

Technical Note

To: Manchester City Council (Planning)

From: Jake Busby (Curtins)

Subject: Surface Water Drainage Strategy

Reference: 20200-CUR-INZ-XX-GN-C-00002

Date: 26th January 2023

This technical note has been prepared in support of an application for planning permission for additional carparking on land within the North Manchester General Hospital (NMGH) campus (hereafter referred to as the TCP05).

The package of works proposed within the planning application comprises:

- Phase 1 and 2 construction of a new temporary carpark;
- Installation of required drainage and other associated infrastructure.

Further details of the works and the proposed surface water drainage strategy is detailed below:

TCP05 Phase 1

The new carpark (phase 1) is to be located in an area of predominantly existing hardstanding (carparking), the now demolished Limbert building and some areas of landscaping. The existing carpark area is positively drained to the existing NMGH networks, as was Limbert building prior to demolition. There is an existing impermeable catchment generating a surface water flow to the NMGH network where the new temporary carpark is proposed. All run-off from within the estate discharges to the surrounding UU network at an unrestricted rate.

There is to be a new surface water network for TCP05 Phase 1, this consists of permeable paving with subbase laid to fall towards a below ground stone trench. The stone trench is to be unlined to allow infiltration where possible, however the available investigations show the soakaway test was successful however the rate was less than 10^{-5} which is not suitable for drainage purposes. The trench shall be filled with a no-fines aggregate of 30% void ratio to provide attenuation. Permeable paving does not provide attenuation in carparks on excessive gradients without the introduction of weirs within the stone substrata, these are prone to failure and create maintenance issues as they are inaccessible. Therefore, all attenuation is provided within the stone filled trench.

The outgoing pipe from the downstream chamber of the stone pit to the existing manhole will need to be fitted with a 50mm orifice plate to limit discharge to a maximum 5 l/s. Climate change is considered against the 1 in 100 year rainfall event with a 25% allowance. There is no climate change consideration for the 1 in 30 year rainfall since the carpark is temporary in nature, climate change is shown in the hydraulic simulation (appended here). The stone filled pit is described as "link surround structure" within the simulation. The total area within phase 1 is 1,600m² (0.16ha). An exceedance of 5m² is shown in the 1 in 100 year event (plus climate change) it is unlikely that climate change will be realised within the lifetime of the carpark, and 5m² is negligible in volume. In reality the excess will sit within the type 3 subbase.

Road gullies and linear drains are easily maintainable from surface level, as is the main sewer run from the proposed manhole. The run of drainage currently within Central Drive ultimately discharges to the UU combined sewer network and therefore risk of pollution is considered very low.

There is

TCP05 Phase 2

The additional carparking to be made available during phase 2 will follow the same strategy as phase 1. A stone filled trench with a 30% void ratio no fines aggregate will provide attenuation as to not exceed the 5 l/s used within Phase 1. The orifice should be swapped to 45mm upon completion of phase 2 to account for the additional hydrostatic pressure.

The total area within phase 2 is 950m² (0.095ha). An exceedance of 2m² is shown in the 1 in 100 year event (plus climate change) it is unlikely that climate change will be realised within the lifetime of the carpark, and 2m² is negligible in volume. In reality the excess will sit within the type 3 subbase.

Maintenance

A management and maintenance plan for the lifetime of the development shall include the arrangements for a maintenance/management contract where required to secure the operation of the sustainable urban drainage scheme throughout its lifetime.

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.

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

Pipes 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.

Pipes are intended to be the main conveyance across the development and where oversized they form the attenuation volume required by the limitation of the discharge rate. They are intended to be dry except for during rainfall events. These have been designed to be self-cleaning where possible 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 and manholes.

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 Schedule	Required Action	Frequency
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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
Regular maintenance\ inspection	Inspect for evidence of poor operation via water level in chambers. If required, take remedial action.	3-monthly, 48 hours after large storms.
	Check and remove large vegetation growth near pipe runs.	Monthly or as required
Remedial Action	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.

The permeable pavements have designed in accordance with CIRIA C697 and BS7533-13.

The permeable pavements are intended to be water quality and attenuation storage features. These features are intended to be dry except during rainfall events. The permeable pavements may also be utilised as an infiltration area or soakaway for other areas of the development.

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 subbase.

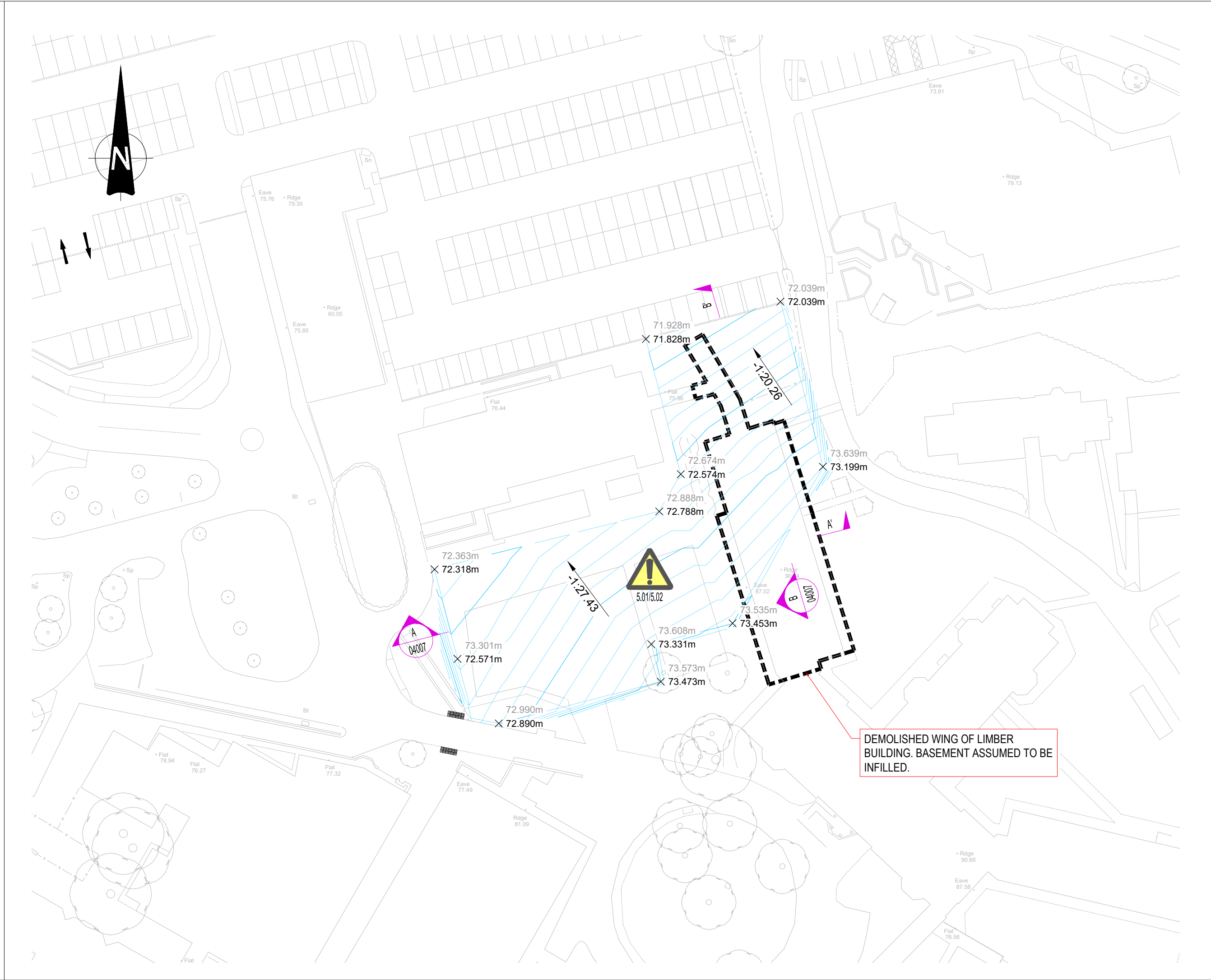
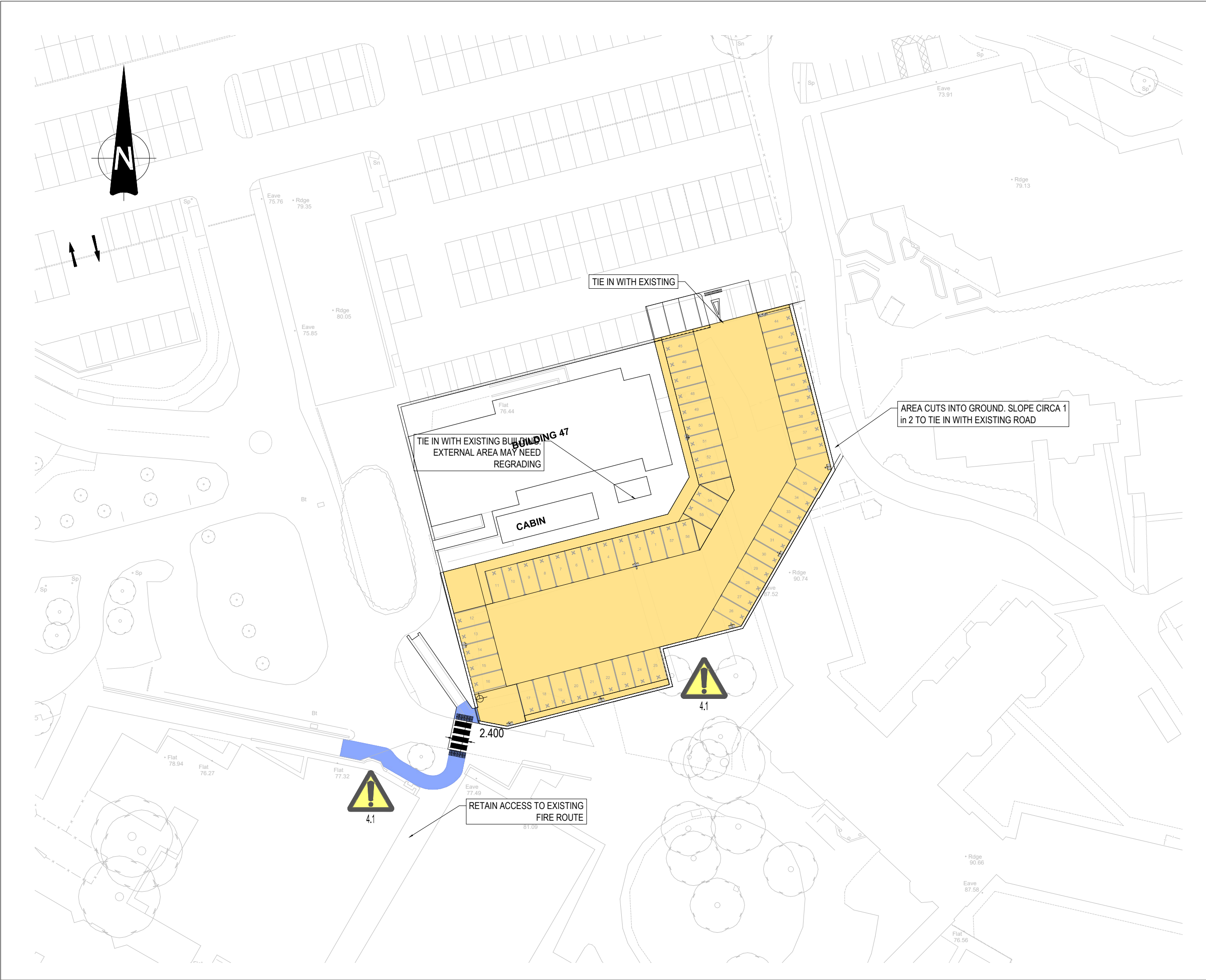
Access for maintenance is provided as this is a surface feature only.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Inspect feature surface to identify evidence of erosion, compaction, ponding, and contamination. Record areas where water is ponding for >48 hours.	Every three months and after large storms.

