manager, with a straight edge of 3 m length placed parallel with or at right angles to the centre line of the road.

The maximum allowable deviation of the surface below the straight edge shall be:

For pavement surfacing	: 3 mm
For binder course surfacing	: 6 mm

TABLE B: MAXIMUM PERMITTED NUMBER OF SURFACE IRREGULARITIES

Irregularity Limits	Surfaces of each lane of carriageway for each irregularity limit			
	4mm		7mm	
Length (m)	300	75	300	75
Pavements 7.3m in width and less	40	18	4	2

9.3.9 RECTIFICATION

Where any tolerance is exceeded the Contractor shall make good the surface of the pavement course or formation in the manner described below:

- (i) **Formation Level**
If the surface is too high it shall be re-trimmed and re-compacted in accordance with the specification. If the surface is too low the deficiency shall be corrected by the addition of fresh acceptable material of the same classification laid and compacted to Specification, or as otherwise directed by the Project Manager.
- (ii) **Unbound and hydraulically bound materials**
The top 75 mm shall be scarified, reshaped with material added or removed as necessary, and re-compacted. The area treated shall be not less than 20 m long and 2 m wide. For hydraulically bound materials, all rectification shall be completed within 48 hours of the binder being added to the material.
- (iii) **Cement bound sub-bases and bases**
The method of correction shall depend on the period which has elapsed between detection of the error and the time of mixing of the material. If this is less than 4 hours, the surface shall be scarified to a depth of not less than 50 mm, surplus material removed or freshly mixed material added as necessary, and re-compacted in accordance with the Specification. If the period is 4 hours or more the full depth of the layer shall be removed from the pavement and replaced with material in accordance with the Specification. In either case the area treated shall be at least 5 m long and the full width of the paving laid

in one operation. If the Contractor proposes rectification within 7 days of laying he shall comply with the following requirement.

- Construction plant and traffic used on pavements under construction shall be suitable in relation to the material, condition and thickness of the courses it traverses so that damage is not caused to the subgrade or the pavement courses already constructed. The wheels or tracks of plant moving over the various pavement courses shall be kept free from deleterious materials.

Alternatively, for sub-bases under concrete pavements the Contractor may make up low areas to a level within the tolerances of this Clause with a 1:4 cement and sand mortar or with an AC4 fine surface course complying with the following:

(iv) **Concrete slabs**

Concrete slabs shall be rectified by planing, grinding or bump cutting. Large depressions, which cannot be dealt with in this way, shall be rectified by cutting out the surface and replacing by a thin bonded surface repair to the following requirements.

Thin Bonded Repairs Materials

- 1 Cement mortar shall be used for depths less than 20 mm and fine concrete for greater depths. Resin mortar may only be used for small patch repairs less than 1 metre long and less than 30 mm in depth and where insufficient time for adequate curing of a cementitious cement mortar exists.
- 2 (The cements, aggregates, admixtures and water shall comply with Section 3 of this specification. The sand (i.e. fine aggregate) for mortars or fine concrete shall be within the limits of 0/4 (CP), 0/4 (MP), 0/2 (MP) or 0/2 (F/P) of BS EN 12620. Coarse aggregate for fine concrete shall be (4/10) single sized aggregate complying with BS EN 12620. All aggregates shall have the same thermal properties as the aggregate in the original concrete, and match other properties as closely as possible. Filler and aggregate for resin mortars shall be pre-packed in the correct proportions and mixed with the resin all in accordance with the manufacturer's instructions.
- 3 The proportions of cement, admixtures, additives to water and aggregates shall be sufficient to provide high early strength mortar or fine concrete or concrete complying with C32/40. For cement mortar the sand (i.e. fine aggregate) to cement ratio shall not be greater than 3. For resin mortar the sand content shall be in accordance with the manufacturer's requirements in the range between 7 and 11 to 1 of resin. High early strength concrete shall be able to achieve 25 N/mm² in less than 48 hours. For thin bonded repairs using high early strength concrete less than 30 mm depth, air entrainment is not required.

Procedure

- 4 Mark out the area to be rectified parallel and perpendicular to the axis of the road. Cut a groove around the perimeter at least 10 mm deep without overcutting into the adjacent slab. Carefully cut out the concrete to the required depth, with a vertical face without undercutting the adjacent slab.
- 5 If a joint is included in the area to be rectified, fix a groove former or corkseal along the line of the joint by chasing out a groove. For joints on the perimeter fix the groove former or corkseal by adhesive to the adjacent slab.
- 6 For cementitious repairs, wet the area of the patch. Keep it wet until the repair material is ready to be placed. Remove excess water, prime the surfaces with cement grout or bonding agent, spread the repair material immediately before the

primed surface is dry, with sufficient surcharge. Thoroughly compact it by vibration ensuring full compaction at the edges and corners.

- 7 Retexture the surface to match the surrounding concrete and cure in accordance with the following requirements.
 - Immediately after the surface treatment described above, the surface and exposed edges of surface slabs shall be cured for a minimum period of 7 days, by the application of an approved resin based aluminised curing compound, or polythene sheeting or an approved sprayed plastic film which hardens into a peelable plastic sheet and which shall be removed before road marking and opening to traffic. Where the concrete is to receive a thin surfacing overlay, the surface and exposed edges shall be cured for a minimum of 7 days by the application of a curing agent which is compatible with the bond coat specified on the British Board of Agrément HAPAS Roads and Bridges Certificate for the thin surfacing.
 - Resin based aluminised curing compound shall contain sufficient flake aluminium in finely divided dispersion to produce a complete coverage of the sprayed surface with a metallic finish. The compound shall become stable and impervious to evaporation of water from the concrete surface within 60 minutes of application and shall have an efficiency index of 90% when tested as described in BS 7542.
 - The curing compound shall not react chemically with the concrete to be cured and shall not crack, peel or disintegrate within three weeks after application.
 - Prior to application, the contents of any containers shall be thoroughly agitated. The curing compound shall be mechanically applied using a fine spray on to the surface at a rate of at least 0.22 l/m². For the sides of slip-formed slabs or when the side forms are removed within 24 hours and for small areas where mechanical application cannot be used, the compound shall be sprayed by hand lance at a rate of at least 0.27 l/m². The rate of spread shall be checked during construction of each trial length and for each 1000 m² of treated slab.
 - The mechanical sprayer shall incorporate an efficient mechanical device for continuous agitation and mixing of the compound in its container during spraying.
 - Continuously reinforced concrete bases shall be cured in accordance with this Clause. Immediately prior to laying the bituminous surfacing or upper base, a cationic bituminous tack coat shall be applied in accordance with BS 594987:2010 at a rate between 0.35 l/m² to 0.55 l/m².
 - To achieve high early strength for early use by vehicles, insulation blankets for accelerated curing shall be closed cell polyethylene foam sheets, minimum 10 mm thick with a 'U' value of 4 watts/m C (or K value of 0.04 watts/m Kelvin) or acceptable material with an equivalent or lower thermal conductivity. They shall be sufficiently robust and capable of being held in place against variations in wind and weather conditions for the necessary curing time. Strength testing shall be undertaken as directed by the Project Manager.
- 8 For resin mortar repairs, ensure the area is dry before application of the primer. Place the repair material within the time allowed by the manufacturer for the primer, and compact it well into the edges to the patch. Apply a brush texture to match the original.

Retexturing of hardened concrete shall be carried out by sawing grooves shall be carried out by sawing grooves as follows.

- Inadequately textured surface slabs shall be macro textured by sawing grooves in the hardened concrete surface at right angles to the longitudinal axis of the pavement with machines using diamond or other abrasive cutting discs.
- Grooves shall be irregularly spaced and shall be not less than 2 mm and not more than 5 mm wide. The sequence of distances between groove centres in mm shall be: 40, 45, 35, 45, 35, 50, 30, 55, 35, 30, 50, 30, 45, 50, 30, 55, 50, 40, 35, 45, 50, 40, 55, 30, 40, 55, 35, 55. A tolerance of ± 3 mm shall be allowed on each of the spacings. The minimum width of grooving head shall be 500 mm and a head not providing a complete sequence of spacings shall use the number of spacings appropriate to its width commencing at the start of thesequence.3Groove depths shall be measured using a tyre tread depth gauge and measurements shall be taken as follows:
 - 1 At 10 locations at least 2 m apart along a diagonal line across a lane width between points 50 m apart longitudinally. No measurement shall be taken within 300 mm of the longitudinal edge of a slab.
 - 2 At each of the 10 locations the depth of 10adjacent grooves shall be measured.
 - 3 Where a grooved area is less than 50 m in length the locations where measurements are taken shall be as (i) but the number shall be proportional to the requirements for 50 m.
 - 4 The average of each set of 10 measurements shall be not less than 3 mm, nor greater than7 mm.
- Slurry from the sawing process shall be prevented from flowing into joints, drains or into lanes being used by traffic, and all resultant debris from the grooving shall be removed

Texturing of replaced surfaces shall be by brushing in accordance with the Specification. Where the slab cannot be rectified as above, the full depth of slab shall be removed and replaced with a slab constructed as directed by the Project Manager to the extent required to obtain compliance with the Specification. Remedial works involving the placing of fresh concrete shall be completed in sufficient time for the concrete strength to have developed before that section of pavement is opened to traffic as required immediately below and as directed by the Project Manager.

- Concrete slabs may be used by traffic when the cube compressive strength is assessed to have reached 25 N/mm² for pavement surface slabs, or 20 N/mm² for bases with asphalt surfacing.
- Sampling and testing for, and compliance with the specified characteristic core strength of designed concretes shall be undertaken by compressive strength testing in accordance with BS EN 13877-2 on cores cut from the full depth of the slab. No correction for maturity shall be applied to the 7 day or 28 day strength.

Concrete cores of the appropriate size shall be taken, cured and tested in accordance with BS EN 12504-1 with the exception that the core shall be cured under water at 20°C $\pm 2^\circ\text{C}$ from as soon as practically possible. The sampling rate shall be as designated in BS EN 13877-2 for Category 2, three cores shall be taken from areas of concrete of up to 3000 m² and one additional core for every further 1000 m² of concrete laid.

9.3.11 USE OF SURFACES BY CONSTRUCTION TRAFFIC

Construction traffic used on pavements under construction shall be suitable in relation to the thickness of the courses it traverses so that damage is not caused to the sub-grade or the material already constructed. The traffic type is to be agreed by the Project Manager.

The wheels or tracks of plant moving over the various pavement courses shall be kept free from deleterious materials.

Bituminous material shall be kept clean and uncontaminated for so long as it remains uncovered by succeeding layers or surface treatment. The only traffic permitted access to the binder course material shall be that engaged in laying and compacting the surface course or, where the binder course is to be blinded and/or surface dressed that engaged on such surface treatment. Should the binder course become contaminated, the Contractor shall make good by cleaning it to the satisfaction of the Project Manager and if this proves impracticable, by removing the layer and replacing it to specification.

Base material used as a temporary surface shall be cleaned and treated with a tack coat before applying any subsequent layers.

9.3.12 ROAD MARKINGS

Road markings shall be white or yellow continuous or intermittent lines, letters or figures laid to the dimensions laid down in the Contract and consisting of one of the materials specified in Clause 2.29.

Thermoplastic material shall be laid to thickness not exceeding 6mm and where it is to be reflectorised the relevant clauses of BS 3262: Part 3:1989, BS 6088 and BS EN 1423:1998 shall apply. A primer shall be used where applied to concrete surfaces.

Paint shall be applied without the use of thinners or additives. Where required to be reflectorised it shall be applied at a rate of not less than 0.55kg/m². All lines shall be applied by approved mechanical means and only on a surface which is clean and dry. The lines shall be laid to a regular alignment.

9.3.13 TRIEF KERBS

Precast concrete Trief kerbs shall be laid true to line and level within a tolerance of + 3mm or - 3mm. Any unit out of tolerance shall be re-laid. The kerbs shall be laid directly onto a 230mm thick bed of grade ST4 concrete and backed with 230mm wide grade ST4 concrete to within 50 mm of the top of the kerb, or as indicated on the Drawings.

The bed and backing shall be reinforced with A393 as shown on the drawings.

A 2 mm joint shall be left between all units. Where the joint is in excess of 3 mm it must be mortared with a granolithic cement sand mortar.

Not less than 24 hours after completion, the space between the back of the kerb and the face of the excavation shall be filled and rammed. No cut length of kerb shall be less than 0.60 m long.

9.3.14 PROTECTION TO COLUMNS

- (i) The integrity and cover to steel reinforcement in columns shall be maintained whether the cosmetic protection of corners of the columns is to be either cast into the concrete or fixed externally.

10. MISCELLANEOUS

10.1 ~~SPECIALIST CONCRETE~~

10.1.1 ~~GENERAL~~

10.2.3 ~~CONCRETE REPAIRS~~

~~Refer to Waterman Group Specification WP_SPC_011 for patch repairs.~~

~~Refer to Waterman Group Specification WP_SPC_012 for general reinforced concrete repairs.~~

10.2.4 ~~POLYESTER CONCRETE~~

~~A two-part polyester resin-based material suitable for the repair, surfacing, jointing and bedding of concrete, brickwork and masonry shall be as specified on the drawings for the bedding and fixing of precast concrete units, fixing of concrete barrier units, patch repairs to concrete floors, bedding of coping stones and infilling where rapid service use is required.~~

~~Summer and winter grades shall be used as agreed with the Project Manager.~~

10.2 ~~STRUCTURAL STEELWORK~~

~~Refer to Waterman Group Specification WP_SPC_001 Specification for Structural Steelwork.~~

10.3 ~~PILING~~

10.3.1 ~~STEEL SHEET PILING~~

~~Steel sheet piling shall comply with ICE Specification for Piling and Embedded Retaining Walls.~~

~~In general, steel sheet piling whether permanent or temporary shall be driven by vibratory, jacking or box silenced percussion systems or a combination of these methods depending on ground conditions and subject to any requirements of the Contract.~~

~~Where steel sheet piling is to be driven in the vicinity of culverts or sewers, vibrationless methods shall be used as appropriate. Except for box silenced systems, the Project Manager shall permit the use of percussion methods for driving piling only in exceptional circumstances and the Contractor shall state with his Tender his intention to seek the Project Manager's consent to such methods.~~

10.3.2 ~~CONCRETE PILING~~

~~Refer to Waterman Group Specification WP/SPC/011 for concrete piling.~~

10.4 TOPOGRAPHICAL SURVEYS

The survey is to be carried out according to information and drawings provided by the ~~Project Manager or Waterman Infrastructure & Environment [delete as appropriate]~~.

