

ANGEL SQUARE PLOTS 2&3

Drainage Strategy

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Glossary

Term	Definition
Attenuation	A method to reduce a flood peak to prevent flooding, often utilising temporary storage, but increasing the duration of the flow.
Brownfield	Land previously developed that has potential to be regenerated.
Catchment	A surface water catchment is the area which water drains into a watercourse. A groundwater catchment is the area that consists of the groundwater river flow.
Design Flood Level	This is the level of flooding that flood defences or mitigation measures are designed against. This is typically the 1% (1 in 100) flood level.
Discharge	The rate of flow of water measured in terms of volume per unit time.
EA	Environment Agency.
Flood Defence	A natural or man-made infrastructure used to prevent certain areas from inundation from flooding, and / or the provision of flood warning systems.
Floodplain	Area of land adjacent to a water course which water flows or is stored during a flood event or would otherwise be flooded in the absence of flood defences.
Flood Resilience	Improving flood resistance, e.g. reducing the risk of properties against flooding events.
Flood Risk	The level of risk to personal safety and damage to property resulting from flooding due to the frequency or likelihood of flood events.
Flood Risk Assessment (FRA)	An assessment of the flood risks to the proposed development over its expected lifetime and the possible flood risks to the surrounding areas, assessing flood flows, flood storage capacity and runoff.
Flood Risk Management (FRM)	Managing and/or reducing flood risk to people, property and the environment.
Flood Zones	The statistical chance of a flood event occurring in any one year, stated as a percentage. PPS25 identifies three flood zones.
Fluvial Flooding	Related or connected to a watercourse (river or stream).
Greenfield	Land which has not been previously developed.
Groundwater	Water present within underground strata known as aquifers.
Inundation	Flooding of land with water.
m AOD	Metres Above Ordnance Datum.
Mitigation	Actions taken to reduce either the probability of flooding or the consequences of flooding or a combination of the two.
Previously Developed Land	Land which is or was occupied by a permanent structure (excluding agricultural or forestry buildings) and associated fixed surface infrastructure.
Red line boundary	Boundary drawn to indicate the site area on which the planning application is based.
Residual Risk	The risk that remains after risk management and mitigation measures have been implemented
Risk	Risk is the probability that an event will occur, and the impact (or consequences) associated with that event.
Runoff	Water flow over surfaces to the drainage system. Runoff occurs if the ground is impermeable or if permeable ground is saturated.
Strategic Flood Risk Assessment (SFRA)	An SFRA is the assessment and 'categorisation' of flood risk on an area-wide basis in accordance with PPS25.
Surface Water Flooding	Surface water flooding occurs when the volume of water is unable to filtrate through the ground to enter drainage systems, and therefore runs quickly off land and results in localised flooding. This type of flooding is usually associated with intense rainfall.
Sustainable Drainage Systems (SuDS)	SuDS are used as a strategy to manage surface water in a sustainable manner or least damaging solution through management practices and physical structures.
Sustainable Development	Development which meets the needs of the present without compromising the ability of future generations to meet their own needs.
Water Table	The top surface of the saturated zone within the aquifer.

1 Overview

This drainage strategy has been prepared to set the principles for the drainage design to serve the 2&3 Angel Square development and for a phased (temporary) solution where only Plot 2 is developed. This report should be read in conjunction with the Buro Happold Flood Risk Assessment (FRA).

The Site is located to the north of Manchester City Centre, approximately 220m east of Manchester Victoria Railway Station and it is surrounded by the Co-op Group headquarters and Angel Square to the west, Miller Street to the south, Angel Street to the north and Angel Gardens to the east.

The drainage strategy will be in accordance with Section H of the Building Regulations, the Manchester City Council Lead Local Flood Authority (LLFA) and United Utilities (UU) requirements.

To be in accordance with UU and the LLFA's criteria, the proposed surface water discharge rate will be based upon a previously agreed flow rate of (5l/s) for the NOMA marketing suite and the Qbar value of the rest of the development area, giving a total proposed discharge rate of 9.55l/s, which has been agreed with UU. Attenuation storage will be required to facilitate the reduction of the proposed flows, and SuDS in the form of rain gardens and below ground attenuation tanks will be included wherever practicable. The surface water network will ultimately discharge to the existing combined sewer network within Miller Street via the public combined sewer located within the access road between Angel Gardens and the site (plot 3).

In the case that only Plot 2 is developed, and due to the proportional area, the flow will be reduced and restricted to 4.4l/s, this will not exceed the total flow that has been agreed with UU (4.4l/s from Plot 2 + 5l/s from NOMA marketing suite = 9.44l/s).

With regards to foul water, the development will be designed with separate drainage systems for both foul and surface water drainage, this will remain separate until the point of discharge to the existing public combined sewer located within the access road between Angel Gardens and the site. United Utilities confirmed that the foul water from this site can be discharged at an unrestricted rate to the existing public combined sewer network.

2 Introduction

2.1 Appointment and Brief

This drainage strategy has been prepared in support of the planning application for the 2&3 Angel Square development (herein referred to as the proposed development). This report should be read in conjunction with the Buro Happold Flood Risk Assessment (FRA).

This report will review and discuss the following:

- Site constraints;
- Review of existing external sewer network;
- Proposed surface water drainage strategy; and
- Proposed foul water drainage strategy

2.2 Limitations

This report is based on the interpretation and assessment of data provided by third parties. It should be noted that the detailed design of the drainage and associated Sustainable Drainage Systems (SuDS) features for the site has not been finalised and the assumptions and information presented herein is subject to design development. Operation and maintenance of all SuDS (including proprietary systems) will need to be considered once the proposed development has been finalised with all specific information presented to those responsible for the maintenance of the facility. Buro Happold cannot be held responsible for the accuracy of third-party data or the conclusions that come from this information or as a result of changes arising from the developing design. The conclusions and findings of this report may change if the proposed development is amended or updated after the date of publishing.

2.3 Review of Available Information

At the time of this report, there were an existing topographical survey provided by ND Oliver dated 22/04/2021, a multi utility infrastructure constraints plan where all the existing utilities of the area are shown, this was provided by WDA dated 21/12/2021 and a CCTV survey of the existing abandoned highway drainage provided by Drain Alert dated 15/09/2021. It should be noted that operational drainage was only found in the NOMA marketing suite area (southern part of the site).

3 Site Description

3.1 Existing Site

The proposed development is located to the north of Manchester City Centre, approximately 220m east of Manchester Victoria Railway Station. The post code and grid reference of the site are M60 0AG and SJ 84368 98985. The site is surrounded by the Co-op Group headquarters and Angel Square to the west, Miller Street to the south, Angel Street to the north and Angel Gardens to the east. The site area is currently occupied by an existing public car park, managed by RCP Parking, with the main access from Angel Street and the temporary NOMA marketing suite is currently under construction in the southern side of the development (Planning Application number: 129631/FO/2021). The immediate surrounding area comprises urban development including residential, warehouses, office and manufacturing facilities. A recent site visit indicates that there is no existing traditional drainage capturing surface water for the car parks, meaning the new marketing suite area only has operational drainage. Figure 1 below shows the boundary of the site and its relative location.

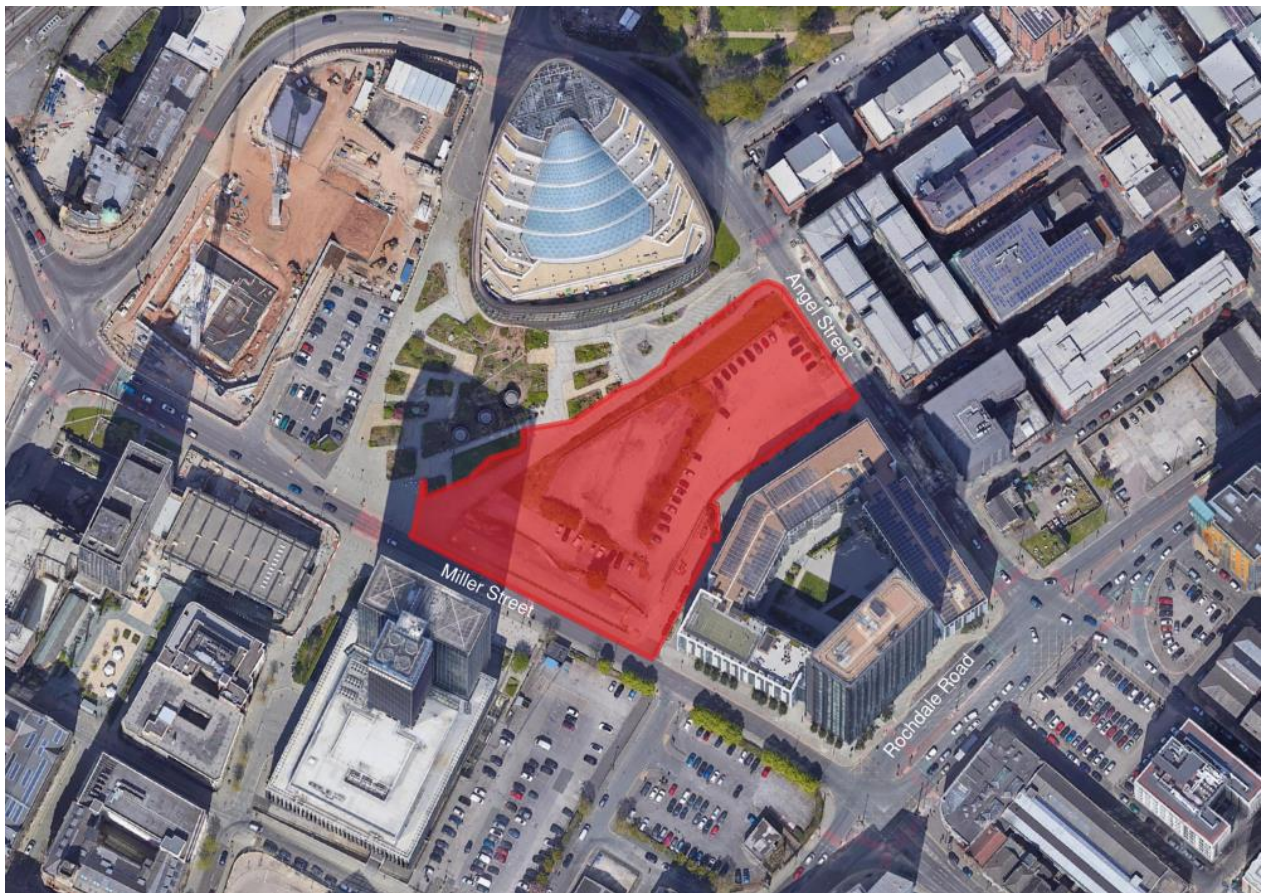


Figure 1-Indicative 2&3 Angel Square site Plan (Map Data from Google Earth©2022)

3.2 Existing Topography

The highest point of the site is located in the northeaster corner along Angel Street with an approximate level of +47.70m AOD. The site slopes down towards the southwest to a low point on Miller Street at a level of approximate

+41.10mAOD. The site levels reduce approximately 6.60m over a distance of approximately 150m (east to west); giving an average gradient of 1:23. Refer to Appendix A for Topographical survey.

3.3 Existing Waterbodies

The nearest watercourses to the Site are the River Irk 200m to the north and the River Irwell, 300m to the west, which are designated as Main River.

3.4 Existing Drainage

Record information obtained from United Utilities (UU) from previous consultation, indicates the following drainage systems are present in the vicinity of the Site:

- 1500mm x 600mm brick combined sewer that conveys flows in a north-westerly direction beneath Miller Street.
- 1850mm diameter brick combined sewer beneath Angel Street which flows in a south-easterly direction.
- 400mm diameter combined sewer connection to Miller Street located at the access road between Angel Gardens and the site (south-eastern part of the development)
- An abandoned 1850mm diameter brick sewer is noted on the sewer records. UU have verbally confirmed on previous consultation for this scheme that although the sewer has been abandoned, there are no records available confirming whether the sewer has been grouted up and/or grubbed up and removed.
- Existing abandoned 300mm diameter highway drain that connects to the combined sewer located at Miller Street. This sewer is currently in use taken flows from the Marketing Suite. This sewer prior to commencement of Plot 3 works will require capping off and grubbed up / abandoned.

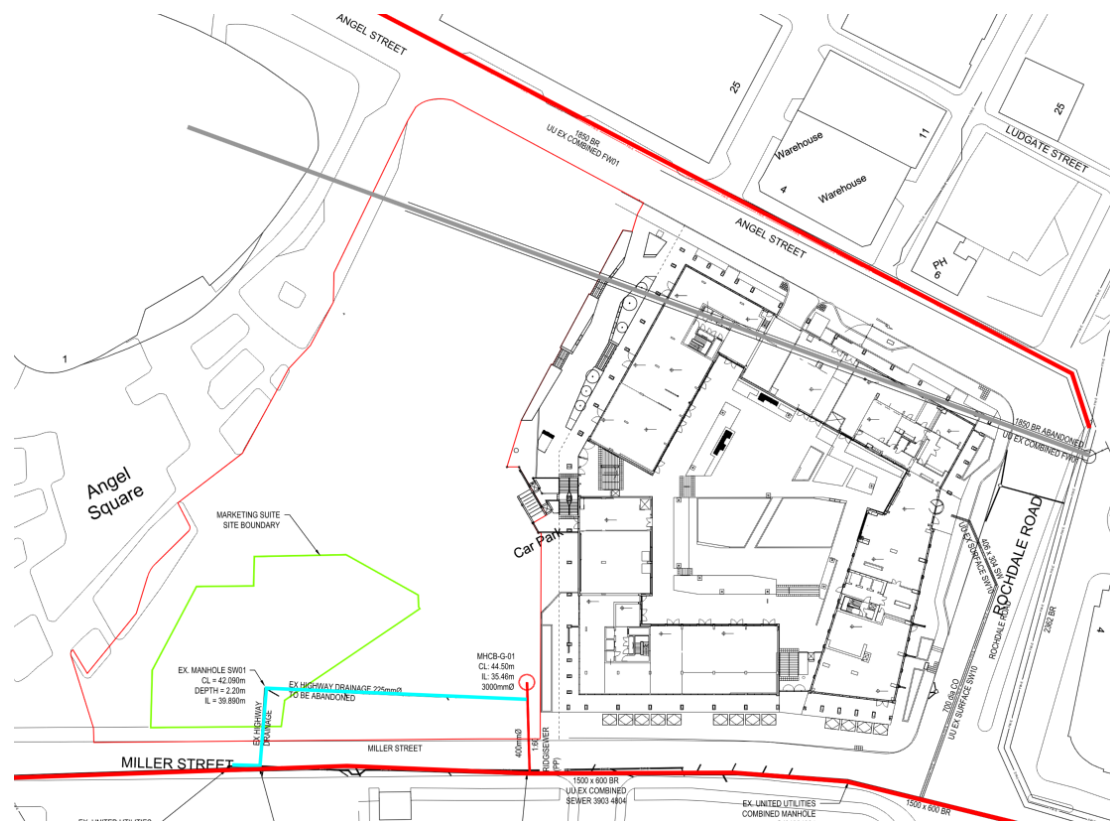


Figure 2-Existing sewers around the site

In addition, a data screening application to the LLFA was requested to identify any existing culvert conduits that could be located within the site and not registered in any authority or public records. Refer to Appendix B for data screening.

3.5 Existing Utilities

The Multi Utility Infrastructure Constraint Plan provided by WDA (refer to Appendix C) shows that the utilities for the site are mainly located to the south of the site area within the public footpath along Miller Street, or to the north within the public footpath along Angel Street. It should be noted that there were some utilities within Unit 2 on the southern part of the site, but they were decommissioned and diverted prior the commencement of the works for the NOMA marketing suite. Additional investigations (trial pits or slit trenches) will be required to ensure proposed drainage located near Miller Street does not clash with the existing utilities.

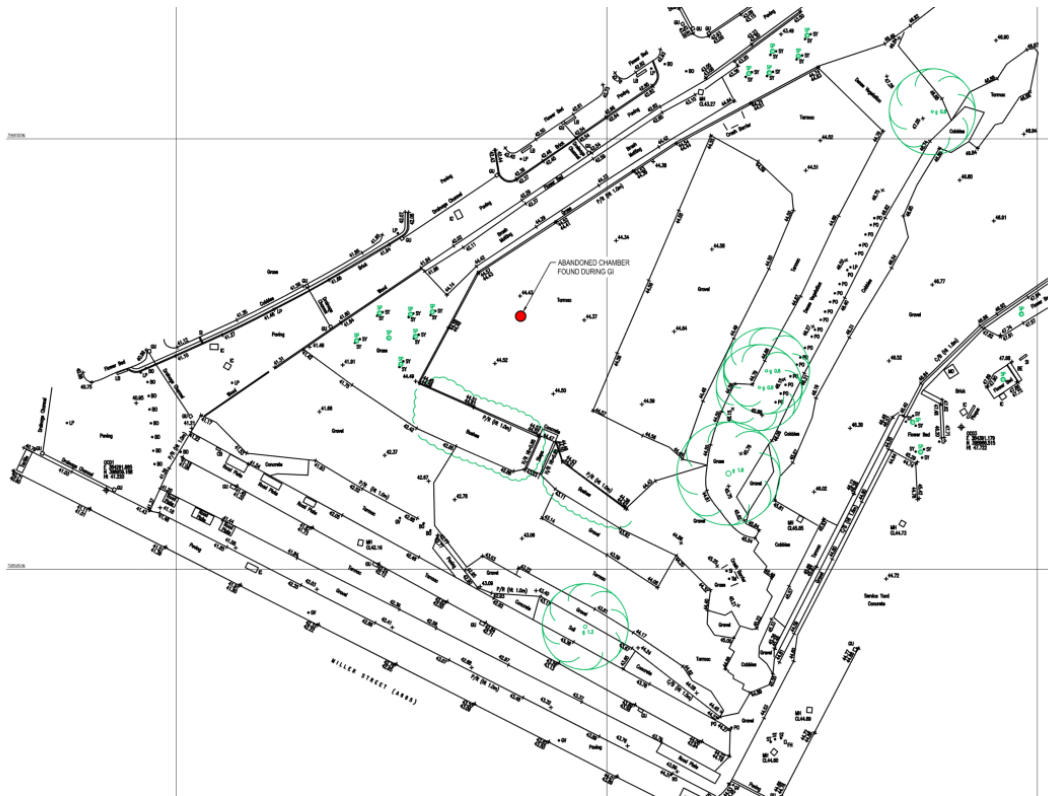
During the Ground Investigation that was undertaken in 2021, it indicated an abandoned chamber that is not recorded in any utility surveys, sewer records or data screening. The chamber looks abandoned as shown in Figure 3 and Figure 4. The site area has been used as a car park for the last 20 years and no drainage is located in that area which suggest that the chamber was part of a private network that was abandoned and covered with tarmac as shown on Figure 3 . Figure 5 shows the location where this chamber was found.



Figure 3-Abandoned chamber found during GI (1)



Figure 4-Abandoned chamber found during GI (2)



4 Proposed development

The development comprises of the proposal to erect two high quality commercial office buildings, with associated public realm, car parking, extensive cycle parking facilities, and highway / access arrangement. The site will be phased, and two scenarios have been identified:

- Scenario1: Plots 2&3 Angel Square delivered concurrently; or,
- Scenario 2: Plot 2 Angel Square delivered first with temporary works at the interface to Plot 3.

Figure 6 indicates scenario 1 whereas Figure 7 indicates scenario 2:



Figure 6-Landscape Masterplan-2&3 developed concurrently (Planit IE)



Figure 7 -Landscape Masterplan-Plot 2 developed first (Planit IE)

5 Proposed surface water drainage strategy

5.1 General

The surface water drainage system will be provided to collect surface water runoff from the site. This will include runoff from proposed roof area and surrounding (landscaped) hardstanding areas. Primary runoff from ground will be from hard impermeable surfaces such as roof and any exposed areas of hard standing.

Collection of external surface water runoff will be captured by series of gullies, linear drainage systems, collector pipes and SuDS whenever possible, connecting to the external below ground drainage system.

5.2 Consultation

5.2.1 United Utilities

A wastewater Pre-Development Enquiry (PDE) was submitted to United Utilities on the 29/04/2022 to determine the proposed surface water and foul water discharge rates and potential points of connection to the existing sewer network. United Utilities confirmed that foul water from the development can be discharged at an unrestricted rate to the existing combined sewer within Miller Street. Surface water from the development can be discharge at a flow rate of 9.55l/s to the same existing public sewer within Miller Street. Refer to Appendix D for correspondence with United Utilities.

5.2.2 Manchester City Council Lead Local Flood Authority

A meeting with the Manchester City Council Lead Local Flood Authority (LLFA) was held 3/05/2022 where the proposed drainage strategy and any authority requirements were discussed. In addition, it was requested a data screening was applied for to confirm no existing culverted watercourses or historic flooding incidents are register within the site area. Refer to Appendix E for correspondence.

An additional meeting was held on 25/03/2024 to discuss outstanding comments regarding their concerns about the concrete tank structures and the high risk of blockage for manholes MH13 and MH04, where the flow is restricted to less than 5l/s. Refer to section 5.13 for blockage risk assessment and Appendix O for Attenuation Tank Design Note which covers the outstanding concerns regarding the concrete tank.

5.3 Climate change

Climate change allowances are based on the Irwell Management Catchment peak rainfall allowance table for the 1% annual exceedance rainfall event produced by the EA. For the proposed development, the design life is considered as more than 50 years and design is considered at the upper end.

Allowance category	Total potential change anticipated for the 2050's	Total potential change anticipated for the 2070's
Upper End	+40%	+45%
Central	+25%	+30%

Table 1-Climate change allowances for peak rainfall in England (1981-2000 baseline)

5.4 Drainage hierarchy

Surface water disposal should be in accordance with the drainage hierarchy in Building Regulations Part H 2010 (2015 edition). This hierarchy is briefly described below:

- Step 1. Disposal on Site

Disposal via infiltration SuDS (Sustainable Drainage Systems) methods should be considered as the first option. The SuDS Manual (CIRIA C753) provides descriptions of the various methods of providing infiltration SuDS including systems such as soakaways, basins and filter strips, together with swales, pervious pavements, detention basins, ponds and other wetland solutions.

Infiltration SuDS such as soakaways should be located, as a minimum, 5m away from any building footprints and title boundaries. Also, the Ground Investigation report shows that the site is underlain mostly by clay and with the proximity to the proposed buildings and surrounding developments, this option is not considered to be viable.

- Step 2. Disposal to a Watercourse

The nearest watercourses to the site are the River Irk 200m to the north and the River Irwell, 300m to the west, which are designated as Main River. Due to the proximity of the watercourses to the proposed development, any direct connection to the watercourses is not considered viable.

- Step 3. Disposal to a Public Sewer

In the event that infiltration SuDS are deemed not suitable, surface water flows will need to be restricted and connected into the existing public sewers. The peak flow rates of surface water leaving the site shall be no greater than 9.55 l/s as per the pre-development response from UU. Attenuation must be provided to cater for the 1 in 100 year plus 45% climate change rainfall event.

It is envisaged to dispose surface water to the public sewer located within the access road between the proposed site and Angel Gardens where it ultimately discharges to the 600 x 1500mm diameter public combined sewer within Miller Street.

5.5 Sustainable Urban Drainage System (SuDS)

Sustainable Urban Drainage Systems are used to reduce the impact of surface water from storm events on the existing environment mimicking the natural run-off characteristics of the site and removing pollutants from the urban run-off at source. There are various solutions which are described in the SuDS Manual (CIRIA C753) and include ground level features including swales and ponds, below ground systems (such as tanks, and infiltration techniques like soakaways).

The proposed development considers the use of sustainable drainage techniques in accordance with local policy. The CIRIA SuDS Manual contains a hierarchy of sustainable methods of capturing and storing rainwater in a descending order: from drainage into the ground to recharging water resources. Where infiltration is not possible, surface water should be stored on site in open water features and then released at a controlled rate. The final option is to store surface water in tanks or cellular storage below ground.

Subject to the ground conditions and infiltration rates SuDS features that could be considered through the detailed design stage include permeable paving, in ground geo-cellular storage tanks and rain gardens. Non-infiltration SuDS features will not reduce the amount of surface water discharged; however, it will significantly delay and mitigate the peak flood flows from the site.

The hierarchy of SuDS techniques is shown in Table 2:

Table 2 SuDS techniques

	SUDS Technique	Flood Reduction	Pollution Reduction	Landscape & Wildlife Benefit	Suitability for the Proposed Development	Comments
<div> <div>Most Sustainable</div> <div>↑</div> <div>↓</div> <div>Least Sustainable</div> </div>	Living roofs	√	√	√	No	Green roofs are not considered for this scheme, given the limited roof space available due to mechanical plant space and introduction of PV and sustainable requirements for the buildings
	Basins & ponds	√	√	√	No	Due to restricted outside space and its intended uses (footpath, vehicular access) there is no location suitable to accommodate a basin or pond. Due to the water quality and maintenance, proposed water feature will be in a different system and will not be within this category.
	-Constructed Wetlands				No	
	-Balancing ponds				No	
	-Detention basins				No	
	-Retention ponds				No	Rain gardens are used where possible.
	Filter strips & swales	√	√	√	No	
	Rain Gardens	√	√	√	Yes	
	Infiltration devices	√	√	√	No	
	-soakaways					Infiltration techniques should be avoided as the site is mostly underlain by clay. Refer to Ground Investigation report.
	-infiltration trenches & basins					
	Permeable surfaces	√	√		No	
	-gravelled areas				No	Unsuited to landscape design
	-solid paving blocks				No	Subject to landscape design
	-porous pavers				No	Unsuited to landscape design
	Tanked systems	√			Yes	Unsuited to landscape design
	-over-sized pipes/tanks				No	Underground attenuation tanks are proposed within hardstand areas subject to coordination of services and other constraints.
	-attenuation cells				Yes	Due to limited space and site constraints, oversized pipes are not considered suitable
						Attenuation cells are proposed under hardstand areas

5.6 SUDs Operation and Maintenance Plan

Regular maintenance of the sustainable drainage system is essential to maintain its performance and avoid failure of the mechanical/electrical components. It is anticipated that the maintenance of the attenuation tanks will be undertaken by an experienced contractor, in cases where geo-cellular units are installed the suppliers will normally offer a maintenance contract for periodic inspections and flushing the system to remove any silt and debris that have been collected. A similar maintenance agreement is normal with the pumping equipment, with the respective suppliers. An agreed maintenance programme will be prepared in accordance with the CIRIA guidance and supervised by the adopting authority. This will be included within the Building Manual for the development on completion. An outline maintenance plan is shown in Appendix F.

5.6.1 Details of the party responsible for maintenance of each feature

Adoptable drainage features shall be adopted by the Lead Local Flood Authority (Manchester City Council) or the Water Authority (United Utilities).

It is currently understood that all drainage, including SuDS features will remain within the ownership of the developer.

5.6.2 Inspection and Maintenance

A specification for inspection and maintenance actions, including frequency of maintenance tasks required for each proposed SuDS, setting out a minimum standard to which the SuDS system must be maintained. This will include information relating to:

- Schedule of cleaning;
- Inspection;
- General repair and maintenance; and
- Replacement details and lifespan.

This information will include specific requirements of proprietary products. This information will need to be collated during the detailed design as part of the H&S File and O&M Manual for the building(s). Maintenance will be in accordance with the specific requirements of each feature and the chosen attenuation supplier, generally:

- Geocellular tank – operation and maintenance in accordance with the tank manufacturers guidance and warranty requirements.
- Concrete tank – Inspections should be carried out during the first year of operation and ideally after every significant storm event to ensure proper functionality. At a minimum, the tank should be CCTV inspected periodically, and sediment should be removed from it. Inspecting the tank walls for structural integrity is not a requirement. However, if man access is taking place to remove sediment, we suggest it would be good practice to visually inspect the interior for defects.

5.7 Maintenance Options, Risks and Safeguards

There are many options that will allow the successful operation and maintenance of a SuDS feature for the lifetime of the proposed development. With each maintenance option there may be associated risks for the onsite and surrounding land and property owners; LPA, LHA and LLFA should the chosen maintenance option become compromised.

The most appropriate maintenance option will be specific to the SuDS features employed.

5.8 Safety and Access

Consideration will be given to safety in design and appropriate consideration of access during the design of the SuDS features used.

CDM Regulations 2015 will be considered and applied to the planning, design and construction and long-term maintenance of the SuDS systems used.

5.9 Existing and proposed impermeable areas

The site boundary has a total area of 0.83ha, where circa 0.70ha can be considered as existing impermeable area shown on Figure 8. It should be noted that there is a section of the public footpath within the site boundary (circa 270m²) that will remain unchanged and therefore, will not be included in the drainage strategy and attenuation volume calculations.



Figure 8- Existing impermeable area

The proposed development will have an estimated impermeable area of circa 0.75ha (as permeable paving cannot infiltrate to the ground it will be considered impermeable area as well) as shown on Figure 9. This is the area that will be used to estimate the proposed attenuation volume.



Figure 9-Proposed impermeable area

5.10 Proposed discharge rate

The site can be split in two: NOMA marketing suite area and the remaining area. The NOMA marketing suite has an area of 0.12ha where United Utilities previously checked that only 0.073ha has operational drainage and therefore can be classified as brownfield. They also estimated that the brownfield land generates 10l/s ($Q = 2.78 \times A \times i = 2.78 \times 0.073 \times 50$).

A recent visit to site confirmed there is no presence of operational drainage in the rest of the remaining area (0.71ha) and therefore, it will be considered as greenfield for the calculations.

The proposed flow rate will be based on the LLFA requirements:

'Details of surface water attenuation that offers a reduction in surface water runoff rate in line with the Manchester Trafford and Salford Strategic Flood Risk Assessment, i.e. for brownfield at least a 50% reduction in runoff rate compared to the existing rates, greenfield runoff rates for greenfield. Note overlap with asset manager consent: LLFA/UU/EA etc.'

Therefore, from the existing brownfield area, the proposed flow will be:

Existing brownfield runoff (l/s)	Reduction	Proposed flow (l/s)
10	50%	5

Table 3-Proposed brown field flow

For the greenfield area, 0.71ha, it has been used the Greenfield runoff tool from HR Wallingford where it indicates that for the remaining area, the proposed discharge rate will be 4.4l/s. Refer to Appendix G for calculations.

Hence, the proposed discharge rate for the site will be **9.55l/s**:

Proposed brownfield flow (l/s)	Proposed greenfield flow (l/s)	Total proposed flow (l/s)
5	4.55	9.55

Table 4-Proposed flow

5.11 Proposed Drainage Strategy for Plots 2&3

The strategy for the surface water drainage of the scheme will be to collect the surface water runoff generated and discharge to a below ground network that connects to the existing public combined sewer on the access road between the site and Angel Gardens, which ultimately discharges to the public combined sewer located in Miller Street, at a restricted flow rate. Proposed discharge rate will be proportional to the area of the respective plots.

To provide flexibility to the scheme, given the constraint with levels and to negate the risk of flooding, the strategy has three locations where the flow will be restricted using a hydrobrake: two for Plot 2 and one on Plot 3 upstream of the connection to the existing public sewer (refer drainage strategy restriction manhole locations. These restrictions ensure that the flow generated on each plot is proportional to the area and also that the agreed rate that is discharged to the public sewer is not exceeded.

Due to the level change across the site, Plot 2 is split in two systems that will merge downstream prior connecting to the public sewer:

- Plot 2 system 1 will collect rainwater runoff from the building roof as well as the eastern external hard landscape that will discharge to Attenuation Tank 1 located within the central area that separates both buildings. Attenuation Tank 1 will provide a storage volume of 183m³. A flow control chamber will be located downstream of the tank, to restrict the flow to 1.1l/s.
- Plot 2 system 2 will collect runoff water from the western landscaped area, the central area between plots 2 and 3 and any runoff that could land in the western balcony. The water will be attenuated in Attenuation Tank 2 prior to being restricted to 3.3l/s in the downstream manhole. Attenuation Tank 2 will provide a storage of 10m³. It should be noted that where possible, the soft landscaped areas will be used to drain the adjacent hardstanding.

The strategy for Plot 3 will be similar to Plot 2 and will have attenuation tanks located both sides of the building. The only flow restriction will be provided upstream to the connection point restricting the flow to the agreed 9.55l/s. Attenuation Tanks 3 & 4 will provide enough storage (45.6m³ and 130m³ respectively) to attenuate the catchment (flow) coming from Plot 3 external landscaping and roof as well as the 4.4l/s from the Plot 2 flow restrictions, without

causing any flooding for the 1 in 100 year storm event plus 45% climate change. It should be noted that two rain gardens located to the west of Plot 3 building collecting the runoff water from the adjacent landscaped hardstanding area.

Table 5 indicates a summary of discharge rates and attenuation volumes.

	Discharge rate (l/s)	Attenuation volume required (m ³)
Plot 2 System 1	1.1	183
Plot 2 System 2	3.3	10
Plot 3	9.55	(45.6+130) 175.6
TOTAL		368.6

Table 5 - Summary of discharge rates and attenuation volumes

Refer to Appendix H for Proposed surface water drainage information.

A hydraulic model of the drainage system using Microdrainage has been undertaken to assess the performance of the proposed drainage strategy against the 1 in 1, 1 in 30 and 1 in 100 year storm return period plus 45% climate change, to ensure building is protected against flooding.

Refer to Appendix I for full details of the network and hydraulic performance.

5.12 Proposed Drainage Strategy for Plot 2

A separate strategy has been developed for scenario 1 in which the site is phased and Plot 2 is developed first. The strategy will be as stated above, having two systems that will merge downstream prior connecting to the public sewer:

- Plot 2 system 1 will collect runoff water from the building roof as well as the eastern external works that will discharge to Attenuation Tank 1 located within the central area that separates both buildings. Attenuation Tank 1 will provide a storage volume of 183m³. Downstream the tank, a flow control chamber will be located to restrict the flow to 1.1l/s.
- Plot 2 system 2 will collect runoff water from the western landscape, the central area and any water that could land in the western balcony. The water will be attenuated in the Attenuation Tank 2 prior being restricted to 3.3l/s in the downstream manhole. Attenuation Tank 2 will provide a storage of 10m³. It should be noted that where there is soft landscaped areas, it will be use to drain the adjacent hardstanding areas that falls towards them.

Table 6 indicates a summary of discharge rates and attenuation volumes.

	Discharge rate (l/s)	Attenuation volume required (m ³)
Plot 2 System 1	1.1	183
Plot 2 System 2	3.3	10
TOTAL	4.4	193

Table 6 - Summary of discharge rates and attenuation volumes for Plot 2 only

Refer to Appendix J for Proposed Surface Water Drainage information.

In this scenario 1, the Noma Marketing Suite will be in operation with an agreed discharge rate of 5.0l/s, being the total in this case of 9.44l/s between Plot 2 and the marketing suite which is less than the 9.55l/s that was agreed with UU for the entire scheme.

A hydraulic model using Microdrainage has been undertaken for this scenario to assess the performance of the proposed drainage strategy against the 1 in 1, 1 in 30 and 1 in 100 year storm return period plus 45% climate change, to ensure building is protected against flooding.

Refer to Appendix K for full details of the network and hydraulic performance.

5.13 Blockage Risk Assessment

MCC LLFA raised concerns about the proposed flow rates for manholes MH13 and MH04 due to the high risk of blockage, as these manholes restrict the flow to less than 5l/s.

Buro Happold contacted Hydro International to provide advice on reducing the risk of blockage in this situation. Their advice is to introduce a screened silt trap upstream of the flow control chamber to fully protect it from debris. The upstream chamber will require maintenance more frequently, but it will be less likely to reduce flows. Refer to Appendix N for full correspondence.

Based on this advice, the following actions will be undertaken to reduce the risk of blockage in manholes MH13 and MH04. Refer to Appendix H and J for proposed surface water drainage layouts:

- SW MH12 and 16 will be a catch pit with a silt trap to capture any potential debris.
- Drainage channels connecting to SW MH12, SW MH13 and SW MH16 will have a sump unit outlet with a plastic silt bucket.
- A penstock valve will be included, in addition to the overflow pipe to the flow control manholes SW MH13 and MH 04 to drain down if the chamber floods.
- A mesh guard bolted to the Tank 1 outgoing pipe will be introduced to ensure any potential debris coming from the roof is captured before it reaches the flow control chamber.
- The O&M Manual for the building will include that these flow control chambers, and upstream catchpit manholes are inspected regularly for the first year (at least every three months or immediately after a significant storm event) until it can be established how frequently the sump fills with debris. After the first year, catchpits should be emptied of debris every six months. However, they still should be checked immediately after a significant storm event to ensure the flow control devices are not blocked.

In addition to the concerns about the blockages, the LLFA raised concerns about the use of concrete tanks. Refer to Appendix O for an Attenuation Tank Design Note that covers the outstanding comments.

5.14 Designing for Exceedance

The proposed site levels are similar to the existing site levels, which means the proposed site will generally fall from northeast to the southwest corner. Any exceedance events will follow the flow paths to Miller Street to the south and Angel Square public realm to the west. The main roads and public realm created will act as the flow paths and divert flow away from buildings to less vulnerable areas. Figure 10- Exceedance routes indicates the exceedance routes for the proposed development:



Figure 10- Exceedance routes

6 Foul Drainage Strategy

6.1 General Drainage Strategy

A separate foul water drainage system will be provided to collect all foul water generated from site via gravitational flow from below ground floor level, discharging to the existing public sewer located on the access road between the site and Angel Gardens, which ultimately discharges to the public combined sewer located in Miller Street.

6.2 Proposed Foul Water Drainage

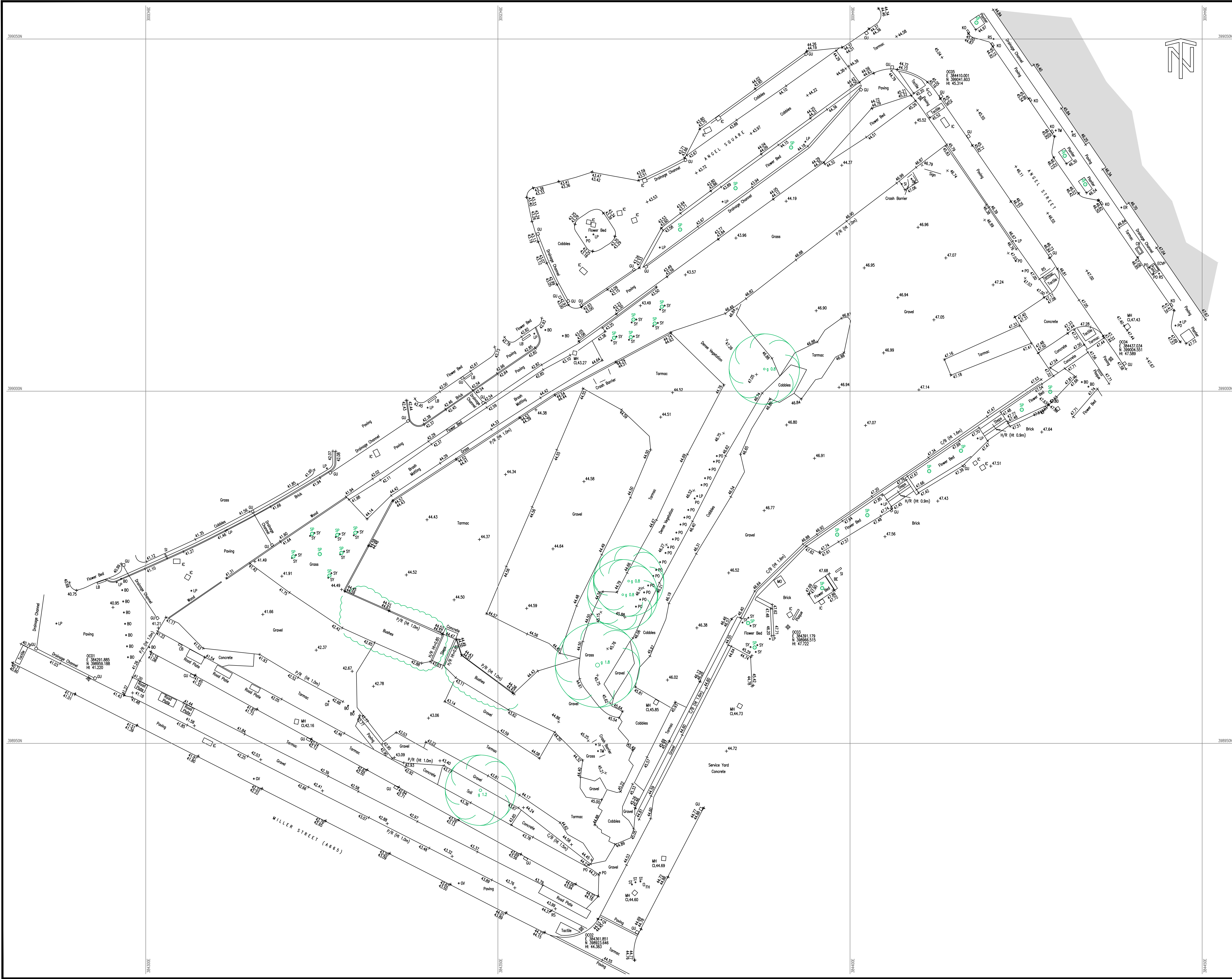
Foul water disposal should be in accordance with the Part H "Drainage and Waste Disposal" of the Building Regulations.

Disposal of foul water will be to the public combined sewers in the vicinity of the site. Any new connections to the existing sewer system will require approval from the relevant authority further to a PDE and potential S106 application for connection to sewer. United Utilities confirmed that the foul water from this site can be drained at an unrestricted rate to the public combined sewer network.

Foul drainage will need to make an allowance for grease traps/interceptors for kitchen areas in the above ground drainage systems. Proposed internal gullies within the car park area will be connected to the foul water drainage system. Any internal foul manholes within the building will have double sealed covers. Any internal manhole to the building will have double sealed cover,

Refer to Appendix L for Proposed foul water drainage general arrangement for 2 & 3 and to Appendix M for the foul water drainage general arrangement for Plot 2 only.

Appendix A Topographical survey



KEY
Grid & Datum - Local Plane Grid related to OS National Grid & Datum
By GNSS RTK Observations

STANDARD ABBREVIATIONS

STREET FURNITURE	LA - LADDER	TS - TRAFFIC SIGNAL
AC - AIR CONDITIONING	LB - LITTER BIN	TP - TELEGRAPH POLE
AL - ALARM	LC - LIGHTING COLUMN	UL - UNABLE TO LEFT
AV - AERIAL	LP - LAMP POST	VB - VEHICLE BELOW
BA - BARRIER	MA - MAST	WB - WATER METER
BB - BUILDING BEACON	MM - MANHOLE	WD - WASH OUT
BD - BUILDING DIVIDE	MD - MONUMENT	WP - WASTE PIPE
BE - BENCH	MP - MILE POST	
BL - BUILDING LIGHT	MR - MONITORING	
BO - BOLLARD	MW - MONITORING WELL	
BP - BOUNDARY POST	NP - NAME PLATE	
BR - BOLLARD	OH - OVERHEAD	
BS - BUS STOP	OSM - ORDNANCE SURVEY	
BU - BUSH	PA - PLAY APPARATUS	
CA - CABLE	PH - PUBLIC HOUSE	
CB - CONTROL BOX	PI - PILE	
CC - CLOSE CIRCUIT TV	PL - PLANT	
CD - CIGARETTE BIN	PM - PARKING METER	
CE - COLUMN	PN - PUMP	
CF - CLOSURE CIRCUIT TV POLE	PP - PETROL PUMP	
CG - DOWN PIPE	PR - ROAD SIGN	
CH - CHIMNEY	RS - ROAD SIGN	
CI - CLOSURE CIRCUIT TV POLE	RW - RETAINING WALL	
CL - CLOSURE CIRCUIT TV POLE	RR - RAINWATER PIPE	
CM - CLOSURE CIRCUIT TV POLE	SA - STATION	
CO - CLOSURE CIRCUIT TV POLE	SC - SPEED CAMERA	
CP - CLOSURE CIRCUIT TV POLE	SD - SAFETY FENCE	
CQ - CLOSURE CIRCUIT TV POLE	SE - SIGNAL	
CR - CLOSURE CIRCUIT TV POLE	SI - SIGN	
CS - CLOSURE CIRCUIT TV POLE	SM - SERVICE MARKER POST	
CT - CLOSURE CIRCUIT TV POLE	SS - SECURITY SENSOR	
CU - CLOSURE CIRCUIT TV POLE	ST - STOP TAP	
CV - CLOSURE CIRCUIT TV POLE	SU - STUMP	
CW - CLOSURE CIRCUIT TV POLE	SV - STOP VALVE	
CX - CLOSURE CIRCUIT TV POLE	SW - SWITCHGEAR	
CY - CLOSURE CIRCUIT TV POLE	SY - STAY	
CZ - CLOSURE CIRCUIT TV POLE	TA - TAP	
DA - DRAIN	TB - TEMPORARY BENCH MARK	
DB - DRAIN	TC - TELEPHONE CALL BOX	
DC - DRAIN	TE - TELEPHONE	
DD - DRAIN	TF - TICKET MACHINE	

SYMBOLS

STATION TABLE

STATION	EASTING	NORTHING	LEVEL
OCO1	E 384291.885	N 398959.188	Ht 41.220
OCO2	E 384301.851	N 398923.646	Ht 44.383
OCO3	E 384301.179	N 398966.515	Ht 47.722
OCO4	E 384337.034	N 399004.551	Ht 47.589
OCO5	E 384410.001	N 399041.603	Ht 45.314

Rev	Date	Drawn	Description	Ch'd	App'd

CHARTERED GEOMATIC SURVEYORS

Jupiter House, 21 Roebuck Lane, Sale, Manchester, M33 7SY
T: 0161 973 3495 F: 0161 962 6819
E: mail@ndoliver.com www.ndoliver.com

Client
GARDINER & THEOBALD LLP
MERCHANT EXCHANGE
17-19 WHITWORTH STREET WEST
MANCHESTER
M1 5WG

Title
ANGEL SQUARE
MILLER STREET
MANCHESTER
TOPOGRAPHICAL SURVEY
SHEET 1 OF 1

Surveyed	PG	Drawn	BW	Drawn Date
Checked	AM	Approved	ND	26/04/2021
Scale	1:250 @ A1	Project	11164	Status
Drawing No	11164 / 001	CAD File	11164_001.dwg	ORIG

Appendix B LLFA data screening



**MANCHESTER
CITY COUNCIL**

Lead Local Flood Authority

Highways Service
Growth and Neighbourhoods Directorate
Manchester City Council
PO Box 532
Town Hall
Manchester
M60 2LA

Email: floodriskmanagement@manchester.gov.uk

DATE 10/05/2021

Dear Sir or Madam,

RE: Our Ref: MCC010/05/2022

We acknowledge with thanks your payment received on 09/05/2022 for our LLFA data screen service.