Maintenance Schedule	Required Action	Frequency
	Check features surface for even gradients	Half yearly
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly.
	Inspect silt accumulation rates and establish appropriate removal frequencies.	Half yearly.
	Inspect silt accumulation rates and establish appropriate brushing frequencies. Silt can also be caused by adjacent landscaping areas which should be reprofiled to provide a flat area or berm adjacent to the paving.	Annually.
Regular maintenance\ inspection	Litter and debris removal	Monthly or as required
	Removal of weed.	Monthly (at start, then as required).
	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.
Remedial Actions	Re-level uneven surfaces and reinstate design levels. This may be required as part of sediment removal.	As required.

Summary

- Infiltration is deemed unviable from the available site investigations.
- Overall there is likely a decrease on the discharge of surface water to the site network through the removal of the Limbert building, existing carparking (phase 1) and building “47” demolished to enable phase 2.
- A flow restriction and attenuation meets planning policy for sustainable drainage.
- There is no increase in flow to the UU sewers.



- GENERAL NOTES:**
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 - ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
 - FOR GENERAL NOTES REFER TO DRAWING.
 - DRAINAGE CONSIDERATIONS GIVEN ON PLAN 04052.
 - KNOWN CONSTRAINTS GIVEN ON PLAN 04053.
 - GEOTECHNICAL ANALYSIS REQUIRED PRIOR TO FURTHER DESIGN.

KEY

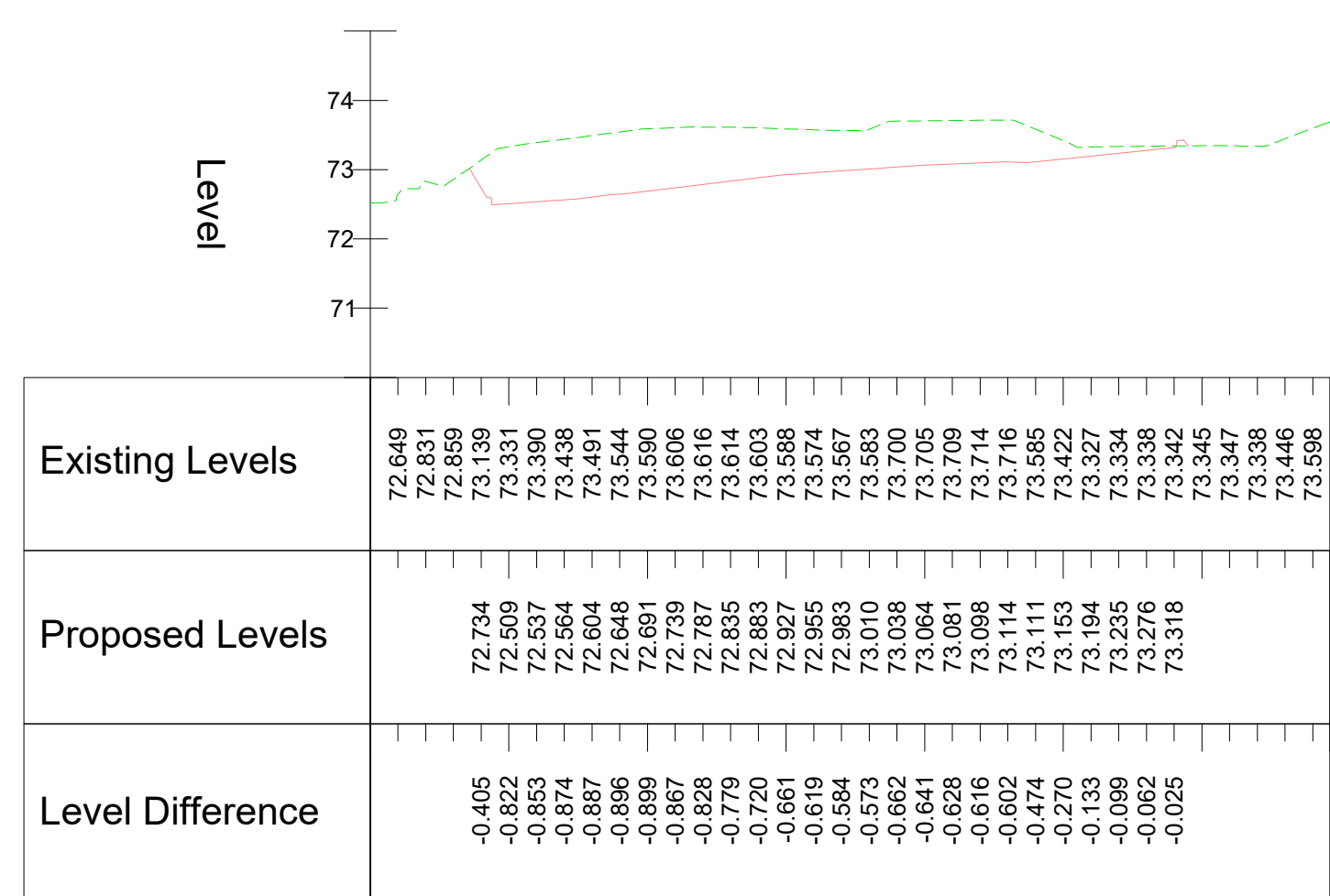
PROPOSED PERMEABLE CAR PARK - SURFACING UNDERLAIN WITH TYPE 3 OPEN GRADED SUB-BASE

PROPOSED ASPHALT FOOTPATH UPGRADE WORKS

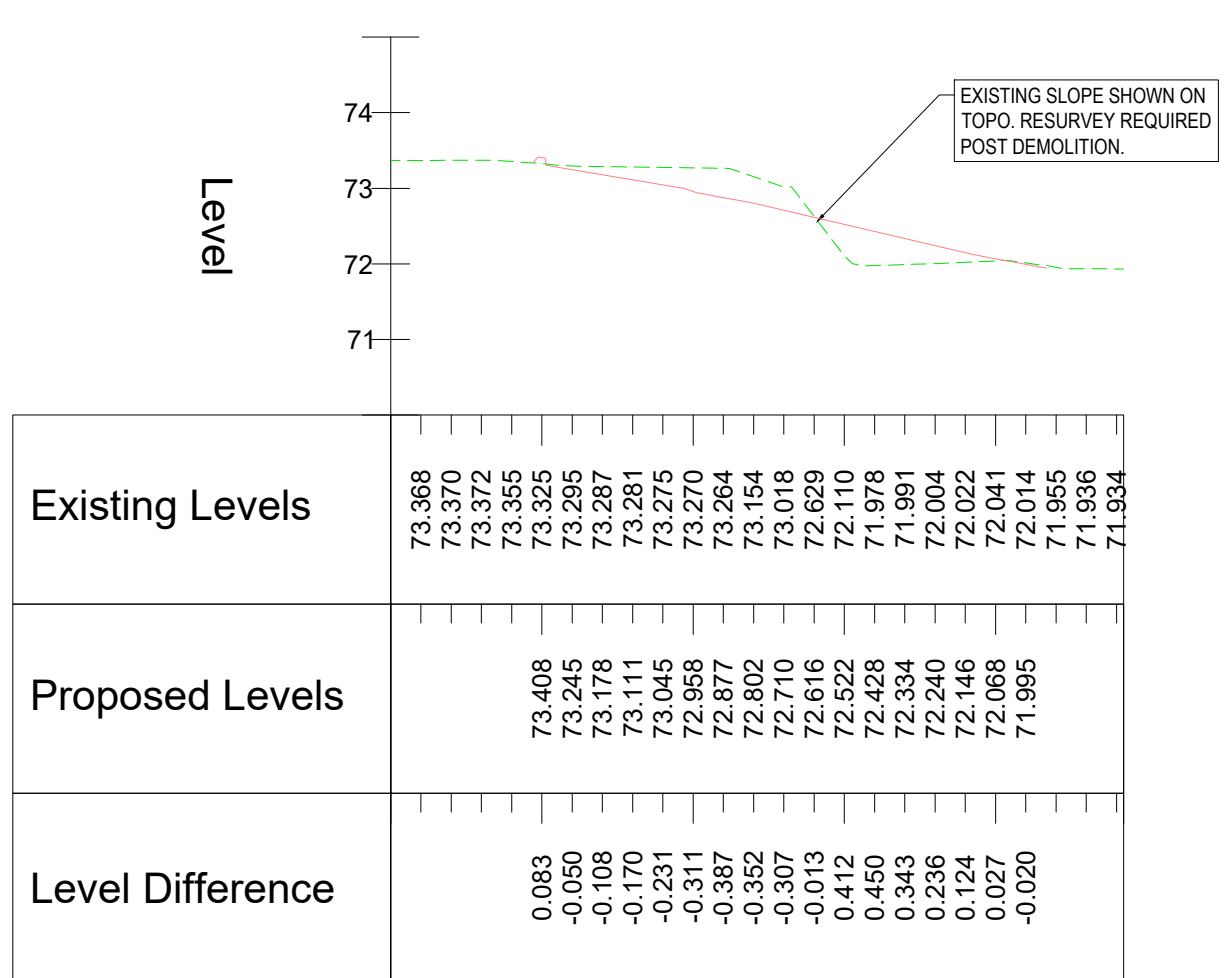
400 x 400 BLISTER TACTILE PAVING UNITS



A-A' - LONGSECTION
SCALE: H 1:500,V 1:100. DATUM: 70.000



B-B' - LONGSECTION
SCALE: H 1:500,V 1:100. DATUM: 70.000



HAZARD REGISTER		
REF.	ITEM (FEATURE, ELEMENT, OR ACTIVITY)	POTENTIAL HAZARD IDENTIFIED
1.0	Enabling / Highwayworks	
1.01	Works adjacent to highways and public areas	Live highway - works may interfere with public
2.0	Side Wide Issues	
2.01	Buried Services	Potential unknown buried services. Health and safety of operatives during excavation works, electrocution, gas explosion, damage to services during works. Supply to the hospital and associate building could be interrupted.
2.02	Asbestos	Potential asbestos hazard associated with the existing buildings or ground
2.03	Undertaken substructures & voids/Rail Basements	Potential collapse of existing buried structures or voids during construction works.
3.0	Existing Buried & Overhead Services	
3.01	Buried services	Proposed activities clash with buried services
4.0	Demolition of Existing Structures / Site Clearance	
4.01	Existing above ground features such as lighting columns and street furniture	Structures and surface features clash with the proposed works
4.06	Vibration and noise generated during works	Damage to nearby buildings due to ground borne vibration from demolition activities. Nuisance/ disturbance of neighbours from noise.
5.0	Excavations and Foundations	
5.01	Earthworks and Excavations	Contaminants in the ground
5.02	Earthworks and Excavations	Unknown ground conditions and unstable ground
9.0	Client Operational Issues and Rules	
9.01	Surrounding Environment	Work is located within an existing Acute Hospital Site. Interactions with public and staff health and safety in adjacent spaces and COVID19 safe working practices apply
9.02	Existing trees	Works may impact trees with root protection zones

AREA OF TCP05 SHOULD BE RESURVEYED FOLLOWING COMPLETION OF LIMBERT BUILDING DEMOLITION WORKS.