10.4.1 INTRODUCTION

General

~~Surveys shall be carried out with the requirements set out in the Manual of Contract Documents for Highways Works Volume 5 Section 1 Part 2 "Specification for Geodetic Surveying Services".~~

Purpose of this brief

~~The purpose of this document is to specify the survey requirements for topographical, underground services, river channels and also surveys for noise evaluation studies by Waterman Infrastructure & Environment.~~

Definition

~~The "Surveyor" shall mean any third party commissioned to provide survey information. The Company shall mean Waterman Infrastructure & Environment Ltd (WIE). The Client shall mean the person or organisation employing the WIE to procure the survey.~~

Contacts

~~For further information and questions regarding this brief, please contact [enter name] at Waterman Infrastructure & Environment, [enter address]. Telephone [enter number] Fax [enter number] email: [enter name]@waterman-group.co.uk.~~

10.4.2 SCOPE AND PURPOSE OF THE SURVEY

Location

Road Name(s): [enter name]
Area of survey: [enter data]
As shown on drawing number: [WIE ?? ??? ???]

Purpose of the survey

~~The purpose is to carry out a 3 dimensional topographical survey of the area shown on the drawings to include the following: [delete as applicable]~~

- ~~• Establish, locate, and survey a framework of permanent ground markers,~~
- ~~• Survey topographical features in accordance with this section,~~
- ~~• Survey underground services in accordance with this section from: [delete as applicable]~~
 - ~~— Service records~~
 - ~~— On-site visual investigation~~
 - ~~— Route tracing,~~
- ~~• Survey for noise evaluation in accordance with this section,~~
- ~~• Survey of river channel cross sections in accordance with this section,~~
- ~~• Prepare digital drawings in AutoCAD compatible format,~~
- ~~• Prepare hardcopy plans without contours at 1:500 for rural areas or 1:250 for urban areas,~~
- ~~• Prepare a string and point digital file for use with the 12d Model program.~~

Brief description of the survey area

Approximate survey area: [???]m².

Approximate plan dimensions: [???]m East-West by [???]m North-South.

Terrain conditions of the survey area are [.....e.g. steep gradients, fields, wetlands etc.]

Areas of special significance [.....e.g. areas of special scientific interest/areas of contamination etc.]

Use of the survey information

[delete/amend as applicable]

Feasibility study for: alignment/ earthworks/ landscape/ environmental/

Outline engineering and/or landscaping plans.....

To provide information on noise calculations/ ground investigation.....

Detailed engineering design for: highway alignment/ drainage/ earthworks

10.4.3 GENERAL REQUIREMENTS

Health and Safety

All activities carried out by the Surveyor during the course of the survey shall be in accordance with current Health and Safety legislation, in particular:

- The Health and Safety at Work Act, 1974;

and legislation relating to

- the environment;
- public safety and site security;
- working in confined spaces;
- vehicles and site transport;
- working on live roads;
- working over water;
- contaminated ground.

The Surveyor shall make provision to carry out any traffic safety and management requirements necessary to undertake the survey on public roads in accordance with all relevant statutory regulations.

Landowners, Occupiers and Entry

Owners and occupiers of all land covered by the survey will have been notified, by the Company or Client, in writing of the period during which entry is likely to be required and their permission for entry obtained. Notwithstanding the above, the Surveyor shall also notify in writing all occupiers before gaining entry and agree with them all routes and means of access. Where the Surveyor is refused, the Surveyor shall immediately notify the Company.

Detail to be surveyed

The details to be surveyed are listed for various survey types in the following sections of this brief:

Section	Survey Type
10.4.4	SURVEYS OF TOPOGRAPHICAL FEATURES
10.4.5	SURVEYS OF UNDERGROUND SERVICES
10.4.6	SURVEYS FOR NOISE EVALUATION
10.4.7	SURVEYS OF RIVER CHANNELS

All continuous features, such as kerb lines, channels, fences etc., shall be represented by continuous string lines. Isolated items, such as gullies, manholes, road signs etc., shall be represented by a simple block defining its location, level and orientation.

The line or point to be surveyed on a feature shall be at the features intersection with the ground surface. Any building or surface that is in a state of change at the time of survey shall be annotated to this effect, with the boundary of the area of change indicated.

The ground surface shall be surveyed such that any point interpolated from this information shall be within the tolerance specified of the actual ground surface location for the area and type of surface involved. These tolerances are given in section 10.4.8.2 and 10.4.8.3 of this brief.

Presentation

All survey information shall be presented in a format and manner that allows for easy use and which permits additional copies to be made as necessary, excepting any limitations which may be imposed in respect of the copyright of data from third parties.

All final products from the source data shall be supplied on stable media. All products supplied shall be intelligible and usable for the purposes specified.

Drawing Annotation

The following information shall be clearly noted on the drawings:

- Reference, Level and co-ordinates of survey stations,
- Cover level and invert levels of all manholes, inspection chambers, and pits,
- Use of any access chamber (e.g. BT, Foul Sewer, Gas etc.)
- All levels taken (including spot levels and levels along a string e.g. kerb line)

Access

The Surveyor shall conform with all requirements of any private or public utility service company involved so far as access to their plant and facilities is concerned. The Company shall identify those facilities which can be inspected by the Surveyor and those which can only be inspected by the statutory undertaker or private utility company concerned.

10.4.4 SURVEYS OF TOPOGRAPHICAL FEATURES

Details to be surveyed

The following features and details shall be surveyed:

Control Points

- a. Ordnance Survey trigonometric stations
- b. Permanent survey stations
- c. Ordnance Survey benchmarks
- d. Permanent benchmarks

Building/Structures

- a. The plinth (of roof) line of all permanent buildings
- b. Open sides of buildings
- c. Pre-fabricated houses
- d. Hutments, camps
- e. Outbuildings
- f. Garden sheds
- g. Glass houses

- h. ~~Covered passages and archways~~
- i. ~~Internal property divisions between abutting buildings where visible externally~~
- j. ~~Ruins or partially demolished buildings or foundations — by the walls and masonry visible at the time of the survey~~
- k. ~~Names and numbers of all buildings trade premises or plots~~
- l. ~~Buildings under construction~~
- m. ~~Bridges~~
- n. ~~Overhangs and canopies~~

Boundary Features

- a. ~~Fences (noting type and height)~~
- b. ~~Gates~~
- c. ~~Stiles~~
- d. ~~Hedges (showing type, height and width)~~
- e. ~~Walls (showing type, height and width)~~
- f. ~~Boundary markers~~

Roads, Tracks and Footpaths

- a. ~~Kerb line or edge of surfacing to carriageways~~
- b. ~~Top of kerb~~
- c. ~~Tracks and bridle paths~~
- d. ~~Rides and drives~~
- e. ~~Footways~~
- f. ~~Pedestrian Crossings~~
- g. ~~Steps~~
- h. ~~Traffic islands~~
- i. ~~Paths in public grounds~~
- j. ~~Paths in private grounds~~
- k. ~~Tunnels and/or underpasses~~
- l. ~~Changes of paved surface materials~~
- m. ~~Bridges and subways~~

Street Furniture and Visible Service Features (including level, size and orientation)

- a. ~~Call boxes — type identified, e.g. Police, RAC, AA, etc.~~
- b. ~~Letter Boxes~~
- c. ~~Bus stops~~
- d. ~~Lamp posts (level at base and top or height)~~
- e. ~~Telecommunication poles~~
- f. ~~Electricity poles~~
- g. ~~Vent pipes~~
- h. ~~Road signs~~
- i. ~~Road and street name boards~~
- j. ~~Hoardings~~
- k. ~~Notice boards~~
- l. ~~Traffic signal and detector boxes~~
- m. ~~Vehicle detector pads~~
- n. ~~Drains and gullies~~
- o. ~~Fire Hydrants~~
- p. ~~Stop valves and stop cocks~~
- q. ~~Manhole and inspection covers~~
- r. ~~Cover or lights to cellars~~
- s. ~~Parking meters and ticket machines~~
- t. ~~Barriers~~
- u. ~~Bollards~~
- v. ~~Marker posts~~

Railways

- a. ~~Gauges faces of railway running rails~~
- b. ~~Points and cross-overs~~
- c. ~~Level crossing~~
- d. ~~Buffers~~
- e. ~~Platforms~~
- f. ~~Bridges~~
- g. ~~Signal boxes~~
- h. ~~Signals~~
- i. ~~Telephone points~~
- j. ~~Height gauges~~
- k. ~~Overhead electrification gantries with heights~~
- l. ~~Tunnels~~
- m. ~~Air shafts~~
- n. ~~Water troughs~~
- o. ~~Warning signs~~
- p. ~~Cable troughs and runs~~
- q. ~~Point/signal operating roads/wires~~

Water, Drainage and Coastal Features

- a. ~~Manholes and catch pits (including cover and invert level, pipe sizes and cover orientation)~~
- b. ~~Lakes and lochs~~
- c. ~~Ponds~~
- d. ~~Reservoirs~~
- e. ~~Rivers~~
- f. ~~Streams~~
- g. ~~Water courses~~
- h. ~~Ditches~~
- i. ~~Canals and towpaths~~
- j. ~~Wells~~
- k. ~~Springs~~
- l. ~~Marshes~~
- m. ~~Locks~~
- n. ~~Aqueducts~~
- o. ~~Water towers~~
- p. ~~Culverts~~
- q. ~~Millraces~~
- r. ~~Syphons~~
- s. ~~Sluice gates~~
- t. ~~Weirs~~
- u. ~~Waterfalls~~
- v. ~~Fords~~
- w. ~~Mooring posts~~
- x. ~~Pumps~~
- y. ~~Troughs~~
- z. ~~Tanks~~
- aa. ~~Fountains~~
- bb. ~~Sewer outfalls~~
- cc. ~~Piers, jetties and landing stages~~
- dd. ~~Harbour walls and breakwaters~~
- ee. ~~Groynes and sea defences~~
- ff. ~~Tunnels~~
- gg. ~~Hydraulic rams~~
- hh. ~~The direction of flow of all rivers, streams and water courses (unless tidal)~~

Slope and Earthworks

- a. ~~Cuttings and embankments~~
- b. ~~Terraced slopes~~
- c. ~~Retaining walls~~
- d. ~~Mounds~~
- e. ~~Open pits~~
- f. ~~Quarries~~
- g. ~~Rock outcrops~~
- h. ~~Tips~~
- i. ~~Adits and mineshafts~~

Woods, Trees and Recreational Areas

- a. ~~Playgrounds and sports fields~~
- b. ~~Parks and open spaces~~
- c. ~~Trees and Woods~~
 - ~~Details of species, girth/diameter (measured 1 m above the ground), height and spread (drawn) of all trees greater than [???] m girth shall be supplied and plotted to scale.~~
 - ~~Isolated trees above [???] m girth.~~
 - ~~Individual trees above [???] m girth in wooded areas.~~
 - ~~Tree count with average girth, height and spread in wooded areas.~~
 - ~~Canopy line to be plotted.~~
 - ~~Staked saplings individual and/or areas thereof to be plotted.~~
 - ~~Schedule of trees.~~
- d. ~~Ornamental garden features~~

Industrial

- a. ~~Tanks~~
- b. ~~Conduits~~
- c. ~~Valve chambers~~
- d. ~~Filter beds~~
- e. ~~Transformers (boundary fences only)~~
- f. ~~Electricity sub stations and switch boxes (boundary fences only)~~
- g. ~~Pylon bases and reference numbers~~
- h. ~~Overhead lines and cables~~
- i. ~~Flagstaffs and masts~~
- j. ~~Gas storage vessels and pipes~~

Accuracy

The planimetric co-ordinates of directly surveyed points shall be correct to $[\pm 0.010]$ m on carriageway and hard surfaces, and $[\pm 0.030]$ m on other surfaces, when checked from the nearest control point.

The levels of directly surveyed points shall be correct to within $[\pm 0.010]$ m on carriageways and hard surfaces and to within $[\pm 0.030]$ m on other surfaces, (except on ploughed or otherwise broken surfaces), when checked from the control point.

Features that cannot be surveyed to the specified accuracy without extensive clearing shall be treated in one of the following methods:

- ~~Surveyed approximately and annotated or labelled accordingly, or,~~
- ~~Cleared with the authority of the Company and surveyed to specified accuracy.~~

Definition

The spacing of points for features and details surveyed shall be such that interpolated points are correct to within ± 0.015 m on hard or well defined features, and to within ± 0.050 m on other features.

The spacing of levels in areas such as fields, open spaces etc. shall be such that the ground configuration, including all discontinuities, is correctly represented except for minor features such as small banks and ditches which are insignificant in terms of earthworks quantities.

The spacing of levels shall be such that interpolated points shall not deviate from the true ground surface by more than ± 0.015 m on hard or well defined surfaces, and by more than ± 0.050 m on other surfaces.

Presentation

The presentation of surveyed information shall be as defined in Section 10.4.9 for drawings and Section 10.4.10 for digital file formats.

10.4.5 SURVEYS OF UNDERGROUND SERVICES

Area of investigation

The area to be investigated shall be the whole area covered by the survey contract unless specified otherwise on drawing number [?????].

Investigation requirements

The method of investigation shall be as requested by the Company and shall be one of the following:

- From service records,
- From service records and on-site visual investigation or,
- From service records, on-site visual investigation and route tracing.

