

Limerick City & County Council in partnership with Limerick Twenty Thirty DAC

Cleeves Riverside Quarter

Engineering Services Report

Reference: CRQMP-ARUP-ZZ-ZZ-RP-CE-0001

C01 | 03 October 2025

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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1. Introduction

This Engineering Services Report has been prepared on behalf of Limerick City & County Council in partnership with Limerick Twenty Thirty DAC (LTT) as part of a planning application for the proposed Cleeves Riverside Quarter Development.

Limerick City and County Council, in partnership with Limerick Twenty Thirty DAC, intends to seek the approval of An Coimisiún Pleanála in accordance with Section 175 and 177AE of the Planning and Development Act 2000, as amended, for a mixed-use development that seeks the regeneration and adaptive reuse of a strategic brownfield site, as part of the Limerick City and County Council ‘World Class Waterfront revitalisation and transformation project’.

The purpose of this report is to outline the civil engineering design (drainage and watermains) proposal for the Cleeves Riverside Quarter (CRQ).

2. The Proposed Development

The proposed development comprises Phase II, of an overall Masterplan with four phases of development proposed. Phase II is subsequent to ongoing stabilisation and repair of the Flaxmill protected structure (Phase I). Phase III is intended to comprise an educational campus, inclusive of the adaptive reuse of the Flaxmill Building as part of that development and will be subject to a future separate application. Phase IV comprising the Shipyard site will be the final phase of development.

The proposed development provides for the (A) Demolition of a number of structures to facilitate development and (B) Construction and phased delivery of (i) buildings within the site ranging in height from 3 – 7 stories (with screened plant at roof level) including (a) 234 no. residential units; (b) 270 no. student bedspaces (PBSA) with ancillary resident services at ground floor level; (c) 256sqm of commercial floorspace; and (d) a creche; (ii) extensive public realm works, (iii) riverside canopy and heritage interpretative panels, (iv) 3 no. dedicated bat houses; (v) Mobility Hub with canopy; and (vi) all ancillary site development works including (a) water services, foul and surface water drainage and associated connections across the site and serving each development zone; (b) attenuation measures; (c) raising the level of North Circular Road; (d) car and bicycle parking; (e) public lighting; (f) telecommunication antennae and (g) all landscaping works. Consent is also sought for use of the PBSA accommodation, outside of student term time, for short-term letting purposes.

The engineering services report examines the phase II development with consideration to future developments in the wider Masterplan.

2.1 Site Location

The site, known locally as ‘Cleeves Riverside Quarter’ comprises the former industrial mill complex (‘Cleeves’) situated on the northern side of the River Shannon, Limerick City and occupies the area between; Stonetown Terrace Road to the northeast; O’Callaghan Strand to the southeast; Condell Road (R527) to the southwest; and, Salesian Primary School and the ‘Fernhill’ residential estate to the northwest and west respectively - all situated in the townland of Farranshone More in Limerick City. The site is dissected by North Circular Road where it extends between Shelborne Road Lower and O’Callaghan Strand.

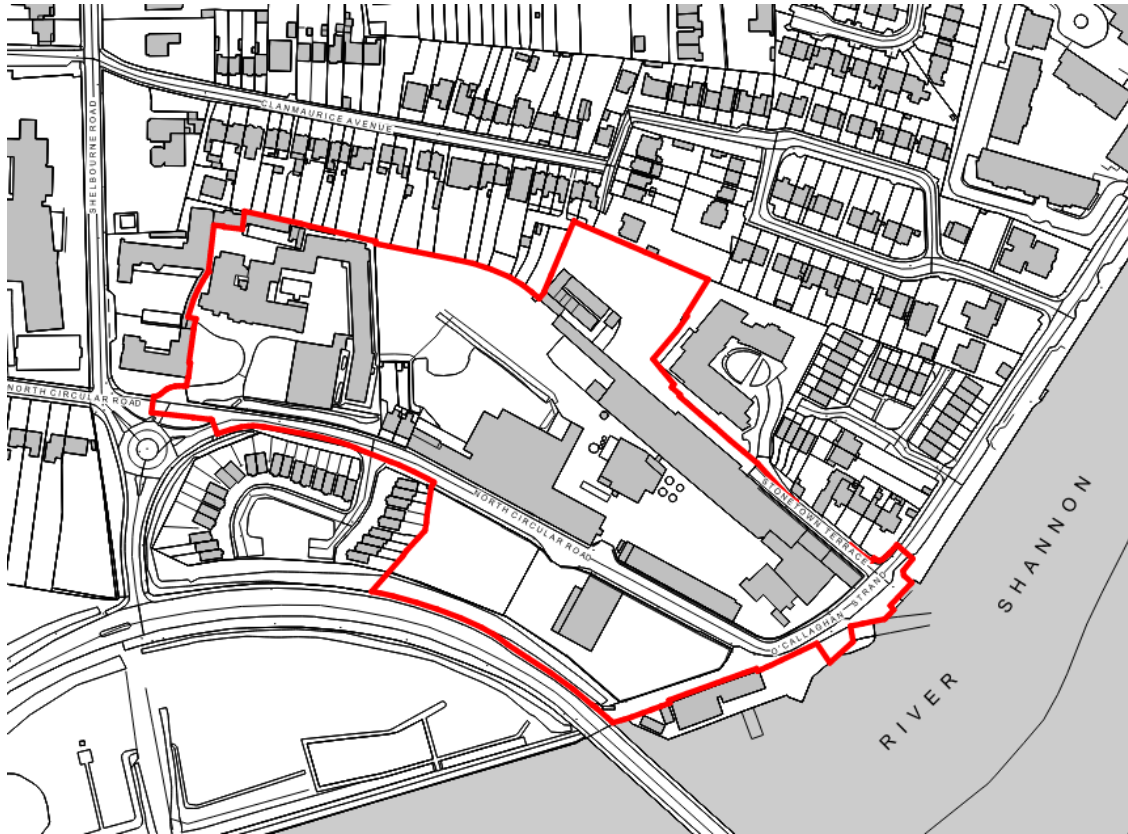


Figure 1: Application Boundary

3. Reference Documents

The basis of the SuDS and drainage strategies outlined in this report are founded on the principles detailed in the below list of documents:

- Part H of the Building Regulations
- BS EN 752 Drain and Sewer Systems outside Buildings
- Limerick Development Plan 2022 to 2028
- CIRIA report C753 The SuDS Manual
- The Greater Dublin Regional Code of Practice for Drainage Works and Irish Water requirements.

4. Background Surveys

4.1 Topographical

A topographical survey of the existing site was carried out by Geodata Chartered Land Surveyors. Refer to Appendix C1 or the site topographical survey. The survey includes contours, spot levels on the site (all to Malin Head datum), the site boundary, road and kerb lines bounding the site as well as existing drainage, chambers and additional services within the site.

4.2 Utility

A utility survey of the existing site has been carried out by Precision Utility Mapping. Refer to Appendix C2 for the existing utility survey in the vicinity of the site.

4.3 CCTV Survey

A detailed CCTV survey of the existing process, foul and surface water drainage systems within the former Cleeves, Salesians and Shipyard sites was undertaken. McBreen carried out the work in 2024 with the CCTV survey confirming the extent and condition of onsite networks and connections to the Uisce Éireann network along the North Circular Road (NCR).

5. Drawings

Refer to Appendix A for the engineering drawings that accompany this report.

6. Existing Services

There is an existing 150mm surface water pipe from the Salesians site that is discharging directly to the combined sewer on NCR via a 300mm internal combined drainage network. There is an existing 225mm Surface Water Sewer serving the apartments at the top of Stonetown Terrace.

There appears to be a 400mm surface water outfall (discharge) via an existing pipe at the Shannon River's north bank from the Flaxmill site. The CCTV survey shows that there are a series of pipes that link the Shannon River to the reservoir from this feature. There was confirmation in early March 2021 of the existence of a flap-gate access point to the Reservoir in the area below the infiltration gallery which has an invert level of 0.33m. The last manhole before the Shannon River has a higher invert level (0.99m), which suggests that the link was designed to drain water from the Shannon River to the reservoir to be used for the industrial process on site. The flap-gate at the reservoir no longer works and thus allows water to enter in either side of the pipe depending on the resultant water level in the Shannon River. The Verde Hydrographic Report from 2021 shows that the tide in the reservoir fluctuates from a minimum low tide of +0.99m ODM to a maximum high tide at +2.00m ODM.

There is a 200mm diameter watermain crossing the Shannon bridge and connecting to a 150mm diameter watermain surrounding the site on the lower NCR, O'Callaghan Strand and on Stonetown Terrace.

There is a large diameter combined sewer located on the lower North Circular Road (NCR) which is indicated as being connected to a 1.8m diameter combined sewer crossing the river just northeast of St Michael's Rowing Club. It is understood that these sewers were installed as part of the Limerick Main Drainage Scheme (LMDS) in the early 2000's. The existing combined sewer in the lower North Circular Road (NCR) between the two sites (Flaxmill & Shipyard) is 1050mm in diameter and has a shallow hydraulic gradient of circa 1/400.

7. Proposed Services

7.1 Proposed Surface Water

7.1.1 Design Criteria

It is proposed to discharge the surface water from the development to the Shannon River via the existing 400 mm diameter discharge pipe. The overall objective is to drain each site as an independent network to enable phasing of the works.

Surface water infrastructure and attenuation facilities will be designed to service a volume equivalent to a 1 in 100-year event plus 30% for climate change and 10% urban creep in agreement with Limerick County Council. Exceedance events beyond the 1 in 100-year will be channelled towards sacrificial areas away from buildings. Building finished floor levels will be raised above adjacent ground levels to an extent commensurate with the flood risk considerations for the individual areas, as a further protection measure.

The aim is to restrict surface water peak discharges from the Cleeves development site to 2 litres/second/hectare, in line with the GDSDS and Limerick City & County Council Water Services requirements, prior to discharge to the Shannon River. Moreover, the critical requirement will be that the final rate of flow discharge that leaves the site does not exceed the current levels.

The primary objective is to use the reservoir as an attenuation facility, managing surface water runoff from the adjacent Salesians, PBSA, and Stonetown Terrace sites. Controlled discharge from the reservoir will be facilitated via a 225 mm diameter outlet pipe, which will traverse through the Flaxmill Plaza site and connect to the final manhole before discharging to the River Shannon.

The remaining development areas—including Flaxmill Plaza, O’Callaghan Strand, Shipyard, and the adjacent roads (NCR, OCS, and Stonetown Road)—will drain independently to the existing discharge pipe network.

Surface water runoff from all internal drainage networks will be treated prior to discharge using a combination of Sustainable Drainage Systems (SuDS) and petrol interceptors, ensuring compliance with water quality and environmental standards.

The overarching strategy for surface water management is to prioritise the implementation of Sustainable Urban Drainage Systems (SuDS) across all development sites. This implementation of SuDS will help to achieve the key objectives of:

- Managing runoff close to source
- Limiting peak discharges to pre-development levels
- Maintaining or improving runoff quality
- Integrating stormwater management and control into the landscape design for the benefits of amenity and recreation
- Mimicking the way existing groundwater, drainage channels and wetlands are supplied with water
- Installing petrol interceptors in all areas with potential exposure to hydrocarbons e.g. car parks
- Minimising the use of buried attenuation tanks (by exception only)
- Use of natural materials for check dams in swales, consider use of recovered rock from site
- Designing detention basins to have various states of water retention to enhance biodiversity and add interest to the landscape
- Planting to comprise of species with low water demand
- Infrastructure plot boundaries to be defined to provide sufficient footprint for implementation of proposed SuDS strategy.

The range of SuDS measures on individual plots will vary from site to site. Ideally systems should treat and control the run-off as close as possible to the source. A Management Train that incorporates a series of features will be incorporated to ensure that the series of features treats and attenuates the stormwater run-off where possible.

Reservoir as attenuation facility

Excess runoff from adjacent sites and SuDS features is routed to the reservoir for attenuation. Surface water calculations prove that there is sufficient capacity in the reservoir to attenuate excess runoff for a 1:100 year storm (plus 30% climate change and 10% urban creep) from the surrounding sites. The total required attenuation volume is 1597.6m³.

A 225 mm diameter outlet pipe is proposed to be laid horizontally from the reservoir to the final discharge manhole, with an invert level of +1.00 m ODM. During attenuation, the water level within the reservoir is expected to rise to +1.90 m ODM, maintaining a freeboard of 2.90 m relative to the proposed ground level at the PBSA (+4.80 m ODM), ensuring adequate flood protection.

A reservoir clean-up strategy be implemented during the construction phase. This should include:

- Controlled draining of the reservoir
- Removal of accumulated sediment
- Survey and inspection of the reservoir bed.

Final manhole within planning boundary

The existing final manhole (ExMHC112) located at the southern boundary of the site, which includes a penstock, is in poor structural condition. It is proposed to construct a new offline manhole (SMH100) adjacent to the existing structure (to keep the existing system operational during construction). The new manhole will be fitted with a TideFlex non-return valve to prevent backflow and protect the site from flooding from the outfall pipe.

Once the new manhole is operational, the existing manhole will be decommissioned and demolished and the discharge pipe from the reservoir will be extended to connect to the new manhole.

7.1.2 Design Rainfall

The Limerick rainfall depth for various return periods and storm duration are provided by Met Eireann as indicated in the following table:

Table 1: Limerick rainfall data

Met Eireann Return Period Rainfall Depths for sliding Durations Irish Grid: Easting: 156985, Northing: 157075,													
DURATION	Interval		Years										
	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	120,
5 mins	2.8,	3.9,	4.6,	5.5,	6.2,	6.7,	8.4,	10.3,	11.6,	13.4,	15.0,	16.2,	17.0,
10 mins	3.9,	5.5,	6.4,	7.7,	8.6,	9.3,	11.7,	14.3,	16.1,	18.6,	20.8,	22.6,	23.8,
15 mins	4.5,	6.5,	7.5,	9.1,	10.2,	11.0,	13.7,	16.9,	19.0,	21.9,	24.5,	26.6,	27.9,
30 mins	5.9,	8.2,	9.4,	11.3,	12.5,	13.5,	16.7,	20.2,	22.6,	25.9,	28.8,	31.0,	32.5,
1 hours	7.6,	10.4,	11.9,	14.0,	15.5,	16.6,	20.2,	24.3,	26.9,	30.6,	33.8,	36.3,	37.9,
2 hours	9.8,	13.2,	14.9,	17.5,	19.1,	20.4,	24.6,	29.1,	32.0,	36.1,	39.6,	42.4,	44.2,
3 hours	11.4,	15.1,	17.1,	19.8,	21.7,	23.1,	27.5,	32.4,	35.5,	39.8,	43.5,	46.4,	48.3,
4 hours	12.7,	16.7,	18.8,	21.7,	23.6,	25.1,	29.8,	34.9,	38.2,	42.7,	46.5,	49.5,	51.4,
6 hours	14.8,	19.2,	21.4,	24.7,	26.8,	28.4,	33.4,	38.8,	42.3,	47.0,	51.1,	54.2,	56.2,
9 hours	17.2,	22.1,	24.5,	28.0,	30.3,	32.0,	37.4,	43.2,	46.9,	51.8,	56.1,	59.4,	61.5,
12 hours	19.2,	24.4,	26.9,	30.7,	33.0,	34.9,	40.5,	46.6,	50.4,	55.5,	60.0,	63.3,	65.5,
18 hours	22.3,	28.0,	30.8,	34.8,	37.4,	39.3,	45.4,	51.8,	55.8,	61.2,	65.9,	69.3,	71.6,
24 hours	24.8,	30.9,	33.9,	38.1,	40.8,	42.9,	49.2,	55.9,	60.0,	65.6,	70.4,	74.0,	76.3,
2 days	31.8,	38.8,	42.2,	47.0,	50.1,	52.3,	59.4,	66.7,	71.2,	77.2,	82.3,	86.1,	88.6,
3 days	37.9,	45.7,	49.5,	54.8,	58.2,	60.7,	68.3,	76.2,	81.1,	87.5,	93.0,	97.0,	99.7,
4 days	43.5,	52.1,	56.2,	61.9,	65.6,	68.3,	76.5,	84.9,	90.1,	97.0,	102.8,	107.1,	109.9,
6 days	53.8,	63.7,	68.5,	75.0,	79.1,	82.2,	91.5,	100.9,	106.7,	114.3,	120.7,	125.4,	128.5,
8 days	63.5,	74.6,	79.9,	87.1,	91.7,	95.0,	105.2,	115.6,	121.9,	130.2,	137.1,	142.2,	145.5,
10 days	72.7,	84.9,	90.7,	98.6,	103.6,	107.2,	118.3,	129.4,	136.2,	145.1,	152.5,	158.0,	161.5,
12 days	81.6,	94.9,	101.1,	109.7,	115.0,	118.9,	130.7,	142.7,	149.9,	159.4,	167.2,	173.0,	176.8,
16 days	99.0,	114.1,	121.2,	130.9,	136.9,	141.3,	154.6,	167.9,	176.0,	186.5,	195.2,	201.6,	205.7,
20 days	115.8,	132.7,	140.6,	151.3,	157.9,	162.8,	177.4,	192.0,	200.8,	212.3,	221.8,	228.7,	233.2,
25 days	136.4,	155.4,	164.2,	176.1,	183.5,	188.9,	205.0,	221.1,	230.8,	243.4,	253.7,	261.3,	266.2,

NOTES:
These values are derived from a Depth Duration Frequency (DDF) Model update 2023
For details refer to:
'Mateus C., and Coonan, B. 2023. Estimation of point rainfall frequencies in Ireland. Technical Note No. 68. Met Eireann',
Available for download at:
<http://hdl.handle.net/2262/102417>

To perform the hydraulic calculations for the Cleeves Riverside Quarter development, a critical storm of 1:100 year, 6-hour storm, with rainfall depth of 54.2mm was used. Allowing for 30% climate change and 10% urban creep we then used a rainfall depth of 77.53mm for sizing of surface water infrastructure and the SuDS components. Refer to Appendix B.1 for the critical storm calculation.

7.1.3 Run-off Coefficient

Selection of a run-off coefficient can be somewhat subjective and there is a vast amount of literature advising on appropriate factors for various ground types, slopes etc. The table below provides a comprehensive selection of potential run-off coefficients for different land uses, soil types and slopes:

Table 2: Runoff coefficient

Land use	Slope	Sand	Loamy	Sandy	Loam	Silt	Silt	Sandy	Clay	Silty	Sandy	Silty	Clay
	(%)		sand	loam		loam		clay	loam	clay	clay	Clay	
Forest	<0.5	0.03	0.07	0.10	0.13	0.17	0.20	0.23	0.27	0.30	0.33	0.37	0.40
	0.5-5	0.07	0.11	0.14	0.17	0.21	0.24	0.27	0.31	0.34	0.37	0.41	0.44
	5-10	0.13	0.17	0.20	0.23	0.27	0.30	0.33	0.37	0.40	0.43	0.47	0.50
	>10	0.25	0.29	0.32	0.35	0.39	0.42	0.45	0.49	0.52	0.55	0.59	0.62
Grass	<0.5	0.13	0.17	0.20	0.23	0.27	0.30	0.33	0.37	0.40	0.43	0.47	0.50
	0.5-5	0.17	0.21	0.24	0.27	0.31	0.34	0.37	0.41	0.44	0.47	0.51	0.54
	5-10	0.23	0.27	0.30	0.33	0.37	0.40	0.43	0.47	0.50	0.53	0.57	0.60
	>10	0.35	0.39	0.42	0.45	0.49	0.52	0.55	0.59	0.62	0.65	0.69	0.72
Crop	<0.5	0.23	0.27	0.30	0.33	0.37	0.40	0.43	0.47	0.50	0.53	0.57	0.60
	0.5-5	0.27	0.31	0.34	0.37	0.41	0.44	0.47	0.51	0.54	0.57	0.61	0.64
	5-10	0.33	0.37	0.40	0.43	0.47	0.50	0.53	0.57	0.60	0.63	0.67	0.70
	>10	0.45	0.49	0.52	0.55	0.59	0.62	0.65	0.69	0.72	0.75	0.79	0.82
Bare soil	<0.5	0.33	0.37	0.40	0.43	0.47	0.50	0.53	0.57	0.60	0.63	0.67	0.70
	0.5-5	0.37	0.41	0.44	0.47	0.51	0.54	0.57	0.61	0.64	0.67	0.71	0.74
	5-10	0.43	0.47	0.50	0.53	0.57	0.60	0.63	0.67	0.70	0.73	0.77	0.80
	>10	0.55	0.59	0.62	0.65	0.69	0.72	0.75	0.79	0.82	0.85	0.89	0.92
IMP		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

For the purposes of the hydraulic calculations in this report we have adopted the following run-off factors:

Table 3: Adopted Runoff coefficients

Land Use	Run-off coefficient
Green Space	0.2 (From table above)
Gravel	0.8
Hard Standing	1.0
Safety Surfacing	0.7
Reservoir Water Body	1.0
Porous Paving	0.6 (As per BS 8515:2009+A1:2013)
Rain Garden	0.7 (on the assumption circa 30% rainfall gets intercepted)
Raised Planters	0.7 (on the assumption circa 30% rainfall gets intercepted)
Tree Pits	0.7 (on the assumption circa 30% rainfall gets intercepted)
Green Roof (Extensive)	0.6 (As per BS 8515:2009+A1:2013)
Swale	1.0 (throttled and attenuated in situ)

7.1.4 Green Infrastructure

The overall strategy for surface water management is to maximise the SuDS features on all the sites within the Cleeves Riverside Quarter development (Salesians, PBSA, Stonetown Terrace, Flaxmill, O’Callaghan Strand and Shipyard).

