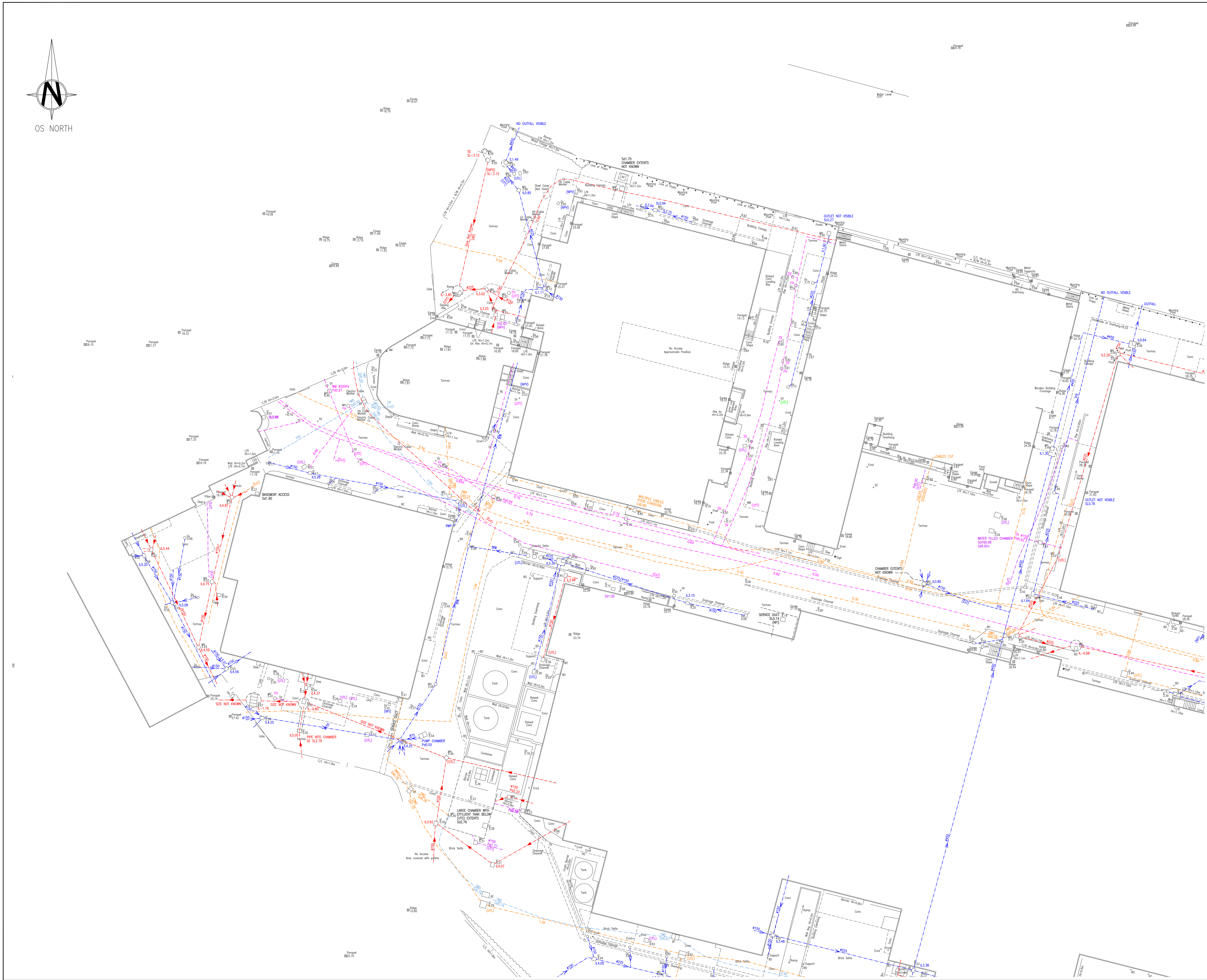
Appendix E – GPR Survey



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NOTES

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3. REFER TO REPORT NO. A108750-1 UTILITIES SURVEY REPORT

TOPO LEGEND

AM	AERIAL MAST	IC/WO	INSPECTION COVER WASH OUT
AC	AIR CONDITIONING UNIT	IL:	INVERT LEVEL
AV	AIR VALVE	TJ	TRACK JOINT
BB	BELISHA BEACON	KO	KERB OUTLET
BL:	BED LEVEL	LAD	LADDER
BM	BENCHMARK	LB	LITTER BIN
B	BOLLARD	LDA	LAY DOWN AREA
BH	BOREHOLE	LP	LAMP POST
BS	BUS STOP	mE	METRES EAST
CAB	CABINET	MH	MANHOLE
CAB/BT	CABINET BRITISH TELECOM.	MHW	MEAN HIGH WATER LEVEL
CAB/EL	CABINET ELECTRIC	MLW	MEAN LOW WATER LEVEL
CAM	CAMERA	mN	METRES NORTH
CAL:	CANOPY LEVEL	MP	MARKER POST
CB	CRASH BARRIER	MP/BT	MARKER POST BRITISH TELECOM.
CBL	CABLE	MP/EL	MARKER POST ELECTRIC
CD	CHANNEL DRAIN	MP/GA	MARKER POST GAS
CDC	CONC. DUCT COVER	MP/WA	MARKER POST WATER
CHS	CHEMICAL OIL STORE	NB	NOTICE BOARD
CLM	COLUMN	NP	NAME PLATE
CNB	CONCRETE BASE	OH	OVERHEAD ITEMS
CNP	CONCRETE PLINTH	OHBT	OVERHEAD BRITISH TELECOM.
CONC.	CONCRETE	OHCBL	OVERHEAD CABLES
CP	CATCHPIT	OHPI	OVERHEAD PIPES
CPL:	CROWN PIPE LEVEL	OHPL	OVERHEAD POWER LINES
CPS	CONC. PIPE SUPPORT	OHPS	OVERHEAD PIPE SUPPORT
CT	CABLE TRAY	OHPB	OVERHEAD PIPEBRIDGE
DB	DROP BARRIER	OHPBS	OVERHEAD PIPEBRIDGE SUPPORT
DBB	DROP BARRIER BOX	P	POLE
DBP	DROP BARRIER POST	PB	POINTS BOX
DK	DROP KERB	PC	PEDESTRIAN CROSSING
DR	DERAILER	PCN	POINT CROSSING NOSE
EEB	EMERGENCY EQUIPMENT BOX	PD	POINTS DETECTOR
EMS	EMERGENCY SHOWER	PL	PEDESTRIAN LIGHTING BOLLARD
EL:	EAVES LEVEL	PLR	POINTS LEVER
EP	ELECTRIC POLE	PM	POINT MOTOR
ER	EARTH ROD	PBX	POST BOX
FBEDS	FLOWER BEDS	PO	POST
FE	FIRE EXTINGUISHER	PR	POINT RODS
FECL	CHAINLINK FENCE	PS	PIPE SUPPORT
FEHE	TEMP. HERAS FENCE	RE	RODDING EYE
FEPA	PANEL FENCE	RGS	PEDESTRIAN BARRIER
FEPE	PALISADE FENCE	RIL:	RIDGE LEVEL
FEPW	POST & WIRE FENCE	RL:	ROOF LEVEL
FEPR	POST & RAIL FENCE	RP	REFLECTOR POST
FEWM	WELDMESH FENCE	RS	ROAD SIGN
FH	FIRE HYDRANT	RSD	ROLLER SHUTTER DOOR
FL	FLOOD LIGHT	RTW	RETAINING WALL
FL:	FLOOR LEVEL	RWP	RAIN WATER PIPE
FP	FOOTPATH	S	SCAR LINES
FS	FLAG STAFF	SD	SLIDING DOOR
G/S/H	TREE GIRTH SPREAD HEIGHT	SIG	RAIL SIGNAL
GAD	GATE DOUBLE	SL:	SOFFIT LEVEL
GAS	GATE SINGLE	SN	GENERAL SIGN
GATS	GATE TURNSTILE	SR	SPEED RESTRICTOR
GB	GRIT BIN	SRK	SPILL RESPONSE KIT
GBS	GAS BOTTLE STORE	STI	STILE
GDC	GRATED DUCT COVER	ST	STOP TAP
GP	GRADIENT POST	STHDR	STEPS WITH HANDRAIL
GRP	GREASE POINT	SV	STOP VALVE
GV	GAS VALVE	SVP	SOIL VENT PIPE
GY	GULLY	SW	STAY WIRE
HDR	HANDRAIL	TEL	TELEPHONE
HR	HEIGHT RESTRICTOR	TFL	TRAFFIC LIGHT
Ht.	HEIGHT	TL:	THRESHOLD LEVEL
IB	INSPECTION BOX (NOT BURIED)	TP	TELEGRAPH POLE
IC	INSPECTION COVER UNKNOWN	TS	TREADLE SWITCH
IC/BH	INSPECTION COVER BOREHOLE	US:	UNDERSIDE LEVEL
IC/BT	INSPECTION COVER BRITISH TELECOM.	UP	DIRECTION OF INCLINE
IC/FH	INSPECTION COVER FIRE HYDRANT	VP	VENT PIPE
IC/EL	INSPECTION COVER ELECTRIC	WJ	WELD JOINT
IC/GA	INSPECTION COVER GAS	WL:	WATER LEVEL
IC/SL	INSPECTION COVER STREET LIGHT	WP	WASTE PIPE
IC/WA	INSPECTION COVER WATER	WYGXXX	SURVEY STATION

GPR/UTILITIES LEGEND

FOUL DRAINAGE	FW — FW
SURFACE WATER DRAINAGE	SW — SW
WATER	W — W
GAS	GAS — GAS
HV ELECTRICITY	HV — HV
LV ELECTRICITY	LV — LV
BT / OPENREACH	BT — BT
UNKNOWN SERVICE	UK — UK
UNDERGROUND CHAMBER	[- - - - -]

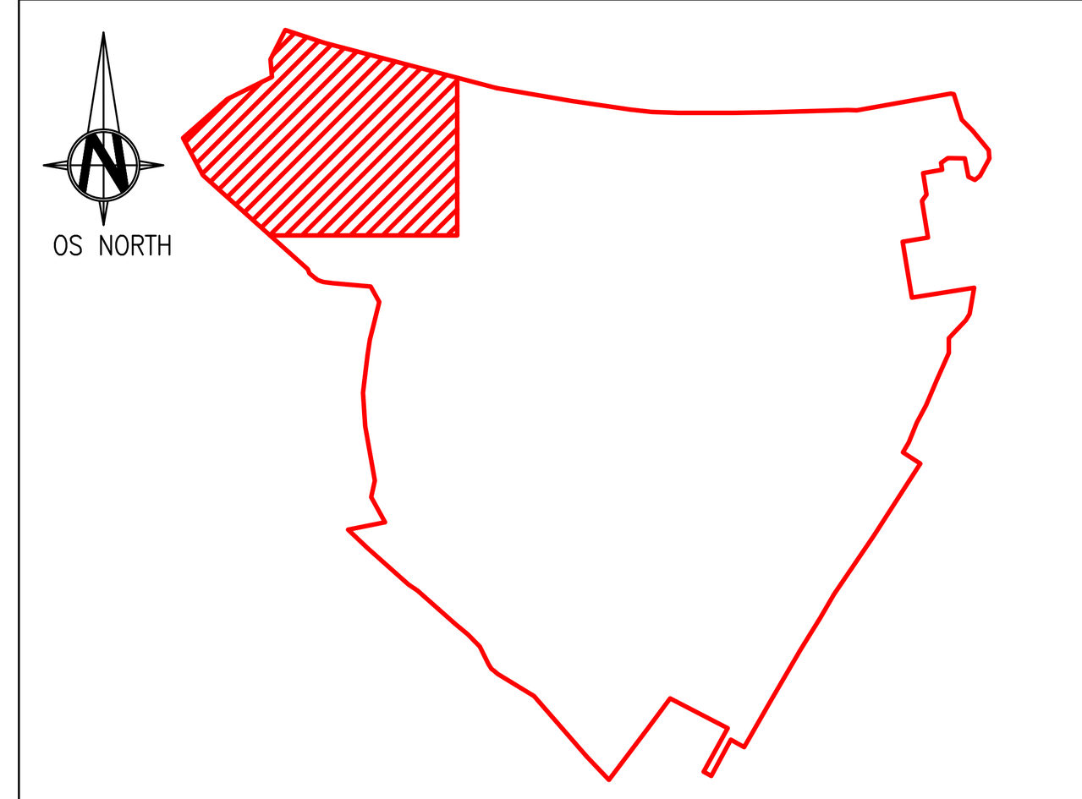
(AC)	ASSUMED CONNECTION
(AR)	ASSUMED ROUTE
BdL	BACK-DROP LEVEL
Cd	CABLE DEPTH
CR	CABLE RISER
d	DEPTH OF SERVICE (APPROX)
Dd	DUCT DEPTH
DT	DISCONNECTING TRAP
(ET)	ELECTRONICALLY TRACED
(EoT)	END OF TRACE
Id	INVERT DEPTH
IL	INVERT LEVEL
HV	HIGH VOLTAGE
LD	LAND DRAIN
LV	LOW VOLTAGE
(NFI)	NO FURTHER INFORMATION
(NPV)	NO PIPES VISIBLE
Pd	PIPE DEPTH
Pe	POLYETHYLENE
PR	PIPE RISER
Sd	SUMP DEPTH
SL	SUMP LEVEL
(UTL)	UNABLE TO LIFT
(UTS)	UNABLE TO SURVEY
(UTT)	UNABLE TO TRACE
WD	WAY-DUCT

ASSOCIATED DRAWINGS

WYG001 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 1 OF 9 (THIS DRAWING)
WYG002 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 2 OF 9
WYG003 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 3 OF 9
WYG004 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 4 OF 9
WYG005 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 5 OF 9
WYG006 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 6 OF 9
WYG007 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 7 OF 9
WYG008 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 8 OF 9
WYG009 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 9 OF 9

LOCATION PLAN

HATCHED AREA SHOWN IN THIS DRAWING – BOLD LINE DEFINES SURVEY EXTENT



REV	DESCRIPTION	BY	CHK	APP	DATE

0 2 4 6 8 10 m
SCALE 1:200

LAKELAND BUSINESS PARK
LAMPLUGH ROAD
COCKERMOUTH
CA13 0QT

TEL: +44 (0)1900 898 600
FAX: +44 (0)1900 826 324
e-mail: cumbria@wyg.com

Project:

Carrow Works
Norwich
NR1 2DD

Drawing Title:

UTILITIES SURVEY
SHEET 1 OF 9

Scale @ A0	Drawn	Date	Checked	Date	Approved	Date
1 : 200	MD	22/11/18	DR	22/11/18	DR	22/11/18

Project No.	Office	Type	Drawing No.	Revision
A108750-1	22	01	WYG001	A

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TOPO LEGEND

AM	AERIAL MAST	IC/WO	INSPECTION COVER WASH OUT
AC	AIR CONDITIONING UNIT	IL:	INVERT LEVEL
AV	AIR VALVE	TJ	TRACK JOINT
BB	BELISHA BEACON	KO	KERB OUTLET
BL:	BED LEVEL	LAD	LADDER
BM	BENCHMARK	LB	LITTER BIN
B	BOLLARD	LDA	LAY DOWN AREA
BH	BOREHOLE	LP	LAMP POST
BS	BUS STOP	mE	METRES EAST
CAB	CABINET	MH	MANHOLE
CAB/BT	CABINET BRITISH TELECOM.	MHW	MEAN HIGH WATER LEVEL
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CAL:	CANOPY LEVEL	MP	MARKER POST
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CDC	CONC. DUCT COVER	MP/WA	MARKER POST WATER
CHS	CHEMICAL OIL STORE	NB	NOTICE BOARD
CLM	COLUMN	NP	NAME PLATE
CNB	CONCRETE BASE	OH	OVERHEAD ITEMS
CNP	CONCRETE PLINTH	OHBT	OVERHEAD BRITISH TELECOM.
CONC.	CONCRETE	OHCBL	OVERHEAD CABLES
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DR	DERAILER	PCN	POINT CROSSING NOSE
EEB	EMERGENCY EQUIPMENT BOX	PD	POINTS DETECTOR
EWS	EMERGENCY SHOWER	PL	PEDESTRIAN LIGHTING BOLLARD
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EP	ELECTRIC POLE	PM	POINT MOTOR
ER	EARTH ROD	PBX	POST BOX
FBEDS	FLOWER BEDS	PO	POST
FE	FIRE EXTINGUISHER	PR	POINT RODS
FECL	CHAINLINK FENCE	PS	PIPE SUPPORT
FEHE	TEMP. HORAG FENCE	RE	RODDING EYE
FEPA	PANEL FENCE	ROS	PEDESTRIAN BARRIER
FEPL	PALISADE FENCE	RIL:	RIDGE LEVEL
FEPW	POST & WIRE FENCE	RL:	ROOF LEVEL
FEPR	POST & RAIL FENCE	RP	REFLECTOR POST
FEWM	WELDMESH FENCE	RS	ROAD SIGN
FH	FIRE HYDRANT	RSD	ROLLER SHUTTER DOOR
FL	FLOOD LIGHT	RTW	RETAINING WALL
FL:	FLOOR LEVEL	RWP	RAIN WATER PIPE
FP	FOOTPATH	S	SCAR LINES
FS	FLAG STAFF	SD	SLIDING DOOR
G/S/H	TREE GIRTH SPREAD HEIGHT	SG	RAIL SIGNAL
GAD	GATE DOUBLE	SL:	SOFFIT LEVEL
GAS	GATE SINGLE	SN	GENERAL SIGN
GATS	GATE TURNSTILE	SR	SPEED RESTRICTOR
GB	GRIT BIN	SRK	SPILL RESPONSE KIT
GBS	GAS BOTTLE STORE	STI	STILE
GDC	GRAVED DUCT COVER	ST	STOP TAP
GP	GRADIENT POST	STHDR	STEPS WITH HANDRAIL
GRP	GREASE POINT	SV	STOP VALVE
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IC/BH	INSPECTION COVER BOREHOLE	US:	UNDERSIDE LEVEL
IC/BT	INSPECTION COVER BRITISH TELECOM.	UP	DIRECTION OF INCLINE
IC/FH	INSPECTION COVER FIRE HYDRANT	VP	VENT PIPE
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IC/GA	INSPECTION COVER GAS	WL:	WATER LEVEL
IC/SL	INSPECTION COVER STREET LIGHT	WP	WASTE PIPE
IC/WA	INSPECTION COVER WATER	WYGXXX	SURVEY STATION

GPR/UTILITIES LEGEND

FOUL DRAINAGE	FW	(AC)	ASSUMED CONNECTION
SURFACE WATER DRAINAGE	SW	(AD)	ASSUMED ROUTE
WATER	W	CA	CABLE ABOVE GROUND LEVEL
GAS	GAS	CB	CABLE BURIED
HV ELECTRICITY	HV	d	DEPTH OF SERVICE (APPROX)
LV ELECTRICITY	LV	Dd	DUCT DEPTH
BT / OPENREACH	BT	DT	DISCONNECTING TRAP
UNKNOWN SERVICE	UK	(ET)	ELECTRONICALLY TRACED
UNDERGROUND CHAMBER		(EoT)	END OF TRACE
		id	INVERT DEPTH
		IL	INVERT LEVEL
		(NF)	NO FURTHER INFORMATION
		(NPV)	NO PIPES VISIBLE
		Pd	PIPE DEPTH
		Pe	POLYETHLENE
		Sd	SUMP DEPTH
		SL	SUMP LEVEL
		(UTL)	UNABLE TO LIFT
		(UTT)	UNABLE TO TRACE
		WD	WAY-DUCT

ASSOCIATED DRAWINGS

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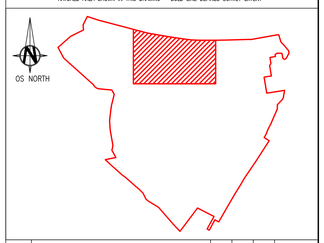


REV	DESCRIPTION	BY	CHK	APP	DATE

0 2 4 6 8 10 m
SCALE 1:200

LAKELAND BUSINESS PARK
LAMPLUGH ROAD
COCKERMOUTH
CA13 0QT

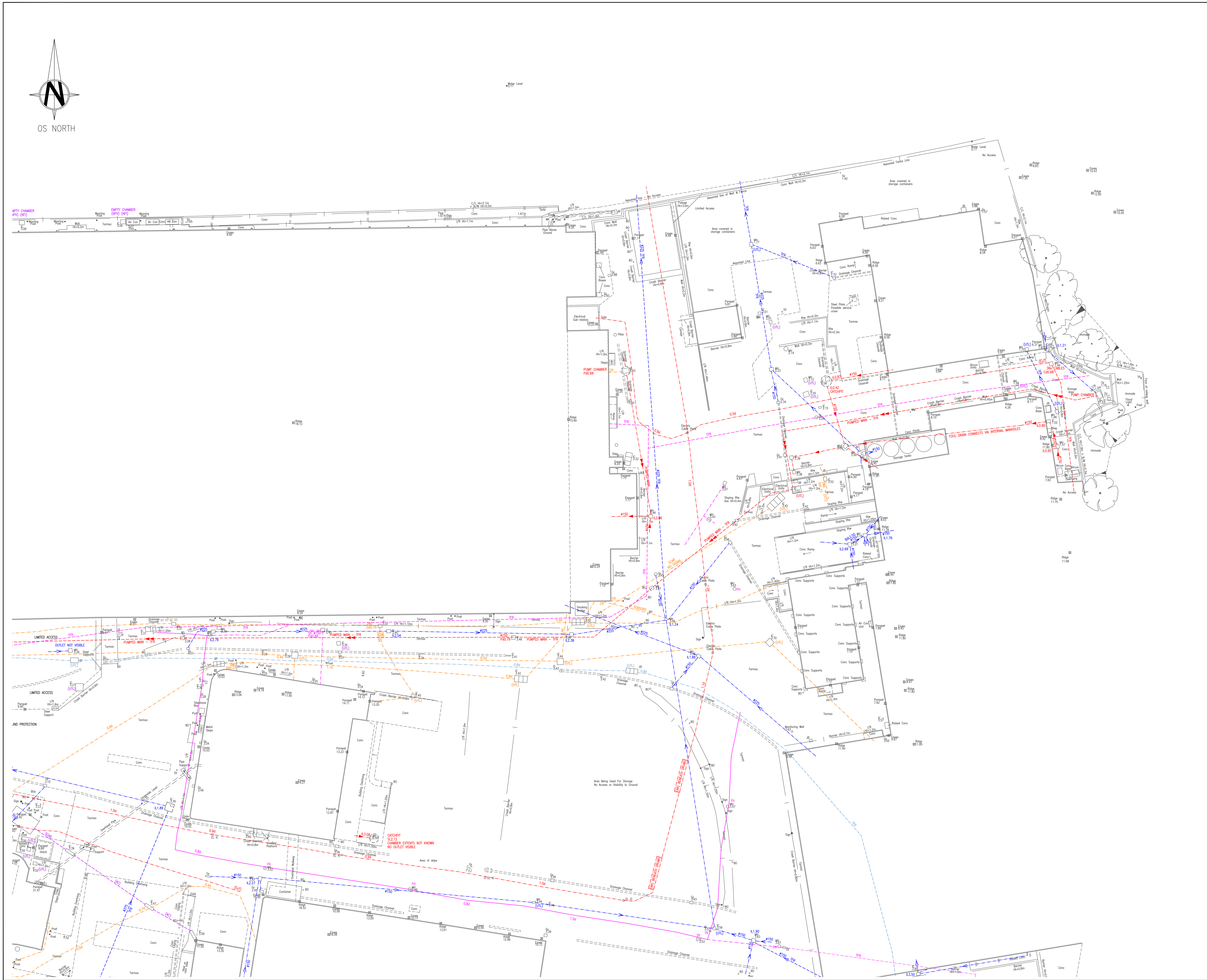
TEL: +44 (0)1900 898 600
FAX: +44 (0)1900 826 324
e-mail: cumbria@wyg.com

Project:
Carrow Works
Norwich
NR1 2DD

Drawing Title:
UTILITIES SURVEY
SHEET 2 OF 9

Scale @ A0	Drawn Date	Checked Date	Approved Date
1 : 200	MD 22/11/18	DR 22/11/18	DR 22/11/18

Project No.	Office	Type	Drawing No.	Revision
A108750-1	22	01	WYG002	A



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AC	AIR CONDITIONING UNIT	IL:	INVERT LEVEL
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GPR/UTILITIES LEGEND

FOUL DRAINAGE	FW ▶ FW
SURFACE WATER DRAINAGE	SW > SW
WATER	W W
GAS	GAS GAS
HV ELECTRICITY	HV HV
LV ELECTRICITY	LV LV
BT / OPENREACH	BT BT
UNKNOWN SERVICE	UK UK
UNDERGROUND CHAMBER	