EXISTING INFILLED BASEMENT TO BE IDENTIFIED AND FILL MATERIAL VERIFIED.

REV.	DESCRIPTION	DATE	DRW.	CHK.
P06	STAGE 5 (S4)	23/01/23	GGP	JDB
P05	STAGE 4 TENDER	17/11/22	GGP	JDB
P04	PLANNING ISSUE (S3)	19/10/22	GGP	JDB
P03	PLANNING ISSUE (S2)	13/10/22	GGP	JDB
P02	PLANNING ISSUE (S1)	11/10/22	GGP	JDB

NHS

Manchester University

NHS Foundation Trust

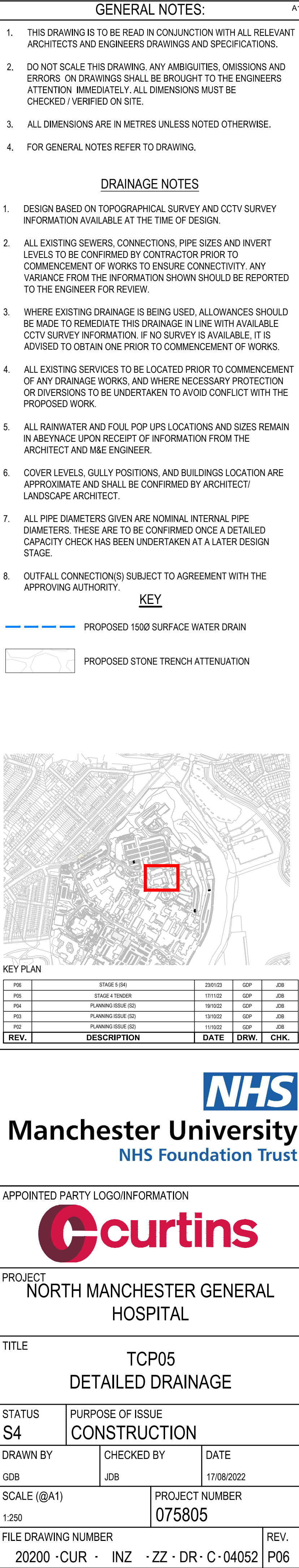
APPOINTED PARTY LOGO/INFORMATION

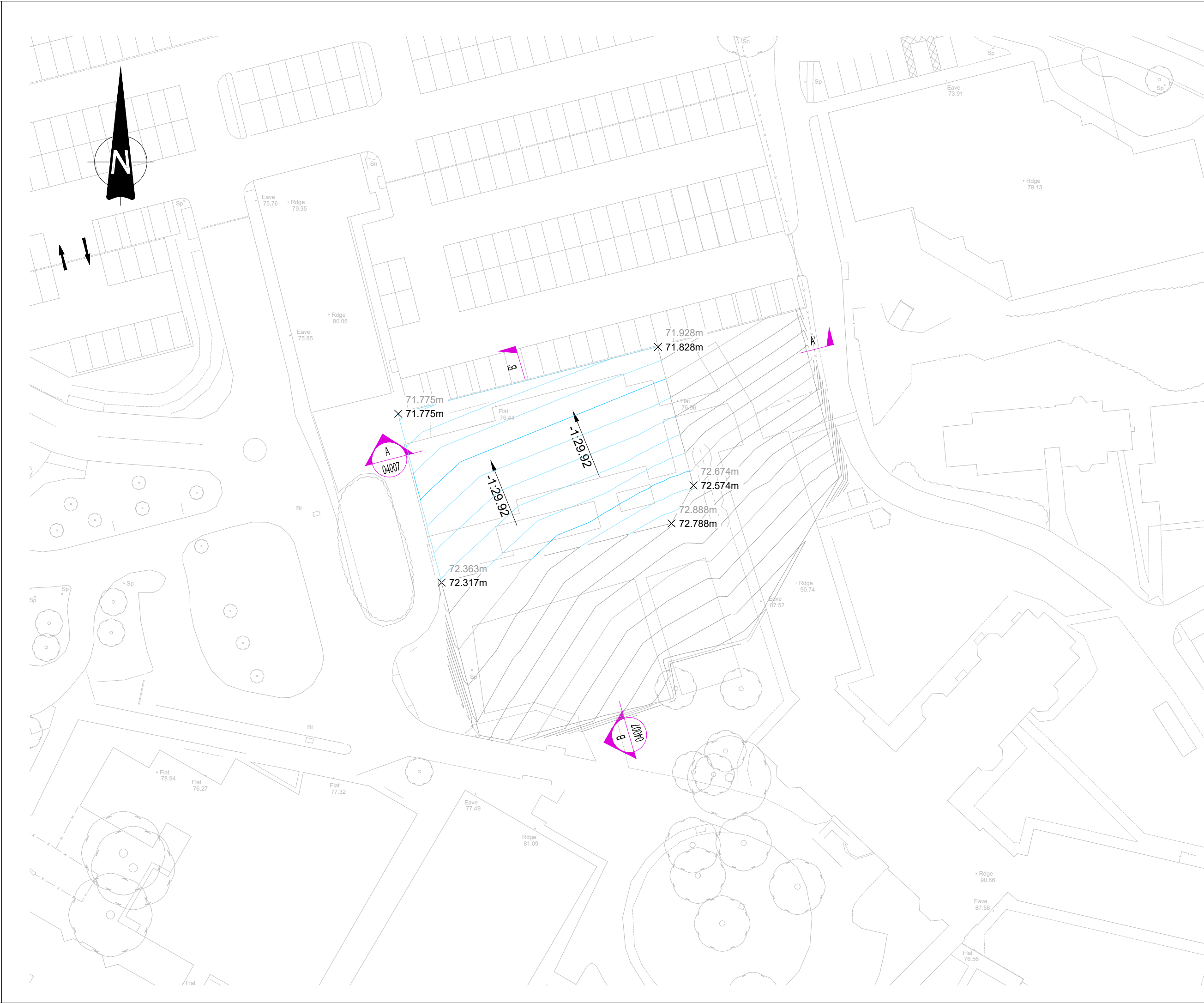
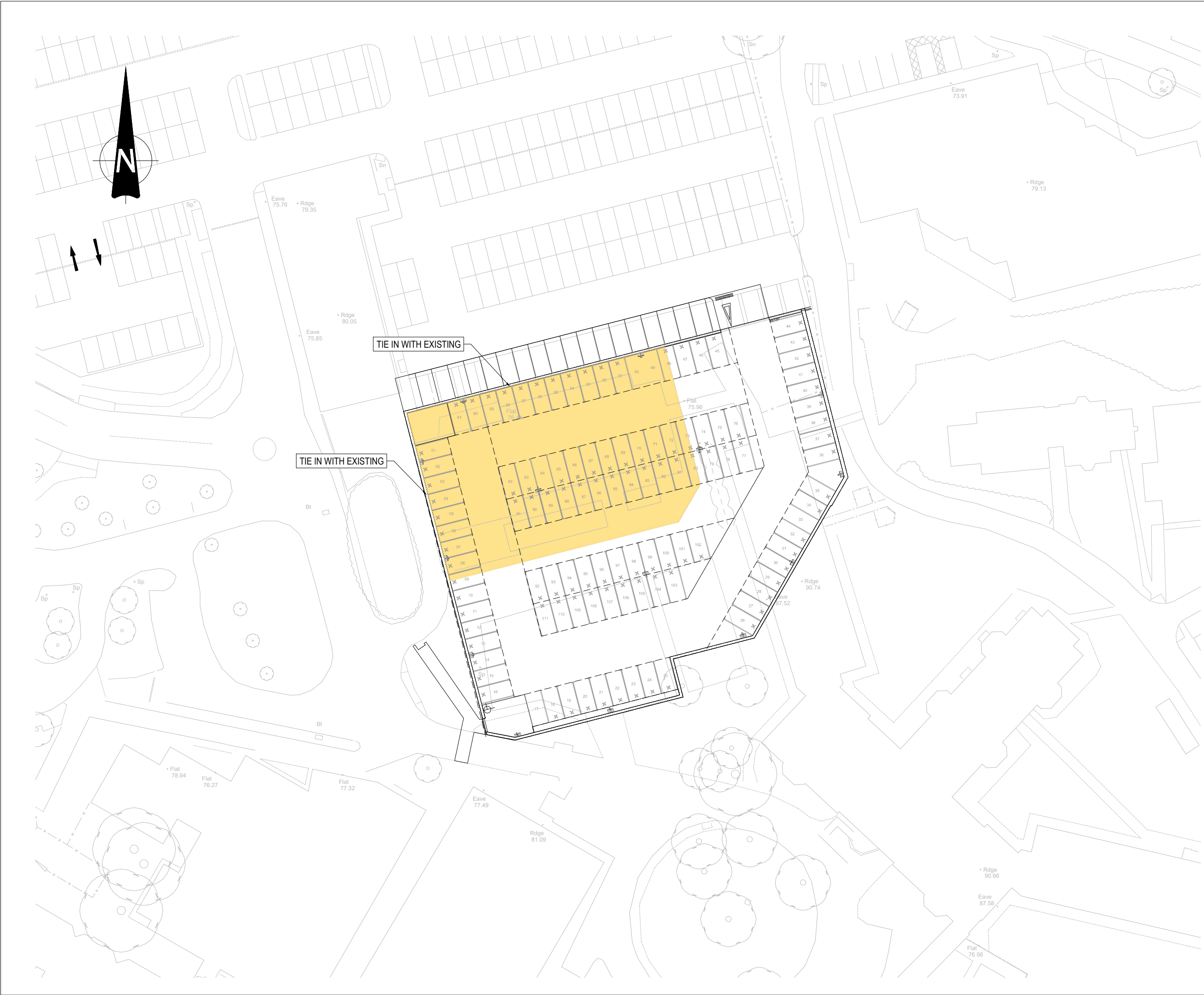