Principles of Green infrastructure

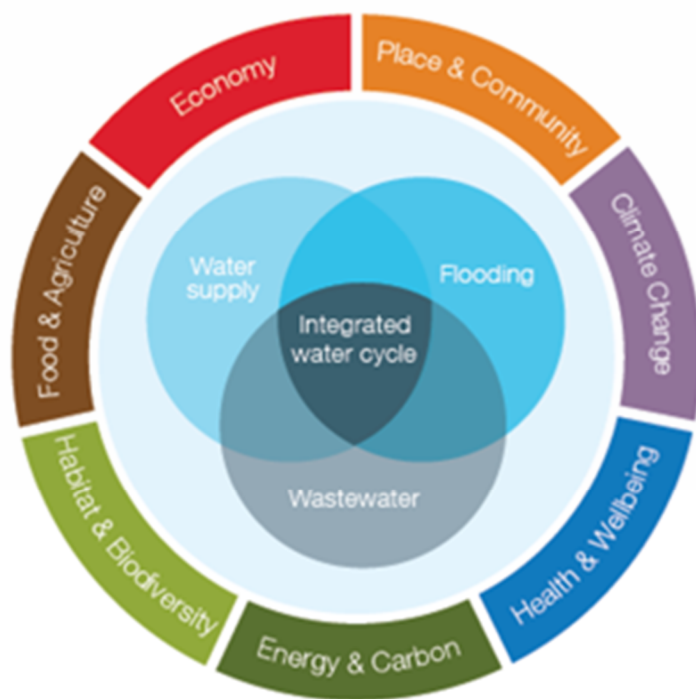
Green Infrastructure (GI) is a strategically planned and delivered network of natural and man-made green (land) and blue (water) spaces that sustain natural processes (CIRIA, 2014). GI delivers a wide variety of benefits for biodiversity, amenity, health and wellbeing and climate change adaptation. GI can be subdivided into assets and functions that may be a park, woodland, green roof or street tree (to name a few) and can range in terms of both size and scale. GI functions relate to the roles that the assets can play if planned and managed in a way that is sensitive to, and includes provision for, natural features and ecosystems services.

The Primary Objective of GI in the context of drainage is to improve the status quo (which has prioritised volumetric control of run-off over at-source volumetric control and water quality improvement) by bringing a new approach to creating sustainable development through Water Sensitive Urban Design.

Water Sensitive Urban Design is the process of integrating water cycle management with the built environment. It is about using the transition of water through communities to add value, to enhance the wellbeing of the people and their environment, both natural and man-made, in a way which is aesthetically pleasing and adds to our overall appreciation and enjoyment of the setting. For new developments, water and its management needs to be central to the planning and urban design ethos.

Arup has identified the elements in the adjacent graphic as core to successful and lasting Water Sensitive Urban Design strategies. In a world of growing populations and changing climates, water management is of key importance for the health and wellbeing of our planet. Arup thinks and plans at catchment scale and fully integrates with the planning and management of urban systems to deliver Water Sensitive Urban Design.

We propose a concept for achieving water supply resilience through blue and green thinking.



Blue thinking

Work with the water cycle

- Use blue space –create, expand, adapt
- Capture, store, treat, re-use and release
- Design places using water
- Natural/semi-natural: puddles, pools, ponds, lakes, streams and rivers
- Man-made: Taps, toilets, reservoirs, canals, swales, fountains, ditches and drains

Green thinking

Work with the landscape

- Use green space – create, expand, adapt
- Capture, store, treat, re-use and release
- Design places using vegetation
- Natural/semi-natural: bush, tree, wood, forest, meadow, wetland
- Man-made: green roof, planter, flowerbed, park, field, footpath, hedgerow

Figure 2: Sustainable Drainage Systems (SuDS) © CIRIA

7.1.5 SuDS

As part of the Cleeves development Arup propose to implement SuDS to the maximum extent possible across the full extent of the site, with the intention of filtering and storing rainfall at source. This will be achieved through a range of techniques and associated flow controls.

Sustainable drainage systems are designed to maximise the opportunities and benefits that can be secured from surface water management. SuDS can take many forms, both above and below ground, and they facilitate four main categories of benefits (water quantity, water quality, amenity and biodiversity).

SuDS deliver high quality drainage while supporting urban areas to cope better with severe rainfall both now and in the future. SuDS also help counteract some of the impacts in the water cycle caused by increased urbanisation, such as reduced infiltration, which in turn can result in diminished groundwater supplies.

The various available solutions for SuDS require a coordinated design between engineering, sustainability consultancy and landscape design.

A Management Train comprising of a series of features will be implemented where feasible to ensure that the series of features treat and attenuate the stormwater run-off to an acceptable quality at greenfield rates of flow. Ideally systems should treat and control the run-off as close as possible to the source.

Several SuDS components in a Management Train facilitates the capture, conveyance and storage of surface water runoff while delivering interception and pollutant risk management. An impermeable lining will be installed beneath the porous paving and rain gardens to prevent infiltration into the made ground, thereby eliminating the risk of pollutant transfer.

The suitability of different SuDS techniques in a Management Train is indicated in the following table:

Table 4: SuDS components within a management train

Indicative suitability of SuDS components within the Management Train				
SuDS component	Interception ¹	Close to source/ primary treatment	Secondary treatment	Tertiary treatment
Rainwater harvesting	Y			
Filter strip	Y	Y		
Swale	Y	Y	Y	
Filter drain	Y		Y	
Pervious pavements	Y	Y		
Bioretention	Y	Y	Y	
Green roof	Y	Y		
Detention basin	Y	Y	Y	
Pond	³	Y ²	Y	Y
Wetland	³	Y ²	Y	Y
Infiltration system (soakaways/ trenches/ blankets/basins)	Y	Y	Y	Y
Attenuation storage tanks	Y ⁴			
Proprietary treatment systems		Y ⁵	Y ⁵	Y ⁵

7.1.6 Proposed SuDS Techniques

Arup proposes the implementation of a Sustainable Urban Drainage Systems (SuDS) strategy across the Cleeves Riverside Quarter development, aligned with the overarching surface water management philosophy. For the purpose of describing the surface water design strategy, the development has been defined as two distinct zones:

- **Zone 1:** This zone encompasses the primary development sites, where dedicated attenuation facilities and SuDS features have been proposed. These include: Salesians, PBSA, Stonetown Terrace, Reservoir, Flaxmill Plaza, O’Callaghan Strand, and Shipyard. Catchments have been delineated around each site to optimise runoff management and integrate SuDS measures such as rain gardens, permeable paving, and green roofs.
- **Zone 2:** This zone includes surrounding road infrastructure with limited space for SuDS implementation and no conventional attenuation facilities. These areas include: North Circular Road, O’Callaghan Strand Road, and Stonetown Terrace Road. Due to spatial constraints, conventional drainage systems will be used, supplemented by targeted SuDS interventions where feasible.

Refer to Appendix B.2 for the extents of Zones 1 and 2.

The proposed SuDS scheme includes the following features for the two zones.

Table 5: Zone 1 SuDS features

Site	Rain Gardens	Tree Pits	Raised Planters	Porous Paving	Swales	Green Roof
Salesians	☒			☒		☒
PBSA			☒	☒		☒
Stonetown Terrace	☒			☒		☒
The Flaxmill Plaza	☒	☒				
O’Callaghan Strand				☒		
Shipyard				☒	☒	

Table 6: Zone 2 SuDS features

Site	Rain Gardens	Tree Pits	Porous Paving
North Circular Road	☒		☒
O'Callaghan Strand Road		☒	
Stonetown Terrace Road			☒

Green Roofs

These are roofs that are adapted or designed to support plants. They are areas of living vegetation, installed on the top of buildings for a range of reasons including visual benefit, ecological value, enhanced building performance and the reduction of surface water run-off. Green roofs offer many benefits including:

- Supporting biodiversity
- Providing cooler buildings in summer
- Cleaning run-off
- Reducing run-off for day-to-day rain.

Green roofs can be installed on a variety of roof types, sizes and slopes. They principally come in two forms – extensive (low substrate depth) and intensive (deeper substrates). Both types are unlikely to increase the load on a roof by more than 20%. Arup has agreed with the architects that an extensive green roof type would be used for the Cleeves development project due to lower maintenance cost.

The principal components of a green roof structure are:

- Waterproof membrane
- Root barrier
- Drainage layer
- Geotextile filter layer
- Soil or growing medium
- Vegetation.

Green roofs absorb most of the rainfall during frequent events but have a similar hydraulic performance to standard roofs once saturated. They can be assumed to meet interception requirements in the summer months based on their minimum retention of 5 to 10mm of rainfall. They can reduce the peak flow and volume of run-off in warmer periods when the soil moisture deficit is high. They are unlikely to perform as well during the winter months when they are likely to be saturated for much of the time. Green roofs are proposed for the Salesians, PBSA and Stonetown Terrace sites, with a coverage of 25% of the total roof area for PBSA and Stonetown Terrace, and 15% coverage of the total roof area for the Salesians site.

Refer to drawing CRQMP-ARUP-XX-00-DR-CE-4407 for proposed green roof details.

Raised planted areas/Rain gardens/Tree pits (bioretention systems)

Bioretention systems are shallow landscaped raised/depressed areas that can reduce runoff rates and volumes and treat pollution through the use of engineered soils and vegetation. They are particularly effective in delivering interception and can also provide attractive landscape features, habitat and biodiversity and cooling of the local microclimate due to evapotranspiration.

Runoff collected by the system ponds temporarily on the surface and then filters through the vegetation and underlying soils. Specified engineered soil mixes can be used as filter media to enhance bioretention

treatment performance. Part of the runoff volume is removed through evaporation and plant transpiration, with excess filtered runoff being collected in a perforated underdrain system.

They are generally used for managing runoff from frequent rainfall events, however attenuation storage on the surface or within the drainage layer can be used to help manage runoff rates. Check dams or weirs can also be used to slow the flow of water moving across the surface of the system.

We propose connecting the rainwater downpipes from the hard standing roof areas to raingardens at ground level, which will be sized to collect and store up to the 1 in 100-year rainfall event.

The principal components of a bioretention system are:

- Vegetation (uptake of pollutants and nutrient removal)
- Filter medium (sand based with organic matter, controls rate at which water filters through the system)
- Transition layer (for filtering of fines, could also be a geotextile)
- Drainage layer (collects water from filter medium and directs to perforated pipes)
- Impermeable lining to avoid infiltration to made ground
- Perforated pipes (collect water from the system and convey it downstream)
- Overflow (diverts exceedance flows to downstream system)

We propose a range of bioretention planting to manage surface water run-off in the following areas:

- Raised planted areas on level 1 of the PBSA development
- Rain gardens at ground level at Salesians, PBSA, Stonetown Terrace, and Flaxmill Plaza
- Tree pits at ground level at Flaxmill Plaza

Refer to Appendix B.3 and B.4 for the location of the proposed bioretention areas and Drawing 1AR-ARUP-ZZ-XX-DR-C-4407 in Appendix A for proposed bioretention planted area details.

Porous/Permeable Paving

These are hard surfaces that can also support vehicles, which also allow rainfall to soak into the ground or into underground storage to slow the release of runoff. Porous surfaces, together with their associated substructures, are an efficient means of managing surface water runoff close to its source – intercepting runoff, reducing the volume and frequency of runoff, and providing a treatment medium.

Building Regulations Part H indicates that Soakaways should not be constructed within 5 m of a building, this ‘rule’ is usually applied where infiltration within the 5m offset from the foundation is not permitted. We propose a no infiltration philosophy for the Cleeves Riverside Quarter project as the porous pavement is within 5m of the proposed building.

Porous pavements are not suitable in areas at high risk of silt loads. They generally require flow controls at the outlets to ensure effective use of the storage in the subbase. The design thickness will be the greater of:

- Required thickness for hydraulic storage
- Required thickness structurally

If the site is sloping (as is the case for the Salesians and Stonetown Terrace sites), then check dams will be required at intervals to maximise the storage in the substructure.

We propose porous paving in the following locations:

- All car parking bays at Shipyard.

- The area bounded by the southeastern face of the O’Callaghan Strand Building and O’Callaghan Strand Road.
- Car parking bays to the east of Stonetown Terrace, along with pedestrian walkways within the Stonetown Terrace site.
- Pedestrian walkways within the southern and western areas of the PBSA site.

The porous paving will be sized to collect and store up to the 1 in 100-year rainfall event where feasible.

The extent of the proposed porous paving are shown in Appendix B.3 & B.4 for Zone 1 & 2 respectively.

Swales

Swales are shallow, flat bottomed, vegetated open channels designed to convey, treat and often attenuate surface water runoff. They can enhance the natural landscape and provide aesthetic and biodiversity benefits. They are designed to slow the water thereby facilitating sedimentation, filtration through the root zone and soil matrix, evapotranspiration and infiltration into the underlying soil.

On sites with steeper gradients, swales can have berms or check dams across the flow path to temporarily pond runoff, reduce velocities and increase pollutant retention and infiltration.

\\Features of the proposed swales include:

- Bottom width 0.5 – 2.0m
- Longitudinal gradient 0.5 – 6%
- Maximum side slope 3%
- Maximum depth up to 600mm

We propose a network of swales on the Shipyard site to take excess runoff from the surrounding road and ground level hard areas and gravel zone. The swales discharge to a collector drain which connects to the internal network and runs to the which also collects runoff from the porous paving. The swales will be fitted with orifice plates to restrict the discharge rate, to encourage infiltration and to attenuate runoff.

Refer to Appendix B.3 for locations of the swales at the Shipyard site and drawing CRQMP-ARUP-ZZ-XX-DR-CE-4406 for a proposed swale detail.

The management train for the proposed SuDS scheme is:

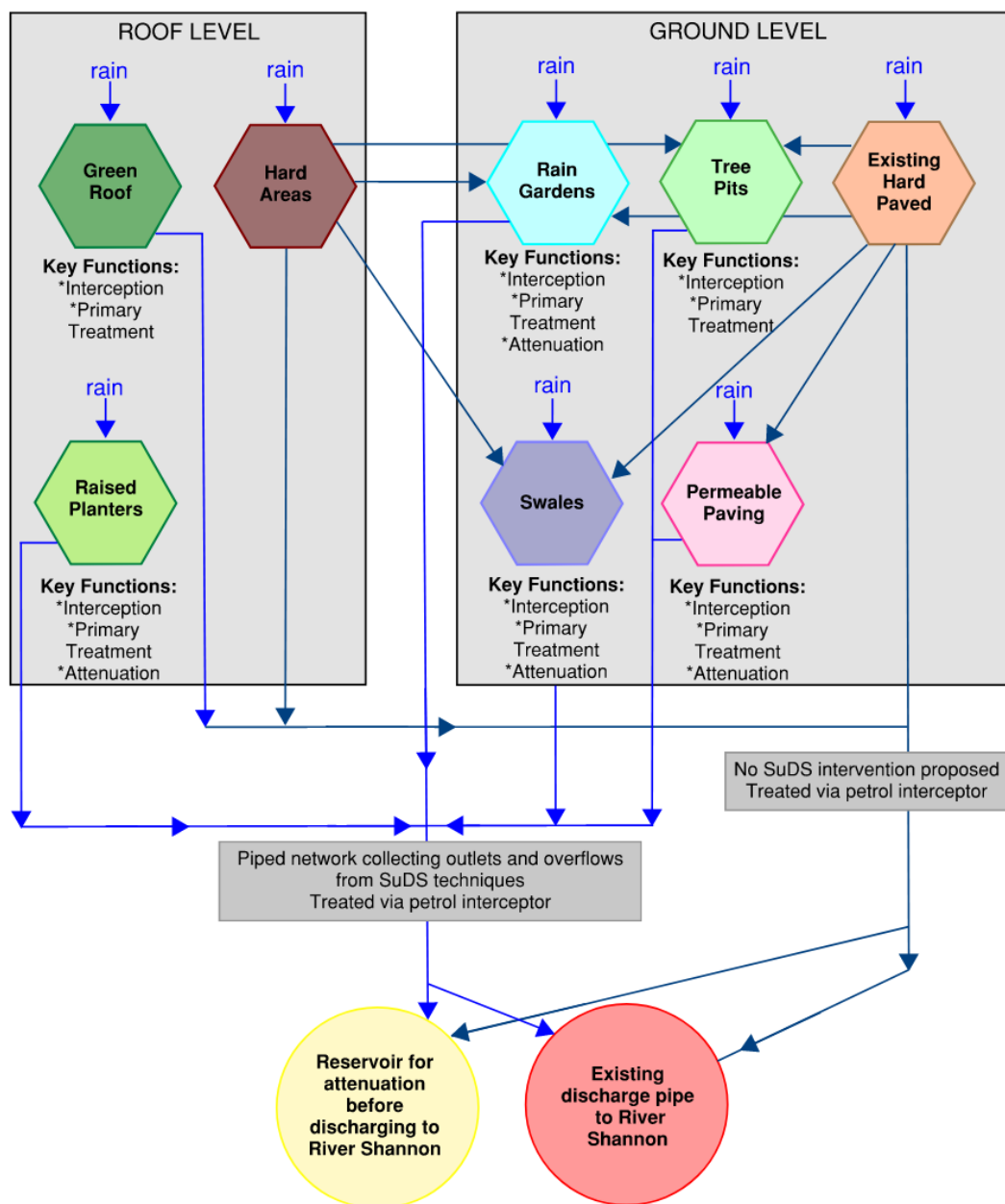


Figure 3: Site Wide SuDS schematic and management train

7.1.7 Catchment Delineation per Zone

For hydraulic calculations, each site within the Cleeves development has been divided into catchments based on SuDS technique/surface finish/topography. Refer to Appendix B.3 and B.4 for the SuDS catchment delineations for Zone 1 and 2 respectively.

Zone 1 (Site catchments):

The catchments for Zone 1 are summarised in the following table:

Table 7: Zone 1 catchments

Site	Catchment Name	Details	Total Area (m ²)
Salesians	GS43-44; GS46-54; GS55-76; GS77-83; GS90-107	Green Space	1633
	RG26-29; RG30-37	Raingarden	285
	G3-9	Gravel	679
	H8-H11; CHS7-9	Hard Standing	6735
	GR5-6	Green Roof	430
	SS4	Safety Surfacing	84
	PPT5-PPT6	Porous Paving	167
PBSA	H12; CHS6; CHS13; H4.1; H3.1; CHS1	Hard Standing	4674
	RG22-25	Raingarden	231
	RP1-3	Raised Planters	61
	GR3-4.1	Green Roof	385
	GS33-42; GS13-14; GA5-8; TGS13-20	Green Space	860
	SS1; SS2	Safety Surfacing	192
	PP5	Porous Paving	493
Stonetown Terrace	GS18-27; GS28.1; GS28.2; GS31-32; GS70; GA1-4	Green Space	986
	RG18-21	Raingarden	34
	G2	Gravel	64
	GR1-2	Green Roof	326
	PP4; PP6-7	Porous Paving	400
	CHS4; H6-7; RHT2	Concrete Hard Standing	1981
Reservoir	GS90-94; TGS21	Green Space	488
	RES1	Reservoir Water Body	2763
	H13.2; CHS10-12	Hard Standing	2104
The Flaxmill Plaza	H3.2; H4.2; H13.1; CHS2-3	Hard Standing	8277
	GS8-10; GS13-14; TGS1-19	Green Space	529
	TP1-6	Tree Pit	268
	RG1-2	Raingarden	121
O'Callaghan Strand	GS15-17; GS108	Green Space	26

Site	Catchment Name	Details	Total Area (m ²)
	PP2	Porous Paving	236
	CHS3; H5	Hard Standing	1613
Shipyard	GS1-2; GS14-15	Green Space	326
	SW1-3; SW6-8	Swale	2581
	PPT1-4	Porous Paving	347
	G1	Gravel	1362
	H1; CHS4	Hard Standing	2978

Zone 2 (Peripheral areas):

The catchments for Zone 2 are summarised in the following table:

Table 8: Zone 2 catchments

Site	Catchment Name	Details	Total Area (m ²)
North Circular Road	GS3-GS7	Green Space	76
	PP1	Porous Paving	784
	RG5-14	Raingarden	162
	RHT1; RHT3	Hard Standing	2294
O'Callaghan Strand Road	GS84-89	Green Space	903
	TP7-9	Tree Pit	83
	CHS14-16	Concrete Hard Standing	1941
Stonetown Terrace Road	RHT2.2; CHS5; CHS4.2	Concrete Hard Standing	677
	PP3	Porous Paving	164
	GS28.2; GS29.2; GS30-32	Green Space	118

Refer to Appendix B3 and B4 for the SuDS catchment delineations for Zone 1 and 2 respectively.