Types of survey

a) From Service Records

This shall comprise the addition of Utility Services record information and Local Drainage Authority drainage, relating information where possible to common detail, services 'furniture', trench scars and overhead lines.

b) From Service Records and On-Site Visual Investigation

This shall include the requirements of a), together with lifting, where permissible, of all service covers except where damage to cover or frame would result, and identifying the contents of chambers. Service runs shall be assumed to be straight unless trench scars show otherwise. Additional requirements shall be as follows:

- Note covers that cannot be raised
- Drainage
 - Measure all invert and backdrop depths
 - Show all pipe sizes and direction of flow
 - Link all manholes by proving connection
 - Show all connections at manholes
 - identify pipe materials where practicable
- Other services
 - Relate chamber contents to record information
 - Relate record information as in a) above

c) From Service Records, On-Site Visual Investigation and Route Tracing.

This shall include the requirements of a) and b) above, together with the following:

- ~~Drainage~~
 - ~~Entry into manholes or pumping chambers is **NOT** required~~
 - ~~Determine outlets to manholes~~
 - ~~Electronically trace the actual route~~
 - ~~Locate concealed manhole positions~~
 - ~~Electronically trace pumping mains and show depths at [???]m intervals~~
 - ~~Determine whether pumping stations have wet or dry wells and also condition of apparatus.~~
- ~~Water and Gas (including LPG)~~
 - ~~Electronically trace all detectable water and gas mains~~
 - ~~Show depths at [???]m intervals on mains~~
 - ~~Provide sizes from [records/visual investigations/excavation].~~
- ~~Electricity~~
 - ~~Electronically trace all high, medium and low voltage cables, street lighting, control cables, etc.~~
 - ~~Provide depths of cables at [???]m intervals~~
- ~~Telephone and Communications~~
 - ~~By arrangement with the relevant utility company, electronically trace all cable routes~~
 - ~~Show depths to top of ducts at joint boxes and the number and formation of the ducts (e.g. 3x2 — 3 ducts wide by 2 deep)~~
- ~~Other Services~~
 - ~~Electronically trace the route of [.....]~~
 - ~~Show depths at [???]m intervals of [.....]~~

Schedules and Reports

Where information is based on records from statutory undertakers, service providers and local authorities, a schedule shall be compiled showing all of the organisations contacted — whether they have plant or mains in the vicinity or not. The schedule shall contain the service, the contact address, telephone, and fax number, and the title, reference number, scale and date of the source data. This search may be performed by the Company and shall be made available to the Surveyor.

CCTV Surveys

A CCTV survey shall be carried out on the following services using colour/black and white photography:

- ~~All foul and storm water sewers in excess of [???]mm diameter~~
- ~~Those sewers indicated on the plan no. [?????]~~
- ~~Jetting of sewers by an appropriate recognised professional company is required prior to survey~~

The following results shall be presented:

- ~~Hardcopy plan marked up to show each surveyed run referenced to the video~~
- ~~CD / DVD disk(s) [delete as applicable]~~

Presentation

The presentation of surveyed information shall be as defined in Section 10.5.9 for drawings and Section 10.5.10 for digital file formats.

10.4.6 SURVEYS FOR NOISE EVALUATION STUDIES

Building Levels

Individual buildings and groups of buildings to be surveyed shall be represented by simplified blocks on the drawings and in the digital files. Levels shall be taken at the following points relative to these blocks and their positions recorded on the survey drawings:

- Ground levels at each of the block corners
- Ground levels at intermediate distances of 10m along the block faces
- The eaves and highest roof point (ridge/parapet) level at each end of the block and at the positions specified above.

Roof types

Types of roofs shall be identified by the surveyor as typical of the simplified block (pitched, gable end, hipped end, flat roof etc.) and recorded on the survey drawings.

Representative ground levels

Representative ground levels, shall be taken as near as possible to the locations shown on drawing number [?????] and recorded on the survey drawings.

Accuracy

Representative ground levels shall be accurate to ± 0.015 m on hard or well-defined features, and to within ± 0.050 m on other features.

Levels of roof features shall be accurate to ± 0.100 m.

Presentation

The presentation of the spot height level survey for noise evaluations shall be as defined in Section 10.5.9 for drawings and Section 10 for digital file formats.

10.5.7 SURVEYS OF RIVER CHANNELS

General

The Company requires detailed cross-sectional information of river channels and associated structures for the purposes of river flow and flood modelling. The surveyed cross-sections are required to tie-in to aerial survey data of the whole catchment. The company will usually commission a remote sensing company to perform an aerial survey of the whole river catchment – this will be made available to the Surveyor upon request.

Details to be surveyed

The following features and details shall be surveyed:

Control Points

- a. Ordnance Survey trigonometric stations
- b. Permanent survey stations
- c. Ordnance Survey benchmarks used in the survey
- d. Permanent benchmarks

Culverts

- a. Cross section at upstream and downstream face
- b. Any changes to the cross-section shape within the culvert
- c. Line and level

- d. ~~Entry and exit structures (headwalls etc.)~~
- e. ~~Material of construction~~
- f. ~~Ground level above the structure~~

Bridges

- a. ~~Cross section at upstream and downstream face of the bridge~~
- b. ~~Piers and supports~~
- c. ~~Bridge reference number~~
- d. ~~Cross sections at the upstream and downstream face of bridges are to include the profile of the low cord (soffit), the high cord (top of parapet/road level) and details of any piers or supporting structure in the channel of riparian area.~~

Weirs

- a. ~~Type of weir (e.g. broad crested, compound, crump, long based, rectangular, roundnosed, sharp crested, vee, etc.)~~
- b. ~~Cross section at upstream and downstream face~~
- c. ~~Principle dimensions of the structure~~

Screens

- 1) ~~Cross section at upstream face~~
- 2) ~~Number of bars and sizes.~~
- 3) ~~Dimensions of the structure.~~

Gates

- a. ~~Cross section at upstream and downstream face~~
- b. ~~Number of gates and sizes.~~
- c. ~~Principle dimension of the structure~~

Gauging Stations

- a. ~~Type of gauging station~~
- b. ~~Cross section at upstream and downstream face and principle dimensions.~~

Investigation requirements

~~Cross sections shall be surveyed at [???]m intervals along the centreline of the river and in addition:~~

- a. ~~at changes in channel slope or width GREATER THAN 10%,~~
- b. ~~at low spots in the channel or banks, and~~
- c. ~~at places where flood levels are known (the flood level shall also be recorded).~~

~~At least 8 points should be measured on each cross section to define the bank top, side slopes and river bed. The cross sections should also extend at least 10m out onto the flood plain.~~

~~The cross sections shall be such that they are perpendicular to the direction of flow in the channel. Each cross section is to be detailed from left to right facing downstream with chainages measured from the left bank. Chainages shall not decrease across the section.~~

~~Chainages shall be measured from the downstream end of the centreline, ascending in an upstream direction. All cross sections and structures surveyed shall be referenced by the chainage at which they cross the centreline.~~

Presentation

~~River cross sections shall be presented in three dimensions in accordance with Section 40 for digital file formats.~~

~~Detailed cross sections of structures shall be presented as individual drawings in accordance with Section 9 for hardcopies, Section 10 for digital file formats and immediately below.~~

Typical bridge cross-section

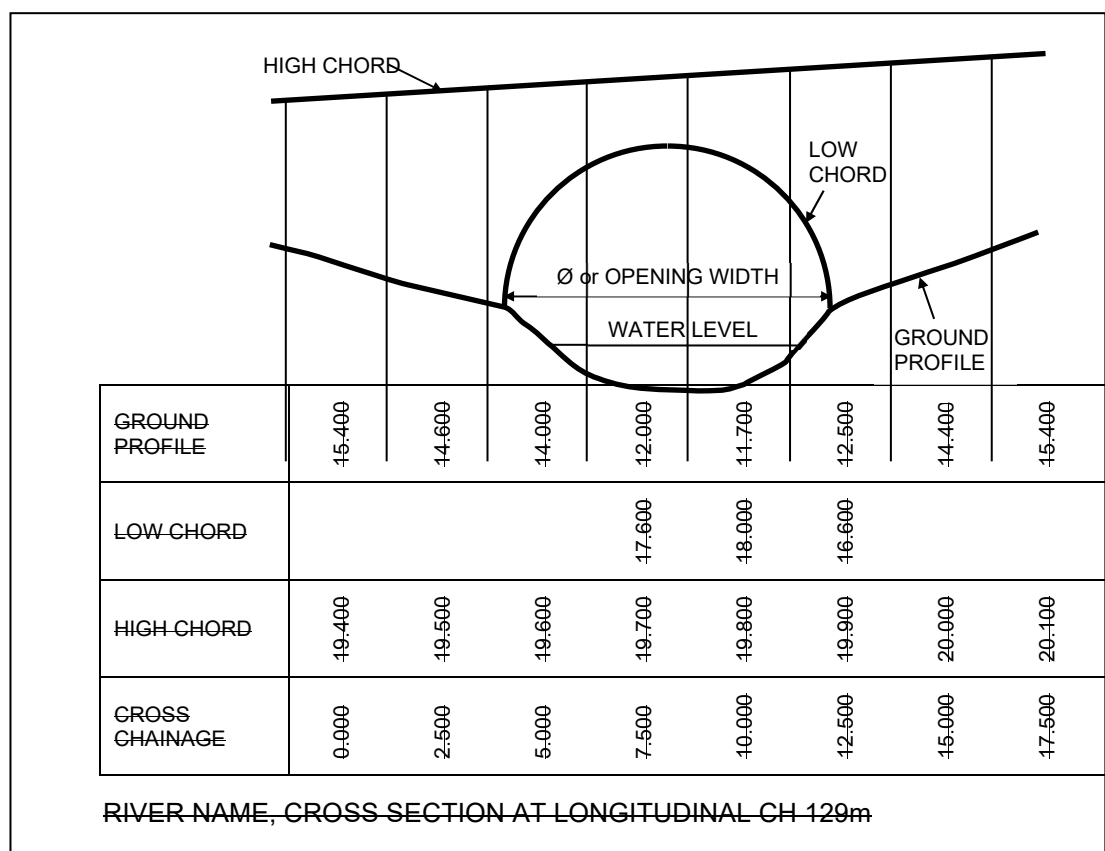


Table 1: Cross Section Description

Cross Section Structure Comments on the Location

10.4.8 PROJECT CONTROL

General

A horizontal and vertical control framework shall be established by the Surveyor. Control points shall be marked (and protected if necessary) in such a manner to allow effective future use. Their construction shall be sufficient to withstand at least 5 years of normal usage, taking into account the surroundings at each location. The types of material used shall be such that their impact on the environment and any normal activities is minimised.

A report of the control points, including co-ordinates, levels and type of control point shall be submitted to the Company. All survey control stations shall be referenced to surrounding details and a location plan prepared by the Surveyor showing these references to permit their later re-establishment.

Horizontal Control

The planimetric control shall be related to one of the following: [choose one]

~~A plane rectangular grid with an origin defined by the nearest National Grid 10km intersection to the south west of the survey area and with the same orientation as the National Grid. The origin co-ordinates of the plane grid shall be equal to the National Grid co-ordinates.~~

~~An arbitrary plane rectangular local grid set up at the Surveyors discretion in a manner agreed by the company/client..~~

~~An existing plane rectangular grid[provide details here]~~

Vertical Control

~~It is required that survey is tied into Ordnance Datum (Newlyn) using the GPS datum network.~~

Control Report

~~On completion of the fieldwork and adjustment, a comprehensive control report shall be prepared detailing the methods used and checks applied, any problems encountered and demonstrating that the results achieved comply with this brief.~~

10.4.9 PRESENTATION OF DRAWINGS

General

~~The final hardcopy and AutoCAD 3D drawings shall show all the surveyed details specified.~~

~~The Surveyor shall include on each drawing sheet a title block displaying the following as a minimum:~~

- ~~• Company Name~~
- ~~• Title as agreed with the Company~~
- ~~• Date~~
- ~~• Drawing number and Revision details~~
- ~~• Scale and Sheet size~~
- ~~• Surveyors name and Draughtsman name~~
- ~~• Key or Legend to the symbols and line styles used on the drawing~~
- ~~• Definition of the direction of north~~

Hardcopy plots

~~Hardcopy plots shall be provided on either film, rolled and contained in a suitable tube, or on quality white paper, folded to A4 size.~~

~~Adjoining drawing sheets shall be overlapped by 50mm with all common detail shown on both drawings.~~

AutoCAD drawing files

~~The AutoCAD drawing files shall conform to the following:~~

- ~~• Digital files provided shall be compatible with the latest release of AutoCAD software.~~
- ~~• The data shall be presented in a clear and logical layered format (such as CI/Sfb Table 1). A copy of the layering protocol used shall be submitted to the Company.~~
- ~~• Representation of continuous features, such as channel or kerbs, shall be by polylines.~~
- ~~• SPLINES shall NOT be used under any circumstance.~~

- All entities shall be coloured BYLAYER and linetypes shall be BYLAYER.
- The file shall be two-dimensional i.e. all entities shall have an elevation (z-value) equal to 0 (zero).
- The file shall be in units of 1 drawn unit equal to 1 metre.
- There shall be only one co-ordinate system used — the AutoCAD World Co-ordinate System (i.e. aligned to the Ordnance Survey).
- All associated files shall be included with the submitted information, including fonts (.shx and .ttf files), shapes (.shx files), plot styles, and the fontmap.
- Digital data files shall be presented on either DVD disks, or CD-ROMs.

10.4.10 PRESENTATION OF POINT AND STRING DIGITAL FILES

General

The Company uses 12D Model for all of their ground modelling and civil, highway and drainage design needs and therefore would prefer to receive digital point and string data files in 12d Model ASCII format (.12da). Failing that, the Company is willing to accept Moss GENIO or 3d dwg/dxf formats.

Digital data files shall be presented on Microsoft Windows compatible media, either:

- 3½" floppy disk or,
- CD-ROM.

The data file may be compressed in a .zip file (compatible with WinZip®) if desired.

Three dimensional digital point and string files shall conform to the requirements of .12da files, Moss GENIO files or AutoCAD compatible files as set out below.