(AC)	ASSUMED CONNECTION
(AR)	ASSUMED ROUTE
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DT	DISCONNECTING TRAP
(ET)	ELECTRONICALLY TRACED
(EoT)	END OF TRACE
Id	INVERT DEPTH
IL	INVERT LEVEL
HV	HIGH VOLTAGE
LD	LAND DRAIN
LV	LOW VOLTAGE
(NFI)	NO FURTHER INFORMATION
(NPV)	NO PIPES VISIBLE
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PR	PIPE RISER
Sd	SUMP DEPTH
SL	SUMP LEVEL
(UTL)	UNABLE TO LIFT
(UTS)	UNABLE TO SURVEY
(UTT)	UNABLE TO TRACE
WD	WAY-DUCT

ASSOCIATED DRAWINGS

WYG001 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 1 OF 9
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LOCATION PLAN

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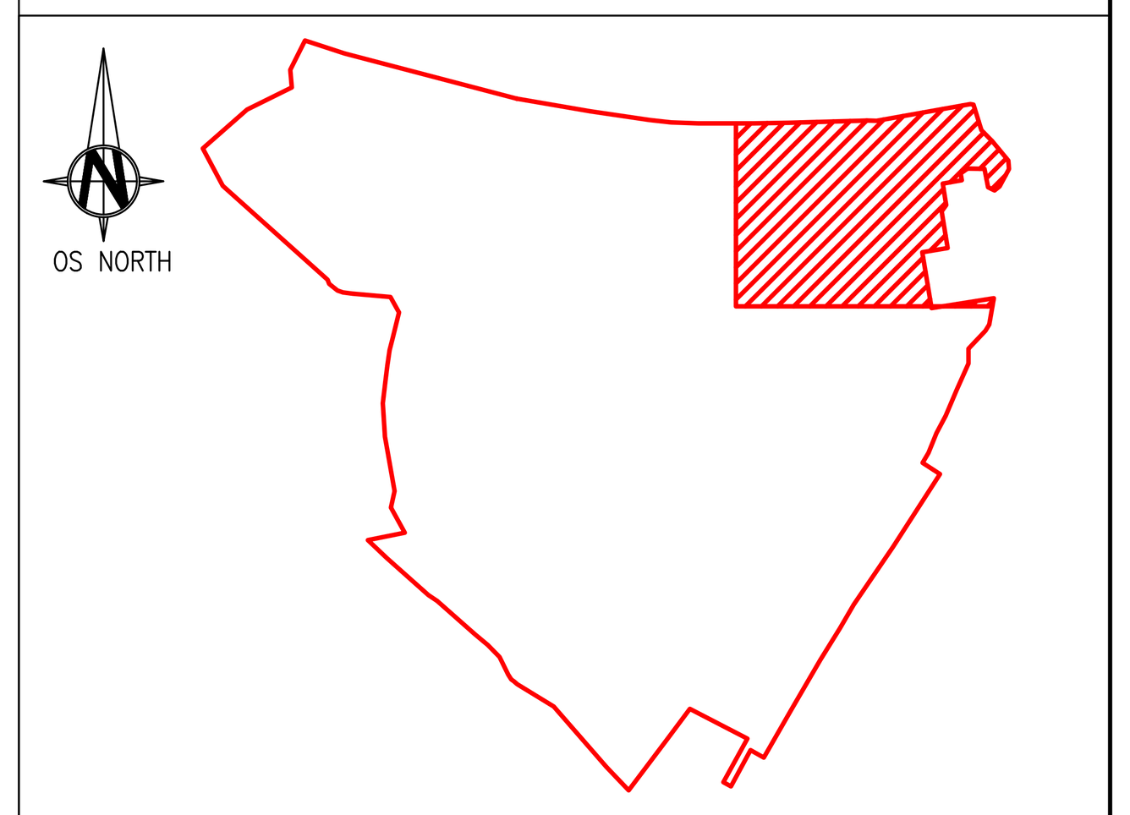


REV	DESCRIPTION	BY	CHK	APP	DATE

0 2 4 6 8 10 m
SCALE 1:200

LAKELAND BUSINESS PARK
LAMPLUGH ROAD
COCKERMOUTH
CA13 0QT

TEL: +44 (0)1900 898 600
FAX: +44 (0)1900 826 324
e-mail: cumbria@wyg.com

Project:

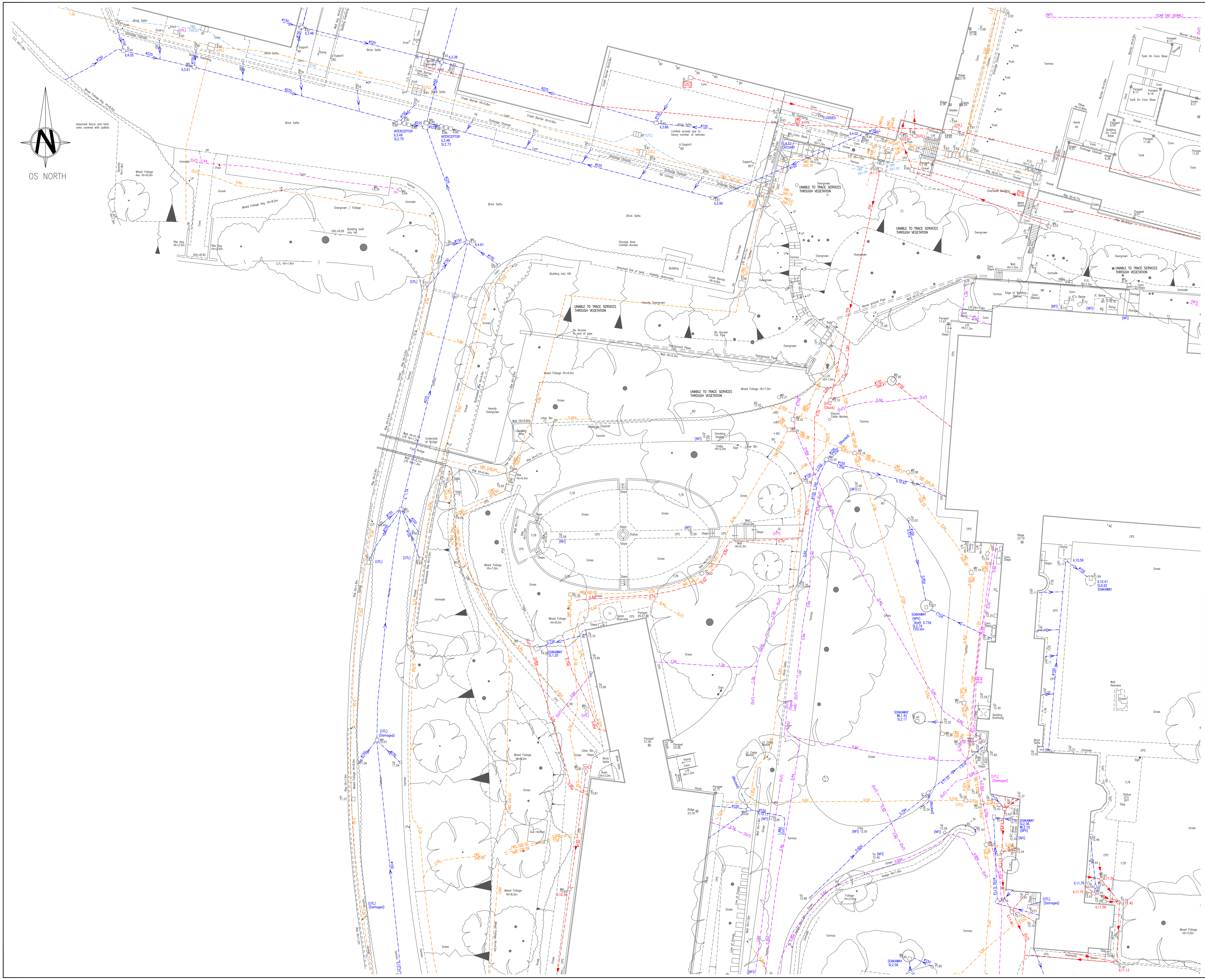
Carrow Works
Norwich
NR1 2DD

Drawing Title:

UTILITIES SURVEY
SHEET 3 OF 9

Scale @ A0	Drawn	Date	Checked	Date	Approved	Date
1 : 200	MD	22/11/18	DR	22/11/18	DR	22/11/18

Project No.	Office	Type	Drawing No.	Revision
A108750-1	22	01	WYG003	A



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3. REFER TO REPORT NO. A108750-1 UTILITIES SURVEY REPORT

TOPO LEGEND

AM	AERIAL MAST	IC/WO	INSPECTION COVER WASH OUT
AC	AIR CONDITIONING UNIT	IL:	INVERT LEVEL
AV	AIR VALVE	TJ	TRACK JOINT
BB	BELISHA BEACON	KO	KERB OUTLET
BL:	BED LEVEL	LAD	LADDER
BM	BENCHMARK	LB	LITTER BIN
B	BOLLARD	LDA	LAY DOWN AREA
BH	BOREHOLE	LP	LAMP POST
BS	BUS STOP	mE	METRES EAST
CAB	CABINET	MH	MANHOLE
CAB/BT	CABINET BRITISH TELECOM.	MHW	MEAN HIGH WATER LEVEL
CAB/EL	CABINET ELECTRIC	MLW	MEAN LOW WATER LEVEL
CAM	CAMERA	mN	METRES NORTH
CAL:	CANOPY LEVEL	MP	MARKER POST
CB	CRASH BARRIER	MP/BT	MARKER POST BRITISH TELECOM.
CBL	CABLE	MP/EL	MARKER POST ELECTRIC
CD	CHANNEL DRAIN	MP/GA	MARKER POST GAS
CDC	CONC. DUCT COVER	MP/WA	MARKER POST WATER
CHS	CHEMICAL OIL STORE	NB	NOTICE BOARD
CLM	COLUMN	NP	NAME PLATE
CNB	CONCRETE BASE	OH	OVERHEAD ITEMS
CNP	CONCRETE PLINTH	OHBT	OVERHEAD BRITISH TELECOM.
CONC.	CONCRETE	OHCBL	OVERHEAD CABLES
CP	CATCHPIT	OHPI	OVERHEAD PIPES
CPL:	CROWN PIPE LEVEL	OHPL	OVERHEAD POWER LINES
CPS	CONC. PIPE SUPPORT	OHPS	OVERHEAD PIPE SUPPORT
CT	CABLE TRAY	OHPB	OVERHEAD PIPEBRIDGE
DB	DROP BARRIER	OHPBS	OVERHEAD PIPEBRIDGE SUPPORT
DBB	DROP BARRIER BOX	P	POLE
DBP	DROP BARRIER POST	PB	POINTS BOX
DK	DROP KERB	PC	PEDESTRIAN CROSSING
DR	DERAILER	PCN	POINT CROSSING NOSE
EEB	EMERGENCY EQUIPMENT BOX	PD	POINTS DETECTOR
EMS	EMERGENCY SHOWER	PL	PEDESTRIAN LIGHTING BOLLARD
EL:	EAVES LEVEL	PLR	POINTS LEVER
EP	ELECTRIC POLE	PM	POINT MOTOR
ER	EARTH ROD	PBX	POST BOX
FBEDS	FLOWER BEDS	PO	POST
FE	FIRE EXTINGUISHER	PR	POINT RODS
FECL	CHAINLINK FENCE	PS	PIPE SUPPORT
FEHE	TEMP. HERAS FENCE	RE	RODDING EYE
FEPA	PANEL FENCE	RGS	PEDESTRIAN BARRIER
FEPE	PALISADE FENCE	RIL:	RIDGE LEVEL
FEPW	POST & WIRE FENCE	RL:	ROOF LEVEL
FEPR	POST & RAIL FENCE	RP	REFLECTOR POST
FEWM	WELDMESH FENCE	RS	ROAD SIGN
FH	FIRE HYDRANT	RSD	ROLLER SHUTTER DOOR
FL	FLOOD LIGHT	RTW	RETAINING WALL
FL:	FLOOR LEVEL	RWP	RAIN WATER PIPE
FP	FOOTPATH	S	SCAR LINES
FS	FLAG STAFF	SD	SLIDING DOOR
G/S/H	TREE GIRTH SPREAD HEIGHT	SIG	RAIL SIGNAL
GAD	GATE DOUBLE	SL:	SOFFIT LEVEL
GAS	GATE SINGLE	SN	GENERAL SIGN
GATS	GATE TURNSTILE	SR	SPEED RESTRICTOR
GB	GRIT BIN	SRK	SPILL RESPONSE KIT
GBS	GAS BOTTLE STORE	STI	STILE
GDC	GRATED DUCT COVER	ST	STOP TAP
GP	GRADIENT POST	STHDR	STEPS WITH HANDRAIL
GRP	GREASE POINT	SV	STOP VALVE
GV	GAS VALVE	SVP	SOIL VENT PIPE
GY	GULLY	SW	STAY WIRE
HDR	HANDRAIL	TEL	TELEPHONE
HR	HEIGHT RESTRICTOR	TFL	TRAFFIC LIGHT
Ht.	HEIGHT	TL:	THRESHOLD LEVEL
IB	INSPECTION BOX (NOT BURIED)	TP	TELEGRAPH POLE
IC	INSPECTION COVER UNKNOWN	TS	TREADLE SWITCH
IC/BH	INSPECTION COVER BOREHOLE	US:	UNDERSIDE LEVEL
IC/BT	INSPECTION COVER BRITISH TELECOM.	UP	DIRECTION OF INCLINE
IC/FH	INSPECTION COVER FIRE HYDRANT	VP	VENT PIPE
IC/EL	INSPECTION COVER ELECTRIC	WJ	WELD JOINT
IC/GA	INSPECTION COVER GAS	WL:	WATER LEVEL
IC/SL	INSPECTION COVER STREET LIGHT	WP	WASTE PIPE
IC/WA	INSPECTION COVER WATER	WYGXXX	SURVEY STATION

GPR/UTILITIES LEGEND

FOUL DRAINAGE	FW → FW
SURFACE WATER DRAINAGE	SW → SW
WATER	W — W
GAS	GAS — GAS
HV ELECTRICITY	HV — HV
LV ELECTRICITY	LV — LV
BT / OPENREACH	BT — BT
UNKNOWN SERVICE	UK — UK
UNDERGROUND CHAMBER	[- - - - -]

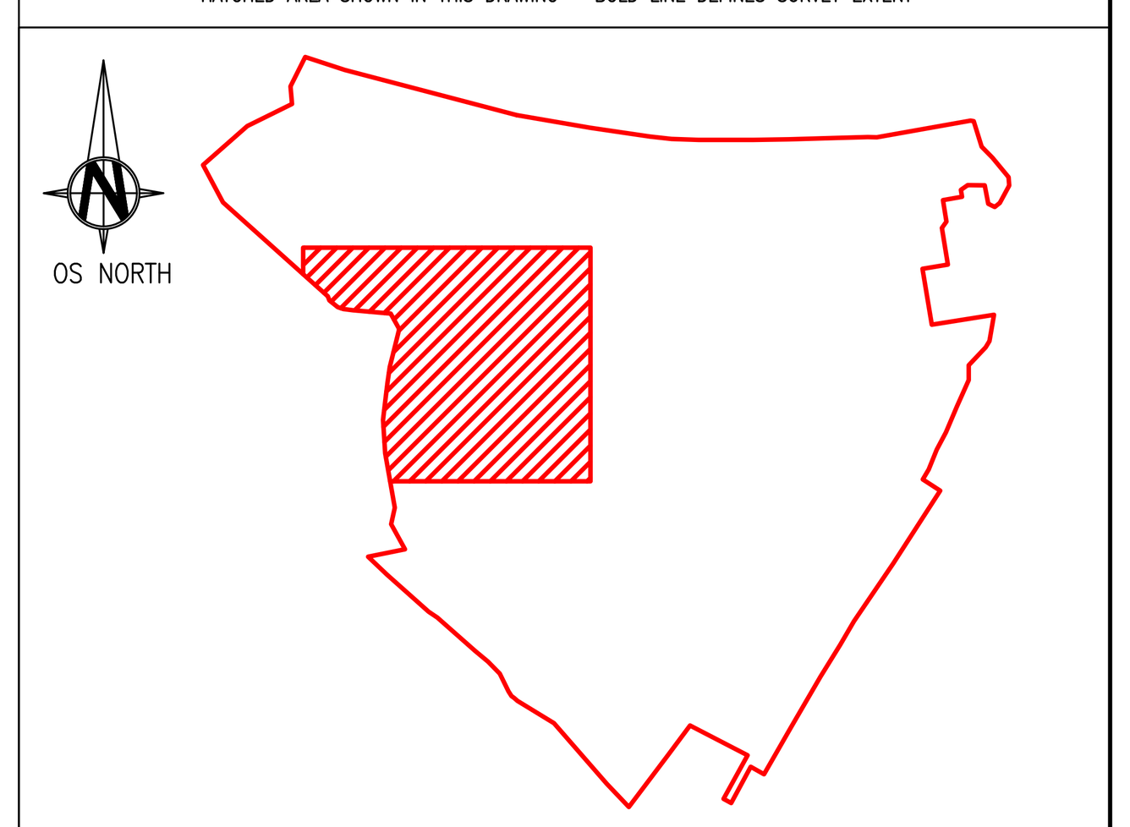
(AC)	ASSUMED CONNECTION
(AR)	ASSUMED ROUTE
BdL	BACK-DROP LEVEL
Cd	CABLE DEPTH
CR	CABLE RISER
d	DEPTH OF SERVICE (APPROX)
Dd	DUCT DEPTH
DT	DISCONNECTING TRAP
(ET)	ELECTRONICALLY TRACED
(EoT)	END OF TRACE
Id	INVERT DEPTH
IL	INVERT LEVEL
HV	HIGH VOLTAGE
LD	LAND DRAIN
LV	LOW VOLTAGE
(NFI)	NO FURTHER INFORMATION
(NPV)	NO PIPES VISIBLE
Pd	PIPE DEPTH
Pe	POLYETHYLENE
PR	PIPE RISER
Sd	SUMP DEPTH
SL	SUMP LEVEL
(UTL)	UNABLE TO LIFT
(UTS)	UNABLE TO SURVEY
(UTT)	UNABLE TO TRACE
WD	WAY-DUCT

ASSOCIATED DRAWINGS

WYG001 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 1 OF 9
WYG002 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 2 OF 9
WYG003 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 3 OF 9
WYG004 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 4 OF 9 (THIS DRAWING)
WYG005 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 5 OF 9
WYG006 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 6 OF 9
WYG007 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 7 OF 9
WYG008 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 8 OF 9
WYG009 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 9 OF 9

LOCATION PLAN

HATCHED AREA SHOWN IN THIS DRAWING – BOLD LINE DEFINES SURVEY EXTENT



REV	DESCRIPTION	BY	CHK	APP	DATE

0 2 4 6 8 10 m
SCALE 1:200

LAKELAND BUSINESS PARK
LAMPLUGH ROAD
COCKERMOUTH
CA13 0QT

TEL: +44 (0)1900 898 600
FAX: +44 (0)1900 826 324
e-mail: cumbria@wyg.com

Project:
Carrow Works
Norwich
NR1 2DD

Drawing Title:
UTILITIES SURVEY
SHEET 4 OF 9

Scale @ A0	Drawn	Date	Checked	Date	Approved	Date
1 : 200	MD	22/11/18	DR	22/11/18	DR	22/11/18

Project No.	Office	Type	Drawing No.	Revision
A108750-1	22	01	WYG004	A

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NOTES

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TOPO LEGEND

AM	AERIAL MAST
AC	AIR CONDITIONING UNIT
AV	AIR VALVE
BB	BELISHA BEACON
BL:	BED LEVEL
BM	BENCHMARK
B	BOLLARD
BH	BOREHOLE
BS	BUS STOP
CAB	CABINET
CAB/BT	CABINET BRITISH TELECOM.
CAB/EL	CABINET ELECTRIC
CAM	CAMERA
CAL:	CANOPY LEVEL
CB	CRASH BARRIER
CBL	CABLE
CD	CHANNEL DRAIN
CDC	CONC. DUCT COVER
CHS	CHEMICAL OIL STORE
CLM	COLUMN
CNB	CONCRETE BASE
CNP	CONCRETE PLINTH
CONC.	CONCRETE
CP	CATCHPIT
CPL:	CROWN PIPE LEVEL
CPS	CONC. PIPE SUPPORT
CT	CABLE TRAY
DB	DROP BARRIER
DBB	DROP BARRIER BOX
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DK	DROP KERB
DR	DERAILER
EEB	EMERGENCY EQUIPMENT BOX
EMS	EMERGENCY SHOWER
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EP	ELECTRIC POLE
ER	EARTH ROD
FBEDS	FLOWER BEDS
FE	FIRE EXTINGUISHER
FECL	CHAINLINK FENCE
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FEPE	PALISADE FENCE
FEPW	POST & WIRE FENCE
FEPR	POST & RAIL FENCE
FEWM	WELDMESH FENCE
FH	FIRE HYDRANT
FL	FLOOD LIGHT
FL:	FLOOR LEVEL
FP	FOOTPATH
FS	FLAG STAFF
G/S/H	TREE GIRTH SPREAD HEIGHT
GAD	GATE DOUBLE
GAS	GATE SINGLE
GATS	GATE TURNSTILE
GB	GRIT BIN
GBS	GAS BOTTLE STORE
GDC	GRATED DUCT COVER
GP	GRADIENT POST
GRP	GREASE POINT
GV	GAS VALVE
GY	GULLY
HDR	HANDRAIL
HR	HEIGHT RESTRICTOR
Ht.	HEIGHT
IB	INSPECTION BOX (NOT BURIED)
IC	INSPECTION COVER UNKNOWN
IC/BH	INSPECTION COVER BOREHOLE
IC/BT	INSPECTION COVER BRITISH TELECOM.
IC/FH	INSPECTION COVER FIRE HYDRANT
IC/EL	INSPECTION COVER ELECTRIC
IC/GA	INSPECTION COVER GAS
IC/SL	INSPECTION COVER STREET LIGHT
IC/WA	INSPECTION COVER WATER

IC/WO	INSPECTION COVER WASH OUT
IL:	INVERT LEVEL
TJ	TRACK JOINT
KO	KERB OUTLET
LAD	LADDER
LB	LITTER BIN
LDA	LAY DOWN AREA
LP	LAMP POST
mE	METRES EAST
MH	MANHOLE
MHW	MEAN HIGH WATER LEVEL
MLW	MEAN LOW WATER LEVEL
mN	METRES NORTH
MP	MARKER POST
MP/BT	MARKER POST BRITISH TELECOM.
MP/EL	MARKER POST ELECTRIC
MP/GA	MARKER POST GAS
MP/WA	MARKER POST WATER
NB	NOTICE BOARD
NP	NAME PLATE
OH	OVERHEAD ITEMS
OHBT	OVERHEAD BRITISH TELECOM.
OHCBL	OVERHEAD CABLES
OHPI	OVERHEAD PIPES
OHPL	OVERHEAD POWER LINES
OHPS	OVERHEAD PIPE SUPPORT
OHPB	OVERHEAD PIPEBRIDGE
OHPBS	OVERHEAD PIPEBRIDGE SUPPORT
P	POLE
PB	POINTS BOX
PC	PEDESTRIAN CROSSING
PCN	POINT CROSSING NOSE
PD	POINTS DETECTOR
PL	PEDESTRIAN LIGHTING BOLLARD
PLR	POINTS LEVER
PM	POINT MOTOR
PBX	POST BOX
PO	POST
PR	POINT RODS
PS	PIPE SUPPORT
RE	RODDING EYE
RGS	PEDESTRIAN BARRIER
RIL:	RIDGE LEVEL
RL:	ROOF LEVEL
RP	REFLECTOR POST
RS	ROAD SIGN
RSD	ROLLER SHUTTER DOOR
RTW	RETAINING WALL
RWP	RAIN WATER PIPE
S	SCAR LINES
SD	SLIDING DOOR
SIG	RAIL SIGNAL
SL:	SOFFIT LEVEL
SN	GENERAL SIGN
SR	SPEED RESTRICTOR
SRK	SPILL RESPONSE KIT
STI	STILE
ST	STOP TAP
STHDR	STEPS WITH HANDRAIL
SV	STOP VALVE
SVP	SOIL VENT PIPE
SW	STAY WIRE
TEL	TELEPHONE
TFL	TRAFFIC LIGHT
TL:	THRESHOLD LEVEL
TP	TELEGRAPH POLE
TS	TREADLE SWITCH
US:	UNDERSIDE LEVEL
UP	DIRECTION OF INCLINE
VP	VENT PIPE
WJ	WELD JOINT
WL:	WATER LEVEL
WP	WASTE PIPE
WYGXXX	SURVEY STATION