7.1.8 QBAR Calculation

Refer to Appendix B5 for the QBAR calculations for the Cleeves development area.

A QBAR calculation was carried out for the site within the redline boundary (5.10 hectares) to determine the allowable run-off rate, as presented in Appendix B.5.

The QBAR_{rural} figure equates to 9.6 l/s so is taken as 10.2 l/s for the overall development.

Sites that drain to the reservoir (Salesians, PBSA and Stonetown Terrace) are effectively in their own catchment as surface water gets attenuated locally in the reservoir for controlled release via the discharge pipe to the Shannon River. We therefore calculated QBAR for the collated area of the sites to determine the allowable outflow from the reservoir.

The QBAR_{rural} figure for the catchments to the reservoir equates to 5.2 l/s. The flow at the outlet can be restricted to be close to this figure via discharge pipe with bespoke size.

7.1.9 Throttles

Outlet structures are proposed to convey and control the flow out of the attenuation features and SuDS components. Their principal function is to throttle the discharge passed downstream in accordance with the GDSDS and thereby enable the attenuation volume to fill. Outlets can either be on the surface, piped systems or slow seepage systems. Outlets are usually built into the downstream side of attenuation features and SuDS components with easy access for maintenance.

The SuDS components at Cleeves Riverside Quarter have been designed to maximise the volume of surface water stored locally (at source). The following throttles will help to achieve this goal:

Table 9: Proposed throttles

SuDS Technique	Throttle
Swale	Outlet Flow Restrictor (orifice)
Porous Paving	Orifice Plate
Raingardens/bioretenention areas/tree pits	Filter Media
Reservoir	Outlet Pipe

Each type of throttle is described in more detail below:

Orifice Plate

An orifice is a circular or rectangular opening of a prescribed shape and size that allows a controlled rate of outflow when the orifice is submerged. The flow rate depends on the height of water above the opening (hydraulic head) and the size and edge treatment of the orifice. When using a simple orifice plate, the flow rate passing through the control is directly proportional to the square root of the upstream head. We propose that orifice plates be installed in the wall of an outlet flow control chamber.

$$Q = C_d A_o \sqrt{2gh}$$

Where:

- Q = orifice discharge rate (m³/s)
- C_d = coefficient of discharge (m) (0.6 if material is thinner than orifice diameter; 0.8 if material is thicker than orifice diameter, 0.92 if edges of orifice are rounded)
- A_o = area of orifice (m²)
- h = hydraulic head (m)
- g = 9.81 m/s²

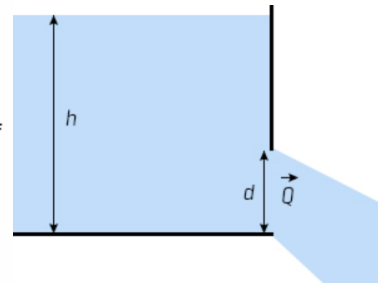


Figure 4: Orifice formula

We have considered 10mm, 20mm, 25mm and 50mm orifice plates. The following table indicates the discharge rate and velocity through the orifice for a range of heads up to 1m:

Table 10: Discharge through orifice

Head (m)	Hydraulics through Orifice							
	50mm		25mm		20mm		10mm	
	Q (l/s)	v (m/s)	Q (l/s)	v (m/s)	Q (l/s)	v (m/s)	Q (l/s)	v (m/s)
0.1	1.71	0.86	0.43	0.87	0.27	0.87	0.07	0.87
0.2	2.41	1.23	0.60	1.23	0.39	1.23	0.10	1.23
0.3	2.95	1.50	0.74	1.50	0.47	1.50	0.12	1.50
0.4	3.41	1.74	0.85	1.74	0.54	1.74	0.14	1.74

Head (m)	Hydraulics through Orifice							
	50mm		25mm		20mm		10mm	
	Q (l/s)	v (m/s)	Q (l/s)	v (m/s)	Q (l/s)	v (m/s)	Q (l/s)	v (m/s)
0.5	3.81	1.94	0.95	1.94	0.61	1.94	0.15	1.94
0.6	4.18	2.13	1.04	2.13	0.67	2.13	0.17	2.13
0.7	4.51	2.30	1.13	2.30	0.72	2.30	0.18	2.30
0.8	4.82	2.46	1.21	2.46	0.77	2.46	0.19	2.46
0.9	5.12	2.61	1.28	2.61	0.81	2.61	0.20	2.61
1.0	5.39	2.75	1.35	2.75	0.86	2.75	0.22	2.75

The maximum head of water on the orifice plate in the swale is circa 1m, resulting in a restricted flow rate through a 10mm orifice of 0.22 l/s at a velocity of 2.75 l/s. Although a 10mm orifice seems small, the SuDS proposals outlined in this report already incorporate a high level of mitigation against blockages in the form of the stone filtration and geotextile wrapping on the perforated pipes. This will prevent large particles getting through to the pipe and the catchpit manhole just upstream of the orifice plate will offer a third line of defence against blockages. The velocity through the 10mm orifice plates for nominal heads is greater than 1m/s so they should be largely self-cleansing.

Filter Media

This material is normally sand based with some source of organic matter and slow-release plant nutrients to maintain healthy plant growth. It filters out pollutants and controls the rate at which water filters through the system. Careful selection of the filter media in the planted areas will restrict the rate of discharge out of the base of the planted areas in extreme rainfall events, effectively serving as a throttle. The permeability of generic soil filter media is assumed to be 300mm/hr.

However, to allow for initial clogging the design is based on 50% of the measured hydraulic conductivity of the compacted medium. In assessing the performance of the bioretention areas we have assumed an infiltration rate of 100mm/hr, equivalent to a flow rate of 0.03 l/s per meter squared of planted area.

Discharge pipe from the reservoir to Shannon River

A 225 mm diameter discharge pipe is proposed to be laid horizontally from the attenuation reservoir to the newly constructed final manhole, with an invert level of +1.00 m ODM. The pipe has been sized to significantly restrict outflow from the reservoir, ensuring controlled discharge to the River Shannon during 1:100 year storm event.

Hydraulic modelling indicates that the maximum head of water at the outlet pipe will be 0.93 m, resulting in a restricted flow rate of 42.97 l/s at a velocity of 1.08 m/s. Whilst this is higher than the QBAR rate, it is somewhat below the existing brownfield runoff rate. For context as to why this diameter pipe and flow is considered to be appropriate and practical, see flows in overall summary Table 13, in Section 7.1.1.

This structure is designed to collect water in the single compartment, which has a small outlet pipe or spout that will discharge water at a low rate to the lower level during frequent, smaller rainfall events. The spout will be fixed with a down-turned nozzle to intercept the water so that it falls directly downward without a trajectory. This will prevent any disruptions caused to pedestrians who might be using the walking deck.

When larger storms occur, compartment would fill due to the limited capacity of the small outlet and spill over the broad crested weir sized to accommodate up the 1:100-year event.

Salesians – Upper outlet

The invert level of the inlet pipe is 8.35 mOD, versus a reservoir maximum water level of 2.00 mOD i.e. a vertical drop of 6.35m.

In the worst-case scenario for the largest storm (1m head of water in the structure) the water will exit the structure at a velocity of 2.7 m/s.

The 1:100-year discharge from the Salesians site feeding the upper outlet is 32.8 l/s. The 100mm outlet pipe, with an upstream head of 1m, can accommodate a flow of 35 l/s implying the upper slot/spillway will rarely if ever be activated. Reducing the outlet pipe diameter will activate the slot/spillway in a more meaningful way.

Salesians – Middle outlet

The structure for the middle outlet is proposed to be the same as that for the upper level.

The invert level of the inlet pipe is 6.34 mOD, versus a reservoir maximum water level of 2.00 mOD i.e. a vertical drop of 4.34m.

The 1:100-year discharge from the Salesians site feeding the outlet is 67.7 l/s. A 150mm outlet pipe, with an upstream head of 1m, can accommodate a flow of 48 l/s implying the upper slot/spillway will be activated in some events.

Salesians – Lower outlet

Due to the limited height between the pipe invert and the reservoir surface we are not proposing any flow control structure, but rather a free outlet protected with a headwall to allow for the 28.9 l/s.

The invert level of the inlet pipe is 4.41 mOD, versus a reservoir maximum water level of 2.00 mOD i.e. a vertical drop of 2.41m.

Stonetown Terrace – Cascade feature

The Stonetown Terrace site has a further complication in that the quarry face is remote from the reservoir (with development between the two zones) so the conveyance from the upper to lower level (maintaining the philosophy of visual engagement with the water) will need to take a different form i.e. cascade feature fixed to the quarry wall.

Arup has engaged extensively with the landscape architect about how best to combine aesthetic (form) with engineering (function) for each of the outlet structures.

The emerging aesthetic for the discharge from upper level of Stonetown Terrace to the lower level is depicted in the image below i.e. a vertical pipe connected to the outlet, discharging to a series of channels fixed retaining wall creating a cascading water feature underlain by a rain garden at ground level below. From the water feature, the discharge will fall onto a hydraulically compact bioretention zone at lower ground and be captured in an underground piped network before descending to reservoir.



Figure 7: Water feature at Stonetown terrace site

The peak discharge from the Stonetown terrace site for the 1:100-year rainfall event is 43.5 l/s through a 225mm pipe.

A vertical pipe with vent would be required at the outlet pipe at high level to direct the flow through 90 degrees down to the alignment of the cascading water feature at a lower level. The elevation drop between Stonetown Terrace to PBSA site is 2.74m.

The cascading channels would need to be a minimum dimension of 250mm wide by 250mm deep. The hydraulics of the channels for a range of flows are shown in the following table:

Table 11: Hydraulics of channel for Stonetown Terrace water feature

Flow Rate (L/s)	Flow Depth (m)	Velocity (m/s)
10	0.049	0.816
20	0.079	1.013
30	0.105	1.143
40	0.13	1.231
50	0.155	1.29
60	0.178	1.348
70	0.201	1.393
80	0.224	1.429

7.1.10 Piped Networks per Zone

All existing utility services within the Cleeves development site are to be decommissioned and removed with the exception of the combined sewer located at the north-western corner of the Salesians site. This sewer currently transverses the site boundary and connects to the neighbouring Salesian Primary School property. It is proposed to divert this combined sewer via a 160 mm diameter pipe, rerouting it off-site in accordance with the drainage strategy.

The surface water drainage network for the Cleeves development is proposed to be constructed as a gravity fed piped system as follows:

- Zone 1 – Gravity drainage from the green roof, discharging directly into rain gardens and subsequently into the final discharge pipework
- Zone 1 – Gravity drainage from hard landscaped areas, planter box overflows, and raised planted area overflows, discharging into the final pipe network
- Zone 2 – Gravity drainage from bioretention areas (rain gardens), with flow throttled prior to discharge into the public drainage system.

An independent surface water drainage system is proposed for each site within the development. These systems will operate separately until they converge at the newly constructed final manhole, from which the combined flow will discharge to the existing outfall leading to the Shannon River.

See Appendix A for detailed wet service drawings for Zone 1 and 2 of the Cleeves development.

7.1.11 Hydraulic Calculations per Zone

Zone 1 volumetric calculations (m³)

The volumetric runoff for each site (see Appendix B.6) was calculated using a rainfall depth of 77.53 mm and runoff factors as detailed in Section 7.1.3.

The runoff volumes per site, including runoff destination, are presented in the Appendix B.6 below.

The various proposed SuDS techniques (see Section 7.1.6) were then sized to store the calculated volume locally for rainfall events up to and including the 1:100-year event plus 30% for climate change and 10% for urban creek, for slow release once the storm abates.

Storage is proposed in the following locations:

- Green roof
- Tree pits/rain gardens
- Raised planted areas
- Porous Paving
- Swales
- Reservoir

The volume of rain falling on the footprint of Zone 1 has been calculated as 3377 m³. Of this, 436 m³ is removed through infiltration, interception and evapotranspiration, with the remaining 2941 m³ distributing between the swales, raingardens, tree pits, porous paving and raised planters, and the remainder discharging directly, without SuDS intervention into the existing drainage network or reservoir.

These figures are summarised in the following table:

Table 12: Volume stored in SuDS techniques and Reservoir – Zone 1

SuDS Technique	Volume stored (m ³)	Comments
Swales	520.5	Each swale discharges through a 10mm orifice at 0.22l/s to the piped network
Raingardens	540.7	Discharges through filter media at 0.03l/s/m ² of planted area to the piped network
Tree Pits	207.5	Discharges through filter media at 0.03l/s/m ² of planted area to the piped network
Porous Paving	53.5	Each porous paving discharges through a 10mm orifice at 0.22l/s to the piped network
Raised Planters	1.5	Discharges through filter media at 0.03l/s/m ² of planted area to the piped network
Total	1323.7	
Other	Volume stored (m ³)	Comments
Reservoir	1288.5	Discharges at 42.97l/s through a 225mm gravity pipe, flow is naturally regulated by pipe diameter and available hydraulic head. Maximum hydraulic head is 0.9m for 1:100 year storm.

The controlled flow from SuDS features within Zone 1, along with the locations of the proposed controls, can be seen below in Appendix B.8.

The philosophy for each SuDS technique/drainage zone and hydraulic sizing is described below:

Green Roofs

Green roofs are proposed for the Salesians, PBSA and Stonetown Terrace sites, with a coverage of 25% of the total roof area for PBSA and Stonetown Terrace, and 15% coverage of the total roof area for the Salesians site. The first 10mm of rainfall on the existing buildings is intercepted by the green roof. All subsequent rainfall is brought to the rain gardens and hard surface on ground level.

The green roofs have been sized to store the entirety of the excess 1 in 100-year rainfall event.

Planter boxes

See catchment delineation Drawings in Appendix B.3 showing locations of planter boxes in Zone 1, with corresponding hydraulic calculation tables in Appendix B.6.

Surface water from the roof downpipes will be routed to the adjacent rain gardens. The planter boxes have been sized to store the entirety of the 1 in 100-year rainfall event.

The filter media within the planter boxes serves as the throttle, restricting the rate of flow to the piped network.

Bioretention areas (raised planted areas)

See catchment delineation Drawings in Appendix B.3 and B.4 showing locations of the proposed bioretention areas in Zone 1 & Zone 2 respectively, with corresponding hydraulic calculation tables in Appendix B.6 & B.7.

We propose bioretention planting on level 1 of the PBSA development to manage surface water run-off.

These areas will offer interception storage of circa 30%, with the surplus runoff draining to the piped network.

Porous Paving

The porous paving collects runoff from the adjacent parking spaces and some soft landscaped areas. They are underlain by a filter drain that has piped connections from the throttled to the piped network. The filter drain network and stone base (30% void ratio) have a capacity to store 53.3 m³.

See catchment delineation Drawings in Appendix B.3 & B.4 showing locations of porous paving in Zone 1 & 2 respectively, with corresponding hydraulic calculation tables in Appendix B.6 & B.7.

Swales

Appendix B3 shows the catchment delineation, with corresponding hydraulic calculation tables in Appendix B6.

The ground level gravel and paving areas are linked to the swale/detention basin with a flow restrictor installed at the outlet of the swales.

SW1, SW2, SW3, SW6, SW7, SW8 connect to the piped network, with the flow restricted via an orifice plate in the outlet pipe.

The total rate of water leaving the swales/dry detention basins is circa 0.9 l/s.

Reservoir

See Appendix B.3 showing the location of the proposed attenuation reservoir.

This reservoir collects runoff from the adjacent sites (Salesians, PBSA and Stonetown Terrace) for restricted discharge to the Shannon River.

It has capacity to store 1289m³ of runoff volume from the surrounding sites, which accounts for circa 40% of the total volumetric runoff from Zone 1.

Zone 1 discharge calculations (l/s)

The estimated existing/pre-development runoff from Zone 1 is 819.8 l/s based on a rainfall intensity of 77.53mm/hr for the 1:100-year rainfall event.

The post development runoff from Zone 1 following implementation of all the SuDS measures is 164.7 l/s discharging to the Shannon River, apportioned as follows:

- 42.97 l/s along the outfall from the reservoir (attenuated flows from Salesians, PBSA, Stonetown Terrace)
- 121.7 l/s from the remainder of Zone 1 (Flaxmill Plaza, Shipyard, O'Callaghan Strand)

This represents an 80% reduction in peak discharge from Zone 1 post implementation of the SuDS measures. The breakdown of the pre vs post development comparison runoff and discharge is detailed in the table below.

Table 13: Detailed comparison of Zone 1 pre and post development volumetric runoff and peak discharge

Site/Zone					Pre Development		Post Development	
	Area (m ²)	Rainfall Depth (mm)	Greenfield (C=0.2) Runoff Rate (L/s)	Qbar (L/s)	Runoff Volume (m ³)	Discharge Rate (l/s)	Runoff Volume (m ³)	Discharge Rate (l/s)
Salesians	10013	77.5	43.2		665.7	185.1	637.4	129.4
PBSA	6896	77.5	29.7		470.7	128.1	441.0	101.6
Stonetown Terrace	3677	77.5	15.9		121.3	33.7	204.6	43.5
Reservoir	5354	77.5	23.1		297.8	82.8	314.6	92.0
Subtotal Zone 1 (Reservoir Inflow)	25940		111.8		1546	429.6	1597.6	366.6
Subtotal Zone 1 (Reservoir Outflow)				5.2				43.0
The Flaxmill Plaza	7593	77.5	32.7		696.1	193.5	670.4	84.9
O'Callaghan Strand	1869	77.5	8.1		144.9	40.3	136.3	35.1
Shipyard	8978	77.5	38.7		562.4	156.4	536.6	1.7
Subtotal Zone 1 (remaining sites)	18440		79.5	3.69	1403.4	390.1	1343.3	121.7
Total Zone 1	44380		191.2	8.88	2948.9	819.8	2941	164.7

7.1.12 Hydraulic Calculations – Zone 2

Zone 2 volumetric calculations (m3)

The volumetric runoff for each catchment (see Appendix B.4) was calculated using a rainfall depth of 77.53 mm and runoff factors as detailed in Section 7.1.3.

The runoff volumes per catchment, including runoff destination, are presented in the Appendix B.7 below.

The various proposed SuDS techniques (see section 8.1.6) were then sized to store the calculated volume locally for rainfall events up to and including the 1:100-year event plus 20% for climate change, for slow release once the storm abates.

Storage is proposed in the following locations:

- Porous paving
- Bioretention areas (rain gardens; tree pits)

The volume of rain falling on the footprint of Zone 2 has been calculated as 558 m³. Of this, 103 m³ is removed through infiltration, interception and evapotranspiration, with the remaining 455 m³ distributing between the swales, raingardens, tree pits, porous paving and raised planters, with a portion discharging directly, without SuDS intervention into the existing drainage network.

These figures are summarised in the following table:

Table 14: Volume stored in SuDS techniques – Zone 2

SuDS Technique	Volume stored (m3)	Comments
Porous Paving	44.1	Discharges through a 10mm orifice at 0.22l/s to the piped network.
Rain garden	103.9	Discharges through filter media at 0.03l/s/m ² of planted area to the piped network.
Tree pits	4.4	Discharges through filter media at 0.03l/s/m ² of planted area the piped network.
Total	152.4	

The controlled flow from SuDS features within Zone 2, along with the locations of the proposed controls, can be seen below in Appendix B.8.

The philosophy for each SuDS technique/drainage zone and hydraulic sizing is described below:

Porous Paving

See Appendix B.4 showing the proposed porous paving to the service area along the western end of the development.

The strategy is to store surface water runoff in the stone layer and filter drain beneath the surface i.e., effectively an in-situ attenuation tank.

The discharge will be throttled at the downstream end of each compartment via installation of a catchpit and orifice plate.

Bioretention areas (rain gardens; tree pits)

See drawing Appendix B.4 showing the location of the proposed bioretention areas.

These areas will offer interception storage of circa 30%, with the rain gardens being further sized to accommodate the 1:100-year rainfall volume.

The excess runoff from the bioretention areas will be drained to the piped network.

Zone 2 discharge calculations (l/s)

The estimated existing/pre-development runoff from Zone 2 is 147.7 l/s based on a rainfall intensity of 77.53mm/hr for the 1:100-year rainfall event.

The post development runoff from Zone 2 (roads) following implementation of all the SuDS measures is 91.9 l/s. Zone 2 runoff will be collected by a combination of existing gulleys/network as well as proposed retrofit SuDS.

This represents a 38% reduction in peak discharge from Zone 2 post implementation of the SuDS measures. The breakdown of the pre vs post development comparison runoff and discharge is detailed in the table below.