Please find enclosed plan showing the results of the data screen. The position of features shown on this plan is approximate only and is given in accordance with the best information currently available.

The enclosed plan cannot be used to substitute a competent site investigation.

The enclosed plan is being provided to you subject to Manchester City Council's terms and conditions which are shown attached.

I trust the above meets your requirements and look forward to hearing from you should you need anything further.

If you have any queries regarding this matter, please do not hesitate to contact us.

Yours Faithfully,

A handwritten signature in black ink, appearing to read 'N. A. Bayliss-Rowe'.

Neil Bayliss-Rowe, Highways Development Control & Flood Risk Manager, Lead Local Flood Authority

TERMS AND CONDITIONS – LLFA DATA SCREEN

These provisions apply to LLFA data supplied by Manchester City Council (“MCC”).

TERMS AND CONDITIONS:

- This data Map and any information supplied with it is issued subject to the provisions contained below, to the exclusion of all others and no party relies upon any representation, warranty, collateral contract or other assurance of any person (whether party to this agreement or not) that is not set out in this agreement or the documents referred to in it.
- MCC has taken all reasonable care to compile this data Map. This data Map and any information supplied with it is provided for general guidance only and MCC makes no representation, undertaking or warranty of any kind as to its accuracy, completeness or being up to date is given or implied.
- In particular, the position of any culverted assets shown on the data Map are approximate only. MCC strongly recommends that a comprehensive site investigation is undertaken in addition to reviewing this data Map to determine and ensure the precise location of any assets. The exact location, positions and depths should be obtained by an appropriate survey which may include but shall not be limited to GPR and CCTV.
- The data screened may be modified over time without notice and therefore this data Map is issued subject to any removal or change in location of the same. The onus is entirely upon you to confirm whether any changes to the data Map have been made subsequent to issue and prior to any works being carried out.
- This data Map and any information shown on it or provided with it must not be relied upon in the event of any development, construction or other works (including but not limited to any excavations) or for the purpose of determining the suitability of a point of connection to discharge.
- No person or legal entity, including any company shall be relieved from any liability howsoever and whensoever arising from damages of any kind caused to assets by reason of the actual position and/or existence of assets being different from those shown on the data Map and any information supplied with it.
- If any provision contained herein is or becomes legally invalid or unenforceable, it will be taken to be severed from the remaining provisions which shall be unaffected and continue in full force and affect.
- This agreement shall be governed by English law and all parties submit to the exclusive jurisdiction of the English courts, save that nothing will prevent MCC from bringing proceedings in any other competent jurisdiction, whether concurrently or otherwise.

DATA SCREEN SYMBOLOGY

Bridge

-  Good
-  Fair
-  Poor
-  Very Poor
-  Unknown

Trash Screen

-  Good
-  Fair
-  Poor
-  Very Poor
-  Unknown

Culvert Orifice

-  Very Good
-  Good
-  Fair
-  Poor
-  Very Poor
-  Unknown

Culvert Conduit

-  CCTV surveyed
-  Not CCTV surveyed
-  Ordinary Watercourse Conduit
-  MCC SuDS
-  MCC Flood Incident Points
-  MCC Section 19 Report
-  MCC Flood Incident Polygons
-  MCC Local Authority Boundary

Supplementary Information where available:

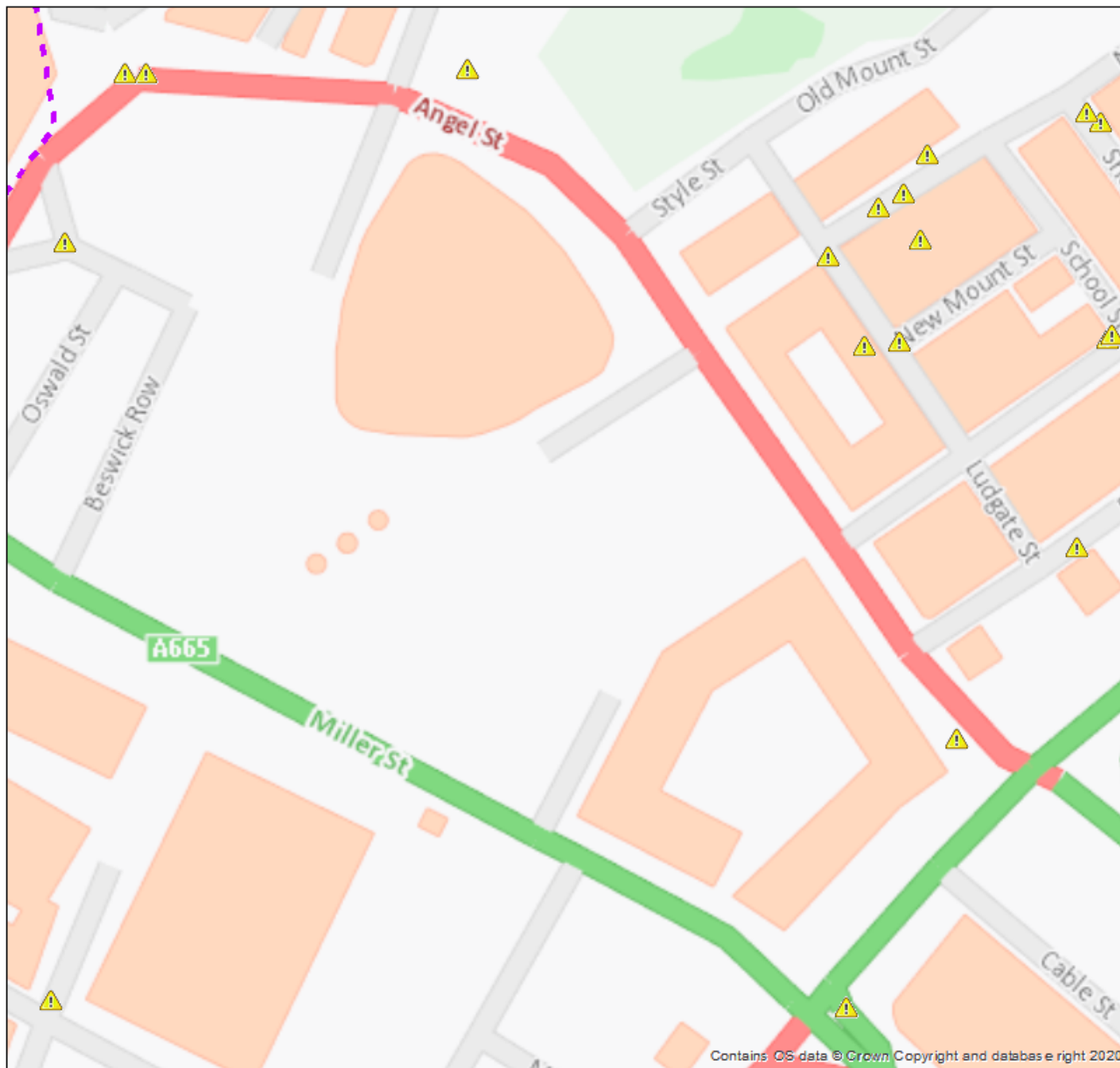
Critical Drainage Area – The site is within the Conurbation Core CDA.

Flood Incidents - There are no recorded flood incidents onsite. The nearest recorded (approximately 50m northeast of the Site) is 'flooding on the highway' dated 16/03/2022.

Culvert Conduits – The LLFA asset register does not record any known or indicative culverted ordinary watercourses within the site boundary. The closest indicative culverted ordinary watercourse is approximately 150m to the northwest.

Survey and Design Archive – The 1984 Manchester City Council drainage survey does not record any known or indicative ordinary watercourses within the site boundary. A georeferenced extract is enclosed.

Any other information identified by LLFA officer during screening – United Utilities records available to us indicate an abandoned combined sewer may cross the northern part of the site. We recommend United Utilities are consulted to confirm whether this asset exists onsite and whether it has been properly decommissioned.



**MANCHESTER
CITY COUNCIL**

LLFA DATA SCREEN

Address/Site Ref:

Angel Square

Our Ref: **MCC010/05/2022**

Author: Manchester City Council LLFA

Date: 10/05/2022

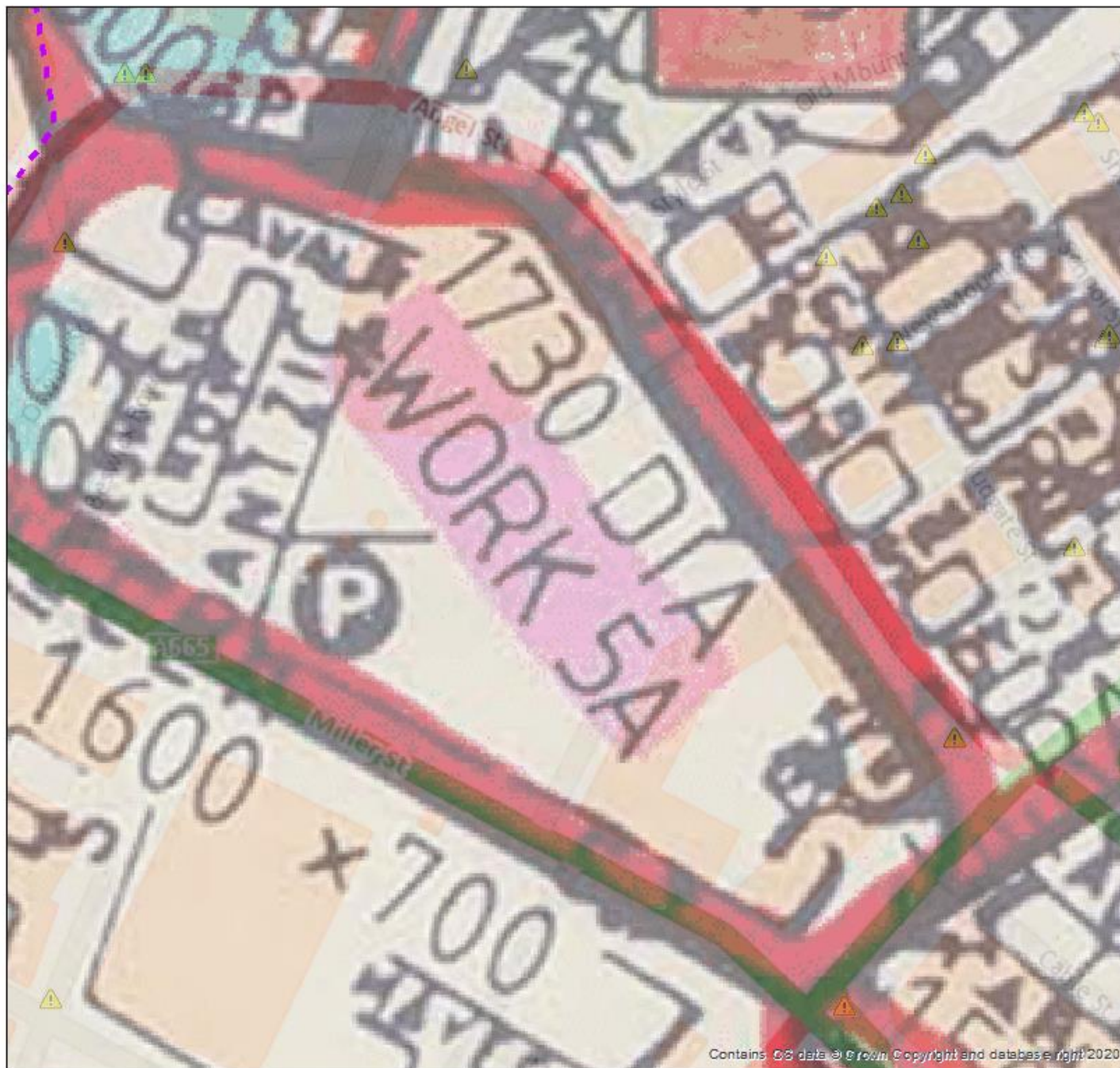
Scale: 1:1,493

The position of features shown on this plan is approximate only and is given in accordance with the best information currently available. Manchester City Council will not accept liability for any loss or damage caused by the actual position being different from those shown.

0 10 20 40
Meters



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**MANCHESTER
CITY COUNCIL**

LLFA DATA SCREEN

Address/Site Ref:

Angel Square

Our Ref:

MCC010/05/2022

Author: Manchester City Council LLFA

Date: 10/05/2022

Scale: 1:1,493

The position of features shown on this plan is approximate only and is given in accordance with the best information currently available. Manchester City Council will not accept liability for any loss or damage caused by the actual position being different from those shown.

0 10 20 40
Meters

N



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Appendix C Multi Utility Infrastructure Constraint Plan



The Utility Information on this drawing has been taken from records supplied by each individual affected Utility Company under a C2 request and is given without warranty, the accuracy thereof cannot be guaranteed, nor can we guarantee the accuracy of the transfer of information to this drawing. No Liability of any kind whatsoever is accepted by WDA Ltd for any error or omission.

This drawing is solely for visual guidance.

Safe Digging practices in accordance with HS(G)47 Avoiding Danger from Underground Services must be used to verify and establish the actual position of each individual service.

RELATED DRAWINGS:

ELECTRICITY: 157-WDA-SS-EX-DR-UC-E100-001
GAS: 157-WDA-SS-EX-DR-UC-G100-001
TELECOMMUNICATIONS: 157-WDA-SS-EX-DR-UC-T100-001
WATER (POTABLE): 157-WDA-SS-EX-DR-UC-W100-001
WATER (SEWERS): 157-WDA-SS-EX-DR-UC-W100-002
TELECOMS PRIVATE DUCT: 157-WDA-SS-EX-DR-UC-M100-001
GAS PRIVATE PIPEWORK: 157-WDA-SS-EX-DR-UC-M100-002
STREET LIGHTING: 157-WDA-SS-EX-DR-UC-M100-003

Background Plan base on Simpson Haugh & Partners Drng No. 10257-SHP-ZZ-TY-PL-A-G100-001 P02 22/07/2020

UTILITY LEGEND

- Water Main
- Water Main (Abandoned)
- Water-Trunk Main
- Surface Water Drain
- Foul Water Sewer
- Foul Water Sewer (Abandoned)
- 33kV Electricity Cable
- 6.6kV Electricity Cable
- 6.6kV Electricity Cable (Abandoned)
- LV Electricity Cable
- LV Electricity Cable (Abandoned)
- Street Lighting
- Gas - Low Pressure
- Future Proofing Main laid by 3rd parties and not gas charged or connected into the NGG network
- British Telecom Cable
- British Telecom Duct (Unoccupied)
- British Telecom Cable (Planned)
- Private Telecom Cable Ducts
- CenturyLink Cable
- City Fibre
- Gamma Fibre Duct
- Gamma Fibre Optic in OLO Duct
- Gamma Fibre Optic in Shared Duct
- Sky
- Virgin Media Cable
- Vodafone Cable
- Zayo Cable
- Zayo Cable Abandoned
- Trunk Water Main Easement
No Work Permitted over or within 5M (Horizontal) of the asset
- 315mm Water Main Easement
No Work Permitted over or within 5M (Horizontal) of the asset

Client(s) NOMA GP Ltd

Project NOMA, MANCHESTER
MASTERPLAN STUDY 2021

Drg Title MULTI UTILITY
INFRASTRUCTURE
CONSTRAINTS PLAN (2021)

Drawing No. 157-WDA-SS-EX-DR-UC-MU100-001
Rev 01

Scale 1:1000
Sheet A1
Drawn By CP
Checked By
Date MAY 2021

Drawing revisions:

Revision	Event	Drawn By	Checked By	Date
01	All Utilities Layouts updated	WD/CP		21/12/2021

Utilities Infrastructure Consultants



Site Appraisals | Masterplanning | Diversions | New Infrastructure

m: 07593 789 872 or 07526 943 594 | e: info@wdassociates.co.uk
1 New Walk, Totnes, TQ9 5HA

www.wdassociates.co.uk

This drawing remains the property of William Downie Associates and should not be distributed, copied or revised without prior consent.

Appendix D Correspondence with United Utilities

Francisco Rodriguez

From: wastewaterdeveloperservices@uuplc.co.uk
Sent: 08 June 2022 16:48
To: Francisco Rodriguez
Cc: Cameron Robinson
Subject: FW: PDE for: Project Noma Plots 2 and 3 UU ICS Ref: 02148156

****External Email. This email originated from outside Buro Happold.****

Good afternoon Francis,

Thanks for your email. After reviewing the ground investigation report, I can confirm that infiltration is not feasible.

Accordingly, we accept discharged surface water from the site into to the 600*1500mm diameter public combined sewer within Miller Street located East of the proposed site at a rate of 9.55l/s.

Kind regards,



Mohammed Aljafarawi
Developer Engineer
Developer Services & Metering
Customer Services
M: 07950474499
unitedutilities.com

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www.unitedutilities.com/subsidiaries

Francisco Rodriguez

From: wastewaterdeveloperservices@uuplc.co.uk
Sent: 24 May 2022 11:00
To: Francisco Rodriguez
Cc: Cameron Robinson
Subject: RE: PDE for: Project Noma Plots 2 and 3 UU ICS Ref: 02148156

Follow Up Flag: Follow up
Flag Status: Flagged

****External Email. This email originated from outside Buro Happold.****

Good afternoon Francisc,

Thanks for your email. United Utilities not considering discharge surface water to the public combined sewer is feasible while more sustainable drainage options available as clarified below:

1. Soakaway or some other adequate infiltration system
2. A combined sewer

In accordance with the hierarchy of drainage options within the National Planning Practice Guidance, discharge to ground via infiltration should be discounted prior to consideration of discharging surface water to the public sewer system. Evidence should be provided to demonstrate how these have been discounted, as outlined in the North West SuDS pro-forma.

If an evidence based assessment has been carried out and confirms that infiltration is not feasible. Then according to our record surface water runoff from the site should be discharged into to the 600*1500mm diameter public combined sewer within Miller Street located East of the proposed site at a rate of 9.55l/s.

We have noted you stated "Discharge to ground – not feasible as per ground investigation report previously attached", the previous report does not show clear evidence of discounted infiltration. [We would be grateful if the applicant can submit the ground investigation report and soil infiltration test report under the BRE365 standard to prove the feasibility of infiltration.](#)

Kind regards,



Mohammed Aljafarawi
Developer Engineer
Developer Services & Metering
Customer Services
unitedutilities.com

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----- Original Message -----

From: Francisco Rodriguez [francisco.rodriguez@burohappold.com]

Sent: 23/05/2022 11:01

To: wastewaterdeveloperservices@uuplc.co.uk; cameron.robinson@burohappold.com

Subject: RE: PDE for: Project Noma Plots 2 and 3 UU Ref : 4200049295

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

Hi Mohammed,

We have received a finalised site boundary for the site as shown on the attached pdf. The site boundary is now 0.83ha. We hope the procedure use originally is still the same and therefore the proposed surface water flow rate is envisaged to be:

1. 5 l/s from the Marketing suite plus (0.12ha)
2. 4.55l/s from the rest of the site that is treated as greenfield (no operational drainage, 0.71 ha).

Could you please confirm that the total surface water flow rate of 9.55l/s for the site is acceptable?

A prompt response will be appreciated.

Kind Regards

Francis

Francisco Rodriguez (Francis)

Infrastructure Engineer
Buro Happold | Cities Infrastructure Leeds

T: +44 (0)1132 042200

www.burohappold.com | [Twitter](#) | [Instagram](#)

BURO HAPPOLD

From: Cameron Robinson <Cameron.Robinson@BuroHappold.com>
Sent: 16 May 2022 11:32
To: Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>
Cc: Francisco Rodriguez <Francisco.Rodriguez@BuroHappold.com>
Subject: RE: PDE for: Project Noma Plots 2 and 3 UU Ref : 4200049295

Hi Mohammed,

Thank you very much for your reply.

As per your email I have outlined the below items requested:

1. Foul Water

1. Proposed discharge at an unrestricted rate to the existing 600x1500mm dia. public combined sewer to east of the development off Miller Street as per drawing NMA-BHE-XX-XX-DR-C-3102 previously attached, showing FW stub location

2. Surface Water

1. Drainage hierarchy previously considered as such:
 1. Discharge to ground – not feasible as per ground investigation report previously attached
 2. Discharge to waterbody – significant distance to nearest waterbody noted, thus not feasible
 3. Discharge to highway drainage – existing abandoned highways drain within site which discharges to public sewer located in Miller Street. Connection currently envisaged for Marketing Suite; application no. 4200039900
 4. Discharge to public sewer – proposed discharge to 600x1500mm dia. public combined sewer to east of development off Miller Street as per drawing NMA-BHE-XX-XX-DR-C-3102 previously attached, showing SW stub location

Furthermore we have engaged early in the process with LLFA to discuss SuDS as MCC require this early on major developments in Manchester; this included culvert screening at their request.

The 0.12ha marketing suite (REF: 4200039900) on the Noma plot has been accepted to discharge at 5l/s – having estimated greenfield runoff for the remaining site are (0.63ha, which generates a Qbar of 4.03l/s) we envisage a total discharge rate of 9.03l/s will be acceptable (see attached greenfield runoff estimation from HR Wallingford online tool).

Therefore, if you have no objections to the above can you confirm that a discharge rate of 9.03l/s is suitable?

We appreciate a timely response so please do let me know if you require anything further.

Cheers,

Cameron

Cameron Robinson
Graduate Infrastructure Engineer
Buro Happold | Cities - Infrastructure (Leeds)

T: +44 (0)113 204 2200
www.burohappold.com | [Twitter](#) | [Instagram](#)

BURO HAPPOLD

From: Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>
Sent: 12 May 2022 11:20
To: Cameron Robinson <Cameron.Robinson@BuroHappold.com>
Cc: Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>; Francisco Rodriguez <Francisco.Rodriguez@BuroHappold.com>
Subject: PDE for: Project Noma Plots 2 and 3 UU Ref : 4200049295

****External Email. This email originated from outside Buro Happold.****

Good afternoon Cameron,

Pre Development Enquiry for: Project Noma Plots 2 and 3 UU Reference Number : 4200049295

We have carried out an assessment of your application which is based on the information provided. This pre-development advice on your drainage strategy will be valid for 12 months. Your drainage strategy will need to be reviewed by other competent authorities as part of the planning process, and we advise that you carry out the necessary site investigations to confirm the viability of your proposals.

If your investigations require access to our public sewer network, we ask that you contact our network engineers with a request for an access certificate via our main contact telephone number 0345 3723223 or refer to the link below:

<https://www.unitedutilities.com/builders-developers/working-near-our-assets/>

Foul Water

Foul flow from this site will be allowed to drain into the public foul water/combined sewer system.

Our preferred point of discharge would be to the 600*1500mm public combined sewer Miller Street located to the East of your proposed development at an unrestricted rate.

If you are able to identify an alternative, more suitable point of discharge, we request that you contact us at your earliest convenience so that we can assess suitability.

Please ensure all proposed manhole chambers cover levels and finished floor levels are higher than the receiving public sewer.

In accordance with our infrastructure plans we may ask you to change your point of connection. Therefore please contact us when you are ready to formalise your drainage proposals, we would suggest before you submit for Full Planning.

Surface Water

All surface water flow from the proposed development should drain in-line with the drainage hierarchy, as outlined in Paragraph 80, (Reference ID: 7-080-20150323), of the National Planning Practice Guidance. We also recommend you prioritise the use of multi-functional sustainable drainage systems for the management of surface water in accordance with national planning policy.

Generally, the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable.

This is outlined as follows, in order of priority:

1. **into the ground (infiltration);**
2. **to a surface waterbody;**
3. **to a surface water sewer or highway drain;**
4. **to a combined sewer.**

For guidance, The [North West SuDS Pro-Forma](#) provides information on the appropriate evidence required at each stage of the hierarchy, to demonstrate how each level has been discounted.

The Lead Local Flood Authority has responsibility for all surface water drainage concerns and their input to your proposal is critical. You should also consider whether it is necessary to discuss your proposal with the Environment Agency, or Internal Drainage Board (if operating in your area).

The Local Planning Authority are the determining authority for any application for planning permission and the appropriate authority for determining cost viability of a proposed drainage scheme, such assessments are outside of the jurisdiction of United Utilities.

Infiltration

Surface water runoff generated from this development should discharge to the ground via infiltration system where feasible.

A detailed evidence based feasibility assessment must be carried out in line with Chapter 25 of the CIRIA SuDS Manual 2015 to determine whether infiltration is a suitable method of surface water disposal.

Particular attention must be paid to Ground Water Source Protection Zones to ensure that the risk of pollution to these valuable resources is not compromised. Details can be obtained from the government website:

<https://www.gov.uk/guidance/groundwater-source-protection-zones-spzs#find-groundwater-spzs>

If your site is in a Groundwater Source Protection Zone, you should have regard to the Environment Agency's approach to Groundwater Protection. Information on this is available via the link below:

<https://www.gov.uk/government/publications/groundwater-protection-position-statements>

Please note that such a location could have implications for the principle of your development and the need for additional mitigating measures to protect the groundwater environment and public water supply in the detailed design of your site.

Waterbody

United Utilities acknowledge that the nearest watercourse is a significant distance off-site.

Highway Drainage

If an evidence based assessment has been carried out and confirms that infiltration is not feasible, we recommend that you investigate the possibility of draining surface water to the highway drain where this ultimately discharges to a watercourse, by contacting the relevant Highway Authority.

Public Sewer

In accordance with the hierarchy of drainage options within the National Planning Practice Guidance, both discharge to ground via infiltration and discharge to a waterbody should be discounted prior to consideration of discharging surface water to the public sewer system. Evidence should be provided to demonstrate how these have been discounted, as outlined in the North West SuDS pro-forma.

Once evidence is provided as outlined above, United Utilities will consider a connection to the 600*1500mm diameter public combined sewer within Miller Street located East of the proposed site at a pass forward flow to be agreed by the Lead Local Flood Authority. United Utilities request that any agreed rate does not exceed 10l/s.

As a Water Company, we have no obligation to accept highway drainage into our public sewer network. However, should your proposals include runoff from highways, we would request that consideration is given to SuDS components that deliver source control are incorporated within the design of the scheme to reduce the volume and frequency of discharges of these flows to the public sewer.

Levels

For low-lying sites, (where the ground level of the site or the level of a basement is below the ground level at the point where the drainage connects to the public sewer), care should be taken to ensure that the property is not at increased risk of flooding. If these circumstances exist, we recommend that you contact us to discuss further. It could affect the detailed design of your site and result in the need to incorporate appropriate mitigating measures in your drainage scheme.

Land drainage / Overland flows / track drainage

United Utilities have no obligation, and furthermore we do not accept land drainage, overland flows or track drainage into the public sewerage network under any circumstances

Existing Water Assets Crossing the Site

It is the developer responsibility to identify utilities on-site. Where clean water assets are shown on our records, we recommend that you contact our Water Pre-Development Team, via the following email address:

DeveloperServicesWater@uuplc.co.uk. Further information for this service can be found on our website via the link below:

<https://www.unitedutilities.com/builders-developers/larger-developments/pre-development/water-pre-dev/>

Connection Application

Although we may discuss and agree discharge points and rates in principle, please be aware that you will have to apply for a formal sewer connection. This is so that we can assess the method of construction, Health & Safety requirements and to ultimately inspect the connection when it is made. Details of the application process and the form itself can be obtained from our website by following the link below:

<https://www.unitedutilities.com/builders-developers/wastewater-services/sewer-connections/sewer-connection/>

We recommend that the detailed design should confirm the locations of all utilities in the area and ensure that any proposed drainage solution considers routing and clash checks where required.

If we can be of any further assistance please don't hesitate to contact us further.

Kind regards,

 United Utilities Water for the North West	Mohammed Aljafarawi Developer Engineer Developer Services & Metering Customer Services Email: Mohammed.Aljafarawi@uuplc.co.uk unitedutilities.com
---	--

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From: Cameron Robinson [<mailto:Cameron.Robinson@BuroHappold.com>]
Sent: 03 May 2022 11:07
To: Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>
Cc: Francisco Rodriguez <Francisco.Rodriguez@BuroHappold.com>
Subject: Wastewater Pre-Development Enquiry: 2,3 Angel Square REF 4200026941

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

Good morning,

I hope you are doing well.

Please find attached pre-development enquiry for 2,3 Angel Square (ref. 4200026941)

This is following previous communications from 2019 since the project has now resumed, of which I have attached the email chain as pdf and reference number above. The site hasn't changed during this time so we hope we can obtain the same discharge rate (10l/s) as it was agreed previously.

We have also attached an indicative drainage strategy with two proposed points of connection.

Please feel free to reach out if you require any further information.

Cheers,

Cameron

Cameron Robinson
Graduate Infrastructure Engineer
Buro Happold | Cities - Infrastructure (Leeds)

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www.burohappold.com | [Twitter](#) | [Instagram](#)

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Appendix E Correspondence with the LLFA



Date	Application Ref / Site Ref
25/03/2024	CDN/23/0654 2 and 3 Angel Square

Meeting Purpose	Information required in Live Planning Application - CDN/23/0654 2 and 3 Angel Square
-----------------	--

Notes:

- MCC LLFA cannot proceed with the current proposals for attenuation tank 1 due to concrete structure that will be constructed in conjunction with the foundations.
- The proposed design has limitations with access challenges for maintenance and repairs. Durability – potential for cracking and deterioration over time, corrosion from moisture or other factors which may require treatment with limited access.
- OB -MCC LLFA has requested - If you re-design this, any design changes must be updated through the entire pack/reflecting within the hydraulic modelling and overall strategy.
- MH13 and MH04 have flow rates below 5 l/s. Particularly MH 04 at 1.1 l/s. MCC recommends a blockage risk assessment for all control orifices less than a 100mm in diameter. We either recommend requesting a higher flow rate or providing a blockage risk assessment.
- This application only requests approval for the drainage arrangement of plot 2 (scenario 2).
- MCC LLFA have been advised that plot 2 is stand alone.
- TE to review and update OB-LLFA
- TE to review and feedback on phasing of plot 2 and 3.

The following information is required to progress this application:

- Method statement, details of integrity of tank, crack protection, deterioration protection, corrosion etc. Maintenance or replacement in unforeseen circumstance details to be provided.
- Blockage risk assessment for MH13 and MH04
- TE to update OB-LLFA
- TE to review and feedback on phasing of plot 2 and 3.

Francisco Rodriguez

From: Flood Risk Management <floodriskmanagement@manchester.gov.uk>
Sent: 25 March 2024 12:45
To: jchatfield@deloitte.co.uk; Francisco Rodriguez; J.Grafton@Gardiner.com
Cc: Jennifer Atkinson; Wray, Katie; Laura Peacock; Owen Beddow
Subject: FW: CDN/23/0654 2 and 3 Angel Square
Attachments: CDN-23-0654 2 and 3 Angel Square.docx

Follow Up Flag: Follow up
Flag Status: Flagged

****External Email. This email originated from outside Buro Happold.****

Hi all,

Thank you for attending today's meeting regarding CDN/23/0654 2 and 3 Angel Square.

For reference, please find attached my notes and actions to progress this CDN application.

Kind regards

Talha Esmail

Flood Risk Engineer – Lead Local Flood Authority

E: talha.esmail@manchester.gov.uk 

From: Flood Risk Management <floodriskmanagement@manchester.gov.uk>
Sent: Thursday, March 21, 2024 11:58 AM
To: Chatfield, Jennifer <jchatfield@deloitte.co.uk>
Cc: Jennifer Atkinson <jennifer.atkinson@manchester.gov.uk>; Wray, Katie <kawray@deloitte.co.uk>
Subject: RE: CDN/23/0654 2 and 3 Angel Square

Hi Jennifer,

10:30 – 11:30 on Monday is fine. I'll send out an invite.

Kind regards

Talha Esmail

Flood Risk Engineer – Lead Local Flood Authority

E: talha.esmail@manchester.gov.uk 

From: Chatfield, Jennifer <jchatfield@deloitte.co.uk>
Sent: Thursday, March 21, 2024 11:47 AM
To: Flood Risk Management <floodriskmanagement@manchester.gov.uk>
Cc: Jennifer Atkinson <jennifer.atkinson@manchester.gov.uk>; Wray, Katie <kawray@deloitte.co.uk>
Subject: RE:CDN/23/0654 2 and 3 Angel Square

Hi Talha,

Would 10:30 – 11:30 work for you next Monday?

Kind Regards

Jennifer Chatfield

Pronouns: she / her / hers

Senior Planner | FA - Real Assets Advisory | Deloitte LLP

D: +44 161 455 8084

jchatfield@deloitte.co.uk | www.deloitte.co.uk

From: Flood Risk Management <floodriskmanagement@manchester.gov.uk>

Sent: 21 March 2024 09:45

To: Chatfield, Jennifer <jchatfield@deloitte.co.uk>

Cc: Jennifer Atkinson <jennifer.atkinson@manchester.gov.uk>; Wray, Katie <kawray@deloitte.co.uk>

Subject: [EXT] RE: CDN/23/0654 2 and 3 Angel Square

Hi Jennifer,

Thank you for your swift response. I'm currently covering for the officer who provided the initial comments as well. I can do Monday morning, 25th March? Alternatively, once the original officer returns, we have availability on April 2nd in the afternoon or April 3rd in the morning or afternoon. I can coordinate for both of us to attend during that week. Please let me know your preference.

Kind regards

Talha Esmail

Flood Risk Engineer – Lead Local Flood Authority

E: talha.esmail@manchester.gov.uk 

From: Chatfield, Jennifer <jchatfield@deloitte.co.uk>

Sent: Wednesday, March 20, 2024 7:26 PM

To: Flood Risk Management <floodriskmanagement@manchester.gov.uk>

Cc: Jennifer Atkinson <jennifer.atkinson@manchester.gov.uk>; Wray, Katie <kawray@deloitte.co.uk>

Subject: RE:CDN/23/0654 2 and 3 Angel Square

Hi Talha,

Please could you advise on any other availability that week – unfortunately the Drainage Consultant is out on training all day on 26th. I have asked if anyone can cover, but in the meantime would appreciate if you can provide an alternative date.

Kind Regards

Jennifer Chatfield

Pronouns: she / her / hers

Senior Planner | FA - Real Assets Advisory | Deloitte LLP

D: +44 161 455 8084

jchatfield@deloitte.co.uk | www.deloitte.co.uk

From: Flood Risk Management <floodriskmanagement@manchester.gov.uk>

Sent: 20 March 2024 14:37

To: Chatfield, Jennifer <jchatfield@deloitte.co.uk>

Cc: Jennifer Atkinson <jennifer.atkinson@manchester.gov.uk>

Subject: [EXT] FW: CDN/23/0654 2 and 3 Angel Square

Hi Jennifer,

Thank you for your email. Do you have availability to discuss CDN/23/0654 2 and 3 Angel Square via MS Teams on Tuesday, 26th March?

We have availability am and pm. Please let me know your preferred time and I'll send out a MS Teams invite accordingly.

Kind regards

Talha Esmail

Flood Risk Engineer – Lead Local Flood Authority

E: talha.esmail@manchester.gov.uk 

From: Chatfield, Jennifer <jchatfield@deloitte.co.uk>

Sent: 18 March 2024 13:21

To: Jennifer Atkinson <jennifer.atkinson@manchester.gov.uk>

Cc: Lam, Matthew <mlam@deloitte.co.uk>; Wray, Katie <kawray@deloitte.co.uk>; Jon Grafton <J.Grafton@Gardiner.com>; Josh Croke <j.croke@gardiner.com>

Subject: RE:CDN/23/0654 2 and 3 Angel Square

Hi Jen,

All correspondence is in the email chain. We have not issued anything to her as we need to discuss her comments directly in order to understand how we can progress. Thanks

Kind Regards

Jennifer Chatfield

Pronouns: she / her / hers

Senior Planner | FA - Real Assets Advisory | Deloitte LLP

D: +44 161 455 8084

jchatfield@deloitte.co.uk | www.deloitte.co.uk

From: Jennifer Atkinson <jennifer.atkinson@manchester.gov.uk>

Sent: 18 March 2024 13:19

To: Chatfield, Jennifer <jchatfield@deloitte.co.uk>

Cc: Lam, Matthew <mlam@deloitte.co.uk>; Wray, Katie <kawray@deloitte.co.uk>; Jon Grafton <J.Grafton@Gardiner.com>; Josh Croke <j.croke@gardiner.com>

Subject: [EXT] Re: CDN/23/0654 2 and 3 Angel Square

Jennifer

Have you sent anything to Laura - if so can you send me that email.

Thanks Jen

Jennifer Atkinson
Principal Planning Manager

Development Management Central Core
Planning Building Control and Licensing - Growth and Development
Manchester City Council

Tel: 0161 234 4517

Francisco Rodriguez

From: Laura Peacock <Laura.Peacock@manchester.gov.uk>
Sent: 05 May 2022 16:42
To: Chatfield, Jennifer; Alan Cave; Paul Thomson; Francisco Rodriguez; Ross Ogilvie
Cc: Jennifer Atkinson
Subject: RE: 2&3 Angel Sq - SUDS Pre-app
Attachments: Angel_Square.docx

Follow Up Flag: Follow up
Flag Status: Flagged

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Good afternoon,

Thanks all for your time on the call,

Please find attached the notes we ran through.

I've summarised the points we discussed RE green SuDS:

- We would like to see conversations had about whether you can link in with the wider Angel Sq.
- Without being too prescriptive, we would recommend considering green SuDS at different levels if you are constricted with the roof (e.g. green walls or green SuDS at ground level, SuDS-enabling the proposed landscaping etc.).
- We recommend exploring if you can use rainwater harvesting to reach volume control standards for SuDS. This could include irrigation components to serve your landscaping, and would not necessarily require storage at roof level. We discussed that this is not the same as attenuation storage.
- We have encouraged holistic consideration of sustainability; while carbon of the building is important we would also recommend considering carbon impacts offsite and what the development is doing for the region. We would point to the carbon emissions required to treat surface water discharged to the public sewer – this is documented e.g. [here](#). We also discussed other non-carbon sustainability issues with the pressure on the public sewer network resulting in raw sewage spills into rivers.

As discussed if you wish to discuss anything further pre-submission, please drop me an email.

Thanks again for your time,

Kind Regards,
Laura

-----Original Appointment-----

From: Chatfield, Jennifer <jchatfield@deloitte.co.uk>
Sent: 03 May 2022 17:03
To: Chatfield, Jennifer; Alan Cave; Paul Thomson; Francisco Rodriguez; Laura Peacock; Ross Ogilvie; Matt Stirton
Cc: Jim Boothroyd; Josh Croke; Wray, Katie; Jennifer Atkinson
Subject: 2&3 Angel Sq - SUDS Pre-app
When: 05 May 2022 15:30-16:30 (UTC+00:00) Dublin, Edinburgh, Lisbon, London.
Where: Microsoft Teams Meeting

Microsoft Teams meeting

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Condition X: No development shall take place until surface water drainage works have been implemented in accordance with Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015) or any subsequent replacements national standards and details that have been submitted to and approved in writing by the Local Planning Authority.

In order to avoid/dischARGE the above drainage condition the following additional information has to be provided:

- *Maximised integration of green SuDS components (utilising infiltration or attenuation) if practicable; - Interception/bioretenion can substitute infiltration.*
- *Details of surface water attenuation that offers a reduction in surface water runoff rate in line with the Manchester Trafford and Salford Strategic Flood Risk Assessment, i.e. for brownfield at least a 50% reduction in runoff rate compared to the existing rates, greenfield runoff rates for greenfield. Note overlap with asset manager consent: LLFA/UU/EA etc.*
- *An existing and proposed impermeable areas drawing to accompany all discharge rate calculations. Make sure any existing greenfield/brownfield split accounted for.*
- *Runoff volume in the 1 in 100 year, 6 hours rainfall shall be constrained to a value as close as is reasonable practicable to the greenfield runoff volume for the same event, but never to exceed the runoff volume from the development site prior to redevelopment;*
- *Evidence that the drainage system has been designed (unless an area is designated to hold and/or convey water as part of the design) so that flooding does not occur during a 1 in 100 year rainfall event with allowance for climate change in any part of a building; - CC to be max appropriate for dev. lifetime & current EA guidance – i.e. currently 40% unless clear it will be decommissioned.*
- *Assessment of overland flow routes for extreme events that is diverted away from buildings (including basements). Overland flow routes need to be designed to convey the flood water in a safe manner in the event of a blockage or exceedance of the proposed drainage system capacity including inlet structures. A layout with overland flow routes needs to be presented with appreciation of these overland flow routes with regards to the properties on site and adjacent properties off site.*
- *Evidenced-based progression through drainage hierarchy. Results of ground investigation carried out under Building Research Establishment Digest 365. Site investigations should be undertaken in locations and at proposed depths of the proposed infiltration devices. Proposal of the attenuation that is achieving half emptying time within 24 hours. If no ground investigations are possible or infiltration is not feasible on site, evidence of alternative surface water disposal routes (as follows) is required.*
- *Where surface water is connected to Main River, any works within or adjacent to the river that would affect it would require consent from Environment Agency. An email of acceptance of proposed flows and/or new connection will suffice.*
- *Where surface water is connected to the public sewer, agreement in principle from United Utilities is required that there is adequate spare capacity in the existing system taking future development requirements into account. An email of acceptance of proposed flows and/or new connection will suffice.*
- *Where surface water is connected to the ordinary watercourse, agreement in principle from Manchester City Council as Lead Local Flood Authority is required. Please note that all new connections to the watercourses shall comply with reduction of flows to Greenfield runoff rates. An email of acceptance of proposed flows and/or new connection will suffice.*

- Where surface water is connected to ordinary watercourse, any works within or adjacent to the watercourse that would affect it would require consent from Manchester City Council as Lead Local Flood Authority. Consent forms can be obtained on the website at:

http://www.manchester.gov.uk/downloads/download/5567/land_drainage_consent_and_guidance.com

- For sites where proposed development would cause unusual pollution risk to surface water (large car park areas (>50 parking spaces) or industrial estates), evidence of pollution control measures (preferably through SuDS) is required.
- Where an application is part of a larger site which already has planning permission it is essential that the new proposal does not compromise the drainage scheme already approved.
- Hydraulic calculation of the proposed drainage system;
- Construction details of flow control and SuDS elements.

Reason: To promote sustainable development, secure proper drainage and to manage the risk of flooding and pollution. This condition is imposed in light of national policies within the NPPF and NPPG and local policies EN08 and EN14.

If there is no clear adoption policy in place to take over the proposed drainage system after construction, we suggest the following construction and maintenance condition to be considered by the LPA:

Condition X: No development hereby permitted shall be occupied until details of the implementation, maintenance and management of the sustainable drainage scheme have been submitted to and approved by the local planning authority. The scheme shall be implemented and thereafter managed and maintained in accordance with the approved details. Those details shall include:

- Verification report providing photographic evidence of construction as per design drawings;
- As built construction drawings if different from design construction drawings;
- Management and maintenance plan for the lifetime of the development which shall include the arrangements for adoption by any public body or statutory undertaker, or any other arrangements to secure the operation of the sustainable drainage scheme throughout its lifetime.

Reason: To manage flooding and pollution and to ensure that a managing body is in place for the sustainable drainage system and there is funding and maintenance mechanism for the lifetime of the development.

Appendix F SUDs Maintenance plan

The table below is based on the CIRIA C753 SuDs Manual, 2015.