PROJECT
NORTH MANCHESTER GENERAL HOSPITAL

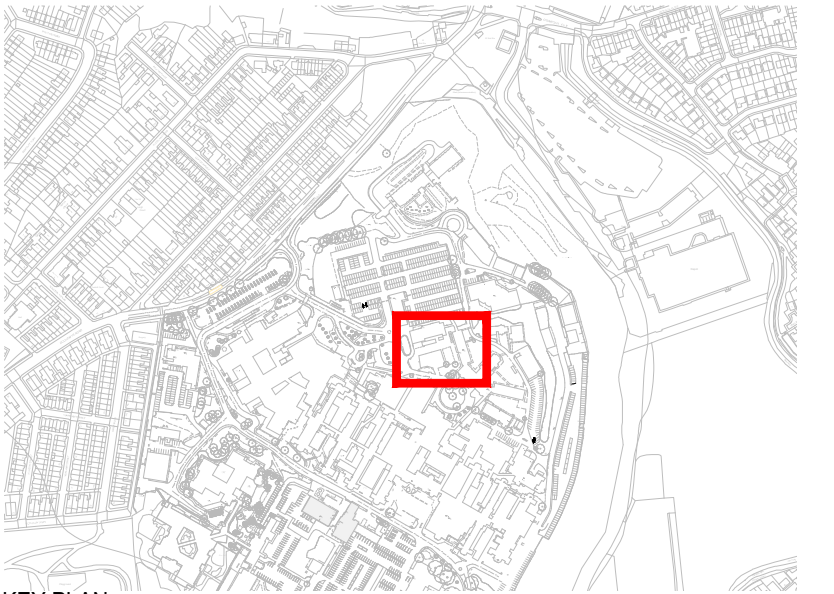
TITLE
TCP05 GENERAL ARRANGEMENT

STATUS S4	PURPOSE OF ISSUE CONSTRUCTION
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SCALE (@A1) 1:500	DATE 17/08/2022
FILE DRAWING NUMBER 20200 · CUR · INZ · ZZ · DR · C · 04051	PROJECT NUMBER 075805
REV. P06	





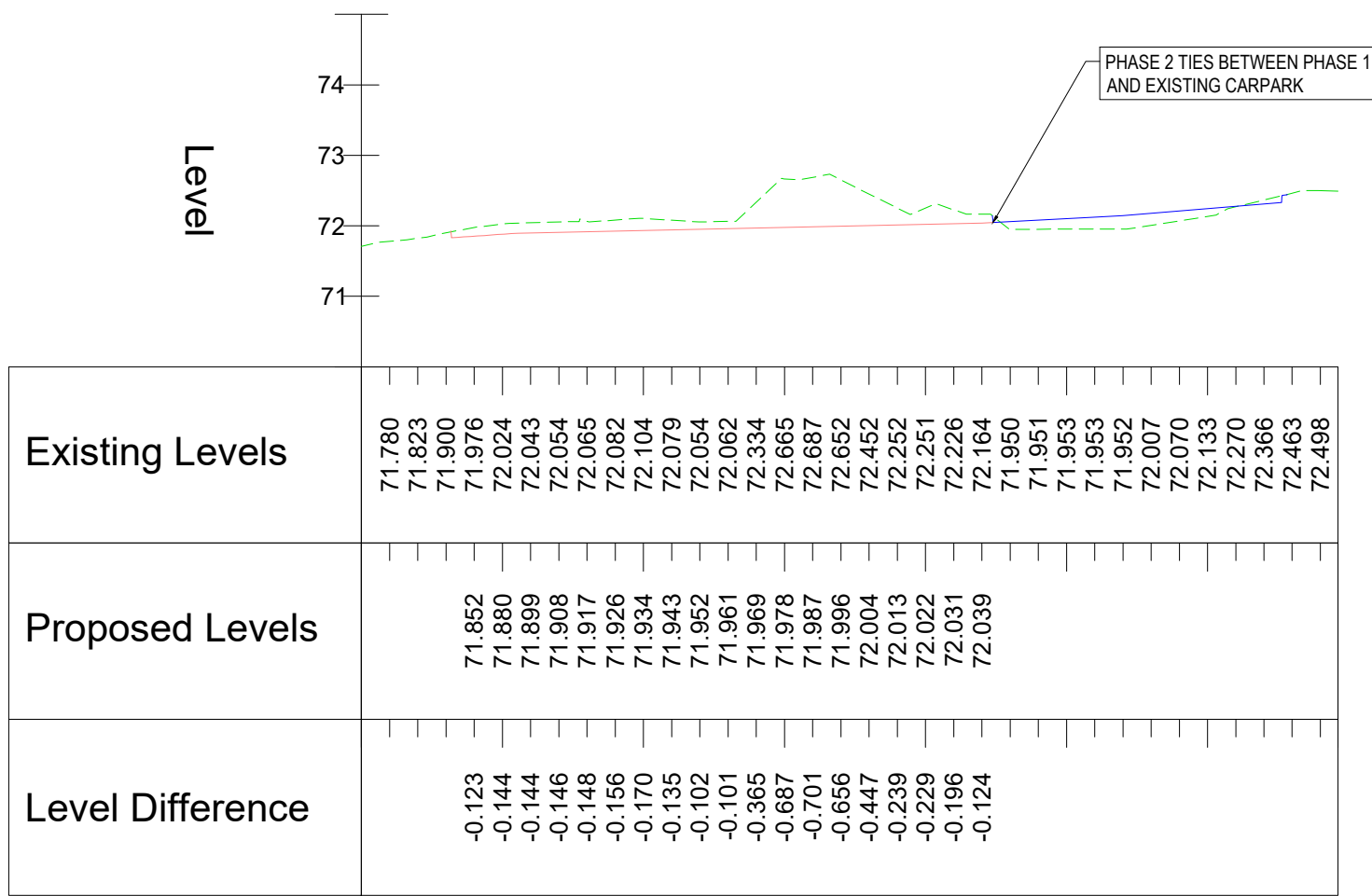
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 - KNOWN CONSTRAINTS GIVEN ON PLAN 04053.
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- KEY**
- PROPOSED PERMEABLE CAR PARK - SURFACING UNDERLAIN WITH TYPE 3 OPEN GRADED SUB-BASE



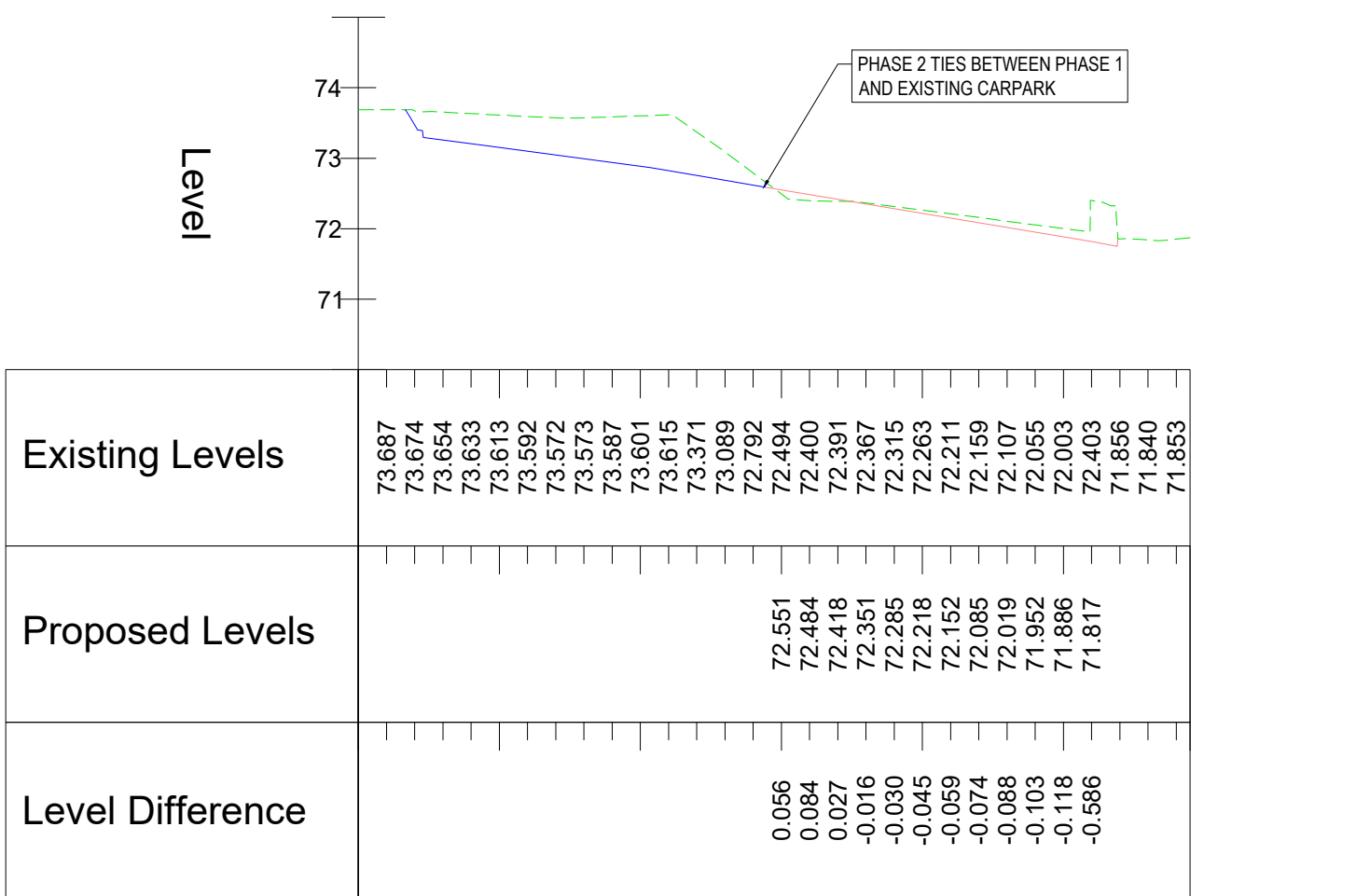
KEY PLAN

REV.	DESCRIPTION	DATE	DRW.	CHK.
P05	STAGE 5 (S4)	24/01/23	GDG	JDB
P04	STAGE 4 TENDER	17/11/22	GDG	JDB
P03	PLANNING ISSUE (S3)	19/10/22	GDG	JDB
P02	PLANNING ISSUE (S2)	13/10/22	GDG	JDB
P01	PLANNING ISSUE (S1)	11/10/22	GDG	JDB

A-A' - LONGSECTION
SCALE: H 1:500,V 1:100. DATUM: 70.000



B-B' - LONGSECTION
SCALE: H 1:500,V 1:100. DATUM: 70.000



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2.02	Asbestos	Potential asbestos hazard associated with the existing buildings or ground.	The contractor shall assess all available information and determine if any further investigation work is required.
2.03	Unidentified substructures & voids/Relic Basements	Collapse of existing buried structures or voids during construction works.	Contractor to review phase 1 & 2 SI reports to familiarise themselves with known site conditions and previous uses. Further scanning and careful stripping of top layer of ground may also be required to identify relic structures in the ground prior to demolition and construction commencing. Contractor to undertake any other investigations considered necessary
3.0 Existing Buried & Overhead Services			
3.01	Buried services	Proposed activities clash with buried services	Accurately locate all buried services and divert where necessary. Divert and disconnect services in accordance with the SI/Safety design intent. Contractor to undertake any other investigations considered necessary
4.0 Demolition of Existing Structures / Site Clearance			
4.01	Existing above ground features such as lighting columns and street furniture	Structures and surface features clash with the proposed works	Ensure all existing features have been identified and protect against damage
4.06	Vibration and noise generated during works	Damage to nearby buildings due to ground borne vibration from demolition activities. Nuisance/disturbance of neighbours from noise.	MANH and Contractor to agree monitoring regime and permitted maximum vibration and noise levels.
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9.01	Surrounding Environment	Work is located within an existing Acute Hospital Site. Interactions with public and staff health and safety in adjacent spaces and COVID19 safe working practices apply	Method statement required by contractors for material management.
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APPOINTED PARTY LOGO/INFORMATION