Table 15: Detailed comparison of Zone 2 pre and post development volumetric runoff and peak discharge

Site/Zone					Pre Development		Post Development	
	Area (m ²)	Rainfall Depth (mm)	Greenfield (C=0.2) Runoff Rate (L/s)	Qbar (L/s)	Runoff Volume (m ³)	Discharge Rate (l/s)	Runoff Volume (m ³)	Discharge Rate (l/s)
North Circular Road	3316	77.5	14.3	1.46	257.1	71.5	224.3	28.4
O'Callaghan Strand Road	2928	77.5	12.6		197.3	54.8	169.0	48.2
Stonetown Terrace Road	1077	77.5	4.6		76.8	21.4	61.9	15.3
Total Zone 2	7320	77.5	31.6	1.46	531.2	147.7	455.2	91.9

7.2 Proposed Foul Water Drainage System

7.2.1 Design Criteria

It is envisaged that the design approach for foul water services from each site will have individual connections to the adjacent Uisce Éireann foul sewers on NCR, O'Callaghan Strand and on Stonetown Terrace.

A Confirmation of Feasibility has been received from Uisce Éireann which has confirmed that the proposed watermain connections are feasible without upgrades to the network. Refer to Appendix C.4 for the received Confirmation of Feasibility from Uisce Éireann.

The buildings will be catered for by individual foul drainage networks within each site discharging to the final connection points. This approach will need to be discussed and agreed with Uisce Éireann when the site layouts and the accommodation / units have been finalised. The key strategies for the wastewater system are the use of gravity networks to avoid the need for pumping where possible, the use of the existing combined sewer to the southwest, and the implementation of demand reduction strategies such as the use of low flow fixtures and fittings.

The key objectives to achieve the strategy are:

- Gravity Networks - The uniform sloping nature of the terrain generally supports the use of gravity sewer collection systems. These will be used where possible to avoid the need for pump stations and associated operating and maintenance costs.
- Using Existing Outfall Sewer - The strategy is to connect the wastewater discharges to the existing public sewers along the north circular road.
- Demand Reduction - Sewer discharge volumes are anticipated to reduce in proportion to the reduction in water demand. Some of the water conservation measures regarding this are:
 - Reducing water demand through water saving technologies i.e. flow restrictors
 - Low flow fixtures and fittings/Dual Flush Toilets - Low flow fixtures conserve water by using a high-pressure technique to produce a strong or equal flow of water with less water than more water-wasting fixtures. Dual flush toilets prevent the full contents of the cistern being discharged with every flush
 - Education and Smart Metering - live recording of water consumption patterns to indicate in real time potential problems with the network; can include a user interface to encourage changes in water usage patterns; can support remote meter reading and billing

The use of techniques such as low flow fixtures and fittings and dual flush toilets combined with smart metering and education of the end users, could realistically achieve up to a 30% reduction in potable water consumption and wastewater discharge.

7.2.2 Demand Estimation

Irish Water Code of Practice for Wastewater Infrastructure Water demands

Table 16: Foul demands (Uisce Éireann)

Property Type	Occupants/Population	Flow	Flow	Flow	Peak factor	Total
		l/h/d	l/d	l/s		l/s
Apartments/Townhouses	788 No. Residents	150	118,200	1.37	6	8.21
Student Accommodation	271 No. Residents	150	40,650	0.47	6	2.82
Commercial/Educational	1161 No. Visitors	90	104,490	1.21	4.5	5.44
Total			263,340	3.05		16.47

The proposed development will have apartments/townhouses across three development sites (Salesians, Stonetown Terrace and O'Callaghan Strand) with an assumed full capacity of 788 No. residents, student accommodation with an assumed full capacity of 271 No. residents and commercial/educational building units with an assumed full capacity of 1161 No. visitors (Flaxmill).

Irish Water Hydraulic Design Guidance of 150 l/h/d for a residential unit, and 100 l/h/d for a commercial/educational building serving visitors.

The estimated daily wastewater hydraulic loading would be 263.3 m³/d, for the proposed development.

This figure equates to an average (DWF) of approximately 3.05 l/s based on a 24-hour day.

Assuming a peaking factor from Irish Water Wastewater Code of Practice of 6 times DWF for residential unit peak discharge, and 4.5 times DWF for commercial/building visitor unit peak discharge. The peak discharge would be 16.47 l/s.

7.3 Proposed Watermain

7.3.1 Design Criteria

There will be specific potable water storage and design requirements for high-rise and large-scale developments on the various sites as well as for firefighting purposes. It is envisaged that the design approach for the provision of potable water to each site will be stand alone, i.e., individual ring mains for each site, with separate metered connections to the existing Uisce Éireann (UE) mains adjacent to each site.

A Confirmation of Feasibility has been received from Uisce Éireann which has confirmed that the proposed wastewater connections are feasible without upgrades to the network. Refer to Appendix C.4 for the received Confirmation of Feasibility from Uisce Éireann.

The intention is for all new developments to be supplied via a ring main system connected to the existing campus network with new sluice valves and hydrants located to meet the requirements of the current Part B Building Regulations and the Local Fire Officer. Any storage or pressure boosting required for use within the new buildings will be designed as part of the MEP scope for each building. No specific capacity issues with

the campus distribution system have been identified during the desk study. The key objectives for the water supply are:

- Resilience - Consider options to supply the development on a ring main system fed from more than one source. Sizing assets to ensure current and future demands can be met
- Demand Reduction strategies to reduce the reliance on potable water, e.g. the use of well water or rainwater harvesting

7.3.2 Demand Estimation

The anticipated average water demand is 3.447 litres / second with a peak demand of 18.506 l/s.

8. Summary

8.1 Surface Water

This report outlines the civil engineering design proposals for the proposed Cleeves Riverside Quarter development. The proposals have been workshopped and aligned with the latest Architect and Landscape Architect drawings.

The overall objective is to drain each site as an independent network to enable phasing of the works. It is proposed to discharge the surface water from the development to the Shannon River via the existing 400 mm diameter discharge pipe. The existing final manhole will be replaced with a new structure, while the existing discharge pipe will be extended to connect to the new manhole.

A key area of focus is green infrastructure (GI). GI is a strategically planned and delivered network of natural and man-made green (land) and blue (water) spaces that sustain natural processes. GI delivers a wide variety of benefits for biodiversity, amenity, health and wellbeing and climate change adaptation. GI in the context of drainage translates into Sustainable Drainage Systems (SuDS). SuDS are designed to maximise the opportunities and benefits that can be secured from surface water management.

The site comprises the following zones:

- Zone 1: Site catchments (Salesians, PBSA, Stonetown Terrace, Reservoir, Flaxmill Plaza, Shipyard, O'Callaghan Strand)
- Zone 2: Peripheral areas (North Circular Road, O'Callaghan Strand Road, Stonetown Terrace Road)

We propose implementing a range of SuDS techniques covering most of the site footprint. i.e., green roof, bioretention areas (planter boxes; raised planted areas; rain gardens; tree pits), porous paving, swales and attenuation reservoir.

The intention is to manage surface water runoff as close to source as possible. Where possible we have linked these SuDS features in a Management Train to facilitate the capture, conveyance and storage of surface water runoff as close to source as possible whilst delivering interception and pollutant risk management.

Most of these SuDS features can be designed to accommodate runoff up to and including the 1:100-year rainfall event. Where constraints such as sloping topography exist, interventions such as the installation of check dams and throttles can be made to maximise the storage of water at source e.g. on the porous paving system.

The volumetric runoff (pre and post development) and peak discharge (pre and post development) has been calculated for Zones 1 and 2, summarised as follows:

Table 17: Comparison of pre and post development volumetric runoff and peak discharge

Area	Greenfield runoff rate (l/s)	Qbar (l/s)	Volumetric Runoff (m³)			Peak Discharge (l/s)		
			Pre-development	Post-development	% reduction	Pre-development	Post-development	% reduction
Zone 1	191.2	8.9	2,949	2,941	0	819	165	80
Zone 2	31.6	1.5	531	455	14	148	92	38
Overall Site	222.8	10.4	3,480	3,396	2	967	257	73

If the full extent of the SuDS measures discussed in this report is implemented:

- The **volumetric** surface water runoff will be reduced by 84 m³, representing a 2% reduction versus pre-development. This is nominal as expected, given attenuation features predominantly store water temporarily rather than removing it completely. The nominal reduction can be attributed to evapotranspiration and infiltration occurring in the various SuDS techniques, which reduce the impermeable area of 78% (pre-development) to 65% (post-development)
- The **peak discharge** from the site will be reduced by 710 l/s, representing a 73% reduction versus pre-development, through installation of various throttles in strategic locations i.e. orifice plates and infiltration techniques (e.g. rain gardens; porous paving, swales) and the restricted discharge pipe from the attenuation reservoir

The QBAR rate for the 5.1 ha Cleeves site has been calculated to be 10.2 l/s in accordance with the Greater Dublin Strategic Drainage Study (GSDSDS) guidelines.

However, the Cleeves development is a large brownfield site, and it is not considered feasible to restrict the post-development discharge to the QBAR rate.

A more realistic benchmark is the pre-development discharge rate. Notwithstanding the significant improvements that have been demonstrated against that benchmark, we have tabled a SuDS scheme that achieves a 14% decrease in the hypothetical greenfield runoff rate for Zone 1 and a slight increase relative to the greenfield runoff rate for Zone 2. This results in the post development runoff rate being reduced to almost greenfield rates, with significant benefits to the receiving environment.

We do not consider it feasible or practical to reduce this rate any further. It would necessitate the installation of large-scale attenuation tanks on the Flaxmill Plaza and O'Callaghan Strand sites, where the available space is already significantly constrained. This would attract disproportionately high capital and ongoing maintenance costs relative to the modest additional reduction that would be achieved. Additionally, the increased material and construction requirements would negatively impact the project's overall carbon footprint.

We therefore respectfully request that An Coimisiún Pleanála consider a relaxation of the usual maximum allowable runoff rate (QBAR) given the significant reduction in previous post development runoff that will be achieved via implementation of the tabled SuDS scheme i.e. a reduction to almost greenfield runoff rates. The proposed drainage strategy ensures minimal impact on the River Shannon as the receiving water body.

8.2 Foul

The proposed foul drainage strategy involves individual connections from each site to the adjacent Uisce Éireann sewers on NCR, O'Callaghan Strand and on Stonetown Terrace roads. Each building will have its own foul drainage network discharging to designated connection points.

The anticipated average foul discharge for the Cleeves development (i.e. combined occupancy of Salesians, Stonetown Terrace, PBSA, O'Callaghan Strand, Flaxmill Plaza sites) is 3.05 l/s with a peak discharge of 16.47 l/s.

8.3 Water

The proposed water supply strategy includes specific potable water storage and design requirements for high-rise and large-scale developments on the various sites, as well as to meet firefighting requirements. It is envisaged that each site will have a stand-alone design approach for the provision of potable water, using individual ring mains, with separate metered connections to the existing Uisce Éireann mains adjacent to each site.

The water supply strategy focuses on reduction by minimising reliance on potable water through well water and rainwater harvesting. Resilience is addressed through a ring main system fed from multiple sources, sized to meet both current and future demand.

The anticipated average water demand for the Cleeves development (i.e. combined occupancy of Salesians, Stonetown Terrace, PBSA, O'Callaghan Strand, Flaxmill Plaza sites) is 3.447 l/s with a peak demand of 18.506 l/s.

Appendix A



Notes:

1. SuDS - Use blue/ green roofs to attenuate surface water flows.
2. Use permeable paving/ porous surfacing to car parking spaces/ pavements.
3. Possibly use green areas as attenuation basins, tree pits etc.

C01	03/10/25	NK	AS	GS
Issued for Planning (Status A2)				
P03	05/09/25	NK	AS	GS
Issued for Information (Status S2)				
P02	22/08/25	WC	AS	GS
Issued for Information (Status S2)				
P01	25/04/25	NK	AS	GS
Issued for Information (Status S2)				
Rev	Date	By	CHKd	Apptd

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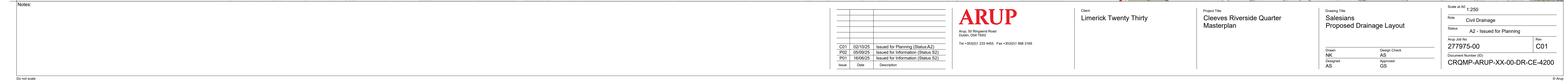
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Limerick Twenty Thirty

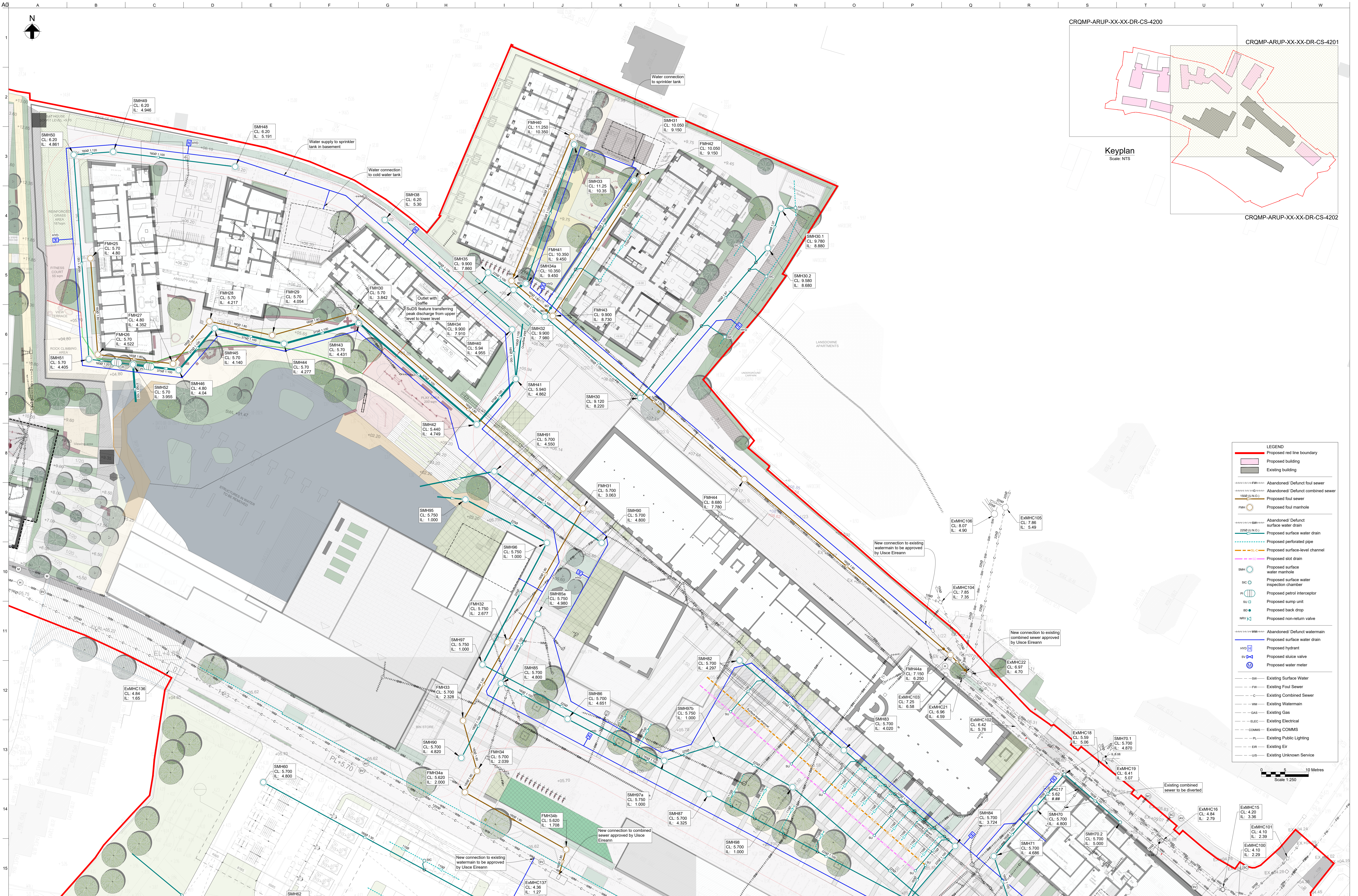
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Cleaves Riverside Quarter Masterplan

Drawing Title
Proposed Drainage & Watermain Overall Layout

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Suitability: A2 - Issued for Planning
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Name: CRQMP-ARUP-XX-00-DR-CE-2100

Scale of A0: 1:500
Rate: Civil Drainage
Suitability: A2 - Issued for Planning
Arup Job No: 277975-00
Name: CRQMP-ARUP-XX-00-DR-CE-2100





Notes:

Backgrounds to be updated to latest architects and landscape architect's plans

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Client: Limerick Twenty Thirty

Project Title: Cleaves Riverside Quarter Masterplan

Drawing Title: The Quarry & Stonetown Terrace Proposed Drainage Layout

Drawn: NK	Design Check: AS
Designed: AS	Approved: GS

Scale at A0: 1:250

Rate: Civil Drainage	Rev: C01
Status: A2 - Issued for Planning	
Arup Job No: 277975-00	
Document Number (E): CRQMP-ARUP-XX-00-DR-CE-4201	



Notes:

Backgrounds to be updated to latest architects and landscape architect's plans

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Client:
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Project Title:
Cleaves Riverside Quarter Masterplan

Drawing Title:
O' Callaghan Strand & Shipyard Proposed Drainage Layout

Scale at A3: 1:250

Rate:	Civil Drainage
Status:	A2 - Issued for Planning
Drawn:	277975-00
Design Check:	AS
Approved:	GS
Rev:	C01