.12da files

- Digital files provided in the 12D Model ASCII (.12da) format shall be in accordance with the definitions set out by 4D Solutions Pty Ltd. A full definition of the .12da file format can be found at www.12d.com.
- The data shall be presented in a clear and logical named format. A copy of the model and string naming protocol used shall be submitted to the Company.
- The file shall be in units of 1 drawn unit equal to 1 metre.
- Representation of continuous data, such as channel or kerbs, shall be by 3d strings.

Moss GENIO files

The GENIO input format shall be either Moss version 6 or 7.

- 12d Model recognises and uses Moss options (001,003,017) to allow variations in the format of the GENIO 080 records.
- Moss free format is allowed. For example: 080,ABCD,5=0.0
- The Moss 10d (volume string) is not allowed in the GENIO file as it will not be read into 12d Model.
- A GENIO file may contain more than one Moss model, each GENIO model being separated by a 999 card.
- 12d Model recognises the following GENIO options for Moss V6 and V7 formats:
 GENIO
 FINISH
 001 — format card
 003 — order card
 017 — angle card
 080 — for 2d, 3d, 4d, 6d, 12d and text strings
 080 — the 3d information only for 5d strings
 090 — triangulation information

999

GENIO comment lines

- 12d Model accepts Moss null values of 999.0
- 12d Model ignores the GENIO options: 080 for 10d strings
- The data shall be presented in a clear and logically name and model format. A copy of the string and model naming protocol used shall be submitted to the Company.
- Representation of continuous data, such as channel or kerbs, shall be by continuous three dimensional strings.
- The file shall be in units of 1 unit equal to 1 metre.

AutoCAD compatible files

- Digital files provided for the use in AutoCAD shall be compatible with Release 2000 of the said software.
- The data shall be presented in a clear and logical layered format. A copy of the layering protocol used shall be submitted to the Company.
- Representation of continuous features, such as channel or kerbs, shall be by polylines.
- SPLINES shall NOT be used in any circumstance.
- All entities shall be coloured BYLAYER and linetypes shall be BYLAYER.
- The file shall be in units of 1 drawn unit equal to 1 metre.
- There shall be only one co-ordinate system used the AutoCAD World Co-ordinate System.
- All associated files shall be included with the submitted information, including fonts (.shx and .ttf files), shapes (.shx files), plots.

10.5 RISING KERBS

10.5.1 INTRODUCTION

The barrier is to resist [state level of resistance required]. Therefore an approved barrier with [state security rating] against forced entry by a [state vehicle type] is required.

The required barrier is a [?]m wide [state product] in accordance with the drawings.

[The following clauses in this section assume a high level of specification. Amend as necessary if a different level or type of specification is required]

10.5.2 SYSTEM REQUIREMENT

The system shall comprise an HSRB with an associated Hydraulic Power Unit (HPU), Control System and Access Control Equipment document.

10.5.3 BLOCKING SEGMENT

Segment Construction

The blocking segment shall be constructed of heavy steel section with mild steel skirts and covers. The road plate should be an anti slip plate to withstand an axle load of 20 tonnes. The blocking segment shall be secured into a subsurface mounting frame and shall be rotated through 43 degrees to secure the roadway. On impact, the forces exerted on the blocking segment should be partially absorbed by the structure with the

~~balance being transmitted through the substantial frame and into the re-enforced foundations. The segment should be designed to absorb and withstand impacts from both US and European manufactured vehicles taking into account the varying weight distribution of both styles.~~

Segment Height

~~The height of the segment when in the closed (raised) position, as measured from the top of the mounting frame, shall be a minimum of 800mm to minimize the possibility of site penetration and to ensure that higher chassis vehicles are restrained.~~

Segment Width

~~The nominal width of the blocking segment shall be [?]m as shown on the drawings.~~

Finish

~~The segment and mounting frame are to be finished with an anti-corrosion paint in black with yellow diagonal stripes over painted on the segments front skirt and road plate.~~

10.5.4 HYDRAULIC SYSTEM (HPU)

Operation

~~The HPU shall consist of a heavy duty motor driving a hydraulic pump which shall actuate, via a manifold and set of electrically operated valves, a hydraulic ram(s). The blocking segment shall be driven both up and down by a double acting hydraulic ram(s) to ensure positive action at all times without reliance on gravity for operation. The HPU shall have the facility to allow a significantly increased raise speed in case of emergency.~~

Hydraulic ram

~~The double acting hydraulic ram(s) fitted to the blocking segment shall be fitted with anti-burst valves as standard to maintain security if damage is sustained to the hydraulic hoses.~~

Limit Switches

~~Limit switches shall be fitted to provide raised and lowered signalling to the control system.~~

~~The switches shall be M30 sized inductive type with no moving parts and have a minimum IP rating of IP68.~~

Motor

~~The heavy duty motor used in the HPU shall be a 230V unit with a power rating sufficiently sized to allow for continuous operation (100% duty cycling). The motor should be protected by a thermal / magnetic trip device mounted in the electrical control panel.~~

Hydraulic Reservoir

~~The hydraulic oil shall be contained in a steel reservoir which is to be sized to allow sufficient oil cooling necessary for 100% duty cycling of the blocker.~~

Power fail conditions

~~A hand pump / release shall be provided to enable the manual raising and lowering of the blocking segment in the event of electrical power failure.~~

Casing

The HPU is to be fitted into a steel cradle which shall have lifting and bolt down points; the cradle shall come complete with an outer cabinet to give protection against the elements.

The cabinet shall have fully lockable and removable full length doors to both the front and rear of the cabinet for ease of access. Vents shall be fitted into the cabinet to allow good air circulation to maintain the ambient temperature.

10.5.5 CONTROL SYSTEM

Main Processor

The HPU shall be controlled by a central programmable logic controller (PLC) which shall accept inputs from the access control system, blocker monitoring equipment and hydraulic pack and output signals to the HPU control valves, back indication system and external signalling. The PLC controller shall be sized to suit site requirements but should have 8 inputs and 6 outputs as a minimum. The initial PLC programming shall be to suit specific client and site requirements however reprogramming of the system must be easily capable of being undertaken at a later date if required. All relays shall be properly mounted and all interconnecting cabling must be in suitable containment running to terminal strips.

Voltage

The main system input voltage is to be a 230V single phase 50Hz supply with the control system operating at 24V AC SELV provided from an internally mounted power supply.

Casing

The control system shall be housed in a general purpose IP65 rated housing with a power isolation switch mounted externally for safety. The housing shall be located inside the main HPU cabinet and should give easy access to all electrical components for connection, maintenance and programming.

10.5.6 ACCESS CONTROL

Remote Control Panel

Each HSRB shall come with its own remote control panel which shall be comprised of push buttons to raise, lower and emergency stop the equipment as well as an electrical key switch to disable the panel when not in use. The blocking segment must be able to instantly reverse on command.

Emergency fast raise

If the system is fitted with an emergency fast raise circuit, then the control panel shall include a panic button which shall be larger than the normal controls and shall self lock on activation (key reset required), the circuit shall by pass all safety systems.

System Interfacing

The control system shall be capable of accepting inputs from any major type of access control as required including, but not limited to, swipe card readers, proximity card readers, inductive loop systems, RF transmitter equipment and biometric readers.

10.5.7 PERFORMANCE

Manufacturers Experience

The manufacturer of the rising barrier shall have a minimum of 15 years' experience in the manufacture, installation and maintenance of this type of equipment and must be a member of a recognized Professional Trade Association.

Performance Testing

The HSRB design shall fully comply with CE regulations and shall have been fully structurally evaluated by a qualified independent testing agency. An actual full scale crash test must have been carried out by a qualified independent testing agency with the HSRB remaining fully operational after the impact. The test shall have consisted of the impact of a roadworthy and fully laden vehicle weighing 7,610Kg (16,742 pounds) travelling at 80 kph (50 mph) into the security face of the HSRB. The impact testing must have been carried out in accordance with the relevant British Standard and exceed the Department of State test standard SD-STD-2.01 Rev A class K12/L3. In addition, the HSRB shall be able to cause sufficient damage to a 7500 kg vehicle travelling at both 50 kph and 80kph so as to destroy the front suspension and main drive train of the vehicle rendering it inoperative.

Speed of operation

Standard operation speed shall be between 4 and 8 seconds for either raising or lowering, with the raise time being reduced to 1.2 seconds when the emergency fast raise system is activated. In normal operation the rising kerb shall be capable of operating at 360 cycles per hour (100% duty cycling at 5 second settings).

10.5.8 TESTING

Equipment Testing

The manufacturer shall have fully tested the rising barrier, HPU, Control System and Access Control equipment prior to dispatch.

- These tests shall be fully traceable to each unit dispatched and must be transparent.
- The testing shall include dimensional checks, workmanship quality and finish as well as full operational testing.
- Once fully tested, the HSRB shall be fitted with a nameplate bearing the manufacturer's details, serial number and test date.
- Copies of the test results shall be given to the Project Manager prior to installation of the equipment.

10.6 DEMOLITION

Refer to Waterman Group Specification "Specification for Demolition Works, WS/SPC/-/013.

10.7 SPECIFICATION FOR SOIL PERMEABILITY TESTING

10.7.1 SPECIFICATION

The specification shall be the "Specification for Ground Investigation" published by Thomas Telford Services, 2nd Edition, with information, amendments and additions as described in the Schedules.

Schedule 1.	Information
Schedule 2.	Exploratory holes
Schedule 3.	Engineer's facilities
Schedule 4.	Specification amendments
Schedule 5.	Specification additions—Geotechnical
Schedule 6.	Specification additions—Environmental

10.7.2 SCHEDULE 1 INFORMATION

Name of Contract:

[Insert name of contract]

Description of Site:

The particular areas to be investigated are [insert location and description of areas]

Purpose of Investigation:

The purpose of this ground investigation is to:

- Provide permeability and infiltration data for the proposed location of soakaway drainage within 10m of the existing soakaway. [amend to suit project].

Scope of Investigation:

The investigation comprises:

- Groundwater Infiltration Testing [state no. of Trial Pit Soakaways]
- The investigation does/does not [delete as appropriate] include a Desk Study. [reference no. if relevant].
- The investigation does/does not [delete as appropriate] include an Interpretative Report [reference no. if relevant].

Geology and Ground Conditions:

Made Ground	To be confirmed by the SI contractor [amend as appropriate]
Drift Deposits	To be confirmed by the SI contractor [amend as appropriate]
Bedrock	To be confirmed by the SI contractor [amend as appropriate]
Mining	To be confirmed by the SI contractor [amend as appropriate]

Schedule of Drawings and Documents

Drawing No.	Drawing Title
[insert drawing number]	Site Location Plan
[insert drawing number]	Proposed Trial Pit Location Plan
	Utility plans, if available, shall be supplied prior to commencement of site works.

Particular Contract Restrictions:

Difficult Access	Liaise with [insert as appropriate] Access gained onto the site from ????? but shall need permission to gain entry. [amend as appropriate]
------------------	--

Access Restrictions	The Project Manager requires at least one week's notice of proposed start date.
Gross Contamination	Refer to SI report no. ????? .
Project Manager/Engineer's approval prior to backfilling	The Project Manager/Engineer's approval is required prior to backfilling of the trial pits.
Underground Services	The Contractor shall consult all relevant bodies, examine such documents as are available and shall satisfy himself as to the exact position of existing services as instructed in Section 2.
Constraints	No known ecological constraints are present. [amend as appropriate]

Particular General Requirements (Section 3):

Access Routes	Liaise with [insert as appropriate] Access gained onto the site from ????? but shall need permission to gain entry. [amend as appropriate]
Notice of Entry	The Project Manager requires at least one week's notice of proposed start date.
Security	All holes, excavations, machines and equipment shall be supervised at all times and the site kept tidy.
Restricted Working Hours	Working hours shall be restricted to Monday-Fridays during the hours 08.30-17.00 unless otherwise agreed with the Project Manager.
Reinstatement	Like for like reinstatement shall be required.
Engineers Facilities	Not required.
Professional Attendance	The Contractor shall provide full time professional attendance on site with a suitably qualified engineer with a minimum of 2 years' experience.
Accuracy of Setting Out	Setting Out. Trial pits shall be set out by the Contractor and agreed by the Project Manager/Engineer to the nearest 1m, prior to the holes being excavated. The [insert as appropriate] must be consulted during the setting out phase to ensure no damage or interference with the current site use. The setting out may be carried out by a tape or GPS. Setting out information shall be provided to the Contractor for purposes of co-ordinating the trial pits. The Contractor shall satisfy themselves that no services are present at the location prior to the commencement of the trial pits.
Traffic Requirements	No works are proposed within the Public Highway. Works are proposed within the soft landscaping. All works shall be carried out in such a manner so as to ensure the safety of site staff and other users of the site.
Quality Management	All works shall be carried out in accordance with a quality management systems in accordance with BS EN ISO 9001:1994.
Surveying	All exploratory holes are required to be surveyed in and co-ordinates and level (mAOD) provided on the borehole logs. The location of the exploratory holes should be accurately located on an As-Built Exploratory Hole Location Plan to be included with the factual report. Levels must be determined to the nearest 0.05mAOD and the location to the nearest 0.2m.