GPR/UTILITIES LEGEND

FOUL DRAINAGE	FW FW
SURFACE WATER DRAINAGE	SW SW
WATER	W W
GAS	GAS GAS
HV ELECTRICITY	HV HV
LV ELECTRICITY	LV LV
BT / OPENREACH	BT BT
UNKNOWN SERVICE	UK UK
UNDERGROUND CHAMBER	

(AC)	ASSUMED CONNECTION
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HV	HIGH VOLTAGE
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(NFI)	NO FURTHER INFORMATION
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PR	PIPE RISER
Sd	SUMP DEPTH
SL	SUMP LEVEL
(UTL)	UNABLE TO LIFT
(UTS)	UNABLE TO SURVEY
(UTT)	UNABLE TO TRACE
WD	WAY-DUCT

ASSOCIATED DRAWINGS

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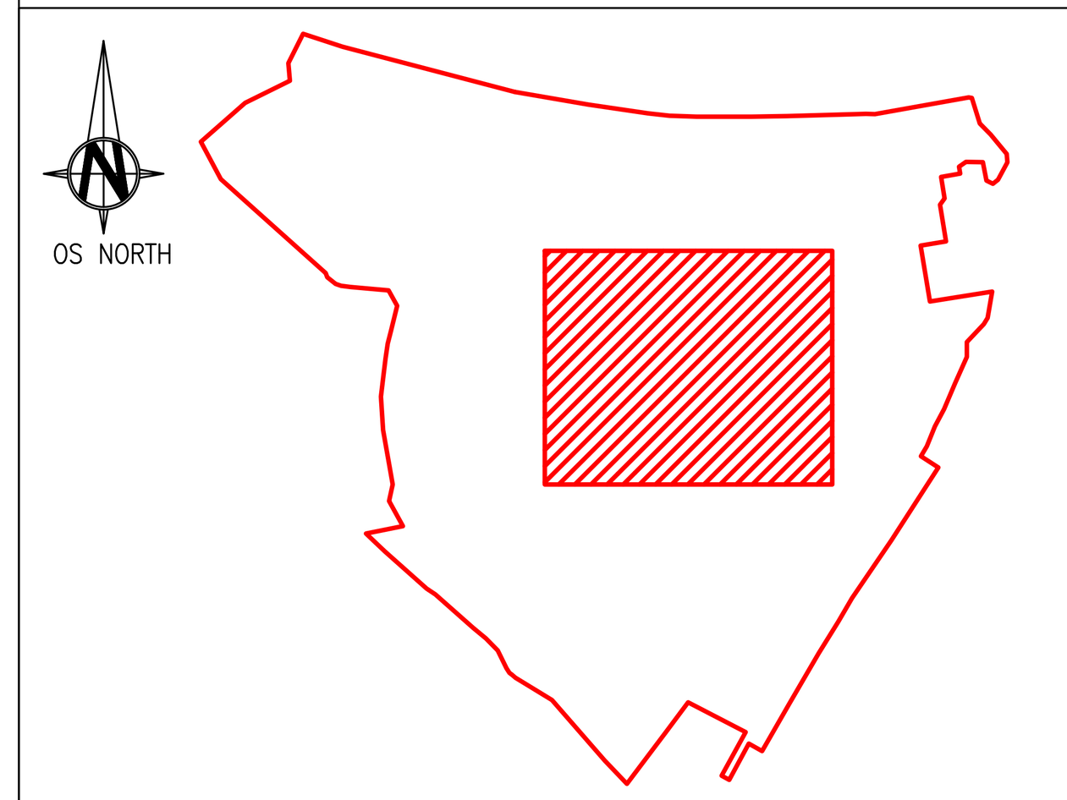
WYG009 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 9 OF 9

LOCATION PLAN

HATCHED AREA SHOWN IN THIS DRAWING – BOLD LINE DEFINES SURVEY EXTENT



REV	DESCRIPTION	BY	CHK	APP	DATE

0 2 4 6 8 10 m
SCALE 1:200

LAKELAND BUSINESS PARK
LAMPLUGH ROAD
COCKERMOUTH
CA13 0QT

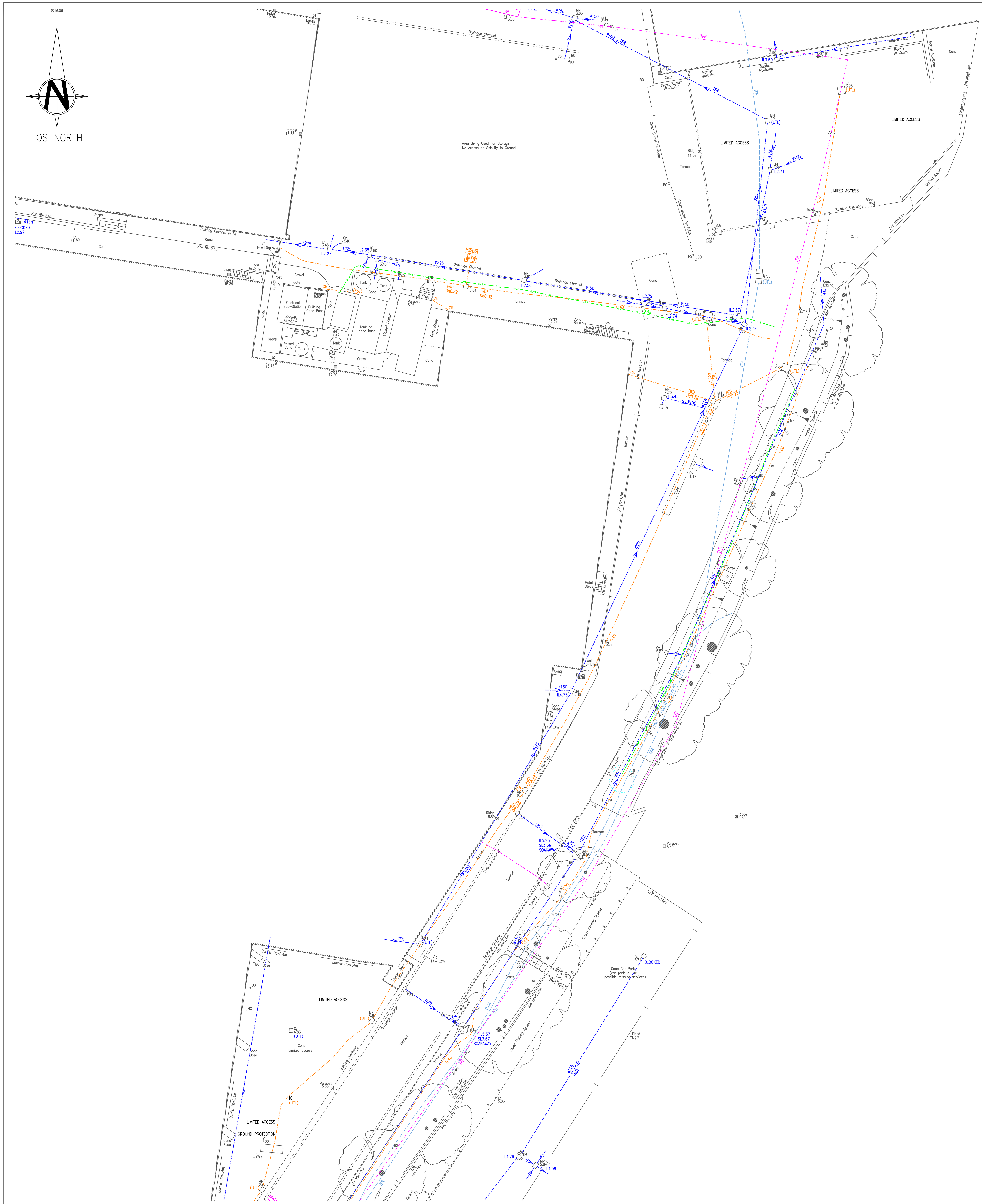
TEL: +44 (0)1900 898 600
FAX: +44 (0)1900 826 324
e-mail: cumbria@wyg.com

Project:
Carrow Works
Norwich
NR1 2DD

Drawing Title:
UTILITIES SURVEY
SHEET 5 OF 9

Scale @ A0	Drawn	Date	Checked	Date	Approved	Date
1 : 200	MD	22/11/18	DR	22/11/18	DR	22/11/18

Project No.	Office	Type	Drawing No.	Revision
A108750-1	22	01	WYG005	A



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TOPO LEGEND

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AC	AIR CONDITIONING UNIT	IL:	INVERT LEVEL
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IC/WA	INSPECTION COVER WATER	WYGXXX	SURVEY STATION

GPR/UTILITIES LEGEND

FOUL DRAINAGE	FW → FW	(AC)	ASSUMED CONNECTION
SURFACE WATER DRAINAGE	SW → SW	(AR)	ASSUMED ROUTE
WATER	W W	BdL	BACK-DROP LEVEL
GAS	GAS GAS	Cd	CABLE DEPTH
HV ELECTRICITY	HV HV	CR	CABLE RISER
LV ELECTRICITY	LV LV	d	DEPTH OF SERVICE (APPROX)
BT / OPENREACH	BT BT	Dd	DUCT DEPTH
UNKNOWN SERVICE	UK UK	DT	DISCONNECTING TRAP
UNDERGROUND CHAMBER	[- - - -]	(ET)	ELECTRONICALLY TRACED
		(EoT)	END OF TRACE
		Id	INVERT DEPTH
		IL	INVERT LEVEL
		HV	HIGH VOLTAGE
		LD	LAND DRAIN
		LV	LOW VOLTAGE
		(NFI)	NO FURTHER INFORMATION
		(NPV)	NO PIPES VISIBLE
		Pd	PIPE DEPTH
		Pe	POLYETHYLENE
		PR	PIPE RISER
		Sd	SUMP DEPTH
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		(UTL)	UNABLE TO LIFT
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		(UTT)	UNABLE TO TRACE
		WD	WAY-DUCT

ASSOCIATED DRAWINGS

WYG001 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 1 OF 9
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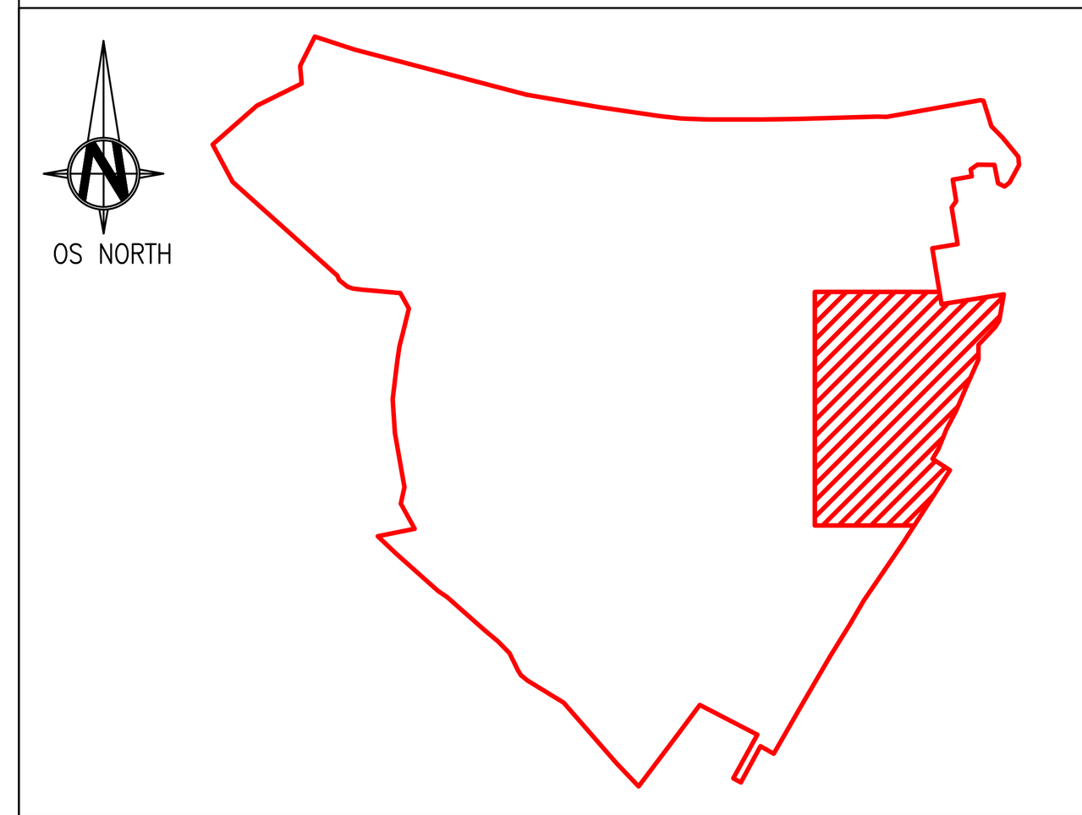
LOCATION PLAN

HATCHED AREA SHOWN IN THIS DRAWING – BOLD LINE DEFINES SURVEY EXTENT



REV	DESCRIPTION	BY	CHK	APP	DATE

0 2 4 6 8 10 m
SCALE 1:200

LAKELAND BUSINESS PARK
LAMPLUGH ROAD
COCKERMOUTH
CA13 0QT

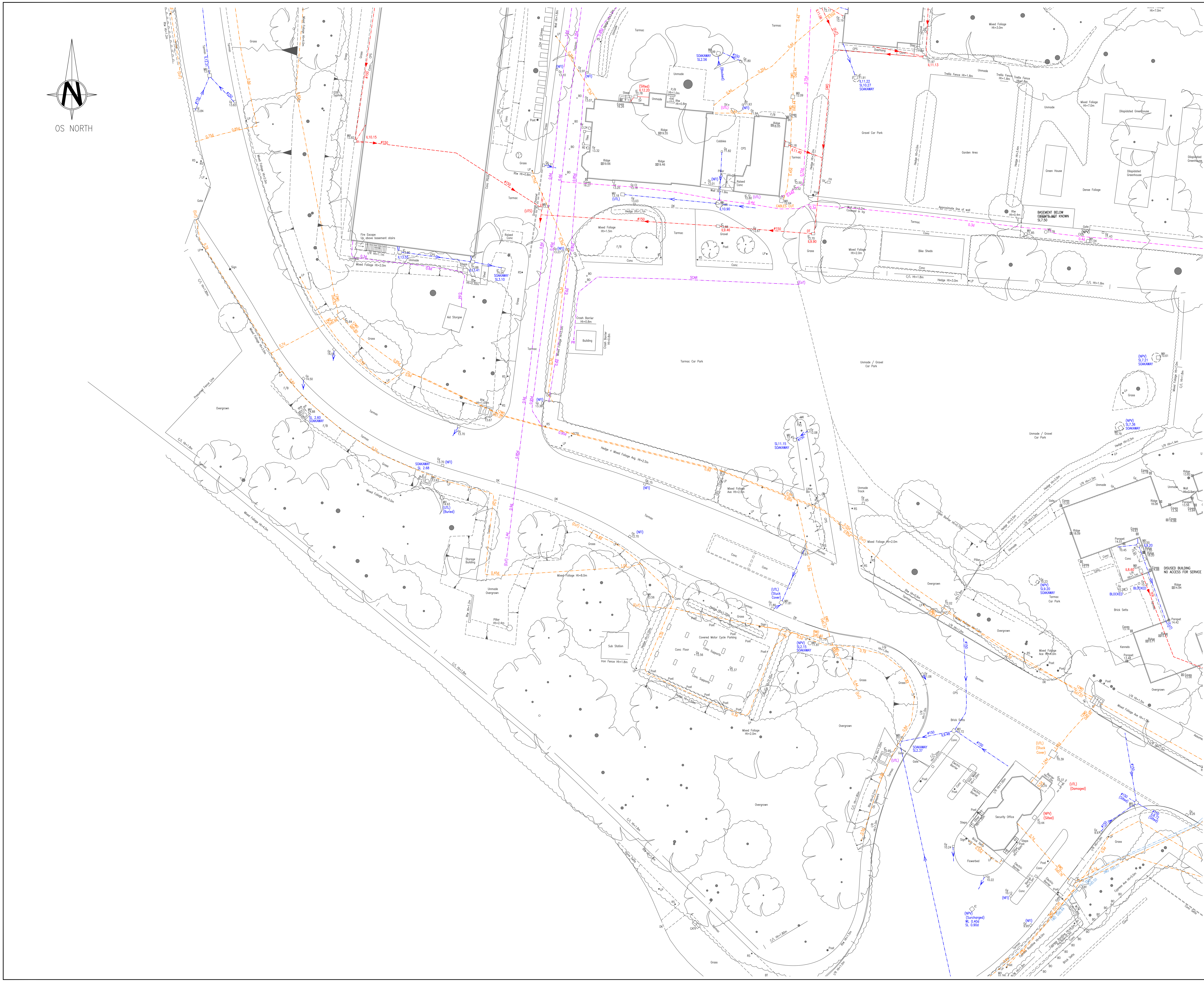
TEL: +44 (0)1900 898 600
FAX: +44 (0)1900 826 324
e-mail: cumbria@wyg.com

Project:
Carrow Works
Norwich
NR1 2DD

Drawing Title:
UTILITIES SURVEY
SHEET 6 OF 9

Scale @ A0	Drawn	Date	Checked	Date	Approved	Date
1 : 200	MD	22/11/18	DR	22/11/18	DR	22/11/18

Project No.	Office	Type	Drawing No.	Revision
A108750-1	22	01	WYG006	A



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3. REFER TO REPORT NO. A108750–1 UTILITIES SURVEY REPORT

TOPO LEGEND

AM	AERIAL MAST	IC/WO	INSPECTION COVER WASH OUT
AC	AIR CONDITIONING UNIT	IL:	INVERT LEVEL
AV	AIR VALVE	TJ	TRACK JOINT
BB	BELISHA BEACON	KO	KERB OUTLET
BL:	BED LEVEL	LAD	LADDER
BM	BENCHMARK	LB	LITTER BIN
B	BOLLARD	LDA	LAY DOWN AREA
BH	BOREHOLE	LP	LAMP POST
BS	BUS STOP	mE	METRES EAST
CAB	CABINET	MH	MANHOLE
CAB/BT	CABINET BRITISH TELECOM.	MHW	MEAN HIGH WATER LEVEL
CAB/EL	CABINET ELECTRIC	MLW	MEAN LOW WATER LEVEL
CAM	CAMERA	mN	METRES NORTH
CAL:	CANOPY LEVEL	MP	MARKER POST
CB	CRASH BARRIER	MP/BT	MARKER POST BRITISH TELECOM.
CBL	CABLE	MP/EL	MARKER POST ELECTRIC
CD	CHANNEL DRAIN	MP/GA	MARKER POST GAS
CDC	CONC. DUCT COVER	MP/WA	MARKER POST WATER
CHS	CHEMICAL OIL STORE	NB	NOTICE BOARD
CLM	COLUMN	NP	NAME PLATE
CNB	CONCRETE BASE	OH	OVERHEAD ITEMS
CNP	CONCRETE PLINTH	OHBT	OVERHEAD BRITISH TELECOM.
CONC.	CONCRETE	OHCBL	OVERHEAD CABLES
CP	CATCHPIT	OHPI	OVERHEAD PIPES
CPL:	CROWN PIPE LEVEL	OHPL	OVERHEAD POWER LINES
CPS	CONC. PIPE SUPPORT	OHPS	OVERHEAD PIPE SUPPORT
CT	CABLE TRAY	OHPB	OVERHEAD PIPEBRIDGE
DB	DROP BARRIER	OHPBS	OVERHEAD PIPEBRIDGE SUPPORT
DBB	DROP BARRIER BOX	P	POLE
DBP	DROP BARRIER POST	PB	POINTS BOX
DK	DROP KERB	PC	PEDESTRIAN CROSSING
DR	DERAILER	PCN	POINT CROSSING NOSE
EEB	EMERGENCY EQUIPMENT BOX	PD	POINTS DETECTOR
EMS	EMERGENCY SHOWER	PL	PEDESTRIAN LIGHTING BOLLARD
EL:	EAVES LEVEL	PLR	POINTS LEVER
EP	ELECTRIC POLE	PM	POINT MOTOR
ER	EARTH ROD	PBX	POST BOX
FBEDS	FLOWER BEDS	PO	POST
FE	FIRE EXTINGUISHER	PR	POINT RODS
FECL	CHAINLINK FENCE	PS	PIPE SUPPORT
FEHE	TEMP. HERAS FENCE	RE	RODDING EYE
FEPA	PANEL FENCE	RGS	PEDESTRIAN BARRIER
FEPE	PALISADE FENCE	RIL:	RIDGE LEVEL
FEPW	POST & WIRE FENCE	RL:	ROOF LEVEL
FEPR	POST & RAIL FENCE	RP	REFLECTOR POST
FEWM	WELDMESH FENCE	RS	ROAD SIGN
FH	FIRE HYDRANT	RSD	ROLLER SHUTTER DOOR
FL	FLOOD LIGHT	RTW	RETAINING WALL
FL:	FLOOR LEVEL	RWP	RAIN WATER PIPE
FP	FOOTPATH	S	SCAR LINES
FS	FLAG STAFF	SD	SLIDING DOOR
G/S/H	TREE GIRTH SPREAD HEIGHT	SIG	RAIL SIGNAL
GAD	GATE DOUBLE	SL:	SOFFIT LEVEL
GAS	GATE SINGLE	SN	GENERAL SIGN
GATS	GATE TURNSTILE	SR	SPEED RESTRICTOR
GB	GRIT BIN	SRK	SPILL RESPONSE KIT
GBS	GAS BOTTLE STORE	STI	STILE
GDC	GRATED DUCT COVER	ST	STOP TAP
GP	GRADIENT POST	STHDR	STEPS WITH HANDRAIL
GRP	GREASE POINT	SV	STOP VALVE
GV	GAS VALVE	SVP	SOIL VENT PIPE
GY	GULLY	SW	STAY WIRE
HDR	HANDRAIL	TEL	TELEPHONE
HR	HEIGHT RESTRICTOR	TFL	TRAFFIC LIGHT
Ht.	HEIGHT	TL:	THRESHOLD LEVEL
IB	INSPECTION BOX (NOT BURIED)	TP	TELEGRAPH POLE
IC	INSPECTION COVER UNKNOWN	TS	TREADLE SWITCH
IC/BH	INSPECTION COVER BOREHOLE	US:	UNDERSIDE LEVEL
IC/BT	INSPECTION COVER BRITISH TELECOM.	UP	DIRECTION OF INCLINE
IC/FH	INSPECTION COVER FIRE HYDRANT	VP	VENT PIPE
IC/EL	INSPECTION COVER ELECTRIC	WJ	WELD JOINT
IC/GA	INSPECTION COVER GAS	WL:	WATER LEVEL
IC/SL	INSPECTION COVER STREET LIGHT	WP	WASTE PIPE
IC/WA	INSPECTION COVER WATER	WYGXXX	SURVEY STATION

GPR/UTILITIES LEGEND

FOUL DRAINAGE	FW → FW
SURFACE WATER DRAINAGE	SW → SW
WATER	W W
GAS	GAS GAS
HV ELECTRICITY	HV HV
LV ELECTRICITY	LV LV
BT / OPENREACH	BT BT
UNKNOWN SERVICE	UK UK
UNDERGROUND CHAMBER	