CRQMP-ARUP-XX-XX-DR-CE-4202

A1

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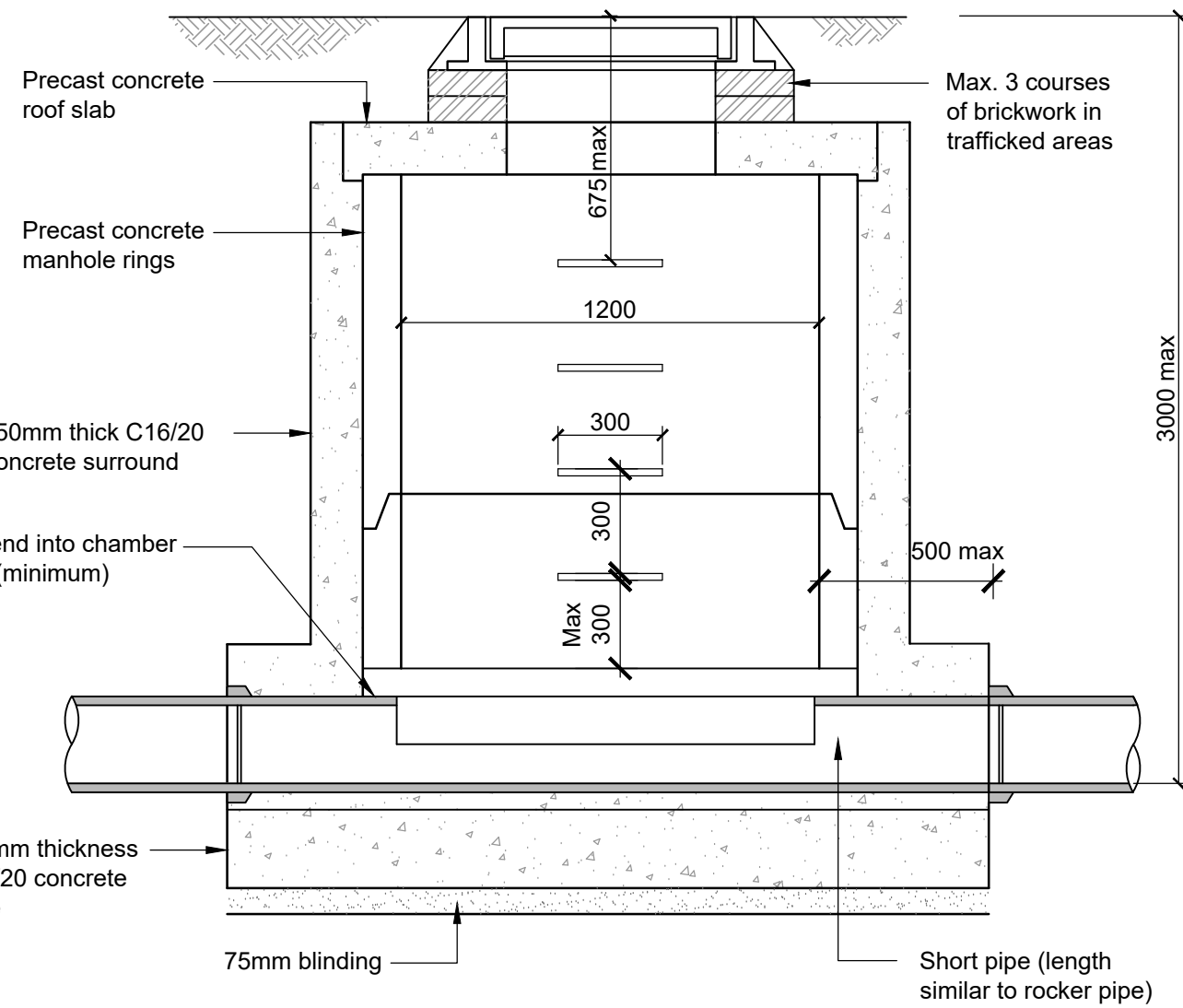
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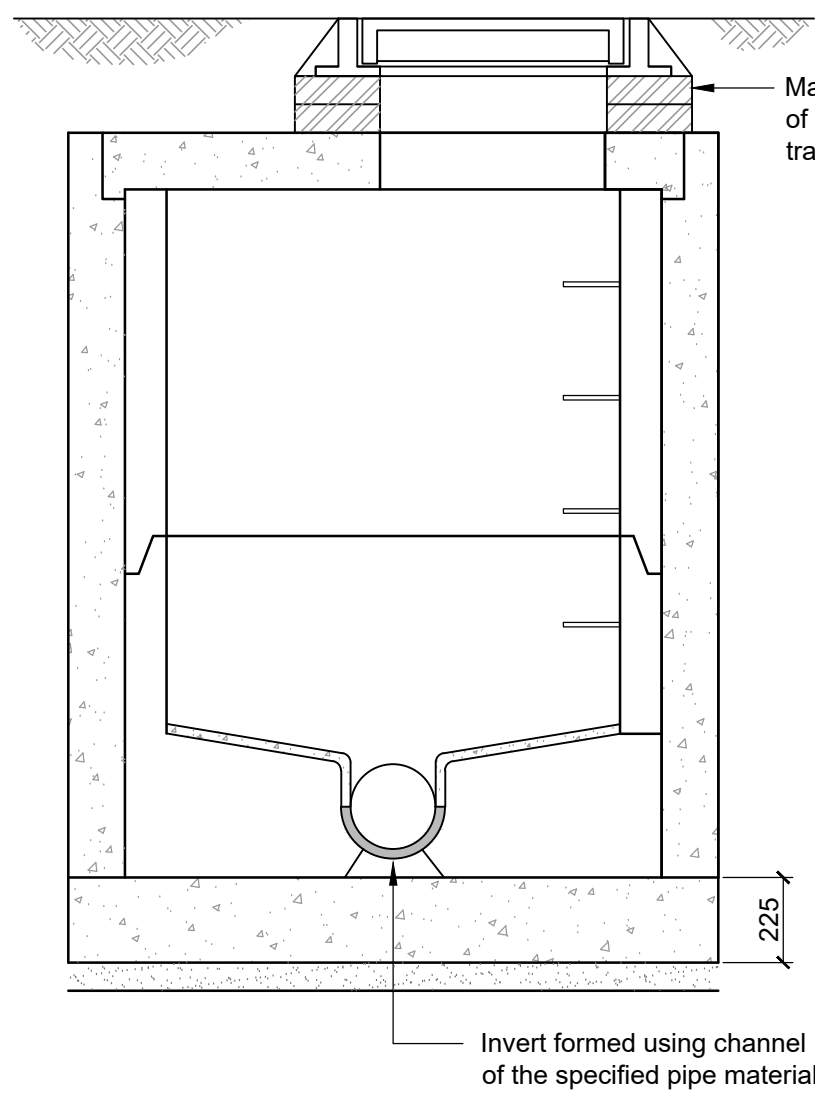
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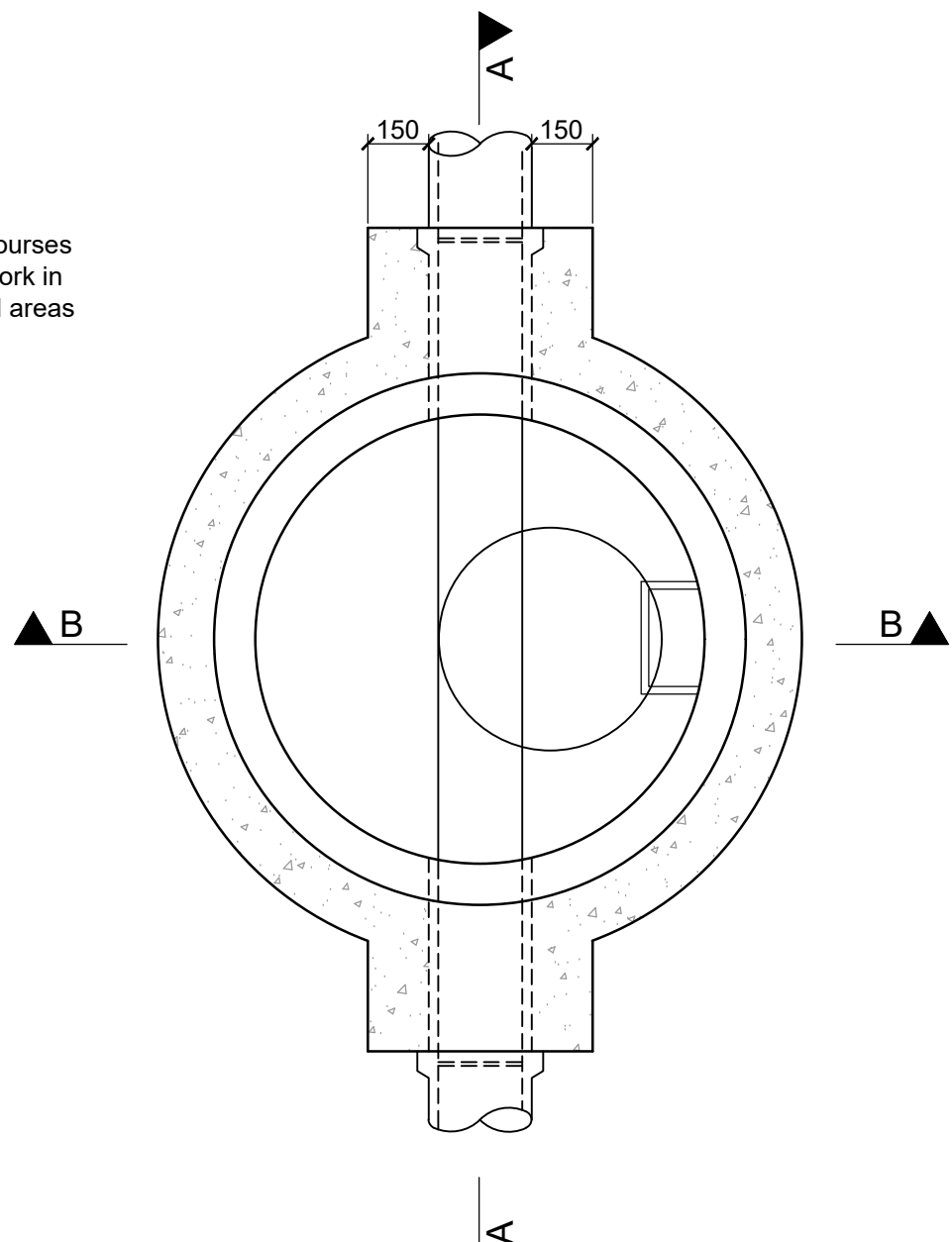
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Section A-A



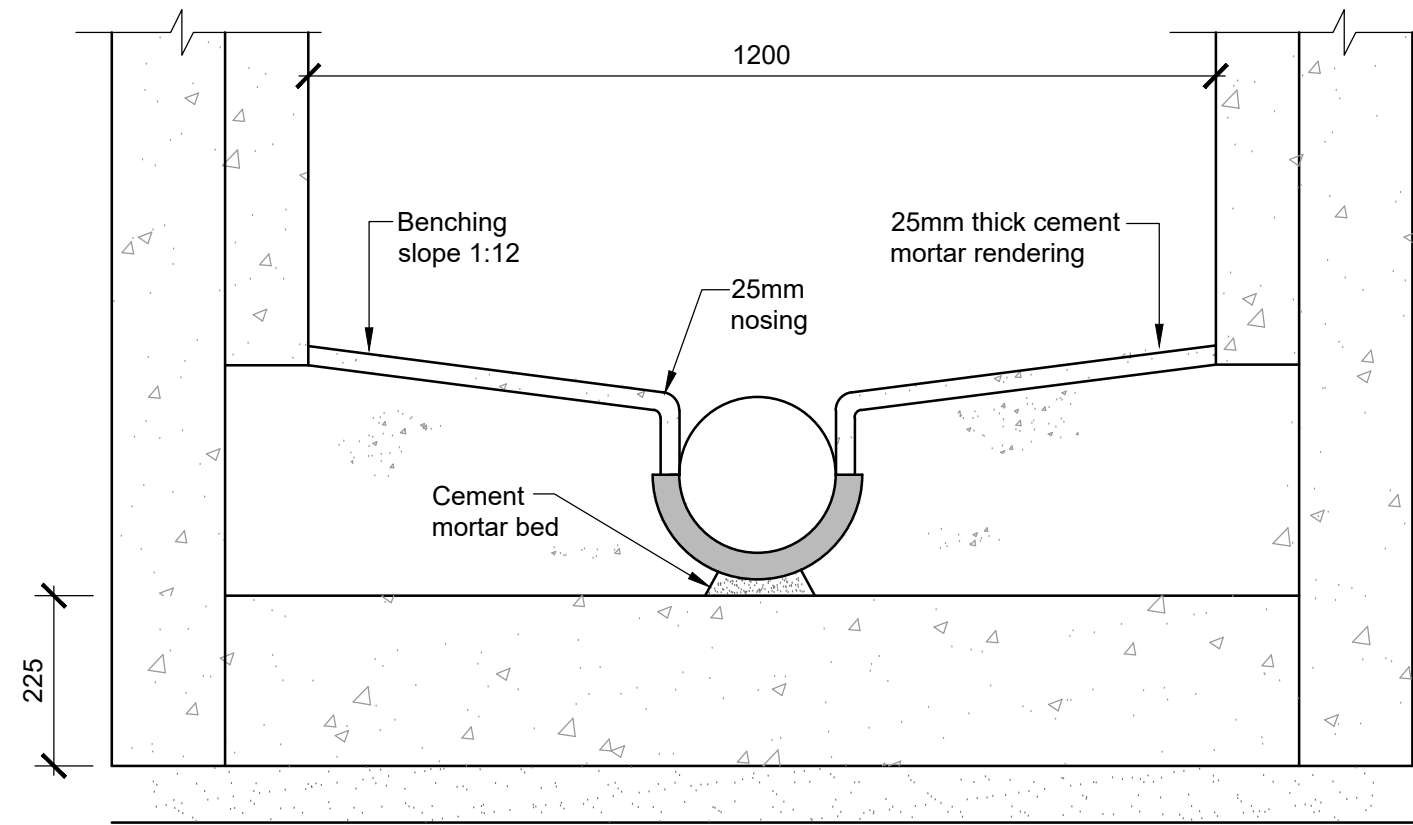
Section B-B



Sectional plan

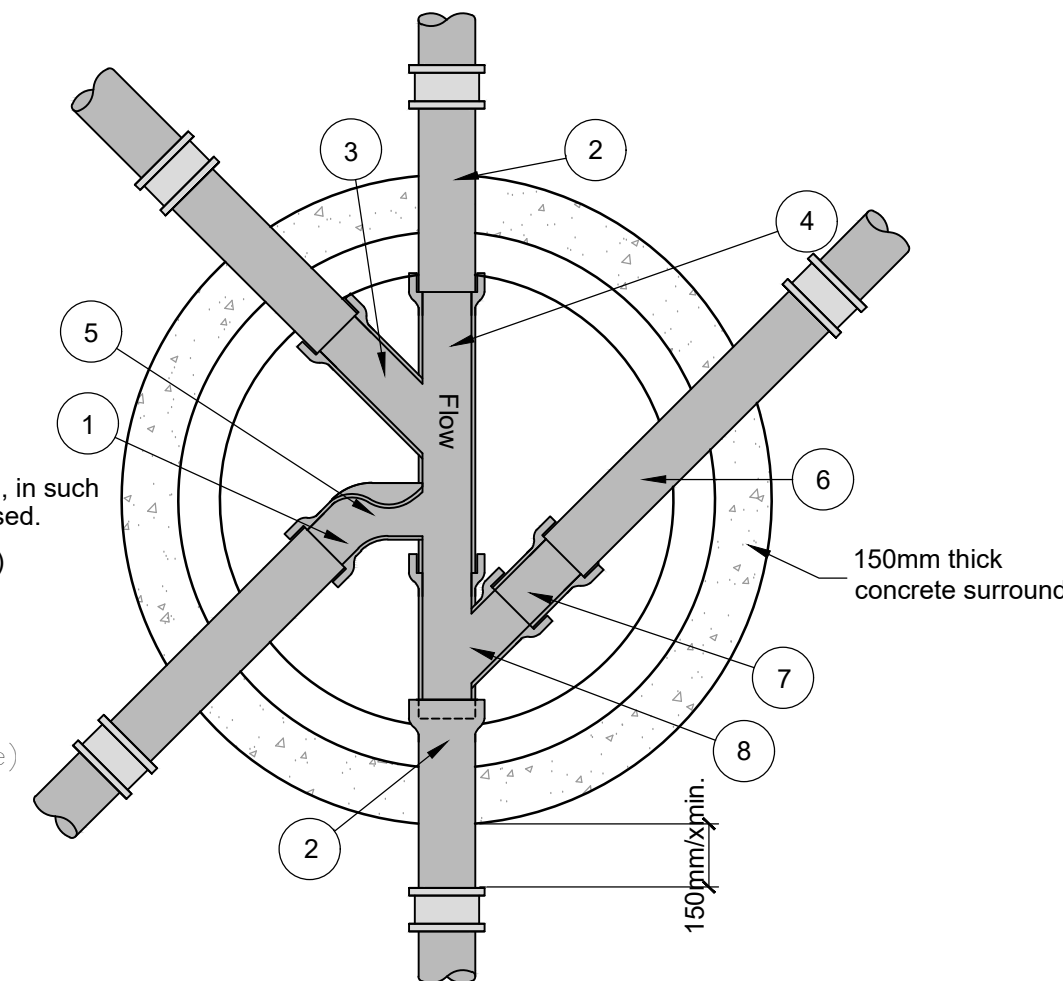
Shallow precast concrete manhole

(Depths up to 3.0m on Pipes up to 300mm dia.)
1:20



Benching detail

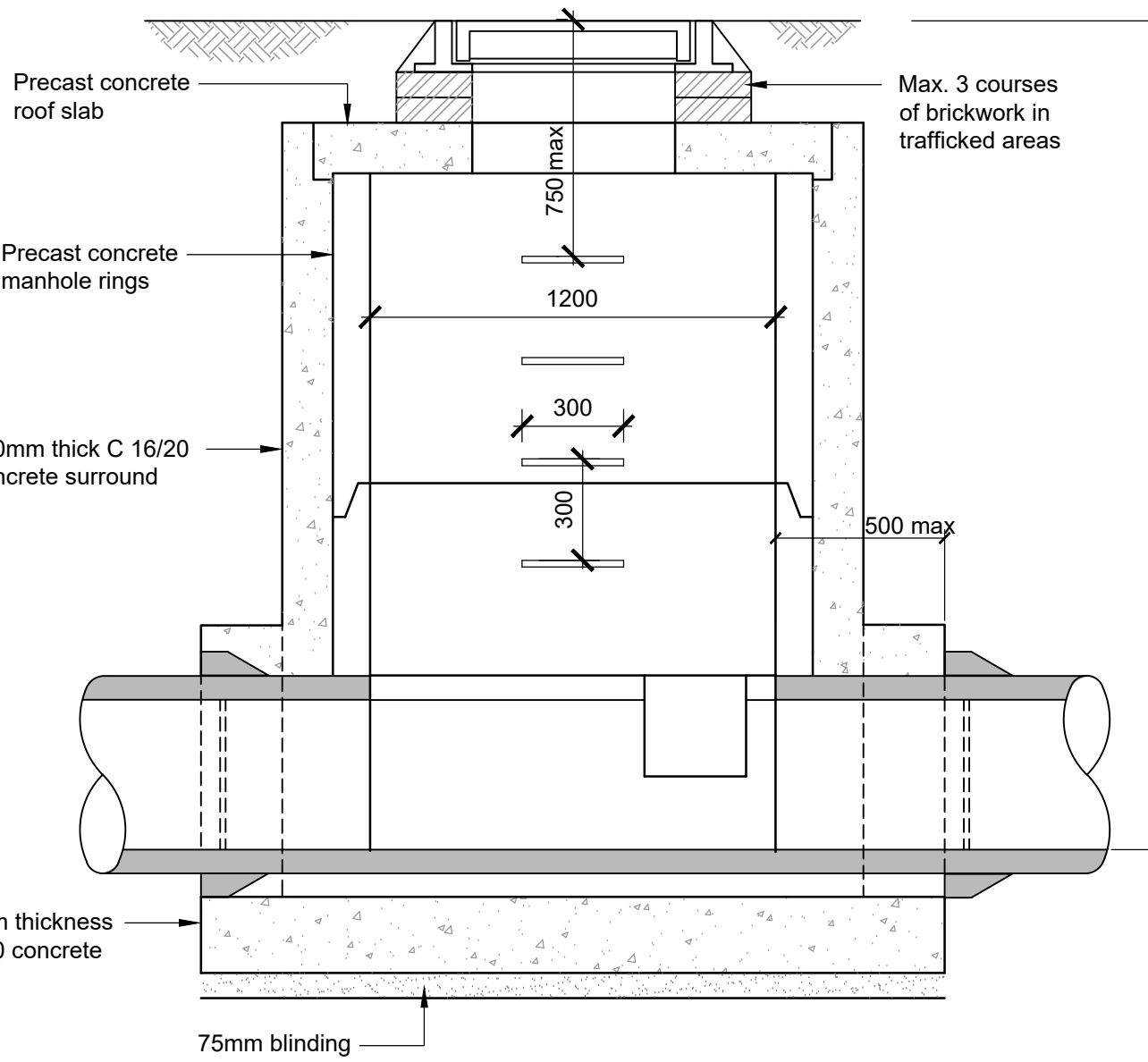
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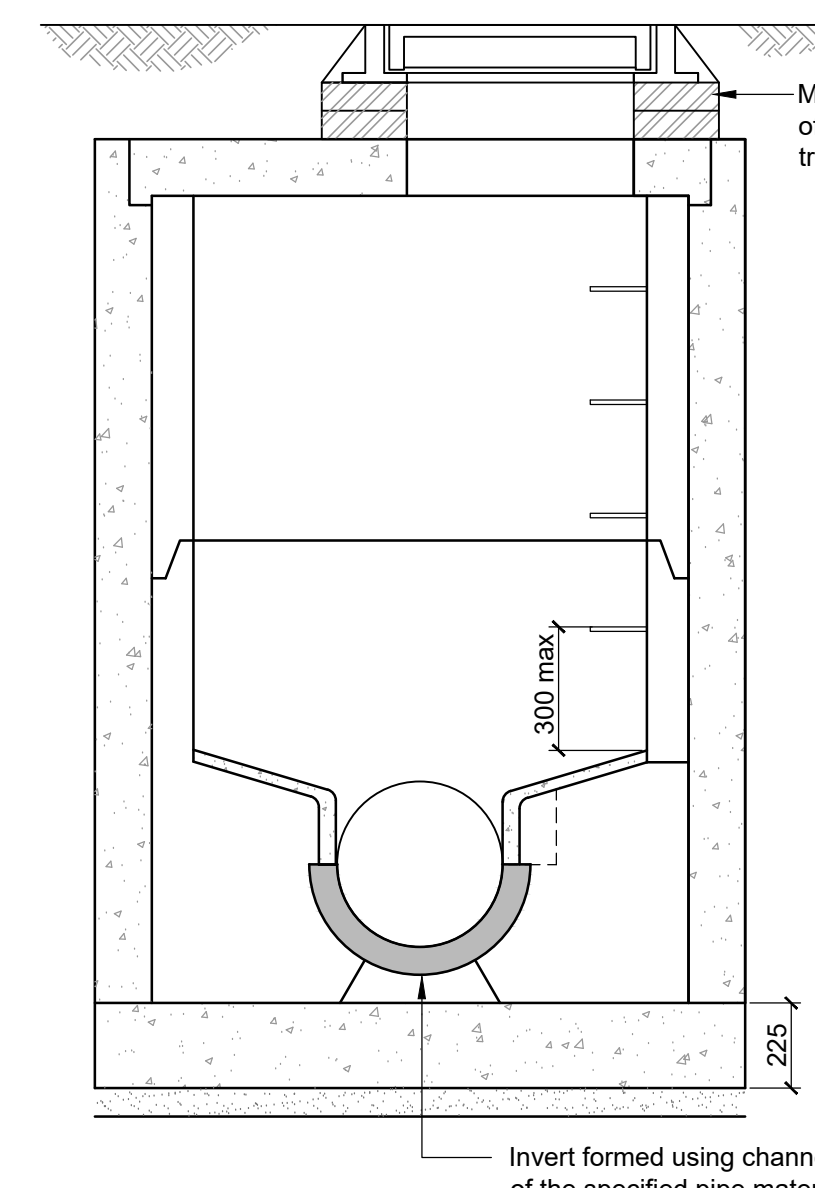
Typical Channel Details
Around Manhole