Particular In-situ Testing Requirements (Section 8):

Testing in Accordance with BS 1377	Not Applicable [amend as appropriate]
Testing in Accordance with BS 5930	Not Applicable [amend as appropriate]
Geophysical Investigations	Not Applicable [amend as appropriate]
Soil Infiltration Rate Tests	Soakaway Pits noted on the drawings appended as S1 and S2. To be taken at least 2.5m below ground level. [amend as appropriate]
Hand Penetrometer and Hand Vane for Shear Strength	Not Applicable [amend as appropriate]
Self-Boring Pressuremeter	Not Applicable [amend as appropriate]

Particular Daily Report Requirements (Section 10):

Daily Reports	Legible engineer borehole and trial pit records shall be made available to the Engineers Representative within one working day of the completion of site works. This may be presented by e-mail or fax.
Special In-Situ Testing and Instrumentation Requirements	None [amend as appropriate]

10.7.3 SCHEDULE 2: EXPLORATORY HOLES – TRIAL PITS

Hole No.	Nominal Depth (m)	Purpose Former Use	Likely Testing	Easting	Northing	Instrumentation	Nearby Hazards & Constraints				Surface
							Services	Traffic	Slope	Other	
[insert no.]	[insert depth]	To assess drainage capacity	Soil Infiltration (Soakaway) to BRE 365 and Soil Infiltration Test to be carried out in the appropriate strata for soakaway.	[insert easting]	[insert northing]	N o n e	[amend as appropriate]	[amend as appropriate]	[amend as appropriate]	[amend as appropriate]	
[insert no.]	[insert depth]	To assess drainage capacity	Soil Infiltration (Soakaway) to BRE 365 and Soil Infiltration Test to be carried out in the appropriate strata for soakaway.	[insert easting]	[insert northing]	N o n e	[amend as appropriate]	[amend as appropriate]	[amend as appropriate]	[amend as appropriate]	

~~10.7.4 SCHEDULE 3: PROJECT MANAGER'S FACILITIES~~

Not required. ~~[amend as appropriate]~~

~~10.7.5 SCHEDULE 4: SPECIFICATION AMENDMENTS~~

None. ~~[amend as appropriate]~~

~~10.7.6 SCHEDULE 5: SPECIFICATION ADDITIONS – GEOTECHNICAL~~

Not required. ~~[amend as appropriate]~~

~~10.7.7 WORKMANSHIP~~

- ~~1. These tests shall be carried out within and be representative of, the proposed infiltration area which should be at least 5m from the intended building and any boundary.~~
- ~~2. Excavate to the same depth of the anticipated full size soakaway below the invert of the incoming drain. For this soakaway, it should be at least 2.5m to the invert from existing ground level.~~
- ~~3. The trial pit should be 0.3 to 1m wide and 1 to 3m long.~~
- ~~4. It should have vertical sides trimmed square and if necessary for stability, should be filled with granular material.~~
- ~~5. Fill the excavated pit with water and allow it to seep away overnight. It is important to saturate the soil surrounding the test hole to simulate day to day conditions in an operational drainage field.~~
- ~~6. When there is no granular material needed, it is advised to place two pegs into the trial pit at the 75% and the 25% level. This allows the water level readings to be taken accurately.~~
- ~~7. Extreme weather conditions should be avoided when testing.~~
- ~~8. The trial pit should be filled, and allowed to drain three times to near empty, with readings taken as follows:~~
 - ~~• The time in which water level took to lower to 75% full~~
 - ~~• The time in which water level took to lower to 25% full~~
- ~~9. When granular material is used, a full height, perforated vertical observation tube should be positioned in the pit so that water level can be monitored with a dip tape.~~
- ~~10. The trial pit is filled on three occasions to give a true reading on the ground conditions. Therefore the soil infiltration rate shall be taken as the worst of these three readings.~~

~~It should be possible to construct a suitably dimensioned pit with a backhoe loader or a mini-excavator. A large volume of water shall be used to determine the soil infiltration rate so a water bowser may be needed. The inflow should be rapid so that the pit can be filled in a short time.~~

~~The soil infiltration rate determination shall be in accordance with the latest version of BRE Digest 365.~~

10.7.8 CHECK SHEET

CHECK SHEET

The contractor is to return the information requested below to the Project Manager/Engineer at least one week prior to work commencing.

1. The size of the soakaway that is proposed:

Width (m) _____ Length (m) _____ Depth (m) _____

2. The area that is to be drained to the soakaway: _____ m²

3. The size of the trial pit:

Width (m) _____ Length (m) _____ Depth (m) _____

4. Please specify the proposed invert level of the drain: _____ m

5. Below is a table [expand as necessary] for inputting the data (times) gathered from the Soil Infiltration Rate tests:

Test Number	75%	25%	25% - 75%
1			
2			
3			

Key

75% _____ The time taken in minutes for the water level to fall to 75% full.

25% _____ The time taken in minutes for the water level to fall to 25% full.

25% - 75% _____ The 25% time minus the 75% time. (This shall give time for the water level to fall from 75% full to 25% full.)

Name: _____ Signature: _____ Date: _____

CH 13.9.12



MIRA Technology Park – Plot 8 & 9 part of the LIF 2 Northern Masterplan

Flood Risk Assessment and Outline Drainage Strategy

July 2022

Waterman Infrastructure & Environment Limited

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Document Reference: EED13833-120-R-1.1.2-FRA
Project Number: EED13833-120

Quality Assurance – Approval Status

This document has been prepared and checked in accordance with
Waterman Group's IMS (BS EN ISO 9001: 2015, BS EN ISO 14001: 2015 and BS EN ISO 45001: 2018)

Issue	Date	Prepared by	Checked by	Approved by
First	12/07/2022	Karen Stokes	Sujal Parikh	Harry Chetty

Comments

A handwritten signature in black ink, appearing to read 'Karen Stokes'.

A handwritten signature in black ink, appearing to read 'S. Parikh', enclosed in a rectangular box.

Disclaimer

This report has been prepared by Waterman Infrastructure & Environment Limited, with all reasonable skill, care and diligence within the terms of the Contract with the client, incorporation of our General Terms and Condition of Business and taking account of the resources devoted to us by agreement with the client.

We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.

This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report at its own risk.

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Executive Summary

Waterman was commissioned by ERI MTP Limited to undertake a Flood Risk Assessment and Outline Drainage Strategy to support the proposed development of Plot 8 & 9 located within the Zone 4 of the MIRA Technology Park (as approved by permission 14/00661/CONDIT).

This report is specifically for the Plot 8 & 9 development, part of the LIF2 Northern Masterplan, providing Research and Development Headquarter building, associated testing facilities, car parking and landscaping. The proposed drainage infrastructure works associated to the Plot 8 & 9 development will be connected into the wider strategic infrastructure works that will be provided as part of LIF 2 Infrastructure works. This wider strategy has been summarized in the planning submissions recently submitted referenced: - *MIRA Technology Park – LIF 2 Infrastructure, Land North of A5 – Ground Conditions and Contamination, Flood Risk assessment and Outline Drainage Strategy* [EED13833-117-R-2.4.2, Dated April 2022]. This report should be read in conjunction with this report to understand the wider site context.

It has been demonstrated from this report that there is a low risk of flooding from fluvial, tidal, pluvial, fluvial, groundwater and artificial sources.

To ensure the development does not increase flood risk offsite, it is proposed to utilise a range of SuDS including impermeably lined permeable paving, impermeably lined filter trench with perforated pipe and below ground cellular storage tanks. The LIF 2 Infrastructure drainage also provides SuDS features such as swales, impermeably lined filter trench and detention basins to attenuate runoff from the Northern Masterplan (Plot 6 to 11) at a Qbar rate. The infrastructure proposal as part of this planning application will provide the surface and foul water drainage infrastructure for Plot 8 & 9. The surface water will be discharged into the proposed infrastructure that will be built as part of the LIF 2 Infrastructure works. This includes discharge of the surface water runoff into an existing ditch/watercourse at the northwest boundary of the site. This watercourse discharges to further west of the field and ultimately into the River Anker to further southwest of the Site. The proposed discharge rate from Plot 8 & 9 will be restricted at the greenfield runoff rate, Qbar. The greenfield runoff rate with the primary surface water network has been designed using MicroDrainage. The detailed drainage design will be developed further in accordance with the preliminary drainage strategy that has been developed at the planning stage

Using the CIRIA pollution indices methodology, it has been established that parts of the development have a medium hazard rating, with the proposed SuDS providing a sufficient level of treatment for runoff. This is from the use of on-site permeable surfacing, infiltration trench, and rain garden facilities. Further treatment will be provided via sitewide detention basins prior to discharging into the existing ditch. Horiba MIRA Estates Department will manage the proposed SuDS, and details of the typical maintenance measures have been included within this report.

The proposed external infrastructure development will provide foul water network to the future plots. The peak foul water discharge rate from the future plots 6 to 11 and a security building will remain circa 5 l/s based on an estimated population of 1,325 people. The proposed foul water drainage network will be connected into an existing Severn Trent Water's foul sewer manhole, MH0350, at the southern boundary of the Horiba MIRA site. Severn Trent Water (STW) has confirmed its approval in principle to this proposal as part of the ongoing discussions for the wider Horiba MIRA site. The peak foul water discharge rate from Plot 8 & 9 will be 1.6 l/s based on an estimated population of 459 people.

The investigation across the wider LIF 2 Masterplan site has been carried out in May 2022. Four infiltration tests were carried out to validate the permeability of the ground at circa 1.8m below ground level. The infiltration tests failed due to Clayey substrata.

In conclusion, the Site is at low risk of flooding and will not increase the risk of flooding elsewhere as a result of the proposed SuDS strategy, in line with the requirements of local and national planning policy.

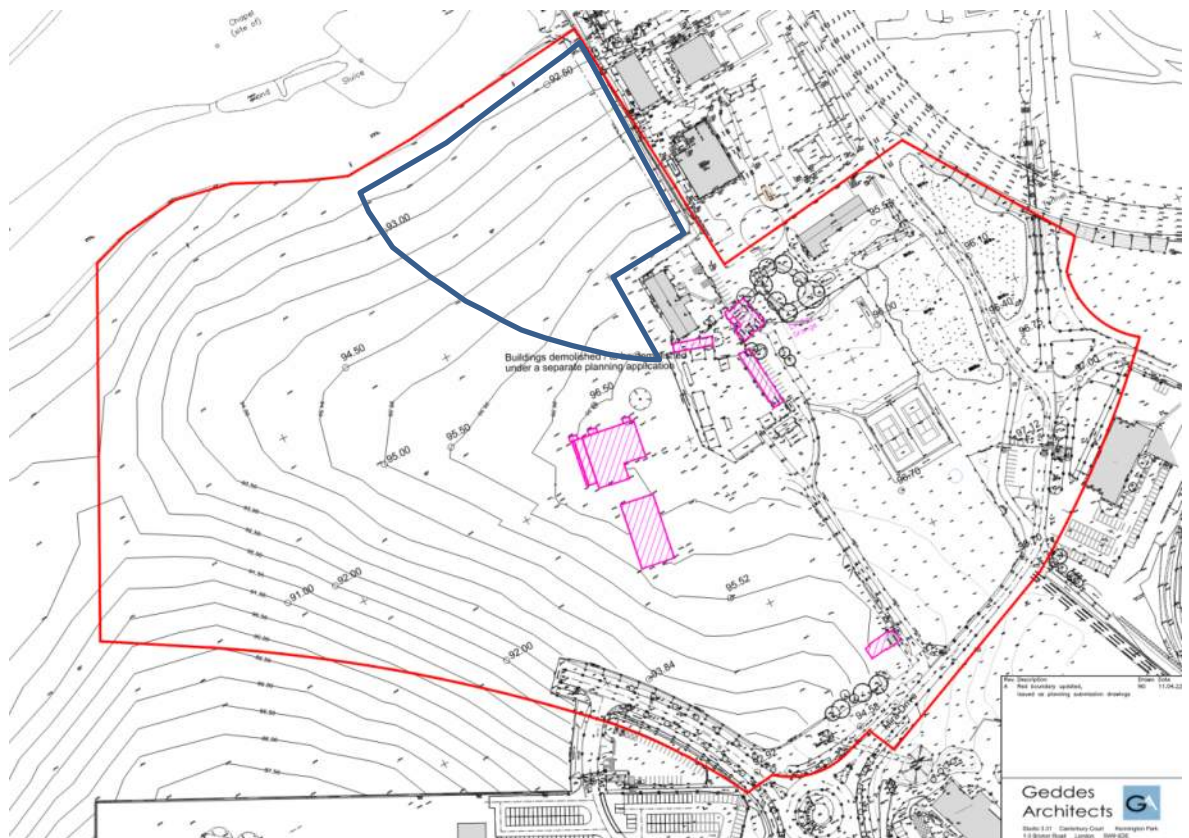
1. Introduction

Waterman was commissioned by ERI MTP Limited to undertake a Flood Risk Assessment and Outline Drainage Strategy to support a planning application on Land North of the A5 at MIRA Technology Park, Nuneaton.

Site Description

- 1.1. The Plot 8 & 9 Site (Blue line boundary) covers an area of approximately 1.8 hectares (ha) and currently forms part of the LIF 2 MIRA Technology Park including currently undeveloped land to the north-west of the Park, farmland and farm buildings in the east.
- 1.2. The wider LIF 2 site boundary, shown in red line below, covers an area of 15.6 hectares (ha).

Figure 1: Site Location



Topography

- 1.3. Based on the Topographic Survey (Appendix A), land levels vary across the Site from circa 96.50m Above Ordnance Datum (AOD) at the south-eastern boundary to circa 92.0m AOD at the north-western boundary. This provides an average gradient of 1 in 40 along its length. The ground profile continues to fall further west towards the existing ditch where ground levels remain 86.0m AOD or lower. Overall, land levels fall from east to west. The majority of the study area comprises open grassland and fields, with small buildings in the central area.

Development Proposals

- 1.4. This report seeks to support the reserved matter planning applications for the proposed development of Plot 8 & 9 within the wider LIF 2 development in Zone 4 of the MIRA Technology Park (as approved by permission 14/00661/CONDIT). Plot 8 & 9 will provide Research and Development Headquarter building, associated testing facilities, car parking and landscaping. A site plan for the proposed development is included in Appendix B. Figure 1 above, shows the location of the Site.

Scope of Report

- 1.5. This report assesses the tidal, fluvial, pluvial, groundwater and artificial sources of flooding upon the Development, in line with national and local planning policy. The management of surface water runoff is also assessed, so as not to have a detrimental effect to the Site or its surroundings. In addition, an assessment of foul drainage has also been included.