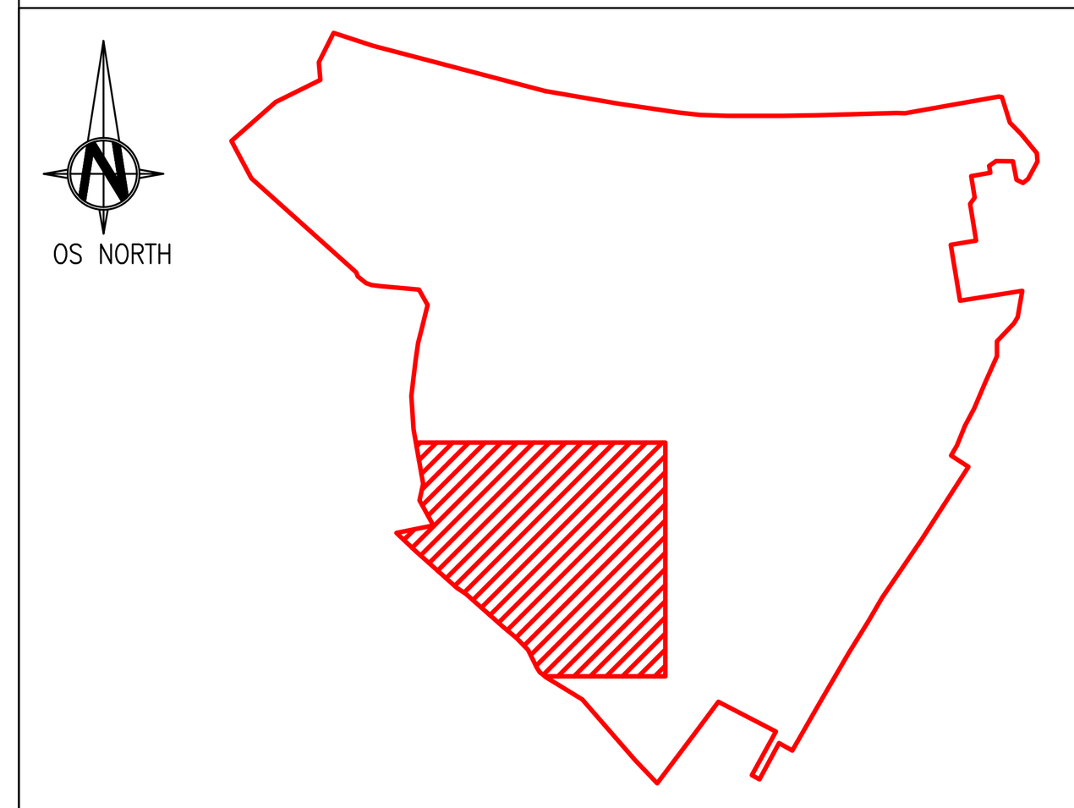
(AC)	ASSUMED CONNECTION
(AR)	ASSUMED ROUTE
BdL	BACK–DROP LEVEL
Cd	CABLE DEPTH
CR	CABLE RISER
d	DEPTH OF SERVICE (APPROX)
Dd	DUCT DEPTH
DT	DISCONNECTING TRAP
(ET)	ELECTRONICALLY TRACED
(EoT)	END OF TRACE
Id	INVERT DEPTH
IL	INVERT LEVEL
HV	HIGH VOLTAGE
LD	LAND DRAIN
LV	LOW VOLTAGE
(NFI)	NO FURTHER INFORMATION
(NPV)	NO PIPES VISIBLE
Pd	PIPE DEPTH
Pe	POLYETHYLENE
PR	PIPE RISER
Sd	SUMP DEPTH
SL	SUMP LEVEL
(UTL)	UNABLE TO LIFT
(UTS)	UNABLE TO SURVEY
(UTT)	UNABLE TO TRACE
WD	WAY–DUCT

ASSOCIATED DRAWINGS

WYG001 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 1 OF 9
WYG002 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 2 OF 9
WYG003 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 3 OF 9
WYG004 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 4 OF 9
WYG005 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 5 OF 9
WYG006 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 6 OF 9
WYG007 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 7 OF 9 (THIS DRAWING)
WYG008 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 8 OF 9
WYG009 – CARROW WORKS, NORWICH, UTILITIES SURVEY, SHEET 9 OF 9

LOCATION PLAN

HATCHED AREA SHOWN IN THIS DRAWING – BOLD LINE DEFINES SURVEY EXTENT



REV	DESCRIPTION	BY	CHK	APP	DATE

0 2 4 6 8 10 m
SCALE 1:200

LAKELAND BUSINESS PARK
LAMPLUGH ROAD
COCKERMOUTH
CA13 0QT

TEL: +44 (0)1900 898 600
FAX: +44 (0)1900 826 324
e-mail: cumbria@wyg.com

Project:
Carrow Works
Norwich
NR1 2DD

Drawing Title:
UTILITIES SURVEY
SHEET 7 OF 9

Scale @ A0	Drawn	Date	Checked	Date	Approved	Date
1 : 200	MD	22/11/18	DR	22/11/18	DR	22/11/18

Project No.	Office	Type	Drawing No.	Revision
A108750-1	22	01	WYG007	A

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TOPO LEGEND

AM	AERIAL MAST	IC/WO	INSPECTION COVER WASH OUT
AC	AIR CONDITIONING UNIT	IL:	INVERT LEVEL
AV	AIR VALVE	TJ	TRACK JOINT
BB	BELISHA BEACON	KO	KERB OUTLET
BL:	BED LEVEL	LAD	LADDER
BM	BENCHMARK	LB	LITTER BIN
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BH	BOREHOLE	LP	LAMP POST
BS	BUS STOP	mE	METRES EAST
CAB	CABINET	MH	MANHOLE
CAB/BT	CABINET BRITISH TELECOM.	MHW	MEAN HIGH WATER LEVEL
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CAM	CAMERA	mN	METRES NORTH
CAL:	CANOPY LEVEL	MP	MARKER POST
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IC/GA	INSPECTION COVER GAS	WL:	WATER LEVEL
IC/SL	INSPECTION COVER STREET LIGHT	WP	WASTE PIPE
IC/WA	INSPECTION COVER WATER	WYGXXX	SURVEY STATION

GPR/UTILITIES LEGEND

FOUL DRAINAGE	FW — FW
SURFACE WATER DRAINAGE	SW — SW
WATER	W — W
GAS	GAS — GAS
HV ELECTRICITY	HV — HV
LV ELECTRICITY	LV — LV
BT / OPENREACH	BT — BT
UNKNOWN SERVICE	UK — UK
UNDERGROUND CHAMBER	

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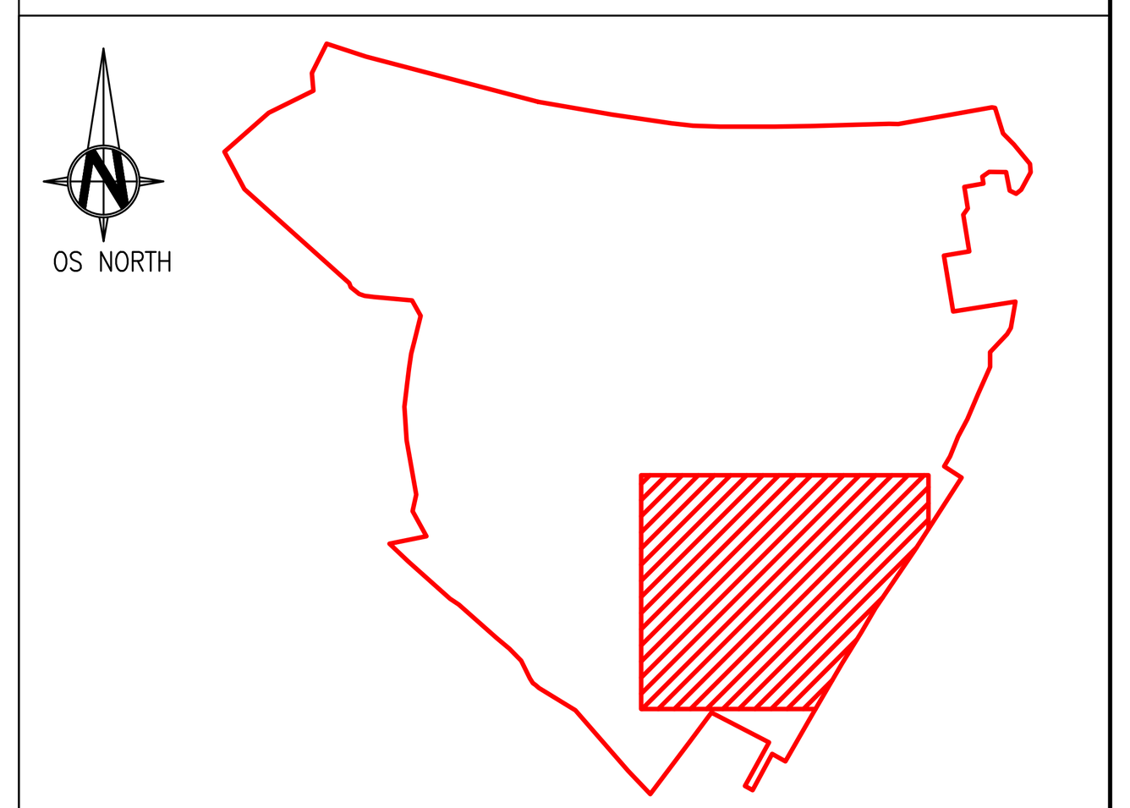


REV	DESCRIPTION	BY	CHK	APP	DATE

0 2 4 6 8 10 m
SCALE 1:200

LAKELAND BUSINESS PARK
LAMPLUGH ROAD
COCKERMOUTH
CA13 0QT

TEL: +44 (0)1900 898 600
FAX: +44 (0)1900 826 324
e-mail: cumbria@wyg.com

Project:

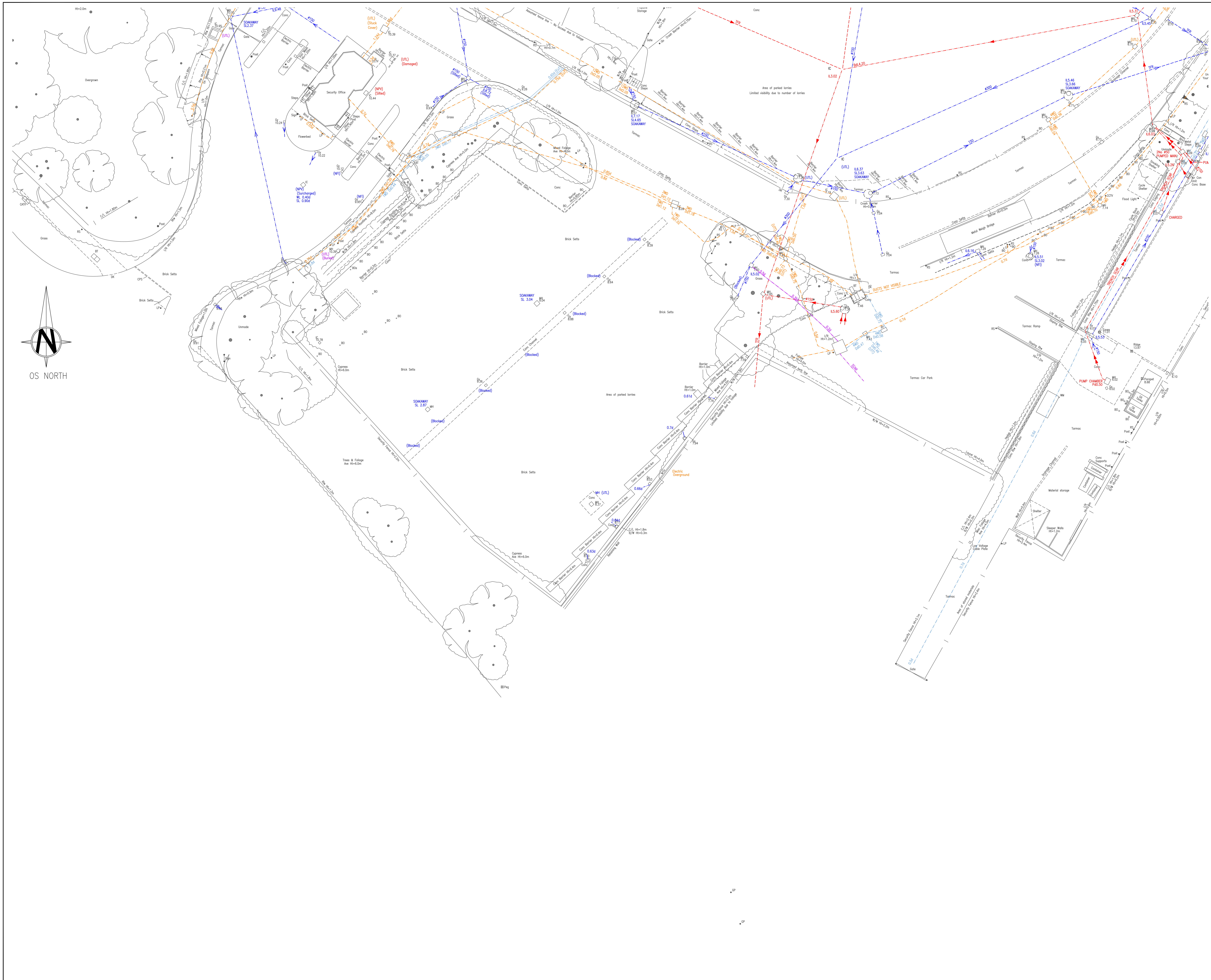
Carrow Works
Norwich
NR1 2DD

Drawing Title:

UTILITIES SURVEY
SHEET 8 OF 9

Scale @ A0	Drawn	Date	Checked	Date	Approved	Date
1 : 200	MD	22/11/18	DR	22/11/18	DR	22/11/18

Project No.	Office	Type	Drawing No.	Revision
A108750-1	22	01	WYG008	A



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SURFACE WATER DRAINAGE	SW SW
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(UTL)	UNABLE TO LIFT
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(UTT)	UNABLE TO TRACE
WD	WAY-DUCT

ASSOCIATED DRAWINGS

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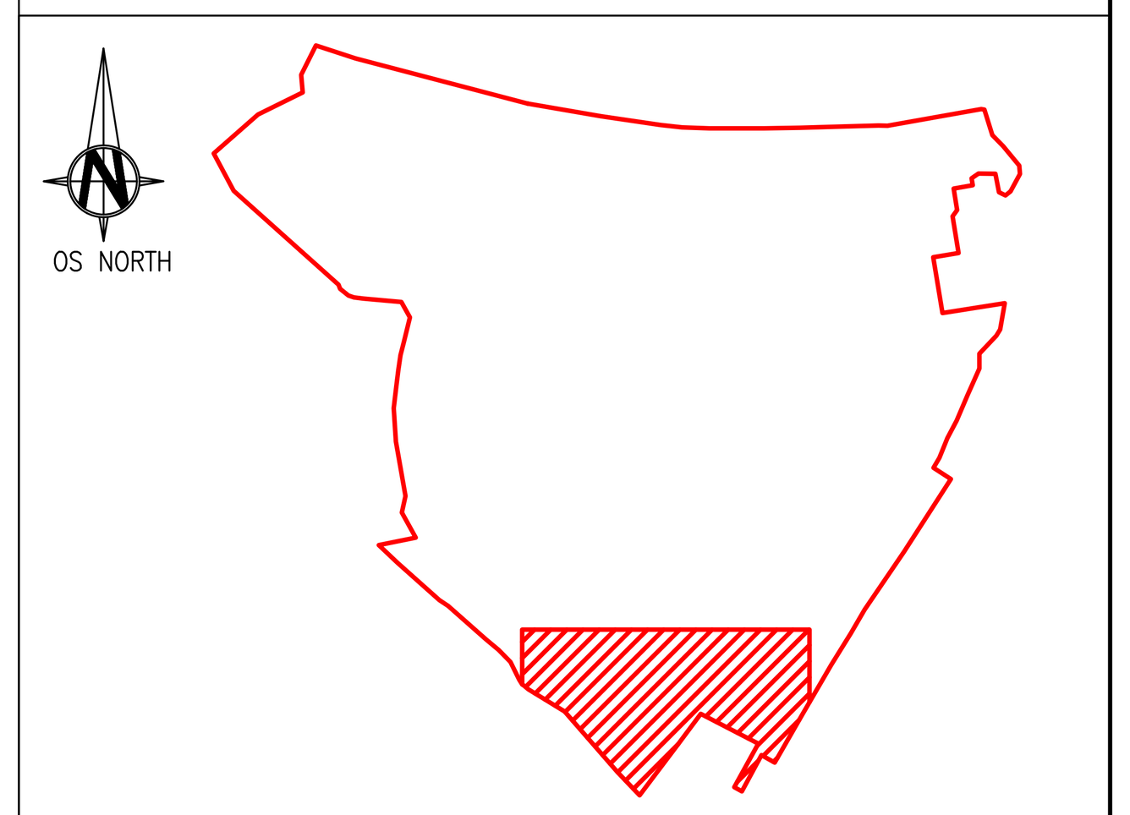
LOCATION PLAN

HATCHED AREA SHOWN IN THIS DRAWING – BOLD LINE DEFINES SURVEY EXTENT



REV	DESCRIPTION	BY	CHK	APP	DATE

0 2 4 6 8 10 m
SCALE 1:200

LAKELAND BUSINESS PARK
LAMPLUGH ROAD
COCKERMOUTH
CA13 0QT

TEL: +44 (0)1900 898 600
FAX: +44 (0)1900 826 324
e-mail: cumbria@wyg.com

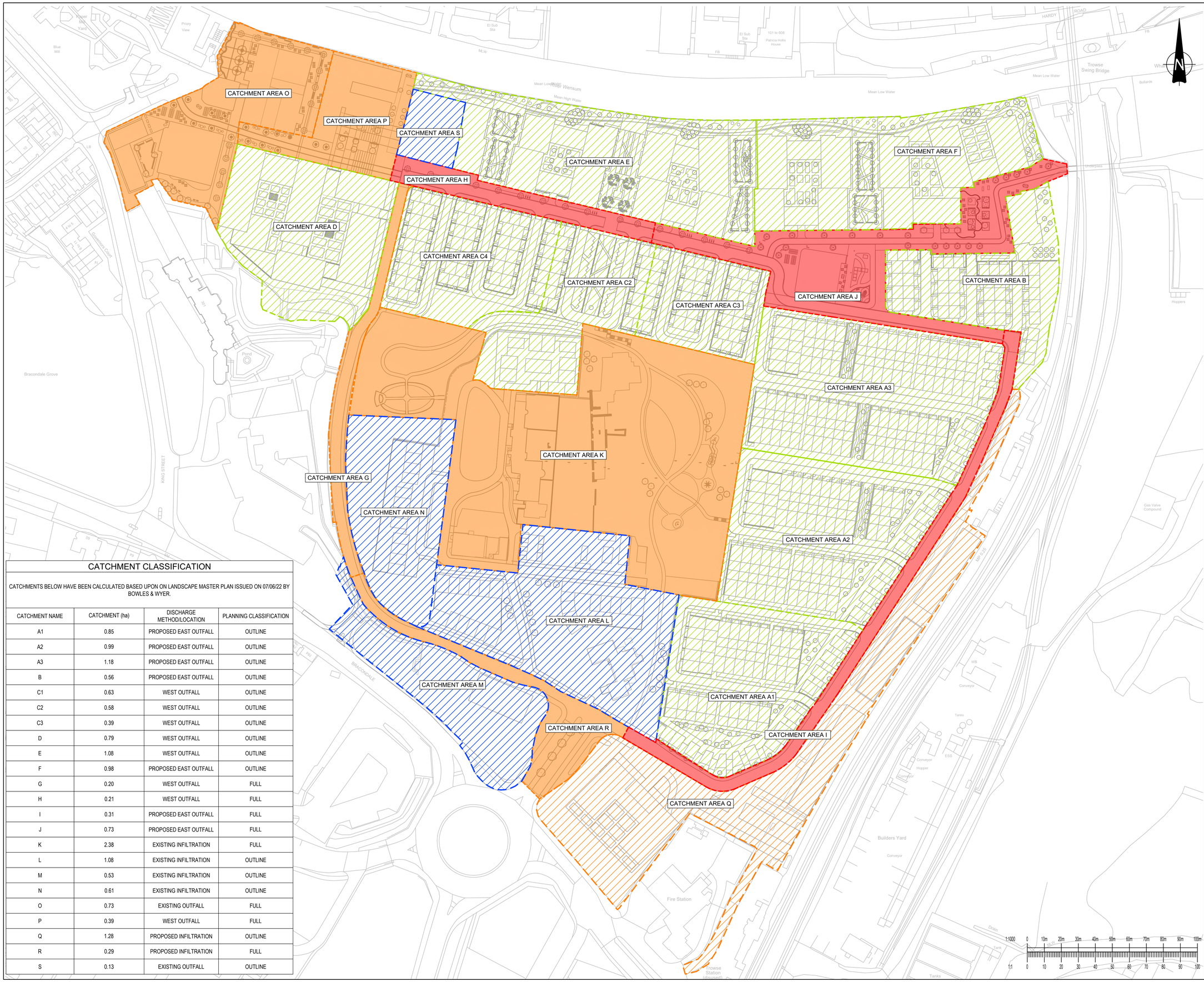
Project:
Carrow Works
Norwich
NR1 2DD

Drawing Title:
UTILITIES SURVEY
SHEET 9 OF 9

Scale @ A0	Drawn	Date	Checked	Date	Approved	Date
1 : 200	MD	22/11/18	DR	22/11/18	DR	22/11/18

Project No.	Office	Type	Drawing No.	Revision
A108750-1	22	01	WYG009	A

Appendix F – Proposed Catchment Drawing



CATCHMENT CLASSIFICATION

CATCHMENTS BELOW HAVE BEEN CALCULATED BASED UPON ON LANDSCAPE MASTER PLAN ISSUED ON 07/06/22 BY BOWLES & WYER.

CATCHMENT NAME	CATCHMENT (ha)	DISCHARGE METHOD/LOCATION	PLANNING CLASSIFICATION
A1	0.85	PROPOSED EAST OUTFALL	OUTLINE
A2	0.99	PROPOSED EAST OUTFALL	OUTLINE
A3	1.18	PROPOSED EAST OUTFALL	OUTLINE
B	0.56	PROPOSED EAST OUTFALL	OUTLINE
C1	0.63	WEST OUTFALL	OUTLINE
C2	0.58	WEST OUTFALL	OUTLINE
C3	0.39	WEST OUTFALL	OUTLINE
D	0.79	WEST OUTFALL	OUTLINE
E	1.08	WEST OUTFALL	OUTLINE
F	0.98	PROPOSED EAST OUTFALL	OUTLINE
G	0.20	WEST OUTFALL	FULL
H	0.21	WEST OUTFALL	FULL
I	0.31	PROPOSED EAST OUTFALL	FULL
J	0.73	PROPOSED EAST OUTFALL	FULL
K	2.38	EXISTING INFILTRATION	FULL
L	1.08	EXISTING INFILTRATION	OUTLINE
M	0.53	EXISTING INFILTRATION	OUTLINE
N	0.61	EXISTING INFILTRATION	OUTLINE
O	0.73	EXISTING OUTFALL	FULL
P	0.39	WEST OUTFALL	FULL
Q	1.28	PROPOSED INFILTRATION	OUTLINE
R	0.29	PROPOSED INFILTRATION	FULL
S	0.13	EXISTING OUTFALL	OUTLINE

GENERAL NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
2. DO NOT SCALE THIS DRAWING. ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS SHALL BE BROUGHT TO THE ENGINEERS ATTENTION IMMEDIATELY. ALL DIMENSIONS MUST BE CHECKED / VERIFIED ON SITE.
3. DESIGN BASED ON PROPOSED SITE PLANS AND INFORMATION AVAILABLE AT THE TIME OF DESIGN. ALL EXISTING SEWERS, CONNECTIONS, PIPE SIZES AND INVERT LEVELS TO BE CONFIRMED BY CONTRACTOR PRIOR TO COMMENCEMENT OF WORKS TO ENSURE CONNECTIVITY. ANY VARIANCE FROM THE INFORMATION SHOWN SHOULD BE REPORTED TO THE ENGINEER FOR REVIEW.
4. DESIGN BASED UPON TOPOGRAPHICAL SURVEY CARRIED OUT BY CD SURVEYS IN AUGUST 2018 JOB NUMBER 1805022.
5. DESIGN BASED ON GPR SURVEY CARRIED OUT BY WYG IN NOVEMBER 2018 PROJECT NUMBER A108750.
6. DESIGN SUBJECT TO PLANNING PERMISSION AGREEMENT WITH LLFA AND ANGLIAN WATER.
7. DESIGN BASED ON EXISTING LEVELS, DESIGN SUBJECT TO CHANGE UPON RECEIPT OF PROPOSED LEVEL STRATEGY.
8. OUTFALL FROM PLOTS SUBJECT TO DESIGN AT DETAILED DESIGN, THE NEED FOR PUMPING MAY BE REQUIRED AND IS TO BE ASSESSED AT DETAILED DESIGN,

KEY:

FULL PLANNING CATCHMENT CLASSIFICATION

-SURFACE WATER TO OUTFALL VIA PROPOSED SEWER SYSTEM.

-SURFACE WATER TO OUTFALL VIA EXISTING DISPOSAL METHOD.

OUTLINE PLANNING CATCHMENT CLASSIFICATION

-SURFACE WATER TO OUTFALL VIA PROPOSED SEWER SYSTEM.

-SURFACE WATER TO OUTFALL VIA PROPOSED INFILTRATION SYSTEM (SUBJECT TO INFILTRATION TESTING)

-SURFACE WATER TO OUTFALL VIA EXISTING DISPOSAL METHOD.