PROJECT
NORTH MANCHESTER GENERAL HOSPITAL

TITLE
TCP05 GENERAL ARRANGEMENT

STATUS
S4

PURPOSE OF ISSUE
CONSTRUCTION

DRAWN BY
GDB

CHECKED BY
JDB

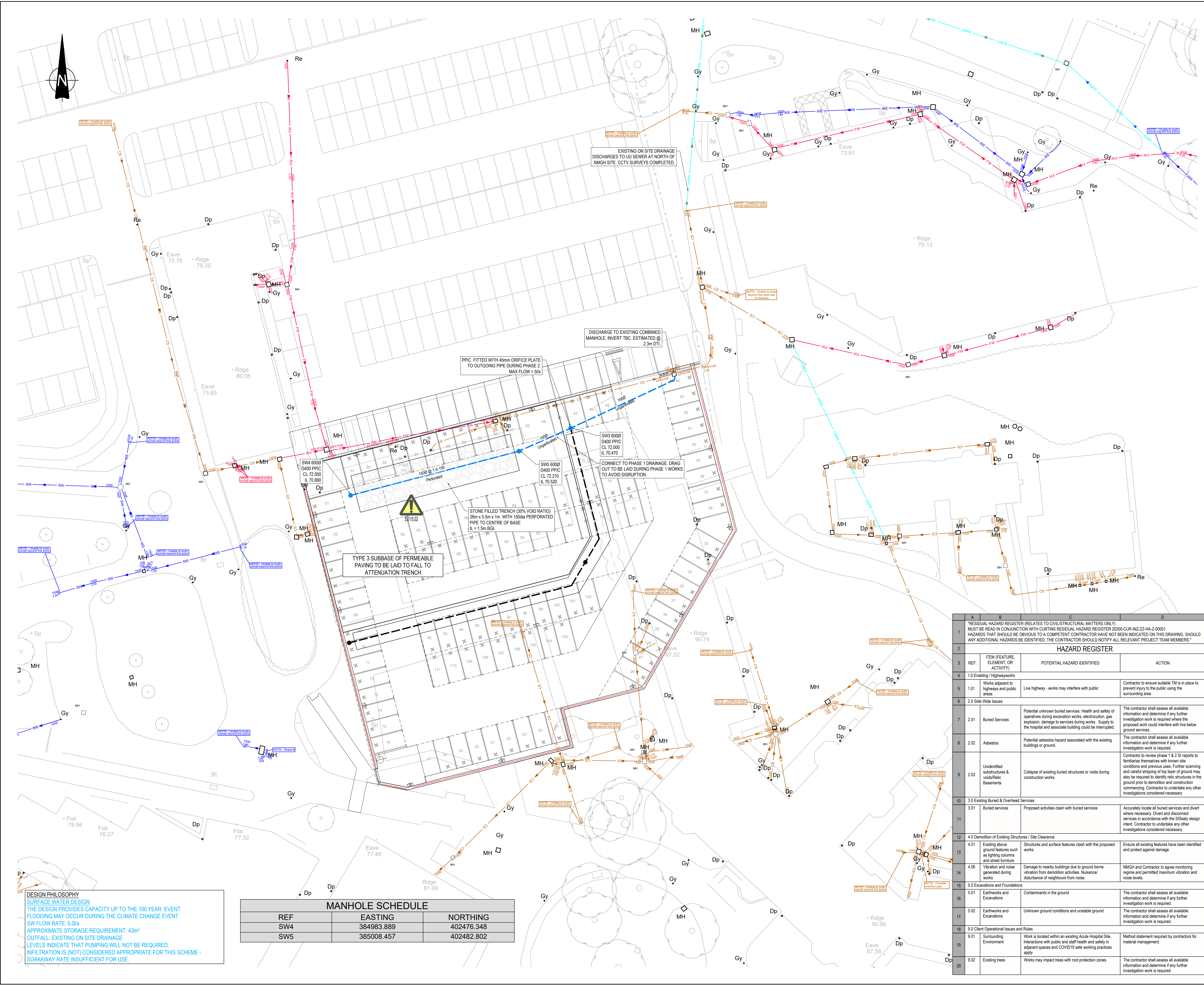
DATE
11/10/2022

SCALE (@A1)
1:500

PROJECT NUMBER
075805

FILE DRAWING NUMBER
20200 · CUR · INZ · ZZ · DR · C · 04055

REV.
P05



GENERAL NOTES:

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DRAINAGE NOTES

1. DESIGN BASED ON TOPOGRAPHICAL SURVEY AND CCTV SURVEY INFORMATION AVAILABLE AT THE TIME OF DESIGN.

2. 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.

3. WHERE EXISTING DRAINAGE IS BEING USED, ALLOWANCES SHOULD BE MADE TO REMEDIATE THIS DRAINAGE IN LINE WITH AVAILABLE CCTV SURVEY INFORMATION. IF NO SURVEY IS AVAILABLE, IT IS ADVISED TO OBTAIN ONE PRIOR TO COMMENCEMENT OF WORKS.

4. ALL EXISTING SERVICES TO BE LOCATED PRIOR TO COMMENCEMENT OF ANY DRAINAGE WORKS, AND WHERE NECESSARY PROTECTION OR DIVERSIONS TO BE UNDERTAKEN TO AVOID CONFLICT WITH THE PROPOSED WORK.

5. ALL RAINWATER AND FOUL POP UPS LOCATIONS AND SIZES REMAIN IN ABEYANCE UPON RECEIPT OF INFORMATION FROM THE ARCHITECT AND M&E ENGINEER.

6. COVER LEVELS, GULLY POSITIONS, AND BUILDINGS LOCATION ARE APPROXIMATE AND SHALL BE CONFIRMED BY ARCHITECT/ LANDSCAPE ARCHITECT.

7. ALL PIPE DIAMETERS GIVEN ARE NOMINAL INTERNAL PIPE DIAMETERS. THESE ARE TO BE CONFIRMED ONCE A DETAILED CAPACITY CHECK HAS BEEN UNDERTAKEN AT A LATER DESIGN STAGE.

8. OUTFALL CONNECTION(S) SUBJECT TO AGREEMENT WITH THE APPROVING AUTHORITY.

KEY

PROPOSED 1500 SURFACE WATER DRAIN

PROPOSED STONE TRENCH ATTENUATION

KEY PLAN

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RESIDUAL HAZARD REGISTER (RELATES TO CIVIL/STRUCTURAL MATTERS ONLY)

MUST BE READ IN CONJUNCTION WITH CURTINS RESIDUAL HAZARD REGISTER 20200-CUR-INZ-ZZ-HA-Z-00001.

HAZARDS THAT SHOULD BE OBVIOUS TO A COMPETENT CONTRACTOR HAVE NOT BEEN INDICATED ON THIS DRAWING. SHOULD ANY ADDITIONAL HAZARDS BE IDENTIFIED, THE CONTRACTOR SHOULD NOTIFY ALL RELEVANT PROJECT TEAM MEMBERS.*