SUDS COMPONENTS MAINTENANCE REQUIREMENTS		
SUDS COMPONENT	Attenuation Tanks	
MAINTENANCE	ACTION	FREQUENCY
Regular maintenance	Check inlets, outlets, control structures and overflows	Monthly or annually, as required
Occasional tasks	Jetting and suction where silt has settled	As required
Remedial work	Reinstate	As required
SUDS COMPONENT	Bioretention Systems/Rain gardens	
MAINTENANCE	ACTION	FREQUENCY
Regular maintenance	Remove litter and surface debris and weeds	Quarterly
	Remove sediment build-up from around inlets or from forebays	Quarterly
	Replace any plants to maintain planting density	As required
Occasional tasks	Infill any holes or scour in the filter medium, improve erosion protection if required	As required
	Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch	As required
Remedial actions	Remove and replace filter medium and vegetation above	As required (>20 years)

Appendix G Greenfield runoff calculation

[Print](#)[Close Report](#)

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by: Cameron Robinson

Site name: Noma 2,3

Site location: Manchester

Site Details

Latitude: 53.48719° N

Longitude: 2.23712° W

Reference: 2409449464

Date: May 23 2022 10:53

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

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 0.71

Methodology

Q_{BAR} estimation method: Calculate from SPR and SAAR

SPR estimation method: Calculate from SOIL type

Soil characteristics

Default Edited

SOIL type: 4 4

HOST class: N/A N/A

SPR/SPRHOST: 0.47 0.47

Hydrological characteristics

Default Edited

SAAR (mm): 891 891

Hydrological region: 10 10

Growth curve factor 1 year: 0.87 0.87

Growth curve factor 30 years: 1.7 1.7

Growth curve factor 100 years: 2.08 2.08

Growth curve factor 200 years: 2.37 2.37

Notes

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

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

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

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

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

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

Greenfield runoff rates

Default

Edited

Q_{BAR} (l/s): 4.55 4.55

1 in 1 year (l/s): 3.95 3.95

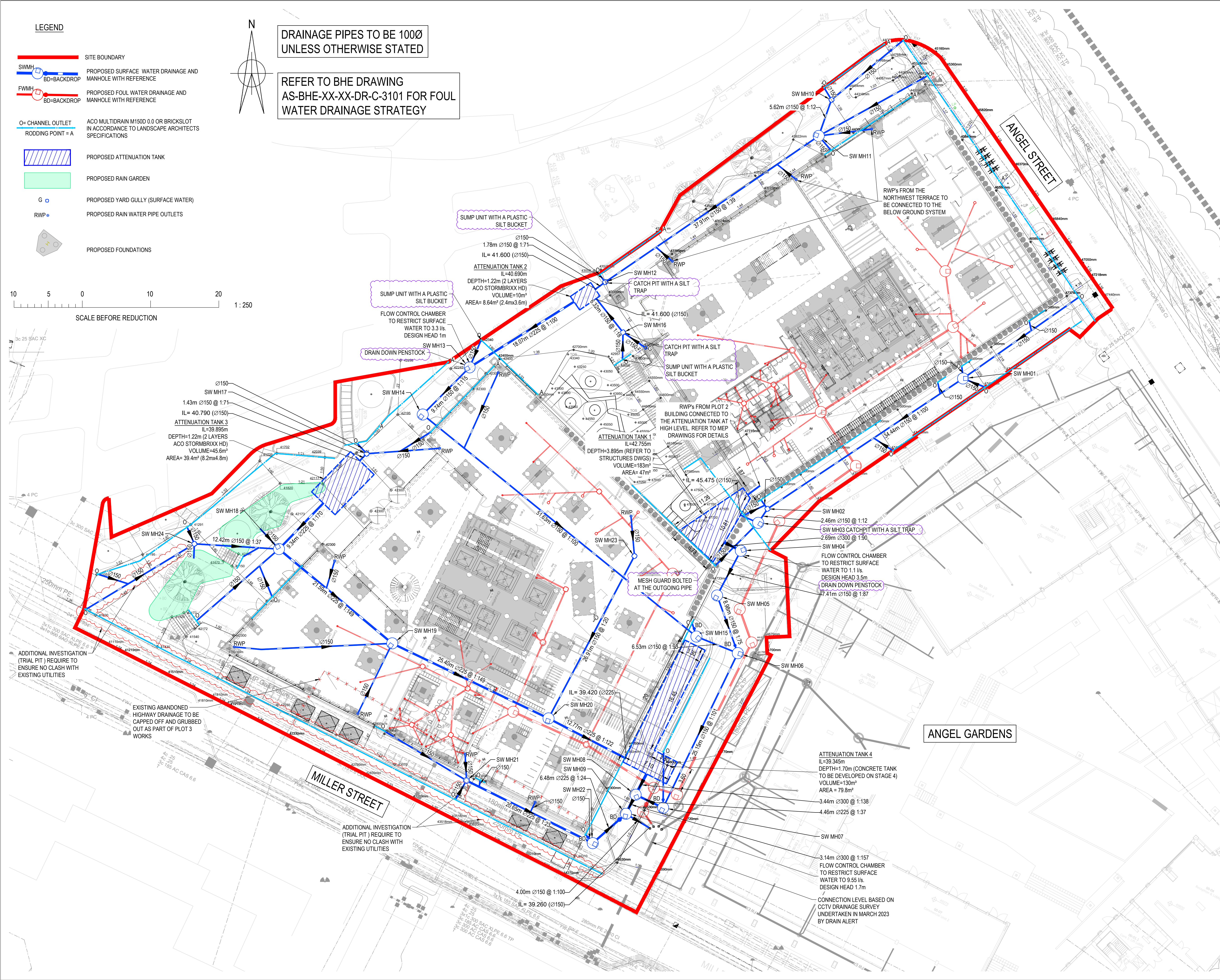
1 in 30 years (l/s): 7.73 7.73

1 in 100 year (l/s): 9.46 9.46

1 in 200 years (l/s): 10.77 10.77

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

Appendix H Proposed Surface Water Drainage Information (2&3)



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- WORKS IN PROXIMITY TO LIVE SERVICES
- WORKS INTERFACE WITH THE PUBLIC ON MILLER STREET AND ANGEL STREET

MAINTENANCE/CLEANING/OPERATION

- WORKS WITHIN POTENTIAL CONFINED SPACE CONDITIONS
- WORKS IN PROXIMITY TO LIVE SERVICES
- WORKS INTERFACE WITH THE PUBLIC ON MILLER STREET AND ANGEL STREET

DECOMMISSIONING/DEMOLITION

- WORKS WITHIN POTENTIAL CONFINED SPACE CONDITIONS
- WORKS IN PROXIMITY TO LIVE SERVICES
- WORKS INTERFACE WITH THE PUBLIC ON MILLER STREET AND ANGEL STREET

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- THE DESIGN OF THIS SCHEME HAS BEEN BASED ON THE FOLLOWING DRAWINGS AND INFORMATION:
 - TOPOGRAPHICAL SURVEY: DRAWING No. 11164_001 RECEIVED APRIL 2021, BY ND OLIVER
 - GPR SURVEY: DRAWING No. 157-WDA-SS-EX-DR-UC-MU100-001-Rev01 RECEIVED MAY 2022, BY WDA
 - ARCHITECT LAYOUT: DRAWING No. AS-CPA-P2-LG-DR-A-2000-P04-GA PLAN - LEVEL LG AND AS-CPA-P3-LG-DR-A-2000-P05-GA PLAN - LEVEL LG RECEIVED 19.04.2023, BY CARTWRIGHT PICKARD
 - LANDSCAPE ARCHITECT LAYOUT: DRAWING No. PL2190.1-PLA-XX-XX-DR-L-1001 RECEIVED 19.04.2023, BY PLANIT
 - LANDSCAPE ARCHITECT LEVELS: DRAWING No. PL2190.1-PLA-XX-XX-DR-L-3000 RECEIVED 13.04.2023, BY PLANIT
- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, DETAILS AND SPECIFICATIONS.
- ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.
- FOR ENGINEERING PROJECT NOTES (DRAINAGE EXTERNAL WORKS, ETC) REFER TO DRAWING AS-BHE-XX-XX-DR-C-0100
- REFER TO DRAWING AS-BHE-XX-XX-DR-C-3800 AND 3801 FOR MANHOLE SCHEDULES.
- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, DETAILS AND SPECIFICATIONS.
- ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.
- PRIOR TO THE COMMENCEMENT OF WORK THE LOCATION, SIZE AND DEPTH OF ALL EXISTING DRAINS/SEWERS AND SERVICES SHALL BE ESTABLISHED BY THE CONTRACTOR. ANY DISCREPANCIES FROM THE INFORMATION INDICATED ON THESE DRAWINGS SHALL IMMEDIATELY BE BROUGHT TO THE ATTENTION OF THE ARCHITECT OR ENGINEER.
- THE CONTRACTOR SHALL ALLOW FOR THE PROTECTION, TEMPORARY AND PERMANENT SUPPORT AND DIVERSION WORKS AS NECESSARY, TO ALL EXISTING SERVICES TO THE SATISFACTION OF THE PUBLIC UTILITIES.
- RAIN GARDEN DETAILS TO BE COORDINATED WITH LANDSCAPE ARCHITECT
- EXISTING DRAINAGE AND UTILITIES FOR THE EXISTING NOMA MARKETING SUITE TO BE ABANDONED PRIOR COMMENCEMENT OF WORKS ON PLOT 3
- EXACT LOCATION OF ANY POWER REQUIREMENT FOR THE SUB STATION TO BE COORDINATED DURING NEXT STAGE OF THE DESIGN
- EXTENT OF BREAKING OUT OF EXISTING CONCRETE SLAB IN THE ACCESS ROAD BETWEEN ANGEL GARDENS AND PLOT 3 TO BE CONFIRMED BY MAIN CONTRACTOR PENDING REVIEW OF EXCAVATION/TEMPORARY WORKS

P03	ADDITIONAL INFORMATION ADDED	09.04.2024	FR	PT	PT
P02	ADDITIONAL INFORMATION ADDED	01.12.2023	FR	PT	PT
P01	ISSUED FOR STAGE 3	28.04.2023	FR	PT	PT

Rev	Description	Date	Iss'd	Rev'd	App'd

STAGE 3

Project Stage

COMMENT

Status of Drawing

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Client: MEPC

Architect: CARTWRIGHT PICKARD

Project: ANGEL SQUARE PLOTS 2 AND 3

Dwg Title: PROPOSED DRAINAGE SURFACE WATER GENERAL ARRANGEMENT

Job No:	0050930	Scale:	A1
Drawn/Designed By:	FR	Checked By:	PT
Approved By:	PT		

Drawing No. AS-BHE-XX-XX-DR-C-3100

Revision

P03

MANHOLE SCHEDULE - 2&3 Noma SW drainage													
NAME	EASTING [m]	NORTHING [m]	COVER LEVEL [m]	INVERT LEVEL [m]	DEPTH [m]	TYPE	COVER LOADING	COVER TYPE	INCOMING PIPE DIAMETER [mm]	INCOMING PIPE IL [m]	OUTGOING PIPE DIAMETER [mm]	OUTGOING PIPE IL [m]	COMMENTS
SW MH01	384414.945	398995.993	47.490	46.150	1.340	1,200 dia. Type B Manhole	B125	RE	150 150 150	46.150 46.150 46.150	150	46.150	
SW MH02	384386.293	398976.893	47.500	45.805	1.695	450 dia. Type D Manhole	B125	RE	150 150	45.805 45.805	150	45.805	
SW MH03	384384.930	398974.849	47.500	45.480	2.020	1,200 dia. Type B Manhole	B125	RE	150 150	45.780 45.780	150	45.780	CATCHPIT 300mm SUMP WITH A SILT TRAP
SW MH04	384382.389	398970.754	47.500	42.725	4.775	1,200 dia. Type A2 Manhole	B125	RE	300	42.725	150	42.725	FLOW CONTROL CHAMBER DISCHARGE RATE LIMITED TO 1.1l/s AT 3.5m DESIGN HEAD. DRAIN DOWN PENSTOCK
SW MH05	384378.912	398964.208	44.720	42.640	2.080	1,200 dia. Type B Manhole	D400	ST	150	42.640	150	42.640	
SW MH06	384381.944	398955.751	44.650	39.840	4.810	1,200 dia. Type A2 Manhole	D400	ST	150 150	42.520 BD 39.840	150	39.840	
SW MH07	384370.999	398933.104	44.650	39.515	5.135	1,200 dia. Type A2 Manhole	D400	ST	150 150	39.590 43.500 BD	225	39.515	
SW MH08	384366.974	398935.022	44.500	39.320	5.180	1,200 dia. Type A2 Manhole	D400	ST	225 300	39.395 39.320	300	39.320	
SW MH09	384365.546	398932.223	44.500	39.300	5.200	1,200 dia. Type A2 Manhole	D400	ST	300 225	39.300 40.875 BD	150	39.300	FLOW CONTROL CHAMBER DISCHARGE RATE LIMITED TO 9.55l/s AT 1.7m DESIGN HEAD. 900x600 CLEAR OPENING
SW MH10	384395.671	399036.814	44.400	43.050	1.350	450 dia. Type D Manhole	D400	RE	150 150	43.050 43.050	150	43.050	
SW MH11	384393.797	399031.518	43.950	42.600	1.350	1,200 dia. Type B Manhole	D400	RE	150 150 150	42.600 42.600 42.600	150	42.600	
SW MH12	384362.512	399010.104	43.000	41.325	1.675	450 dia. Type D Manhole	B125	RE	150 150	41.625 41.625	150	41.625	CATCHPIT 300mm SUMP WITH A SILT TRAP
SW MH13	384342.651	398997.621	42.260	40.510	1.750	1,200 dia. Type B Manhole	B125	RE	225 150	40.510 40.585	150	40.510	FLOW CONTROL CHAMBER DISCHARGE RATE LIMITED TO 3.3l/s AT 1m DESIGN HEAD. DRAIN DOWN PENSTOCK
SW MH14	384335.785	398990.713	42.250	40.425	1.825	1,200 dia. Type B Manhole	B125	RE	150	40.425	150	40.425	
SW MH15	384375.882	398958.184	42.300	39.910	2.390	1,200 dia. Type B Manhole	D400	ST	150 150	39.910 41.250 BD	150	39.910	
SW MH16	384365.133	399002.747	43.000	41.650	1.350	450 dia. Type D Manhole	B125	RE	150 150	41.950 41.950	150	41.950	CATCHPIT 300mm SUMP WITH A SILT TRAP
SW MH17	384327.570	398984.976	42.160	40.510	1.650	450 dia. Type D Manhole	B125	RE	150 150	40.810 40.810	150	40.810	CATCHPIT 300mm SUMP WITH A SILT TRAP
SW MH18	384314.726	398971.005	42.250	39.840	2.410	1,200 dia. Type B Manhole	B125	RE	150 225 150 150	39.915 39.840 39.915 39.915	225	39.840	
SW MH19	384331.316	398957.188	42.300	39.695	2.605	1,200 dia. Type B Manhole	B125	RE	225 150 150	39.695 39.770 39.770	225	39.695	DOUBLE SEALED COVER
SW MH20	384354.219	398946.200	42.300	39.525	2.775	1,200 dia. Type B Manhole	B125	ST	225 150	39.525 39.600	225	39.525	DOUBLE SEALED COVER
SW MH21	384342.199	398937.102	43.490	42.065	1.425	600 dia. Type D Manhole	B125	RE	150 150 150	42.140 42.140 42.140	225	42.065	
SW MH22	384360.693	398927.922	44.300	41.150	3.15	1,200 dia. Type B Manhole	B125	RE	225 150	41.150 42.650 BD	225	41.150	
SW MH23	384366.804	398969.982	42.300	40.950	1.350	450 dia. Type D Manhole	D400	ST	150	40.950	150	40.950	DOUBLE SEALED COVER
SW MH24	384302.332	398971.768	41.300	40.250	1.050	450 dia. Type D Manhole	B125	RE	150 150 150	40.250 40.250 40.250	150	40.250	

ABBREVIATIONS

ST - SOLID TOP
RE - RECESSED COVER
BD - BACKDROP

REFER TO DRAWING
AS-BHE-XX-XX-DR-C-3801 FOR
FOUL WATER MANHOLE
SCHEDULE

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- WORKS WITHIN POTENTIAL CONFINED SPACE CONDITIONS
- WORKS IN PROXIMITY TO LIVE SERVICES
- WORKS INTERFACE WITH THE PUBLIC ON MILLER STREET AND ANGEL STREET

MAINTENANCE/CLEANING/OPERATION

- WORKS WITHIN POTENTIAL CONFINED SPACE CONDITIONS
- WORKS IN PROXIMITY TO LIVE SERVICES
- WORKS INTERFACE WITH THE PUBLIC ON MILLER STREET AND ANGEL STREET

DECOMMISSIONING/DEMOLITION

- WORKS WITHIN POTENTIAL CONFINED SPACE CONDITIONS
- WORKS IN PROXIMITY TO LIVE SERVICES
- WORKS INTERFACE WITH THE PUBLIC ON MILLER STREET AND ANGEL STREET

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2.

ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.
3.

THE CONTRACTOR SHALL TAKE ALL NECESSARY SAFETY PRECAUTIONS IN LINE WITH CURRENT LEGISLATION WHEN WORKING IN/NEAR CONFINED SPACES, DEEP EXCAVATIONS AND UTILITIES.
4.

WHERE INFILL MANHOLE COVERS ARE SPECIFIED THE LOCATION OF MANHOLES AND ORIENTATION OF THE COVERS SHALL BE COORDINATED ON SITE TO SUIT THE SURFACING MATERIAL AND PAVING ARRANGEMENT WHEREVER POSSIBLE.
5.

REFER TO BHE DRAWING No. AS-BHE-XX-XX-DR-C-3100 & 3101 FOR DRAINAGE GENERAL ARRANGEMENTS.

P02	GENERAL UPDATES	09.04.2024	FR	PT	PT
P01	ISSUED FOR STAGE 3	28.04.2023	FR	PT	PT
Rev	Description	Date	Iss'd	Rev'd	App'd

STAGE 3

Project Stage

COMMENT

Status of Drawing

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ArchitectCARTWRIGHT PICKARD

ProjectANGEL SQUARE PLOTS 2 AND 3

Dwg TitlePROPOSED DRAINAGE
SURFACE WATER
MANHOLE SCHEDULE

Job No.
0050930

Scale@A1
NTS

Drawn/Designed By
FR

Checked By
PT

Approved By
PT

Drawing No.
AS-BHE-XX-XX-DR-C-3800

Revision
P02

MANHOLE SCHEDULE - 2&3 Noma FW drainage													
NAME	EASTING [m]	NORTHING [m]	COVER LEVEL [m]	INVERT LEVEL [m]	DEPTH [m]	TYPE	COVER LOADING	COVER TYPE	INCOMING PIPE DIAMETER [mm]	INCOMING PIPE IL [m]	OUTGOING PIPE DIAMETER [mm]	OUTGOING PIPE IL [m]	COMMENTS
FW MH01	384412.349	399011.705	44.000	42.650	1.350	1,200 dia. Type B Manhole	D400	ST	100 100	42.700 42.700	150	42.650	DOUBLE SEALED COVER
FW MH02	384413.485	399005.535	44.000	42.450	1.550	1,200 dia. Type B Manhole	D400	ST	150 150 100	42.575 42.575 42.625	225	42.450	DOUBLE SEALED COVER
FW MH03	384394.099	398991.088	43.000	41.760	1.240	1,200 dia. Type B Manhole	B125	ST	150 100 100 225	41.835 41.885 41.885 41.760	225	41.760	DOUBLE SEALED COVER
FW MH04	384399.238	398983.189	47.630	41.610	6.020	1,200 dia. Type A2 Manhole	B125	RE	225	41.610	225	41.610	
FW MH05	384388.022	398975.107	47.500	41.400	6.100	1,200 dia. Type A2 Manhole	B125	RE	225	41.400	225	41.400	
FW MH06	384382.222	398962.188	44.720	41.220	3.500	1,200 dia. Type A2 Manhole	D400	ST	225	41.220	225	41.220	
FW MH07	384383.960	398957.318	44.650	41.155	3.495	1,200 dia. Type A2 Manhole	D400	ST	225	41.155	225	41.155	
FW MH08	384373.038	398935.060	44.650	40.520	4.130	1,200 dia. Type A2 Manhole	D400	ST	225	40.520	225	40.520	
FW MH09	384369.632	398936.038	44.600	40.430	4.170	1,200 dia. Type A2 Manhole	D400	ST	225 225	40.430 40.430	225	40.430	
FW MH10	384368.049	398932.546	44.530	39.215	5.315	1,200 dia. Type A2 Manhole	D400	ST	225	40.380 BD	225	39.215	
FW MH11	384389.938	399000.140	43.000	41.950	1.050	600 dia. Type D Manhole	B125	ST	100 100	42.000 42.000	150	41.950	DOUBLE SEALED COVER
FW MH12	384391.523	398997.853	43.000	41.900	1.100	600 dia. Type D Manhole	B125	RE	150 150	41.900 41.900	150	41.900	DOUBLE SEALED COVER
FW MH13	384382.839	398992.351	43.000	42.000	1.000	450 dia. Type D Manhole	B125	RE	100 100 100 100	42.050 42.050 42.050 42.050	150	42.000	DOUBLE SEALED COVER
FW MH14	384387.181	398995.102	43.000	41.950	1.050	450 dia. Type D Manhole	B125	RE	150 100 100 100	41.950 42.000 42.000 42.000	150	41.950	DOUBLE SEALED COVER
FW MH15	384335.770	398953.802	42.300	41.300	1.000	450 dia. Type D Manhole	B125	RE	100 100	41.300 41.300	100	41.300	DOUBLE SEALED COVER
FW MH16	384342.372	398950.579	42.300	41.140	1.160	450 dia. Type D Manhole	B125	RE	100 150 100 100	41.190 41.140 41.190 41.190	150	41.140	DOUBLE SEALED COVER
FW MH17	384349.041	398947.166	42.300	40.955	1.345	1,200 dia. Type B Manhole	B125	RE	150 150 100	41.030 41.030 41.080	225	40.955	DOUBLE SEALED COVER
FW MH18	384359.730	398942.368	42.300	40.580	1.720	600 dia. Type D Manhole	B125	RE	225 150	40.580 40.655	225	40.580	DOUBLE SEALED COVER
FW MH19	384334.180	398945.263	42.300	41.250	1.050	450 dia. Type D Manhole	B125	RE	100 100 100 100	41.300 41.300 41.300 41.300	150	41.250	DOUBLE SEALED COVER
FW MH20	384339.900	398943.777	42.300	41.250	1.050	450 dia. Type D Manhole	B125	RE	100 100 100	41.300 41.300 41.300	150	41.250	DOUBLE SEALED COVER
FW MH21	384356.750	398965.123	42.300	41.250	1.050	450 dia. Type D Manhole	D400	ST	150	41.250	150	41.250	DOUBLE SEALED COVER
FW MH22	384353.402	398957.325	42.300	41.155	1.145	600 dia. Type D Manhole	B125	RE	150 150	41.155 41.155	150	41.155	DOUBLE SEALED COVER
FW MH23	384361.639	398979.437	42.300	41.150	1.150	450 dia. Type D Manhole	D400	ST	100 100	41.200 41.200	150	41.150	DOUBLE SEALED COVER
FW MH24	384372.403	398967.389	42.300	40.970	1.330	1,200 dia. Type B Manhole	D400	ST	150	40.970	150	40.970	DOUBLE SEALED COVER

ABBREVIATIONS

ST - SOLID TOP
RE - RECESSED COVER
BD - BACKDROP

REFER TO DRAWING
AS-BHE-XX-XX-DR-C-3800 FOR
SURFACE WATER MANHOLE
SCHEDULE

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- REFER TO BHE DRAWING No. AS-BHE-XX-XX-DR-C-3100 & 3101 FOR DRAINAGE GENERAL ARRANGEMENTS.

P01 ISSUED FOR STAGE 3				28.04.2023	FR	PT	PT
Rev	Description	Date	Iss'd	Rev'd	App'd		

STAGE 3

Project Stage

COMMENT

Status of Drawing

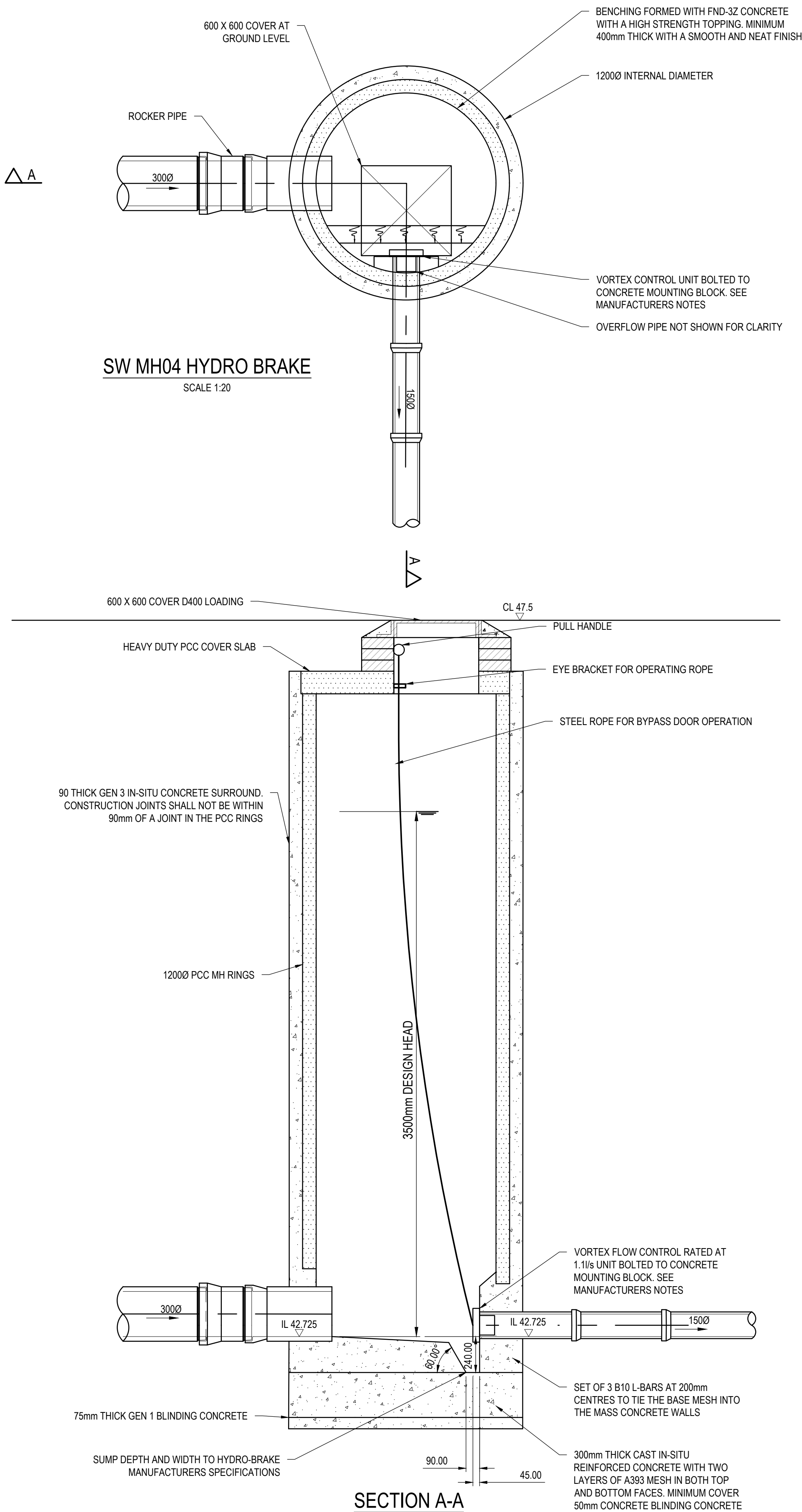
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Client MEPC
Architect CARTWRIGHT PICKARD
Project ANGEL SQUARE PLOTS 2 AND 3
Dwg Title PROPOSED DRAINAGE
FOUL WATER
MANHOLE SCHEDULE

Job No. 0050930		Scale@A1 NTS	
Drawn/Designed By. FR	Checked By. PT	Approved By. PT	
Drawing No. AS-BHE-XX-XX-DR-C-3801			Revision P01

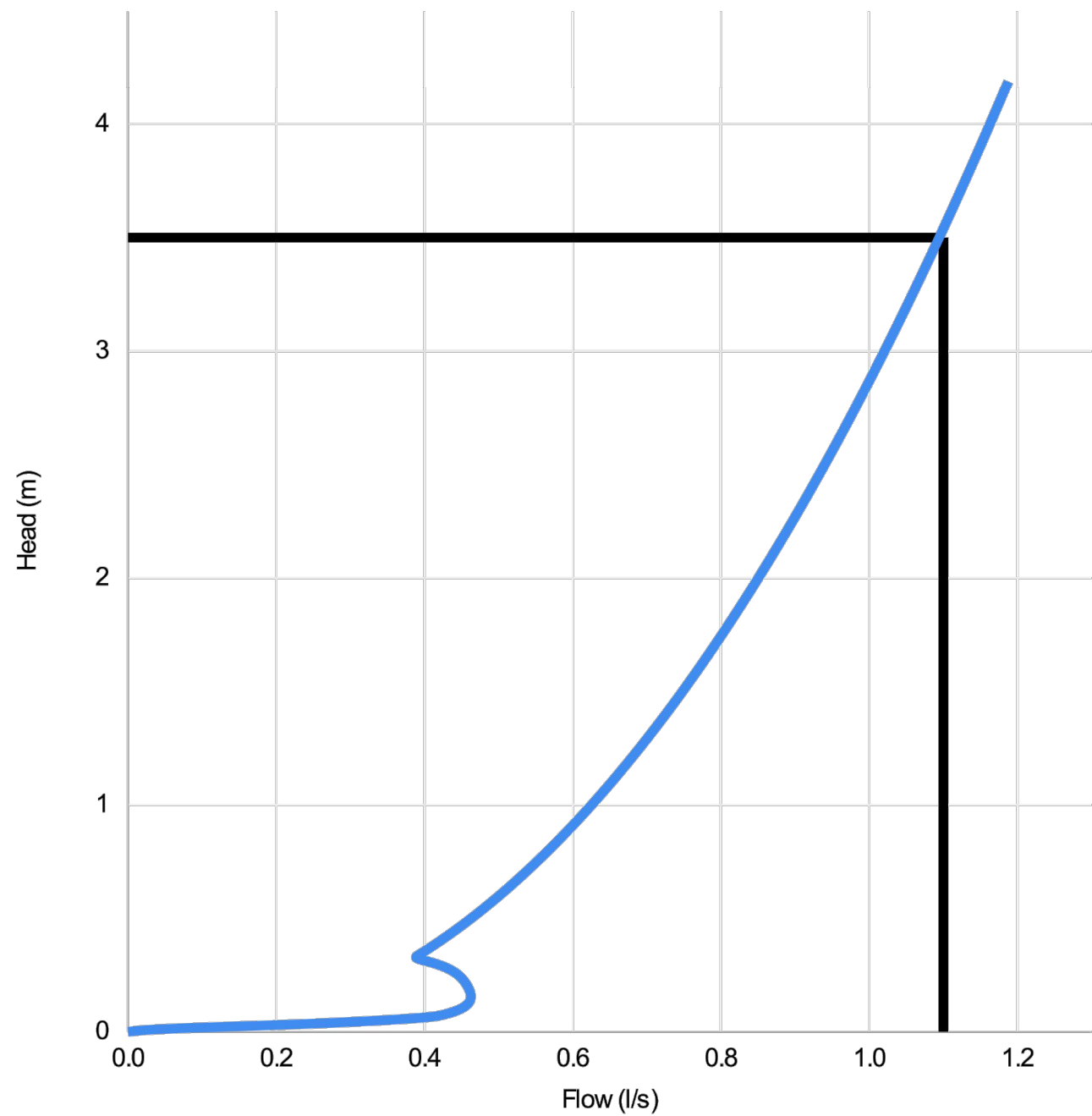


HYDRO BRAKE TO BE HANDLED AND INSTALLED IN STRICT ACCORDANCE WITH MANUFACTURERS RECOMMENDATIONS

Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	3.500	1.100
Flush-Flo	0.155	0.463
Kick-Flo®	0.324	0.385
Mean Flow		0.770

hydro-int.com/patents



Head (m)	Flow (l/s)
0.000	0.000
0.121	0.458
0.241	0.449
0.362	0.404
0.483	0.456
0.603	0.502
0.724	0.543
0.845	0.581
0.966	0.616
1.086	0.649
1.207	0.679
1.328	0.709
1.448	0.737
1.569	0.763
1.690	0.789
1.810	0.813
1.931	0.837
2.052	0.860
2.172	0.883
2.293	0.904
2.414	0.925
2.534	0.946
2.655	0.966
2.776	0.985
2.897	1.005
3.017	1.023
3.138	1.042
3.259	1.059
3.379	1.077
3.500	1.094

DESIGN ADVICE

The head/flow characteristics of this SHE-0036-1100-3500-1100 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.

! The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.



DATE	22/04/2023 10:51
Site	Angel Square Plots 2 & 3
DESIGNER	Francisco Rodriguez
Ref	0050930

SHE-0036-1100-3500-1100

Hydro-Brake Optimum®

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- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL DRAINAGE LAYOUTS, SCHEDULES AND DETAILS.
- THE DEVELOPER SHALL REVIEW THE DESIGN CRITERIA, MATERIAL STANDARDS AND WORKMANSHIP SPECIFICATION FOR THE PROPOSED ADAPTABLE SEWERS IN ACCORDANCE WITH SEWERS FOR ADOPTION AND THE REQUIREMENTS OF THE STATUTORY UNDERTAKER / BUILDING CONTROL AND THE SPECIFIC REQUIREMENTS OF THE CLIENT.
- THE CONTRACTOR SHALL TAKE ALL NECESSARY SAFETY PRECAUTIONS IN LINE WITH CURRENT LEGISLATION WHEN WORKING IN/NEAR CONFINED SPACES, DEEP EXCAVATIONS AND UTILITIES.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
- ALL DRAINAGE SHALL BE CONSTRUCTED IN ACCORDANCE WITH BS EN 752 DRAINS AND SEWERS OUTSIDE BUILDINGS, THE CURRENT LOCAL BUILDING REGULATIONS AND TO THE SATISFACTION OF THE WATER AUTHORITY / BUILDING CONTROL OR SPECIFIC REQUIREMENTS OF THE CLIENT IF APPLICABLE.
- BURIED CONCRETE, INCLUDING PRECAST CONCRETE TO BE DESIGNED TO BRE DIGEST 1. CONCRETE IN AGGRESSIVE GROUND. SULPHATE RESISTING CEMENT SHALL BE USED UNLESS AN ALTERNATIVE IS AGREED WITH THE SUPERVISING OFFICER/ENGINEER.
- FOR DESIGNED, DESIGNATED OR STANDARDISED PRESCRIBED CONCRETE REFER TO BS EN 206-1 AND BS 8500. THEY SHALL HAVE A 20mm NOMINAL MAXIMUM SIZE OF AGGREGATE, AND A SLUMP CLASS S2 FOR TARGET 70mm AND NO ADMIXTURES.
- ALL PIPES SHALL BE LAID SOFFIT TO SOFFIT UNLESS STATED OTHERWISE ON THE MANHOLE SCHEDULE.
- MANHOLES & COVER SLABS TO BS EN 1917 AND BS 5911-3. PREFORMED SWEPT CHANNELS SHALL BE USED AT JUNCTIONS AND NO BRANCH SHALL ENTER AT LESS THAN 90 DEGREES FROM THE OUTGOING SEWER.
- MANHOLE COVERS TO BE TO BS EN 124.
- ALL PROPRIETARY PRODUCTS ARE TO BE INSTALLED STRICTLY IN ACCORDANCE WITH THE MANUFACTURERS REQUIREMENTS AND SPECIFICATION.

P01 ISSUED FOR STAGE 3

28.04.2023 MG FR PT

Rev	Description	Date	Iss'd	Rev'd	App'd
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STAGE 3

Project Stage

COMMENT

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Architect **CARTWRIGHT PICKARD**
Project **ANGEL SQUARE PLOTS 2 AND 3**
Dwg Title **DRAINAGE DETAILS SHEET 5**

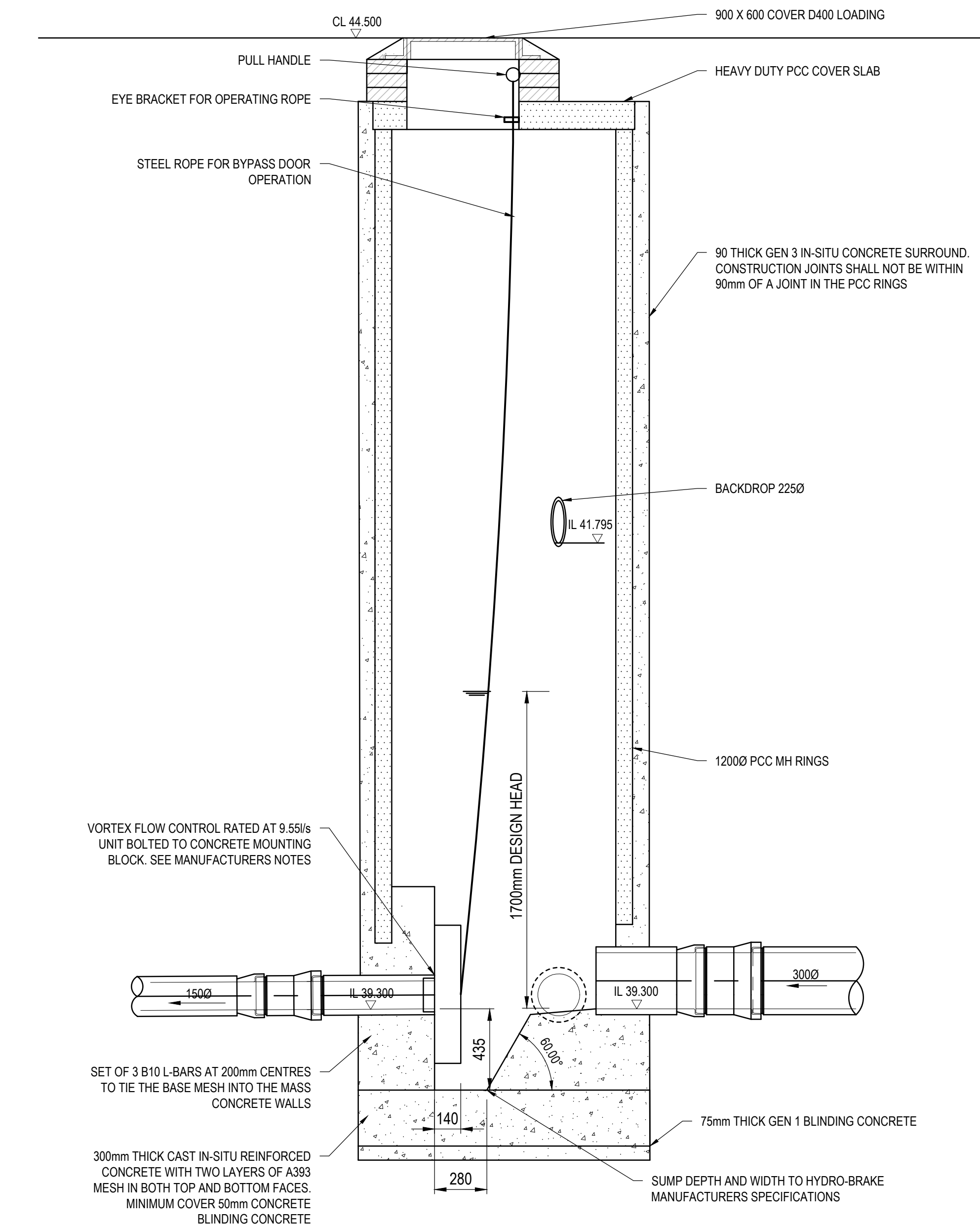
Job No.
0050930

Scale@A1
AS SHOWN

Drawn/Designed By: **MG**
Checked By: **FR**
Approved By: **PT**

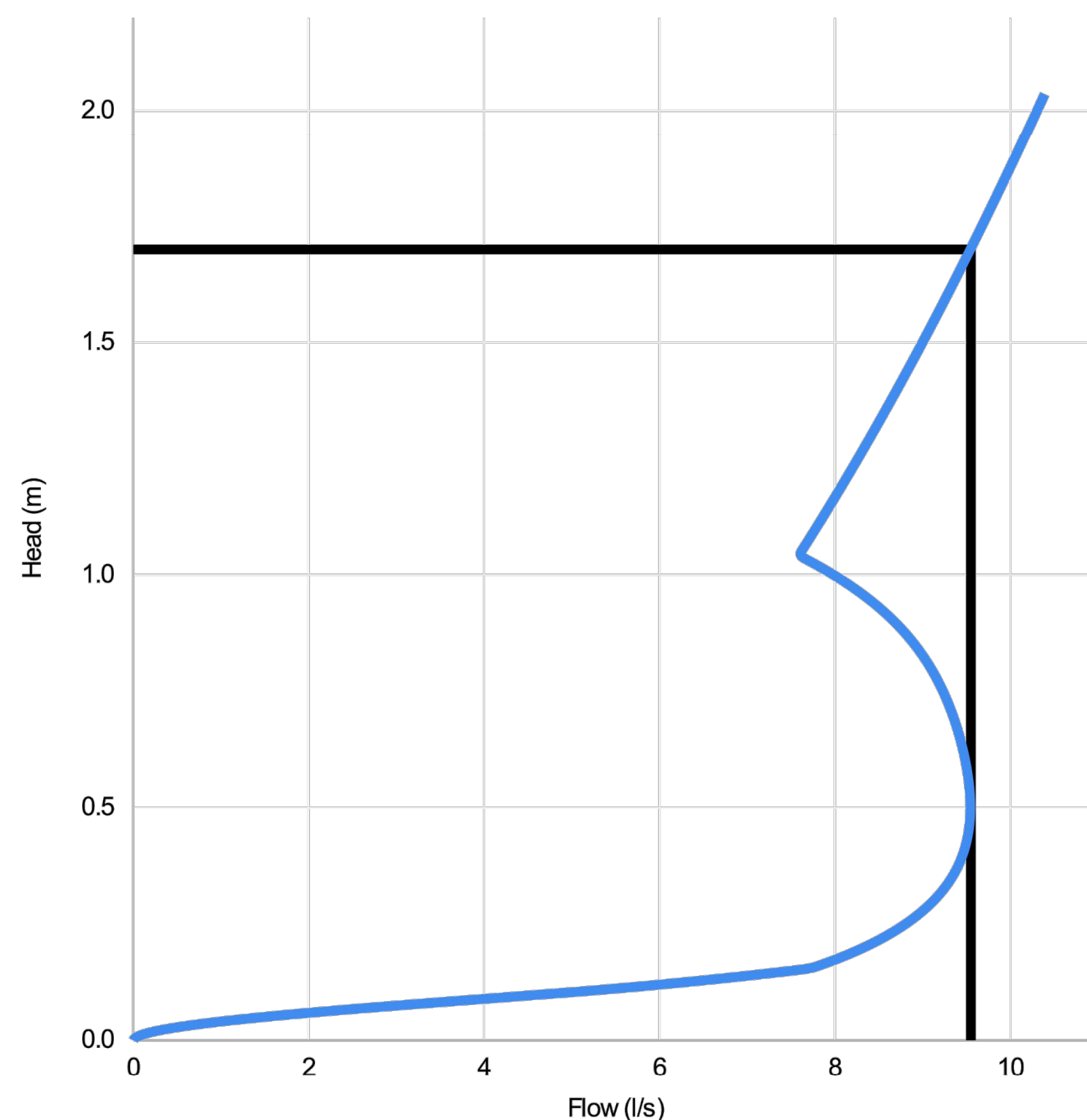
Drawing No.
AS-BHE-XX-XX-DR-C-3704

Revision
P01



WRc
APPROVED
PT/329/0412

Head (m)	Flow (l/s)
0.000	0.000
0.059	1.969
0.117	5.859
0.176	8.036
0.234	8.677
0.293	9.087
0.352	9.338
0.410	9.477
0.469	9.536
0.528	9.539
0.586	9.501
0.645	9.432
0.703	9.334
0.762	9.202
0.821	9.023
0.879	8.782
0.938	8.455
0.997	8.018
1.055	7.631
1.114	7.826
1.172	8.016
1.231	8.201
1.290	8.382
1.348	8.558
1.407	8.731
1.466	8.900
1.524	9.065
1.583	9.228
1.641	9.387
1.700	9.543



DESIGN ADVICE	The head/flow characteristics of this SHE-0132-9550-1700-9550 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.		
!	The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.		
DATE	26/04/2023 07:05		SHE-0132-9550-1700-9550 Hydro-Brake Optimum®
Site	Angel Square Plots 2 & 3		
DESIGNER	Francisco Rodriguez		
Ref	0050930		
© 2018 Hydro International, Shearwater House, Clevedon Hall Estate, Victoria Road, Clevedon, BS21 7RD, Tel 01275 878371 Fax 01275 874979 Web www.hydro-int.com Email designtools@hydro-int.com			

HYDRO BRAKE TO BE HANDLED AND INSTALLED IN
STRICT ACCORDANCE WITH MANUFACTURERS
RECOMMENDATIONS

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CONSTRUCTION

- WORKS WITHIN POTENTIAL CONFINED SPACE CONDITIONS
- WORKS IN PROXIMITY TO LIVE SERVICES
- WORKS INTERFACE WITH THE PUBLIC ON MILLER STREET AND ANGEL STREET

MAINTENANCE/CLEANING/OPERATION

- WORKS WITHIN POTENTIAL CONFINED SPACE CONDITIONS
- WORKS IN PROXIMITY TO LIVE SERVICES
- WORKS INTERFACE WITH THE PUBLIC ON MILLER STREET AND ANGEL STREET

DECOMMISSIONING/DEMOLITION.

- WORKS WITHIN POTENTIAL CONFINED SPACE CONDITIONS
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1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL DRAINAGE LAYOUTS, SCHEDULES AND DETAILS.
2. THE DEVELOPER SHALL REVIEW THE DESIGN CRITERIA, MATERIAL STANDARDS AND WORKMANSHIP SPECIFICATION FOR THE PROPOSED ADAPTABLE SEWERS IN ACCORDANCE WITH SEWERS FOR ADOPTION AND THE REQUIREMENTS OF THE STATUTORY UNDERTAKER / BUILDING CONTROL AND THE SPECIFIC REQUIREMENTS OF THE CLIENT.
3. THE CONTRACTOR SHALL TAKE ALL NECESSARY SAFETY PRECAUTIONS IN LINE WITH CURRENT LEGISLATION WHEN WORKING IN NEAR CONFINED SPACES, DEEP EXCAVATIONS AND UTILITIES.
4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
5. ALL DRAINAGE SHALL BE CONSTRUCTED IN ACCORDANCE WITH BS EN 752 DRAINS AND SEWERS OUTSIDE BUILDINGS, TO CURRENT LOCAL BUILDING REGULATIONS AND TO THE SATISFACTION OF THE WATER AUTHORITY / BUILDING CONTROL OR SPECIFIC REQUIREMENTS OF THE CLIENT IF APPLICABLE.
6. BURNED CONCRETE, INCLUDING PRECAST CONCRETE TO BE DESIGNED TO BE DURE BIGEST 1. CONCRETE IN AGGRESSIVE GROUND. SULPHATE RESISTING CEMENT SHALL BE USED UNLESS AN ALTERNATIVE IS AGREED WITH THE SUPERVISING OFFICER/ENGINEER.
7. FOR DESIGNED, DESIGNATED OR STANDARDISED PRESCRIBED CONCRETE REFER TO BS EN 206-1 AND BS 8500. THEY SHALL HAVE A 20mm NOMINAL MAXIMUM SIZE OF AGGREGATE, AND A SLUMP CLASS S2 FOR TARGET 70mm AND NO ADMIXTURES.
8. ALL PIPES SHALL BE LAID SUFFIT TO SUFFIT UNLESS STATED OTHERWISE ON THE MANHOLE SCHEDULE.
9. MANHOLES & COVER SLABS TO BS EN 1917 AND BS 5911-3. PREFORMED SWEEP CHANNELS SHALL BE USED AT JUNCTIONS AND NO BRANCH SHALL ENTER AT LESS THAN 90 DEGREES FROM THE OUTGOING SEWER.
10. MANHOLE COVERS TO BE TO BS EN 124.
11. ALL PROPRIETARY PRODUCTS ARE TO BE INSTALLED STRICTLY IN ACCORDANCE WITH THE MANUFACTURERS REQUIREMENTS AND SPECIFICATION.