2. Planning Policy and Guidance

National Planning Policy Framework

- 2.1. The National Planning Policy Framework¹ (NPPF) 2021 states that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere.
- 2.2. The aim of the Sequential Test is to steer new development to areas with the lowest risk of flooding. Development should not be allocated or permitted if there are reasonably available Sites appropriate for the proposed development in areas with a lower risk of flooding.
- 2.3. If it is not possible for development to be located in zones with a lower risk of flooding (taking into account wider sustainable development objectives), it may be necessary to demonstrate through the Exception Test that:
 - The development would provide wider sustainability benefits to the community that outweigh the flood risk; and
 - The development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.
- 2.4. The NPPF states that when determining planning applications, Local Planning Authorities (LPA) should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a Site-specific Flood Risk Assessment. Development should only be allowed in areas at risk of flooding where it can be demonstrated that:
 - Within the Site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;
 - The development is appropriately flood resistant and resilient;
 - It incorporates Sustainable Drainage Systems (SuDS), unless there is clear evidence that this would be inappropriate;
 - Any residual risk can be safely managed; and
 - Safe access and escape routes are included where appropriate, as part of an agreed emergency plan.
- 2.5. Major developments should incorporate SuDS unless there is clear evidence that this would be inappropriate. The systems used should:
 - Take account of advice from the lead local flood authority;
 - Have appropriate proposed minimum operational standards;
 - Have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and
 - Where possible, provide multifunctional benefits.
- 2.6. Flood risk vulnerability is split into five classifications in Annex 3 of the NPPF as follows:
 - Essential Infrastructure, e.g. essential transport and utility infrastructure, wind turbines;
 - Highly Vulnerable, e.g. emergency services (those required to be operational during flooding),

¹ Ministry of Housing, Communities and Local Government, February 2019. *National Planning Policy Framework*

basement dwellings;

- More Vulnerable, e.g. residential dwellings, hospitals, schools, hotels, drinking establishments;
- Less Vulnerable, e.g. retail, offices, storage and distribution, leisure, restaurants; and
- Water-Compatible Development, e.g. docks, marinas, wharves.

Planning Practice Guidance

- 2.7. The Planning Practice Guidance² (PPG) provides additional guidance to LPAs to ensure effective implementation of the planning policies set out within the NPPF regarding development in areas at risk of flooding.
- 2.8. The PPG states that developers and LPAs should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of SuDS. Referencing information provided by the Environment Agency (EA), the PPG provides advice on taking account of climate change, setting out recommended contingency allowances for net sea level rise and peak rainfall intensities. It also advises on flood resilience and resistance measures when dealing with the residual risks remaining after applying the sequential approach and mitigating actions.
- 2.9. The PPG also includes advice on flood risk vulnerability and flood zone compatibility. The following flood zones refer to the probability of river and sea flooding, without the presence of defences:
- Zone 1 - low probability: less than 1 in 1000 annual probability of river or sea flooding (<0.1%) in any year;
 - Zone 2 - medium probability: between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% to 0.1%) or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% to 0.1%) in any year;
 - Zone 3a - high probability: 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability flooding from the sea (>0.5%) in any year; and
 - Zone 3b - the functional floodplain: where water has to flow or be stored in times of flood; identification should take account of local circumstances but would typically flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme 1 in 1,000 (0.1%) flood.

Sequential and Exception Test

- 2.10. The Site is located within Flood Zone 1, and therefore neither the Sequential Test nor Exception Test is required to be applied.

Hinckley & Bosworth Borough Council Core Strategy

- 2.11. The Core Strategy³ was adopted in 2009 and provides the overarching strategy for Hinckley & Bosworth. The Core Strategy requires that *'flood mitigation measures, such as sustainable urban drainage, will need to be incorporated into new developments to ensure this issue is suitably addressed.'*

Hinckley & Bosworth Borough Council Site Allocations and DM Policies DPD

² Ministry of Housing, Communities and Local Government, March 2014. *Planning Practice Guidance*

³ Hinckley and Bosworth Council, December 2009. *Local Development Framework: Core Strategy*.

- 2.12. The Site Allocations and DM Policies DPD⁴ was adopted in July 2016. Policy DM 7 (h) states that ‘...development doesn’t create or exacerbate flooding by being located away from areas of flood risk unless adequately mitigated against in line with National Policy.’

Strategic Flood Risk Assessment for Hinkley & Bosworth Borough Council

- 2.13. This SFRA⁵ was published in 2019 and forms part of the evidence base on flood risk issues to support the production of the Local Plan to 2036. This is a Level 1 Strategic Flood Risk Assessment (SFRA) and it was used to inform decisions on the location of future development and the preparation of sustainable policies for the long-term management of flood risk.

Leicestershire County Council Preliminary Flood Risk Assessment

- 2.14. This PFRA⁶ was published in 2011 in accordance with the Flood Risk Regulations 2009 and provides a high-level summary of significant flood risk across the county based on readily available information.

Leicestershire County Council Local Flood Risk Management Strategy

- 2.15. The Leicestershire County Council Local Flood Risk Management Strategy⁷ (LFRMS) was produced in August 2015. The LFRMS provides an overview and assessment of local flood risk in Warwickshire and how to manage and reduce local flood risk.

⁴ Hinkley and Bosworth Council, July 2016. *Local Plan 2006-2026: Site Allocations and Development Management Policies DPD*.

⁵ JBA, July 2009. 2019s0332 – *Strategic Flood Risk Assessment for Hinkley and Bosworth Borough Council*.

⁶ URS/Scott Wilson, June 2011. *Leicestershire County Council Preliminary Flood Risk Assessment*.

⁷ Leicestershire County Council, August 2015. *Local Flood Risk Management Strategy*.

3. Sources of Potential Flooding

Pluvial

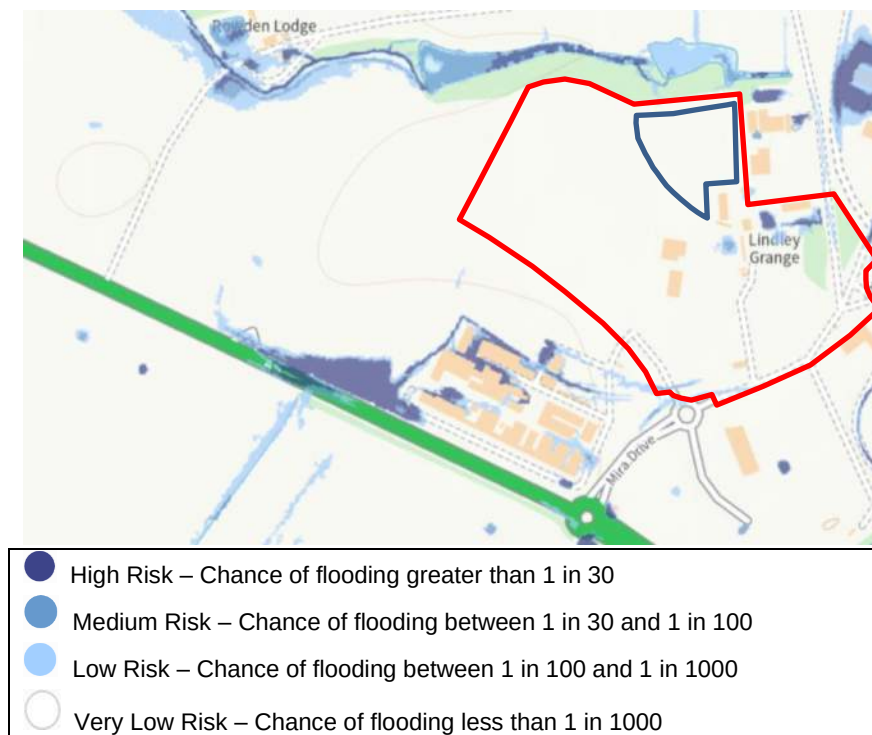
- 3.1. Pluvial flooding occurs when natural and engineered drainage systems lack capacity to manage the volume of rainfall. Pluvial flooding can occur in urban areas during an extreme, high intensity, low duration summer rainfall event which overwhelms the local surface water drainage systems. This flood water would then be conveyed via overland flow routes based on the local topography.

Overland Surface Water

- 3.2. Review of the EA's Flood Risk from Surface Water maps (Figure 2) indicates that the area of proposed development is mostly at 'low' risk of surface water flooding.
- 3.3. There is a small area of the Site to the north, near Rowden Lodge, which is shown to be 'low' to 'moderate' risk. The extent of flooding shown is considered to be attributed to the localised ditch network and associated low spots within the wider site.

The methods used to derive the EA's mapping do not explicitly include the influence watercourses, which often results in an overestimation of the risk of flooding adjacent to the watercourse. The surface water shown to accumulate adjacent to the watercourse would in reality be intercepted by the watercourse and flow away from the site downstream. Nevertheless, no development is shown to be located in the extent of flooding shown by the EA's mapping. Therefore, the risk of flooding to the Development is concluded to be low.

Figure 2: Environment Agency Flood Risk from Surface Water



- LIF 2 Wider Site Location
- Plot 8 & 9 Site Boundary

Source: <https://flood-warning-information.service.gov.uk/long-term-flood-risk>

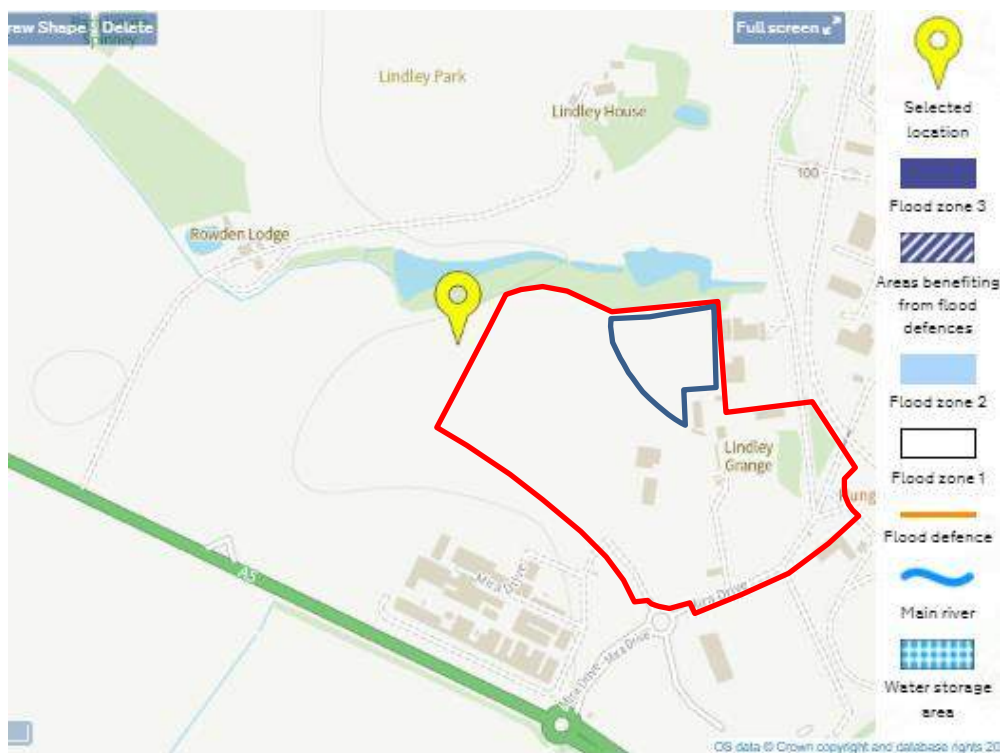
Sewer Flooding

- 3.4. There are no public sewers within the Site. The nearest sewer is located along the A5 to the south of the Site.
- 3.5. The SFRA (map grid B2) shows that there are no historic flooding records at this Site.
- 3.6. The proposals for development also include a surface water drainage system which will be designed to ensure no adverse impact from flooding to users of the Site.
- 3.7. The risk of flooding from sewers is therefore considered to be low.

Fluvial

- 3.8. According to the Environment Agency's (EA) Flood Map for Planning (Figure 3), the Site is located within Flood Zone 1, indicating a low probability (less than 1 in 1000 years) of fluvial flooding.

Figure 3: Environment Agency Flood Map for Planning (Rivers and Sea)



- 3.9. As mentioned above, there is an ordinary watercourse to the north-west of the Site. There is no modelled flood level data available for this watercourse. However, when considering the EA's Flood Risk from Surface Water mapping (Figure 2) as a worst-case scenario, it has been shown that the Development is located outside the extent of flooding shown by the EA's mapping and therefore is considered to be at low risk of flooding from fluvial flooding (Figure 3).

Tidal

- 3.10. According to the Environment Agency's (EA) Flood Map for Planning, the Site is located within Flood Zone 1, indicating a low probability (less than 1 in 1000 years) of tidal flooding.
- 3.11. The Site is located a significant distance from the coastline and is elevated above predicted tidal levels, now and in the future when considering an allowance for climate change.
- 3.12. The risk of flooding from tidal sources is therefore considered to be low.

Groundwater

- 3.13. Based on the underlying geology at the Site (set out in Section 1), the permeability of the ground will be limited. The EA's aquifer designation mapping shows the Site is located on a Secondary B aquifer, with strips of Secondary (undifferentiated) overlain with localised Secondary A aquifers within the superficial deposits. The aquifer is shown to have a low productivity (fissured) on the BGS hydrogeology mapping.
- 3.14. The above is supported by the absence of historic flooding records at the Site shown on map grid B2 of the SFRA.
- 3.15. The proposals for development also do not include any subterranean elements. On this basis, the risk of flooding due to groundwater sources is low.

Artificial Sources

- 3.16. The EA's Flood Risk from Reservoirs mapping (Figure 4) shows the Site to be outside of the area at risk of flooding in the unlikely event of a failure of a reservoir.
- 3.17. A review of OS mapping identifies two ponds to the north of the Site. The Development is elevated above these ponds by a height greater than any anticipated rise in water level.
- 3.18. The risk of flooding due to artificial sources is therefore considered to be low.

Summary

- 3.19. The Site is considered to be at a low risk of flooding from pluvial, fluvial, tidal, groundwater and artificial sources.
- 3.20. The SuDS measures proposed to limit the rate of runoff into the receiving watercourse and ensure no increase risk of pluvial flooding to the surrounding area are presented in Chapter 4.