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MANHOLE SCHEDULE

REF	EASTING	NORTHING
SW4	384983.889	402476.348
SW5	385008.457	402482.802

DESIGN PHILOSOPHY

SURFACE WATER DESIGN

THE DESIGN PROVIDES CAPACITY UP TO THE 100 YEAR EVENT FLOODING MAY OCCUR DURING THE CLIMATE CHANGE EVENT

SW FLOW RATE: 5.0ls

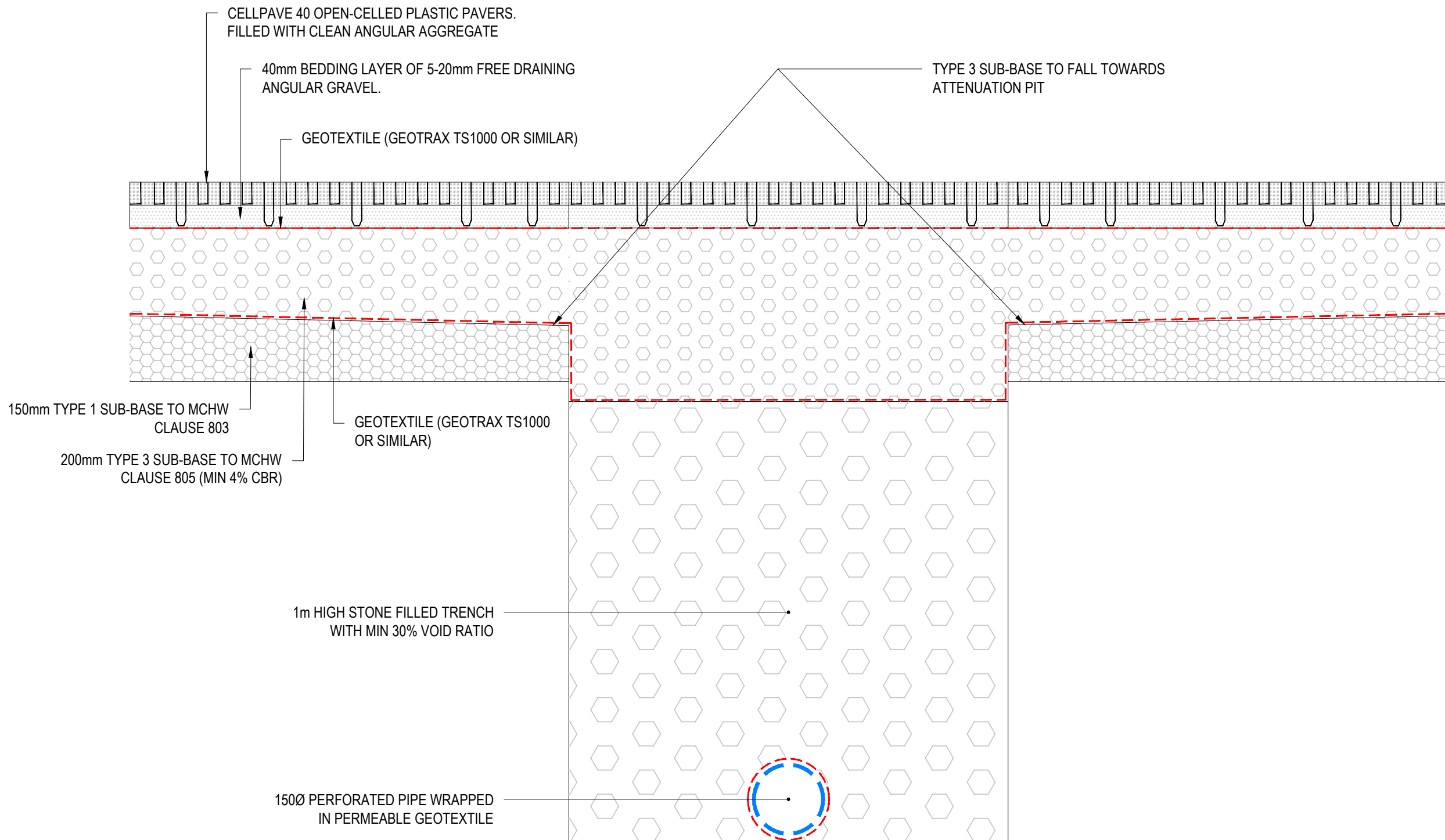
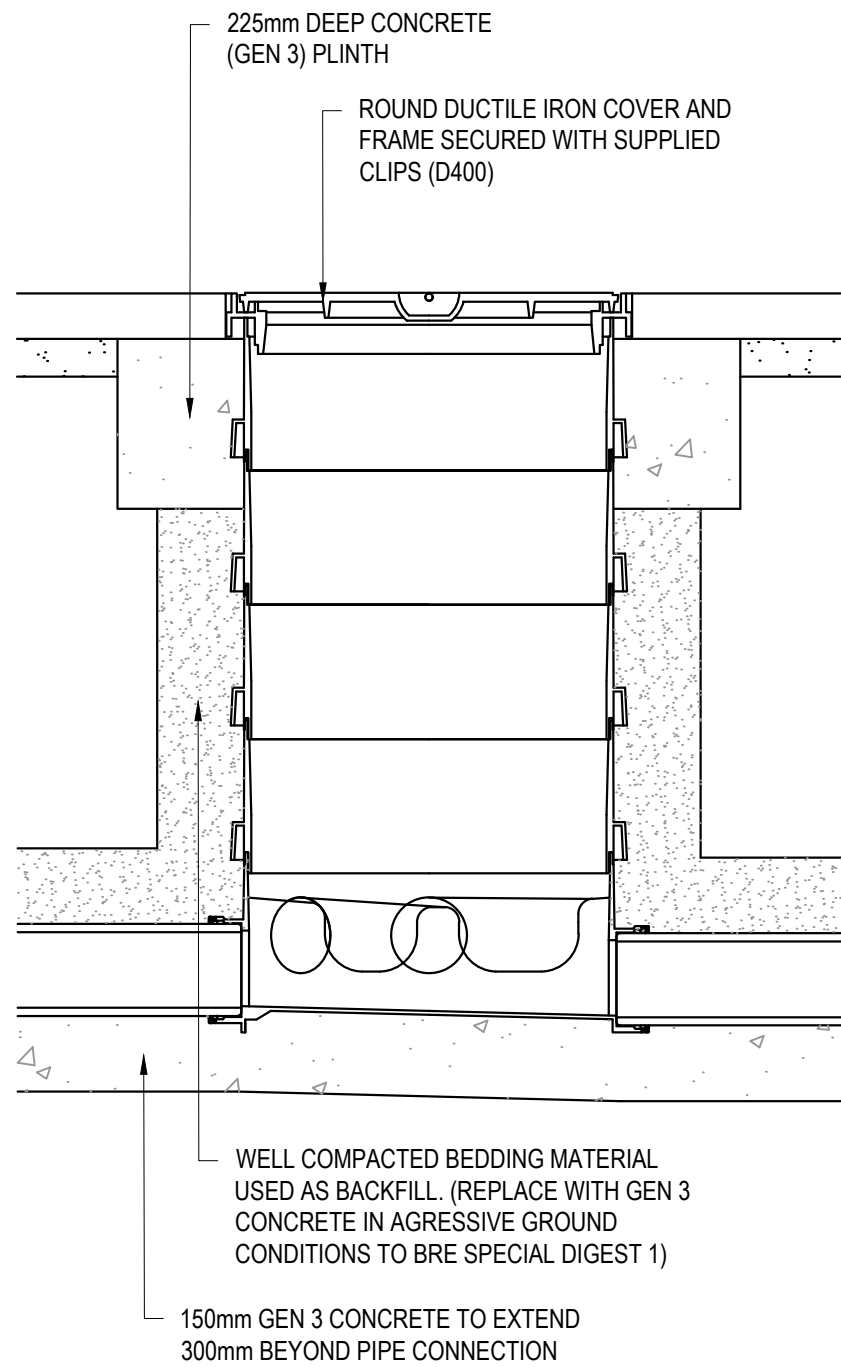
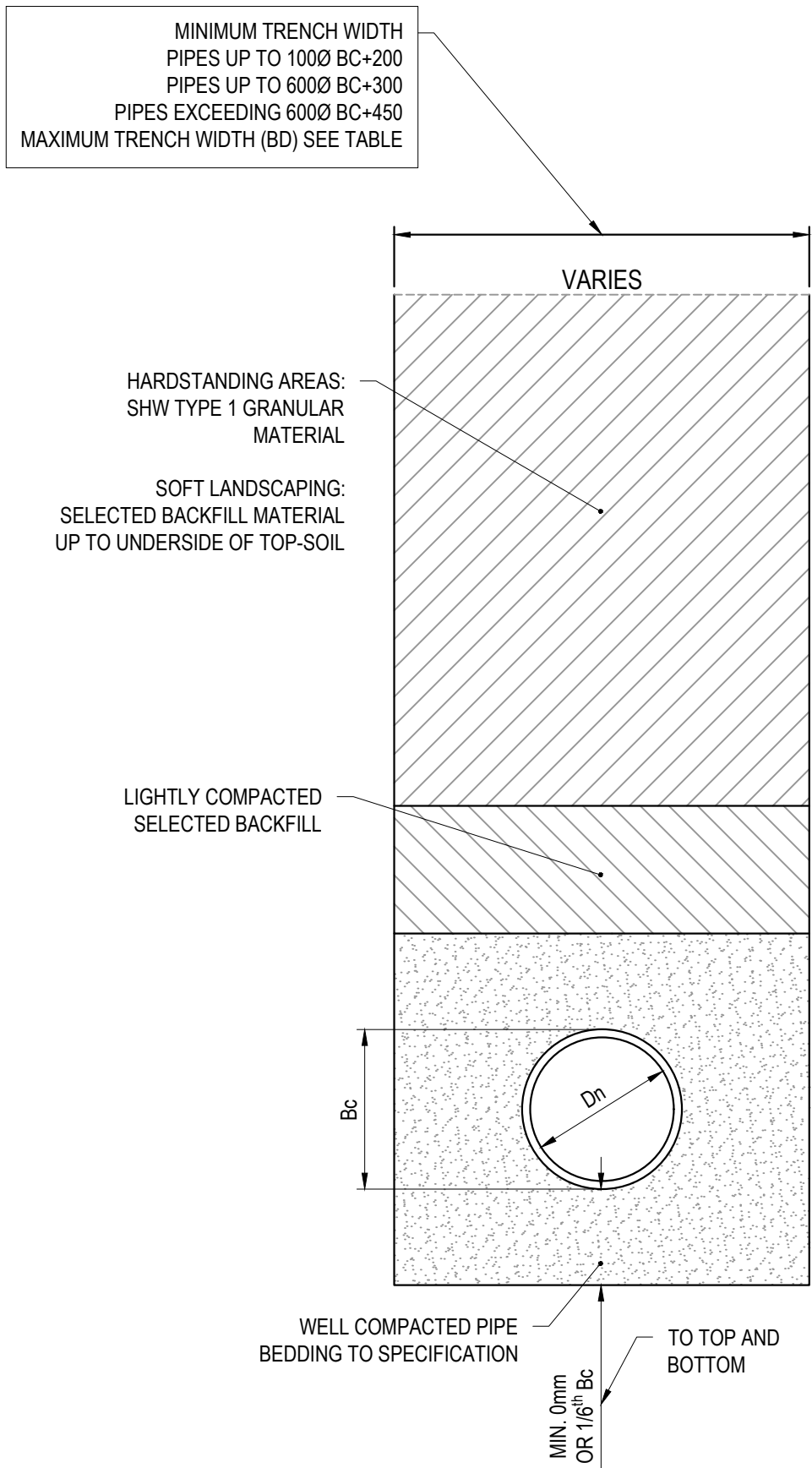
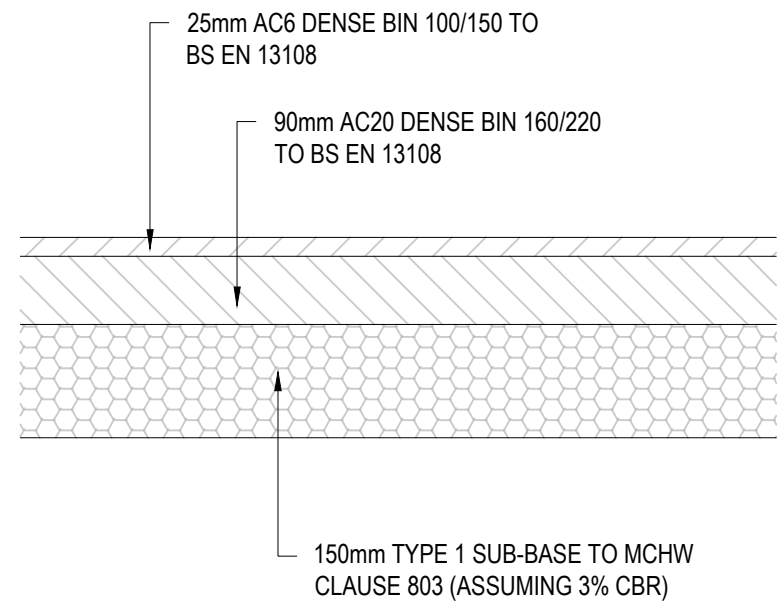
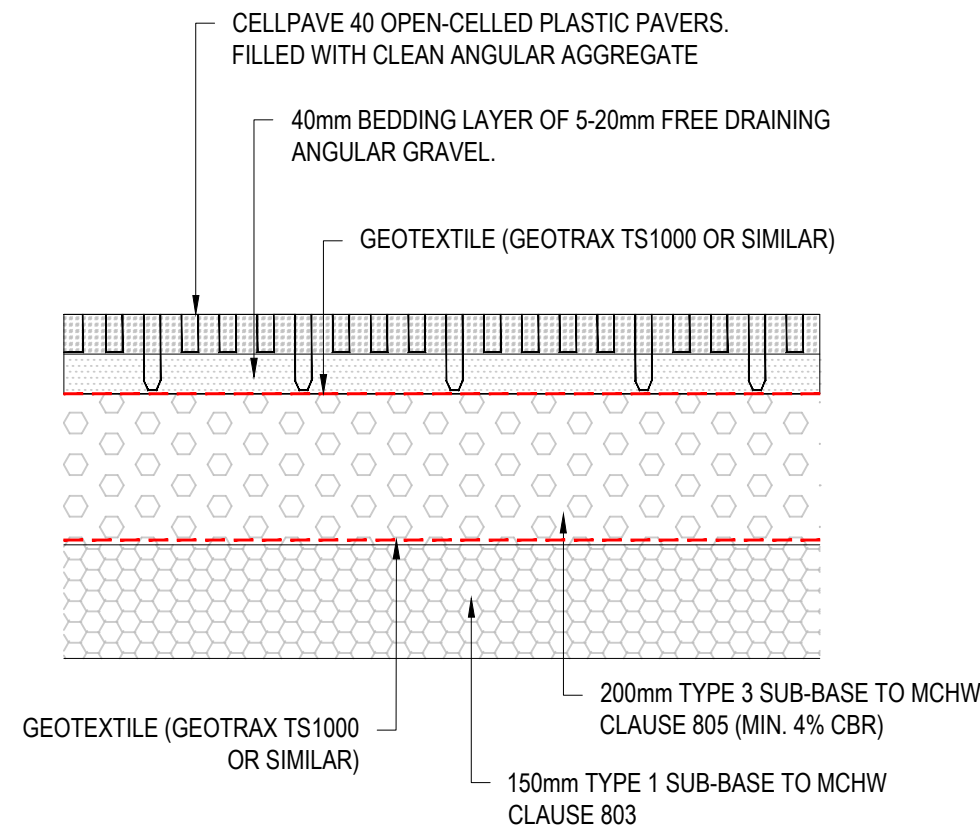
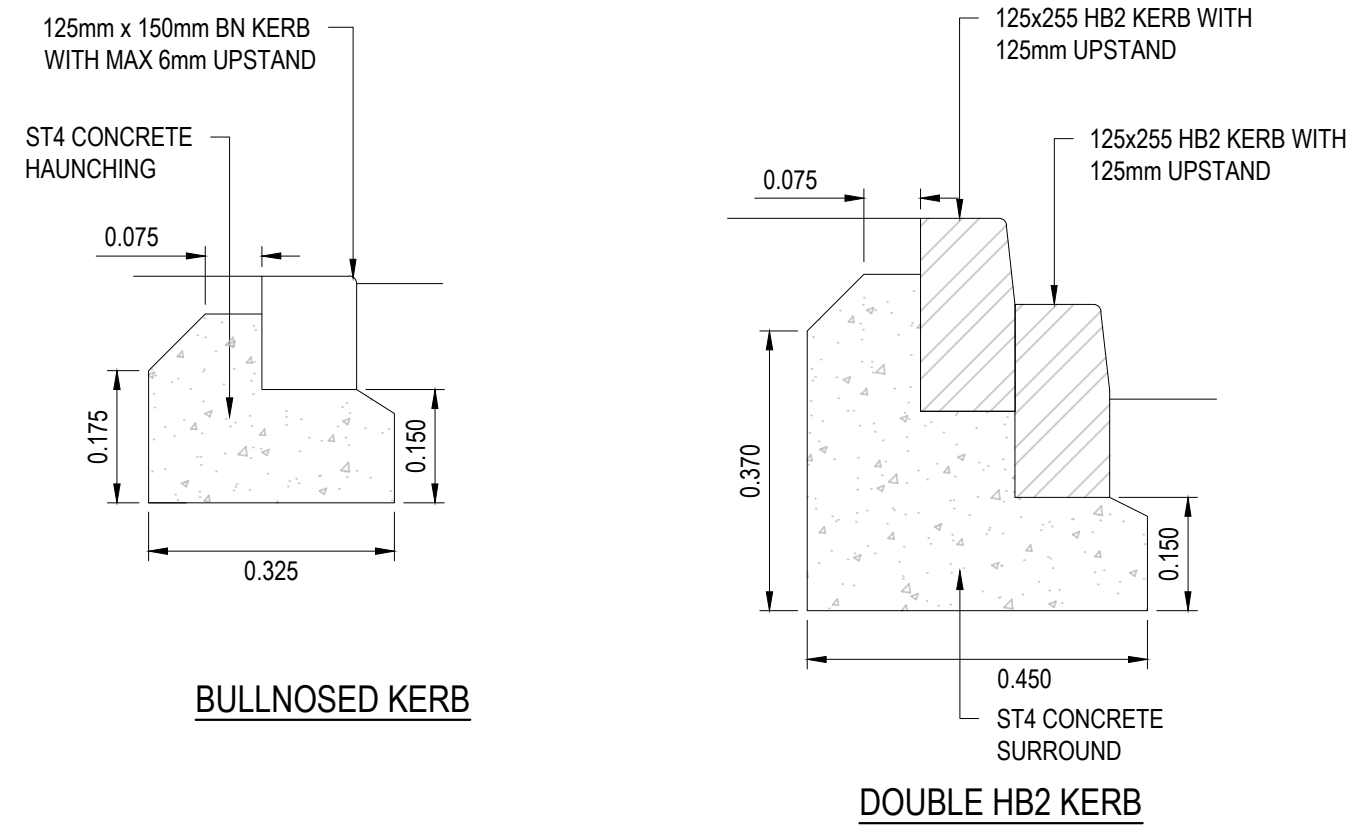
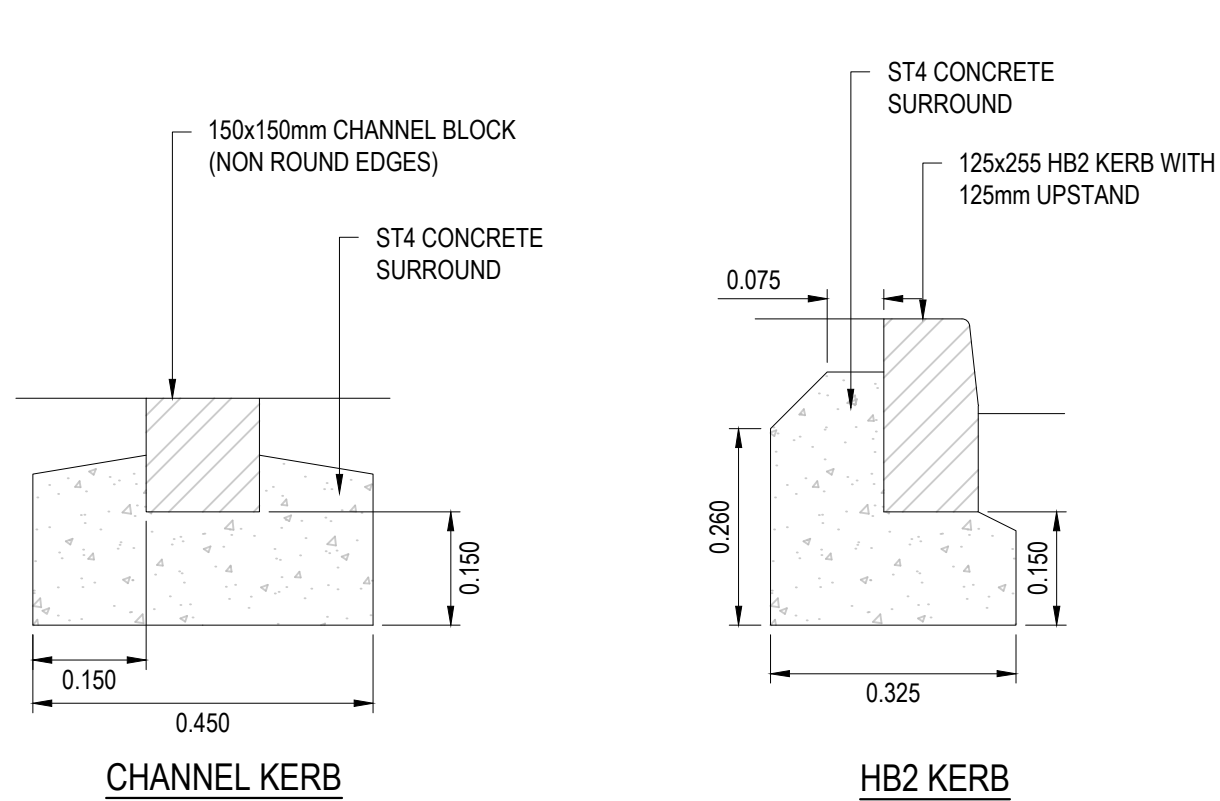
APPROXIMATE STORAGE REQUIREMENT: 43m³