Rev:	Description:	Date:	By:	Chkd:
P02	LANDSCAPE ARCHITECT LAYOUT UPDATE	21/06/22	DR-W	MS
P01	STAGE 3 ISSUE	13/05/22	MM	MS

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Status: SUITABLE FOR INFORMATION — S2

Project: CARROW WORKS

Drg Title: OUTLINE DRAINAGE CATCHMENTS

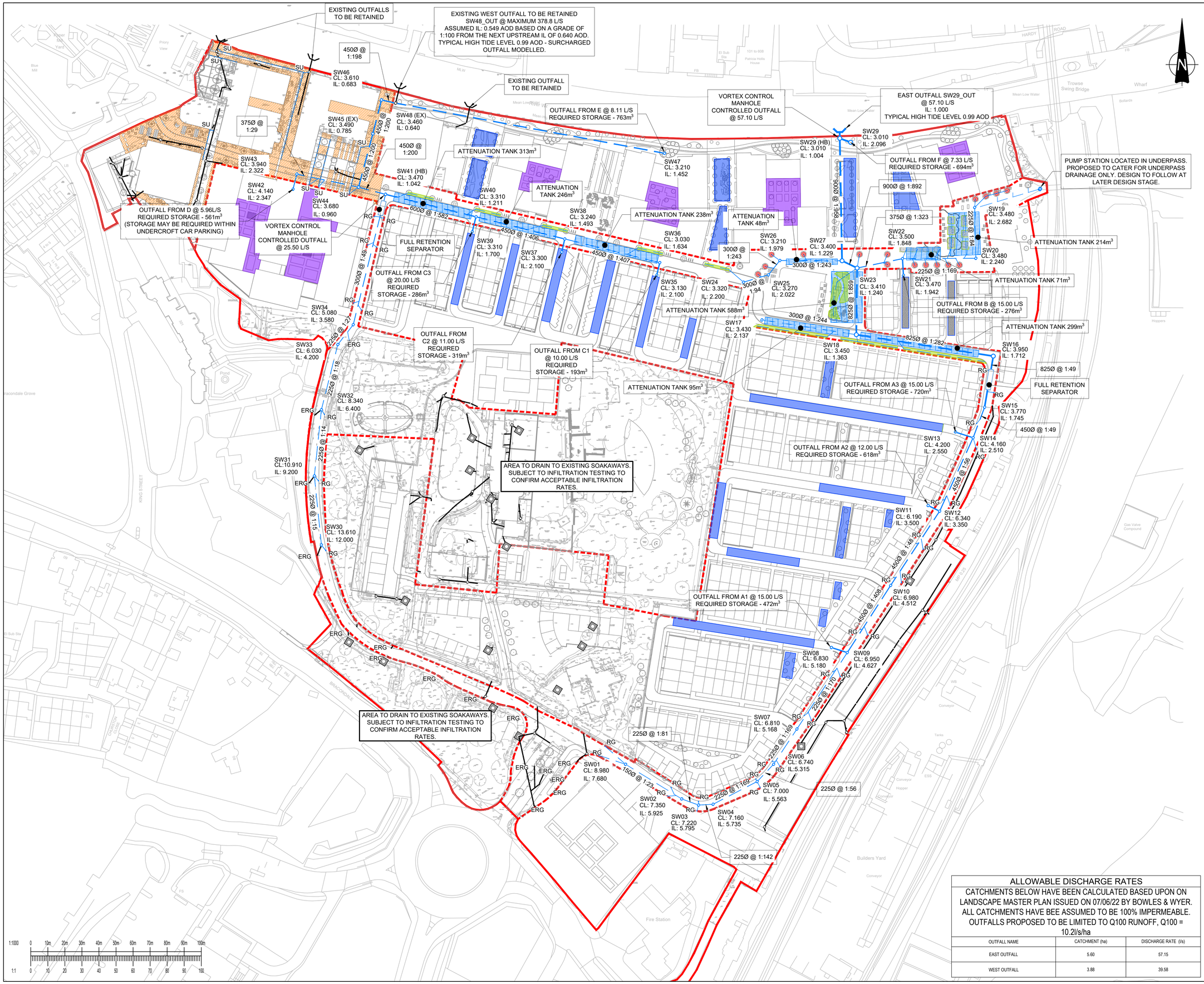
Drawn By	Designed By	Checked By
M.MARTIN	M.MARTIN	M.SMITH
	Date: 10/06/22	Scales @ A1: 1:1000

1:1000 0 10m 20m 30m 40m 50m 60m 70m 80m 90m 100m
1:1 0 10 20 30 40 50 60 70 80 90 100

Project No - Originator - Function - Spatial - Form - Discipline - Number: 081440 -CUR -XX - XX - D - C - 92031

Revision: P02

Appendix G –Proposed Drainage General Arrangement



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8. OUTFALL FROM PLOTS SUBJECT TO DESIGN AT DETAILED DESIGN, THE NEED FOR PUMPING MAY BE REQUIRED AND IS TO BE ASSESSED AT DETAILED DESIGN,

KEY:

FULL PLANNING DRAINAGE

- 150Ø — -SURFACE WATER DRAIN.
- -SURFACE WATER CHAMBER.
- SU — -SURFACE LINEAR CHANNEL.
- RG — -ROAD GULLEY.
- -BIORETENTION AREA WITH PERFORATED PIPE.
- -TREE PIT.
- -BELOW GROUND SURFACE WATER ATTENUATION SYSTEM.
- -FULL RETENTION PETROL INTERCEPTOR.
- -SURFACE WATER PUMP CHAMBER WITH RISING MAIN.
- -PROPOSED SURFACE WATER OUTFALL.
- -GRANULAR SUBBASE FOR TREATMENT.

OUTLINE PLANNING DRAINAGE

- -INDICATIVE LOCATION OF STORAGE.
- -INDICATIVE LOCATION OF BLUE ROOF.

EXISTING DRAINAGE

- -EXISTING SURFACE WATER DRAIN TO BE RETAINED.
- -EXISTING SURFACE WATER CHAMBER TO BE RETAINED.
- -EXISTING SURFACE WATER SOAKAWAY TO BE RETAINED.
- ERG — -EXISTING ROAD GULLEY TO BE RETAINED.
- -EXISTING SURFACE WATER OUTFALL TO BE RETAINED.

BOUNDARIES

- -APPLICATION BOUNDARY.
- -FULL PLANNING APPLICATION BOUNDARY.

ALLOWABLE DISCHARGE RATES

CATCHMENTS BELOW HAVE BEEN CALCULATED BASED UPON ON LANDSCAPE MASTER PLAN ISSUED ON 07/06/22 BY BOWLES & WYER. ALL CATCHMENTS HAVE BEE ASSUMED TO BE 100% IMPERMEABLE. OUTFALLS PROPOSED TO BE LIMITED TO Q100 RUNOFF, Q100 = 10.2l/s/ha

OUTFALL NAME	CATCHMENT (ha)	DISCHARGE RATE (l/s)
EAST OUTFALL	5.60	57.15
WEST OUTFALL	3.88	39.58

Rev:	Description:	Date:	By:	Chkd:
P02	LANDSCAPE ARCHITECT LAYOUT UPDATE	21/06/22	DR-W	MS
P01	PRELIMINARY ISSUE	10/06/22	MM	MS

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Status: SUITABLE FOR INFORMATION — S2

Project: CARROW WORKS

Drg Title: OUTLINE DRAINAGE STRATEGY

Drawn By	Designed By	Checked By
M.MARTIN	M.MARTIN	M.SMITH
	Date: 10/06/22	Scales @ A1: 1:1000

Project No - Originator - Function - Spatial - Form - Discipline - Number: 081440 -CUR -XX - XX - D - C - 92030

Revision: P02

1:1000 0 10m 20m 30m 40m 50m 60m 70m 80m 90m 100m
1:1 0 10 20 30 40 50 60 70 80 90 100

Appendix H – Hydraulic Calculations

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.043	5.00	8.980	1200	624287.310	307227.784	1.300
2			7.350	1200	624320.235	307207.473	1.425
3	0.015	5.00	7.220	1200	624330.114	307203.879	1.425
4			7.160	1200	624338.629	307204.348	1.425
5	0.033	5.00	7.000	1200	624364.477	307217.666	1.437
6	0.021	5.00	6.740	1200	624374.101	307227.796	1.425
7	0.042	5.00	6.810	1200	624387.802	307248.482	1.642
8	0.847	5.00	6.830	1200	624408.033	307296.255	1.650
9	0.038	5.00	6.950	1350	624417.343	307293.303	2.323
10	0.042	5.00	6.980	1350	624442.765	307332.696	2.468
11	0.995	5.00	6.190	1350	624464.747	307379.567	2.690
12	0.034	5.00	6.340	1350	624471.507	307376.222	2.990
13	1.177	5.00	4.200	1350	624480.790	307422.616	1.650
14	0.014	5.00	4.160	1350	624491.135	307419.306	1.650
15	0.022	5.00	3.770	1800	624497.569	307437.207	2.025
16	0.061	5.00	3.950	1800	624502.579	307464.606	2.238
17	0.099	5.00	3.430	1200	624362.578	307487.565	1.293
18	0.064	5.00	3.450	1800	624422.607	307477.618	2.087
19	0.061	5.00	3.480	1200	624486.916	307558.337	0.798
20	0.120	5.00	3.480	1200	624490.819	307521.604	1.240
21	0.563	5.00	3.470	1350	624450.256	307514.604	1.528
22	0.053	5.00	3.500	1350	624449.835	307520.431	1.652
23	0.080	5.00	3.410	1800	624423.106	307518.837	2.170
24	0.101	5.00	3.320	1200	624354.590	307509.313	1.120
25	0.046	5.00	3.270	1200	624368.488	307518.466	1.248
26	0.030	5.00	3.210	1200	624377.778	307523.234	1.231
27	0.021	5.00	3.400	1800	624414.271	307523.106	2.171
28	0.982	5.00	3.010	1200	624420.505	307591.194	0.914
29			3.010	1950	624412.947	307594.904	2.006
29_OUT			3.010	1950	624412.796	307599.362	2.010
30	0.059	5.00	13.610	1200	624108.927	307356.415	1.610
31	0.041	5.00	10.910	1200	624104.786	307396.911	1.710
32			8.310	1200	624108.910	307435.738	1.910
33	0.044	5.00	6.030	1200	624118.553	307474.000	1.830
34	0.052	5.00	5.080	1200	624127.594	307485.596	1.500
35	0.390	5.00	3.130	1200	624305.583	307514.657	1.030
36			3.030	1350	624306.898	307520.093	1.396
37	0.584	5.00	3.300	1200	624249.858	307528.203	1.200
38	0.063	5.00	3.240	1350	624251.115	307533.798	1.747
39	0.629	5.00	3.310	1200	624197.373	307540.066	1.610
40	0.067	5.00	3.310	1500	624199.114	307546.905	2.099
41	0.077	5.00	3.470	2100	624146.044	307560.282	2.428
42	0.795	5.00	4.140	1350	624092.255	307565.040	1.793
43			3.940	1350	624094.110	307572.886	1.618
44			3.680	1800	624130.048	307563.745	2.720
45	0.521	5.00	3.490	1800	624139.092	307597.617	2.705
46			3.610	1800	624144.115	307617.413	2.927
47	1.082	5.00	3.210	1350	624310.144	307586.148	1.758
48			3.460	1800	624152.443	307615.563	2.820
48_OUT			3.470	1350	624154.603	307624.365	2.921

Links (Input)

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.016	29	29_OUT	4.461	0.600	1.004	1.000	0.004	1115.1	1050	12.29	50.0
1.015	27	29	71.810	0.600	1.229	1.154	0.075	957.5	900	12.21	50.0
9.000	28	29	8.419	0.600	2.096	1.829	0.267	31.5	300	5.05	50.0
1.014	23	27	9.812	0.600	1.240	1.229	0.011	892.0	900	11.02	50.0
8.002	26	27	36.493	0.600	1.979	1.829	0.150	243.3	300	5.95	50.0
8.001	25	26	10.442	0.600	2.022	1.979	0.043	242.8	300	5.34	50.0
8.000	24	25	16.641	0.600	2.200	2.022	0.178	93.5	300	5.17	50.0
1.013	18	23	41.222	0.600	1.363	1.315	0.048	858.8	825	10.86	50.0
6.002	22	23	26.776	0.600	1.848	1.765	0.083	322.6	375	6.56	50.0
6.001	20	22	41.001	0.600	2.240	1.998	0.242	169.4	225	6.11	50.0
7.000	21	22	5.842	0.600	1.942	1.923	0.019	307.5	375	5.09	50.0
6.000	19	20	36.940	0.600	2.682	2.240	0.442	83.6	225	5.43	50.0
1.012	16	18	81.024	0.600	1.712	1.425	0.287	282.3	825	10.18	50.0
5.000	17	18	60.848	0.600	2.137	1.888	0.249	244.4	300	6.01	50.0
1.011	15	16	27.853	0.600	1.745	1.712	0.033	844.0	825	9.41	50.0
1.010	14	15	19.022	0.600	2.510	2.120	0.390	48.8	450	8.96	50.0
1.009	12	14	47.344	0.600	3.350	2.510	0.840	56.4	450	8.85	50.0
4.000	13	14	10.862	0.600	2.550	2.510	0.040	271.5	450	5.15	50.0
1.008	10	12	52.160	0.600	4.512	3.425	1.087	48.0	450	8.56	50.0
3.000	11	12	7.542	0.600	3.500	3.425	0.075	100.0	375	5.07	50.0
1.007	9	10	46.884	0.600	4.627	4.512	0.115	407.7	450	8.26	50.0
1.006	7	9	53.680	0.600	5.168	4.852	0.316	169.9	225	7.48	50.0
2.000	8	9	9.767	0.600	5.180	4.852	0.328	29.8	300	5.06	50.0
1.005	6	7	24.812	0.600	5.315	5.168	0.147	168.8	225	6.59	50.0
1.004	5	6	13.973	0.600	5.563	5.315	0.248	56.3	225	6.17	50.0
1.003	4	5	29.077	0.600	5.735	5.563	0.172	169.1	225	6.04	50.0
1.002	3	4	8.528	0.600	5.795	5.735	0.060	142.1	225	5.56	50.0
1.001	2	3	10.512	0.600	5.925	5.795	0.130	80.9	225	5.43	50.0
1.000	1	2	38.686	0.600	7.680	6.000	1.680	23.0	150	5.31	50.0
10.009	48	48_OUT	9.063	0.600	0.640	0.549	0.091	99.6	450	8.67	50.0
10.008	46	48	8.531	0.600	0.683	0.640	0.043	198.4	450	8.60	50.0
15.000	47	48	160.421	0.600	1.452	0.640	0.812	197.6	450	6.85	50.0
10.007	45	46	20.423	0.600	0.785	0.683	0.102	200.2	450	8.55	50.0
10.006	44	45	35.061	0.600	0.960	0.785	0.175	200.3	450	8.44	50.0
10.005	41	44	16.367	0.600	1.042	0.960	0.082	199.6	450	8.03	50.0
14.001	43	44	37.082	0.600	2.322	1.035	1.287	28.8	375	5.32	50.0
14.000	42	43	8.062	0.600	2.347	2.322	0.025	322.5	375	5.13	50.0
10.004	34	41	76.931	0.600	3.580	1.970	1.610	47.8	300	6.25	50.0
11.003	40	41	54.730	0.600	1.211	1.117	0.094	582.2	600	7.79	50.0
13.000	39	40	7.057	0.600	1.700	1.586	0.114	61.9	300	5.06	50.0
11.002	38	40	53.627	0.600	1.493	1.361	0.132	406.3	450	6.88	50.0
12.000	37	38	5.734	0.600	2.100	1.815	0.285	20.1	225	5.03	50.0
11.001	36	38	57.442	0.600	1.634	1.493	0.141	407.4	450	5.99	50.0
11.000	35	36	5.593	0.600	2.100	1.859	0.241	23.2	225	5.03	50.0
10.003	33	34	14.704	0.600	4.200	3.655	0.545	27.0	225	5.69	50.0
10.002	32	33	39.458	0.600	6.400	4.200	2.200	17.9	225	5.59	50.0
10.001	31	32	39.045	0.600	9.200	6.400	2.800	13.9	225	5.38	50.0
10.000	30	31	40.707	0.600	12.000	9.200	2.800	14.5	225	5.20	50.0

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Detailed
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	20.000	Drain Down Time (mins)	240
Ratio-R	0.400	Additional Storage (m³/ha)	20.0
Summer CV	0.950	Check Discharge Rate(s)	x
Winter CV	0.950	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	40	0	0
100	45	0	0

Node 48_OUT Surcharged Outfall

Overrides Design Area	x	Depression Storage Area (m²)	0	Evapo-transpiration (mm/day)	0
Overrides Design Additional Inflow	x	Depression Storage Depth (mm)	0		

Applies to All storms

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
0	0.441	250	0.441	500	0.441	750	0.441	1000	0.441	1250	0.441
50	0.441	300	0.441	550	0.441	800	0.441	1050	0.441	1300	0.441
100	0.441	350	0.441	600	0.441	850	0.441	1100	0.441	1350	0.441
150	0.441	400	0.441	650	0.441	900	0.441	1150	0.441	1400	0.441
200	0.441	450	0.441	700	0.441	950	0.441	1200	0.441	1450	0.441

Node 29 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	1.004	Product Number	CTL-SHE-0299-5720-2000-5720
Design Depth (m)	2.000	Min Outlet Diameter (m)	0.375
Design Flow (l/s)	57.2	Min Node Diameter (mm)	

Node 8 Online Depth/Flow Control

Flap Valve	x	Replaces Downstream Link	✓	Invert Level (m)	5.180

Depth (m)	Flow (l/s)
0.001	15.000

Node 11 Online Depth/Flow Control

Flap Valve	x	Replaces Downstream Link	✓	Invert Level (m)	3.500

Depth (m)	Flow (l/s)
0.001	12.000

Node 13 Online Depth/Flow Control

Flap Valve x | Replaces Downstream Link ✓ | Invert Level (m) 2.550

Depth (m)	Flow (l/s)
0.001	15.000

Node 21 Online Depth/Flow Control

Flap Valve x | Replaces Downstream Link ✓ | Invert Level (m) 1.942

Depth (m)	Flow (l/s)
0.001	15.000

Node 28 Online Depth/Flow Control

Flap Valve x | Replaces Downstream Link ✓ | Invert Level (m) 2.096

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.001	7.330	2.000	7.330

Node 47 Online Depth/Flow Control

Flap Valve x | Replaces Downstream Link ✓ | Invert Level (m) 1.452

Depth (m)	Flow (l/s)
0.001	8.110

Node 42 Online Depth/Flow Control

Flap Valve x | Replaces Downstream Link ✓ | Invert Level (m) 2.347

Depth (m)	Flow (l/s)
0.001	5.960

Node 41 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	1.042	Product Number	CTL-SHE-0202-2550-2300-2550
Design Depth (m)	2.300	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	25.5	Min Node Diameter (mm)	1800

Node 35 Online Depth/Flow Control

Flap Valve x | Replaces Downstream Link ✓ | Invert Level (m) 2.100

Depth (m)	Flow (l/s)
0.001	10.000

Node 37 Online Depth/Flow Control

Flap Valve x | Replaces Downstream Link ✓ | Invert Level (m) 2.100

Depth (m)	Flow (l/s)
0.001	11.000

Node 39 Online Depth/Flow Control

Flap Valve x | Replaces Downstream Link ✓ | Invert Level (m) 1.700

Depth (m)	Flow (l/s)
0.001	20.000

Node 8 Depth/Area Storage Structure

Base Inf Coefficient (m/hr) 0.00000 | Safety Factor 2.0 | Invert Level (m) 5.180
Side Inf Coefficient (m/hr) 0.00000 | Porosity 1.00 | Time to half empty (mins) 0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1200.0	0.0	1.200	1200.0	0.0	1.201	0.0	0.0

Node 11 Depth/Area Storage Structure

Base Inf Coefficient (m/hr) 0.00000 | Safety Factor 2.0 | Invert Level (m) 3.500
Side Inf Coefficient (m/hr) 0.00000 | Porosity 1.00 | Time to half empty (mins) 0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1200.0	0.0	1.200	1200.0	0.0	1.201	0.0	0.0

Node 13 Depth/Area Storage Structure

Base Inf Coefficient (m/hr) 0.00000 | Safety Factor 2.0 | Invert Level (m) 2.550
Side Inf Coefficient (m/hr) 0.00000 | Porosity 1.00 | Time to half empty (mins) 0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1200.0	0.0	1.200	1200.0	0.0	1.201	0.0	0.0

Node 21 Depth/Area Storage Structure

Base Inf Coefficient (m/hr) 0.00000 | Safety Factor 2.0 | Invert Level (m) 1.942
Side Inf Coefficient (m/hr) 0.00000 | Porosity 1.00 | Time to half empty (mins) 0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1200.0	0.0	1.200	1200.0	0.0	1.201	0.0	0.0

Node 28 Depth/Area Storage Structure

Base Inf Coefficient (m/hr) 0.00000 | Safety Factor 2.0 | Invert Level (m) 2.096
Side Inf Coefficient (m/hr) 0.00000 | Porosity 1.00 | Time to half empty (mins)

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1200.0	0.0	1.200	1200.0	0.0	1.201	0.0	0.0

Node 23 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	1.240
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	550.0	0.0	1.125	550.0	0.0	1.126	0.0	0.0

Node 35 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	2.100
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1200.0	0.0	1.200	1200.0	0.0	1.201	0.0	0.0

Node 37 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	2.100
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1200.0	0.0	1.200	1200.0	0.0	1.201	0.0	0.0

Node 39 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	1.700
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1200.0	0.0	1.200	1200.0	0.0	1.201	0.0	0.0

Node 42 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	2.347
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1200.0	0.0	1.200	1200.0	0.0	1.201	0.0	0.0

Node 47 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	1.452
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	80

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1200.0	0.0	1.200	1200.0	0.0	1.201	0.0	0.0

Node 20 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	2.240
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	330

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	450.0	0.0	0.500	450.0	0.0	0.501	0.0	0.0

Node 17 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	2.137
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	200.0	0.0	0.500	200.0	0.0	0.501	0.0	0.0

Node 41 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	1.042
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	220.0	0.0	1.500	220.0	0.0	1.501	0.0	0.0

Node 40 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	1.211
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	230.0	0.0	1.125	230.0	0.0	1.126	0.0	0.0

Node 38 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	1.493
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	250.0	0.0	1.000	250.0	0.0	1.001	0.0	0.0

Node 22 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	1.848
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	150.0	0.0	0.500	150.0	0.0	0.501	0.0	0.0

Node 27 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	1.229
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	100.0	0.0	0.500	100.0	0.0	0.501	0.0	0.0

Node 16 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	1.712
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	280.0	0.0	1.125	280.0	0.0	1.126	0.0	0.0

Results for 1 year Critical Storm Duration. Lowest mass balance: 97.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	10	7.725	0.045	7.4	0.0817	0.0000	OK
15 minute summer	2	10	5.980	0.055	7.2	0.0622	0.0000	OK
15 minute summer	3	11	5.873	0.078	9.7	0.1047	0.0000	OK
15 minute summer	4	11	5.813	0.078	9.8	0.0881	0.0000	OK
15 minute summer	5	11	5.635	0.072	15.2	0.1147	0.0000	OK
15 minute summer	6	11	5.426	0.111	18.6	0.1585	0.0000	OK
15 minute summer	7	12	5.297	0.129	25.2	0.2112	0.0000	OK
60 minute summer	8	48	5.227	0.047	97.2	56.5325	0.0000	OK
15 minute summer	9	12	4.788	0.161	44.5	0.2845	0.0000	OK
15 minute summer	10	12	4.613	0.101	50.4	0.1790	0.0000	OK
60 minute winter	11	59	3.567	0.067	82.5	80.5573	0.0000	OK
15 minute summer	12	12	3.469	0.119	67.0	0.1976	0.0000	OK
60 minute winter	13	58	2.626	0.076	97.6	92.7002	0.0000	OK
15 minute summer	14	12	2.650	0.140	83.9	0.2226	0.0000	OK
15 minute winter	15	6	2.054	0.309	84.1	0.8526	0.0000	OK
60 minute summer	16	39	1.863	0.151	80.7	40.7368	0.0000	OK
120 minute summer	17	76	2.180	0.043	7.5	8.3577	0.0000	OK
360 minute summer	18	280	1.618	0.255	58.9	0.8041	0.0000	OK
15 minute summer	19	10	2.763	0.081	10.3	0.2149	0.0000	OK
240 minute summer	20	152	2.285	0.045	8.8	19.3805	0.0000	OK
30 minute summer	21	26	1.967	0.025	85.7	30.7598	0.0000	OK
180 minute summer	22	112	1.958	0.110	20.0	15.8619	0.0000	OK
360 minute summer	23	288	1.613	0.373	80.1	196.0783	0.0000	OK
15 minute summer	24	10	2.277	0.077	17.2	0.2275	0.0000	OK
15 minute summer	25	11	2.158	0.136	24.9	0.2553	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	7.2	1.620	0.194	0.1724	
15 minute summer	2	1.001	3	7.2	0.736	0.124	0.1034	
15 minute summer	3	1.002	4	9.8	0.804	0.225	0.1039	
15 minute summer	4	1.003	5	9.8	0.849	0.246	0.3361	
15 minute summer	5	1.004	6	15.2	1.000	0.219	0.2132	
15 minute summer	6	1.005	7	18.5	0.866	0.464	0.5303	
15 minute summer	7	1.006	9	24.3	1.048	0.610	1.2426	
15 minute summer	8	Depth/Flow	9	15.0				
15 minute summer	9	1.007	10	44.8	1.166	0.282	1.8212	
15 minute summer	10	1.008	12	50.5	1.937	0.108	1.3601	
15 minute summer	11	Depth/Flow	12	12.0				
15 minute summer	12	1.009	14	67.1	1.785	0.156	1.7827	
15 minute summer	13	Depth/Flow	14	15.0				
15 minute summer	14	1.010	15	83.7	2.129	0.181	0.7485	
15 minute summer	15	1.011	16	86.5	1.616	0.160	2.4630	
60 minute summer	16	1.012	18	69.5	1.059	0.074	5.3194	
120 minute summer	17	5.000	18	3.2	0.520	0.045	0.3707	
60 minute summer	18	1.013	23	75.9	0.876	0.141	3.5843	
15 minute summer	19	6.000	20	10.4	1.702	0.183	0.2562	
240 minute summer	20	6.001	22	3.5	0.618	0.087	0.2291	
15 minute summer	21	Depth/Flow	22	15.0				
180 minute summer	22	6.002	23	19.7	0.781	0.177	0.6737	
60 minute summer	23	1.014	27	59.8	0.627	0.090	1.5009	
15 minute summer	24	8.000	25	17.0	0.767	0.148	0.3773	
15 minute summer	25	8.001	26	24.3	0.795	0.343	0.3284	