Scale 1:20

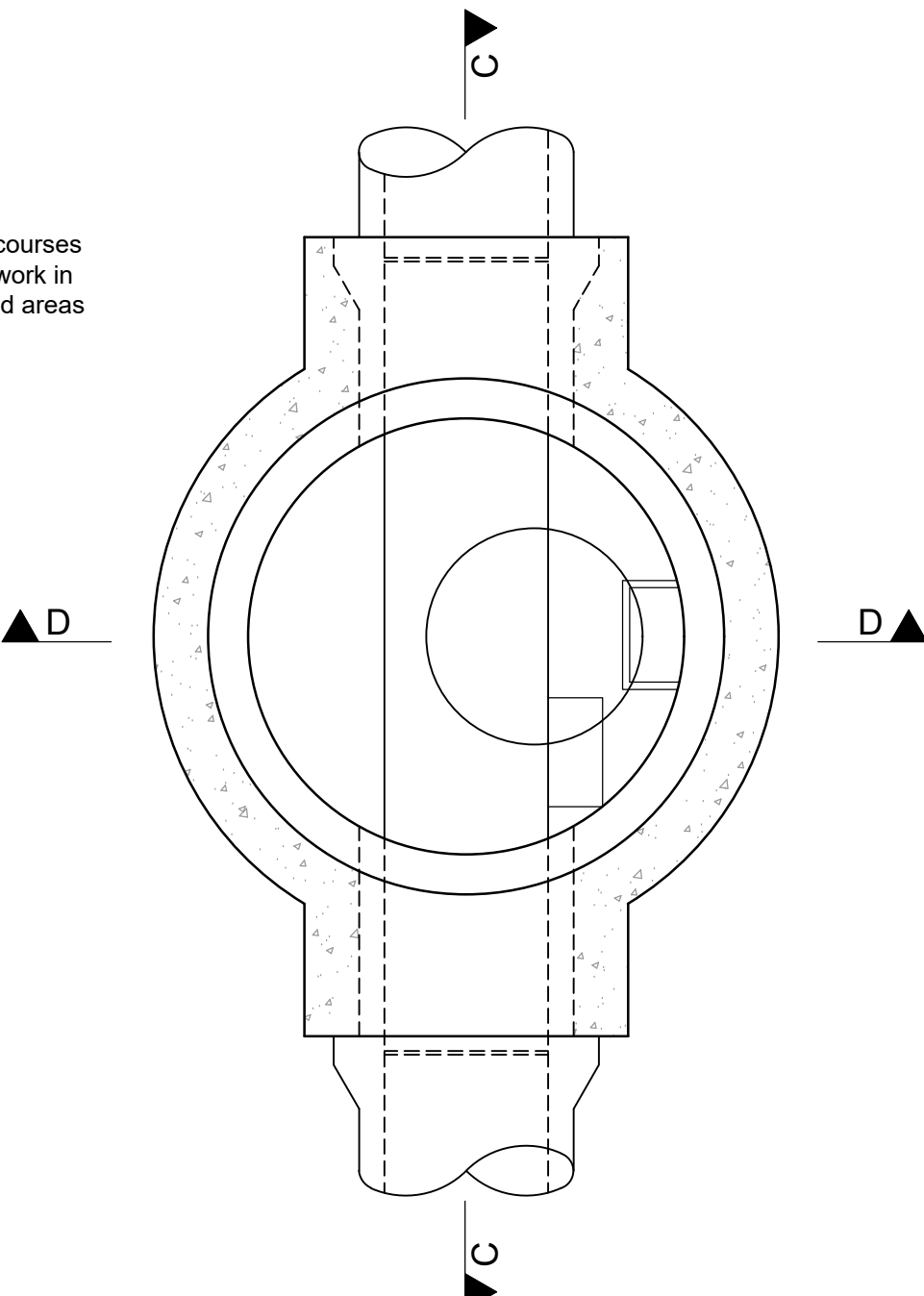
- Angles over 90° are not preferred, in such cases $\frac{3}{4}$ section bends must be used.
- Short length of pipe. (rocker pipe)
- $\frac{1}{2}$ section bend.
- Channel pipe.
- $\frac{3}{4}$ section bend.
- Short length pipe. (rocker pipe)
- Short section of channel pipe.
- Right hand channel junction.



Section C-C



Section D-D

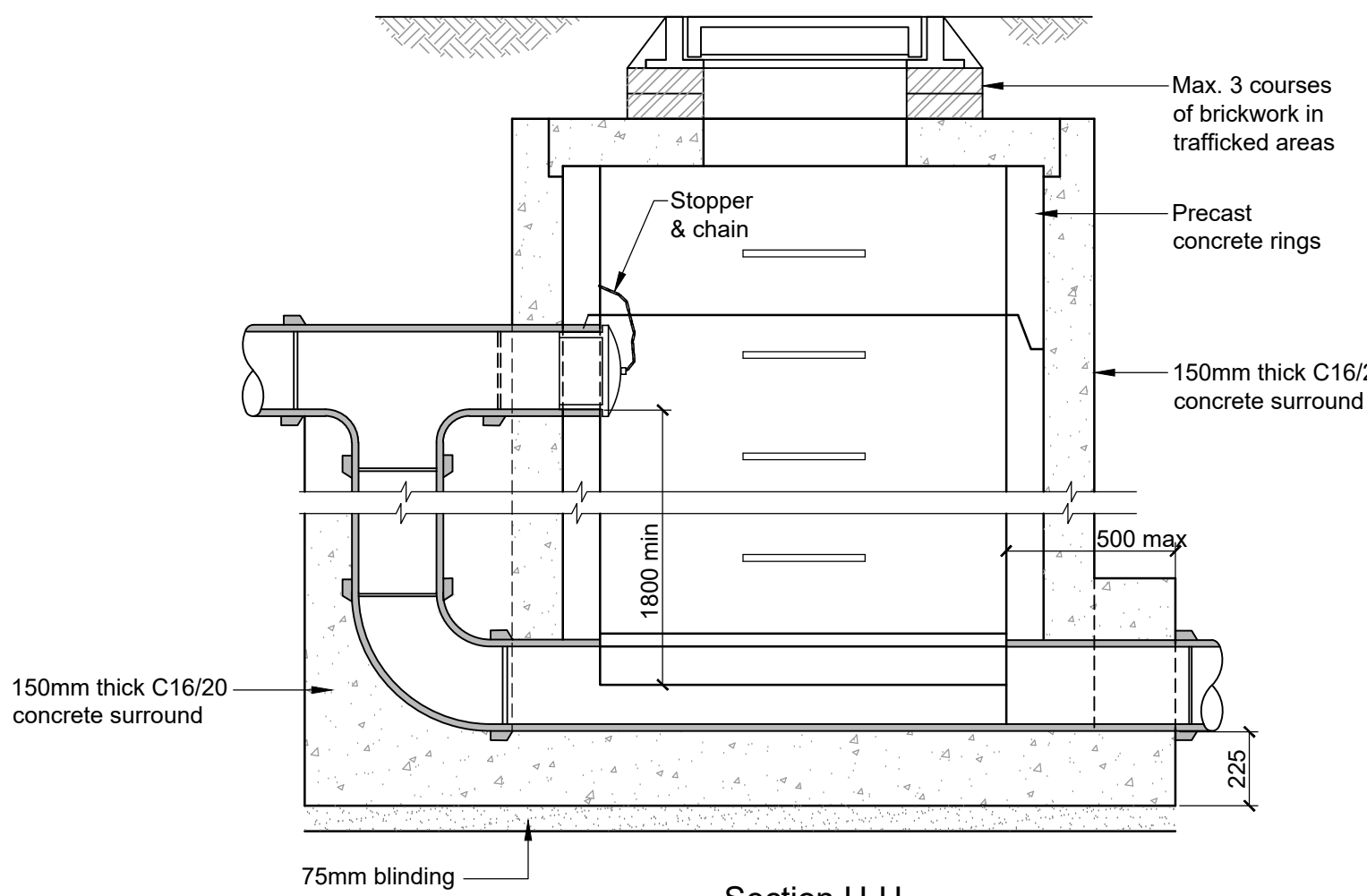


Sectional plan

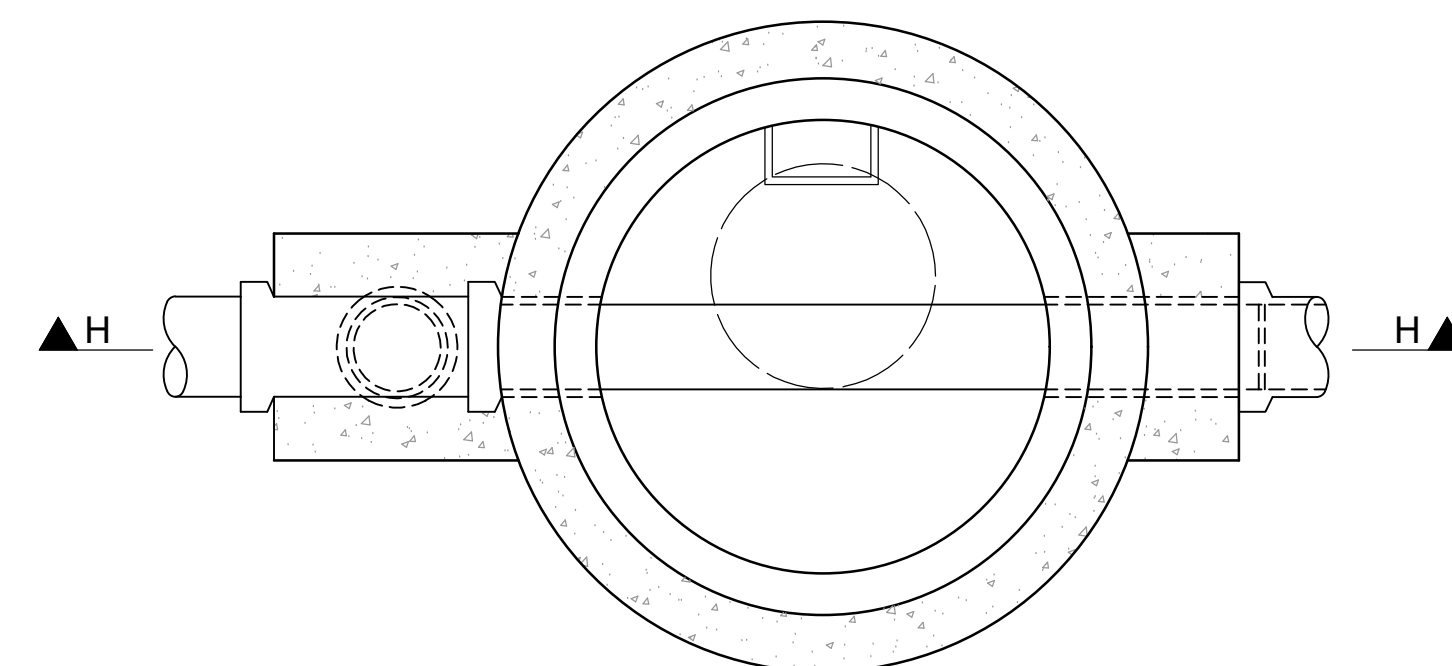
Shallow precast concrete manhole

(depths up to 3.0m on pipes greater than 300mm dia.)
1:20

Manhole sizes	
Pipe dia. mm	Manhole size dia.
100 - 300	1.2m Ø
375 - 750	1.5m Ø
750 - 900	1.8m Ø



Section H-H



Vertical backdrop manhole

1:20

C01	03/10/25	DB	AS	GS
Issued for Planning (Status A2)				
P01	02/07/25	DB	AS	GS
Issued for Information (Status S2)				
Rev	Date	By	Chkd	Appd

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Client
Limerick Twenty Thirty

Project Title
Cleaves Riverside Quarter
Masterplan

Drawing Title
Proposed Details
Sheet 1

Scale at A1
As Shown

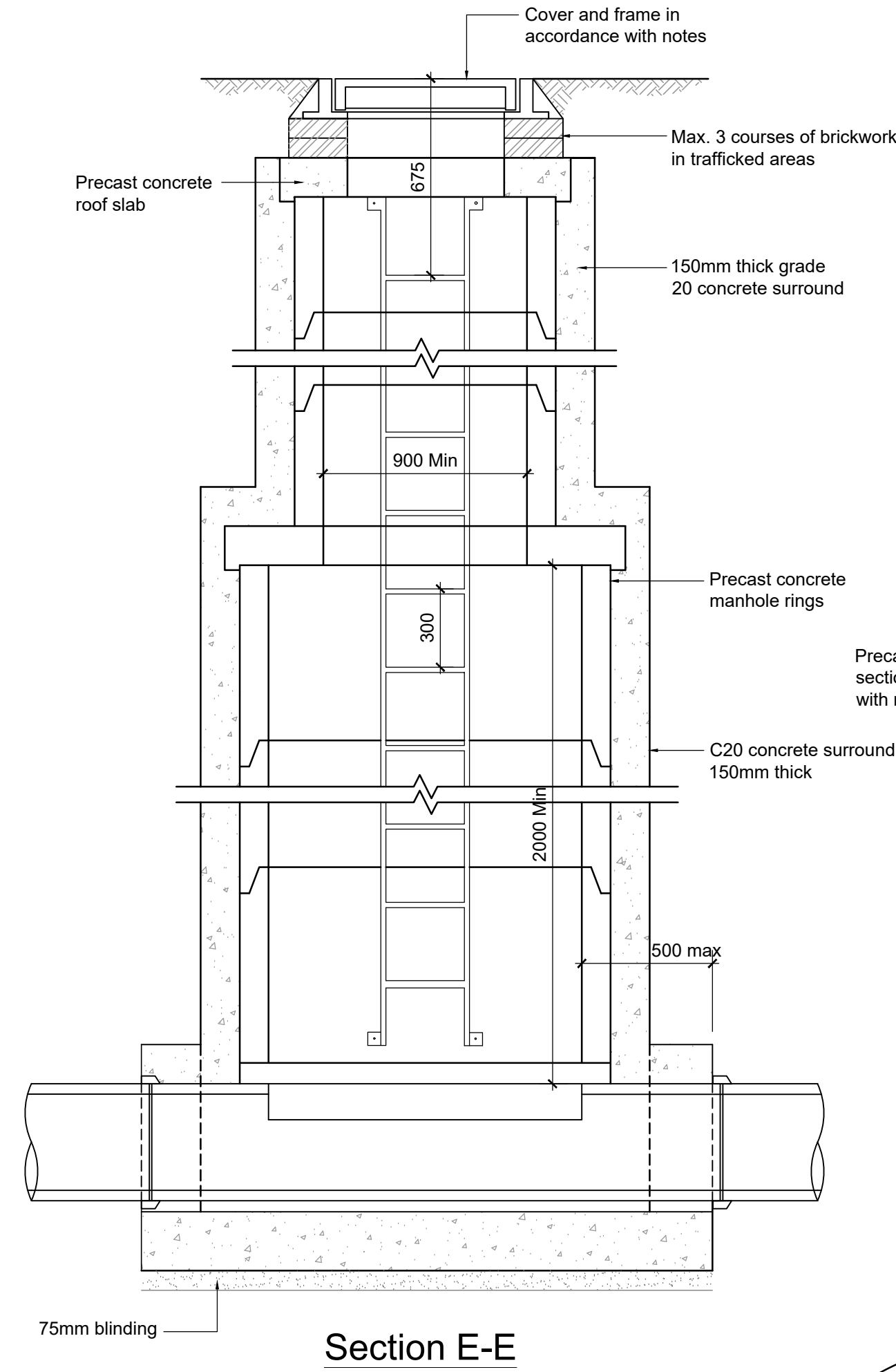
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Civil Drainage

Suitability
A2 - Issued for Planning

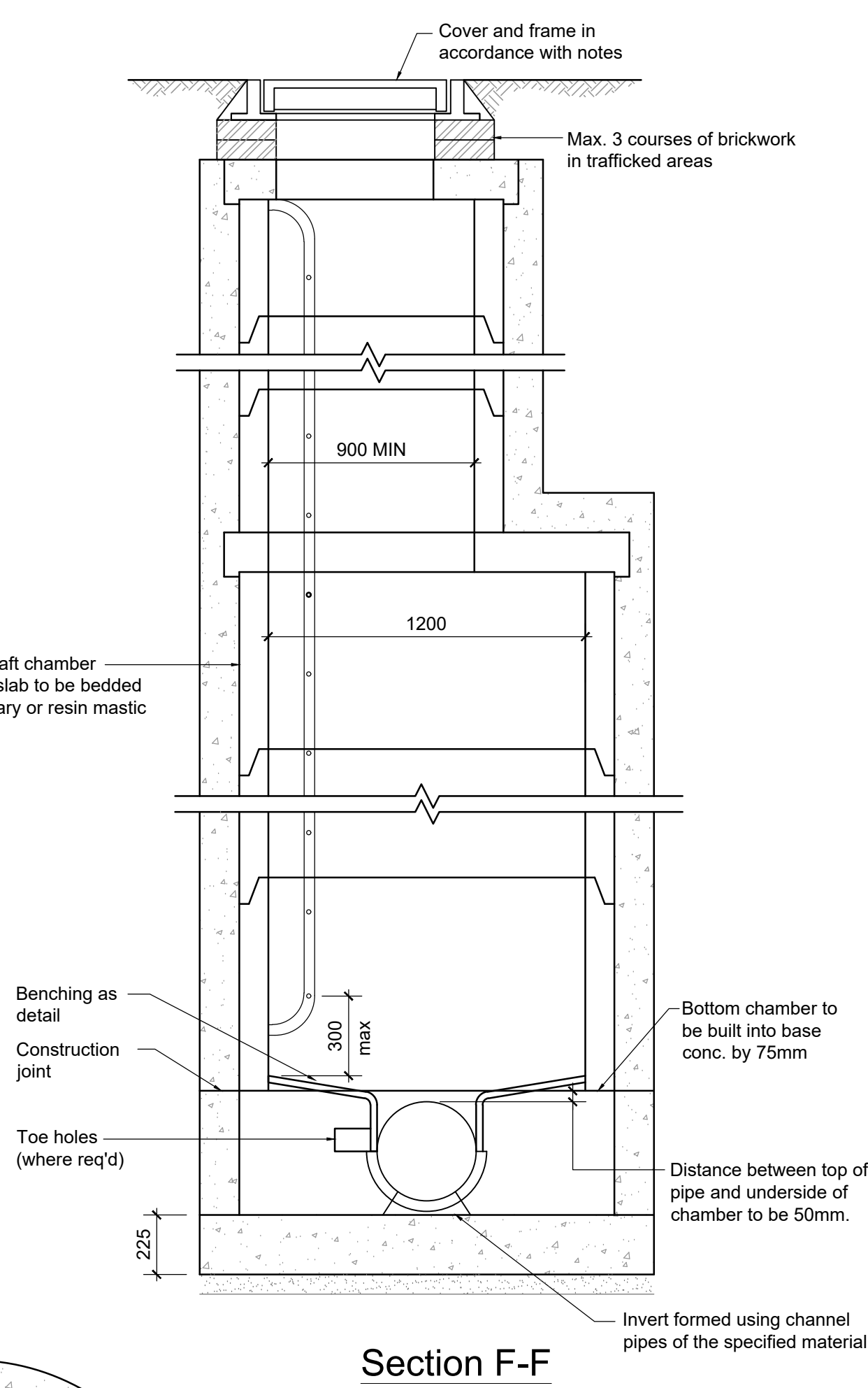
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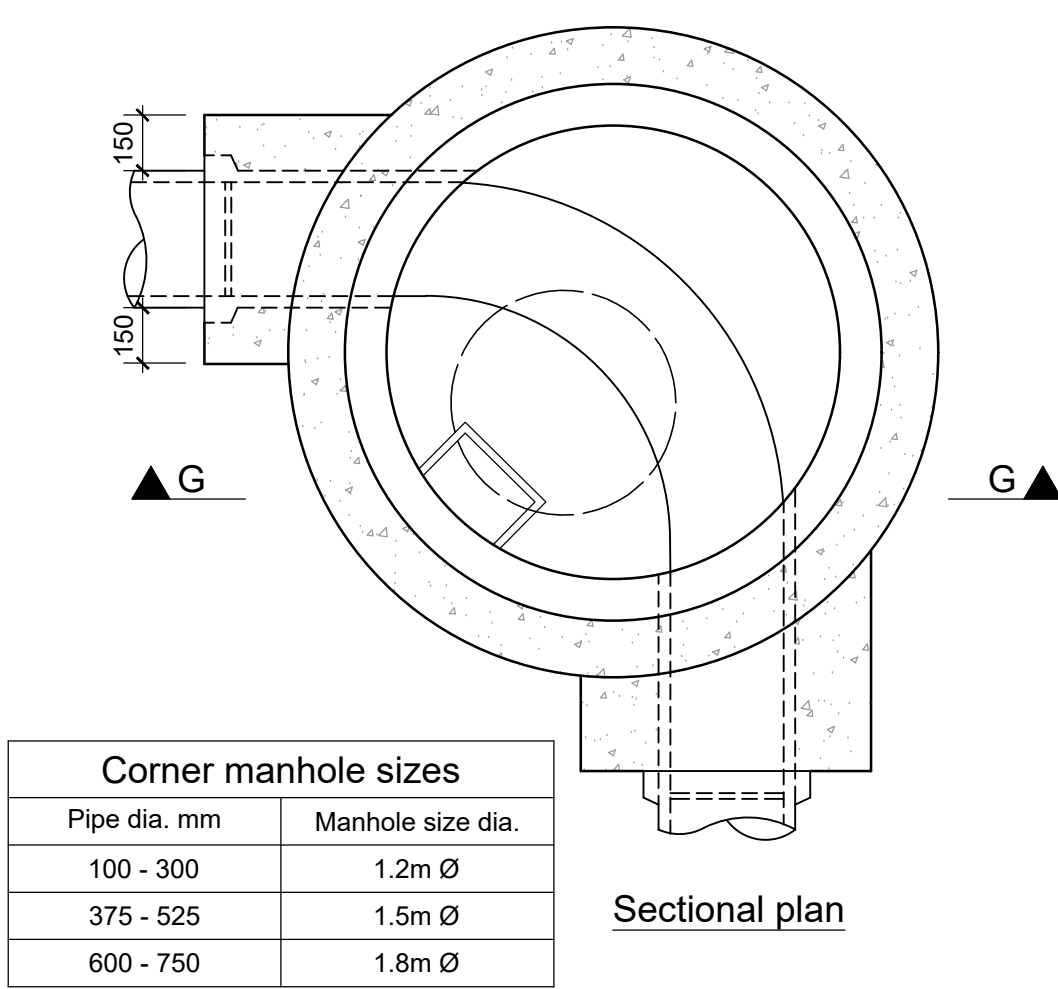
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Section E-E