P01 ISSUED FOR STAGE 3

28.04.2023 MG FR PT

Rev	Description	Date	Iss'd	Rev'd	App'd
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STAGE 3

Project Stage

COMMENT

Status of Drawing

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Client	MEPC
Architect	CARTWRIGHT PICKARD
Project	ANGEL SQUARE PLOTS 2 AND 3
Dwg Title	DRAINAGE DETAILS SHEET 6

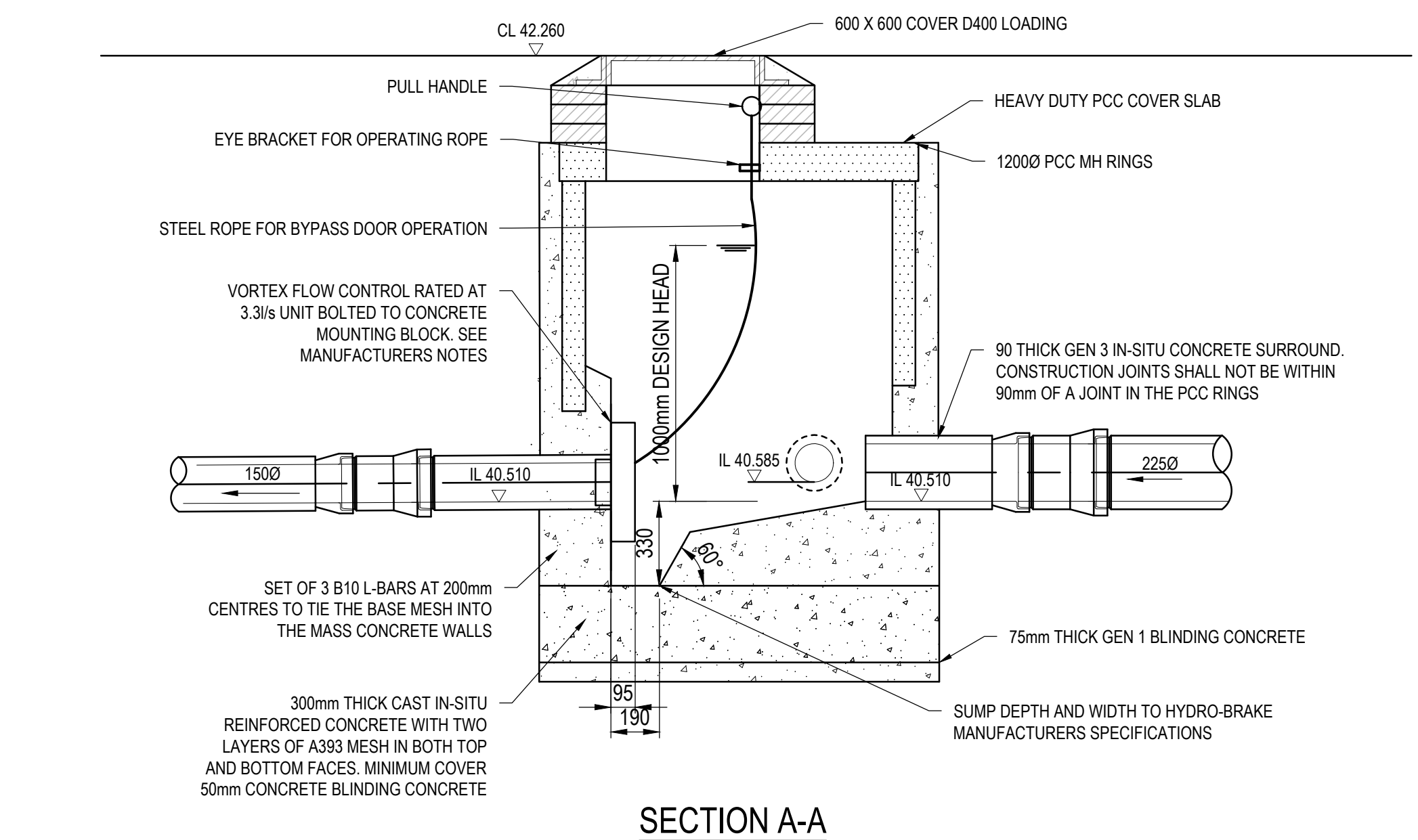
Job No.
0050930

Scale@A1
AS SHOWN

Drawn/Designed By. MG	Checked By. FR	Approved By. PT
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Drawing No.
AS-BHE-XX-XX-DR-C-3705

Revision
P01



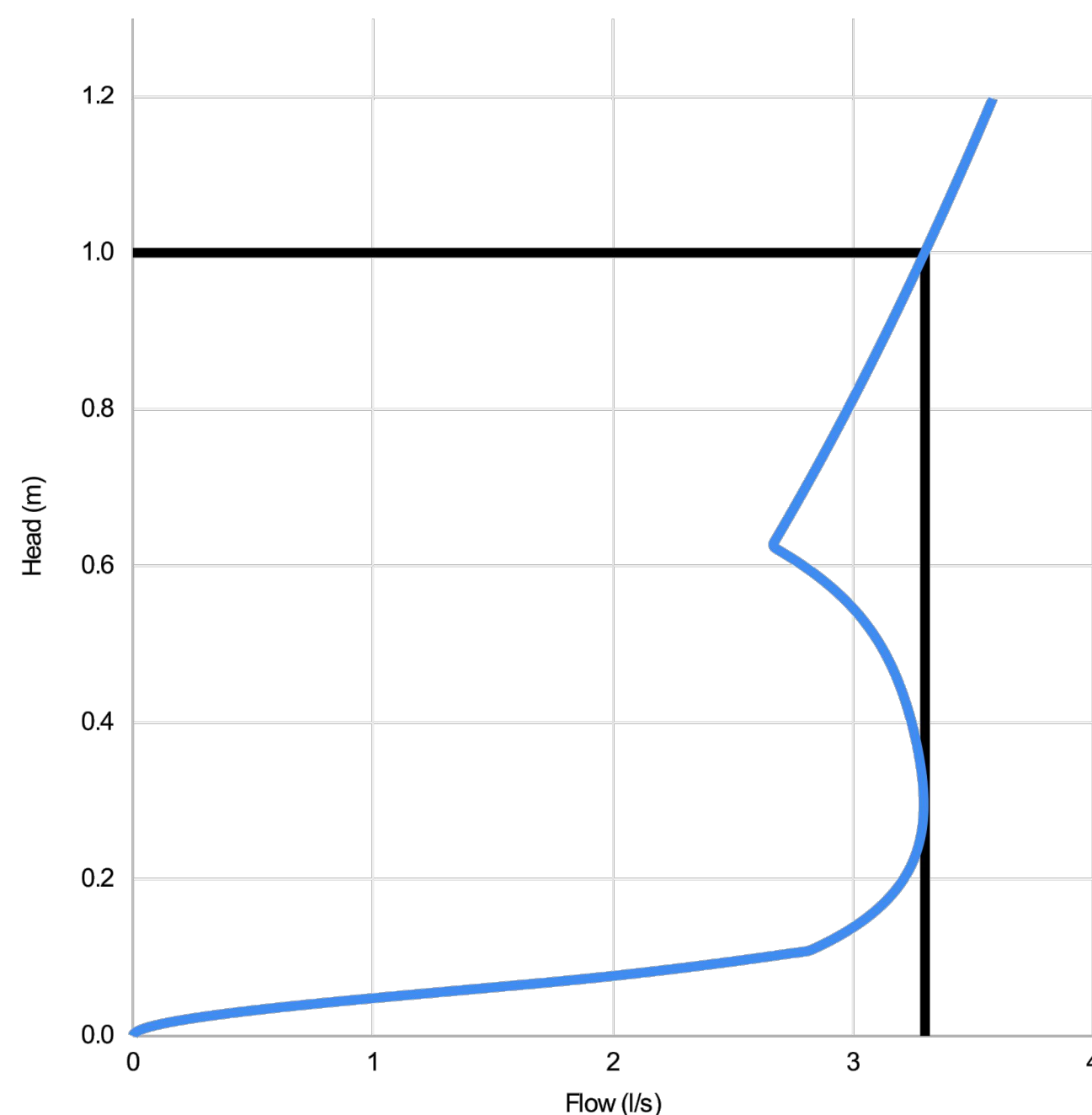
Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	1.000	3.300
Flush-Flo	0.296	3.295
Kick-Flo®	0.624	2.660
Mean Flow		2.882



PT/329/0412

hydro-int.com/patents



Head (m)	Flow (l/s)
0.000	0.000
0.034	0.557
0.069	1.756
0.103	2.698
0.138	2.998
0.172	3.138
0.207	3.224
0.241	3.272
0.276	3.292
0.310	3.294
0.345	3.282
0.379	3.261
0.414	3.232
0.448	3.194
0.483	3.143
0.517	3.076
0.552	2.983
0.586	2.856
0.621	2.687
0.655	2.719
0.690	2.783
0.724	2.845
0.759	2.906
0.793	2.966
0.828	3.024
0.862	3.081
0.897	3.137
0.931	3.192
0.966	3.245
1.000	3.298

DESIGN ADVICE

The head/flow characteristics of this SHE-0086-3300-1000-3300 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.

!

The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

DATE	22/04/2023 10:53
Site	Angel Square Plots 2 & 3
DESIGNER	Francisco Rodriguez
Ref	0050930



Hydro
International

SHE-0086-3300-1000-3300

Hydro-Brake Optimum®

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DECOMMISSIONING/DEMOLITION

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P01 ISSUED FOR STAGE 3

28.04.2023 MG FR PT

Rev	Description	Date	Iss'd	Rev'd	App
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STAGE 3

Project Stage

COMMENT

Status of Drawing	Date	By	Checked by	Reviewed by	Approved by	Signature	Date	Remarks
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Client	MEPC
Architect	CARTWRIGHT PICKARD
Project	ANGEL SQUARE PLOTS 2 AND 3
Dwg Title	DRAINAGE DETAILS SHEET 7

Job No.
0050930

Scale ②A

Drawn/Designed By:
MG

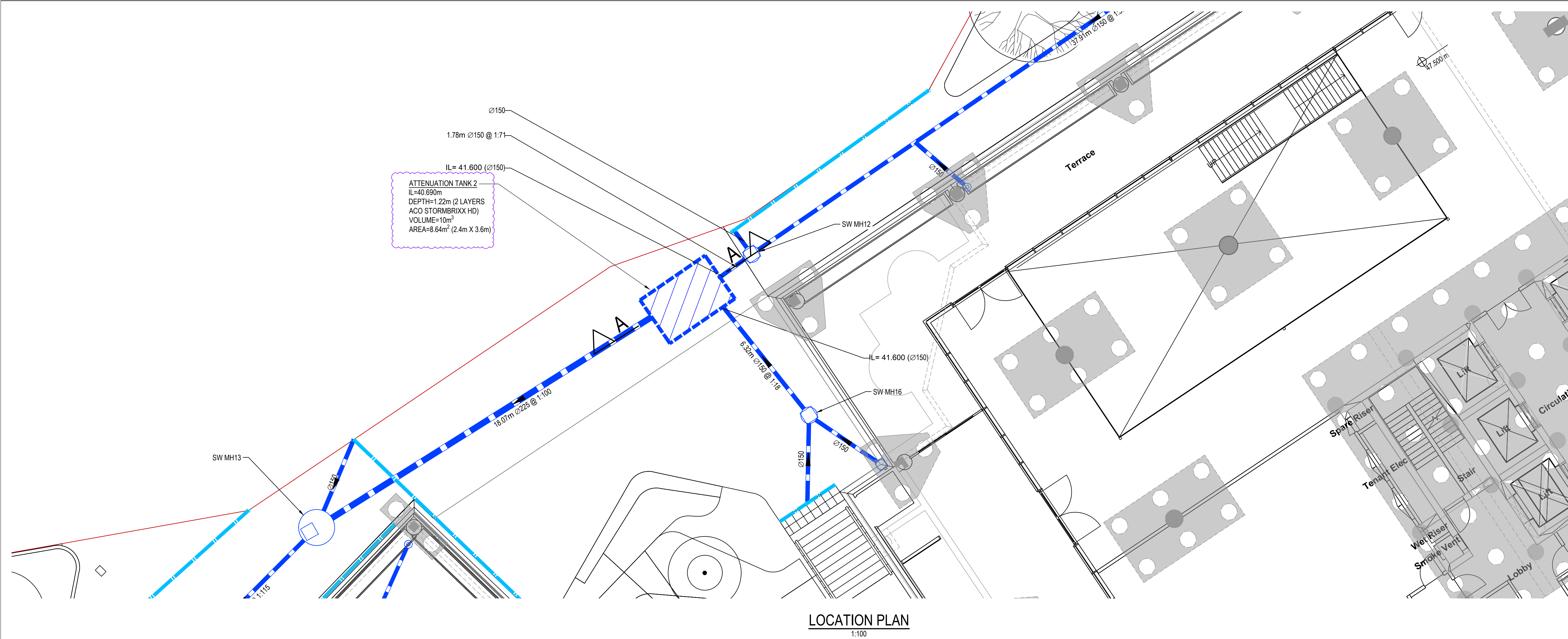
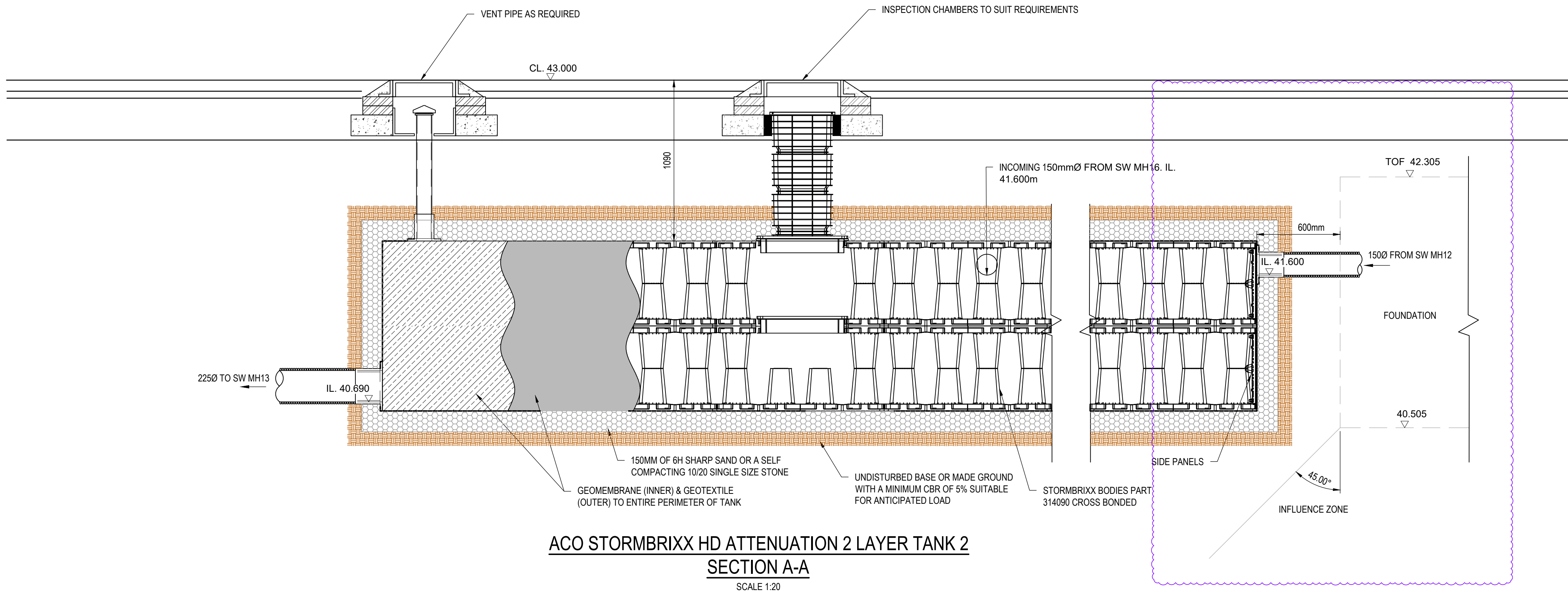
Checked By	
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Drawing No.

AS-BHE-XX-XX-DR-C-3706

Revision
P01



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P02	ADDITIONAL INFORMATION ADDED	01.12.2023	FR	PT	PT
P01	ISSUED FOR STAGE 3	28.04.2023	HB	FR	PT
Rev	Description	Date	Iss'd	Rev'd	App'd

STAGE 3

Project Stage

COMMENT

Status of Drawing

BURO HAPPOLD

3 Wellington Place
Leeds
LS1 4 AP
UK

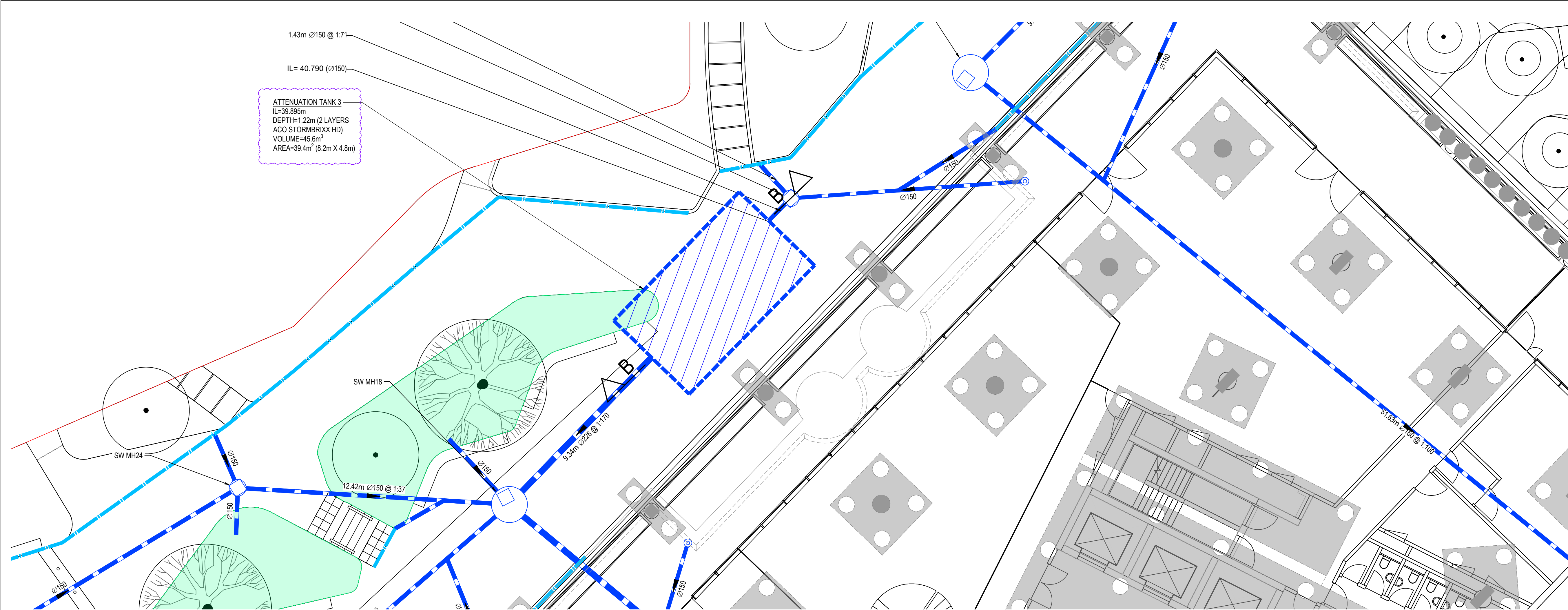
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Fax: +44 (0)1970 787 4144
Email: 00509090@burohappold.com
Web: www.burohappold.com

Client: MEPC
Architect: CARTWRIGHT PICKARD
Project: ANGEL SQUARE PLOTS 2 AND 3
Dwg Title: DRAINAGE DETAILS SHEET 8

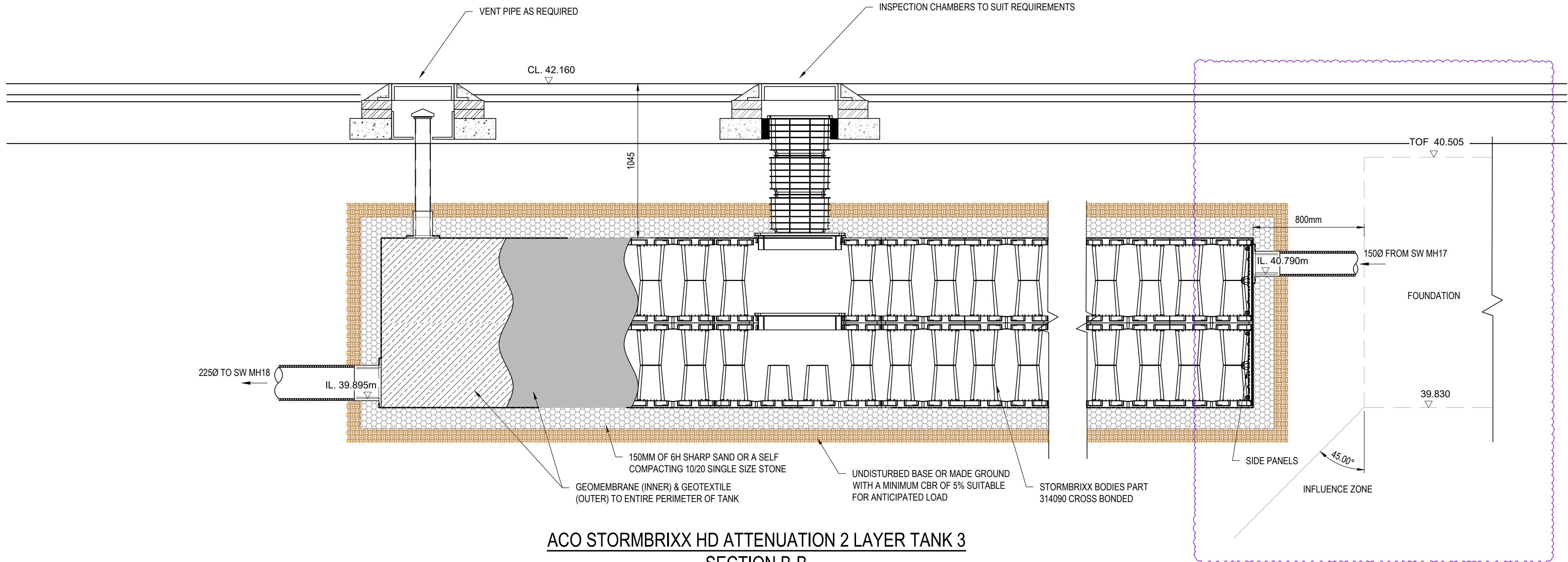
Job No: 0050930
Scale: A1
AS SHOWN

Drawn/Designed By: HB
Checked By: FR
Approved By: PT

Drawing No: AS-BHE-XX-XX-DR-C-3707
Revision: P02



LOCATION PLAN
1:100



ACO STORMBRIXX HD ATTENUATION 2 LAYER TANK 3
SECTION B-B
SCALE 1:20

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P02	ADDITIONAL INFORMATION ADDED	01.12.2023	FR	PT	PT
P01	ISSUED FOR STAGE 3	28.04.2023	HB	FR	PT
Rev	Description	Date	Iss'd	Rev'd	App'd

STAGE 3

Project Stage

COMMENT

Status of Drawing

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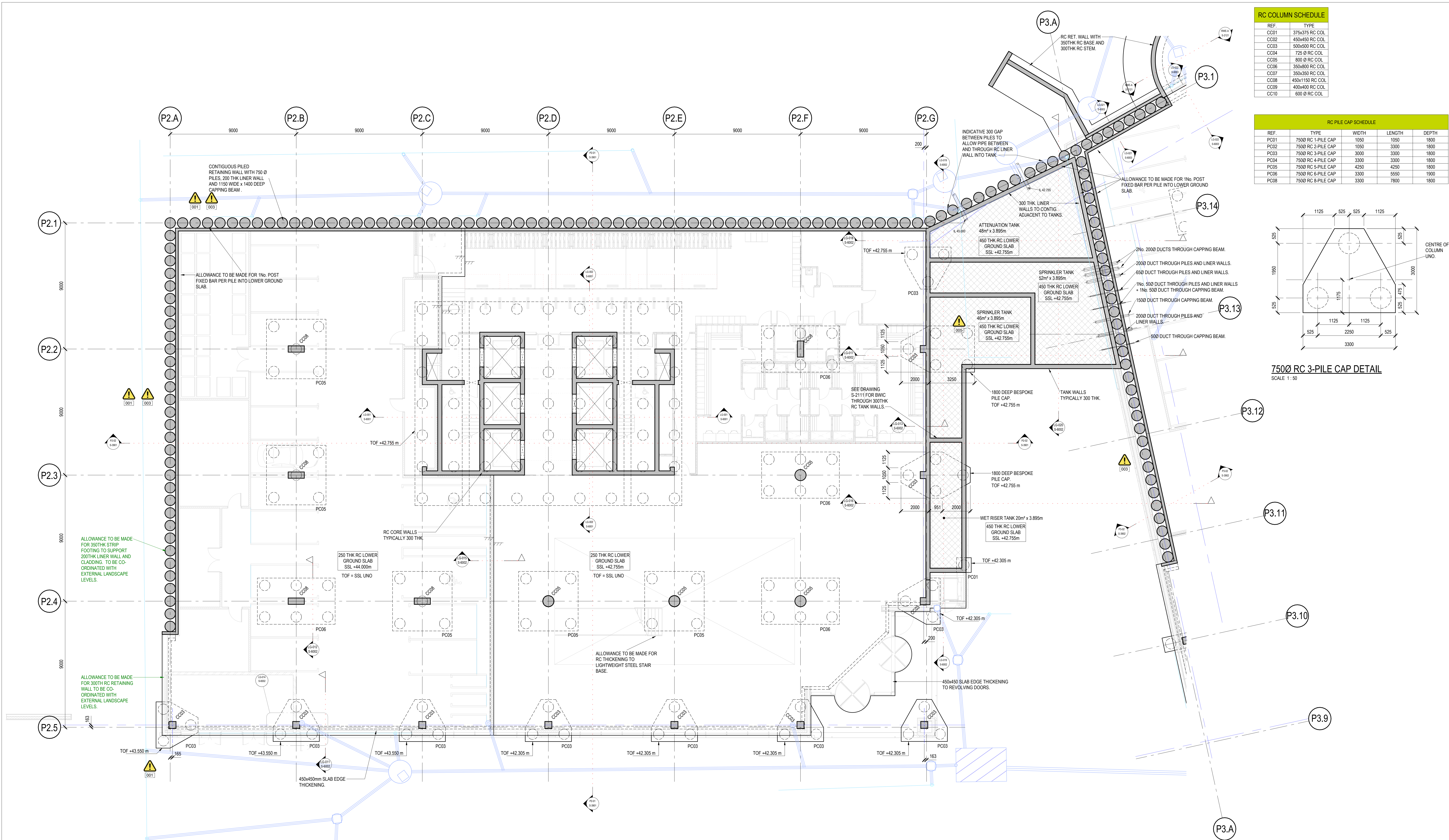
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Web: www.burohappold.com

Client: MEPC
Architect: CARTWRIGHT PICKARD
Project: ANGEL SQUARE PLOTS 2 AND 3
Dwg Title: DRAINAGE DETAILS SHEET 9

Job No:	0050930	Scale:	A1
Drawn/Designed By:	HB	Checked By:	FR
Drawing No:	AS-BHE-XX-XX-DR-C-3708	Approved By:	PT
Revision:			

P02

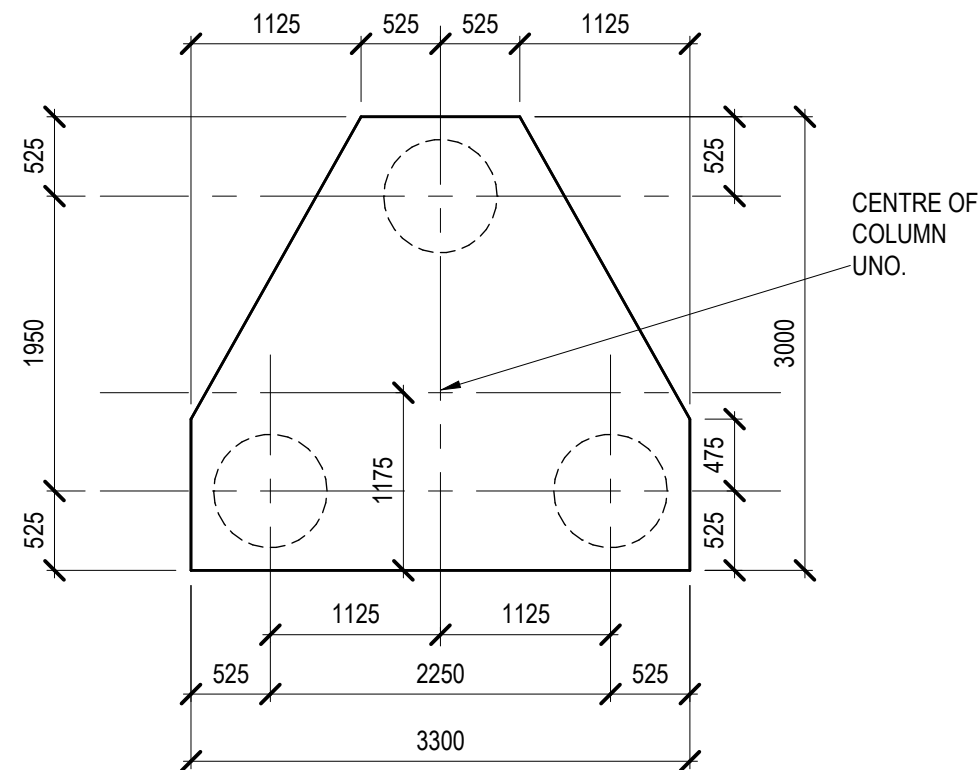


RC COLUMN SCHEDULE

REF.	TYPE
C001	375x375 RC COL
C002	450x450 RC COL
C003	500x500 RC COL
C004	725 Ø RC COL
C005	800 Ø RC COL
C006	350x800 RC COL
C007	350x350 RC COL
C008	450x1150 RC COL
C009	400x400 RC COL
C010	600 Ø RC COL

RC PILE CAP SCHEDULE

REF.	TYPE	WIDTH	LENGTH	DEPTH
PC01	7500 RC 1-PILE CAP	1050	1050	1800
PC02	7500 RC 2-PILE CAP	1050	3300	1800
PC03	7500 RC 3-PILE CAP	3000	3300	1800
PC04	7500 RC 4-PILE CAP	3300	3300	1800
PC05	7500 RC 5-PILE CAP	4250	4250	1800
PC06	7500 RC 6-PILE CAP	3300	5550	1900
PC08	7500 RC 8-PILE CAP	3300	7800	1800



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CONSTRUCTION
[001] PROPOSED PILE FOUNDATIONS IN CLOSE PROXIMITY TO EXISTING UTILITIES SHOWN ON HIGH-SURVEY REF TO BE ASSSESSED BY CIVIL ENGINEER FIRST.
[002] INDICATIVE PILE DESIGN ASSUMES PILES ARE PROPPED BY THE GROUND FLOOR SLAB. MAIN CONTRACTOR TO PROVIDE TEMPORARY PROPPING DURING EXCAVATION OR REPAIR. CANTILEVER PILES ALTERNATIVE WITH SPECIALIST PILE DESIGNER.
[003] TANKS WITH LIMITED ACCESS HATCHES. FORMWORK STRATEGY TO BE DEVELOPED WITH MAIN CONTRACTOR.
[005]

MAINTENANCE/CLANNING/OPERATION

DECOMMISSIONING/DEMOLITION

Notes

REFER TO DRAWING S-0001 FOR GENERAL NOTES.
PILING ARRANGEMENT BASED ON A PILE CAPACITY OF 2700N (KL) FOR TOP PILES.

REV	STAGE 3 ISSUE	21.04.23	TC	AS
REV	STAGE 2 ISSUE	26.05.22	TC	HS
REV	Description	Date	Dim	Appr

STAGE 3

Project Stage

S3 - FOR REVIEW AND COMMENT

Status of Drawing

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Web: www.burohappold.com

Client

Architect

Project

Plot 2
Lower Ground Floor
Structural General Arrangement

Job No.

050930

Scale/Alt

As indicated

Drawn By

TC

Checked By

HS

Approved By

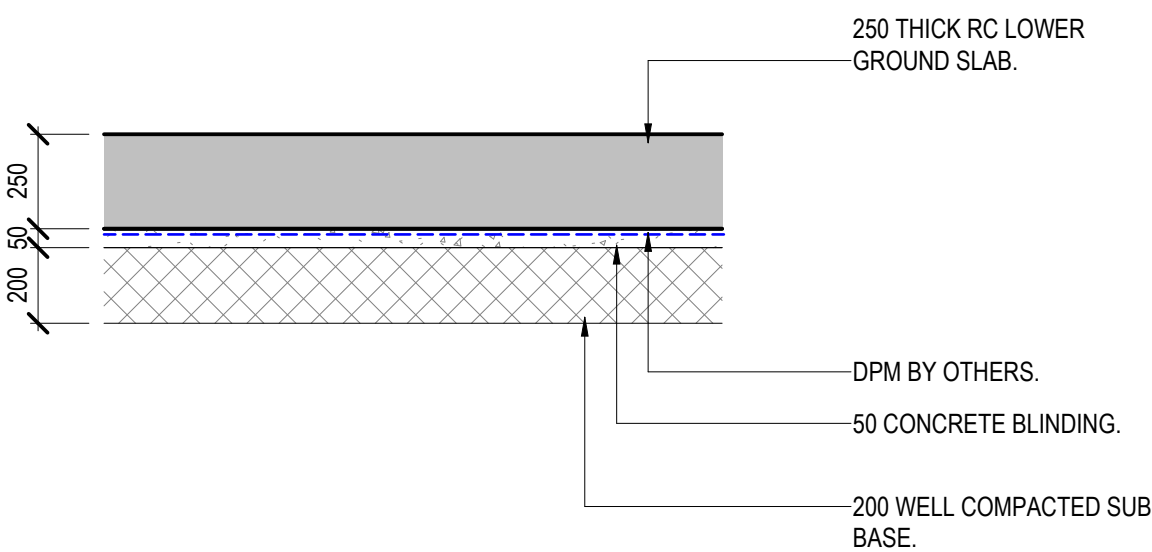
JE

Revision

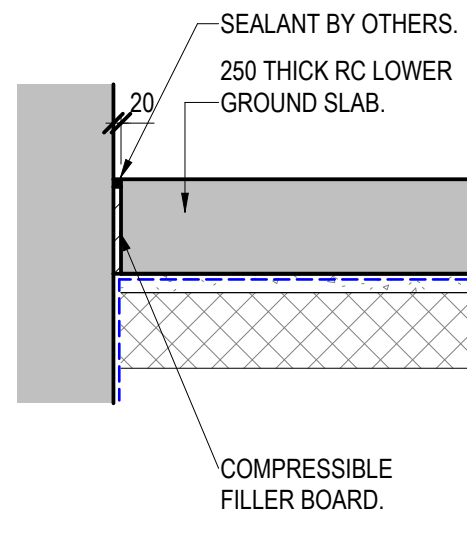
AS-BHE-P2-LG-DR-S-0991

P02

UNDERSLAB INSULATION REQUIREMENTS TO BE CONFIRMED BY OTHERS. SUB-BASE SHOWN ALSO APPLIES TO 450 THK LOWER GROUND TANKS BASE SLAB.