Results for 1 year Critical Storm Duration. Lowest mass balance: 97.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	26	11	2.118	0.139	29.4	0.2239	0.0000	OK
360 minute summer	27	288	1.612	0.383	58.6	37.4102	0.0000	OK
120 minute winter	28	116	2.177	0.081	51.3	98.8264	0.0000	OK
360 minute summer	29	288	1.610	0.606	59.5	1.8085	0.0000	OK
15 minute summer	29_OUT	1	1.000	0.000	54.5	0.0000	0.0000	OK
15 minute summer	30	10	12.041	0.041	10.0	0.0762	0.0000	OK
15 minute summer	31	10	9.253	0.053	16.9	0.0850	0.0000	OK
15 minute summer	32	11	6.456	0.056	16.8	0.0630	0.0000	OK
15 minute summer	33	11	4.279	0.079	24.0	0.1279	0.0000	OK
15 minute summer	34	11	3.672	0.092	32.3	0.1668	0.0000	OK
30 minute summer	35	26	2.118	0.018	59.2	21.9775	0.0000	OK
15 minute winter	36	7	1.720	0.086	10.0	0.1229	0.0000	OK
60 minute summer	37	47	2.131	0.031	67.0	38.1404	0.0000	OK
180 minute summer	38	108	1.610	0.117	24.6	28.1418	0.0000	OK
30 minute summer	39	25	1.726	0.026	95.6	31.1615	0.0000	OK
240 minute summer	40	188	1.496	0.285	45.2	62.9117	0.0000	OK
240 minute summer	41	192	1.494	0.452	54.5	96.4220	0.0000	SURCHARGED
120 minute winter	42	116	2.413	0.066	41.5	80.0221	0.0000	OK
15 minute summer	43	9	2.355	0.033	6.0	0.0475	0.0000	OK
240 minute summer	44	192	1.069	0.109	30.5	0.2786	0.0000	OK
15 minute summer	45	11	1.046	0.261	93.9	1.6695	0.0000	OK
15 minute summer	46	11	1.020	0.337	93.7	0.8566	0.0000	OK
120 minute winter	47	116	1.541	0.089	56.5	108.3732	0.0000	OK
15 minute summer	48	7	1.004	0.364	102.0	0.9267	0.0000	OK
15 minute summer	48_OUT	1	0.990	0.441	102.3	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	26	8.002	27	29.3	0.955	0.414	1.1211	
120 minute summer	27	1.015	29	58.1	0.681	0.091	17.9434	
15 minute summer	28	Depth/Flow	29	7.3				
360 minute summer	29	Hydro-Brake®	29_OUT	57.1				1123.9
15 minute summer	30	10.000	31	9.9	1.666	0.072	0.2435	
15 minute summer	31	10.001	32	16.8	2.292	0.120	0.2858	
15 minute summer	32	10.002	33	16.7	1.671	0.135	0.3964	
15 minute summer	33	10.003	34	24.0	2.009	0.239	0.1760	
15 minute summer	34	10.004	41	32.2	1.788	0.200	1.3862	
15 minute summer	35	Depth/Flow	36	10.0				
15 minute winter	36	11.001	38	10.3	0.995	0.065	1.3503	
15 minute summer	37	Depth/Flow	38	11.0				
180 minute summer	38	11.002	40	22.9	0.766	0.144	1.7759	
15 minute summer	39	Depth/Flow	40	20.0				
120 minute summer	40	11.003	41	43.4	0.768	0.153	7.7267	
240 minute summer	41	Hydro-Brake®	44	24.6				
15 minute summer	42	Depth/Flow	43	6.0				
180 minute winter	43	14.001	44	6.0	1.269	0.016	0.1791	
240 minute summer	44	10.006	45	30.5	0.602	0.134	1.8489	
15 minute summer	45	10.007	46	93.7	0.839	0.411	2.2721	
15 minute summer	46	10.008	48	93.9	0.710	0.410	1.1270	
15 minute summer	47	Depth/Flow	48	8.1				
15 minute summer	48	10.009	48_OUT	102.3	0.685	0.316	1.3372	299.7

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 97.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	10	7.773	0.093	25.3	0.1667	0.0000	OK
15 minute summer	2	12	6.315	0.390	24.9	0.4415	0.0000	SURCHARGED
15 minute summer	3	12	6.297	0.502	33.9	0.6736	0.0000	SURCHARGED
15 minute summer	4	12	6.268	0.533	29.2	0.6031	0.0000	SURCHARGED
15 minute summer	5	12	6.200	0.637	45.8	1.0146	0.0000	SURCHARGED
15 minute summer	6	12	6.105	0.790	46.0	1.1246	0.0000	SURCHARGED
15 minute summer	7	12	5.875	0.707	65.7	1.1575	0.0000	SURCHARGED
120 minute winter	8	118	5.440	0.260	145.2	315.3951	0.0000	OK
15 minute summer	9	11	4.871	0.244	97.6	0.4297	0.0000	OK
15 minute summer	10	11	4.671	0.159	120.3	0.2822	0.0000	OK
180 minute winter	11	180	3.846	0.346	125.6	418.6187	0.0000	OK
15 minute summer	12	11	3.536	0.186	149.7	0.3092	0.0000	OK
180 minute winter	13	176	2.951	0.401	148.6	487.0556	0.0000	OK
15 minute summer	14	11	2.722	0.212	171.7	0.3382	0.0000	OK
960 minute winter	15	945	2.351	0.606	52.6	1.6741	0.0000	OK
960 minute winter	16	945	2.350	0.638	54.7	171.8114	0.0000	OK
960 minute winter	17	945	2.350	0.213	5.5	41.0327	0.0000	OK
960 minute winter	18	945	2.350	0.987	60.1	3.1184	0.0000	SURCHARGED
15 minute summer	19	10	2.835	0.153	35.5	0.4057	0.0000	OK
60 minute summer	20	42	2.353	0.113	70.1	48.7036	0.0000	OK
60 minute winter	21	60	2.090	0.148	157.4	178.4613	0.0000	OK
960 minute winter	22	945	2.349	0.501	22.7	72.3524	0.0000	SURCHARGED
960 minute winter	23	945	2.349	1.109	119.1	583.0616	0.0000	SURCHARGED
15 minute summer	24	11	2.536	0.336	59.1	0.9880	0.0000	SURCHARGED
15 minute summer	25	11	2.477	0.455	81.2	0.8529	0.0000	SURCHARGED

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	24.9	2.221	0.669	0.5496	
15 minute summer	2	1.001	3	25.1	0.920	0.433	0.4181	
15 minute winter	3	1.002	4	29.7	1.019	0.682	0.3392	
30 minute summer	4	1.003	5	28.5	0.999	0.714	1.1564	
30 minute summer	5	1.004	6	38.0	1.089	0.548	0.5557	
15 minute summer	6	1.005	7	46.2	1.162	1.159	0.9868	
15 minute summer	7	1.006	9	63.2	1.591	1.590	2.0811	
15 minute summer	8	Depth/Flow	9	15.0				
15 minute summer	9	1.007	10	97.0	1.421	0.610	3.2333	
15 minute summer	10	1.008	12	118.7	2.444	0.254	2.5395	
15 minute summer	11	Depth/Flow	12	12.0				
15 minute summer	12	1.009	14	149.2	2.205	0.346	3.2041	
15 minute summer	13	Depth/Flow	14	15.0				
15 minute summer	14	1.010	15	170.2	2.531	0.367	1.2839	
15 minute summer	15	1.011	16	180.9	1.766	0.334	3.5260	
30 minute summer	16	1.012	18	155.4	1.198	0.165	12.0573	
60 minute summer	17	5.000	18	18.9	0.854	0.267	1.3472	
30 minute summer	18	1.013	23	185.5	1.138	0.345	13.2950	
15 minute summer	19	6.000	20	35.7	2.091	0.627	0.6640	
60 minute summer	20	6.001	22	19.3	0.989	0.486	0.8024	
15 minute summer	21	Depth/Flow	22	15.0				
60 minute summer	22	6.002	23	40.4	0.953	0.365	1.2231	
960 minute winter	23	1.014	27	171.2	0.562	0.259	6.2186	
15 minute summer	24	8.000	25	55.4	0.946	0.482	1.1718	
15 minute summer	25	8.001	26	80.7	1.146	1.137	0.7353	

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 97.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	26	11	2.386	0.407	97.3	0.6570	0.0000	SURCHARGED
960 minute winter	27	960	2.365	1.136	174.1	50.6610	0.0000	SURCHARGED
360 minute winter	28	352	2.486	0.390	73.7	477.0287	0.0000	SURCHARGED
720 minute winter	29	615	2.552	1.548	161.2	4.6211	0.0000	SURCHARGED
15 minute summer	29_OUT	1	1.000	0.000	57.1	0.0000	0.0000	OK
15 minute summer	30	10	12.076	0.076	34.4	0.1422	0.0000	OK
15 minute summer	31	10	9.303	0.103	58.3	0.1655	0.0000	OK
15 minute summer	32	10	6.507	0.107	57.8	0.1213	0.0000	OK
15 minute summer	33	11	4.379	0.179	83.2	0.2895	0.0000	OK
15 minute summer	34	11	3.769	0.189	112.0	0.3438	0.0000	OK
120 minute winter	35	116	2.204	0.104	66.7	125.3608	0.0000	OK
600 minute winter	36	585	2.176	0.542	10.0	0.7757	0.0000	SURCHARGED
120 minute winter	37	118	2.276	0.176	100.1	213.2893	0.0000	OK
600 minute winter	38	585	2.175	0.682	24.2	163.5496	0.0000	SURCHARGED
60 minute winter	39	60	1.856	0.156	175.6	188.3910	0.0000	OK
600 minute winter	40	585	2.173	0.962	46.6	212.4696	0.0000	SURCHARGED
600 minute winter	41	585	2.172	1.130	41.1	240.7991	0.0000	SURCHARGED
360 minute winter	42	352	2.666	0.319	59.6	385.7162	0.0000	OK
15 minute summer	43	21	2.355	0.033	6.0	0.0475	0.0000	OK
15 minute summer	44	11	1.509	0.549	56.7	1.3962	0.0000	SURCHARGED
15 minute summer	45	11	1.512	0.727	304.0	4.6490	0.0000	SURCHARGED
15 minute summer	46	11	1.283	0.600	276.3	1.5282	0.0000	SURCHARGED
360 minute winter	47	352	1.884	0.432	81.1	523.9989	0.0000	OK
15 minute summer	48	11	1.142	0.502	284.5	1.2786	0.0000	SURCHARGED
15 minute summer	48_OUT	1	0.990	0.441	284.6	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	26	8.002	27	96.2	1.391	1.357	2.3914	
720 minute summer	27	1.015	29	160.0	0.668	0.250	45.5113	
15 minute summer	28	Depth/Flow	29	7.3				
15 minute summer	29	Hydro-Brake®	29_OUT	57.1				837.3
15 minute summer	30	10.000	31	34.2	2.331	0.249	0.5991	
15 minute summer	31	10.001	32	57.8	3.192	0.413	0.7076	
15 minute summer	32	10.002	33	57.4	2.156	0.465	1.0355	
15 minute summer	33	10.003	34	82.6	2.621	0.822	0.4622	
15 minute summer	34	10.004	41	112.1	2.450	0.696	3.5204	
15 minute summer	35	Depth/Flow	36	10.0				
15 minute winter	36	11.001	38	10.5	1.012	0.066	1.5240	
15 minute summer	37	Depth/Flow	38	11.0				
120 minute summer	38	11.002	40	34.1	0.818	0.214	8.4935	
15 minute summer	39	Depth/Flow	40	20.0				
30 minute summer	40	11.003	41	49.8	0.595	0.176	14.5136	
60 minute winter	41	Hydro-Brake®	44	25.5				
15 minute summer	42	Depth/Flow	43	6.0				
60 minute summer	43	14.001	44	6.0	1.269	0.016	1.5059	
15 minute summer	44	10.006	45	-50.7	0.615	-0.223	5.5552	
15 minute summer	45	10.007	46	276.3	1.744	1.212	3.2359	
15 minute summer	46	10.008	48	276.4	1.745	1.207	1.3517	
15 minute summer	47	Depth/Flow	48	8.1				
15 minute summer	48	10.009	48_OUT	284.6	1.796	0.878	1.4325	688.9

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 97.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	12	7.906	0.226	34.0	0.4058	0.0000	SURCHARGED
15 minute summer	2	13	7.057	1.132	32.7	1.2807	0.0000	FLOOD RISK
15 minute summer	3	13	7.021	1.226	41.8	1.6466	0.0000	FLOOD RISK
15 minute summer	4	13	6.973	1.238	30.8	1.4006	0.0000	FLOOD RISK
15 minute summer	5	13	6.837	1.274	46.5	2.0293	0.0000	FLOOD RISK
15 minute summer	6	12	6.697	1.382	56.0	1.9660	0.0000	FLOOD RISK
15 minute summer	7	12	6.367	1.199	79.6	1.9633	0.0000	SURCHARGED
180 minute winter	8	176	5.570	0.390	145.1	472.2516	0.0000	SURCHARGED
15 minute summer	9	11	4.899	0.272	118.0	0.4790	0.0000	OK
15 minute summer	10	11	4.691	0.179	148.0	0.3170	0.0000	OK
240 minute winter	11	236	4.011	0.511	137.3	618.2252	0.0000	SURCHARGED
15 minute summer	12	11	3.560	0.210	183.5	0.3492	0.0000	OK
240 minute winter	13	236	3.143	0.593	162.4	720.5401	0.0000	SURCHARGED
1440 minute winter	14	1380	2.796	0.286	51.3	0.4565	0.0000	OK
480 minute summer	15	680	2.797	1.052	159.4	2.9065	0.0000	SURCHARGED
1440 minute winter	16	1380	2.795	1.083	53.6	291.3417	0.0000	SURCHARGED
1440 minute winter	17	1380	2.794	0.657	7.0	96.8485	0.0000	SURCHARGED
1440 minute winter	18	1380	2.794	1.431	57.3	4.5192	0.0000	SURCHARGED
15 minute summer	19	10	2.870	0.188	47.7	0.4980	0.0000	OK
1440 minute winter	20	1380	2.794	0.554	15.0	215.6611	0.0000	SURCHARGED
120 minute winter	21	118	2.170	0.228	131.4	276.1178	0.0000	OK
1440 minute winter	22	1380	2.794	0.946	22.6	73.2789	0.0000	SURCHARGED
1440 minute winter	23	1380	2.794	1.554	114.4	593.1773	0.0000	SURCHARGED
15 minute summer	24	11	2.927	0.727	79.5	2.1382	0.0000	SURCHARGED
15 minute summer	25	11	2.822	0.800	108.6	1.4997	0.0000	SURCHARGED

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	32.7	2.296	0.878	0.6811	
15 minute summer	2	1.001	3	30.5	0.923	0.527	0.4181	
30 minute summer	3	1.002	4	33.1	1.027	0.761	0.3392	
15 minute summer	4	1.003	5	34.3	0.968	0.861	1.1564	
15 minute summer	5	1.004	6	47.9	1.204	0.690	0.5557	
15 minute summer	6	1.005	7	57.7	1.450	1.445	0.9868	
15 minute summer	7	1.006	9	78.1	1.963	1.963	2.1133	
15 minute summer	8	Depth/Flow	9	15.0				
15 minute summer	9	1.007	10	117.7	1.491	0.740	3.7245	
15 minute summer	10	1.008	12	146.1	2.582	0.312	2.9596	
15 minute summer	11	Depth/Flow	12	12.0				
15 minute summer	12	1.009	14	182.9	2.309	0.424	3.7522	
15 minute summer	13	Depth/Flow	14	15.0				
15 minute summer	14	1.010	15	206.7	2.642	0.446	1.4921	
15 minute summer	15	1.011	16	221.3	1.842	0.408	4.2127	
30 minute summer	16	1.012	18	198.7	1.236	0.211	21.5229	
60 minute summer	17	5.000	18	28.5	0.956	0.402	1.9539	
30 minute summer	18	1.013	23	246.7	1.240	0.459	18.2929	
15 minute summer	19	6.000	20	47.8	2.122	0.840	0.8629	
60 minute summer	20	6.001	22	29.1	1.083	0.732	1.1028	
15 minute summer	21	Depth/Flow	22	15.0				
480 minute winter	22	6.002	23	57.0	0.868	0.514	2.9533	
120 minute summer	23	1.014	27	171.4	0.565	0.259	6.2186	
15 minute summer	24	8.000	25	74.0	1.050	0.643	1.1718	
15 minute summer	25	8.001	26	107.5	1.527	1.515	0.7353	

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 97.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	26	1380	2.794	0.815	10.9	1.3155	0.0000	SURCHARGED
1440 minute winter	27	1380	2.793	1.564	135.3	51.8356	0.0000	SURCHARGED
480 minute winter	28	472	2.664	0.568	78.5	694.1614	0.0000	SURCHARGED
1440 minute winter	29	1380	2.793	1.789	134.7	5.3417	0.0000	FLOOD RISK
15 minute summer	29_OUT	1	1.000	0.000	57.1	0.0000	0.0000	OK
15 minute summer	30	10	12.089	0.089	46.3	0.1667	0.0000	OK
15 minute summer	31	10	9.323	0.123	78.5	0.1981	0.0000	OK
15 minute summer	32	10	6.528	0.128	77.9	0.1450	0.0000	OK
15 minute summer	33	11	4.718	0.518	112.1	0.8372	0.0000	SURCHARGED
15 minute summer	34	11	3.813	0.233	147.7	0.4241	0.0000	OK
120 minute winter	35	118	2.260	0.160	90.8	193.6052	0.0000	OK
360 minute summer	36	512	2.745	1.111	10.0	1.5893	0.0000	FLOOD RISK
180 minute winter	37	176	2.364	0.264	100.0	319.2698	0.0000	SURCHARGED
360 minute summer	38	512	2.744	1.251	29.5	240.3164	0.0000	SURCHARGED
120 minute winter	39	116	1.937	0.237	146.7	286.7192	0.0000	OK
720 minute winter	40	645	2.965	1.754	196.8	250.1377	0.0000	SURCHARGED
360 minute summer	41	512	2.739	1.697	49.6	320.5540	0.0000	SURCHARGED
480 minute winter	42	472	2.811	0.464	63.5	561.2491	0.0000	SURCHARGED
30 minute summer	43	11	2.355	0.033	6.0	0.0475	0.0000	OK
15 minute summer	44	11	1.922	0.962	74.7	2.4475	0.0000	SURCHARGED
15 minute summer	45	11	1.923	1.138	408.7	7.2819	0.0000	SURCHARGED
15 minute summer	46	11	1.513	0.830	370.3	2.1126	0.0000	SURCHARGED
480 minute winter	47	472	2.081	0.629	86.4	763.2164	0.0000	SURCHARGED
15 minute summer	48	11	1.260	0.620	378.8	1.5771	0.0000	SURCHARGED
15 minute summer	48_OUT	1	0.990	0.441	378.8	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	26	8.002	27	128.7	1.829	1.814	2.5041	
2880 minute summer	27	1.015	29	160.3	0.653	0.251	45.5113	
15 minute summer	28	Depth/Flow	29	7.3				
15 minute winter	29	Hydro-Brake®	29_OUT	57.1				838.3
15 minute summer	30	10.000	31	46.1	2.504	0.336	0.7495	
15 minute summer	31	10.001	32	77.9	3.422	0.556	0.8884	
15 minute summer	32	10.002	33	77.3	2.179	0.626	1.2456	
15 minute summer	33	10.003	34	109.2	2.747	1.087	0.5848	
15 minute summer	34	10.004	41	145.6	2.563	0.904	4.3907	
15 minute summer	35	Depth/Flow	36	10.0				
360 minute summer	36	11.001	38	12.6	0.756	0.079	9.1013	
15 minute summer	37	Depth/Flow	38	11.0				
600 minute summer	38	11.002	40	85.7	0.750	0.537	8.4968	
15 minute summer	39	Depth/Flow	40	20.0				
960 minute winter	40	11.003	41	131.4	0.584	0.464	15.4162	
30 minute winter	41	Hydro-Brake®	44	25.5				
15 minute summer	42	Depth/Flow	43	6.0				
30 minute summer	43	14.001	44	6.0	1.269	0.016	2.1315	
15 minute summer	44	10.006	45	-68.8	0.618	-0.302	5.5552	
15 minute summer	45	10.007	46	370.3	2.338	1.625	3.2359	
15 minute summer	46	10.008	48	370.6	2.340	1.619	1.3517	
15 minute summer	47	Depth/Flow	48	8.1				
15 minute summer	48	10.009	48_OUT	378.8	2.391	1.169	1.4325	741.8

Appendix I – Hydraulic Calculations Including Flood Event Surcharged Outfalls

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.043	5.00	8.980	1200	624287.310	307227.784	1.300
2			7.350	1200	624320.235	307207.473	1.425
3	0.015	5.00	7.220	1200	624330.114	307203.879	1.425
4			7.160	1200	624338.629	307204.348	1.425
5	0.033	5.00	7.000	1200	624364.477	307217.666	1.437
6	0.021	5.00	6.740	1200	624374.101	307227.796	1.425
7	0.042	5.00	6.810	1200	624387.802	307248.482	1.642
8	0.847	5.00	6.830	1200	624408.033	307296.255	1.650
9	0.038	5.00	6.950	1350	624417.343	307293.303	2.323
10	0.042	5.00	6.980	1350	624442.765	307332.696	2.468
11	0.995	5.00	6.190	1350	624464.747	307379.567	2.690
12	0.034	5.00	6.340	1350	624471.507	307376.222	2.990
13	1.177	5.00	4.200	1350	624480.790	307422.616	1.650
14	0.014	5.00	4.160	1350	624491.135	307419.306	1.650
15	0.022	5.00	3.770	1800	624497.569	307437.207	2.025
16	0.061	5.00	3.950	1800	624502.579	307464.606	2.238
17	0.099	5.00	3.430	1200	624362.578	307487.565	1.293
18	0.064	5.00	3.450	1800	624422.607	307477.618	2.087
19	0.061	5.00	3.480	1200	624486.916	307558.337	0.798
20	0.120	5.00	3.480	1200	624490.819	307521.604	1.240
21	0.563	5.00	3.470	1350	624450.256	307514.604	1.528
22	0.053	5.00	3.500	1350	624449.835	307520.431	1.652
23	0.080	5.00	3.410	1800	624423.106	307518.837	2.170
24	0.101	5.00	3.320	1200	624354.590	307509.313	1.120
25	0.046	5.00	3.270	1200	624368.488	307518.466	1.248
26	0.030	5.00	3.210	1200	624377.778	307523.234	1.231
27	0.021	5.00	3.400	1800	624414.271	307523.106	2.171
28	0.982	5.00	3.010	1200	624420.505	307591.194	0.914
29			3.010	1950	624412.947	307594.904	2.006
29_OUT			3.010	1950	624412.796	307599.362	2.010
30	0.059	5.00	13.610	1200	624108.927	307356.415	1.610
31	0.041	5.00	10.910	1200	624104.786	307396.911	1.710
32			8.310	1200	624108.910	307435.738	1.910
33	0.044	5.00	6.030	1200	624118.553	307474.000	1.830
34	0.052	5.00	5.080	1200	624127.594	307485.596	1.500
35	0.390	5.00	3.130	1200	624305.583	307514.657	1.030
36			3.030	1350	624306.898	307520.093	1.396
37	0.584	5.00	3.300	1200	624249.858	307528.203	1.200
38	0.063	5.00	3.240	1350	624251.115	307533.798	1.747
39	0.629	5.00	3.310	1200	624197.373	307540.066	1.610
40	0.067	5.00	3.310	1500	624199.114	307546.905	2.099
41	0.077	5.00	3.470	2100	624146.044	307560.282	2.428
42	0.795	5.00	4.140	1350	624092.255	307565.040	1.793
43			3.940	1350	624094.110	307572.886	1.618
44			3.680	1800	624130.048	307563.745	2.720
45	0.521	5.00	3.490	1800	624139.092	307597.617	2.705
46			3.610	1800	624144.115	307617.413	2.927
47	1.082	5.00	3.210	1350	624310.144	307586.148	1.758
48			3.460	1800	624152.443	307615.563	2.820
48_OUT			3.470	1350	624154.603	307624.365	2.921