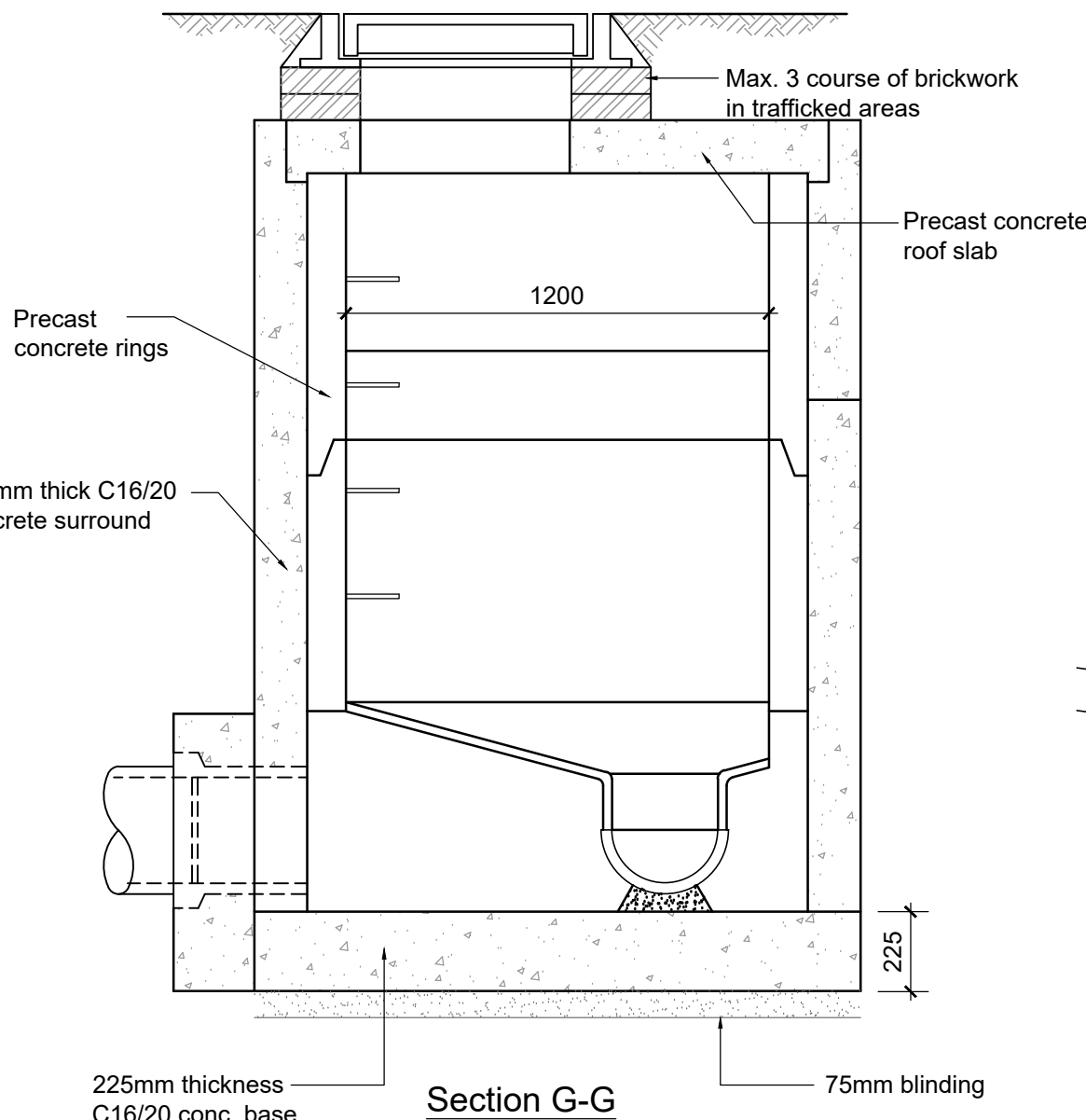


Section F-F



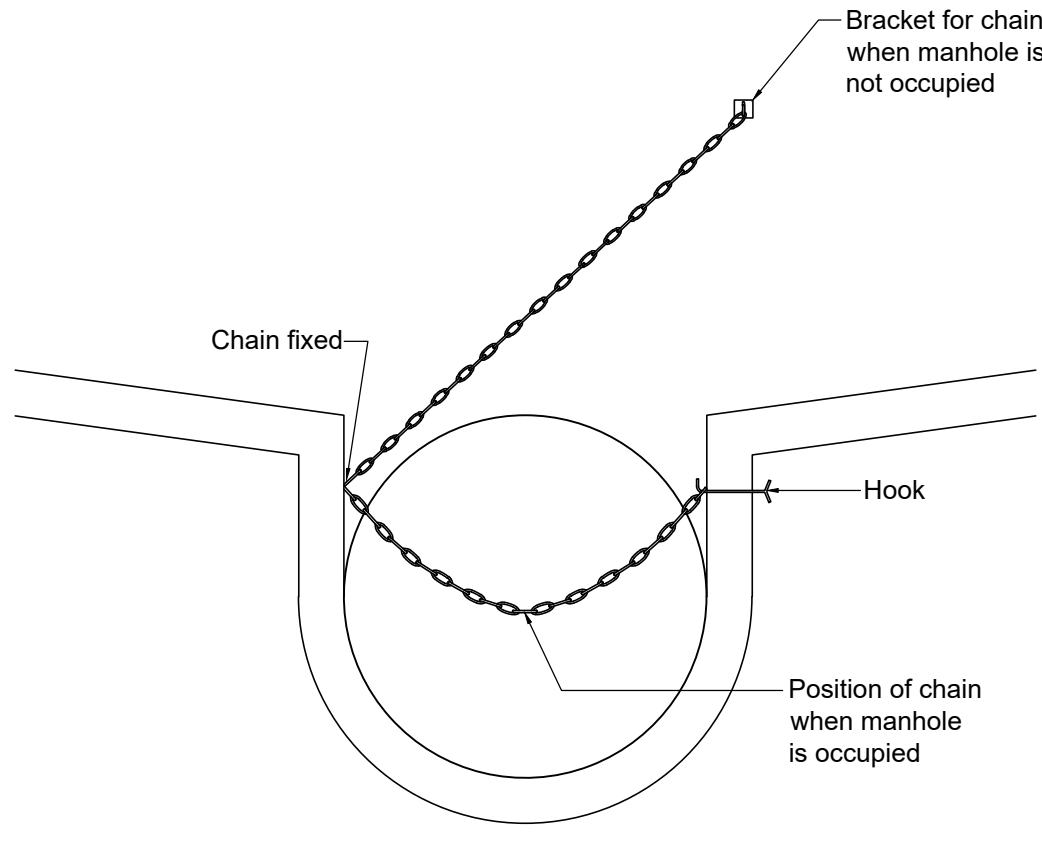
Corner manhole sizes	
Pipe dia. mm	Manhole size dia.
100 - 300	1.2m Ø
375 - 525	1.5m Ø
600 - 750	1.8m Ø

Sectional plan



Section G-G

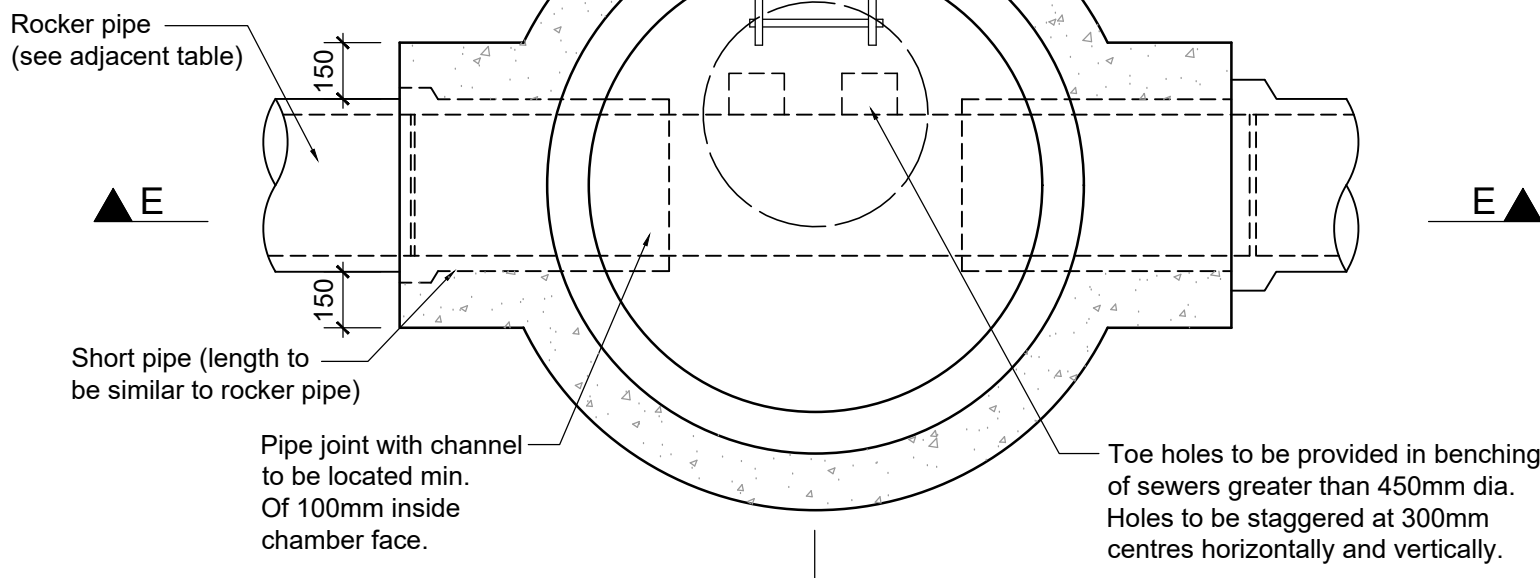
Precast concrete corner manhole
(If over 3.0m deep use shaft for deep manhole)
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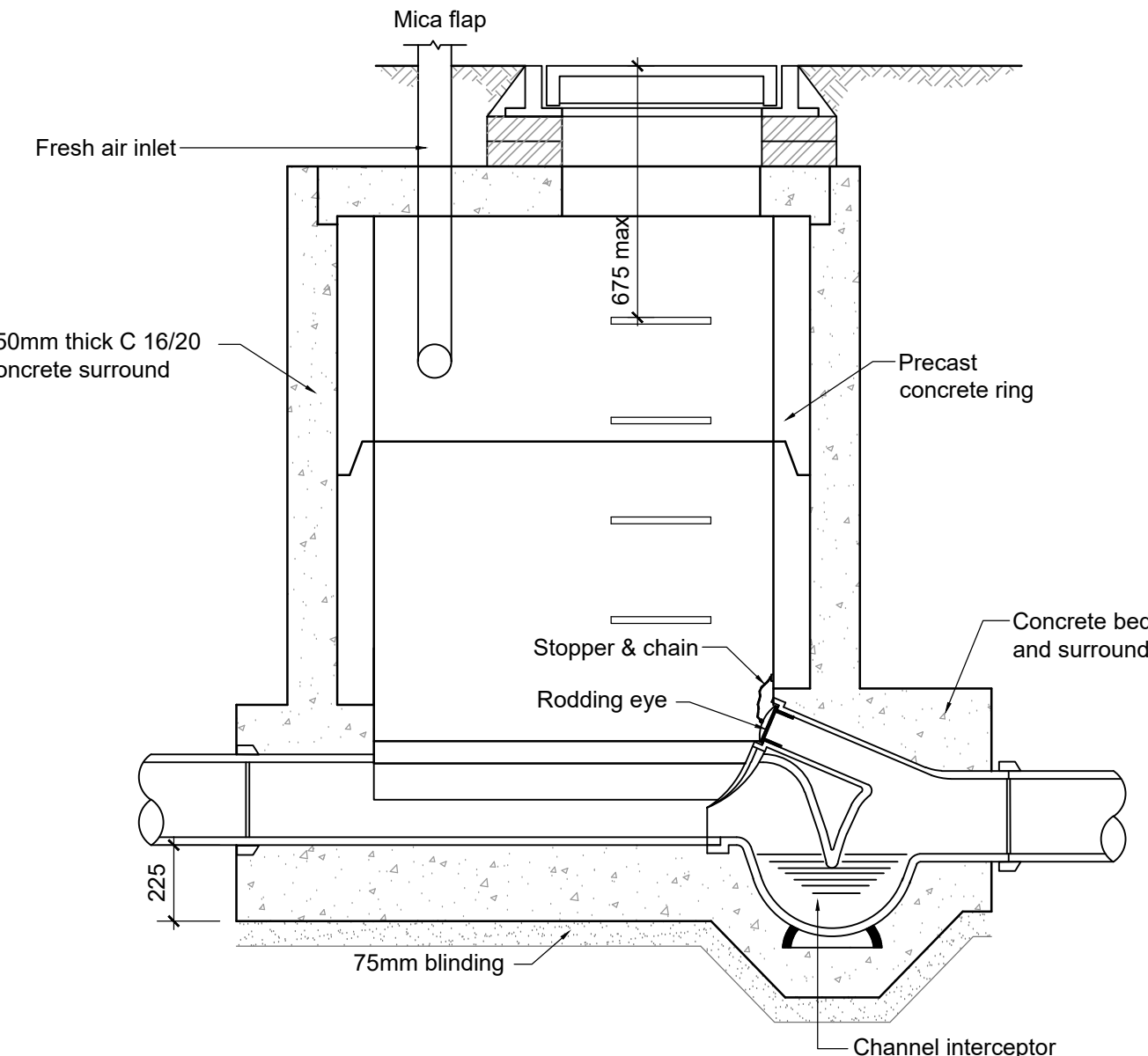
Safety chain detail
(For pipe diameters greater than 600mm)
1:20

Manhole sizes	
Pipe dia. Mm	Manhole size dia.
100 - 300	1.2m Ø
375 - 750	1.5m Ø
750 - 900	1.8m Ø
1050-1200	2.1m Ø

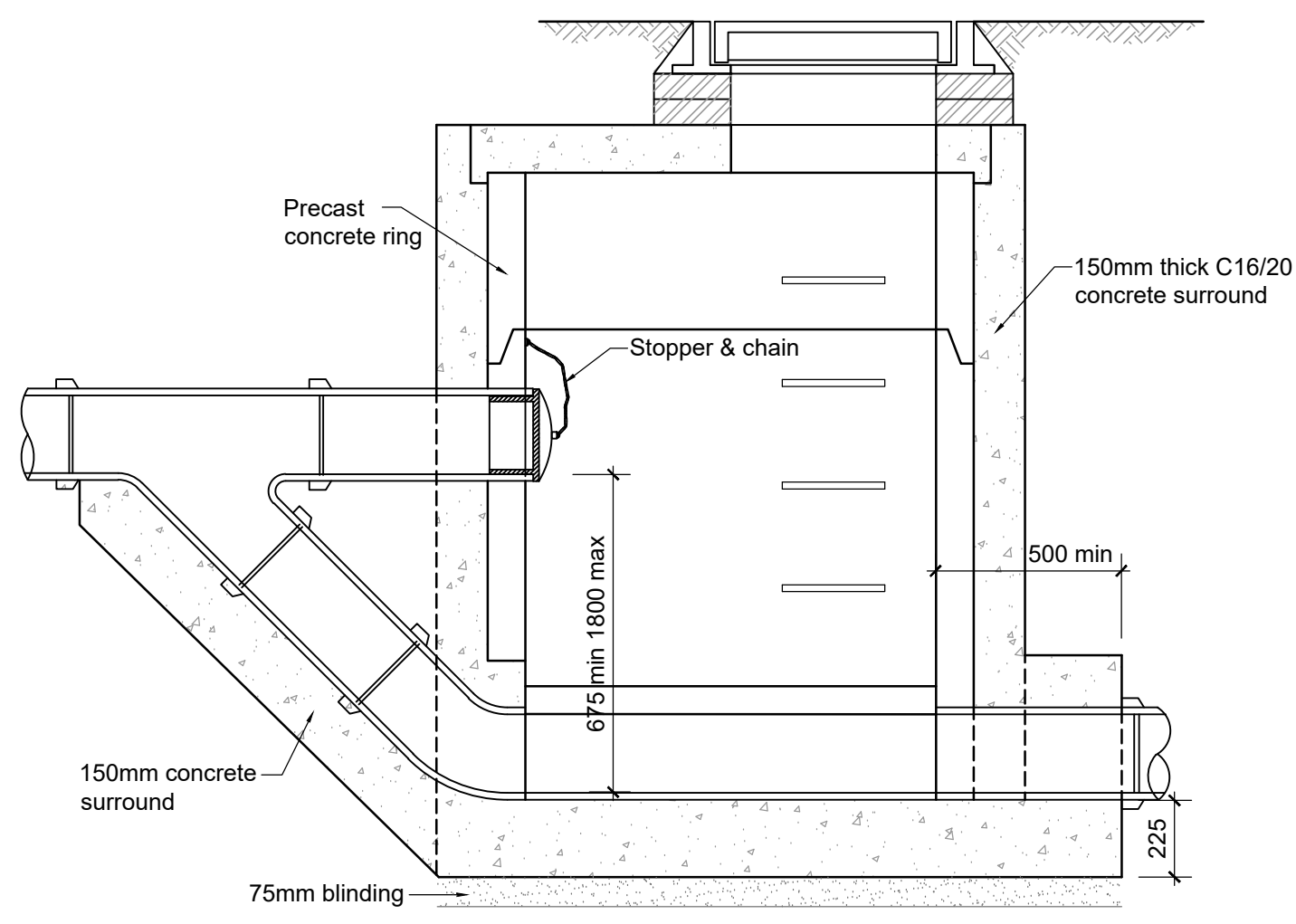
Rocker pipes	
Pipe dia. mm	Rocker pipe length
150 - 450	0.5 - 0.75m
525 - 750	0.75 - 1.0m



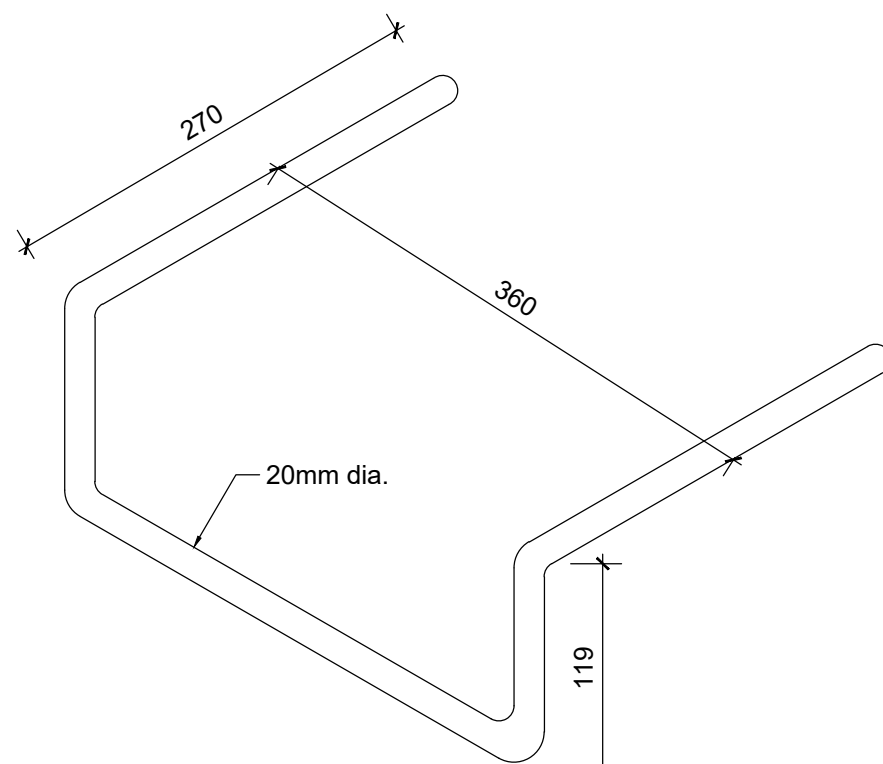
Sectional plan
Deep precast concrete manhole
(Depths over 3.0m & up to 5.5m)
1:20



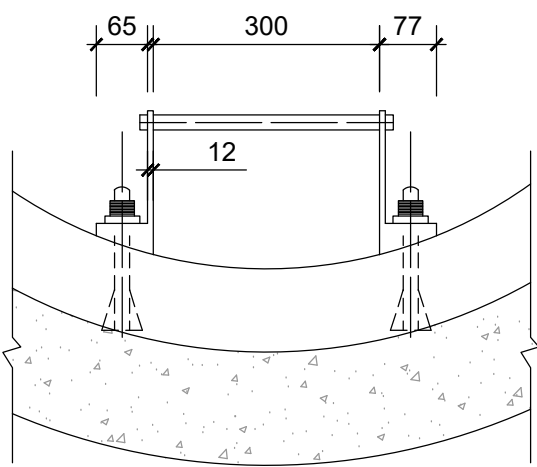
Detail of channel interceptor
1:20



Ramped backdrop manhole
1:20



Ladder rungs
1:20



Access ladder detail
1:20

Notes:
Manhole construction

Concrete manholes shall be constructed of precast units complying with I.S.420 and shall be of the dimensions as shown on the drawing. The base, and benching shall be formed insitu of C16/20 concrete. The base shall be 225mm thick and the channel be purpose made half round channels. The precast rings shall be surrounded in 150mm thick C16/20 concrete. A flexible joint shall be provided to each pipe within 500mm of the inner face of the manhole wall. Projecting pipes shall be surrounded with C16/20 concrete with the base been cast monolithically with the manhole base. A further "rocker" pipe shall be provided for pipes up to 450mm dia. Of 500mm to 750mm length, and pipes greater than 450mm dia. 750mm to 1000mm length.