4. Surface Water Drainage Strategy

Existing Drainage

- 4.1. Severn Trent Water sewer records (Appendix F) indicate that there is a 225mm diameter foul sewer to the south of the Site taking existing Horiba MIRA development. There is no adopted surface water network in the vicinity of the Site. Given the relatively impermeable underlying ground conditions, it is expected that infiltration of surface water runoff is limited. Therefore, the majority of the surface water runoff from the Site currently flows overland using the existing topography of the Site and is intercepted by the ordinary watercourse at the northwest of the site boundary.

Proposed Surface Water Discharge

- 4.2. The proposed surface water drainage system would be designed to convey surface water only, with foul water being discharged separately. The design would be in accordance with BS EN 752 – Drain and Sewer Systems Outside Buildings, BS EN 12056 – Gravity Drainage Systems Inside Buildings, and Approved Document H of Building Regulations.
- 4.3. In line with Building Regulations and the PPG, the following hierarchy of surface water disposal should be adhered to, in decreasing order of preference.
- i. Discharge to ground;
 - ii. Discharge to surface water body;
 - iii. Discharge to a surface water sewer; and
 - iv. Discharge to a combined sewer.

Discharge to Ground

- 4.4. As noted previously, the underlying geology is considered to have low permeability which is expected to be too low to utilise infiltration. On this basis, management of surface water via infiltration is not considered feasible. This assumption will be validated by undertaking infiltration tests as per BRE Digest 365 across the site at the detailed design stage.

Discharge to a Surface Water Body

- 4.5. As noted previously, there is an ordinary watercourse at the northwest of the Site and intercepts surface water runoff from the pre-developed Site. It is therefore proposed that surface water would discharge to this watercourse at the greenfield runoff rate to mimic the existing scenario.

Discharge to a Sewer

- 4.6. As noted above, there are not any adopted surface water sewer in the vicinity of the site. The nearest sewers to the development are designated for foul water only. As a preferable solution for managing the surface water runoff has been identified as mentioned in point 4.5 above, the connection of surface water into the foul sewer has been discounted.

Sustainable Drainage Systems

- 4.7. The most sustainable way to drain surface water runoff is through the use of SuDS, which need to be considered in relation to Site-specific constraints.
- 4.8. SuDS mimic the natural drainage system and provide a method of surface water drainage which can decrease the quantity of water discharged, and hence reduce the risk of flooding. In addition to reducing flood risk, SuDS features can improve water quality, and provide biodiversity and amenity benefits.
- 4.9. A variety of SuDS are available to reduce or temporarily hold back the discharge of surface water runoff. The potential for SuDS was considered throughout the design development. Table 1 outlines the potential SuDS devices and their constraints and opportunities at the Site.

Table 1: Sustainable Drainage Techniques

Device	Description	Constraints/Comments	✓/✗
Green/brown/blue roofs (source control)	Provide soft landscaping at roof level which reduces surface water runoff	Green roofs are not considered viable for the proposed infrastructure related development.	✗
Infiltration devices & Soakaways (source control)	Store runoff and allow water to percolate into the ground via natural infiltration	The underlying geology precludes the potential for infiltration.	✗
Pervious surfaces (source control)	Storm water is allowed to infiltrate through the surface into a storage layer, from which it can either infiltrate and/or slowly release to sewers	Pervious surfacing is to be maximised across the proposed car parks to provide a level of treatment for surface water in addition to attenuation within the sub-base. Due to the underlying geology these would likely to be impermeably lined.	✓
Rainwater harvesting (source control)	Reduces the annual average rate of runoff from the Site by reusing water for non-potable uses e.g. toilet flushing or water butts	There is deemed to be insufficient demand for water to facilitate rainwater harvesting.	✗
Swales (permeable conveyance)	Broad shallow channels that convey / store runoff, and allow infiltration (ground conditions permitting)	Swales are to be utilized to drain part of the proposed service yard to convey surface water runoff with an underground filter pipe.	✗

Device	Description	Constraints/Comments	✓/✗
Filter drains & perforated pipes (permeable conveyance)	Trenches filled with granular materials (which are designed to take flows from adjacent impermeable areas) that convey runoff while allowing infiltration and/or slow release to sewers	Impermeably lined Filter drains will be used with perforated pipe along the access road. Due to the underlying geology these would likely be lined.	✓
Filter Strips (permeable conveyance)	Wide gently sloping areas of grass or dense vegetation that remove pollutants from runoff from adjacent areas	Filter strips are not proposed on Plot 8 & 9 but on the wider development. Filter drains will be used instead.	✗
Infiltration basins (end of pipe treatment)	Depressions in the surface designed to store runoff and allow infiltration through the base	Due to the underlying geology the inclusion of infiltration basins is not deemed feasible.	✗
Bioretention Systems / Rain Garden (end of pipe treatment)	A shallow landscaped depression which allows runoff to pond temporarily on the surface before filtering through vegetation and underlying soils	Bioretention systems/rain gardens could be utilised adjacent to the service yards as both an amenity feature with limited attenuation and to reduce pollution indices.	✓
Detention Basins	Depressions in the surface designed to store runoff without infiltration through the base	Detention basins are proposed within the wider scheme (LIF 2 Infrastructure works) to attenuate surface water whilst providing amenity and environmental benefits, including treating surface water runoff before discharging to the watercourse.	✓
Attenuation Underground (end of pipe treatment)	Oversized pipes or geo-cellular tanks designed to store water below ground level	A below ground geo-cellular attenuation tank is proposed to attenuate runoff.	✓

Proposed Surface Water Drainage Strategy

- 4.10. This report sets out the principles of the SuDS scheme, and the final strategy would be confirmed at the detailed design stage.
- 4.11. The total Site area within the red line boundary is circa 1.8 ha with 1.57 ha being impermeable surfaces draining into the surface water system. The surface water strategy for Plot 8 & 9 will rely on

an outfall built as part of the LIF 2 Infrastructure works, which then discharges into the existing watercourse. The outline drainage strategy layout in Appendix C shows the indicative location of the proposed outfall to the southwestern side of the Plot 8 + 9 boundary into the LIF 2 strategic infrastructure works.

- 4.12. The following strategy has been developed based on the indicative site plan (Appendix B) which shows that the development will increase the impermeable area within the Site than existing greenfield scenario.
- 4.13. The greenfield runoff rate calculated for the Site is in line with the IoH124 method is 4.40 l/s/ha.
- 4.14. The surface water discharge rate from all of the future plots over the LIF2 development, including Plot 8 + 9, will be restricted to Qbar rate, maintaining the final discharge from the site wide discharge rate to remain at Qbar rate.
- 4.15. A preliminary hydraulic model for Plot 8 & 9 has been designed in Microdrainage Windes allowing the proposed hardstanding areas related to the infrastructure works and peak flow rates from Plot 8 & 9 to estimate the pipe sizes and the required attenuation within the site boundary. See Table 2 and Appendix D for calculations.

Table 2: Impermeable area and limiting greenfield discharge rate for Plot 8 & 9

	Impermeable Area (ha)	Greenfield Runoff Rate (QBAR)	Proposed Restricted Runoff Rate (l/s)
Plot 8 & 9	1.57	6.9	6.0* <i>[lower as agreed in LIF 2 submission]</i>

- 4.16. The required volume of attenuation has been established using MicroDrainage Network module based on a rainfall event of 1 in 100-year storm including a 40% allowance for climate change. The strategy has also been assessed for the 1 in 2 year and 1 in 30-year return period event.
- 4.17. The following assumptions have been made in deriving the outline drainage strategy:
 - CIRIA SuDS Manual Section 24.7.2 recommends allowing Urban Creep for residential developments. The proposed development is a commercial refurbishment and any amendments to the proposal is via a planning permission. Considering its confined nature, the Urban Creep is not applicable on this scheme.
 - No above ground flooding occurs for the 1 in 100-year event including a 40% allowance for climate change. The flooding will use the overland flood route through the proposed roads and discharge into the swale.
 - For the lower duration storm events (15 mins and 30 mins storm duration), the FSR methodology has been used and the longer duration (60 mins and longer), FEH methodology has been used. Both critical durations for each of these methodologies have been outputted in Appendix D.
 - Attenuation and flow restriction will be provided for each of the future plots.

Long Term Storage

- 4.18. Long-term storage aims to address the additional volume of runoff from extreme events caused by

the development when compared to pre-development runoff volume. The post-development runoff volume will remain less than the pre-development runoff volume. Calculations are shown in Appendix D below. Hydraulic calculations showing the outcome of the pre and post development runoff volume, derived using 1 in 100-year 6-hour storm duration, are included in Appendix D.

Table 3: Runoff Volume Comparison – Pre & Post Development

Pre-Development Runoff Volume	Post-Development Runoff Volume
451 m ³	211 m ³
Post-Development Runoff Volume < Pre-Development Runoff Volume	

Interception

- 4.19. BS 8582 requires that the first 5mm of rainfall should be prevented from leaving the site. This is called “interception” and the benefits are that the run-off characteristics of the site will more closely reflect greenfield runoff rate behaviour and that the pollution load from small events, which is proportionally higher, will be contained on site. All the surface water runoff generated by the proposed development will be disposed via one of or a combination of trapped gullies, catchpit sumps, permeable paving, swale, filter trenches and detention basins. The proposed drainage network includes a variety of SuDS features, which provides pollution mitigation at source level that prevents the surface water runoff generated by the first rainfall to depths up to 5mm leaving from the site.

Water Quality

- 4.20. During normal operation of the Site, given the nature of the proposals the pollution hazard as outlined in Table 26.2 of the CIRIA SuDS Manual would be classed as medium level. It is therefore important that the proposed drainage strategy is designed to mitigate the potential for contamination.
- 4.21. Appropriate treatment would be incorporated into the drainage system to ensure that the quality of water discharged is acceptable. This would be achieved through the incorporation of a variety of SuDS features such as permeable paving, swale, filter trenches and detention basins. The pollution hazard and proposed mitigation indices, based on the CIRIA SuDS manual, are set out in Table 4, Table 5 and Table 6 below, this confirms that the quality of water discharged from the Site would be appropriate.

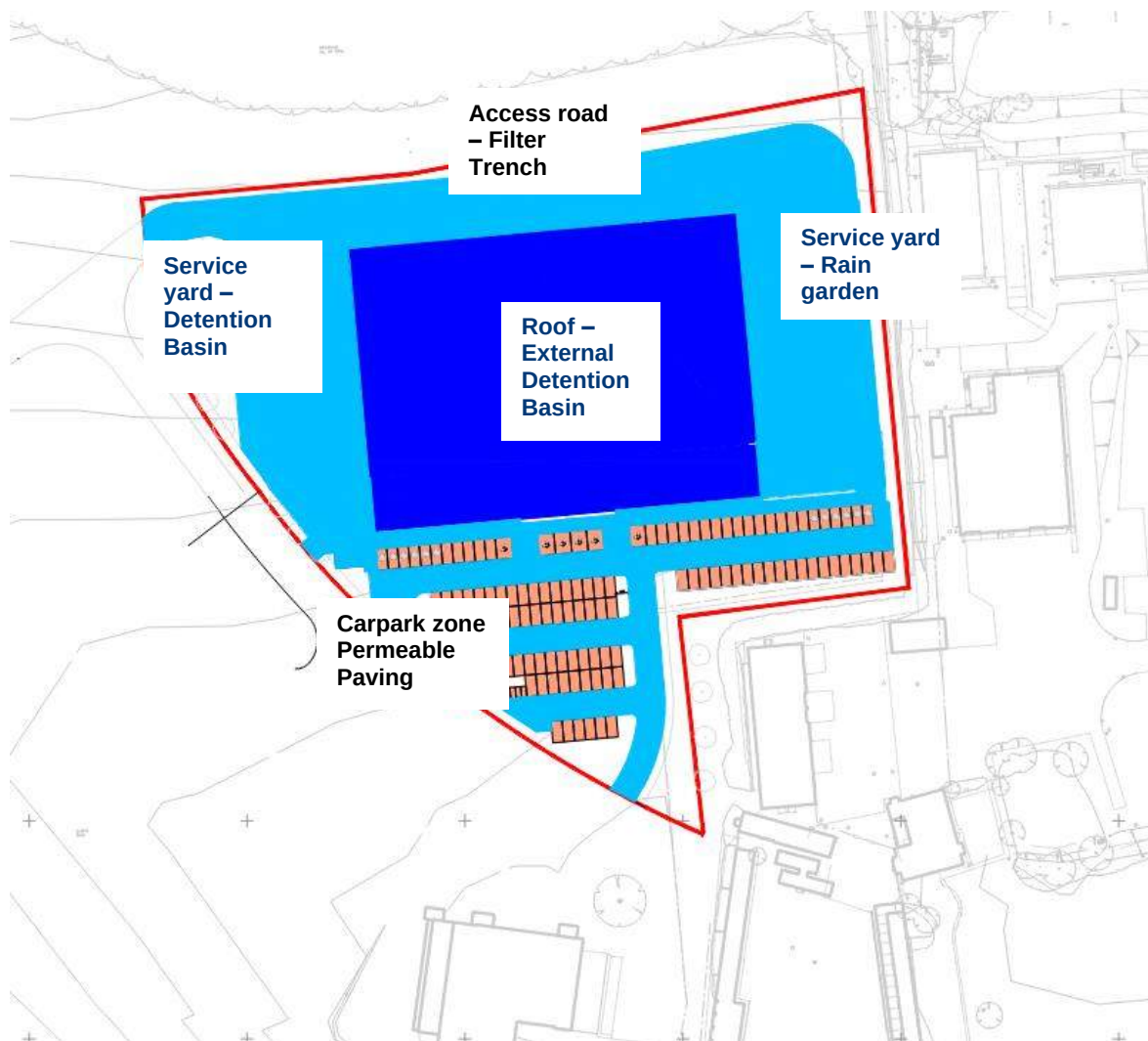


Figure 4: Catchment summary for mitigation measures

Table 4: Pollution Hazard Indices

Catchment Type	Pollution Hazard Level	Requirements for Discharge to Surface Waters	Pollution Hazard Indices		
			Suspended Solids	Metals	Hydro-Carbons
Commercial Roof	Low	Simple Index Approach	0.3	0.2	0.05
Commercial Yard and Delivery Areas	Medium	Simple Index Approach	0.7	0.6	0.7

and Parking						
Access Road (<300 vehicles/day)	Low	Simple Index Approach	0.5	0.4	0.4	

Table 5: Pollution Mitigation Indices

Catchment Type	Pollution Hazard Indices		
	Suspended Solids	Metals	Hydro-Carbons
Impermeably Line Permeable Paving	0.7	0.6	0.7
Infiltration Trench	0.4	0.4	0.4
Rain garden	0.8	0.8	0.8
Detention Basin	0.5	0.5	0.6

Table 6: Total SuDS Mitigation Indices

Catchment Type	Pollution Hazard Level	First Stage	Second Stage	Pollution Hazard Indices		
				Suspended Solids	Metals	Hydro-Carbons
Commercial Roof	Low	Site Wide Detention Basin		0.5	0.5	0.6
Eastern Service Yard	Medium	Rain garden	Site Wide Detention Basin	1.0*	1.0*	1.0*
Western Service Yard	Medium	Detention Basin	Site Wide Detention Basin	0.75	0.75	0.9
Access Road	Low	Filter Trench	Site Wide Detention	0.65	0.65	0.70

Basin							
Car Parking Bays	Medium	Permeable Paving	Site Wide Detention Basin	1.0*	0.85	1.0*	

* Maximum mitigation indices have been kept as 1.0.