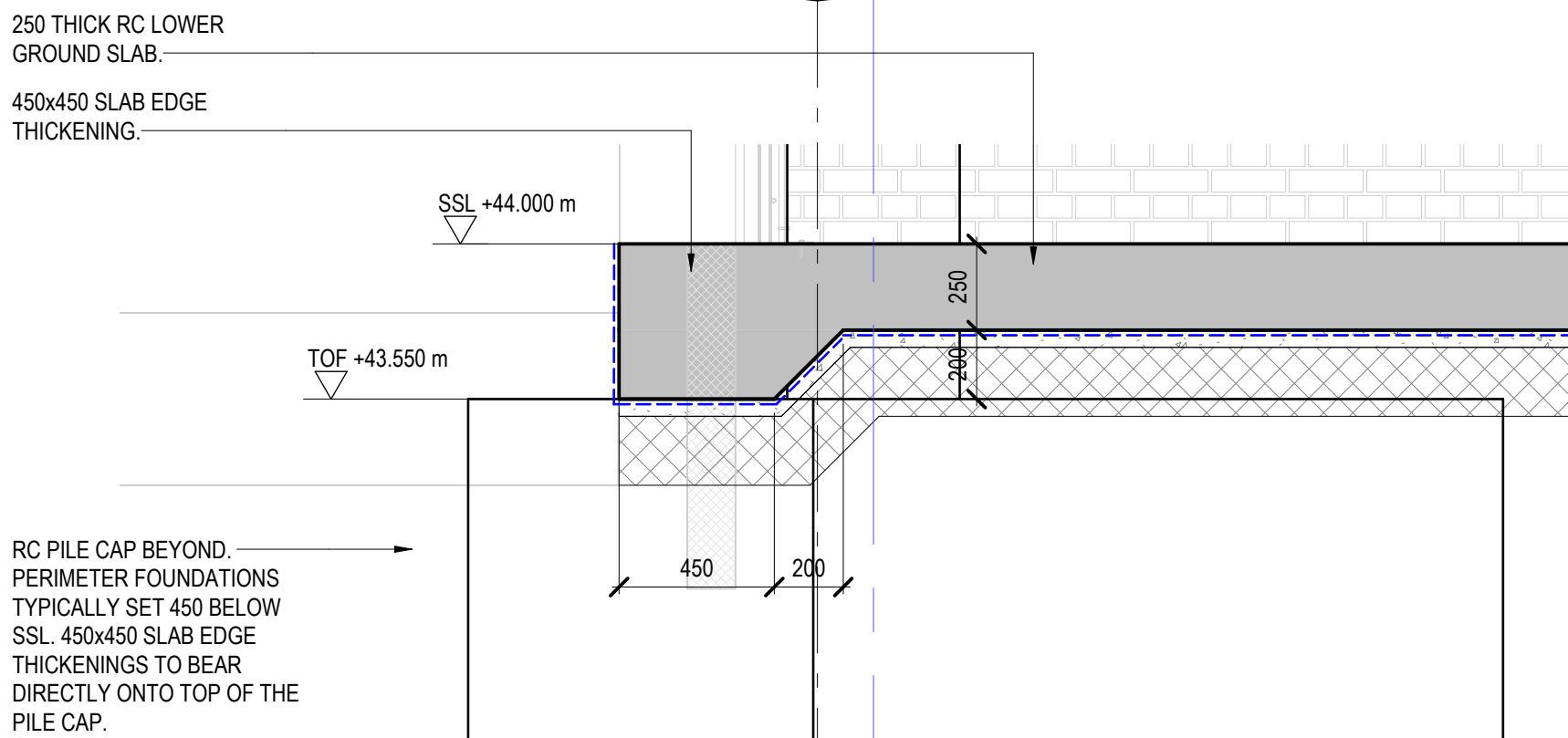
TYPICAL GROUND BEARING SLAB BUILD UP



TYPICAL ISOLATION JOINT DETAIL

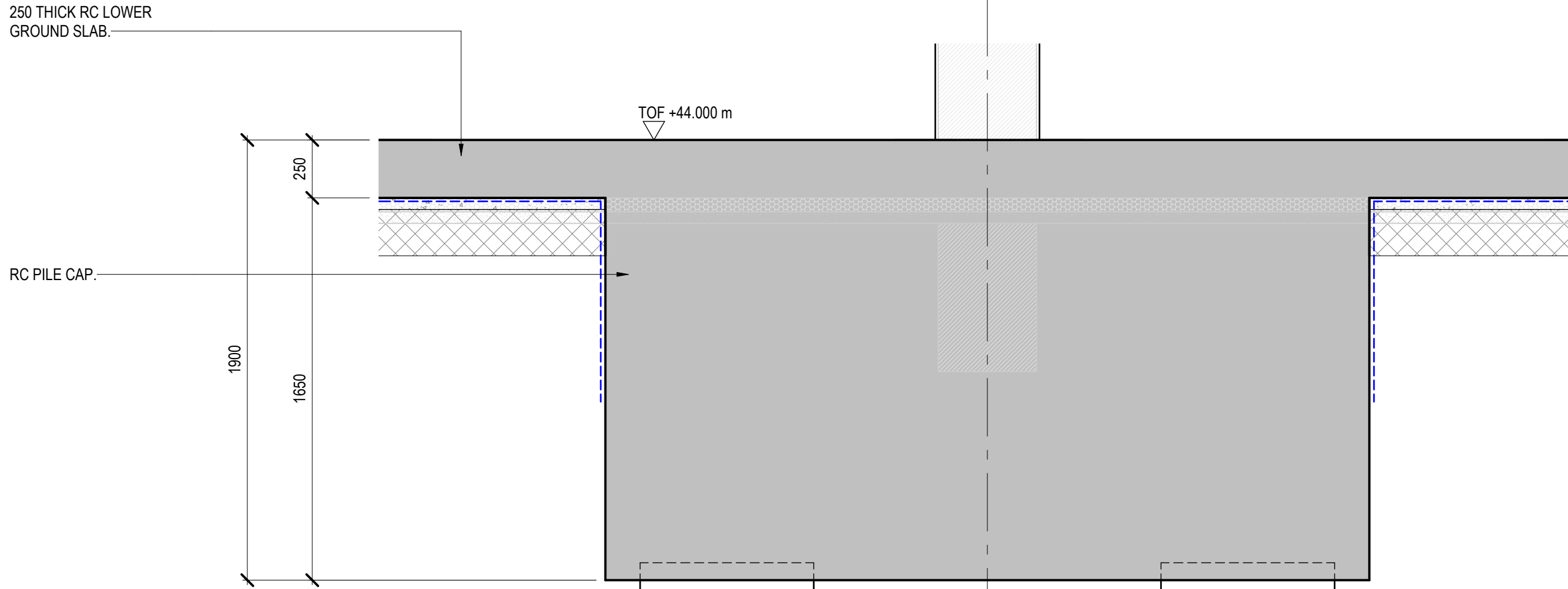
TYPICAL GROUND BEARING SLAB DETAILS

SCALE 1 : 20



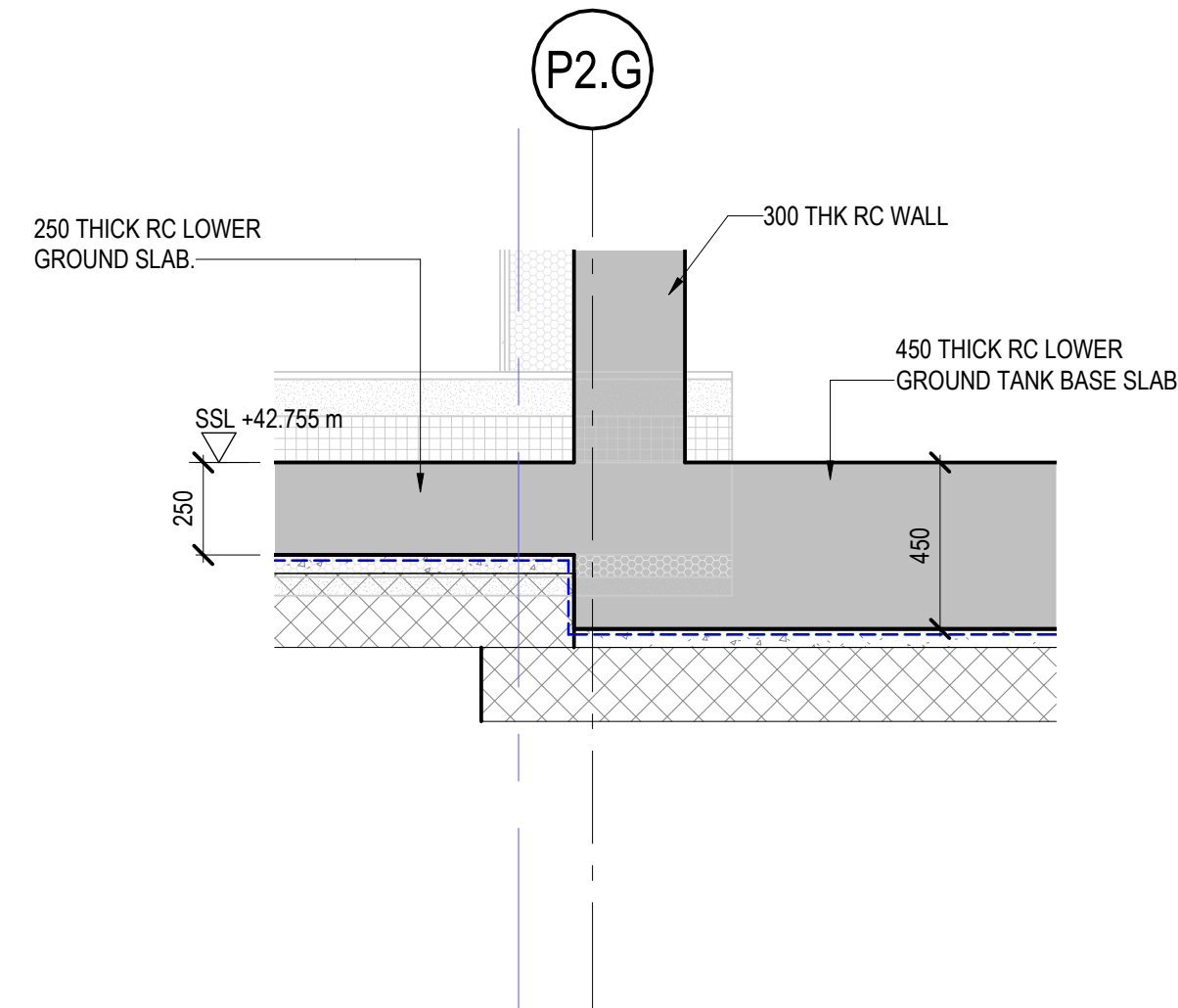
LG-011

SCALE 1 : 20



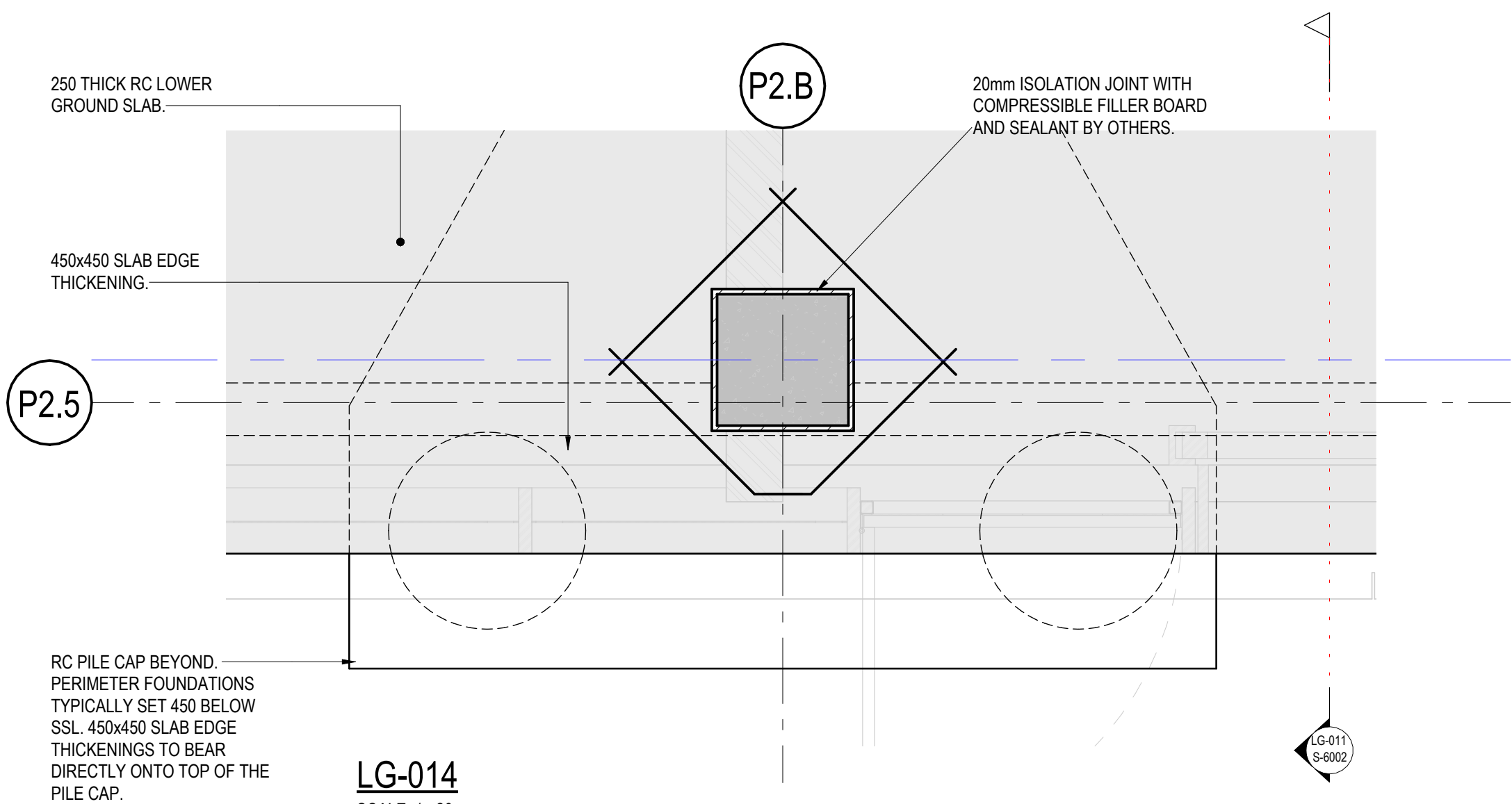
LG-012

SCALE 1 : 20



LG-013

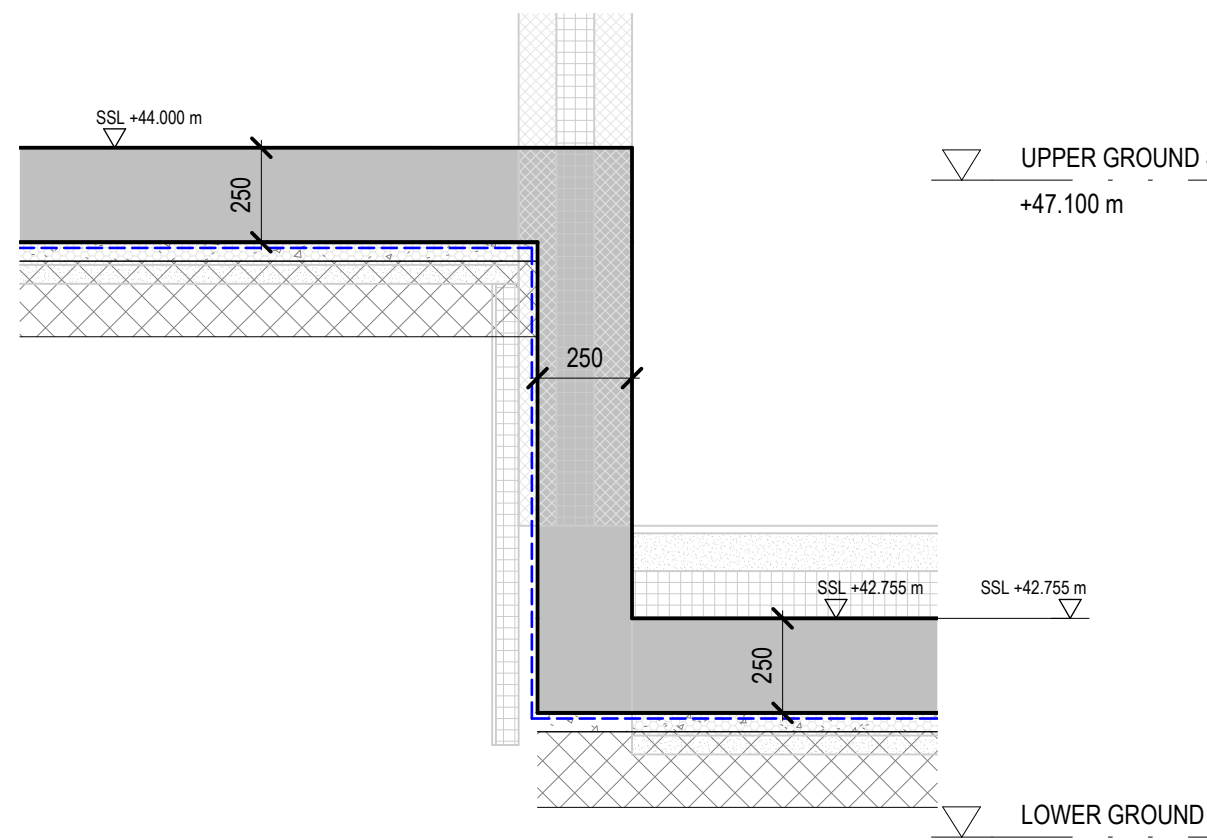
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LG-014

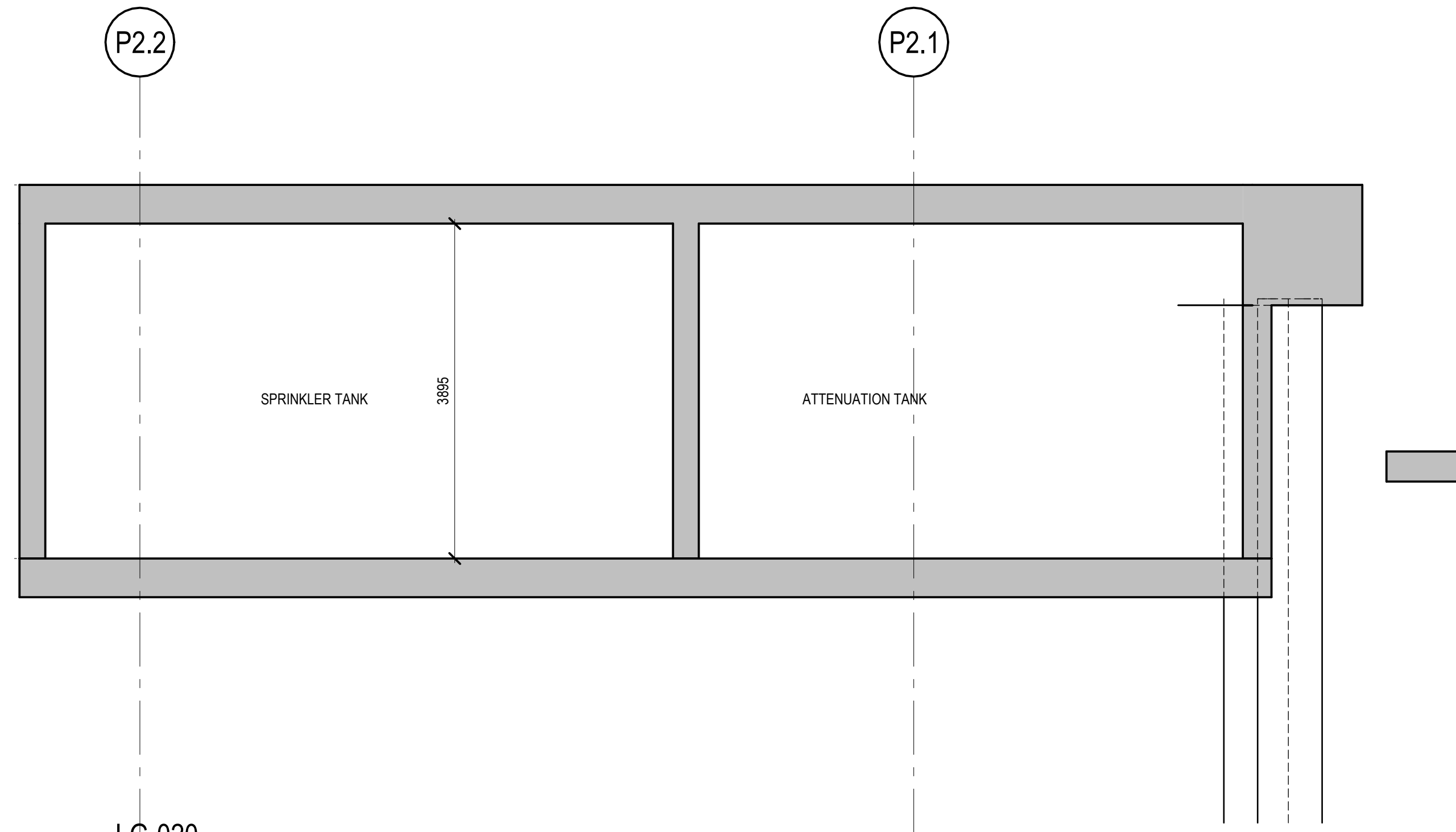
SCALE 1 : 20

DETAIL TYPICAL TO PERIMETER COLUMN AND FOUNDATIONS WITH PILE CAP SET 450mm BELOW SSL. 450x450mm SLAB EDGE THICKENINGS TO BEAR DIRECTLY ONTO TOP OF THE PILE CAP AND 20mm ISOLATION JOINT TO FACE OF COLUMN.



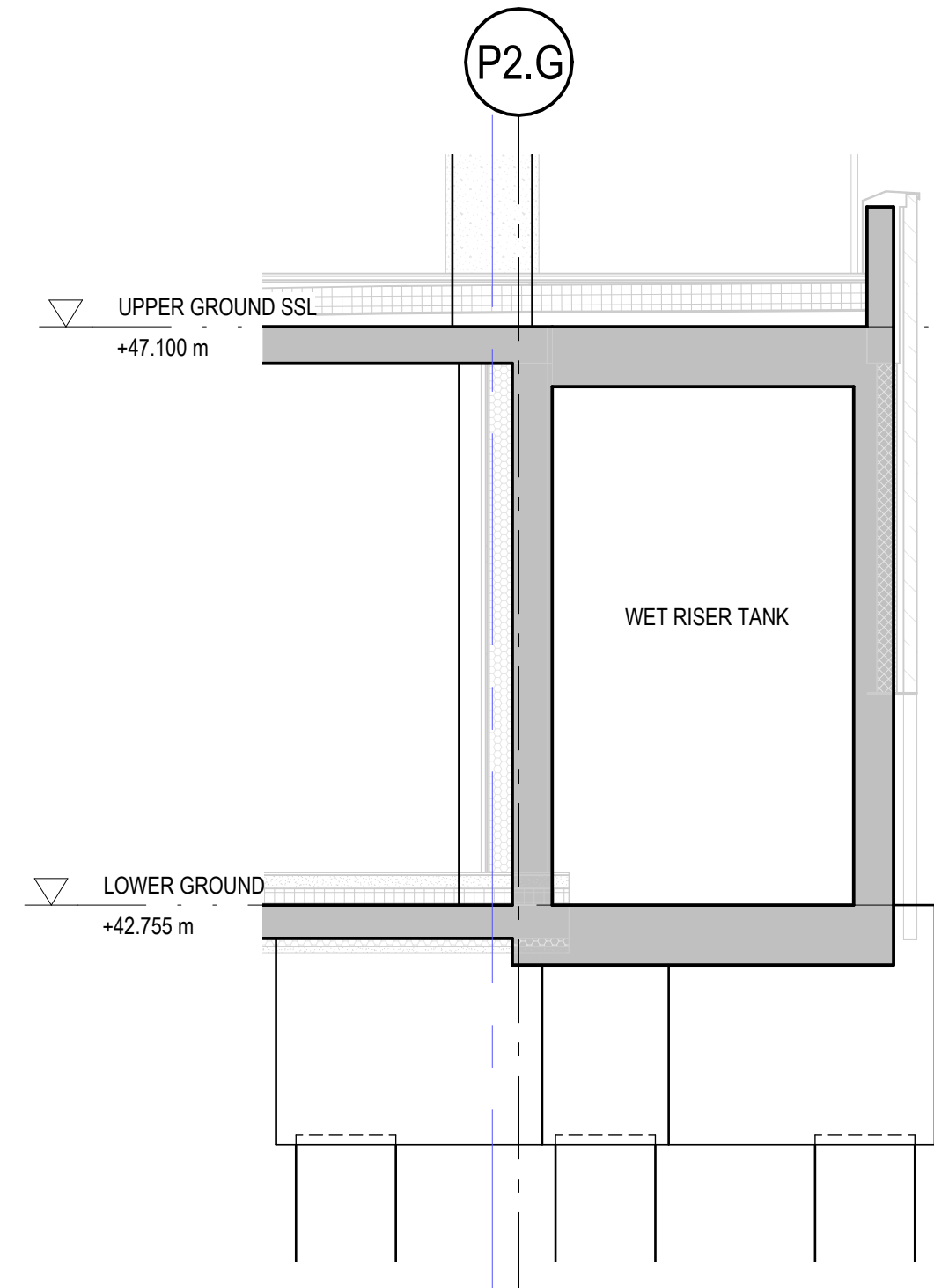
LG-015

SCALE 1 : 20



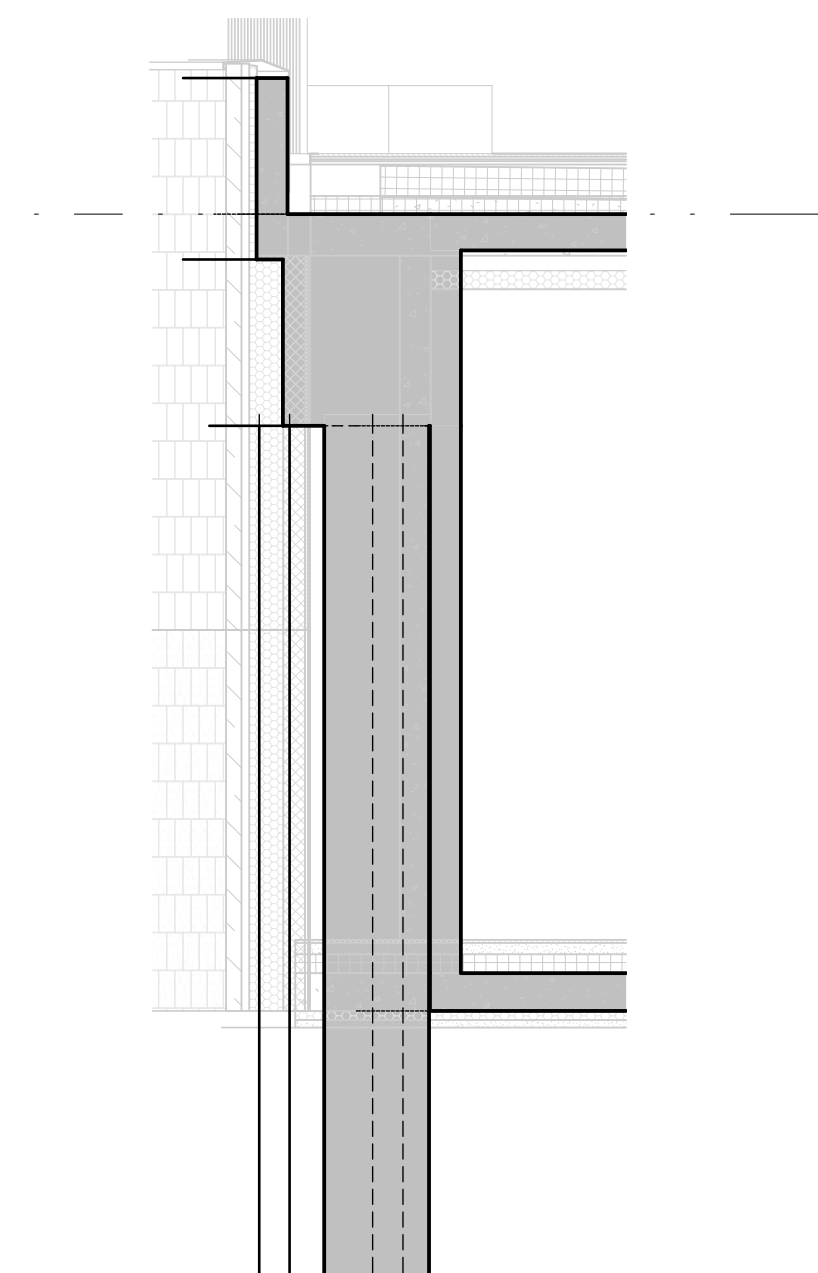
LG-020

SCALE 1 : 50



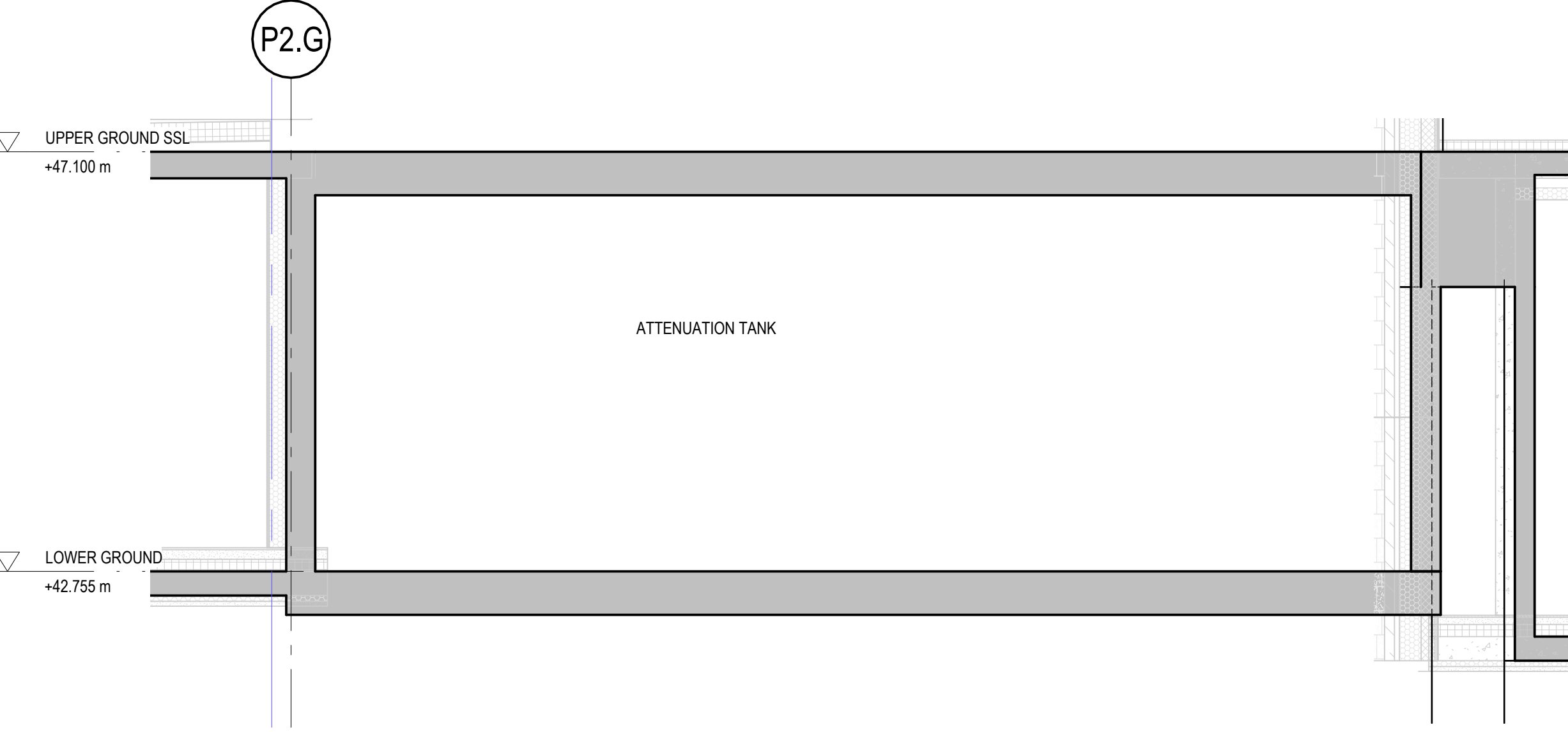
LG-016

SCALE 1 : 50



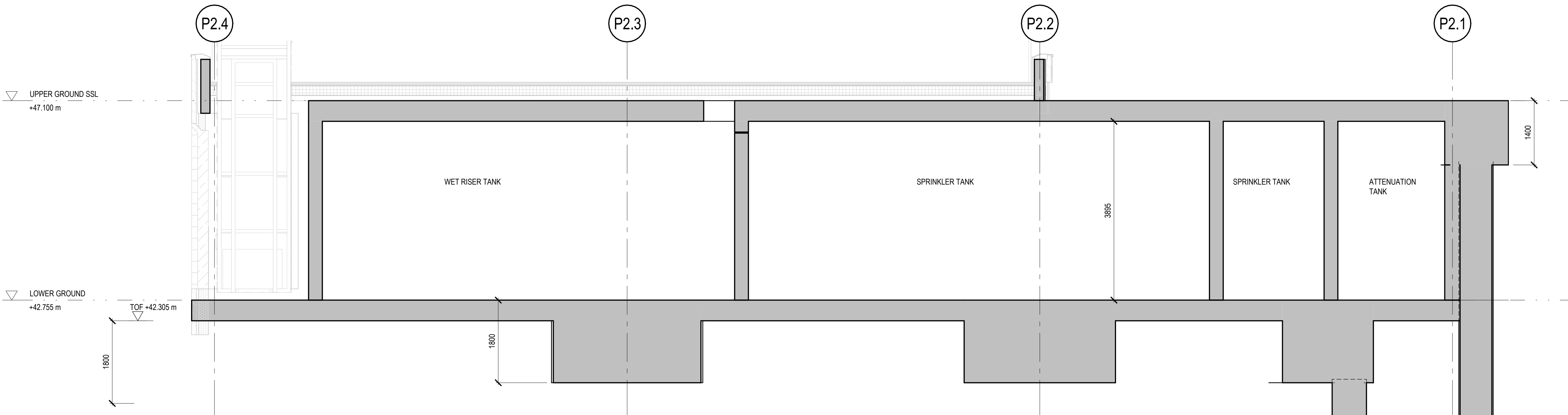
LG-017

SCALE 1 : 50



LG-018

SCALE 1 : 50



LG-019

SCALE 1 : 50

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MAINTENANCE/CLANNING/OPERATION

DECOMMISSIONING/DEMOLITION

Notes

REFER TO DRAWING S-001 FOR GENERAL NOTES.

Rev	Description	Date	Drawn	App'd
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STAGE 3

S3 - FOR REVIEW AND COMMENTS

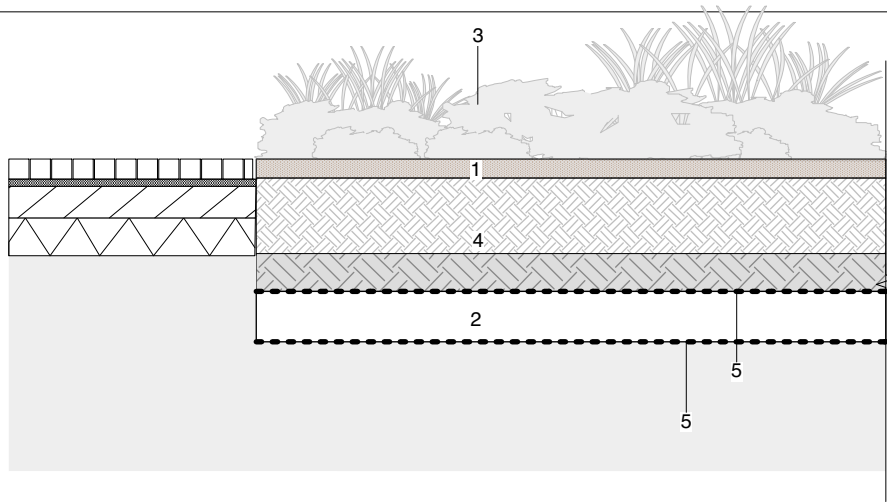
Scale of Drawing

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Client: MEPC
Architect: CARTWRIGHT PICKARD
Project: ANGEL SQUARE PLOTS 2 AND 3
Drawing Title: LOWER GROUND SECTIONS AND DETAILS SHEET 2

Job No: 050930	Scale: As indicated
Drawn By: TC	Checked By: BB
Approved By: JE	Revision: P01

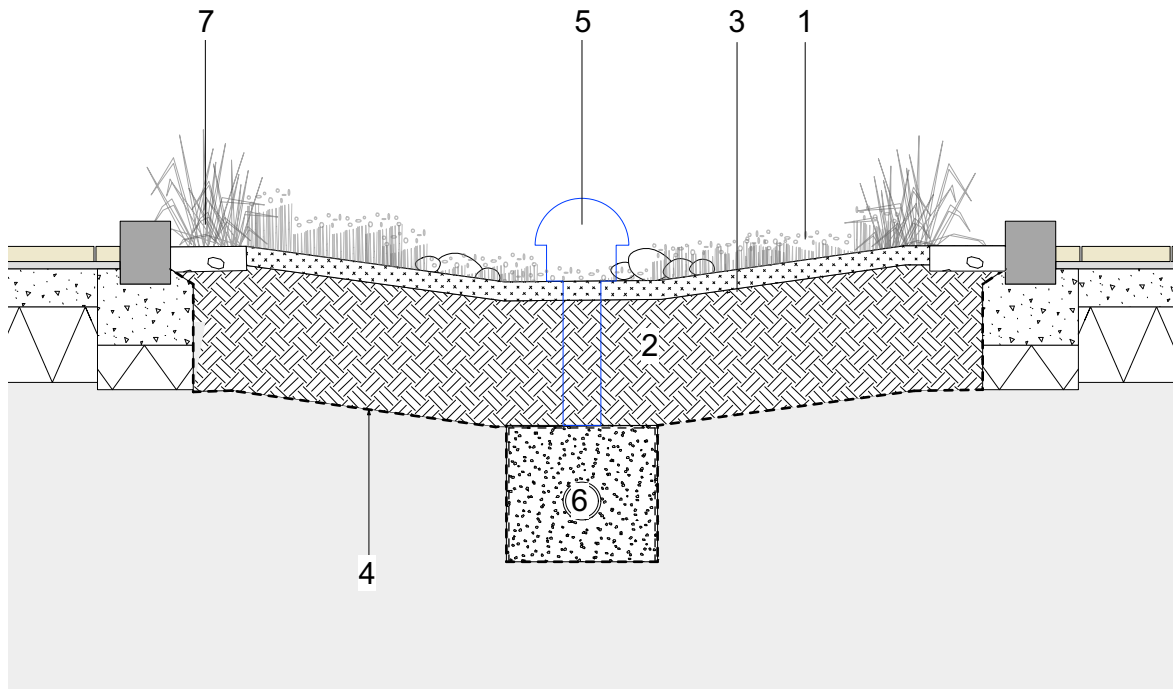


S1

Typical softworks build up

Scale: 1:25

1. 75mm depth bark mulch layer
2. Drainage layer 300mm type 3 clean stone to base
3. Ornamental Planting. Refer to softworks schedule 2190.1-PLA-XX-XX-DR-L-2000
4. To have minimum depth 450mm (150mm subsoil/ 300mm topsoil) To specification clause Q28
5. Geotextile membrane (refer to clause Q31/385A)



S2

Typical rain garden build up

Scale: 1:25

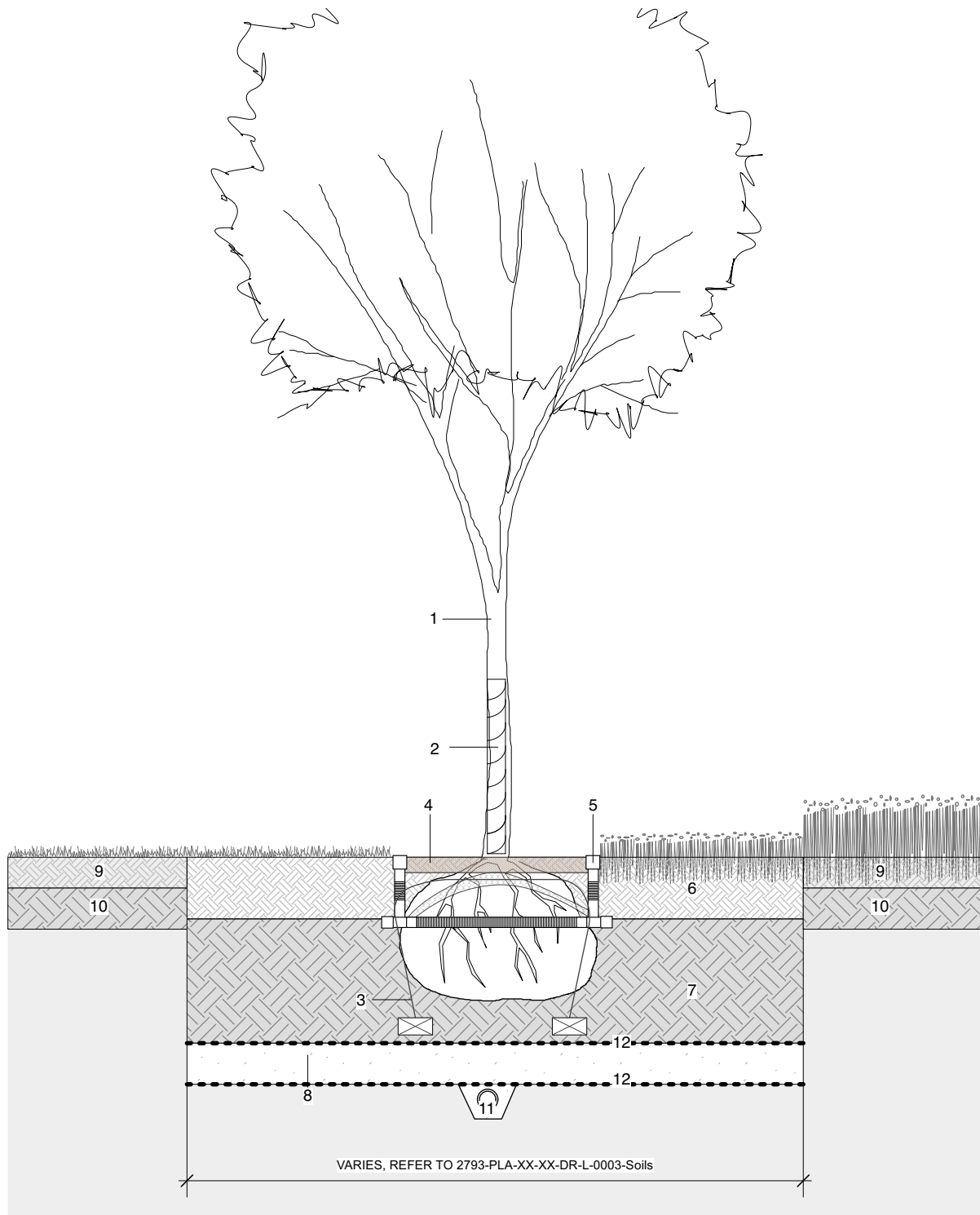
1. Proposed Planting - refer to softworks schedule
2. Porous free draining soil (sand based soil with organic matter) Sample to be approved by LA prior to installation. Refer to soils plan
3. Site won crushed stone mulch
Sample to be approved by Landscape architect. To specification clause Q23/160B
4. Geomembrane liner - to engineer's specification
5. Dome Grill overflow with stainless steelsurround to exposed pipe work above ground. Geotextile membrane - to engineer's specification.
To specification clause Q31/385A.
6. Collector perforated plastic pipe in clean course open no fines, graded aggregate - to engineer's specification
7. Scour protection detail to surface water inlets and around overflow gullies: 300mm wide x 100mm deep gravel strip, lined with geotextile filtration membrane (Terram).
Gravel: 10-20mm Fogg Brook pebbles
Supplier: Offerton Sand and Gravel

S3

Typical tree in soft build up

Scale: 1:30

1. Semi-mature and EHS tree planting. Refer to Softworks Plan 2190.1-PLA-XX-XX-DR-L-2000 for locations and schedules.
2. Hessian wrapping to trunk.
3. Tree anchoring deadman anchoring system Deadman Fixing Kit - Plati-Mat® - RF2RDMP or equal and approved.
4. 75mm Bark mulch layer 800mm diameter to each tree pit. Refer to Q31/485J.
5. Water and air pipe system (refer to Q31/512J) to be used in addition to automated irrigation system by others.
6. Imported topsoil to top 300mm depth of tree pit / trench.
7. Imported subsoil to bottom 600mm depth of tree pit / trench.
8. Drainage layer 100mm clean stone to base of tree pits.
9. Imported topsoil to top 150mm depth grass / wildflower areas.
10. Imported subsoil to bottom 200mm depth grass / wildflower areas.
11. If necessary due to ground conditions (poor water percolation), tree pits to have active drainage connections to drainage system.
12. Geotextile membrane (refer to clause Q31/385A)

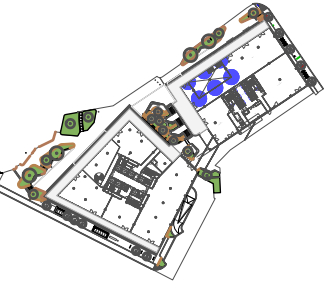


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NOTES:

1. Do not scale from this drawing.
2. Always work to noted dimensions.
3. All dimensions are in millimetres unless otherwise stated.
4. All setting out, levels and dimensions to be agreed on site.
5. The dimensions of all materials must be checked on site before being laid out.
6. This drawing must be read with the relevant specification clauses and detail drawings.
7. Order of construction and setting out to be agreed on site.

Location plan



S1-P02 07-07-23 Stage 3+ Issue EKH MS
S1-P01 05-05-23 Stage 3 EKH MS

Revision	Date	Description	Drawn	Apprvd.
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Client MEPC

Project 2&3 Angel Square

Drg Title Typical Softworks Detail

Created on 03/05/2023 Created by EKH Approved by MS

Scale AS NOTED Size A3 Workstage Stage 3+

Drg No. 2190.1-PLA-XX-XX-DR-L-6000 Suitability S4 Revision P02

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Appendix I Hydraulic calculations results (2&3)

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Online Controls for Storm- both plots

Hydro-Brake® Optimum Manhole: SSW MH4, DS/PN: S1.004, Volume (m³): 5.7

Unit Reference	MD-SHE-0036-1100-3500-1100
Design Head (m)	3.500
Design Flow (l/s)	1.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	36
Invert Level (m)	42.725
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.500	1.1
Flush-Flo™	0.155	0.5
Kick-Flo®	0.324	0.4
Mean Flow over Head Range	-	0.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.4	1.200	0.7	3.000	1.0	7.000	1.5
0.200	0.5	1.400	0.7	3.500	1.1	7.500	1.6
0.300	0.4	1.600	0.8	4.000	1.2	8.000	1.6
0.400	0.4	1.800	0.8	4.500	1.2	8.500	1.6
0.500	0.5	2.000	0.9	5.000	1.3	9.000	1.7
0.600	0.5	2.200	0.9	5.500	1.3	9.500	1.7
0.800	0.6	2.400	0.9	6.000	1.4		
1.000	0.6	2.600	1.0	6.500	1.5		

Hydro-Brake® Optimum Manhole: SSW MH13, DS/PN: S2.004, Volume (m³): 2.7

Unit Reference	MD-SHE-0086-3300-1000-3300
Design Head (m)	1.000
Design Flow (l/s)	3.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	86
Invert Level (m)	40.510
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

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Hydro-Brake® Optimum Manhole: SSW MH13, DS/PN: S2.004, Volume (m³): 2.7

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.3
Flush-Flo™	0.296	3.3
Kick-Flo®	0.624	2.7
Mean Flow over Head Range	-	2.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.6	1.200	3.6	3.000	5.5	7.000	8.2
0.200	3.2	1.400	3.9	3.500	5.9	7.500	8.5
0.300	3.3	1.600	4.1	4.000	6.3	8.000	8.7
0.400	3.2	1.800	4.3	4.500	6.6	8.500	9.0
0.500	3.1	2.000	4.5	5.000	7.0	9.000	9.2
0.600	2.8	2.200	4.8	5.500	7.3	9.500	9.5
0.800	3.0	2.400	4.9	6.000	7.6		
1.000	3.3	2.600	5.1	6.500	7.9		

Hydro-Brake® Optimum Manhole: SSW MH9, DS/PN: S1.009, Volume (m³): 6.0

Unit Reference	MD-SHE-0133-9600-1700-9600
Design Head (m)	1.700
Design Flow (l/s)	9.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	133
Invert Level (m)	39.300
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.700	9.6
Flush-Flo™	0.501	9.6
Kick-Flo®	1.040	7.6
Mean Flow over Head Range	-	8.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.8	0.300	9.2	0.500	9.6	0.800	9.1
0.200	8.4	0.400	9.5	0.600	9.5	1.000	8.0

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Storage Structures for Storm- both plots

Tank or Pond Manhole: STANK 1, DS/PN: S1.003

Invert Level (m) 42.755

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	47.0	3.895	47.0	3.896	0.0

Cellular Storage Manhole: STANK 2, DS/PN: S2.003

Invert Level (m) 40.690 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	8.6	0.0	1.221	0.0	0.0
1.220	8.6	0.0			

Cellular Storage Manhole: STANK 3, DS/PN: S4.001

Invert Level (m) 39.895 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	39.3	0.0	1.221	0.0	0.0
1.220	39.3	0.0			

Cellular Storage Manhole: STANK 4, DS/PN: S4.005

Invert Level (m) 39.345 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	79.8	0.0	1.701	0.0	0.0
1.700	79.8	0.0			

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)

for Storm- both plots

Simulation Criteria

Areal Reduction Factor 1.000

Hot Start (mins) 0

Hot Start Level (mm) 0

Manhole Headloss Coeff (Global) 0.500

Foul Sewage per hectare (l/s) 0.000

Additional Flow - % of Total Flow 0.000

MADD Factor * 10m³/ha Storage 2.000

Inlet Coeffiecient 0.800

Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0

Number of Online Controls 3

Number of Offline Controls 0

Number of Storage Structures 4

Number of Time/Area Diagrams 0

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR

Region England and Wales Cv (Summer) 0.750

M5-60 (mm) 18.000

Ratio R 0.360

Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0

Analysis Timestep 2.5 Second Increment (Extended)

DTS Status OFF

DVD Status ON

Inertia Status ON

Profile(s) Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440

Return Period(s) (years) 1, 30, 100

Climate Change (%) 0, 0, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	SSW MH1	15 Winter	1	+0%	100/600 Winter			
S1.001	SSW MH2	15 Winter	1	+0%	30/15 Summer			
S1.002	SSW MH3	15 Winter	1	+0%	30/15 Summer			
S1.003	STANK 1	600 Winter	1	+0%	1/30 Summer			
S1.004	SSW MH4	600 Winter	1	+0%	1/15 Summer			
S1.005	SSW MH5	600 Winter	1	+0%				
S2.000	SSW MH10	15 Summer	1	+0%				
S2.001	SSWMH 11	15 Winter	1	+0%				
S2.002	SSW MH12	15 Winter	1	+0%				
S3.000	SSWMH 16	15 Winter	1	+0%				
S2.003	STANK 2	15 Winter	1	+0%	30/15 Winter			
S2.004	SSW MH13	15 Winter	1	+0%	1/15 Winter			
S2.005	SSW MH14	15 Winter	1	+0%	100/15 Summer			
S2.006	SSW MH15	15 Winter	1	+0%	30/15 Summer			
S1.006	SSW MH6	15 Winter	1	+0%	30/15 Summer			
S1.007	SSW MH7	60 Winter	1	+0%	30/15 Summer			
S4.000	SSW MH17	15 Winter	1	+0%	100/120 Winter			
S4.001	STANK 3	30 Winter	1	+0%	30/120 Winter			

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm- both plots

PN	US/MH Name	Water	Surcharged	Flooded	Flow / Cap.	Overflow (l/s)	Half Drain	Pipe	Status
		Level (m)	Depth (m)	Volume (m³)			Time (mins)	Flow (l/s)	
S1.000	SSW MH1	46.188	-0.112	0.000	0.14			2.4	OK
S1.001	SSW MH2	45.863	-0.092	0.000	0.32			3.5	OK
S1.002	SSW MH3	45.852	-0.077	0.000	0.47			5.0	OK
S1.003	STANK 1	43.464	0.409	0.000	0.01			0.6	SURCHARGED
S1.004	SSW MH4	43.473	0.598	0.000	0.03			0.5	SURCHARGED
S1.005	SSW MH5	42.657	-0.133	0.000	0.03			0.5	OK
S2.000	SSW MH10	43.050	-0.150	0.000	0.00			0.0	OK
S2.001	SSWMH 11	42.621	-0.129	0.000	0.05			1.3	OK
S2.002	SSW MH12	41.667	-0.108	0.000	0.17			1.7	OK
S3.000	SSWMH 16	41.966	-0.084	0.000	0.06			0.7	OK
S2.003	STANK 2	40.721	-0.194	0.000	0.05		9	2.2	OK
S2.004	SSW MH13	40.672	0.012	0.000	0.20			3.1	SURCHARGED
S2.005	SSW MH14	40.467	-0.108	0.000	0.18			3.1	OK
S2.006	SSW MH15	39.990	-0.070	0.000	0.54			8.2	OK
S1.006	SSW MH6	39.917	-0.073	0.000	0.51			8.7	OK
S1.007	SSW MH7	39.613	-0.127	0.000	0.18			8.8	OK
S4.000	SSW MH17	40.845	-0.115	0.000	0.12			1.7	OK
S4.001	STANK 3	39.915	-0.205	0.000	0.02		20	0.6	OK

PN	US/MH Name	Level Exceeded
S1.000	SSW MH1	
S1.001	SSW MH2	
S1.002	SSW MH3	
S1.003	STANK 1	
S1.004	SSW MH4	
S1.005	SSW MH5	
S2.000	SSW MH10	
S2.001	SSWMH 11	
S2.002	SSW MH12	
S3.000	SSWMH 16	
S2.003	STANK 2	
S2.004	SSW MH13	
S2.005	SSW MH14	
S2.006	SSW MH15	
S1.006	SSW MH6	
S1.007	SSW MH7	
S4.000	SSW MH17	
S4.001	STANK 3	

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<u>30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)</u> <u>for Storm- both plots</u>									
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	
S5.000	SSW MH24	15 Winter	30	+0%	100/15 Summer				
S4.002	SSWMH 18	120 Winter	30	+0%	30/15 Winter				
S4.003	SSWMH 19	120 Winter	30	+0%	30/15 Summer				
S6.000	SSW MH23	15 Winter	30	+0%					
S4.004	SSWMH 20	120 Winter	30	+0%	30/15 Summer				
S4.005	STANK 4	120 Winter	30	+0%	30/15 Summer				
S1.008	SSW MH8	120 Winter	30	+0%	30/15 Summer				
S7.000	SSW MH21	15 Winter	30	+0%	100/15 Summer				
S7.001	SSW MH22	15 Winter	30	+0%	100/15 Summer				
S1.009	SSW MH9	120 Winter	30	+0%	1/15 Summer				
PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S5.000	SSW MH24	40.411	-0.049	0.000	0.78			22.7	OK
S4.002	SSWMH 18	40.167	0.102	0.000	0.22			8.4	SURCHARGED
S4.003	SSWMH 19	40.164	0.244	0.000	0.39			15.3	SURCHARGED
S6.000	SSW MH23	41.009	-0.091	0.000	0.32			12.4	OK
S4.004	SSWMH 20	40.157	0.407	0.000	0.47			17.3	SURCHARGED
S4.005	STANK 4	40.151	0.506	0.000	0.19		117	9.4	SURCHARGED
S1.008	SSW MH8	40.175	0.555	0.000	0.20			10.3	SURCHARGED
S7.000	SSW MH21	42.143	-0.107	0.000	0.53			24.6	OK
S7.001	SSW MH22	42.021	-0.064	0.000	0.84			30.0	OK
S1.009	SSW MH9	40.182	0.732	0.000	0.76			9.6	SURCHARGED
PN	US/MH Name	Level Exceeded							
S5.000	SSW MH24								
S4.002	SSWMH 18								
S4.003	SSWMH 19								
S6.000	SSW MH23								
S4.004	SSWMH 20								
S4.005	STANK 4								
S1.008	SSW MH8								
S7.000	SSW MH21								
S7.001	SSW MH22								
S1.009	SSW MH9								
©1982-2020 Innovyze									