OUTFALL: EXISTING ON SITE DRAINAGE

LEVELS INDICATE THAT PUMPING WILL NOT BE REQUIRED.

INFILTRATION IS (NOT) CONSIDERED APPROPRIATE FOR THIS SCHEME - SOAKAWAY RATE INSUFFICIENT FOR USE.

\\na3\projects\075805-NM&H_Acute_Hospital\04-Production\44-Models Drawings\04\A1



INDICATIVE SECTION THROUGH
ATTENUATION TRENCH

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REV.	DESCRIPTION	DATE	DRW.	CHK.
P02	STAGE 5 (S4)	24/01/23	GDP	JDB
P01	STAGE 4 TENDER	17/11/22	GDP	JDB



APPOINTED PARTY LOGO/INFORMATION



PROJECT
NORTH MANCHESTER GENERAL
HOSPITAL

TITLE
TCP05 EXTERNAL WORKS
AND DRAINAGE DETAILS

STATUS S4	PURPOSE OF ISSUE CONSTRUCTION		
DRAWN BY GDP		CHECKED BY JDB	DATE 17/11/2022
SCALE (@A1) 1:10		PROJECT NUMBER 075805	
FILE DRAWING NUMBER 20200 · CUR · INZ · ZZ · DR · C · 04801			REV. P02

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
✓ SW1	0.098	5.00	72.355	600	1.500
✓ SW2	0.062	5.00	72.718	600	2.118
✓ SW4	0.095	5.00	72.050	600	1.360
✓ SW5	0.000		72.210	600	1.690
✓ SW3	0.000		72.000	600	1.530
✓ OUT	0.000		72.050	100	1.749

Links

Name	US Node	DS Node	Length (m)	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)
? 1.000	SW1	SW2	36.421	70.855	70.600	0.255	142.8	150	5.72
? 1.001	SW2	SW3	19.680	70.600	70.470	0.130	151.4	150	6.13
? 2.000	SW4	SW5	25.402	70.690	70.520	0.170	149.4	150	5.52
? 2.001	SW5	SW3	8.276	70.520	70.470	0.050	165.5	150	5.69
? 1.002	SW3	OUT	17.053	70.470	70.301	0.169	100.9	150	6.41

Name	US Node	DS Node	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Minimum Depth (m)	Maximum Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
? 1.000	SW1	SW2	0.839	14.8	13.3	1.350	1.968	1.350	1.968	0.098	0.0
? 1.001	SW2	SW3	0.814	14.4	21.7	1.968	1.380	1.380	1.968	0.160	0.0
? 2.000	SW4	SW5	0.820	14.5	12.9	1.210	1.540	1.210	1.540	0.095	0.0
? 2.001	SW5	SW3	0.778	13.8	12.9	1.540	1.380	1.380	1.540	0.095	0.0
? 1.002	SW3	OUT	1.000	17.7	34.6	1.380	1.599	1.380	1.599	0.255	0.0