Management Plan

- 4.22. The on-Site drainage network and SuDS would be privately managed and maintained for the lifetime of the development, ensuring that they remain fit for purpose and function appropriately. The management company/operator would be appointed post-planning.
- 4.23. The CIRIA SuDS Manual sets out the requirement for developers to consider the operation, management and maintenance of all SuDS.
- 4.24. Post construction, Horiba MIRA Estates Department will be responsible for the SuDS included in the scheme. 7 outlines what maintenance is anticipated for the proposed SuDS features.

Table 7: Indicative SuDS Maintenance Regime

SuDS	
Task	Frequency
Pervious Surfaces	
- Stabilise and mow contributing adjacent areas - Removal/management of weeds - Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving - Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
Initial sweeping	Monthly for 3 months after installation
Inspect for evidence of poor operation and/or weed growth	Three-monthly, 48 hours after large storms in first 6 months
Brushing and vacuuming	Once a year (after autumn) or as required
- Inspect silt accumulation rates and establish appropriate brushing frequencies - Monitor inspection chambers	Annually
Rehabilitation of surface and upped substructure removed by remedial sweeping	Every 10-15 years or as required
Swale & Detention Basin	
- Reseed areas of poor vegetation growth - Repair erosion or other damage by reseedling or re-turfing - Repair/rehabilitation of inlets, outlets and overflows - Relevel uneven surfaces and reinstate design levels	As required
- Remove litter and debris - Inspect inlets, outlets and overflows for blockages and clear if needed - Inspect banksides, structures, pipework etc for physical damage - Cut grass for access routes - Manage other vegetation and remove nuisance plants - Inspect inlets and facility surface for silt accumulation	Monthly

SuDS	
Task	Frequency
Cut grass in and around basin	Six Monthly
- Check any penstocks and other mechanical devices - Tidy all dead growth before start of growing season - Remove sediment from inlets, outlet and forebay - Manage wetland plants where provided	Annually
Remove sediment from inlets, outlets, forebay and main basins where required	Every 5 years or as required
Filter Trench	
- Remove litter and debris from surface - Inspect filter drain surface, inlet/outlet pipework from access chamber	Monthly
- Remove or control tree roots where they are encroaching the sides of the filter drain - Clear perforated pipework of blockages	As required
Underground Attenuation	
Inspection of silt traps, manholes and pipework, and remove any sediment/debris	Quarterly or as required
Jetting of main structure to remove any sediment build up	Annually or as required
Flow Control Device	
Inspection flow control manhole	Quarterly or as required for first year and then every six monthly

Defra Non-Statutory Technical Standards for SuDS

- 4.25. In March 2015 Defra produced Non-statutory Technical Standards for Sustainable Drainage Systems. 8 shows how this development will comply with the non-technical standards. Reference to the full standards on-line, will be required for a full understanding.

Table 8: Defra Technical Standards Compliance

Ref	DEFRA Title	Proposed Restricted Runoff Rate (l/s)
S1	Flood Risk Outside Development	Not applicable as peak flow will be restricted to the greenfield runoff rate, Qbar

Ref	DEFRA Title	Proposed Restricted Runoff Rate (l/s)
S2	Peak Flow Control	Compliant: Peak flow will be restricted to the greenfield runoff rate, Qbar
S3	Peak Flow Control	Not applicable as the existing site is greenfield
S4	Volume Control	Compliant: post development's greenfield volume will be lower than the predevelopment site
S5	Volume Control	Not applicable as the existing site is greenfield
S6	Volume Control	Not applicable as the site is compliant to S4
S7	Flood Risk Within Development	Compliant: The development will not flood any surface areas for the 1:30 year event
S8	Flood Risk Within Development	Compliant: The development is designed to flood only specified contained surface areas to a limited extent for the 1:100 year plus 40% CC event. Other building areas are a minimum of 150mm above surrounding ground levels and will not flood for the 1:100 year event.
S9	Flood Risk Within Development	Compliant: Exceedance routes are designed into the layout by level design avoiding buildings and allowing excess water to flow overground towards swale, basin and existing ditches.
S10	Structural Integrity	All drainage components design life is 100 years with the exception of filter media which is designed to be replaced periodically.
S11	Structural Integrity	All drainage products will be of a suitable nature and quality for their intended use.
S12	Designing for Maintenance Considerations	Compliant, as no surface water pumping is proposed.
S13	Construction	Connections to the existing drainage system will be done at an existing watercourse and will be agreed with the LLFA via a drainage consent
S14	Construction	Connections to the existing drainage system will be done at an existing watercourse and will be agreed with the LLFA via a drainage consent

5. Proposed Foul Drainage Strategy

- 5.1. The proposed foul drainage would be designed in accordance with BS EN 752 – Drain and Sewer Systems Outside Buildings, BS EN 12056 – Gravity Drainage Systems Inside Buildings, and Approved Document H of Building Regulations.
- 5.2. An existing 225mm diameter adopted foul sewer is located at the south of the Site, which discharges the existing MIRA development. Severn Trent Water are proposing a new trunk sewer further downstream of the site to improve capacity of their foul water infrastructure.
- 5.3. The proposed external infrastructure development will provide foul water network connection to the proposed plot. The proposed site wide foul water drainage network will be connected into an existing Severn Trent Water's foul sewer manhole, MH0350, at the southern boundary of the Horiba MIRA site.
- 5.4. The estimated population from Plot 8 & 9 is summarised in Table 9 below. The peak flow rate has been calculated using the daily water consumption provided for Office Buildings in British Water's Code of Practice, Flows and Loads – 4. Based on water usage of 50 l/day/person for an office building, the average flow will remain 0.25 l/s and the peak flow (6 x DWF) will remain circa 1.60 l/s. For LIF 2 Northern Masterplan (Plots 6 to 11) the total population will remain in circa 1,325 people, which will generate a peak flow of 5 l/s. Severn Trent confirmed their approval to this overall proposed population and peak flow into their sewer. A formal Section 106 application for the connection will be made at a later stage of the Plot 8 & 9 design works.

Table 9: Estimated Population for Plot 8 & 9 and foul water flow rate

	Estimated Population	Peak Foul discharge rate (l/s)
Plot 8	231	0.80
Plot 9	228	0.80
Total	459	1.60

6. Conclusions

- 6.1. It has been demonstrated there is a low risk of flooding from fluvial, tidal, pluvial, fluvial, groundwater and artificial sources on the proposed site.
- 6.2. The existing undeveloped site's runoff flows towards west where it intercepts with the existing unnamed watercourse. The runoff from the proposed development will be restricted to QBAR through the use of SuDS, mimicking the existing scenario.
- 6.3. It is proposed to utilise a range of SuDS including permeable paving, swales, filter strip and underground storage tanks to attenuate runoff from the development. The external surface water network that will be installed as part of LIF 2 Infrastructure works will include detention basins. The proposed development on Plot 8 & 9 will provide foul water and surface water drainage to connect into the site wide infrastructure drainage from the LIF 2 works. Plot 8 & 9 will be restricted to the Greenfield Runoff Rate, Qbar, of 6 l/s. The surface water runoff will be connected into the existing ditch at the northwest boundary of the entire site at the overall Greenfield Runoff Rate, Qbar. A formal drainage consent will be obtained from the LLFA at a later stage of the design, prior to connection being made. A preliminary hydraulic model has been designed to estimate the sizes of the pipes and attenuation, which will be validated through a detailed drainage design at a later stage.
- 6.4. Using the CIRIA pollution indices methodology, it has been established that the development has a medium to high hazard rating for the external infrastructure, but that the proposed SuDS will provide sufficient level of treatment for runoff through the use of permeable surfacing, swales, rain gardens, and detention basins. A company will be appointed to manage the proposed SuDS, and details of typical maintenance measures have been included within this report.
- 6.5. The foul water drainage infrastructure will be provided for Plot 8 & 9 as part of the infrastructure proposal with spur connection at the plot boundary and will be coordinated with the design teams. Severn Trent Water has confirmed approval to the proposed peak flow from Plots 6 to 11 as part of the wider masterplan development within the MIRA site. A Section 106 application for connection will be made at a later stage of the design.
- 6.6. In conclusion, the Site is at a low risk of flooding and will not increase the risk of flooding elsewhere as a result of the proposed SuDS strategy, in line with the requirements of local and national planning policy.

APPENDICES

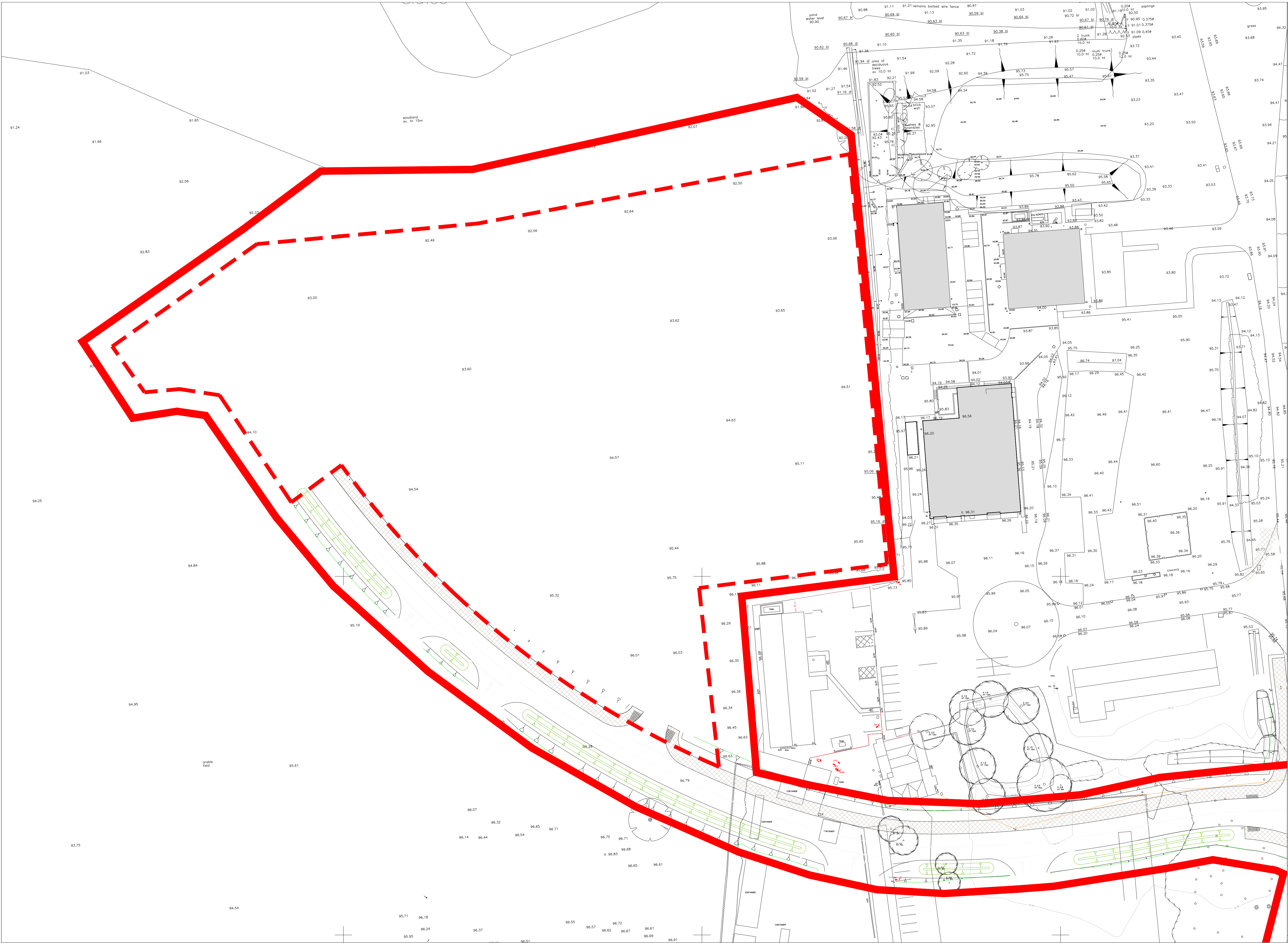
A. Topographic Survey

Appendices

MIRA Technology Park – Plot 8 & 9 part of the LIF 2 Northern Masterplan

Project Number: EED13833-120

Document Reference: EED13833-120-R-1.1.2-FRA



— Planning boundary
- - - Site boundary

Rev.	Description	Drawn Date
A	Reserve matters planning submission	NC 08.07.22

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Client **ERI MTP LTD**

Project **Plot 8&9**

Title **Existing Site Plan**

DATE	04.07.2022	CHECK STAGE	PLANNING
DRAWN	SM	CHECK DATE	.
SCALE	1:500 @ A1	CHECKED BY	.

21.016(P)100 **A**

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