Manhole Schedules for Storm- both plots

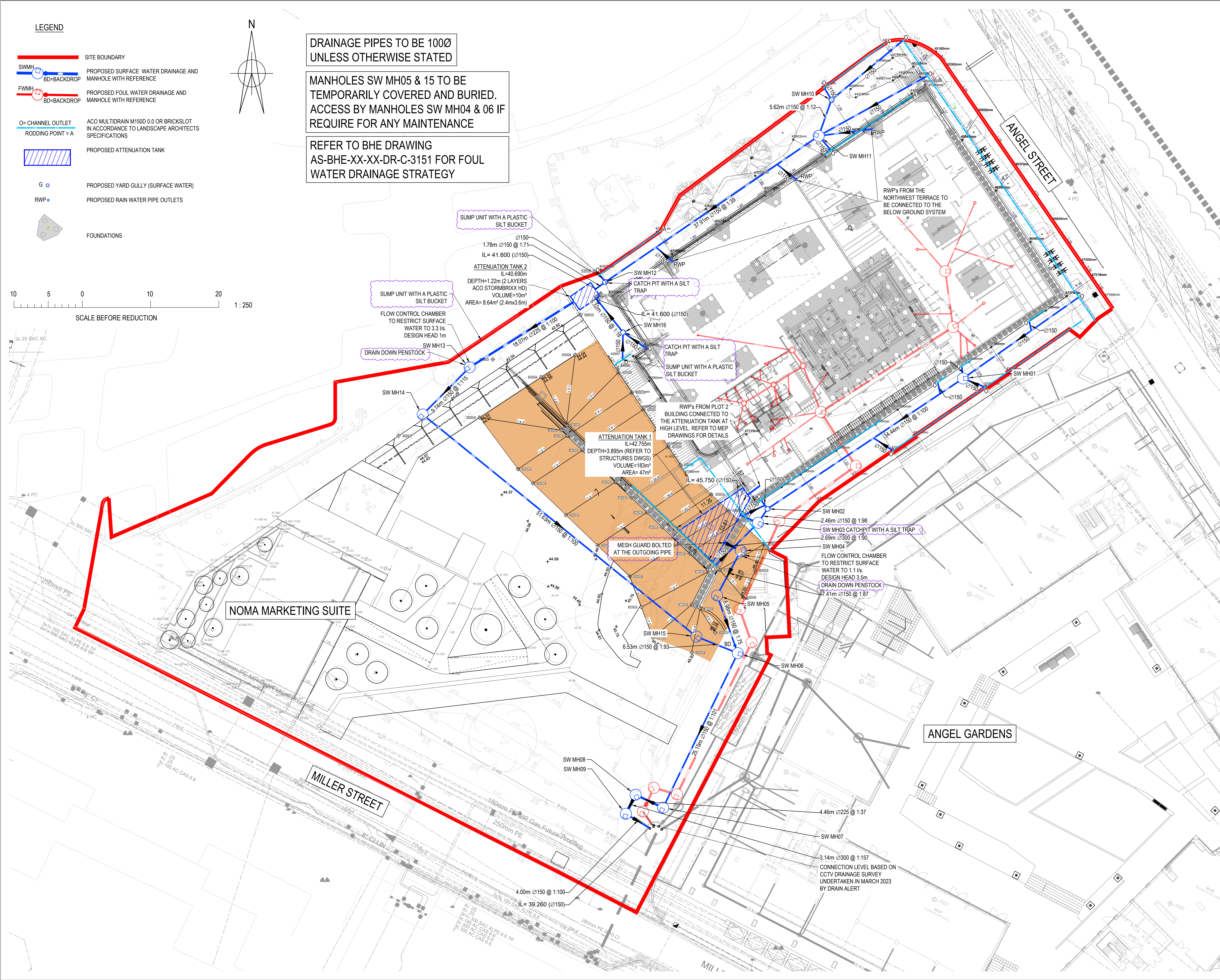
MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SSW MH17	384327.570	398984.976	384327.570	398984.976	Required	
STANK 3	384321.854	398978.368	384321.854	398978.368	Required	
SSW MH24	384302.332	398971.768	384302.332	398971.768	Required	
SSWMH 18	384314.726	398971.005	384314.726	398971.005	Required	
SSWMH 19	384331.316	398957.188	384331.316	398957.188	Required	
SSW MH23	384366.804	398969.982	384366.804	398969.982	Required	
SSWMH 20	384354.219	398946.200	384354.219	398946.200	Required	
STANK 4	384369.529	398939.841	384369.529	398939.841	Required	

Manhole Schedules for Storm- both plots

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SSW MH8	384366.974	398935.022	384366.974	398935.022	Required	
SSW MH21	384345.787	398935.075	384345.787	398935.075	Required	
SSW MH22	384360.693	398927.922	384360.693	398927.922	Required	
SSW MH9	384365.546	398932.223	384365.546	398932.223	Required	
SEX MH	384369.300	398929.950			No Entry	

Appendix J Proposed Surface Water Drainage Information

Plot 2



LEGEND

SITE BOUNDARY

PROPOSED SURFACE WATER DRAINAGE AND MANHOLE WITH REFERENCE

PROPOSED FOUL WATER DRAINAGE AND MANHOLE WITH REFERENCE

ACO MULTIDRAIN M150D 0.0 OR BRICKSLOT IN ACCORDANCE TO LANDSCAPE ARCHITECTS SPECIFICATIONS

PROPOSED ATTENUATION TANK

PROPOSED YARD GULLY (SURFACE WATER)

PROPOSED RAIN WATER PIPE OUTLETS

FOUNDATIONS

105

SCALE BEFORE REDUCTION

1:250

HEALTH AND SAFETY INFORMATION

IN ADDITION TO THE HAZARDOUS RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:

CONSTRUCTION

MAINTENANCE/CLEANING/OPERATION

DECOMMISSIONING/DEMOLITION

GENERAL NOTES:

1. THE DESIGN OF THIS SCHEME HAS BEEN BASED ON THE FOLLOWING DRAWINGS AND INFORMATION:

• TOPOGRAPHICAL SURVEY: DRAWING No. 11164_001 RECEIVED APRIL 2021, BY ND OLIVER

• GPR SURVEY: DRAWING No. 157-WDA-SS-EX-DR-UC-MU100-001-Rev01 RECEIVED MAY 2022, BY WDA

• ARCHITECT LAYOUT DRAWING No. AS-CPA-P2-LG-DR-A-2000-P04-GA PLAN - LEVEL LG RECEIVED 19.04.2023, BY CARTWRIGHT PICKARD

• LANDSCAPE ARCHITECT LAYOUT DRAWING No. PL2190.1-PLA-XX-XX-DR-L-0001 RECEIVED 18.04.2023, BY PLANIT.

• LANDSCAPE ARCHITECT LEVELS DRAWING No. PL2190.1-PLA-XX-XX-DR-L-0002 RECEIVED 18.04.2023, BY PLANIT.

2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, DETAILS AND SPECIFICATIONS.

3. ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.

4. FOR ENGINEERING PROJECT NOTES (DRAINAGE, EXTERNAL WORKS, ETC) REFER TO DRAWING AS-BHE-XX-XX-DR-C-100

5. REFER TO DRAWING AS-BHE-XX-XX-DR-C-3850 FOR MANHOLE SCHEDULES.

6. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, DETAILS AND SPECIFICATIONS.

7. ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.

8. PRIOR TO THE COMMENCEMENT OF WORK THE LOCATION, SIZE AND DEPTH OF ALL EXISTING DRAINS/SEWERS AND SERVICES SHALL BE ESTABLISHED BY THE CONTRACTOR. ANY DISCREPANCIES FROM THE INFORMATION INDICATED ON THESE DRAWINGS SHALL IMMEDIATELY BE BROUGHT TO THE ATTENTION OF THE ARCHITECT OR ENGINEER.

9. THE CONTRACTOR SHALL ALLOW FOR THE PROTECTION, TEMPORARY AND PERMANENT SUPPORT AND DIVERSION WORKS AS NECESSARY, TO ALL EXISTING SERVICES TO THE SATISFACTION OF THE PUBLIC UTILITIES.

10. EXTENT OF BREAKING OUT OF EXISTING CONCRETE SLAB IN THE ACCESS ROAD BETWEEN ANGEL GARDENS AND PLOT 3 TO BE CONFIRMED BY MAIN CONTRACTOR PENDING REVIEW OF EXCAVATION/TEMPORARY WORKS

P03 ADDITIONAL INFORMATION ADDED09.04.2024FRPTPT

P02 ADDITIONAL INFORMATION ADDED01.12.2023FRPTPT

P01 ISSUED FOR STAGE 328.04.2023FRPTPT

RevDescriptionDateIss'dRev'dApp'd

STAGE 3

Project Stage

COMMENT

Status of Drawing

BURO HAPPOLD

3 Wellington PlaceLeedsLS1 4 AP, UK

Client:MEPC

Architect:CARTWRIGHT PICKARD

Project:ANGEL SQUARE PLOTS 2 AND 3

Dwg Title:PROPOSED DRAINAGE SURFACE WATER GENERAL ARRANGEMENT PLOT 2

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Scale: A11:250

Drawn/Designed By:FR

Checked By:PT

Approved By:PT

Drawing No:AS-BHE-XX-XX-DR-C-3150

Revision: P03

MANHOLE SCHEDULE - AS Plot 2 SW drainage													
NAME	EASTING [m]	NORTHING [m]	COVER LEVEL [m]	INVERT LEVEL [m]	DEPTH [m]	TYPE	COVER LOADING	COVER TYPE	INCOMING PIPE DIAMETER [mm]	INCOMING PIPE IL [m]	OUTGOING PIPE DIAMETER [mm]	OUTGOING PIPE IL [m]	COMMENTS
SW MH01	384414.945	398995.993	47.490	46.150	1.340	1,200 dia. Type B Manhole	B125	RE	150 150 150	46.150 46.150 46.150	150	46.150	
SW MH02	384386.293	398976.893	47.500	45.805	1.695	450 dia. Type D Manhole	B125	RE	150 150	45.805 45.805	150	45.805	
SW MH03	384384.930	398974.849	47.500	45.480	2.020	1,200 dia. Type B Manhole	B125	RE	150 150	45.780 45.780	150	45.780	CATCHPIT 300mm SUMP WITH A SILT TRAP
SW MH04	384382.389	398970.754	47.500	42.725	4.775	1,200 dia. Type A2 Manhole	B125	RE	300	42.725	150	42.725	FLOW CONTROL CHAMBER DISCHARGE RATE LIMITED TO 1.1l/s AT 3.5m DESIGN HEAD. DRAIN DOWN PENSTOCK
SW MH05	384378.912	398964.208	44.720	42.640	2.080	1,200 dia. Type B Manhole	D400	ST	150	42.640	150	42.640	
SW MH06	384381.944	398955.751	44.650	39.840	4.810	1,200 dia. Type A2 Manhole	D400	ST	150 150	42.520 BD 39.840	150	39.840	
SW MH07	384370.999	398933.104	44.650	39.515	5.135	1,200 dia. Type A2 Manhole	D400	ST	150 150	39.590 43.500 BD	225	39.515	
SW MH08	384366.974	398935.022	44.500	39.320	5.180	1,200 dia. Type A2 Manhole	D400	ST	225 300	39.395 39.320	300	39.320	
SW MH09	384365.546	398932.223	44.500	39.300	5.200	1,200 dia. Type A2 Manhole	D400	ST	300 225	39.300 40.875 BD	150	39.300	
SW MH10	384395.671	399036.814	44.400	43.050	1.350	450 dia. Type D Manhole	D400	RE	150 150	43.050 43.050	150	43.050	
SW MH11	384393.797	399031.518	43.950	42.600	1.350	1,200 dia. Type B Manhole	D400	RE	150 150 150 150	42.600 42.600 42.600 42.600	150	42.600	
SW MH12	384362.512	399010.104	43.000	41.325	1.675	450 dia. Type D Manhole	B125	RE	150 150	41.625 41.625	150	41.625	CATCHPIT 300mm SUMP WITH A SILT TRAP
SW MH13	384342.651	398997.621	42.260	40.510	1.750	1,200 dia. Type B Manhole	B125	RE	225 150	40.510 40.585	150	40.510	FLOW CONTROL CHAMBER DISCHARGE RATE LIMITED TO 3.3l/s AT 1m DESIGN HEAD. DRAIN DOWN PENSTOCK
SW MH14	384335.785	398990.713	42.250	40.425	1.825	1,200 dia. Type B Manhole	B125	RE	150	40.425	150	40.425	
SW MH15	384375.882	398958.184	42.300	39.910	2.390	1,200 dia. Type B Manhole	D400	ST	150 150	39.910 41.250 BD	150	39.910	
SW MH16	384365.133	399002.747	43.000	41.650	1.350	450 dia. Type D Manhole	B125	RE	150 150	41.950 41.950	150	41.950	CATCHPIT 300mm SUMP WITH A SILT TRAP

MANHOLE SCHEDULE - AS Plot 2 FW drainage													
NAME	EASTING [m]	NORTHING [m]	COVER LEVEL [m]	INVERT LEVEL [m]	DEPTH [m]	TYPE	COVER LOADING	COVER TYPE	INCOMING PIPE DIAMETER [mm]	INCOMING PIPE IL [m]	OUTGOING PIPE DIAMETER [mm]	OUTGOING PIPE IL [m]	COMMENTS
FW MH01	384412.349	399011.705	44.000	42.650	1.350	1,200 dia. Type B Manhole	D400	ST	100 100	42.700 42.700	150	42.650	DOUBLE SEALED COVER
FW MH02	384413.485	399005.535	44.000	42.450	1.550	1,200 dia. Type B Manhole	D400	ST	150 150 100	42.575 42.575 42.625	225	42.450	DOUBLE SEALED COVER
FW MH03	384394.099	398991.088	43.000	41.760	1.240	1,200 dia. Type B Manhole	B125	ST	150 100 100 225	41.835 41.885 41.885 41.760	225	41.760	DOUBLE SEALED COVER
FW MH04	384399.238	398983.189	47.630	41.610	6.020	1,200 dia. Type A2 Manhole	B125	RE	225	41.610	225	41.610	
FW MH05	384388.022	398975.107	47.500	41.400	6.100	1,200 dia. Type A2 Manhole	B125	RE	225	41.400	225	41.400	
FW MH06	384382.222	398962.188	44.720	41.220	3.500	1,200 dia. Type A2 Manhole	D400	ST	225	41.220	225	41.220	
FW MH07	384383.960	398957.318	44.650	41.155	3.495	1,200 dia. Type A2 Manhole	D400	ST	225	41.155	225	41.155	
FW MH08	384373.038	398935.060	44.650	40.520	4.130	1,200 dia. Type A2 Manhole	D400	ST	225	40.520	225	40.520	
FW MH09	384369.632	398936.038	44.600	40.430	4.170	1,200 dia. Type A2 Manhole	D400	ST	225 225	40.430 40.430	225	40.430	
FW MH10	384368.049	398932.546	44.530	39.215	5.315	1,200 dia. Type A2 Manhole	D400	ST	225	40.380 BD	225	39.215	
FW MH11	384389.938	399000.140	43.000	41.950	1.050	600 dia. Type D Manhole	B125	ST	100 100	42.000 42.000	150	41.950	DOUBLE SEALED COVER
FW MH12	384391.523	398997.853	43.000	41.900	1.100	600 dia. Type D Manhole	B125	RE	150 150	41.900 41.900	150	41.900	DOUBLE SEALED COVER
FW MH13	384382.839	398992.351	43.000	42.000	1.000	450 dia. Type D Manhole	B125	RE	100 100 100 100	42.050 42.050 42.050 42.050	150	42.000	DOUBLE SEALED COVER
FW MH14	384387.181	398995.102	43.000	41.950	1.050	450 dia. Type D Manhole	B125	RE	150 100 100 100	41.950 42.000 42.000 42.000	150	41.950	DOUBLE SEALED COVER

ABBREVIATIONS

ST - SOLID TOP
RE - RECESSED COVER
BD - BACKDROP

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- WORKS WITHIN POTENTIAL CONFINED SPACE CONDITIONS
- WORKS IN PROXIMITY TO LIVE SERVICES
- WORKS INTERFACE WITH THE PUBLIC ON MILLER STREET AND ANGEL STREET

MAINTENANCE/CLEANING/OPERATION

- WORKS WITHIN POTENTIAL CONFINED SPACE CONDITIONS
- WORKS IN PROXIMITY TO LIVE SERVICES
- WORKS INTERFACE WITH THE PUBLIC ON MILLER STREET AND ANGEL STREET

DECOMMISSIONING/DEMOLITION

- WORKS WITHIN POTENTIAL CONFINED SPACE CONDITIONS
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- WORKS INTERFACE WITH THE PUBLIC ON MILLER STREET AND ANGEL STREET

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2.

ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.

3.

THE CONTRACTOR SHALL TAKE ALL NECESSARY SAFETY PRECAUTIONS IN LINE WITH CURRENT LEGISLATION WHEN WORKING IN/NEAR CONFINED SPACES, DEEP EXCAVATIONS AND UTILITIES.

4.

WHERE INFILL MANHOLE COVERS ARE SPECIFIED THE LOCATION OF MANHOLES AND ORIENTATION OF THE COVERS SHALL BE COORDINATED ON SITE TO SUIT THE SURFACING MATERIAL AND PAVING ARRANGEMENT WHEREVER POSSIBLE.

5.

REFER TO BHE DRAWING No. AS-BHE-XX-XX-DR-C-3150 & 3151 FOR DRAINAGE GENERAL ARRANGEMENTS.

P02	GENERAL UPDATES	09.04.2024	FR	PT	PT
P01	ISSUED FOR STAGE 3	28.04.2023	FR	PT	PT
Rev	Description	Date	Iss'd	Revd	App'd

STAGE 3

Project Stage

COMMENT

Status of Drawing

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ClientMEPC

ArchitectCARTWRIGHT PICKARD

ProjectANGEL SQUARE PLOTS 2 AND 3

Dwg TitlePROPOSED DRAINAGE SURFACE AND FOUL WATER MANHOLE SCHEDULE PLOT 2

Job No.0050930

Scale@A1NTS

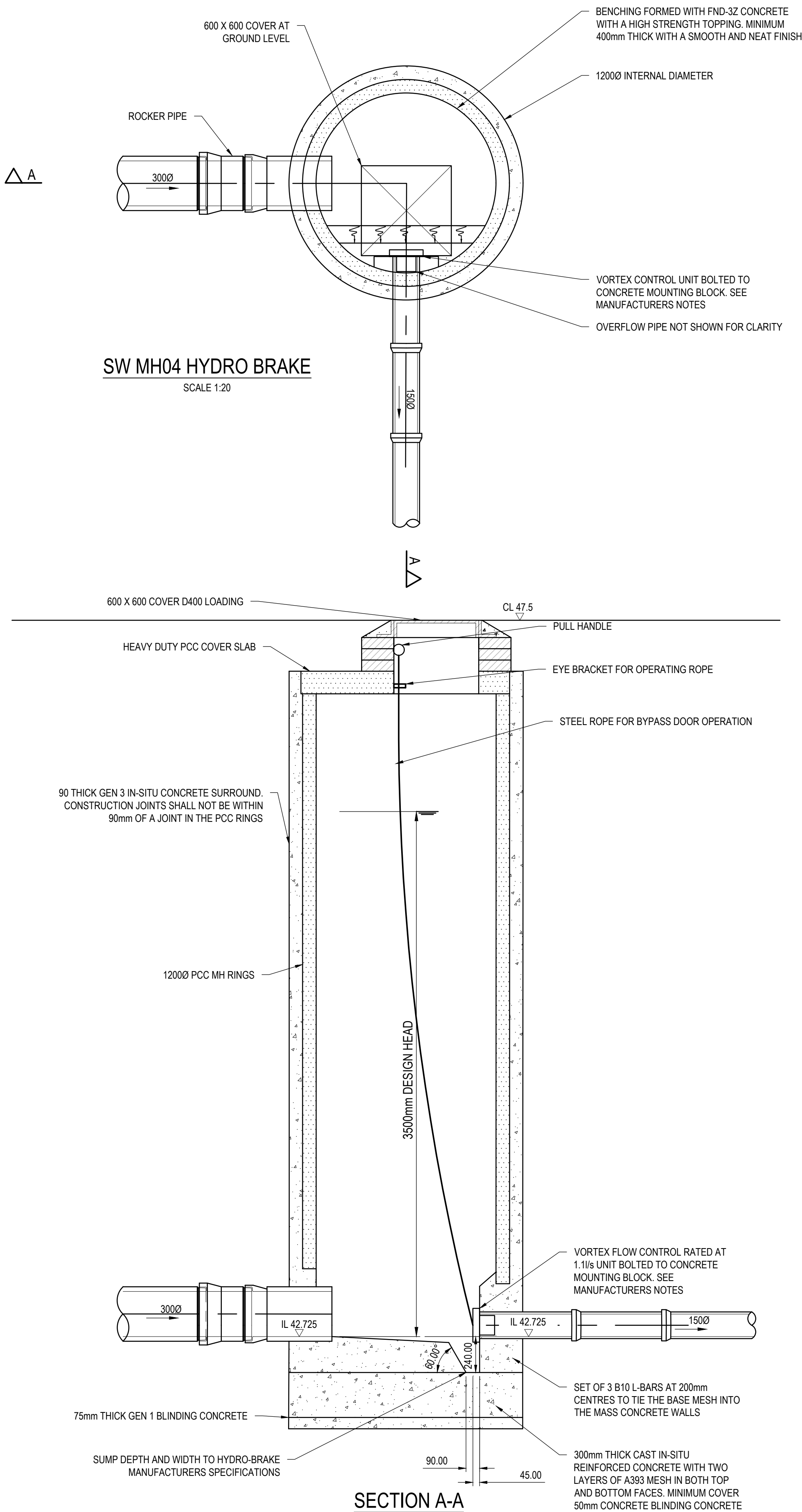
Drawn/Designed ByFR

Checked ByPT

Approved ByPT

Drawing No.AS-BHE-XX-XX-DR-C-3850

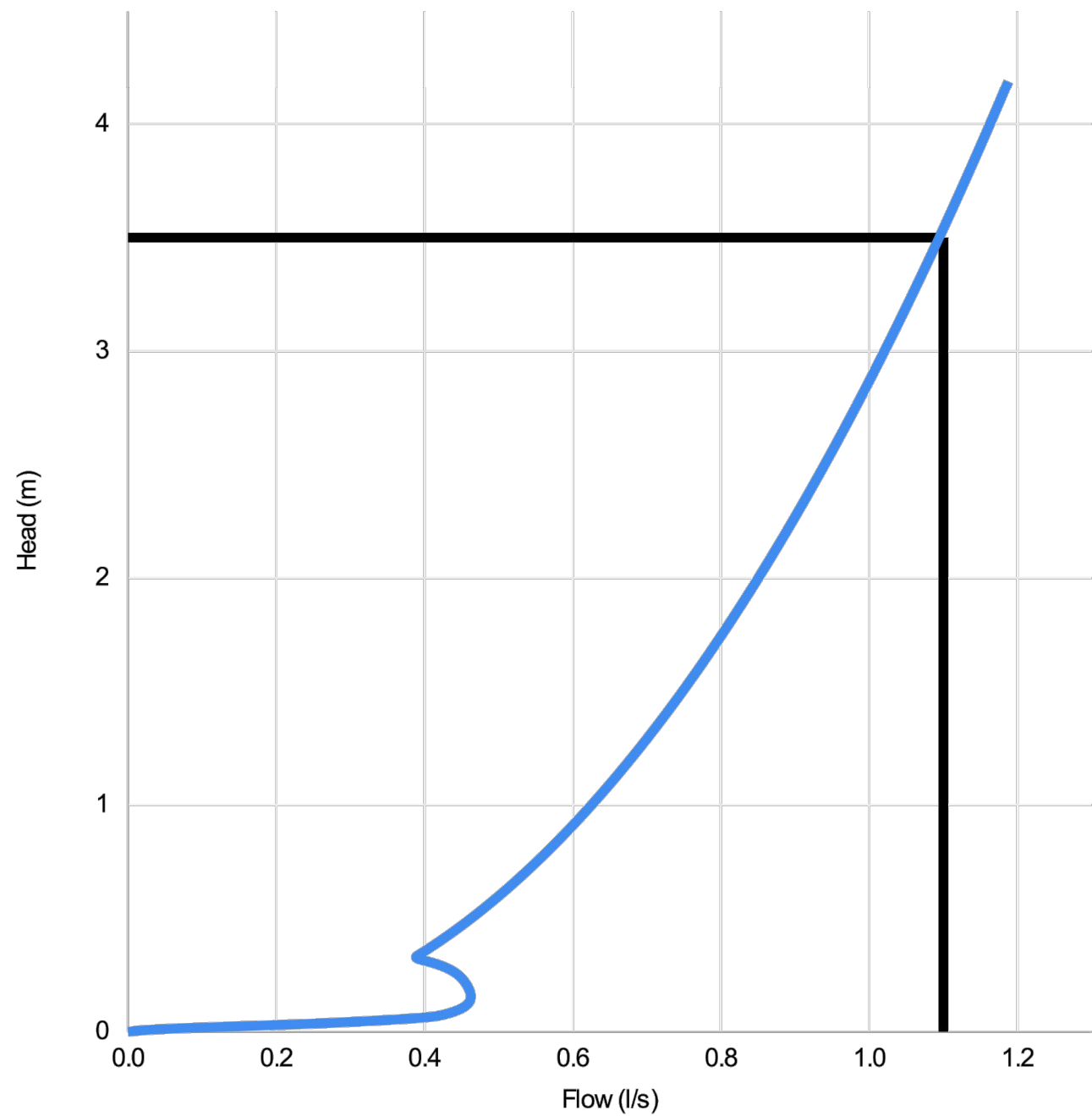
RevisionP02



Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	3.500	1.100
Flush-Flo	0.155	0.463
Kick-Flo®	0.324	0.385
Mean Flow		0.770

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Head (m)	Flow (l/s)
0.000	0.000
0.121	0.458
0.241	0.449
0.362	0.404
0.483	0.456
0.603	0.502
0.724	0.543
0.845	0.581
0.966	0.616
1.086	0.649
1.207	0.679
1.328	0.709
1.448	0.737
1.569	0.763
1.690	0.789
1.810	0.813
1.931	0.837
2.052	0.860
2.172	0.883
2.293	0.904
2.414	0.925
2.534	0.946
2.655	0.966
2.776	0.985
2.897	1.005
3.017	1.023
3.138	1.042
3.259	1.059
3.379	1.077
3.500	1.094

DESIGN ADVICE

The head/flow characteristics of this SHE-0036-1100-3500-1100 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.

! The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.



DATE	22/04/2023 10:51
Site	Angel Square Plots 2 & 3
DESIGNER	Francisco Rodriguez
Ref	0050930

SHE-0036-1100-3500-1100

Hydro-Brake Optimum®

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- WORKS IN PROXIMITY TO LIVE SERVICES
- WORKS INTERFACE WITH THE PUBLIC ON MILLER STREET AND ANGEL STREET

MAINTENANCE/CLEANING/OPERATION

- WORKS WITHIN POTENTIAL CONFINED SPACE CONDITIONS
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DECOMMISSIONING/DEMOLITION

- WORKS WITHIN POTENTIAL CONFINED SPACE CONDITIONS
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- THE DEVELOPER SHALL REVIEW THE DESIGN CRITERIA, MATERIAL STANDARDS AND WORKMANSHIP SPECIFICATION FOR THE PROPOSED ADAPTABLE SEWERS IN ACCORDANCE WITH SEWERS FOR ADOPTION AND THE REQUIREMENTS OF THE STATUTORY UNDERTAKER / BUILDING CONTROL AND THE SPECIFIC REQUIREMENTS OF THE CLIENT.
- THE CONTRACTOR SHALL TAKE ALL NECESSARY SAFETY PRECAUTIONS IN LINE WITH CURRENT LEGISLATION WHEN WORKING IN/NEAR CONFINED SPACES, DEEP EXCAVATIONS AND UTILITIES.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
- ALL DRAINAGE SHALL BE CONSTRUCTED IN ACCORDANCE WITH BS EN 752 DRAINS AND SEWERS OUTSIDE BUILDINGS, THE CURRENT LOCAL BUILDING REGULATIONS AND TO THE SATISFACTION OF THE WATER AUTHORITY / BUILDING CONTROL OR SPECIFIC REQUIREMENTS OF THE CLIENT IF APPLICABLE.
- BURIED CONCRETE, INCLUDING PRECAST CONCRETE TO BE DESIGNED TO BRE DIGEST 1. CONCRETE IN AGGRESSIVE GROUND. SULPHATE RESISTING CEMENT SHALL BE USED UNLESS AN ALTERNATIVE IS AGREED WITH THE SUPERVISING OFFICER/ENGINEER.
- FOR DESIGNED, DESIGNATED OR STANDARDISED PRESCRIBED CONCRETE REFER TO BS EN 206-1 AND BS 8500. THEY SHALL HAVE A 20mm NOMINAL MAXIMUM SIZE OF AGGREGATE, AND A SLUMP CLASS S2 FOR TARGET 70mm AND NO ADMIXTURES.
- ALL PIPES SHALL BE LAID SOFFIT TO SOFFIT UNLESS STATED OTHERWISE ON THE MANHOLE SCHEDULE.
- MANHOLES & COVER SLABS TO BS EN 1917 AND BS 5911-3. PREFORMED SWEPT CHANNELS SHALL BE USED AT JUNCTIONS AND NO BRANCH SHALL ENTER AT LESS THAN 90 DEGREES FROM THE OUTGOING SEWER.
- MANHOLE COVERS TO BE TO BS EN 124.
- ALL PROPRIETARY PRODUCTS ARE TO BE INSTALLED STRICTLY IN ACCORDANCE WITH THE MANUFACTURERS REQUIREMENTS AND SPECIFICATION.

P01 ISSUED FOR STAGE 3

28.04.2023 MG FR PT

Rev	Description	Date	Iss'd	Rev'd	App'd
-----	-------------	------	-------	-------	-------

STAGE 3

Project Stage

COMMENT

Status of Drawing

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Client **MEPC**
Architect **CARTWRIGHT PICKARD**
Project **ANGEL SQUARE PLOTS 2 AND 3**
Dwg Title **DRAINAGE DETAILS SHEET 5**

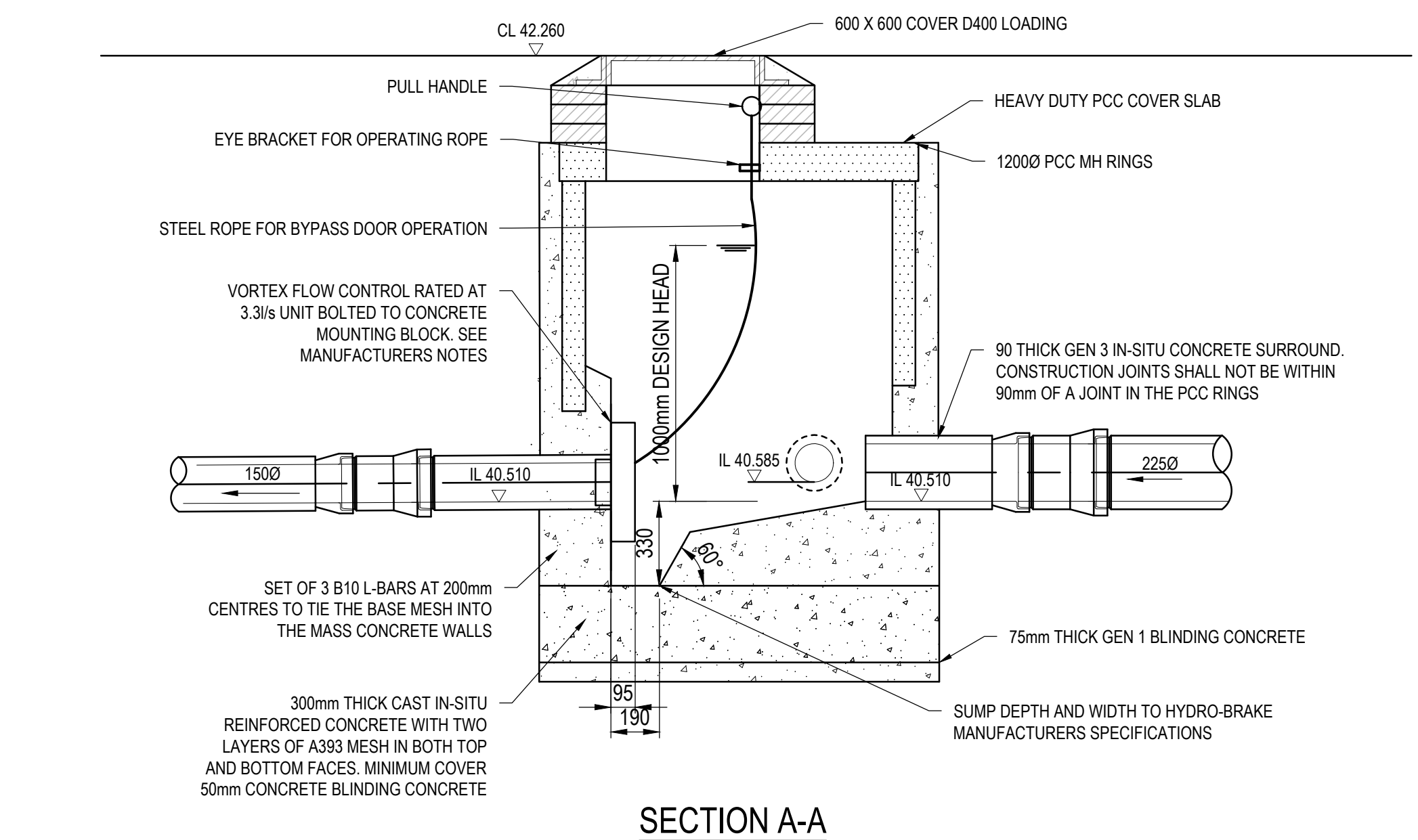
Job No.
0050930

Scale@A1
AS SHOWN

Drawn/Designed By: **MG**
Checked By: **FR**
Approved By: **PT**

Drawing No.
AS-BHE-XX-XX-DR-C-3704

Revision
P01



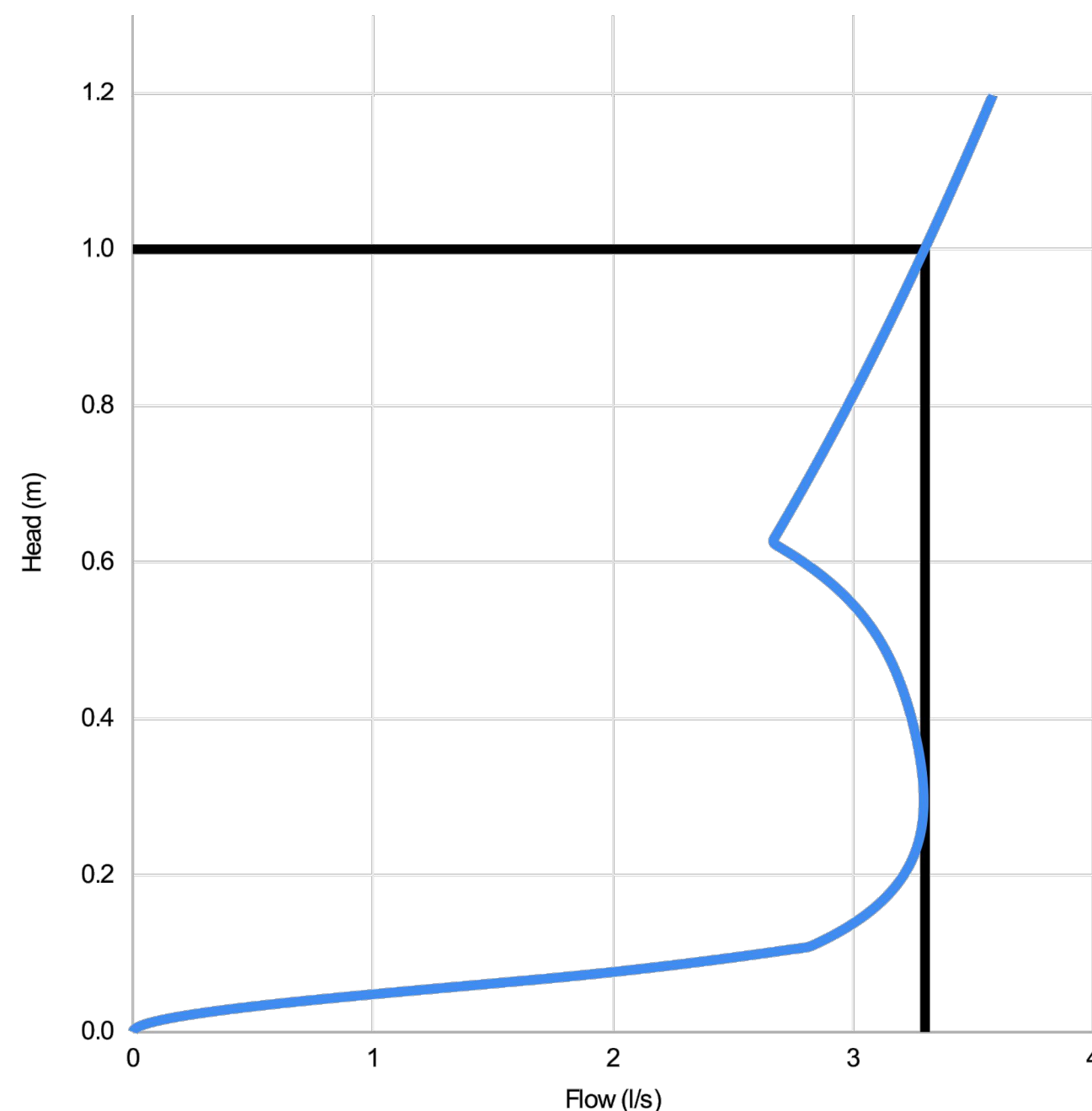
Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	1.000	3.300
Flush-Flo	0.296	3.295
Kick-Flo®	0.624	2.660
Mean Flow		2.882



PT/329/0412

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Head (m)	Flow (l/s)
0.000	0.000
0.034	0.557
0.069	1.756
0.103	2.698
0.138	2.998
0.172	3.138
0.207	3.224
0.241	3.272
0.276	3.292
0.310	3.294
0.345	3.282
0.379	3.261
0.414	3.232
0.448	3.194
0.483	3.143
0.517	3.076
0.552	2.983
0.586	2.856
0.621	2.687
0.655	2.719
0.690	2.783
0.724	2.845
0.759	2.906
0.793	2.966
0.828	3.024
0.862	3.081
0.897	3.137
0.931	3.192
0.966	3.245
1.000	3.298

DESIGN ADVICE

The head/flow characteristics of this SHE-0086-3300-1000-3300 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.

!

The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

DATE	22/04/2023 10:53
Site	Angel Square Plots 2 & 3
DESIGNER	Francisco Rodriguez
Ref	0050930

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SHE-0086-3300-1000-3300

Hydro-Brake Optimum®

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CONSTRUCTION

- WORKS WITHIN POTENTIAL CONFINED SPACE CONDITIONS
- WORKS IN PROXIMITY TO LIVE SERVICES
- WORKS INTERFACE WITH THE PUBLIC ON MILLER STREET AND ANGEL STREET

MAINTENANCE/CLEANING/OPERATION

- WORKS WITHIN POTENTIAL CONFINED SPACE CONDITIONS
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DECOMMISSIONING/DEMOLITION

- WORKS WITHIN POTENTIAL CONFINED SPACE CONDITIONS
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2. THE DEVELOPER SHALL REVIEW THE DESIGN CRITERIA, MATERIAL STANDARDS AND WORKMANSHIP SPECIFICATION FOR THE PROPOSED ADAPTABLE SEWERS IN ACCORDANCE WITH SEWERS FOR ADOPTION AND THE REQUIREMENTS OF THE STATUTORY UNDERTAKER / BUILDING CONTROL AND THE SPECIFIC REQUIREMENTS OF THE CLIENT.
3. THE CONTRACTOR SHALL TAKE ALL NECESSARY SAFETY PRECAUTIONS IN LINE WITH CURRENT LEGISLATION WHEN WORKING IN/NEAR CONFINED SPACES, DEEP EXCAVATION AND UTILITIES.
4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
5. ALL DRAINAGE SHALL BE CONSTRUCTED IN ACCORDANCE WITH BS EN 752 DRAINS AND SEWERS OUTSIDE BUILDINGS, THE CURRENT LOCAL BUILDING REGULATIONS AND TO THE SATISFACTION OF THE WATER AUTHORITY / BUILDING CONTROL OR SPECIFIC REQUIREMENTS OF THE CLIENT IF APPLICABLE.
6. BURED CONCRETE, INCLUDING PRECAST CONCRETE TO B DESIGNED TO BRE DIGEST 1, CONCRETE IN AGGRESSIVE GROUND. SULPHATE RESISTING CEMENT SHALL BE USED UNLESS AN ALTERNATIVE IS AGREED WITH THE SUPERVISING OFFICER/ENGINEER.
7. FOR DESIGNED, DESIGNATED OR STANDARDISED PRESCRIBED CONCRETE REFER TO BS EN 206-1 AND BS 8500. THEY SHALL HAVE A 20mm NOMINAL MAXIMUM SIZE AGGREGATE, AND A SLUMP CLASS S2 FOR TARGET 70mm AND NO ADMIXTURES.
8. ALL PIPES SHALL BE LAID SOFFIT TO SOFFIT UNLESS STATED OTHERWISE ON THE MANHOLE SCHEDULE.
9. MANHOLES & COVER SLABS TO BS EN 1917 AND BS 5911-3. PREFORMED SUEZ CHANNELS SHALL BE USED AT JUNCTIONS AND NO BRANCH SHALL ENTER AT LESS THAN DEGREES FROM THE OUTGOING SEWER.
10. MANHOLE COVERS TO BE TO BS EN 124.
11. ALL PROPRIETARY PRODUCTS ARE TO BE INSTALLED STRICTLY IN ACCORDANCE WITH THE MANUFACTURERS REQUIREMENTS AND SPECIFICATION.