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	36.421	142.8	150	Default Pipe	72.355	70.855	1.350	72.718	70.600	1.968
1.001	19.680	151.4	150	Default Pipe	72.718	70.600	1.968	72.000	70.470	1.380
2.000	25.402	149.4	150	Default Pipe	72.050	70.690	1.210	72.210	70.520	1.540
2.001	8.276	165.5	150	Default Pipe	72.210	70.520	1.540	72.000	70.470	1.380

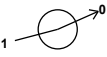
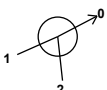
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	SW1	600	Manhole	1	SW2	600	Manhole	1
1.001	SW2	600	Manhole	1	SW3	600	Manhole	1
2.000	SW4	600	Manhole	1	SW5	600	Manhole	1
2.001	SW5	600	Manhole	1	SW3	600	Manhole	1

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.002	17.053	100.9	150	Default Pipe	72.000	70.470	1.380	72.050	70.301	1.599

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.002	SW3	600	Manhole	1	OUT	100	Manhole	1

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SW1	384983.699	402454.817	72.355	1.500	600				
						0	1.000	70.855	150
SW2	385018.163	402466.595	72.718	2.118	600		1	1.000	70.600
						0	1.001	70.600	150
SW4	384983.889	402476.348	72.050	1.360	600				
						0	2.000	70.690	150
SW5	385008.457	402482.802	72.210	1.690	600		1	2.000	70.520
						0	2.001	70.520	150
SW3	385016.022	402486.158	72.000	1.530	600		1	2.001	70.470
						2	1.001	70.470	150
						0	1.002	70.470	150
OUT	385031.136	402494.055	72.050	1.749	100		1	1.002	70.301
									150

Node SW3 Online Orifice Control

Flap Valve	x	Invert Level (m)	70.470	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Diameter (m)	0.045		

Node SW2 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Link	1.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	70.600	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	200	Diameter (mm)	2500

Node SW3 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Link	1.001
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	70.470	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	240	Diameter (mm)	2500

Node SW5 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Link	2.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	70.520	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	224	Diameter (mm)	5500

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 15 minute summer	109.521	30.991	2 year 1440 minute summer	5.891	1.579
1 year 15 minute winter	76.857	30.991	2 year 1440 minute winter	3.959	1.579
1 year 30 minute summer	71.439	20.215	30 year 15 minute summer	268.706	76.035
1 year 30 minute winter	50.133	20.215	30 year 15 minute winter	188.566	76.035
1 year 60 minute summer	48.435	12.800	30 year 30 minute summer	174.929	49.499
1 year 60 minute winter	32.179	12.800	30 year 30 minute winter	122.757	49.499
1 year 120 minute summer	30.053	7.942	30 year 60 minute summer	116.589	30.811
1 year 120 minute winter	19.966	7.942	30 year 60 minute winter	77.459	30.811
1 year 180 minute summer	23.233	5.979	30 year 120 minute summer	70.438	18.615
1 year 180 minute winter	15.102	5.979	30 year 120 minute winter	46.797	18.615
1 year 240 minute summer	18.475	4.882	30 year 180 minute summer	53.298	13.715
1 year 240 minute winter	12.274	4.882	30 year 180 minute winter	34.645	13.715
1 year 360 minute summer	14.169	3.646	30 year 240 minute summer	41.604	10.995
1 year 360 minute winter	9.210	3.646	30 year 240 minute winter	27.641	10.995
1 year 480 minute summer	11.185	2.956	30 year 360 minute summer	31.221	8.034
1 year 480 minute winter	7.431	2.956	30 year 360 minute winter	20.295	8.034
1 year 600 minute summer	9.182	2.511	30 year 480 minute summer	24.324	6.428
1 year 600 minute winter	6.274	2.511	30 year 480 minute winter	16.160	6.428
1 year 720 minute summer	8.203	2.199	30 year 600 minute summer	19.756	5.404
1 year 720 minute winter	5.513	2.199	30 year 600 minute winter	13.498	5.404
1 year 960 minute summer	6.768	1.782	30 year 720 minute summer	17.490	4.687
1 year 960 minute winter	4.483	1.782	30 year 720 minute winter	11.754	4.687
1 year 1440 minute summer	4.949	1.326	30 year 960 minute summer	14.215	3.743
1 year 1440 minute winter	3.326	1.326	30 year 960 minute winter	9.416	3.743
2 year 15 minute summer	141.566	40.058	30 year 1440 minute summer	10.161	2.723
2 year 15 minute winter	99.345	40.058	30 year 1440 minute winter	6.829	2.723
2 year 30 minute summer	91.753	25.963	100 year +25% CC 15 minute summer	435.923	123.351
2 year 30 minute winter	64.388	25.963	100 year +25% CC 15 minute winter	305.911	123.351
2 year 60 minute summer	61.301	16.200	100 year +25% CC 30 minute summer	286.207	80.987
2 year 60 minute winter	40.727	16.200	100 year +25% CC 30 minute winter	200.847	80.987
2 year 120 minute summer	37.449	9.897	100 year +25% CC 60 minute summer	191.610	50.637
2 year 120 minute winter	24.880	9.897	100 year +25% CC 60 minute winter	127.301	50.637
2 year 180 minute summer	28.672	7.378	100 year +25% CC 120 minute summer	115.702	30.577
2 year 180 minute winter	18.637	7.378	100 year +25% CC 120 minute winter	76.870	30.577
2 year 240 minute summer	22.636	5.982	100 year +25% CC 180 minute summer	87.258	22.454
2 year 240 minute winter	15.039	5.982	100 year +25% CC 180 minute winter	56.720	22.454
2 year 360 minute summer	17.235	4.435	100 year +25% CC 240 minute summer	67.836	17.927
2 year 360 minute winter	11.203	4.435	100 year +25% CC 240 minute winter	45.069	17.927
2 year 480 minute summer	13.550	3.581	100 year +25% CC 360 minute summer	50.604	13.022
2 year 480 minute winter	9.003	3.581	100 year +25% CC 360 minute winter	32.894	13.022
2 year 600 minute summer	11.088	3.033	100 year +25% CC 480 minute summer	39.267	10.377
2 year 600 minute winter	7.576	3.033	100 year +25% CC 480 minute winter	26.088	10.377
2 year 720 minute summer	9.878	2.647	100 year +25% CC 600 minute summer	31.789	8.695
2 year 720 minute winter	6.639	2.647	100 year +25% CC 600 minute winter	21.720	8.695
2 year 960 minute summer	8.113	2.136	100 year +25% CC 720 minute summer	28.065	7.522
2 year 960 minute winter	5.374	2.136	100 year +25% CC 720 minute winter	18.862	7.522

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +25% CC 960 minute summer	22.707	5.979	100 year +25% CC 1440 minute summer	16.120	4.320
100 year +25% CC 960 minute winter	15.042	5.979	100 year +25% CC 1440 minute winter	10.834	4.320

Results for 1 year Critical Storm Duration. Lowest mass balance: 98.53%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW1	10	70.966	0.111	13.8	0.1770	0.0000	OK
120 minute winter	SW2	96	70.867	0.267	7.4	3.9519	0.0000	SURCHARGED
120 minute winter	SW4	96	70.867	0.177	4.4	0.2965	0.0000	SURCHARGED
120 minute winter	SW5	96	70.866	0.346	5.0	10.8893	0.0000	SURCHARGED
120 minute winter	SW3	96	70.865	0.395	5.0	4.8824	0.0000	SURCHARGED
15 minute summer	OUT	1	70.301	0.000	2.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW1	1.000	SW2	13.4	0.848	0.907	0.5761	
120 minute winter	SW2	1.001	SW3	5.0	0.363	0.345	0.3465	
120 minute winter	SW4	2.000	SW5	4.3	0.449	0.294	0.4472	
120 minute winter	SW5	2.001	SW3	1.3	0.201	0.093	0.1457	
120 minute winter	SW3	Orifice	OUT	2.6				34.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 98.53%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW1	11	71.170	0.315	17.9	0.5007	0.0000	SURCHARGED
120 minute winter	SW2	100	70.943	0.343	9.2	6.0192	0.0000	SURCHARGED
15 minute winter	SW4	11	70.947	0.257	17.3	0.4316	0.0000	SURCHARGED
120 minute winter	SW5	100	70.941	0.421	6.3	14.0514	0.0000	SURCHARGED
120 minute winter	SW3	100	70.940	0.470	5.7	6.0098	0.0000	SURCHARGED
15 minute summer	OUT	1	70.301	0.000	2.4	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW1	1.000	SW2	15.9	0.901	1.071	0.6412	
120 minute winter	SW2	1.001	SW3	5.7	0.388	0.394	0.3465	
15 minute winter	SW4	2.000	SW5	15.7	0.900	1.086	0.4472	
120 minute winter	SW5	2.001	SW3	1.4	0.214	0.098	0.1457	
120 minute winter	SW3	Orifice	OUT	2.8				42.4

Results for 30 year Critical Storm Duration. Lowest mass balance: 98.53%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW1	12	72.110	1.255	33.8	1.9942	0.0000	FLOOD RISK
120 minute winter	SW2	116	71.310	0.710	16.8	16.3461	0.0000	SURCHARGED
15 minute winter	SW4	11	71.601	0.911	32.8	1.5313	0.0000	SURCHARGED
120 minute winter	SW5	118	71.306	0.786	11.4	29.4858	0.0000	SURCHARGED
120 minute winter	SW3	116	71.306	0.836	8.8	11.5068	0.0000	SURCHARGED
15 minute summer	OUT	1	70.301	0.000	3.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW1	1.000	SW2	28.5	1.619	1.923	0.6412	
120 minute winter	SW2	1.001	SW3	8.8	0.499	0.611	0.3465	
15 minute winter	SW4	2.000	SW5	29.1	1.654	2.011	0.4472	
120 minute winter	SW5	2.001	SW3	1.9	0.241	0.136	0.1457	
120 minute winter	SW3	Orifice	OUT	3.8				63.2

Results for 100 year +25% CC Critical Storm Duration. Lowest mass balance: 98.53%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW1	9	72.355	1.500	54.9	2.3835	5.0036	FLOOD
180 minute winter	SW2	172	71.851	1.251	20.3	31.5682	0.0000	SURCHARGED
15 minute winter	SW4	10	72.050	1.360	53.2	2.2848	2.3434	FLOOD
180 minute winter	SW5	172	71.844	1.324	13.8	52.1542	0.0000	SURCHARGED
180 minute winter	SW3	172	71.843	1.373	10.8	19.5824	0.0000	FLOOD RISK
15 minute summer	OUT	1	70.301	0.000	3.5	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW1	1.000	SW2	32.1	1.826	2.169	0.6412	
180 minute winter	SW2	1.001	SW3	10.8	0.611	0.747	0.3465	
15 minute winter	SW4	2.000	SW5	36.1	2.048	2.490	0.4472	
180 minute winter	SW5	2.001	SW3	2.4	0.225	0.175	0.1457	
180 minute winter	SW3	Orifice	OUT	4.9				95.8