Links (Input)

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.016	29	29_OUT	4.461	0.600	1.004	1.000	0.004	1115.1	1050	12.29	50.0
1.015	27	29	71.810	0.600	1.229	1.154	0.075	957.5	900	12.21	50.0
9.000	28	29	8.419	0.600	2.096	1.829	0.267	31.5	300	5.05	50.0
1.014	23	27	9.812	0.600	1.240	1.229	0.011	892.0	900	11.02	50.0
8.002	26	27	36.493	0.600	1.979	1.829	0.150	243.3	300	5.95	50.0
8.001	25	26	10.442	0.600	2.022	1.979	0.043	242.8	300	5.34	50.0
8.000	24	25	16.641	0.600	2.200	2.022	0.178	93.5	300	5.17	50.0
1.013	18	23	41.222	0.600	1.363	1.315	0.048	858.8	825	10.86	50.0
6.002	22	23	26.776	0.600	1.848	1.765	0.083	322.6	375	6.56	50.0
6.001	20	22	41.001	0.600	2.240	1.998	0.242	169.4	225	6.11	50.0
7.000	21	22	5.842	0.600	1.942	1.923	0.019	307.5	375	5.09	50.0
6.000	19	20	36.940	0.600	2.682	2.240	0.442	83.6	225	5.43	50.0
1.012	16	18	81.024	0.600	1.712	1.425	0.287	282.3	825	10.18	50.0
5.000	17	18	60.848	0.600	2.137	1.888	0.249	244.4	300	6.01	50.0
1.011	15	16	27.853	0.600	1.745	1.712	0.033	844.0	825	9.41	50.0
1.010	14	15	19.022	0.600	2.510	2.120	0.390	48.8	450	8.96	50.0
1.009	12	14	47.344	0.600	3.350	2.510	0.840	56.4	450	8.85	50.0
4.000	13	14	10.862	0.600	2.550	2.510	0.040	271.5	450	5.15	50.0
1.008	10	12	52.160	0.600	4.512	3.425	1.087	48.0	450	8.56	50.0
3.000	11	12	7.542	0.600	3.500	3.425	0.075	100.0	375	5.07	50.0
1.007	9	10	46.884	0.600	4.627	4.512	0.115	407.7	450	8.26	50.0
1.006	7	9	53.680	0.600	5.168	4.852	0.316	169.9	225	7.48	50.0
2.000	8	9	9.767	0.600	5.180	4.852	0.328	29.8	300	5.06	50.0
1.005	6	7	24.812	0.600	5.315	5.168	0.147	168.8	225	6.59	50.0
1.004	5	6	13.973	0.600	5.563	5.315	0.248	56.3	225	6.17	50.0
1.003	4	5	29.077	0.600	5.735	5.563	0.172	169.1	225	6.04	50.0
1.002	3	4	8.528	0.600	5.795	5.735	0.060	142.1	225	5.56	50.0
1.001	2	3	10.512	0.600	5.925	5.795	0.130	80.9	225	5.43	50.0
1.000	1	2	38.686	0.600	7.680	6.000	1.680	23.0	150	5.31	50.0
10.009	48	48_OUT	9.063	0.600	0.640	0.549	0.091	99.6	450	8.67	50.0
10.008	46	48	8.531	0.600	0.683	0.640	0.043	198.4	450	8.60	50.0
15.000	47	48	160.421	0.600	1.452	0.640	0.812	197.6	450	6.85	50.0
10.007	45	46	20.423	0.600	0.785	0.683	0.102	200.2	450	8.55	50.0
10.006	44	45	35.061	0.600	0.960	0.785	0.175	200.3	450	8.44	50.0
10.005	41	44	16.367	0.600	1.042	0.960	0.082	199.6	450	8.03	50.0
14.001	43	44	37.082	0.600	2.322	1.035	1.287	28.8	375	5.32	50.0
14.000	42	43	8.062	0.600	2.347	2.322	0.025	322.5	375	5.13	50.0
10.004	34	41	76.931	0.600	3.580	1.970	1.610	47.8	300	6.25	50.0
11.003	40	41	54.730	0.600	1.211	1.117	0.094	582.2	600	7.79	50.0
13.000	39	40	7.057	0.600	1.700	1.586	0.114	61.9	300	5.06	50.0
11.002	38	40	53.627	0.600	1.493	1.361	0.132	406.3	450	6.88	50.0
12.000	37	38	5.734	0.600	2.100	1.815	0.285	20.1	225	5.03	50.0
11.001	36	38	57.442	0.600	1.634	1.493	0.141	407.4	450	5.99	50.0
11.000	35	36	5.593	0.600	2.100	1.859	0.241	23.2	225	5.03	50.0
10.003	33	34	14.704	0.600	4.200	3.655	0.545	27.0	225	5.69	50.0
10.002	32	33	39.458	0.600	6.400	4.200	2.200	17.9	225	5.59	50.0
10.001	31	32	39.045	0.600	9.200	6.400	2.800	13.9	225	5.38	50.0
10.000	30	31	40.707	0.600	12.000	9.200	2.800	14.5	225	5.20	50.0

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	✓
M5-60 (mm)	20.000	Drain Down Time (mins)	240
Ratio-R	0.400	Additional Storage (m³/ha)	20.0
Summer CV	0.950	Check Discharge Rate(s)	x
Winter CV	0.950	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160
30	120	240	480	720	1440	2880

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
30	40	0	0
100	45	0	0

Node 48_OUT Surcharged Outfall

Overrides Design Area	x	Depression Storage Area (m²)	0	Evapo-transpiration (mm/day)	0
Overrides Design Additional Inflow	x	Depression Storage Depth (mm)	0		

Applies to All storms

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
0	1.401	250	1.401	500	1.401	750	1.401	1000	1.401	1250	1.401
50	1.401	300	1.401	550	1.401	800	1.401	1050	1.401	1300	1.401
100	1.401	350	1.401	600	1.401	850	1.401	1100	1.401	1350	1.401
150	1.401	400	1.401	650	1.401	900	1.401	1150	1.401	1400	1.401
200	1.401	450	1.401	700	1.401	950	1.401	1200	1.401	1450	1.401

Node 29_OUT Surcharged Outfall

Overrides Design Area	x	Depression Storage Area (m²)	0	Evapo-transpiration (mm/day)	0
Overrides Design Additional Inflow	x	Depression Storage Depth (mm)	0		

Applies to All storms

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
0	0.950	250	0.950	500	0.950	750	0.950	1000	0.950	1250	0.950
50	0.950	300	0.950	550	0.950	800	0.950	1050	0.950	1300	0.950
100	0.950	350	0.950	600	0.950	850	0.950	1100	0.950	1350	0.950
150	0.950	400	0.950	650	0.950	900	0.950	1150	0.950	1400	0.950
200	0.950	450	0.950	700	0.950	950	0.950	1200	0.950	1450	0.950

Node 29 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	1.004	Product Number	CTL-SHE-0299-5720-2000-5720
Design Depth (m)	2.000	Min Outlet Diameter (m)	0.375
Design Flow (l/s)	57.2	Min Node Diameter (mm)	

Node 8 Online Depth/Flow Control

Flap Valve	x	Replaces Downstream Link	✓	Invert Level (m)	5.180

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.001	15.000	2.000	15.000

Node 11 Online Depth/Flow Control

Flap Valve x | Replaces Downstream Link ✓ | Invert Level (m) 3.500

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.001	12.000	2.000	12.000

Node 13 Online Depth/Flow Control

Flap Valve x | Replaces Downstream Link ✓ | Invert Level (m) 2.550

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.001	15.000	2.000	15.000

Node 21 Online Depth/Flow Control

Flap Valve x | Replaces Downstream Link ✓ | Invert Level (m) 1.942

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.001	15.000	2.000	15.000

Node 28 Online Depth/Flow Control

Flap Valve x | Replaces Downstream Link ✓ | Invert Level (m) 2.096

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.001	7.330	2.000	7.330

Node 47 Online Depth/Flow Control

Flap Valve x | Replaces Downstream Link ✓ | Invert Level (m) 1.452

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.001	8.110	2.000	8.110

Node 42 Online Depth/Flow Control

Flap Valve x | Replaces Downstream Link ✓ | Invert Level (m) 2.347

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.001	5.960	2.000	5.960

Node 41 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	1.042	Product Number	CTL-SHE-0202-2550-2300-2550
Design Depth (m)	2.300	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	25.5	Min Node Diameter (mm)	1800

Node 35 Online Depth/Flow Control

Flap Valve x | Replaces Downstream Link ✓ | Invert Level (m) 2.100

Depth (m)	Flow (l/s)
0.001	10.000

Node 37 Online Depth/Flow Control

Flap Valve x | Replaces Downstream Link ✓ | Invert Level (m) 2.100

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.001	11.000	2.000	11.000

Node 39 Online Depth/Flow Control

Flap Valve x | Replaces Downstream Link ✓ | Invert Level (m) 1.700

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.001	20.000	1.610	20.000

Node 8 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	5.180
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1200.0	0.0	1.200	1200.0	0.0	1.201	0.0	0.0

Node 11 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	3.500
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1200.0	0.0	1.200	1200.0	0.0	1.201	0.0	0.0

Node 13 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	2.550
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1200.0	0.0	1.200	1200.0	0.0	1.201	0.0	0.0

Node 21 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	1.942
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1200.0	0.0	1.200	1200.0	0.0	1.201	0.0	0.0

Node 28 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	2.096
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1200.0	0.0	1.200	1200.0	0.0	1.201	0.0	0.0

Node 23 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	1.240
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	550.0	0.0	1.125	550.0	0.0	1.126	0.0	0.0

Node 35 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	2.100
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1200.0	0.0	1.200	1200.0	0.0	1.201	0.0	0.0

Node 37 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	2.100
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1200.0	0.0	1.200	1200.0	0.0	1.201	0.0	0.0

Node 39 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	1.700
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1200.0	0.0	1.200	1200.0	0.0	1.201	0.0	0.0

Node 42 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	2.347
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1200.0	0.0	1.200	1200.0	0.0	1.201	0.0	0.0

Node 47 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	1.452
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	72

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1200.0	0.0	1.200	1200.0	0.0	1.201	0.0	0.0

Node 20 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	2.240
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	450.0	0.0	0.500	450.0	0.0	0.501	0.0	0.0

Node 17 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	2.137
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	200.0	0.0	0.500	200.0	0.0	0.501	0.0	0.0

Node 41 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	1.042
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	220.0	0.0	1.500	220.0	0.0	1.501	0.0	0.0

Node 40 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	1.211
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	230.0	0.0	1.125	230.0	0.0	1.126	0.0	0.0

Node 38 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	1.493
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	250.0	0.0	1.000	250.0	0.0	1.001	0.0	0.0

Node 22 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	1.848
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	150.0	0.0	0.500	150.0	0.0	0.501	0.0	0.0

Node 27 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	1.229
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	100.0	0.0	0.500	100.0	0.0	0.501	0.0	0.0

Node 16 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	1.712
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	280.0	0.0	1.125	280.0	0.0	1.126	0.0	0.0

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 99.15%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	10	7.773	0.093	25.3	0.1668	0.0000	OK
15 minute summer	2	12	6.318	0.393	24.9	0.4448	0.0000	SURCHARGED
15 minute summer	3	12	6.299	0.504	33.9	0.6773	0.0000	SURCHARGED
15 minute summer	4	12	6.271	0.536	29.3	0.6063	0.0000	SURCHARGED
15 minute summer	5	12	6.202	0.639	45.9	1.0186	0.0000	SURCHARGED
15 minute summer	6	12	6.108	0.793	46.0	1.1279	0.0000	SURCHARGED
15 minute summer	7	12	5.877	0.709	65.7	1.1603	0.0000	SURCHARGED
120 minute winter	8	118	5.440	0.260	145.2	315.3987	0.0000	OK
15 minute summer	9	11	4.871	0.244	97.6	0.4299	0.0000	OK
15 minute summer	10	11	4.672	0.160	120.3	0.2824	0.0000	OK
180 minute winter	11	180	3.846	0.346	125.6	418.7112	0.0000	OK
15 minute summer	12	11	3.536	0.186	149.8	0.3094	0.0000	OK
180 minute winter	13	180	2.951	0.401	148.6	487.0854	0.0000	OK
960 minute winter	14	645	3.025	0.515	51.8	0.8221	0.0000	SURCHARGED
960 minute winter	15	645	3.018	1.273	52.6	3.5178	0.0000	SURCHARGED
960 minute winter	16	645	3.018	1.306	54.0	303.4200	0.0000	SURCHARGED
600 minute summer	17	570	3.016	0.879	18.7	97.4420	0.0000	SURCHARGED
960 minute winter	18	645	3.017	1.654	57.5	5.2223	0.0000	SURCHARGED
960 minute winter	19	645	3.047	0.365	2.1	0.9678	0.0000	SURCHARGED
960 minute winter	20	645	3.041	0.801	19.2	216.4198	0.0000	SURCHARGED
60 minute winter	21	60	2.090	0.148	157.4	178.4663	0.0000	OK
960 minute winter	22	645	3.023	1.175	23.5	73.7537	0.0000	SURCHARGED
960 minute winter	23	645	3.015	1.775	84.1	593.9030	0.0000	SURCHARGED
960 minute winter	24	645	3.023	0.823	3.5	2.4188	0.0000	FLOOD RISK
960 minute winter	25	645	3.021	0.999	5.0	1.8735	0.0000	FLOOD RISK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	24.9	2.221	0.669	0.5492	
15 minute summer	2	1.001	3	25.1	0.919	0.434	0.4181	
15 minute winter	3	1.002	4	29.8	1.018	0.684	0.3392	
30 minute summer	4	1.003	5	28.7	0.999	0.721	1.1564	
30 minute summer	5	1.004	6	37.9	1.087	0.546	0.5557	
15 minute summer	6	1.005	7	46.3	1.164	1.160	0.9868	
15 minute summer	7	1.006	9	63.3	1.592	1.591	2.0813	
15 minute summer	8	Depth/Flow	9	15.0				
15 minute summer	9	1.007	10	97.1	1.422	0.610	3.2358	
15 minute summer	10	1.008	12	118.8	2.445	0.254	2.5411	
15 minute summer	11	Depth/Flow	12	12.0				
15 minute summer	12	1.009	14	149.3	2.205	0.346	3.2062	
15 minute summer	13	Depth/Flow	14	15.0				
15 minute summer	14	1.010	15	170.3	2.532	0.367	1.2846	
15 minute summer	15	1.011	16	181.0	1.764	0.334	3.5276	
30 minute summer	16	1.012	18	155.5	1.198	0.165	10.5351	
60 minute summer	17	5.000	18	18.9	0.854	0.267	3.0790	
30 minute summer	18	1.013	23	185.7	1.139	0.346	9.3110	
15 minute summer	19	6.000	20	35.7	2.089	0.627	0.6639	
60 minute summer	20	6.001	22	19.4	0.989	0.486	0.8770	
15 minute summer	21	Depth/Flow	22	15.0				
60 minute summer	22	6.002	23	40.4	0.953	0.365	2.9533	
960 minute winter	23	1.014	27	81.7	-0.245	0.123	6.2186	
15 minute summer	24	8.000	25	55.5	0.946	0.482	1.1718	
15 minute summer	25	8.001	26	80.7	1.146	1.137	0.7353	

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 99.15%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute winter	26	645	3.020	1.041	6.0	1.6814	0.0000	FLOOD RISK
960 minute winter	27	645	3.016	1.787	87.9	52.4454	0.0000	SURCHARGED
240 minute winter	28	240	2.482	0.386	100.3	471.4329	0.0000	SURCHARGED
960 minute winter	29	645	3.010	2.006	99.3	5.9899	208.1083	FLOOD
15 minute summer	29_OUT	1	1.950	0.950	0.0	0.0000	0.0000	OK
15 minute summer	30	10	12.076	0.076	34.4	0.1422	0.0000	OK
15 minute summer	31	10	9.303	0.103	58.3	0.1655	0.0000	OK
15 minute summer	32	10	6.507	0.107	57.8	0.1213	0.0000	OK
15 minute summer	33	11	4.379	0.179	83.3	0.2895	0.0000	OK
15 minute summer	34	11	3.769	0.189	112.0	0.3440	0.0000	OK
120 minute winter	35	116	2.204	0.104	66.7	125.3624	0.0000	OK
960 minute winter	36	525	3.030	1.396	31.5	1.9977	233.8607	FLOOD
120 minute winter	37	118	2.276	0.176	100.1	213.2924	0.0000	OK
360 minute winter	38	328	3.054	1.561	33.8	240.9843	0.0000	FLOOD RISK
60 minute winter	39	60	1.856	0.156	175.6	188.3954	0.0000	OK
360 minute winter	40	328	3.068	1.857	40.0	250.3857	0.0000	FLOOD RISK
360 minute winter	41	328	3.071	2.029	42.9	321.9124	0.0000	SURCHARGED
240 minute winter	42	240	2.662	0.315	81.2	381.2640	0.0000	OK
15 minute summer	43	11	2.469	0.147	8.7	0.2101	0.0000	OK
15 minute summer	44	11	2.469	1.509	106.2	3.8410	0.0000	SURCHARGED
15 minute summer	45	11	2.465	1.680	303.9	10.7446	0.0000	SURCHARGED
15 minute summer	46	11	2.238	1.555	273.8	3.9578	0.0000	SURCHARGED
240 minute winter	47	240	1.879	0.427	110.4	518.4045	0.0000	OK
15 minute summer	48	11	2.100	1.460	281.3	3.7158	0.0000	SURCHARGED
15 minute summer	48_OUT	1	1.950	1.401	280.9	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	26	8.002	27	96.3	1.391	1.357	2.3916	
960 minute winter	27	1.015	29	92.0	-0.151	0.144	45.5113	
15 minute summer	28	Depth/Flow	29	7.3				
360 minute winter	29	Hydro-Brake®	29_OUT	57.1				1436.1
15 minute summer	30	10.000	31	34.2	2.331	0.249	0.5992	
15 minute summer	31	10.001	32	57.8	3.191	0.413	0.7079	
15 minute summer	32	10.002	33	57.4	2.155	0.465	1.0365	
15 minute summer	33	10.003	34	82.6	2.621	0.822	0.4624	
15 minute summer	34	10.004	41	112.2	2.451	0.696	3.5229	
15 minute summer	35	Depth/Flow	36	10.0				
480 minute summer	36	11.001	38	-25.7	0.681	-0.162	9.1013	
15 minute summer	37	Depth/Flow	38	11.0				
60 minute summer	38	11.002	40	33.8	0.796	0.212	8.4968	
15 minute summer	39	Depth/Flow	40	20.0				
30 minute summer	40	11.003	41	-56.7	0.521	-0.200	12.0391	
1440 minute summer	41	Hydro-Brake®	44	25.5				
15 minute summer	42	Depth/Flow	43	6.0				
15 minute summer	43	14.001	44	22.1	1.269	0.059	2.7859	
15 minute summer	44	10.006	45	-100.2	-0.632	-0.440	5.5552	
15 minute summer	45	10.007	46	273.8	1.728	1.201	3.2359	
15 minute summer	46	10.008	48	273.2	1.724	1.193	1.3517	
15 minute summer	47	Depth/Flow	48	8.1				
15 minute summer	48	10.009	48_OUT	280.9	1.773	0.867	1.4360	96.4

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.15%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	12	7.907	0.227	34.0	0.4085	0.0000	SURCHARGED
15 minute summer	2	13	7.061	1.136	32.7	1.2848	0.0000	FLOOD RISK
15 minute summer	3	13	7.025	1.230	42.2	1.6519	0.0000	FLOOD RISK
15 minute summer	4	13	6.977	1.242	30.8	1.4051	0.0000	FLOOD RISK
15 minute summer	5	13	6.840	1.277	46.5	2.0349	0.0000	FLOOD RISK
15 minute summer	6	12	6.700	1.385	56.0	1.9715	0.0000	FLOOD RISK
15 minute summer	7	12	6.370	1.202	79.6	1.9680	0.0000	SURCHARGED
180 minute winter	8	176	5.570	0.390	145.1	472.2542	0.0000	SURCHARGED
15 minute summer	9	11	4.899	0.272	118.1	0.4793	0.0000	OK
15 minute summer	10	11	4.691	0.179	148.0	0.3172	0.0000	OK
240 minute winter	11	236	4.011	0.511	137.3	618.2277	0.0000	SURCHARGED
15 minute summer	12	11	3.560	0.210	183.6	0.3494	0.0000	OK
240 minute winter	13	236	3.143	0.593	162.4	720.5424	0.0000	SURCHARGED
360 minute winter	14	344	3.036	0.526	70.2	0.8392	0.0000	SURCHARGED
360 minute winter	15	344	3.028	1.283	72.4	3.5443	0.0000	SURCHARGED
360 minute winter	16	344	3.026	1.314	77.2	303.4468	0.0000	SURCHARGED
360 minute winter	17	344	3.029	0.892	22.3	97.4745	0.0000	SURCHARGED
360 minute winter	18	344	3.022	1.659	58.2	5.2392	0.0000	SURCHARGED
600 minute summer	19	375	3.072	0.390	5.9	1.0350	0.0000	SURCHARGED
360 minute winter	20	344	3.043	0.803	32.9	216.4250	0.0000	SURCHARGED
120 minute winter	21	118	2.170	0.228	131.4	276.1208	0.0000	OK
360 minute winter	22	344	3.025	1.177	34.7	73.7568	0.0000	SURCHARGED
1440 minute winter	23	780	3.018	1.778	87.3	593.9143	0.0000	SURCHARGED
360 minute winter	24	344	3.030	0.830	10.2	2.4389	0.0000	FLOOD RISK
360 minute summer	25	344	3.028	1.006	22.5	1.8853	0.0000	FLOOD RISK

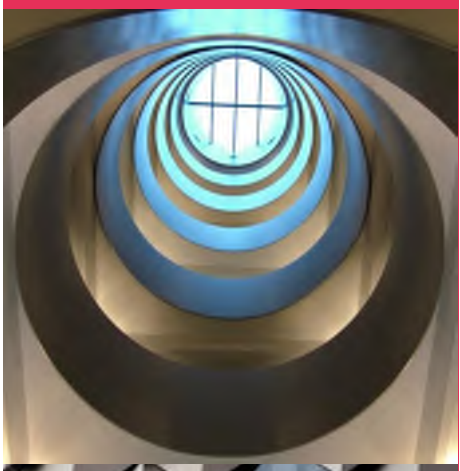
Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	32.7	2.297	0.878	0.6811	
15 minute summer	2	1.001	3	30.9	0.923	0.535	0.4181	
30 minute summer	3	1.002	4	33.2	1.028	0.763	0.3392	
15 minute summer	4	1.003	5	34.4	0.967	0.864	1.1564	
15 minute summer	5	1.004	6	48.0	1.207	0.691	0.5557	
15 minute summer	6	1.005	7	57.8	1.452	1.448	0.9868	
15 minute summer	7	1.006	9	78.1	1.965	1.965	2.1133	
15 minute summer	8	Depth/Flow	9	15.0				
15 minute summer	9	1.007	10	117.8	1.492	0.740	3.7271	
15 minute summer	10	1.008	12	146.2	2.583	0.313	2.9613	
15 minute summer	11	Depth/Flow	12	12.0				
15 minute summer	12	1.009	14	183.1	2.309	0.424	3.7550	
15 minute summer	13	Depth/Flow	14	15.0				
15 minute summer	14	1.010	15	206.9	2.642	0.446	1.4931	
15 minute summer	15	1.011	16	221.5	1.841	0.409	4.2153	
30 minute summer	16	1.012	18	198.9	1.237	0.211	14.1784	
60 minute summer	17	5.000	18	28.5	0.956	0.402	3.3945	
30 minute summer	18	1.013	23	246.9	1.240	0.460	14.1896	
15 minute summer	19	6.000	20	47.8	2.121	0.840	0.8627	
720 minute summer	20	6.001	22	-35.9	-0.904	-0.903	1.6307	
15 minute summer	21	Depth/Flow	22	15.0				
60 minute summer	22	6.002	23	53.1	1.028	0.480	2.9533	
15 minute summer	23	1.014	27	-115.9	-1.237	-0.175	2.2760	
15 minute summer	24	8.000	25	74.0	1.051	0.644	1.1718	
15 minute summer	25	8.001	26	107.6	1.528	1.515	0.7353	