P01 ISSUED FOR STAGE 3

28.04.2023 MG FR PT

Rev	Description	Date	Iss'd	Rev'd	App
-----	-------------	------	-------	-------	-----

STAGE 3

Project Stage

COMMENT

Status of Drawing								
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Client	MEPC
Architect	CARTWRIGHT PICKARD
Project	ANGEL SQUARE PLOTS 2 AND 3
Dwg Title	DRAINAGE DETAILS SHEET 7

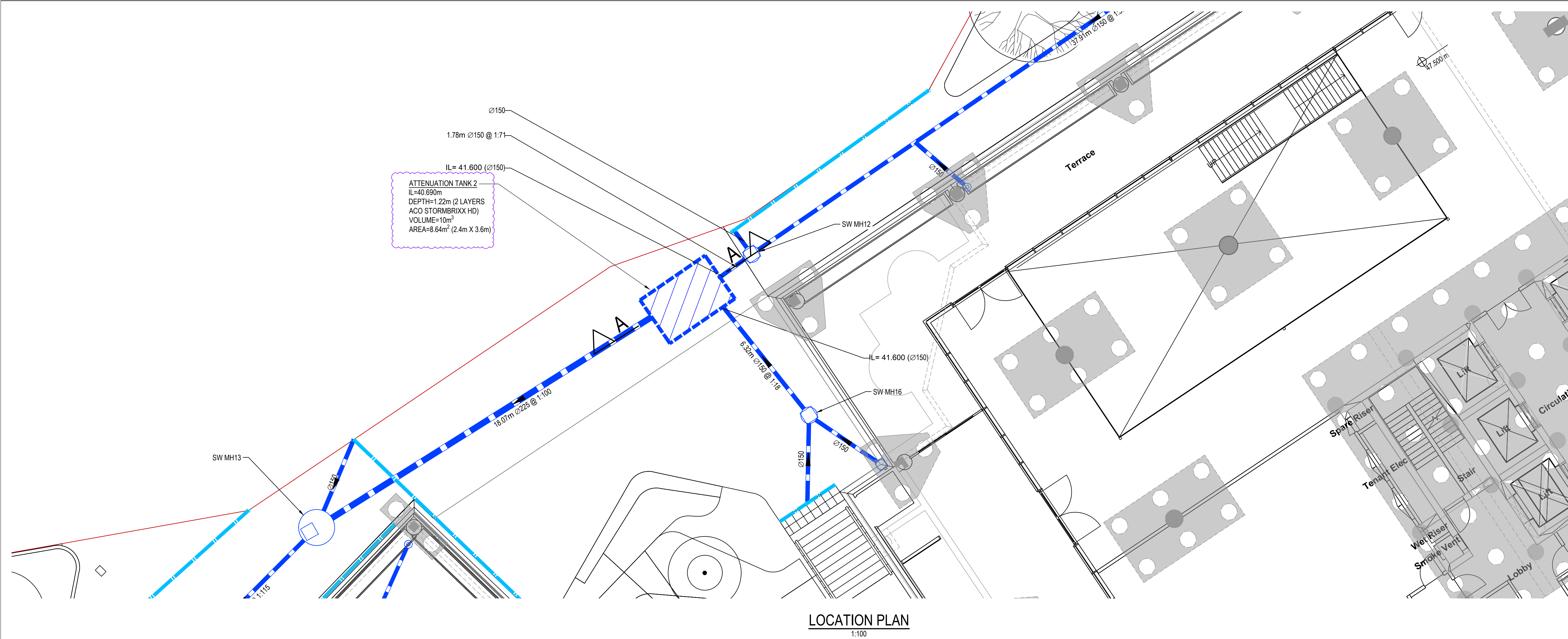
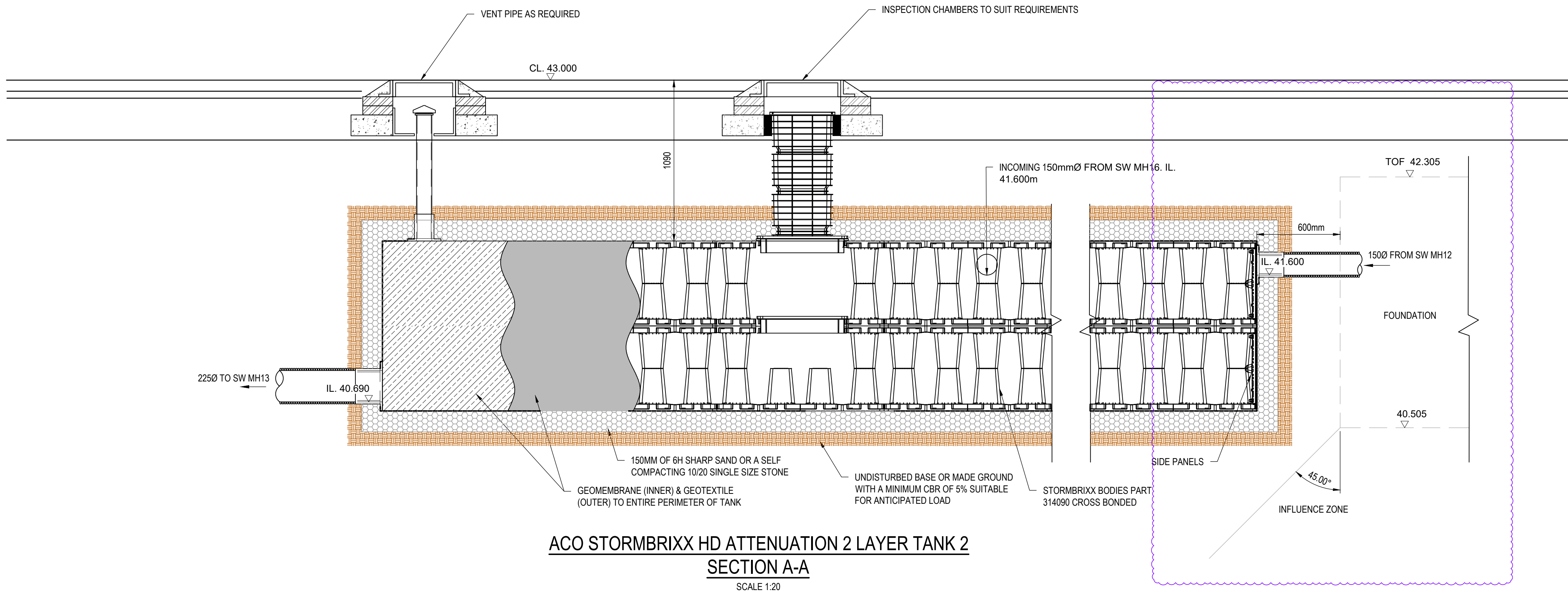
Job No.
0050930

Scale@A1
AS SHOWN

Drawn/Designed By. MG	Checked By. FR	Approved By. PT
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Drawing No.
AS-BHE-XX-XX-DR-C-3706

Revision
P01



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- DO NOT SCALE THIS DRAWING.
- HEALTH AND SAFETY INFORMATION**
- IN ADDITION TO THE HAZARDOUS RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:
- CONSTRUCTION**
- WORKS WITHIN POTENTIAL CONFINED SPACE CONDITIONS
 - WORKS IN PROXIMITY TO LIVE SERVICES
 - WORKS INTERFACE WITH THE PUBLIC ON MILLER STREET AND ANGEL STREET
- MAINTENANCE/CLEANING/OPERATION**
- WORKS WITHIN POTENTIAL CONFINED SPACE CONDITIONS
 - WORKS IN PROXIMITY TO LIVE SERVICES
 - WORKS IN INTERFACE WITH THE PUBLIC ON MILLER STREET AND ANGEL STREET
- DECOMMISSIONING/DEMOLITION**
- WORKS WITHIN POTENTIAL CONFINED SPACE CONDITIONS
 - WORKS IN PROXIMITY TO LIVE SERVICES
 - WORKS INTERFACE WITH THE PUBLIC ON MILLER STREET AND ANGEL STREET
- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL DRAINAGE LAYOUTS, SCHEDULES AND DETAILS.
 - THE DEVELOPER SHALL REVIEW THE DESIGN CRITERIA, MATERIAL STANDARDS AND WORKMANSHIP SPECIFICATION FOR THE PROPOSED ADOPTABLE SEWERS IN ACCORDANCE WITH SEWERS FOR ADOPTION AND THE REQUIREMENTS OF THE STATUTORY UNDERTAKER / BUILDING CONTROL AND THE SPECIFIC REQUIREMENTS OF THE CLIENT.
 - THE CONTRACTOR SHALL TAKE ALL NECESSARY SAFETY PRECAUTIONS IN LINE WITH CURRENT LEGISLATION WHEN WORKING IN/NEAR CONFINED SPACES, DEEP EXCAVATIONS AND UTILITIES.
 - ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
 - ALL DRAINAGE SHALL BE CONSTRUCTED IN ACCORDANCE WITH BS EN 752 DRAINS AND SEWERS OUTSIDE BUILDINGS, THE CURRENT LOCAL BUILDING REGULATIONS AND TO THE SATISFACTION OF THE WATER AUTHORITY / BUILDING CONTROL OR SPECIFIC REQUIREMENTS OF THE CLIENT IF APPLICABLE.
 - BURIED CONCRETE, INCLUDING PRECAST CONCRETE TO BE DESIGNED TO BRE DIGEST 1. CONCRETE IN AGGRESSIVE GROUND. SULPHATE RESISTING CEMENT SHALL BE USED UNLESS AN ALTERNATIVE IS AGREED WITH THE SUPERVISING OFFICER/ENGINEER.
 - FOR DESIGNED, DESIGNATED OR STANDARDISED PRESCRIBED CONCRETE REFER TO BS EN 206-1 AND BS 8500. THEY SHALL HAVE A 20mm NOMINAL MAXIMUM SIZE OF AGGREGATE, AND A SLUMP CLASS S2 FOR TARGET 70mm AND NO ADMIXTURES.
 - ALL PIPES SHALL BE LAID SOFFIT TO SOFFIT UNLESS STATED OTHERWISE ON THE MANHOLE SCHEDULE.
 - MANHOLES & COVER SLABS TO BS EN 1917 AND BS 5911-3. PREFORMED SWEEP CHANNELS SHALL BE USED AT JUNCTIONS AND NO BRANCH SHALL ENTER AT LESS THAN 90 DEGREES FROM THE OUTGOING SEWER.
 - MANHOLE COVERS TO BE TO BS EN 124.
 - ALL PROPRIETARY PRODUCTS ARE TO BE INSTALLED STRICTLY IN ACCORDANCE WITH THE MANUFACTURERS REQUIREMENTS AND SPECIFICATION.

P02	ADDITIONAL INFORMATION ADDED	01.12.2023	FR	PT	PT
P01	ISSUED FOR STAGE 3	28.04.2023	HB	FR	PT
Rev	Description	Date	Iss'd	Rev'd	App'd

STAGE 3

Project Stage

COMMENT

Status of Drawing

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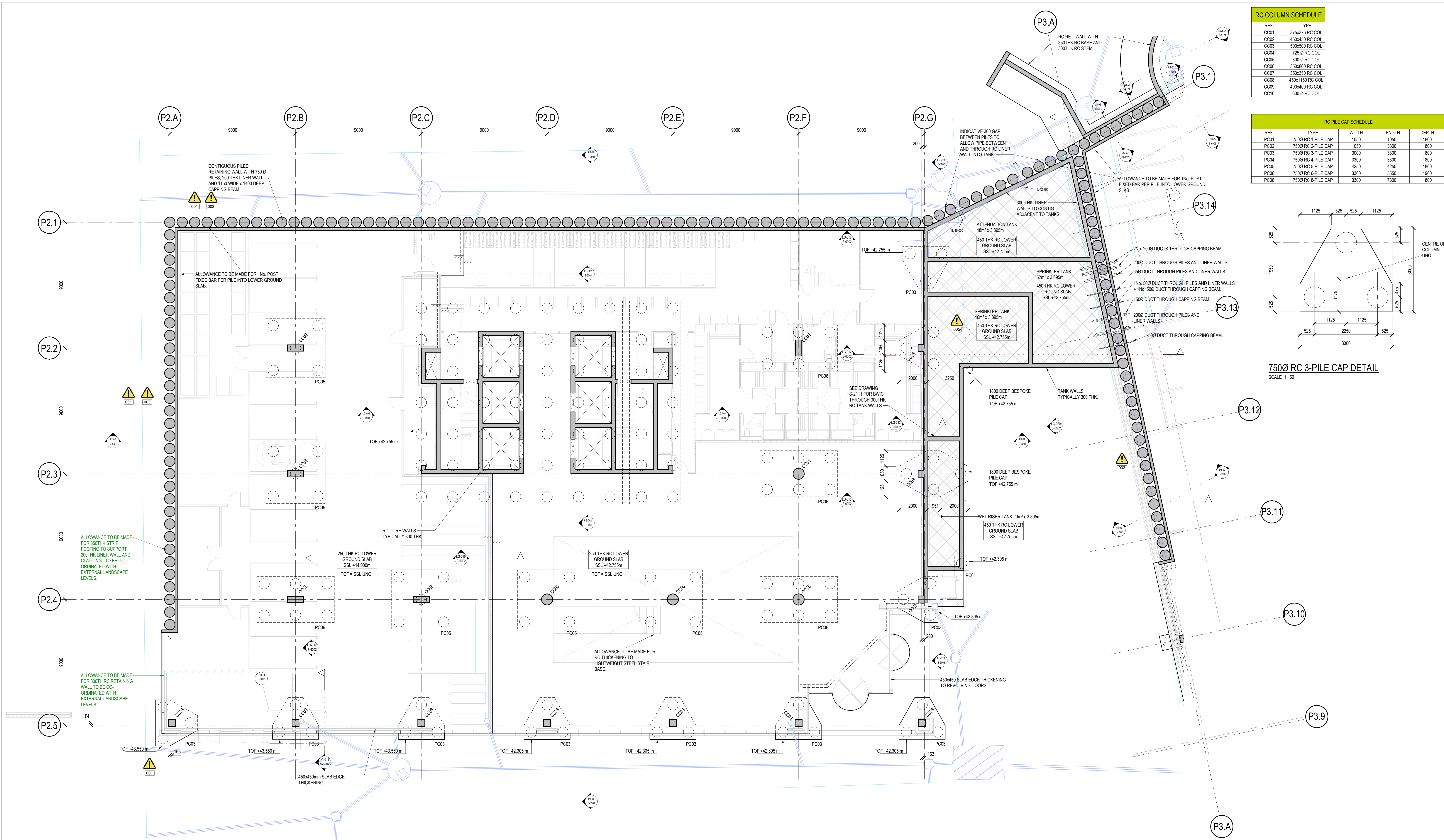
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Email: 00509090@burohappold.com
Web: www.burohappold.com

Client: MEPC
Architect: CARTWRIGHT PICKARD
Project: ANGEL SQUARE PLOTS 2 AND 3
Dwg Title: DRAINAGE DETAILS SHEET 8

Job No:	0050930	Scale:	A1
Drawn/Designed By:	HB	Checked By:	FR
Approved By:	PT	Revision:	AS SHOWN

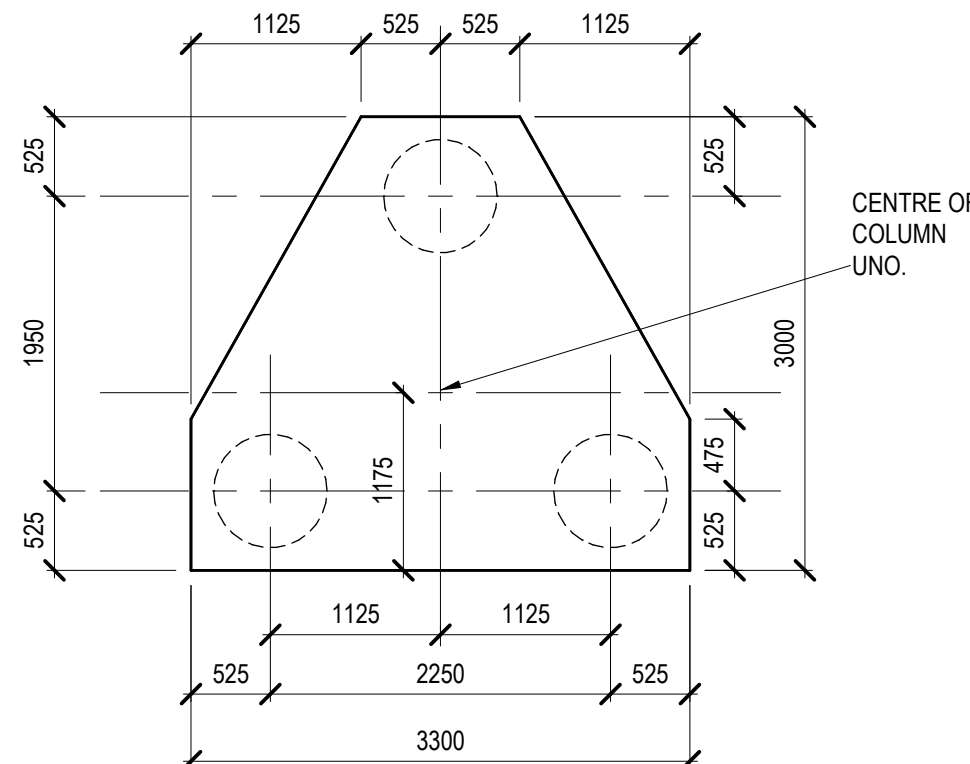
AS-BHE-XX-XX-DR-C-3707

P02



RC COLUMN SCHEDULE	
REF.	TYPE
CC01	375x375 RC COL
CC02	450x450 RC COL
CC03	500x500 RC COL
CC04	725 Ø RC COL
CC05	800 Ø RC COL
CC06	350x800 RC COL
CC07	350x350 RC COL
CC08	450x1150 RC COL
CC09	400x400 RC COL
CC10	600 Ø RC COL

RC PILE CAP SCHEDULE				
REF.	TYPE	WIDTH	LENGTH	DEPTH
PC01	7500 RC 1-PILE CAP	1050	1050	1800
PC02	7500 RC 2-PILE CAP	1050	3300	1800
PC03	7500 RC 3-PILE CAP	3000	3300	1800
PC04	7500 RC 4-PILE CAP	3300	3300	1800
PC05	7500 RC 5-PILE CAP	4250	4250	1800
PC06	7500 RC 6-PILE CAP	3300	5550	1900
PC08	7500 RC 8-PILE CAP	3300	7800	1800



7500 RC 3-PILE CAP DETAIL
SCALE 1 : 50

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IN ADDITION TO THE HAZARDOUSNESS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILLED ON THIS DRAWING, NOTE THE FOLLOWING:
CONSTRUCTION
[001] PROPOSED PILE FOUNDATIONS IN CLOSE PROXIMITY TO EXISTING UTILITIES SHOWN ON HIGH-SURVEY REF TO BE AVOIDED OR DELETED AND/OR RELOCATED.
[002] INDICATIVE PILE DESIGN ASSUMES PILES ARE PROPPED BY THE GROUND FLOOR SLAB. MAIN CONTRACTOR TO PROVIDE TEMPORARY PROPPING SUPPORTS. EXCAVATION OR REPAIR/REINFORCEMENT PILES ALTERNATIVE WITH SPECIALIST PILE DESIGNER.
[003] TANKS WITH LIMITED ACCESS HATCHES. FORMWORK STRATEGY TO BE DEVELOPED WITH MAIN CONTRACTOR.
[005]

MAINTENANCE/CLANNING/OPERATION

DECOMMISSIONING/DEMOLITION

Notes

REFER TO DRAWING S-0001 FOR GENERAL NOTES.
PILING ARRANGEMENT BASED ON A PILE CAPACITY OF 2700N (SLD) FOR TOP PILES.

REV	STAGE 3 ISSUE	21.04.23	TC	AS
REV	STAGE 2 ISSUE	26.05.22	TC	HS
REV	Description	Date	Dim	Appr

STAGE 3

Project Stage

S3 - FOR REVIEW AND COMMENT

Status of Drawing

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Client

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Architect

CARTWRIGHT PICKARD

Project

ANGEL SQUARE PLOTS 2 AND 3

Design

PLOT 2

LOWER GROUND FLOOR

STRUCTURAL GENERAL ARRANGEMENT

Job No.

050930

Scale/ID

As indicated

Drawn By

TC

Checked By

HS

Approved By

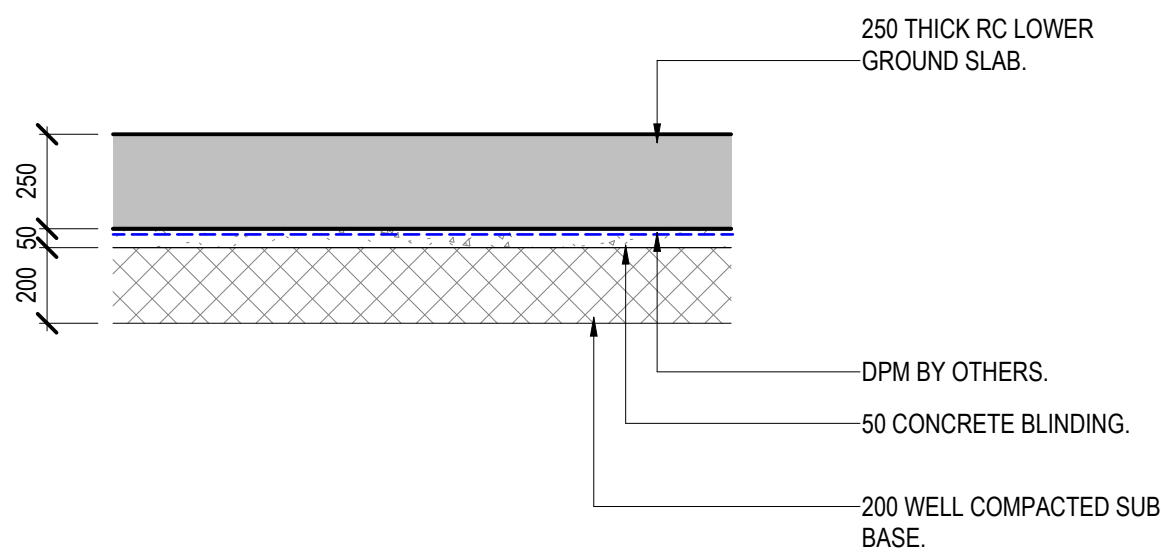
JE

Revision

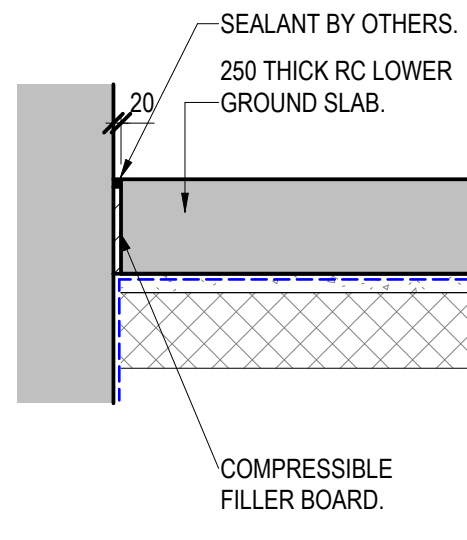
AS-BHE-P2-LG-DR-S-0991

P02

UNDERSLAB INSULATION REQUIREMENTS TO BE CONFIRMED BY OTHERS. SUB-BASE SHOWN ALSO APPLIES TO 450 THK LOWER GROUND TANKS BASE SLAB.



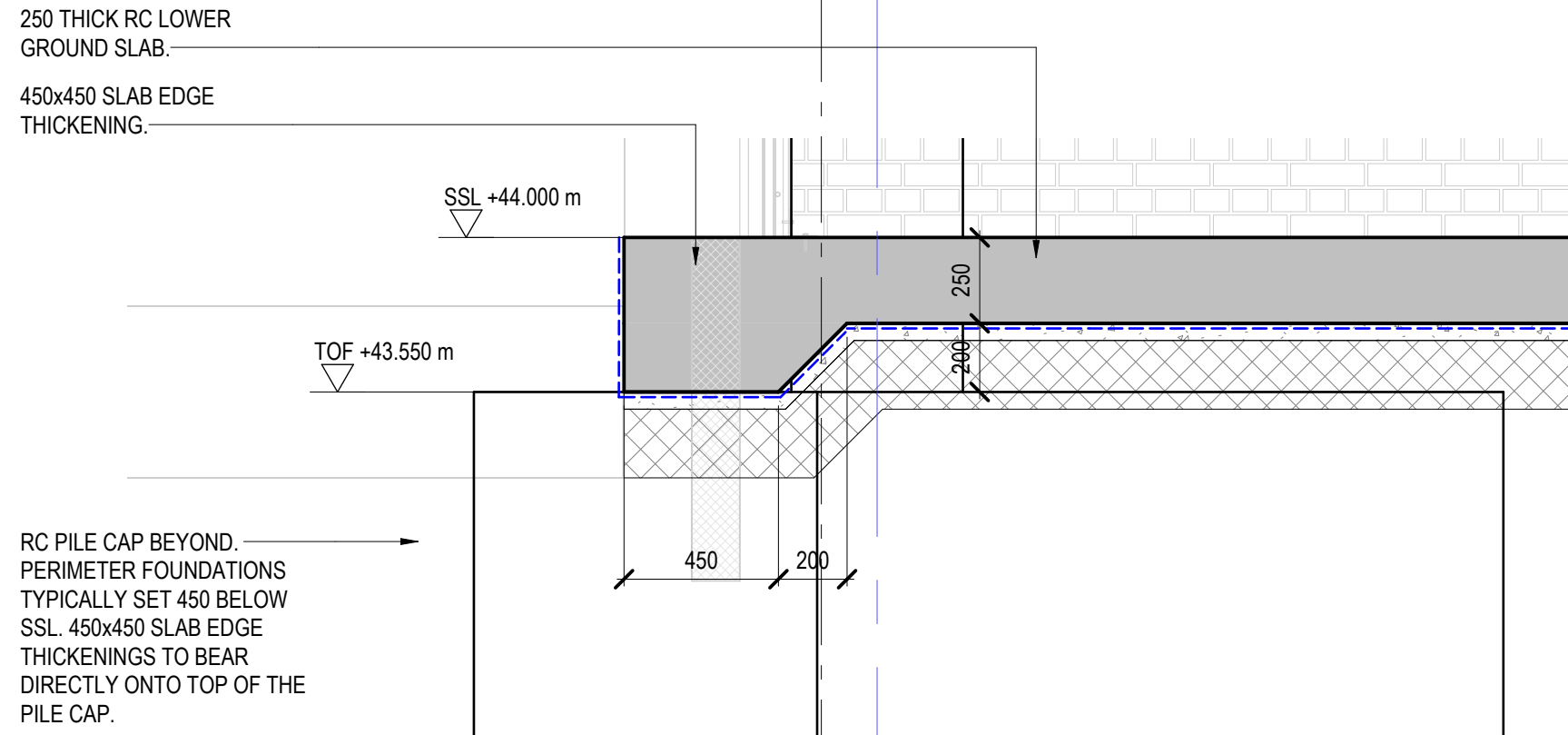
TYPICAL GROUND BEARING SLAB BUILD UP



TYPICAL ISOLATION JOINT DETAIL

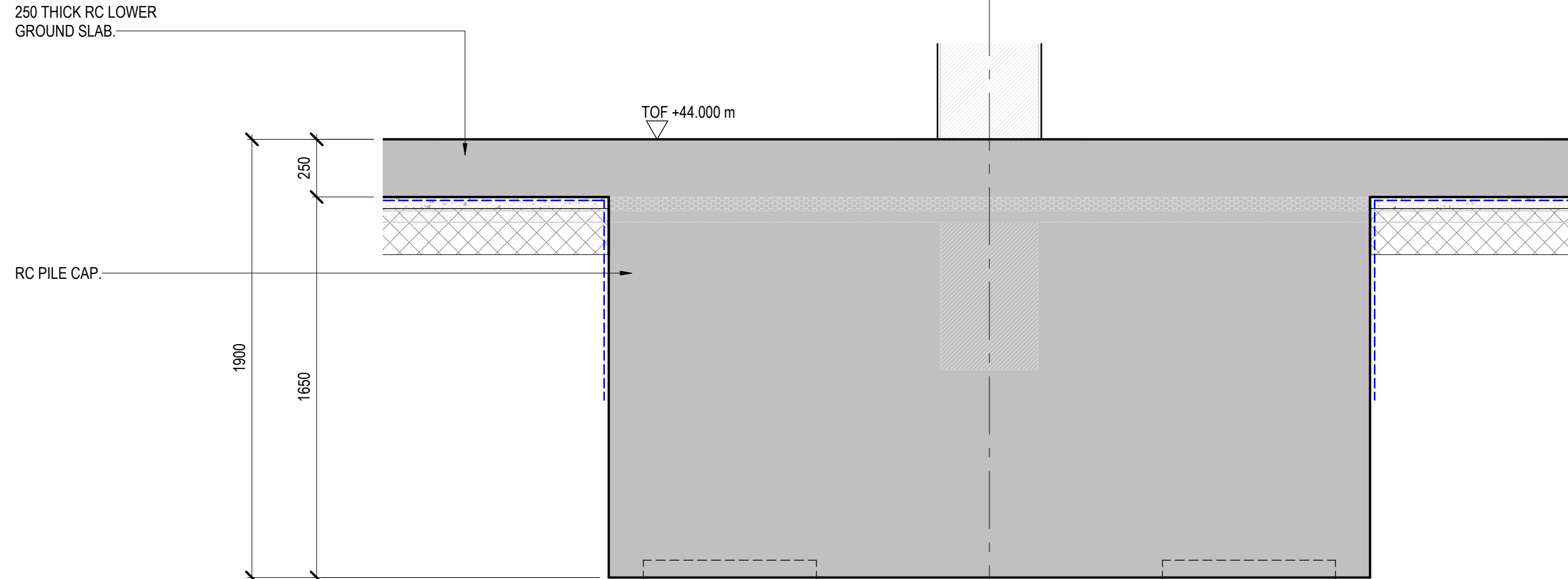
TYPICAL GROUND BEARING SLAB DETAILS

SCALE 1 : 20



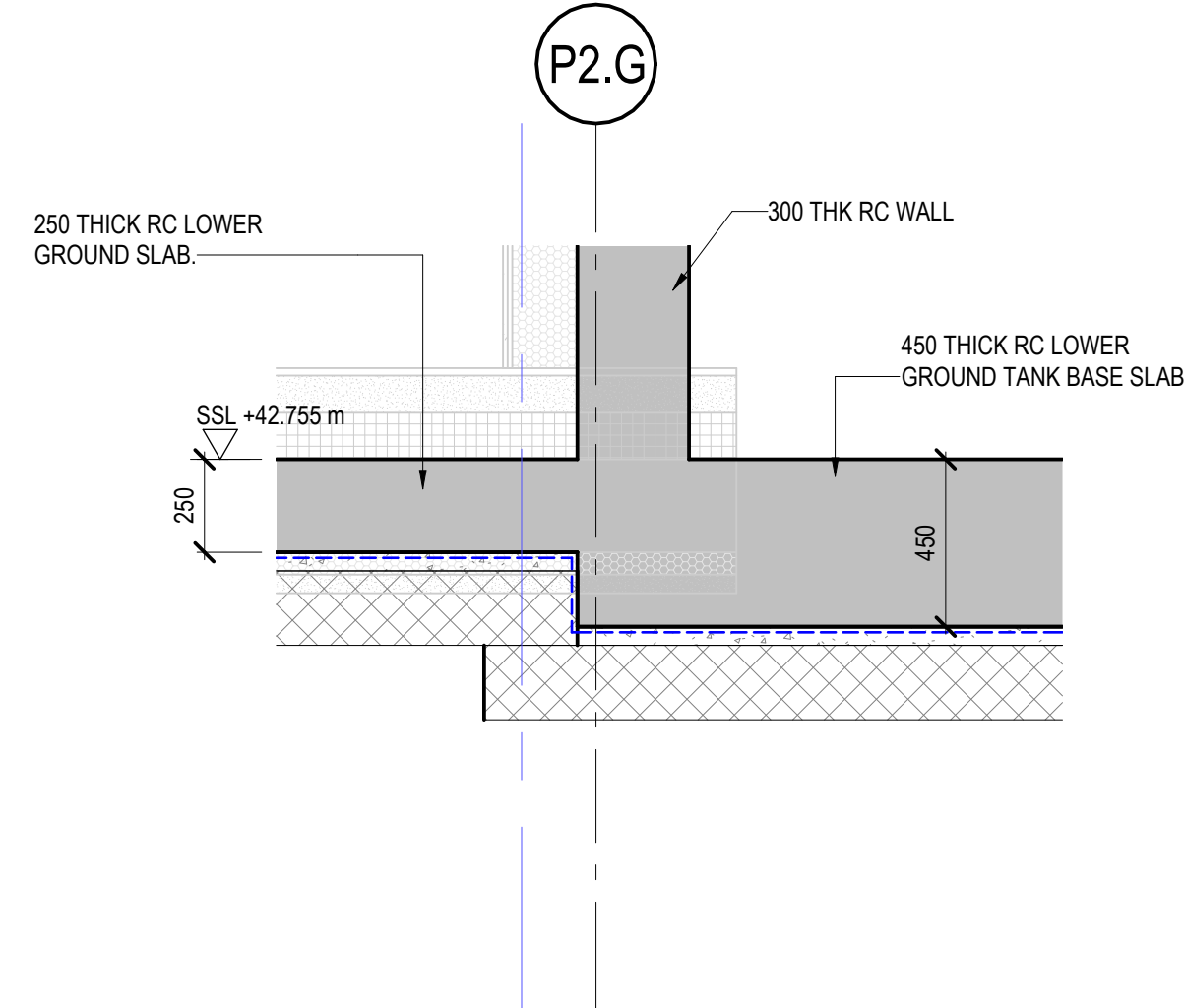
LG-011

SCALE 1 : 20



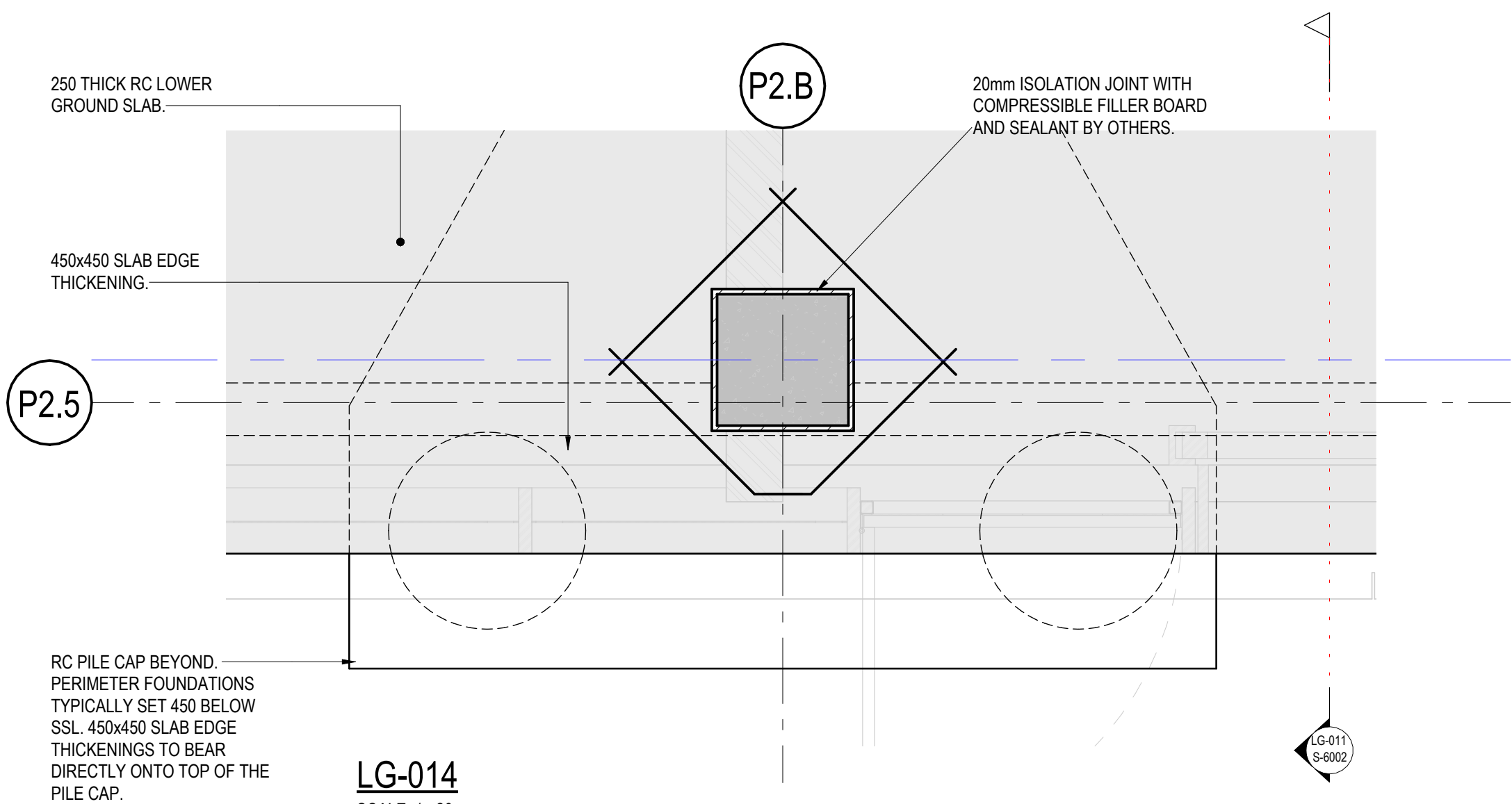
LG-012

SCALE 1 : 20



LG-013

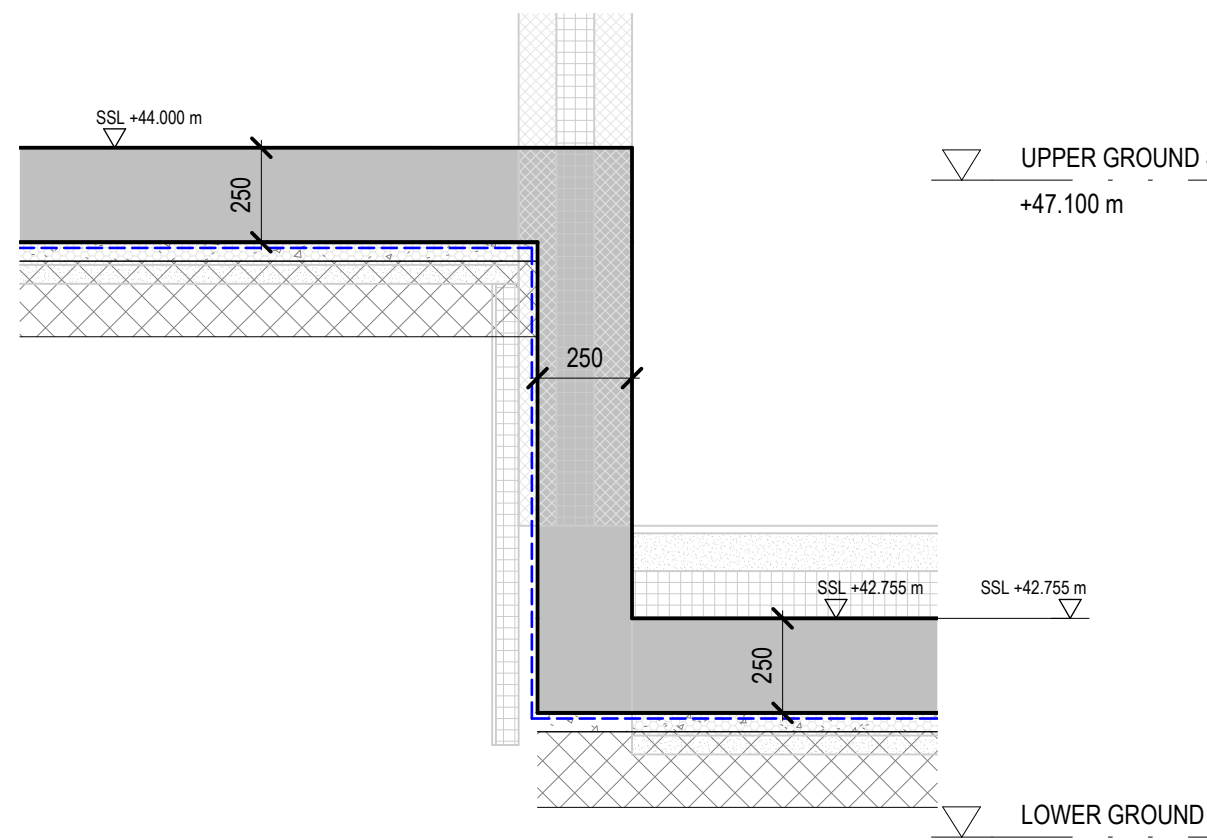
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LG-014

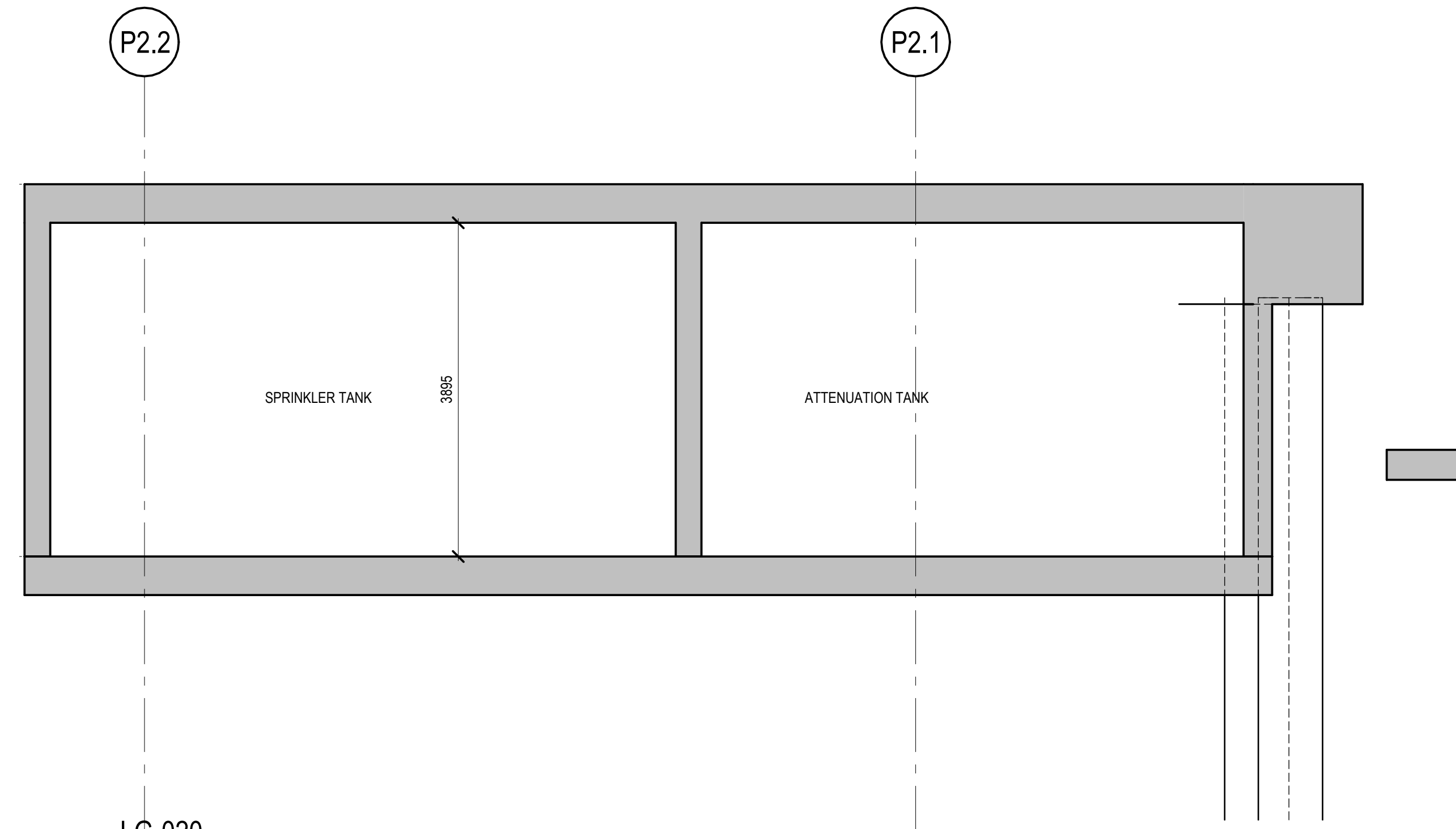
SCALE 1 : 20

DETAIL TYPICAL TO PERIMETER COLUMN AND FOUNDATIONS WITH PILE CAP SET 450mm BELOW SSL. 450x450mm SLAB EDGE THICKENINGS TO BEAR DIRECTLY ONTO TOP OF THE PILE CAP AND 20mm ISOLATION JOINT TO FACE OF COLUMN.