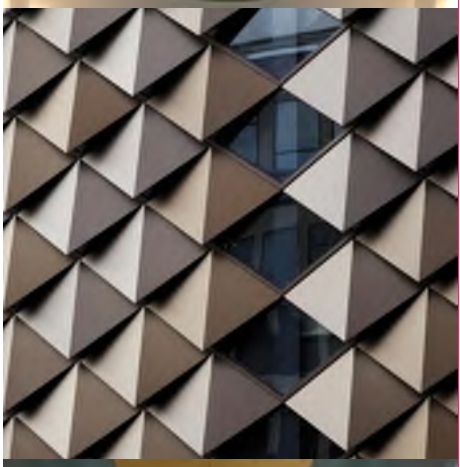
Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.15%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute summer	26	344	3.025	1.046	25.9	1.6900	0.0000	FLOOD RISK
360 minute winter	27	344	3.019	1.790	70.1	52.4549	0.0000	SURCHARGED
360 minute winter	28	352	2.660	0.564	98.9	689.5019	0.0000	SURCHARGED
1440 minute winter	29	780	3.010	2.006	104.1	5.9899	677.2858	FLOOD
15 minute summer	29_OUT	1	1.950	0.950	0.0	0.0000	0.0000	OK
15 minute summer	30	10	12.089	0.089	46.3	0.1668	0.0000	OK
15 minute summer	31	10	9.323	0.123	78.5	0.1982	0.0000	OK
15 minute summer	32	10	6.528	0.128	77.9	0.1451	0.0000	OK
15 minute summer	33	11	4.720	0.520	112.1	0.8400	0.0000	SURCHARGED
15 minute summer	34	11	3.814	0.234	147.8	0.4247	0.0000	OK
120 minute winter	35	118	2.260	0.160	90.8	193.6081	0.0000	OK
1440 minute winter	36	690	3.030	1.396	37.7	1.9977	510.6465	FLOOD
180 minute winter	37	176	2.364	0.264	100.0	319.2721	0.0000	SURCHARGED
600 minute winter	38	345	3.047	1.554	28.3	240.9700	0.0000	FLOOD RISK
120 minute winter	39	116	1.937	0.237	146.7	286.7214	0.0000	OK
600 minute winter	40	345	3.062	1.851	34.0	250.3708	0.0000	FLOOD RISK
600 minute winter	41	345	3.069	2.027	44.9	321.9038	0.0000	SURCHARGED
360 minute winter	42	352	2.808	0.461	80.1	557.6172	0.0000	SURCHARGED
15 minute summer	43	11	2.895	0.573	35.8	0.8194	0.0000	SURCHARGED
15 minute summer	44	11	2.894	1.934	89.1	4.9226	0.0000	SURCHARGED
15 minute summer	45	11	2.919	2.134	408.6	13.6510	0.0000	SURCHARGED
15 minute summer	46	11	2.496	1.813	376.9	4.6132	0.0000	SURCHARGED
360 minute winter	47	352	2.077	0.625	108.9	758.1454	0.0000	SURCHARGED
15 minute summer	48	11	2.233	1.593	385.4	4.0535	0.0000	SURCHARGED
15 minute summer	48_OUT	1	1.950	1.401	385.3	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	26	8.002	27	128.7	1.829	1.815	2.5042	
960 minute summer	27	1.015	29	104.2	-0.213	0.163	45.5113	
15 minute summer	28	Depth/Flow	29	7.3				
240 minute winter	29	Hydro-Brake®	29_OUT	57.1				1201.1
15 minute summer	30	10.000	31	46.1	2.504	0.336	0.7499	
15 minute summer	31	10.001	32	77.9	3.420	0.556	0.8889	
15 minute summer	32	10.002	33	77.3	2.179	0.626	1.2460	
15 minute summer	33	10.003	34	109.4	2.750	1.088	0.5848	
15 minute summer	34	10.004	41	145.7	2.564	0.904	4.3948	
15 minute summer	35	Depth/Flow	36	10.0				
720 minute summer	36	11.001	38	-43.3	0.546	-0.272	9.1013	
15 minute summer	37	Depth/Flow	38	11.0				
480 minute winter	38	11.002	40	73.1	0.660	0.459	8.4968	
15 minute summer	39	Depth/Flow	40	20.0				
30 minute summer	40	11.003	41	-86.2	-0.565	-0.304	13.8793	
240 minute winter	41	Hydro-Brake®	44	25.5				
15 minute summer	42	Depth/Flow	43	6.0				
15 minute summer	43	14.001	44	42.6	1.268	0.114	4.0900	
15 minute winter	44	10.006	45	-97.6	-0.616	-0.428	5.5552	
15 minute summer	45	10.007	46	376.9	2.379	1.654	3.2359	
15 minute summer	46	10.008	48	377.3	2.381	1.648	1.3517	
15 minute summer	47	Depth/Flow	48	8.1				
15 minute summer	48	10.009	48_OUT	385.3	2.432	1.189	1.4360	139.9

Appendix J – Operations and Maintenance manual





Carrow Works, Norwich

Drainage Operations and Maintenance Manual

Curtins Ref: 081440-CUR-XX-XX-T-C-92032

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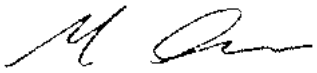
This report has been prepared for the sole benefit, use, and information for the client. The liability of Curtins Consulting Limited with respect to the information contained in the report will not extend to any third party.

Author	Signature	Date
Matthew Martin BSc (Hons) EngTech Infrastructure Engineer		14/06/2022

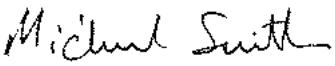
Reviewed	Signature	Date
Michael Smith **MEng(Hons)** Principal Civil Engineer		14/06/2022

Table of Contents

1.0 Introduction

1.1 Project Background

Curtins Consulting Limited has been appointed by Fuel Properties (Norwich) Limited to prepare a Drainage Operations and Maintenance Manual to supplement Drainage Strategy produced by Curtins. Document reference: 081440-CUR-XX-XX-T-C-92031.

Particular reference is paid to the inspection, aftercare and maintenance of SuDs drainage features as part of this manual in order to demonstrate to the LLFA or adopting authority the effectiveness and longevity of the SuDs features designed within the scheme as opposed to the standard Building Regulations local and domestic drainage and/or the main discharge drainage connections to 'Design and Construction Guidance for foul and surface water sewers offered for adoption under the Code for adoption agreements for water and sewerage companies operating wholly or mainly in England' standards.

This report is based on current best practice guidance as described in the SuDS Manual, CIRIA, C753.

Proposals contained or forming part of this report represent the design intent and may be subject to alteration or adjustment in completing the detailed design for this project. Where such adjustments are undertaken as part of the detailed design and are deemed a material derivation from the intent contained in this document, prior approval shall be obtained from the relevant authority in advance of commencing such works.

1.2 Scope of O&M Manual

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

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

2.0 Geocellular Units

2.1 Location and Description

Geocellular Units are located throughout the site, as shown on drainage drawing '081440-CUR-XX-XX-D-C-92030'.

Geocellular units are proprietary products and therefore manufacturer's specific recommendations should also be taken in to consideration above what has been prepared in this document. Additionally, different manufacturers may have different connection types and arrangements which will need to be taken in to consideration.

2.2 Operation

The geocellular units, along with permeable paving, are intended to attenuate the discharge from the site up to and including the 1 in 100 year plus 45% climate change event.

Access for maintenance has been provided through inspection chambers.

2.3 Inspection and Maintenance Regime

Regular inspection and maintenance is important for the effective operation of geocellular units as designed. As the feature is buried a regularly inspection regime is very important to ensure the correct functionality of the surface water drainage network. Maintenance responsibility for the geocellular units and their surrounding areas should be placed with Fuel Properties (Norwich) Limited as noted in section 1.1.

Sediment\material removal should be undertaken in consultation with the environmental regulator to confirm appropriate protocols; especially where run-off is taken from potentially contaminated areas such as car parks/service yards.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required)	Inspect inlets, outlets and overflows for blockages, and clear if required. If faults persist jetting and CCTV survey may be required.	Monthly and after large storms.
	Check penstocks and other mechanical devices (if present).	Half yearly.
	Inspect ventilation cowl (if present)	Monthly and after large storms.

Maintenance Schedule	Required Action	Frequency
Regular maintenance\inspection	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then six monthly
	Debris removal from catchment surface (where may cause risks to performance)	Monthly
	Where rainfall infiltrates into blocks from above, check surface of filter for blockage by silt, algae or other matter. Remove and replace surface infiltration medium as necessary.	Monthly (and after large storms)
	Remove sediment from pre-treatment structures	Annually (or as required after heavy rainfall events)
Remedial actions	Repair/rehabilitation of inlets, outlet, overflows and vents.	As required.

3.0 Permeable Pavements

3.1 Location and Description

The permeable pavement is located within the outline plots and as a granular subbase in the retained building area of the site as shown on drainage drawing '081440-CUR-XX-XX-D-C-92030'.

The permeable pavement has been designed in accordance with CIRIA C753.

Permeable pavements contain proprietary products and as such, the manufacturer's recommendations should be followed where used.

3.2 Operation

Permeable pavements are an efficient mean of managing surface water runoff close to its source – intercepting runoff, reducing the volume and frequency of runoff, and providing a treatment medium.

The surface has been designed to be porous or to contain gaps where rain can flow through the upper construction layers in to the voided stone which makes up the sub-base.

3.3 Inspection and Maintenance Regime

Regular inspection and maintenance is important for the effective operation of the pervious pavement. Maintenance responsibility for the pavement and its surrounding area should be placed with Fuel Properties (Norwich) Limited.

Sediment/material removal should be undertaken in consultation with the environmental regulator to confirm appropriate protocols, as run-off is taken from potentially contaminated areas such as car parks/service yards.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required)	Initial inspection.	Monthly for three months after installation.
	Inspect for evidence of poor operation and/or weed growth. If required, take remedial action.	3-monthly, 48 hours after large storms in first six months.
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually.
	Monitor inspection chambers.	Annually.

Maintenance Schedule	Required Action	Frequency
Regular maintenance/inspection	Brushing and vacuuming.	Three times/year at end of winter, mid-summer, after autumn leaf fall, or as required based on site-specific observations of clogging or manufacturers' recommendations.
Occasional maintenance	Removal of weed or management using glyphospate applied directly into the weeds by an applicator rather than spraying.	As required – one per year on less frequently used pavements.
	Stabilise and mow contributing and adjacent areas.	As required.
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving.	As required.
	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 materials.	As required.
	Rehabilitation of surface and upper substructure by remedial sweeping.	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging).

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4.0 Pipes (Including Oversized)

4.1 Location and Description

Pipes are the main conveyance across the site with the network as shown on drainage drawing '081440-CUR-XX-XX-D-C-92030'.

Pipes are proprietary products and the materials can vary across the site and as such where used the manufacturer's recommendations should be followed. Regardless of the product used, the pipes will be fully compliant with the Curtins' drainage specification.

4.2 Operation

They are intended to be dry except for during rainfall events. These have been designed to be self-cleansing for smaller diameter pipes, and for larger diameters the risk is reduced due to the overall pipe size.

Access for maintenance is provided through access chambers, manholes, rodding plates and rodding eyes.

4.3 Inspection and Maintenance Regime

Regular inspection and maintenance is important to identify areas which may have been obstructed/clogged and may not be draining correctly thus exposing the development to a greater level of flood risk. Maintenance responsibility for the pipes should be placed with Fuel Properties (Norwich) Limited.

Sediment/material removal should be undertaken in consultation with the environmental regulator to confirm appropriate protocols, as run-off is taken from potentially contaminated areas such as car parks/service yards.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required)	Initial inspection should be provided as post construction CCTV survey.	N/A
	Inspect for evidence of poor operation via water level in chambers. If required, take remedial action.	3-monthly, 48 hours after large storms.
Occasional maintenance	Check and remove large vegetation growth near pipe runs.	6 monthly

Maintenance Schedule	Required Action	Frequency
Remedial actions	Rod through poorly performing runs as initial remediation.	As required.
	If continued poor performance jet and CCTV survey poorly performing runs.	As required.
	Seek advice as to remediation techniques suitable for the type of performance issue and location.	As required If above does not improve performance.

5.0 Pumping station

5.1 Location and Description

Pump Stations location/s are shown on drainage drawing '081440-CUR-XX-XX-D-C-92030'.

5.2 Operation

The surface water pumping station is proposed to discharge storm water from the site up to and including the 1 in 100 year plus 45% climate change event at a rate TBC.

Access for maintenance has been provided through inspection chambers.

5.3 Inspection and Maintenance Regime

A Pump design has yet to be carried out for the pump station for the site. The maintenance regime is to be in accordance with the manufacturer's guidance. Pump Manufacturers offer maintenance plans which will be the responsibility of Fuel Properties (Norwich) Limited to confirm.

6.0 Slot Drains/Channel Drains

6.1 Location and Description

Slot drains and channel drains are used throughout the site, as shown on drainage drawing '081440-CUR-XX-XX-D-C-92030'.

Slot drains and channel drains are proprietary products, and the materials can vary across the site and as such where used the manufacture's recommendations should be followed. Regardless of the product used the pipes will be fully compliant with the Curtins drainage specification.

6.2 Operation

Slot drains and channel drains have been designed so that they are self-cleansing where possible to reduce the regularity of maintenance on these items. Rodding and access points have been provided at the start of all runs, changes in sizes of channel and half-way points.

Access for maintenance is provided through the units themselves.

6.3 Inspection and Maintenance Regime

Regular inspection and maintenance is important to identify areas which may have been obstructed/clogged and may not be drainage correctly thus exposing the development to a greater level of flood risk. Maintenance responsibility for the slot drains/gulleys should be placed with Fuel Properties (Norwich) Limited.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required)	Initial inspection should be provided as post construction CCTV survey.	N/A
	Inspect for evidence of poor operation via water level in gulleys/sump units. If required take remedial action.	3-monthly, 48 hours after large storms.
Occasional maintenance	Check and remove large vegetation growth near slot drain/channel drain catchment areas.	6 monthly
Remedial actions	Rod through poorly performing runs as initial remediation.	As required.

Maintenance Schedule	Required Action	Frequency
	If continued poor performance jet and CCTV survey poorly performing runs.	As required.
	Seek advice as to remediation techniques suitable for the type of performance issue and location.	As required If above does not improve performance.

7.0 Gullies

7.1 Location and Description

Gullies are used throughout the site, as seen on drainage drawing '081440-CUR-XX-XX-D-C-92030'.

Gullies are proprietary products, and the materials can vary across the site and as such where used the manufacture's recommendations should be followed. Regardless of the product used the pipes will be fully compliant with the Curtins drainage specification.

7.2 Operation

Gullies should be of the trapped variety and contain a sump to help mitigate pollutants entering the wider system. Gullies are to contain a removal stopper to allow for rodding to be carried out if necessary.

Access for maintenance is provided through the units themselves.

7.3 Inspection and Maintenance Regime

Regular inspection and maintenance is important to identify areas which may have been obstructed/clogged and may not be drainage correctly thus exposing the development to a greater level of flood risk. Maintenance responsibility for the gullies should be placed with Fuel Properties (Norwich) Limited.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required)	Initial inspection should be provided as post construction CCTV survey.	N/A
	Inspect for evidence of poor operation via water level in trapped gulley. If required take remedial action.	3-monthly, 48 hours after large storms.
Occasional maintenance	Check and remove large vegetation growth near gulley catchment areas.	6 monthly
	Removal siltation or debris within trapped gulley	6 monthly or as required
Remedial actions	Rod through poorly performing runs as initial remediation.	As required.
	If continued poor performance jet and CCTV survey poorly performing runs.	As required.
	Seek advice as to remediation techniques suitable for the type of performance issue and location.	As required If above does not improve performance.

8.0 Oil Separator

8.1 Waste Removal and Servicing

- Separated light liquid must be removed from separator when the oil capacity has been reached.
- An oil level alarm system is available for purchase which gives warning when the separated light liquid/water interface level reaches 90% of the maximum recommended oil storage volume.
- Separators should be inspected at least every six months or more frequently if experience dictates. A log should be maintained detailing the depth of oil found, any oil volume removed and any silt removal or cleaning carried out.
- Frequently, the construction programme itself generates large and perhaps unusual quantities of silt and grit. We do recommend that following the initial installation, an inspection of the separator contents be made to check that building rubble has not entered the unit. Further inspections at 3 and 6 months should be made so as to be able to assess the volumes of silt and oil accumulated. The inspection and emptying programme can then be defined following the first 6 months site experience. We recommend leaving a maximum interval between inspections of 6 months.
- Alarm probes should be removed and cleaned with water whenever waste material is removed from the separator. Please note the alarm may alert until the liquid level is replaced.
- Separator waste is a “special waste” under the terms of The Waste Management Code of Practice. The Code imposes a duty of care on the waste producer to ensure that the Cleansing contractor is registered with the Environment Agency and that the final disposal of the waste is to a licensed facility.

8.2 Waste Removal Procedure – Oil & Silt

- Oil can only be effectively removed when there is no flow entering the unit. Isolate the unit and prevent flow from entering. Always remove the oil before attempting to remove the coalescer. If this is not done, when the coalescer is withdrawn the oil can coat the media surface and when replaced the oil may be forced through the media, contaminating the effluent.
- Remove the access cover and lower the desludging hose in to the separation chamber. Draw off the surface oil.
- If removing the silt, lower the desludge hose to the base of the tank and empty the contents of the chamber. Ensure that you access and clean both compartments.
- Remove the alarm probe, if fitted, clean with water and replace.
- Consider the period of time that the coalescer has been installed and consider removing and inspecting (cleaning or replacing) the coalescer media. If removed, ensure that it is correctly replaced and secured into position. Replace the access covers. It is best to lower the water level to aid re-fitting.
- Re-fill the separator with clean water up to the outlet level.

- If an alarm is fitted, it will display an alarm condition until the separator is re-filled. Check alarm operation when unit full.

8.3 Checking the Coalescer Assembly

- Coalescers, where fitted, may be cleaned periodically to maintain efficiency. Coalescers should be checked following a major incident and media replaced if necessary.
- Identify the type and size of separator (shown on labels inside the access neck).
- Assemblies weighing less than 25 Kg may be removed by hand. Heavier assemblies should be lifted by mechanical means. Any lifting device employed must be capable of lifting:
    1. In excess of the maximum assembly weight.
    2. The assembly completely out of the access shaft.
    3. Giving a smooth and controlled lift.
    4. Swinging the assembly to one side clear of the access shaft.
- Ensure that the area around the access shaft is clear and that there is space to place the assembly once removed. If space is not available, it will be necessary to support the assembly over the access shaft. e.g. by scaffold poles and platform.
- Only remove the access cover when necessary to remove the assembly. Do not leave the access shaft uncovered and unattended.

8.4 Removing the coalescer assembly.

- Undo any fixings which secure the coalescer to the access shaft (if fitted).
- Lift the assembly with a smooth and steady motion. Coalescers will become lighter as water drains from the exposed media. Allow the water to drain completely. Assemblies blocked with fine silt may be very heavy.
- Fully extract the assembly and set it down adjacent to the access shaft.

8.5 Cleaning the coalescer assembly/ Media Replacement.

- Hose down the assembly using clean water at normal pressure. If the media is heavily contaminated with oil and silt, it may not be possible to clean it effectively by hosing. Do not allow untreated cleaning water to pass out of the unit. Continue hosing until the water runs clear.
- To replace the media, undo the banding. Slide media of the core tube and slide new media on. Ensure all the apertures on the core tube are covered by the media. Re-secure or replace banding. Consider replacing media and banding every two years.

8.6 Replacing the coalescer assembly.

- Position it over the access shaft.
- Lower the assembly steadily into the access shaft ensuring that the end locates within the sump at the bottom of the tank. Re-secure the fixings (if fitted).
- Replace the access cover.

9.0 Hydrobrakes

9.1 Location and Description

Hydrobrakes are used as the primary flow control on site, as seen on drainage drawing '081440-CUR-XX-XX-D-C-92030'.

Hydrobrakes are proprietary products the manufacture's recommendations should be followed. Regardless of the product used the pipes will be fully compliant with the Curtins drainage specification.

9.2 Operation

Hydrobrakes should be installed as manufactures instructions and to manufactures minimum recommended dimensions. Sumps should be provided in accordance with design construction details.

Access for maintenance is provided through the units themselves.

9.3 Inspection and Maintenance Regime

Normally, little maintenance is required as there are no moving parts within the Hydro-Brake Flow Control. Hydro-Brake Flow Controls are fitted with a pivoting by-pass door, which allows the manhole chamber to be drained down should blockages occur. The smaller type conical units, below the minimum recommended size, are also supplied with roding facilities or vortex suppressor pipes as standard. Following installation of the Hydro-Brake Flow Control it is vitally important that any extraneous material i.e. Building materials are removed from the unit and the chamber. After the system is made live, it is recommended that each unit be inspected monthly for three months and thereafter at six monthly intervals with hose down if required. If problems are experienced Hydro International is to be contacted so that an investigation may be made. Hydro-Brake Flow Controls are typically manufactured from grade 304 Stainless Steel which has an estimated life span in excess of the design life of drainage systems.

Maintenance responsibility for the hydrobrakes units and their chambers should be placed with Fuel Properties (Norwich) Limited.

10.0 Bioretention Systems

10.1 Location and Description

A Bioretention Trench is located at the channel lines of proposed highways of the site as shown on drainage drawing '081440-CUR-XX-XX-D-C-92030'.

10.2 Operation

The bioretention systems are intended to attenuate the discharge from the site up to and including the 1 in 100 year plus 45% climate change event.

Access for maintenance will be provided through inspection chambers or rodding eyes.

10.3 Inspection and Maintenance Regime

Regular inspection and maintenance are important for the effective operation of the systems as designed. As the feature is buried a regularly inspection regime is very important to ensure the correct functionality of the surface water drainage network. Maintenance responsibility for the bioretention systems and their surrounding areas should be placed with Fuel Properties (Norwich) Limited.

Sediment\material removal should be undertaken in consultation with the environmental regulator to confirm appropriate protocols; especially where run-off is taken from potentially contaminated areas such as car parks/service yards.

11.0 Blue Roofs (including podium drainage)

11.1 Location and Description

Blue Roof are storage units underneath the green/brown roof to provide attenuation storage. For Maintenance purposes the podium storage can be treated as though it is a blue roof.

Blue Roofs are proprietary products and therefore manufacturer's specific recommendations should also be taken in to consideration above what has been prepared in this document. Additionally, different manufacturers may have different connection types and arrangements which will need to be taken in to consideration. The Blue roof installation and, maintenance should be according to BS 6229:2018.

11.2 Operation

The blue roof units are intended to attenuate the discharge from the site up to and including the 1 in 100 year plus 45% climate change event. Proper Waterproofing and load calculations has to be integrated with the structural design. Access for maintenance has to be provided as per the supplier guidelines.

11.3 Inspection and Maintenance Regime

Regular inspection and maintenance are important to ensure that the outlets are free of debris and blockages. Maintenance responsibility for the geocellular units and their surrounding areas should be placed with Fuel Properties (Norwich) Limited. Manufacturer guidelines to be incorporated to the following maintenance Regime.

Maintenance Schedule	Required Action	Frequency
Regular inspections	Inspect drain inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system.	Annually and after severe storms
	Visual Inspection of the waterproofing system at all upstands to ensure it is firmly adhered to the detail.	Annually and after severe storms
	Inspect and identify any areas that are not operating correctly, If required, take remedial action.	Monthly for 3 months, then six monthly

Maintenance Schedule	Required Action	Frequency
Regular maintenance	Remove fallen leaves and debris.	Six monthly and annually or as required
Remedial actions	If drain inlet has settled, cracked or moved, investigate and repair as appropriate.	As required

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