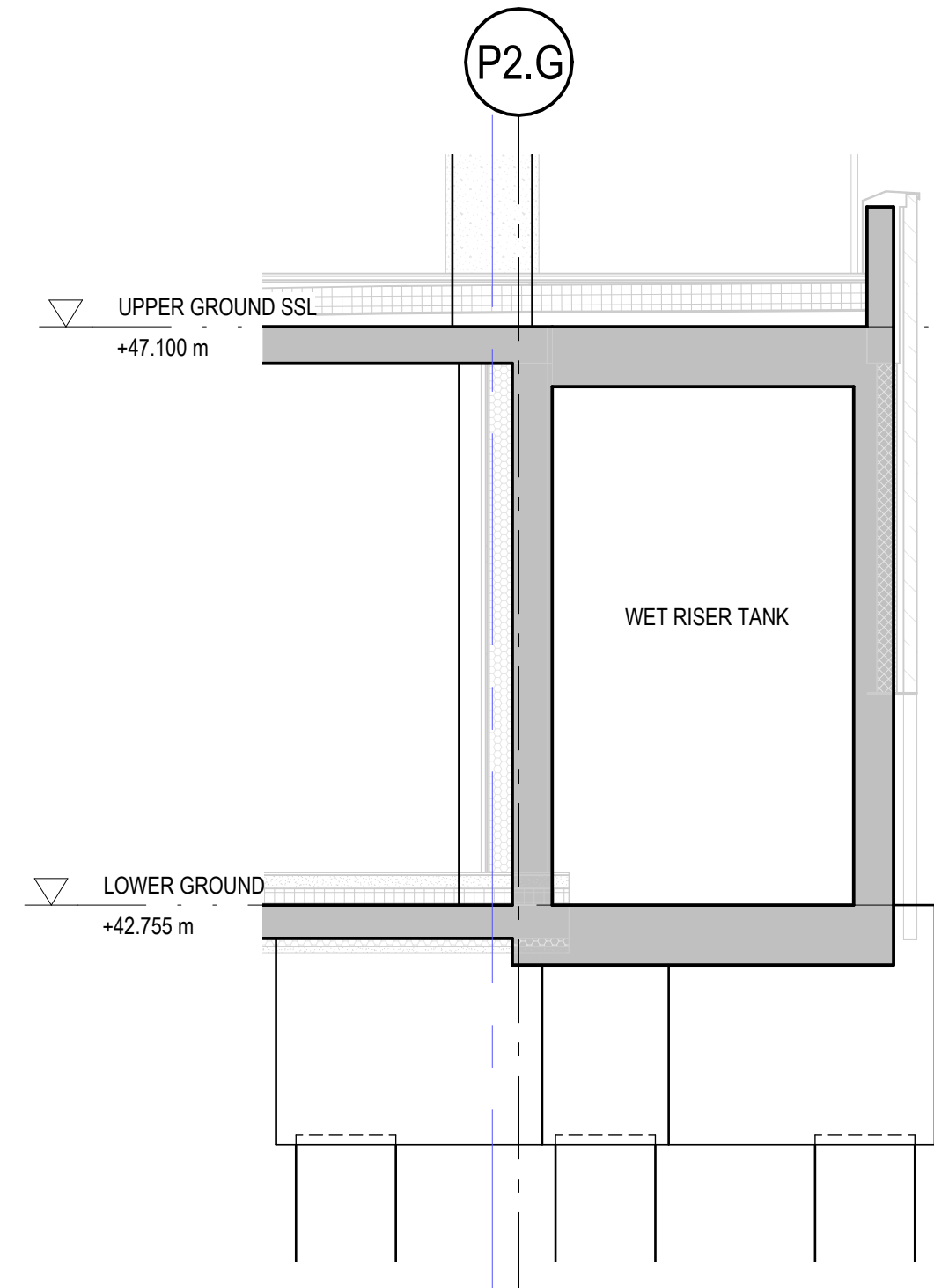
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SCALE 1 : 20



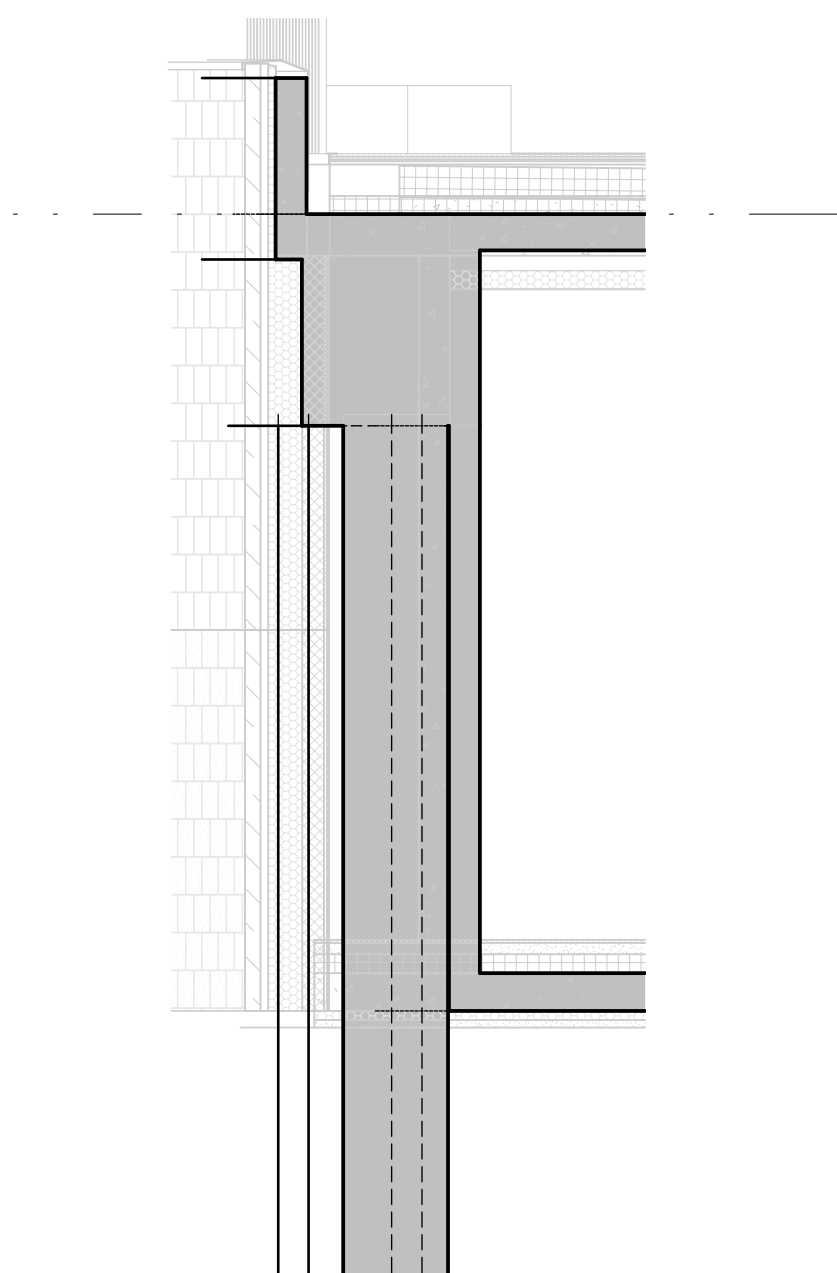
LG-020

SCALE 1 : 50



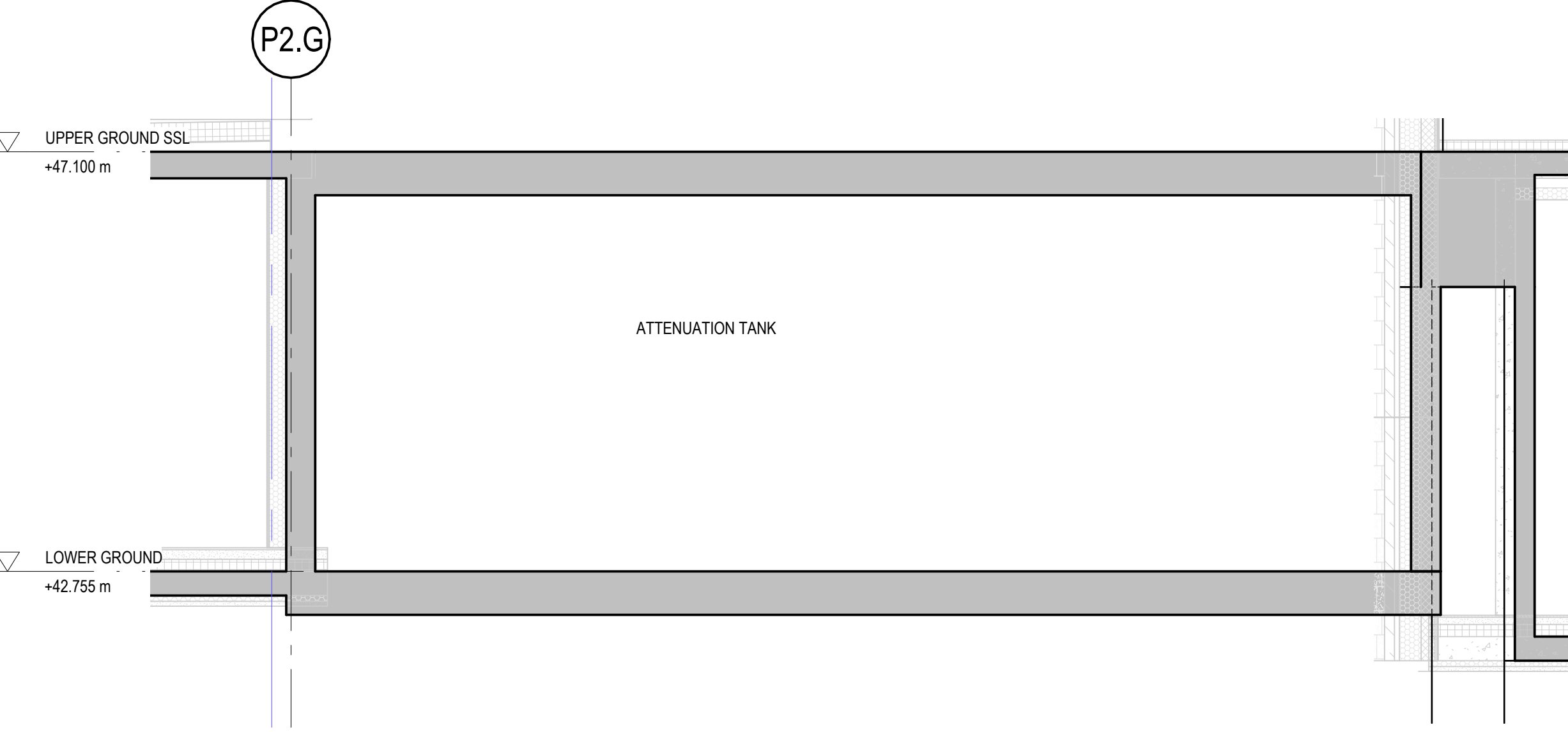
LG-016

SCALE 1 : 50



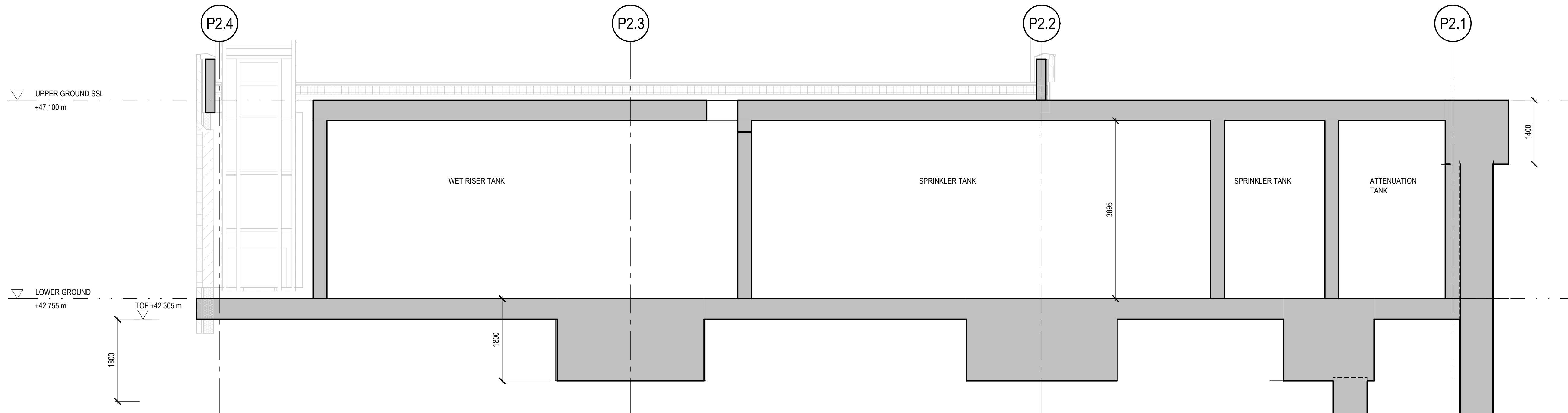
LG-017

SCALE 1 : 50



LG-018

SCALE 1 : 50



LG-019

SCALE 1 : 50

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MAINTENANCE/CLANNING/OPERATION

DECOMMISSIONING/DEMOLITION

Notes

REFER TO DRAWING S-001 FOR GENERAL NOTES.

Rev	Description	Date	Drawn	App'd
-----	-------------	------	-------	-------

STAGE 3

S3 - FOR REVIEW AND COMMENTS

Scale of Drawing

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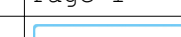
Client: MEPC
Architect: CARTWRIGHT PICKARD
Project: ANGEL SQUARE PLOTS 2 AND 3
Drawing Title: LOWER GROUND SECTIONS AND DETAILS SHEET 2

Job No:	Scale:	As indicated
050930	Drawn By:	TC
	Checked By:	BB
	Approved By:	JE

Drawing No: AS-BHE-XX-LG-DR-S-6002

Revision

Appendix K Hydraulic calculations results Plot 2

BuroHappold Ltd		Page 1
Camden Mill		
Lower Bristol Road		
Bath		
Date 26/04/2023 08:07	Designed by frodrigu	
File 2&3 NOMA_230421.MDX	Checked by	
Innovyze	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method

Pipe Sizes STANDARD Manhole Sizes STANDARD

Designed with Level Soffits

« - Indicates pipe capacity < flow

Network Results Table

BuroHappold Ltd		Page 3
Camden Mill Lower Bristol Road Bath		
Date 26/04/2023 08:07 File 2&3 NOMA_230421.MDX	Designed by frodrigu Checked by	
Innovyze	Network 2020.1.3	

Online Controls for plot 2 only

Hydro-Brake® Optimum Manhole: SSW MH4, DS/PN: S1.004, Volume (m³): 5.7

Unit Reference	MD-SHE-0036-1100-3500-1100
Design Head (m)	3.500
Design Flow (l/s)	1.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	36
Invert Level (m)	42.725
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.500	1.1
Flush-Flo™	0.155	0.5
Kick-Flo®	0.324	0.4
Mean Flow over Head Range	-	0.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.4	1.200	0.7	3.000	1.0	7.000	1.5
0.200	0.5	1.400	0.7	3.500	1.1	7.500	1.6
0.300	0.4	1.600	0.8	4.000	1.2	8.000	1.6
0.400	0.4	1.800	0.8	4.500	1.2	8.500	1.6
0.500	0.5	2.000	0.9	5.000	1.3	9.000	1.7
0.600	0.5	2.200	0.9	5.500	1.3	9.500	1.7
0.800	0.6	2.400	0.9	6.000	1.4		
1.000	0.6	2.600	1.0	6.500	1.5		

Hydro-Brake® Optimum Manhole: SSW MH13, DS/PN: S2.004, Volume (m³): 2.7

Unit Reference	MD-SHE-0086-3300-1000-3300
Design Head (m)	1.000
Design Flow (l/s)	3.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	86
Invert Level (m)	40.510
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

BuroHappold Ltd		Page 4
Camden Mill Lower Bristol Road Bath		
Date 26/04/2023 08:07 File 2&3 NOMA_230421.MDX	Designed by frodrigu Checked by	
Innovyze	Network 2020.1.3	

Hydro-Brake® Optimum Manhole: SSW MH13, DS/PN: S2.004, Volume (m³): 2.7

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.3
Flush-Flo™	0.296	3.3
Kick-Flo®	0.624	2.7
Mean Flow over Head Range	-	2.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.6	1.200	3.6	3.000	5.5	7.000	8.2
0.200	3.2	1.400	3.9	3.500	5.9	7.500	8.5
0.300	3.3	1.600	4.1	4.000	6.3	8.000	8.7
0.400	3.2	1.800	4.3	4.500	6.6	8.500	9.0
0.500	3.1	2.000	4.5	5.000	7.0	9.000	9.2
0.600	2.8	2.200	4.8	5.500	7.3	9.500	9.5
0.800	3.0	2.400	4.9	6.000	7.6		
1.000	3.3	2.600	5.1	6.500	7.9		

Hydro-Brake® Optimum Manhole: SSW MH9, DS/PN: S1.009, Volume (m³): 5.8

Unit Reference	MD-SHE-0133-9600-1700-9600
Design Head (m)	1.700
Design Flow (l/s)	9.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	133
Invert Level (m)	39.300
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.700	9.6
Flush-Flo™	0.501	9.6
Kick-Flo®	1.040	7.6
Mean Flow over Head Range	-	8.4

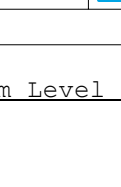
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.8	0.300	9.2	0.500	9.6	0.800	9.1
0.200	8.4	0.400	9.5	0.600	9.5	1.000	8.0

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BuroHappold Ltd			Page 5				
Camden Mill Lower Bristol Road Bath							
Date 26/04/2023 08:07 File 2&3 NOMA_230421.MDX		Designed by frodrigu Checked by					
Innovyze		Network 2020.1.3					
<u>Hydro-Brake® Optimum Manhole: SSW MH9, DS/PN: S1.009, Volume (m³): 5.8</u>							
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	8.1	2.400	11.3	5.000	16.0	8.000	20.1
1.400	8.8	2.600	11.7	5.500	16.8	8.500	20.6
1.600	9.3	3.000	12.6	6.000	17.5	9.000	21.2
1.800	9.9	3.500	13.5	6.500	18.2	9.500	21.8
2.000	10.4	4.000	14.4	7.000	18.8		
2.200	10.8	4.500	15.2	7.500	19.4		
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BuroHappold Ltd		Page 6																														
Camden Mill Lower Bristol Road Bath																																
Date 26/04/2023 08:07 File 2&3 NOMA_230421.MDX	Designed by frodrigu Checked by																															
Innovyze Network 2020.1.3																																
<p style="text-align: center;"><u>Storage Structures for plot 2 only</u></p> <p style="text-align: center;"><u>Tank or Pond Manhole: STANK 1, DS/PN: S1.003</u></p> <p style="text-align: center;">Invert Level (m) 42.755</p> <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th></tr><tr><td>0.000</td><td>47.0</td><td>3.895</td><td>47.0</td><td>3.896</td><td>0.0</td></tr></table> <p style="text-align: center;"><u>Cellular Storage Manhole: STANK 2, DS/PN: S2.003</u></p> <p style="text-align: center;">Invert Level (m) 40.690 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000</p> <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>8.6</td><td>0.0</td><td>1.221</td><td>0.0</td><td>0.0</td></tr><tr><td>1.220</td><td>8.6</td><td>0.0</td><td></td><td></td><td></td></tr></table>			Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	47.0	3.895	47.0	3.896	0.0	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	8.6	0.0	1.221	0.0	0.0	1.220	8.6	0.0			
Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)																											
0.000	47.0	3.895	47.0	3.896	0.0																											
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)																											
0.000	8.6	0.0	1.221	0.0	0.0																											
1.220	8.6	0.0																														
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BuroHappold Ltd		Page 7
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Date 26/04/2023 08:07 File 2&3 NOMA_230421.MDX		
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Innovyze		Network 2020.1.3

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for plot 2 only

Simulation Criteria

Areal Reduction Factor 1.000	Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0	MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0	Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500	Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000	

Number of Input Hydrographs 0	Number of Storage Structures 2
Number of Online Controls 3	Number of Time/Area Diagrams 0
Number of Offline Controls 0	Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R 0.360
Region England and Wales Cv (Summer)	0.750	
M5-60 (mm)	18.000 Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep 2.5 Second Increment (Extended)	
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	SSW MH1	15 Winter	1	+0%	100/600 Winter			
S1.001	SSW MH2	15 Winter	1	+0%	30/15 Summer			
S1.002	SSW MH3	15 Winter	1	+0%	30/15 Summer			
S1.003	STANK 1	600 Winter	1	+0%	1/30 Summer			
S1.004	SSW MH4	600 Winter	1	+0%	1/15 Summer			
S1.005	SSW MH5	600 Winter	1	+0%				
S2.000	SSW MH10	15 Summer	1	+0%				
S2.001	SSWMH 11	15 Winter	1	+0%				
S2.002	SSW MH12	15 Winter	1	+0%				
S3.000	SSWMH 16	15 Winter	1	+0%				
S2.003	STANK 2	15 Winter	1	+0%	30/15 Winter			
S2.004	SSW MH13	15 Winter	1	+0%	1/15 Winter			
S2.005	SSW MH14	15 Winter	1	+0%				
S2.006	SSW MH15	15 Winter	1	+0%				
S1.006	SSW MH6	15 Winter	1	+0%				
S1.007	SSW MH7	15 Winter	1	+0%				
S1.008	SSW MH8	15 Winter	1	+0%				
S1.009	SSW MH9	15 Winter	1	+0%				

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Simulation Criteria

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Rainfall Model	FSR	Ratio R	0.360
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

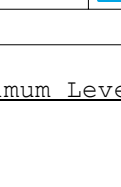
Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
n Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 45

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for plot 2 only

PN	US/MH Name	Water	Surcharged	Flooded	Flow / Cap.	Half Drain	Pipe	Status
		Level (m)	Depth (m)	Volume (m³)		Overflow (l/s)	Time (mins)	
S1.000	SSW MH1	46.211	-0.089	0.000	0.34		5.8	OK
S1.001	SSW MH2	45.959	0.004	0.000	0.84		9.1	SURCHARGED
S1.002	SSW MH3	45.945	0.015	0.000	1.27		13.6	SURCHARGED
S1.003	STANK 1	44.572	1.517	0.000	0.02		0.9	SURCHARGED
S1.004	SSW MH4	44.583	1.708	0.000	0.05		0.8	SURCHARGED
S1.005	SSW MH5	42.661	-0.129	0.000	0.05		0.8	OK
S2.000	SSW MH10	43.050	-0.150	0.000	0.00		0.0	OK
S2.001	SSWMH 11	42.637	-0.113	0.000	0.14		3.9	OK
S2.002	SSW MH12	41.702	-0.073	0.000	0.53		5.2	OK
S3.000	SSWMH 16	41.975	-0.075	0.000	0.14		1.6	OK
S2.003	STANK 2	40.950	0.035	0.000	0.06	14	2.7	SURCHARGED
S2.004	SSW MH13	40.946	0.286	0.000	0.21		3.3	SURCHARGED
S2.005	SSW MH14	40.469	-0.106	0.000	0.19		3.3	OK
S2.006	SSW MH15	39.957	-0.103	0.000	0.22		3.3	OK
S1.006	SSW MH6	39.889	-0.101	0.000	0.23		4.0	OK
S1.007	SSW MH7	39.557	-0.183	0.000	0.08		4.0	OK
S1.008	SSW MH8	39.392	-0.228	0.000	0.08		4.0	OK
S1.009	SSW MH9	39.388	-0.062	0.000	0.32		4.0	OK

PN	US/MH Name	Level Exceeded
S1.000	SSW MH1	
S1.001	SSW MH2	
S1.002	SSW MH3	
S1.003	STANK 1	
S1.004	SSW MH4	
S1.005	SSW MH5	
S2.000	SSW MH10	
S2.001	SSWMH 11	
S2.002	SSW MH12	
S3.000	SSWMH 16	
S2.003	STANK 2	
S2.004	SSW MH13	
S2.005	SSW MH14	
S2.006	SSW MH15	
S1.006	SSW MH6	
S1.007	SSW MH7	
S1.008	SSW MH8	
S1.009	SSW MH9	

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Camden Mill Lower Bristol Road Bath		
Date 26/04/2023 08:07 File 2&3 NOMA_230421.MDX		
Designed by frodrigu Checked by		
Innovyze		Network 2020.1.3

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for plot 2 only

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.360
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	SSW MH1	1440 Winter	100	+45%	100/600 Winter			
S1.001	SSW MH2	1440 Winter	100	+45%	30/15 Summer			
S1.002	SSW MH3	1440 Winter	100	+45%	30/15 Summer			
S1.003	STANK 1	1440 Winter	100	+45%	1/30 Summer			
S1.004	SSW MH4	1440 Winter	100	+45%	1/15 Summer			
S1.005	SSW MH5	1440 Winter	100	+45%				
S2.000	SSW MH10	15 Summer	100	+45%				
S2.001	SSWMH 11	15 Winter	100	+45%				
S2.002	SSW MH12	15 Winter	100	+45%				
S3.000	SSWMH 16	15 Winter	100	+45%				
S2.003	STANK 2	60 Winter	100	+45%	30/15 Winter			
S2.004	SSW MH13	60 Winter	100	+45%	1/15 Winter			
S2.005	SSW MH14	60 Winter	100	+45%				
S2.006	SSW MH15	60 Winter	100	+45%				
S1.006	SSW MH6	180 Winter	100	+45%				
S1.007	SSW MH7	180 Winter	100	+45%				
S1.008	SSW MH8	180 Winter	100	+45%				
S1.009	SSW MH9	180 Winter	100	+45%				

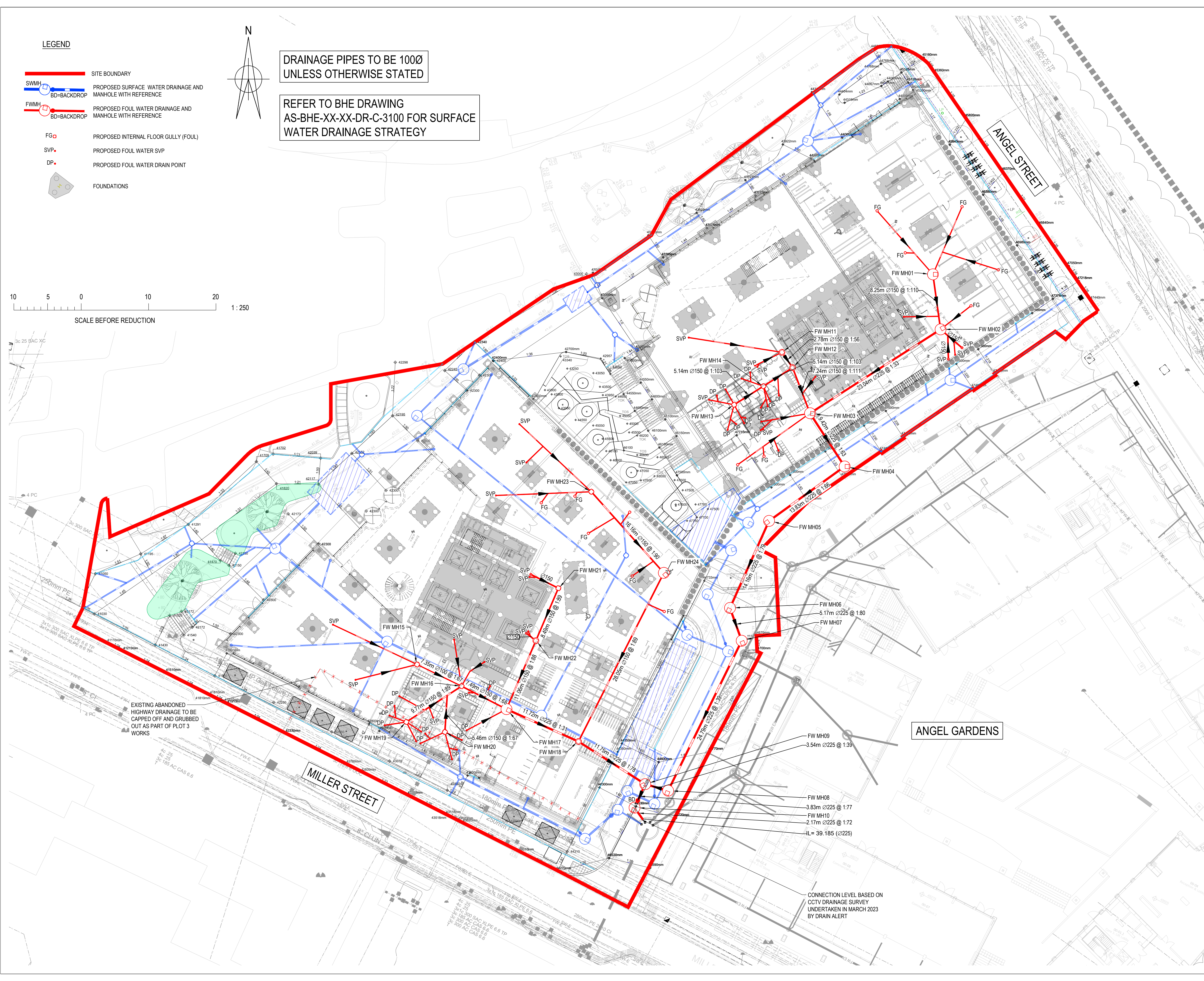
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100 year Return Period Summary of Critical Results by Maximum Level (Rank
1) for plot 2 only

PN	US/MH Name	Water	Surcharged	Flooded	Flow / Cap.	Half Drain	Pipe	Status
		Level (m)	Depth (m)	Volume (m³)		Overflow (l/s)	Time (mins)	
S1.000	SSW MH1	46.457	0.157	0.000	0.03		0.6	SURCHARGED
S1.001	SSW MH2	46.457	0.502	0.000	0.08		0.9	SURCHARGED
S1.002	SSW MH3	46.457	0.527	0.000	0.13		1.3	SURCHARGED
S1.003	STANK 1	46.456	3.401	0.000	0.02		1.3	SURCHARGED
S1.004	SSW MH4	46.466	3.591	0.000	0.07		1.1	SURCHARGED
S1.005	SSW MH5	42.664	-0.126	0.000	0.06		1.1	OK
S2.000	SSW MH10	43.050	-0.150	0.000	0.00		0.0	OK
S2.001	SSWMH 11	42.652	-0.098	0.000	0.26		7.3	OK
S2.002	SSW MH12	41.744	-0.031	0.000	0.98		9.7	OK
S3.000	SSWMH 16	41.985	-0.065	0.000	0.27		3.1	OK
S2.003	STANK 2	41.522	0.607	0.000	0.06	36	2.8	SURCHARGED
S2.004	SSW MH13	41.519	0.859	0.000	0.21		3.3	SURCHARGED
S2.005	SSW MH14	40.469	-0.106	0.000	0.19		3.3	OK
S2.006	SSW MH15	39.957	-0.103	0.000	0.22		3.3	OK
S1.006	SSW MH6	39.891	-0.099	0.000	0.26		4.3	OK
S1.007	SSW MH7	39.560	-0.180	0.000	0.09		4.3	OK
S1.008	SSW MH8	39.397	-0.223	0.000	0.08		4.3	OK
S1.009	SSW MH9	39.393	-0.057	0.000	0.34		4.3	OK

	US/MH	Level
PN	Name	Exceeded
S1.000	SSW MH1	
S1.001	SSW MH2	
S1.002	SSW MH3	
S1.003	STANK 1	
S1.004	SSW MH4	
S1.005	SSW MH5	
S2.000	SSW MH10	
S2.001	SSWMH 11	
S2.002	SSW MH12	
S3.000	SSWMH 16	
S2.003	STANK 2	
S2.004	SSW MH13	
S2.005	SSW MH14	
S2.006	SSW MH15	
S1.006	SSW MH6	
S1.007	SSW MH7	
S1.008	SSW MH8	
S1.009	SSW MH9	

Appendix L Proposed Foul Water Drainage General Arrangement (2&3)



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DO NOT SCALE THIS DRAWING.

HEALTH AND SAFETY INFORMATION
IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:

CONSTRUCTION

- WORKS WITHIN POTENTIAL CONFINED SPACE CONDITIONS
- WORKS IN PROXIMITY TO LIVE SERVICES
- WORKS INTERFERENCE WITH THE PUBLIC ON MILLER STREET AND ANGEL STREET

MAINTENANCE/CLEANING/OPERATION

- WORKS WITHIN POTENTIAL CONFINED SPACE CONDITIONS
- WORKS IN PROXIMITY TO LIVE SERVICES
- WORKS INTERFERENCE WITH THE PUBLIC ON MILLER STREET AND ANGEL STREET

DECOMMISSIONING/DEMOLITION

- WORKS WITHIN POTENTIAL CONFINED SPACE CONDITIONS
- WORKS IN PROXIMITY TO LIVE SERVICES
- WORKS INTERFERENCE WITH THE PUBLIC ON MILLER STREET AND ANGEL STREET

GENERAL NOTES:

- THE DESIGN OF THIS SCHEME HAS BEEN BASED ON THE FOLLOWING DRAWINGS AND INFORMATION:
 - TOPOGRAPHICAL SURVEY: DRAWING No. 11164_001 RECEIVED APRIL 2021, BY ND OLIVER
 - GPR SURVEY: DRAWING No. 157-WDA-SS-EX-DR-UC-MU100-001-Rev01 RECEIVED MAY 2022, BY WDA
 - ARCHITECT LAYOUT: DRAWING No. AS-CPA-P2-LG-DR-A-2000-P04-GA PLAN - LEVEL LG AND AS-CPA-P3-LG-DR-A-2000-P05-GA PLAN - LEVEL LG RECEIVED 19.04.2023, BY CARTWRIGHT PICKARD
 - LANDSCAPE ARCHITECT LAYOUT: DRAWING No. PL2190.1-PLA-XX-XX-DR-L-1001 RECEIVED 19.04.2023, BY PLANIT.
 - LANDSCAPE ARCHITECT LEVELS: DRAWING No. PL2190.1-PLA-XX-XX-DR-L-3000 RECEIVED 13.04.2023, BY PLANIT.
- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, DETAILS AND SPECIFICATIONS.
- ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.
- FOR ENGINEERING PROJECT NOTES (DRAINAGE, EXTERNAL WORKS, ETC) REFER TO DRAWING AS-BHE-XX-XX-DR-C-0100
- REFER TO DRAWING AS-BHE-XX-XX-DR-C-3800 AND 3801 FOR MANHOLE SCHEDULES.
- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, DETAILS AND SPECIFICATIONS.
- ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.
- PRIOR TO THE COMMENCEMENT OF WORK THE LOCATION, SIZE AND DEPTH OF ALL EXISTING DRAINS/SEWERS AND SERVICES SHALL BE ESTABLISHED BY THE CONTRACTOR. ANY DISCREPANCIES FROM THE INFORMATION INDICATED ON THESE DRAWINGS SHALL IMMEDIATELY BE BROUGHT TO THE ATTENTION OF THE ARCHITECT OR ENGINEER.
- THE CONTRACTOR SHALL ALLOW FOR THE PROTECTION, TEMPORARY AND PERMANENT SUPPORT AND DIVERSION WORKS AS NECESSARY, TO ALL EXISTING SERVICES TO THE SATISFACTION OF THE PUBLIC UTILITIES.
- RAIN GARDEN DETAILS TO BE COORDINATED WITH LANDSCAPE ARCHITECT
- EXISTING DRAINAGE AND UTILITIES FOR THE EXISTING NOMA MARKETING SUITE TO BE ABANDONED PRIOR COMMENCEMENT OF WORKS ON PLOT 3
- EXACT LOCATION OF ANY POWER REQUIREMENT FOR THE SUB STATION TO BE COORDINATED DURING NEXT STAGE OF THE DESIGN
- EXTENT OF BREAKING OUT OF EXISTING CONCRETE SLAB IN THE ACCESS ROAD BETWEEN ANGEL GARDENS AND PLOT 3 TO BE CONFIRMED BY MAIN CONTRACTOR PENDING REVIEW OF EXCAVATION/TEMPORARY WORKS

P01 ISSUED FOR STAGE 3 28.04.2023 FR PT PT

Rev	Description	Date	Iss'd	Rev'd	App'd
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STAGE 3

Project Stage

COMMENT

Status of Drawing

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Web: www.burohappold.com

Client: MEPC
Architect: CARTWRIGHT PICKARD
Project: ANGEL SQUARE PLOTS 2 AND 3
Dwg Title: PROPOSED DRAINAGE FOUL WATER GENERAL ARRANGEMENT

Job No: 0050930
Scale: A1
1:250

Drawn/Designed By: FR
Checked By: PT
Approved By: PT

Drawing No: AS-BHE-XX-XX-DR-C-3101
Revision: P01

Appendix M Proposed Foul Water Drainage General Arrangement Plot 2

Appendix N Correspondence with Hydro International

Francisco Rodriguez

From: Karl Hall <khall@hydro-int.com>
Sent: 13 February 2024 14:38
To: Francisco Rodriguez
Subject: Small Hydro-Brake blockage risk

Follow Up Flag: Follow up
Flag Status: Flagged

****External Email. This email originated from outside Buro Happold.****

Hi Francisco

Further to our chat last week, as I mentioned, you will receive a response direct from our head office in response to your query about very small Hydro-Brakes (which I haven't access to at the moment), but they will probably suggest that the small Hydro-Brakes are protected by having wire mesh baskets fitted over them. This is not however my preferred solution – see below. If we place a basket over the Hydro-Brake, the mesh size of that basket needs to be even smaller than opening in the Hydro-Brake, obviously, and so what we are doing by using this approach is moving the blockage risk from the Hydro-Brake to the mesh basket that we've placed over it. If the basket does the job that it is designed to so, then it will collect debris in the flow and eventually start to blind, reducing the flow through the Hydro-Brake behind it, and affecting the hydraulics of the flow control. Additionally, if the basket completely blocks with debris, the chamber will flood, kicking in the high-level overflow that we should provide. Additionally a penstock would need to be built in the chamber to drain down if the chamber floods.

In my opinion the best solution, and one that should satisfy the LLFA, is to introduce a screened silt trap upstream of the flow control chamber. The downstream flow control chamber is then fully protected from the risk of blockage by debris. The upstream chamber is of course a maintenance item, but the upstream chamber is (depending on the product chosen) a lot less likely to create a reduction in flows.

You therefore have two options here, one is the mesh basket that may be offered as a solution by head office, or the above, depending on what the LLFA feels like agreeing with.

Hope this helps,

Regards
Karl

Francisco Rodriguez

From: Harvey Farrington-Thorne <hfarringtonthorne@hydro-int.com>
Sent: 12 February 2024 11:34
To: Francisco Rodriguez
Cc: Paul Thomson
Subject: RE: 2&3 Angel Square Manchester- Risk of blockage query TT45036

Follow Up Flag: Follow up
Flag Status: Flagged

****External Email. This email originated from outside Buro Happold.****

Hi Francisco,

Thanks for the email. We cannot provide a 'blockage risk assessment' however, we can comment. Hopefully, the below provides clarification and can help with regards to your correspondence with the LLFA.

I can see that the flows are quite low and that does increase the likeliness of blockage as the orifice sizes are quite small. Our recommended minimum opening is 75mm for safe day-to-day functionality and so the 1.1 l/s Hydro-Brake is quite a bit lower than that. The unit must be protected from debris entrapment and therefore the mesh guard is to be supplied for that unit to help reduce the risk of blockage. Including this mesh guard, however, means that this unit cannot be provided with a drain down bypass door, and therefore we recommend that provisions are made to enable drain down of the chamber when/if needed. The drawings you have sent indicate the inclusion of an overflow pipe which is good, but they are not illustrated. So, it is important to ensure they are included. Another option for this is a penstock for drain down.

Moreover, it is essential that interception of debris is ensured upstream of the Hydro-brake chambers. Silt-traps in the attenuation upstream would greatly reduce the risk of sediment reaching and blocking the Hydro-brake. Also, a vortex separator that removes sediment from the runoff would also massively reduce the risk of blockage. Other SuDS such as filter drains will also limit the debris that could make their way to the Hydro-brake. We can provide attenuation tanks with silt traps, and we also sell vortex separators- Downstream Defender Select.

Finally, we would recommend the Hydro-brakes will be checked regularly to ensure they are not blocked in the first year after installation. Please let me know if you have any questions.

Kind regards,

Harvey Farrington-Thorne
BEng (Hons)
Applications Engineer
Direct Dial: +44 1275 337935



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From: Francisco Rodriguez <Francisco.Rodriguez@BuroHappold.com>
Sent: Friday, February 9, 2024 8:30 AM
To: Design Tools <designtools@hydro-int.com>
Cc: Paul Thomson <Paul.Thomson@BuroHappold.com>
Subject: 2&3 Angel Square Manchester- Risk of blockage query

This Message Is From an External Sender

This message came from outside your organization.

Good Morning,

Hope you are keeping well.

We are working on a project in the centre of Manchester where we have a limited discharge rate of 4.4l/s. Due to the level difference in the proposed development, we split the surface water network in two, limiting the flows to 3.3l/s and 1.1l/s.

We have received the following comment from the LLFA regarding their concerns due to the high risk of blockage:

- We have concerns with the proposed flow rates for manholes MH13 and MH04, due to the high risk of blockage. Where flow rates <5 l/s are proposed, evidence of blockage risk assessment is required, including evidence from the flow control manufacturer where necessary.

Could you please provide evidence of blockage risk assessment that we can send to the LLFA to comply with their comment?

Please see attached the drainage strategy drawing and hydrobrake details.

Please let us know if you need further information.

Kind Regards

Francis

Francisco Rodriguez (Francis) CEng MICE
Senior Infrastructure Engineer
Buro Happold | Cities Infrastructure Leeds

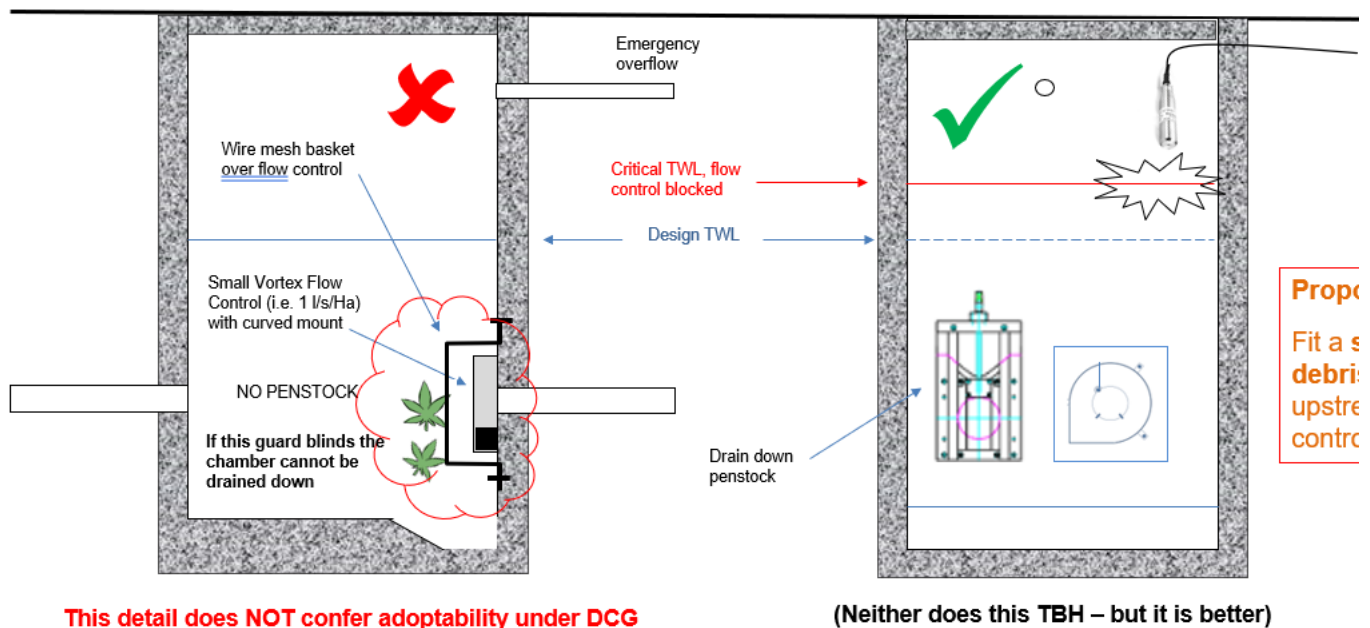
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Small Flow Control – Critical Risk, Do's and Don't's



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Appendix O Attenuation Tank Design Note

BURO HAPPOLD	Attenuation Tank Design Note	Date: 04/04/24
	Project: NOMA Plots 2 & 3	Revision: 00
	Status: For Information	Author: John Edgell

Executive Summary

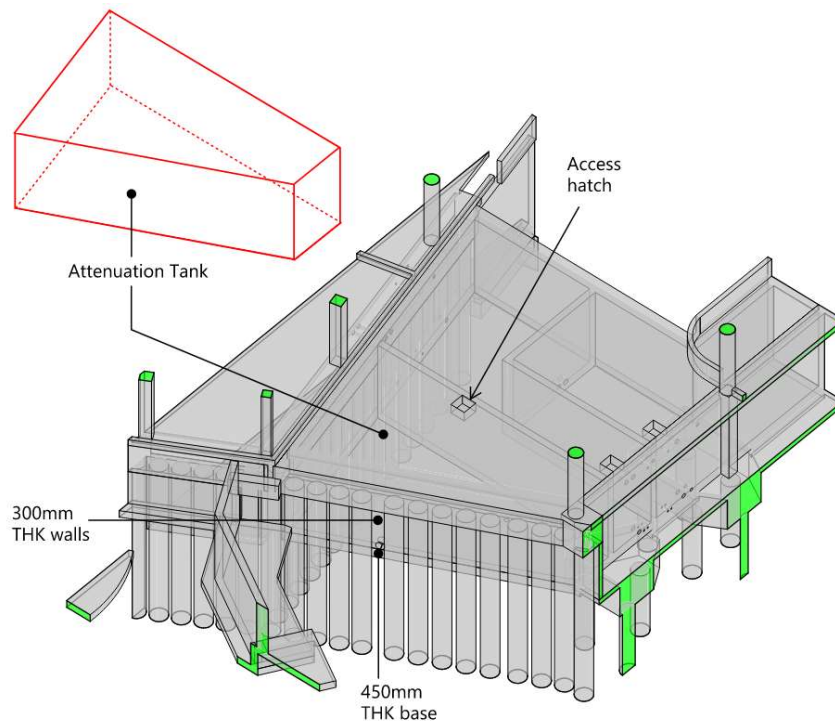
Concern has been raised regarding the design of the attenuation tank, primarily around durability and the difficulty of maintenance, repair or replacement. The attenuation tank has the same design life as the adjacent buildings that it serves. It is designed to the appropriate industry guidance as a liquid containing reinforced concrete structure. The commissioning process will provide confirmation that the tanks have the appropriate water tightness at building completion. Localized repair of the tank is possible but it is difficult to foresee a significant breach of the tank integrity without considerable structural movement which would have wider and more onerous implications for the adjacent buildings.

Background

The drainage design requires an attenuation tank to reduce the flow to an acceptable discharge rate. There is insufficient space for a stand alone tank outside the building footprint and within the site boundary. The design team have arrived at a solution using a reinforced concrete (RC) attenuation tank, located between the two buildings (plots 2 and 3). Manchester City Council (MCC) have raised durability concerns due to the limited access for maintenance and repair. The tank will be constructed with the foundations, an item MCC also consider a potential issue.

Tank Design & Construction

The attenuation tank is formed from 300mm thick RC walls and 450mm thick RC base and lid. The tank is built integrally with the capping beam and piled foundations for the plots. On two sides the tank walls from the interface with the lower ground floor within the plots. One side separates the attenuation tank from the sprinkler tank and the final side has the contiguous piled wall behind forming retaining the adjacent earth.



The performance of the tank is defined as a minimum water tightness class of 1, as defined by BS EN 1992-3:2006 *Eurocode 2. Design of concrete structures – Liquid retaining and containing structures*. British Standard 8102:2022 *Protection of Below Ground Structures Against Water Ingress*, defines the performance of tightness class 1 as “No seepage. Damp areas from internal external sources are tolerable.” This is an appropriate specification for a below ground tank.

The design life of the RC tank is 50 years, commensurate with the design life of the building. This is as defined in the UK National Annex to Eurocode 2 as appropriate for “buildings and other common structures”.

The specification calls for the concrete to be inspected after casting with non-conformity defects recorded and remediated. As part of the commissioning process the system will be tested.

Inspection & Maintenance

Man-entry access to the attenuation tank is via a manhole cover in the lid with winched access. To facilitate man-entry the incoming water will be either diverted to bypass the tank and provide a dry area or works to be undertaking during a dry period in the summer months when it is envisaged the tank may be empty to allow safe access. Inspections should be carried out during the first year of operation and ideally after every significant storm event to ensure proper functionality. At a minimum, the tank should be CCTV inspected periodically, and sediment should be removed from it.

Inspecting the tank walls for structural integrity is not a requirement. However, if man access is taking place to remove sediment we suggest it would be good practice to visually inspect the interior for defects.

Tank Integrity

For the tank to leak, cracks need to propagate through the full thickness of the concrete (minimum of 300mm thick). It will be designed to prevent this and the quality of the construction and commissioning will confirm it is adequate at the time of installation. The structural design will be durable and, considering structural integrity, without maintenance for the life of building.

The tank has been designed to be integral with the surrounding foundations. Significant movement of the 750mm diameter, 20-25m long, rock socketed piles that support the adjacent buildings would distress the tank. As with the RC frame, the piles are designed to prevent this. Therefore we do not believe the integral nature of the design is an issue. If there is foundation movement to such an extent that it compromises the tank, we would expect to see signs of distress in the buildings that would need immediate structural investigation.

If there is an issue either with the design or construction of the tank and post-installation, a leak is identified the tank could be accessed, surveyed to and a patch repair undertaken from the inside. The method of this is not explored in any detail as it would constitute a failure of the design and/or construction to meet the brief.

The attenuation tank is adjacent to the sprinkler and wet riser RC tanks. Leaks in these tanks would be a major issue for the client to resolve. Both the sprinkler and wet riser tanks are life safety systems. A failure of these tanks would prevent the buildings being operational.

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