Covers

Manhole covers and frames to comply with the requirements of IS/EN 124:2015. Covers in roadways to be an approved minimum Class D400 with 600mm clear opening with polyester resin bedding material for fixing manhole frames as per clause in Arup Specification (Materials). Covers in grassed areas and footpaths not adjacent to roadways to be minimum Class C250 with 600mm clear opening. Maximum of 3 courses of engineering bricks to be provided under manhole frames in trafficked areas with 2 courses in un-trafficked areas.

Ladder rungs

Ladder rungs shall be 20mm diameter mild steel heavily galvanised after manufacture as shown on the drawing and fitted at 300mm centres. Length embedded in wall 125mm.

Access ladders

Access ladders to be manufactured from mild steel with 65mm x 12mm stringers 300mm apart with 20mm diameter rungs at 300mm c/c. Mild steel stays 65mm x 12mm to be provided at intervals not exceeding 2.4m. Ladder and stays to be heavily galvanised to BS 729 after manufacture. The ladder is to be fixed with 18mm diameter stainless steel bolts.

Benching

Benching is to be formed in C16/20 concrete and should rise vertically from the top edge of the channel to a height not less than that of the soffit of the outlet and slope upwards to meet the wall of the manhole at at gradient of 1:12 (min. rise 25mm). It should be floated with a steel float to a smooth hard surface with a 25mm thick coat of 1:2 cement mortar laid while the benching concrete is still green. The channel shall be purpose made half round channels of the same material as the pipeline or other as approved by the engineer.

C01	03/10/25	DB	AS	GS
Issued for Planning (Status A2)				
P01	02/07/25	DB	AS	GS
Issued for Information (Status S2)				
Rev	Date	By	Chkd	Appd

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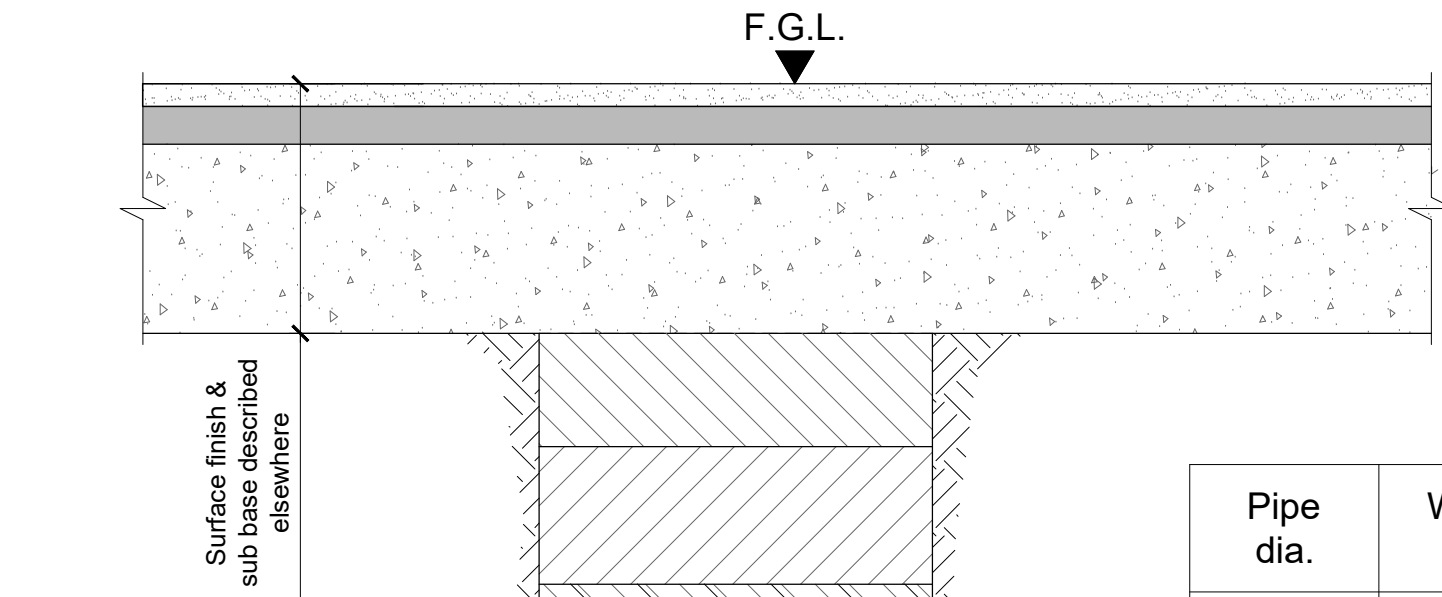
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Client
Limerick Twenty Thirty

Project Title
Cleaves Riverside Quarter
Masterplan

Drawing Title
Proposed Details
Sheet 2

Scale at A1	1:20
Role	Civil Drainage
Suitability	A2 - Issued for Planning
Arup Job No	277975-00
Name	CRQMP-ARUP-XX-00-DR-CE-4402
Rev	C01



Clause 804/808 backfill in trafficked areas compacted in accordance with specification selected excavated backfill in untrafficked areas

Where cover < 1.2m in trafficked areas & 0.900m in untrafficked areas and under building slabs use concrete bed & surround to detail shown

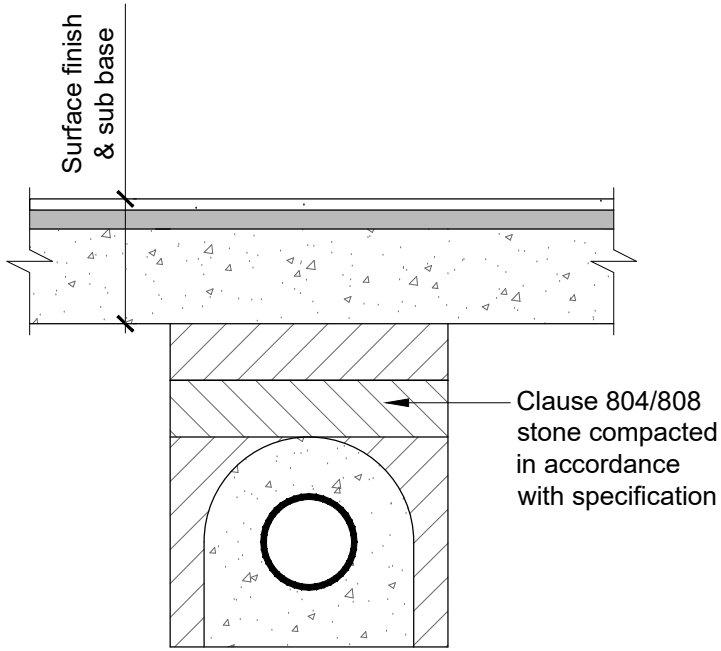
Bed of granular material thoroughly compacted before laying pipes

Typical Pipe Bedding
Scale 1:20

Pipe dia.	Width bd	"Y" rock, etc.
100	550	200
150	600	200
225	700	200
300	750	200
375	1050	200
450	1150	200
600	1350	200

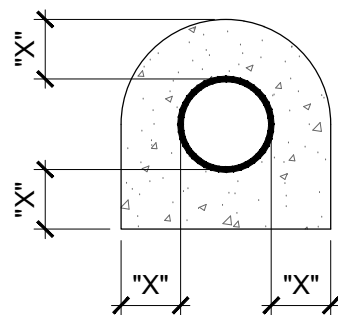
Detail of granular bed and surround to surface water and foul drainage

Note:
The material for the granular bedding & surround shall be coarse graded aggregate between 5-20mm in size or as advised on layout / specific detail drawings.

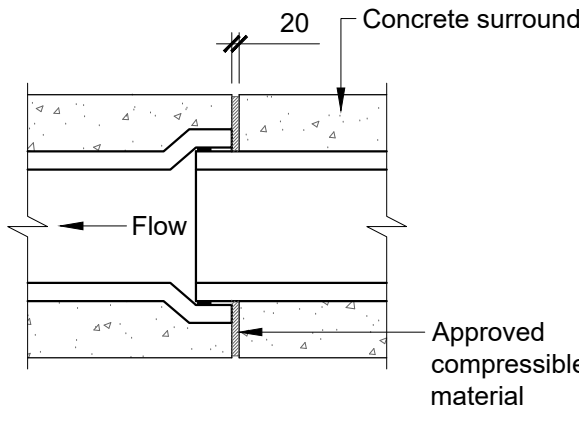


Concrete bed & surround

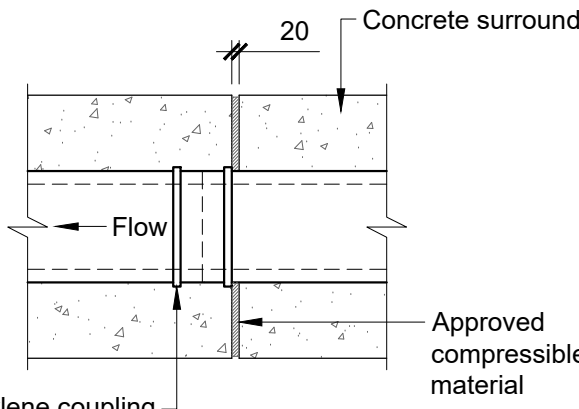
Dimension "X" = 150mm for pipes < 6000



Concrete bed & surround

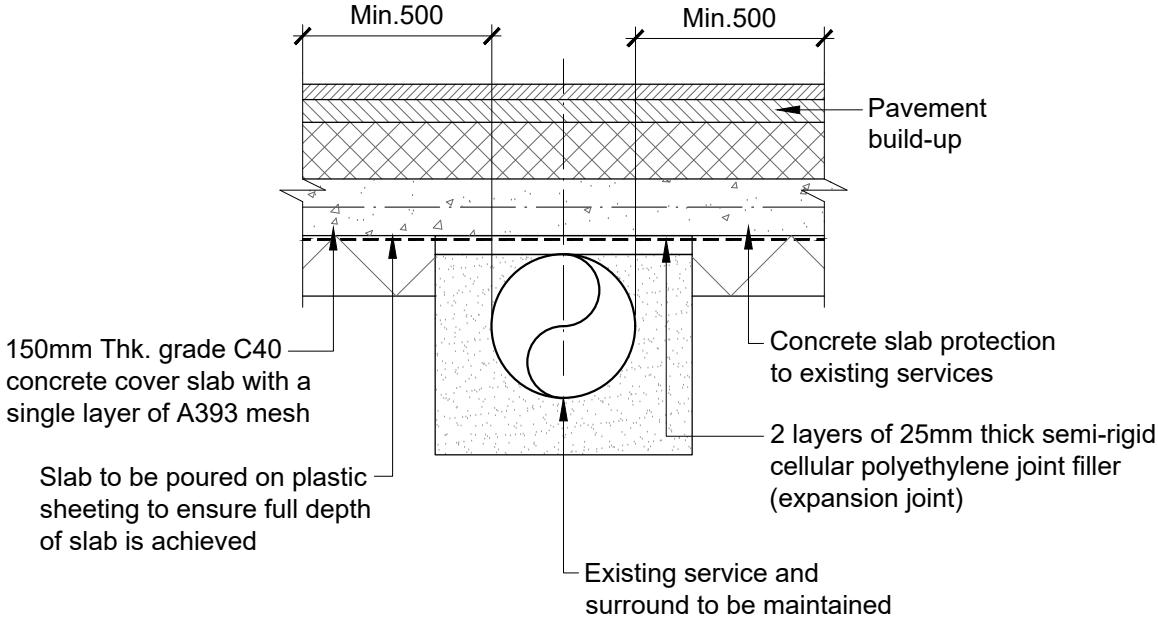


Joint in concrete surround to flexible jointed spigot & socket concrete pipes



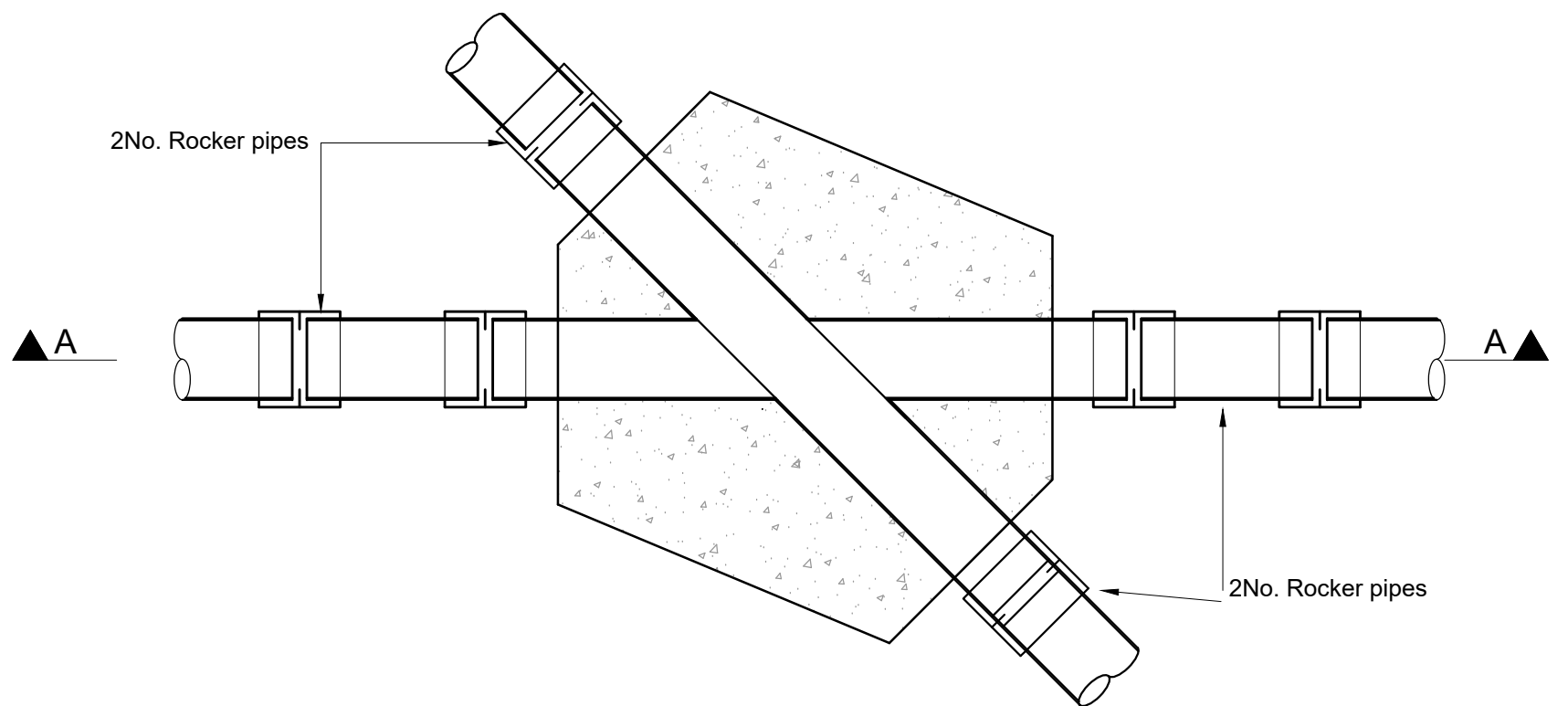
Joint in concrete surround to clayware pipes

- Notes:
- Concrete to be grade 20
 - Joints with approved compressible material shall not be more than 5m apart
 - Where sewers have a concrete bed & surround, flexibility of all joints is to be maintained by providing a flexible joint through concrete using a compressible board. Board to be pre-cut to pipe diameter and to provide a complete break between the concrete surrounds. The compressible board is to be 18mm thick for pipe sizes up to 450mm diameter and 36mm thick for larger diameters

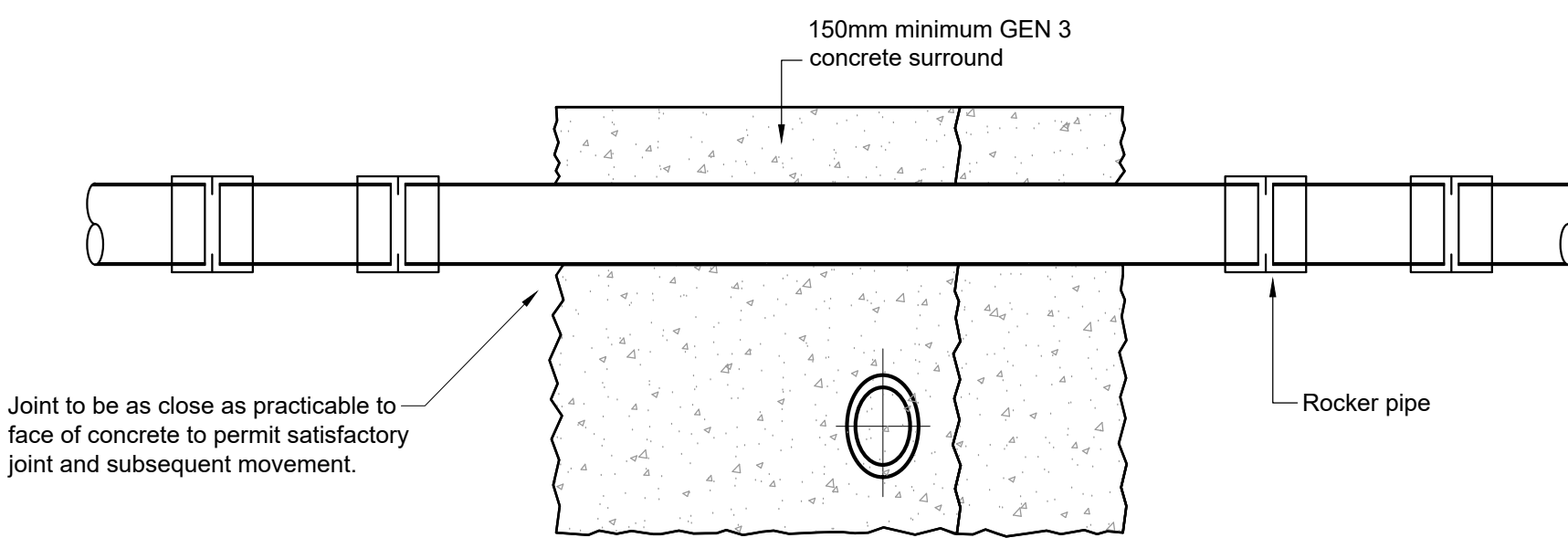


Pipe Protection Detail 2
Scale 1:20

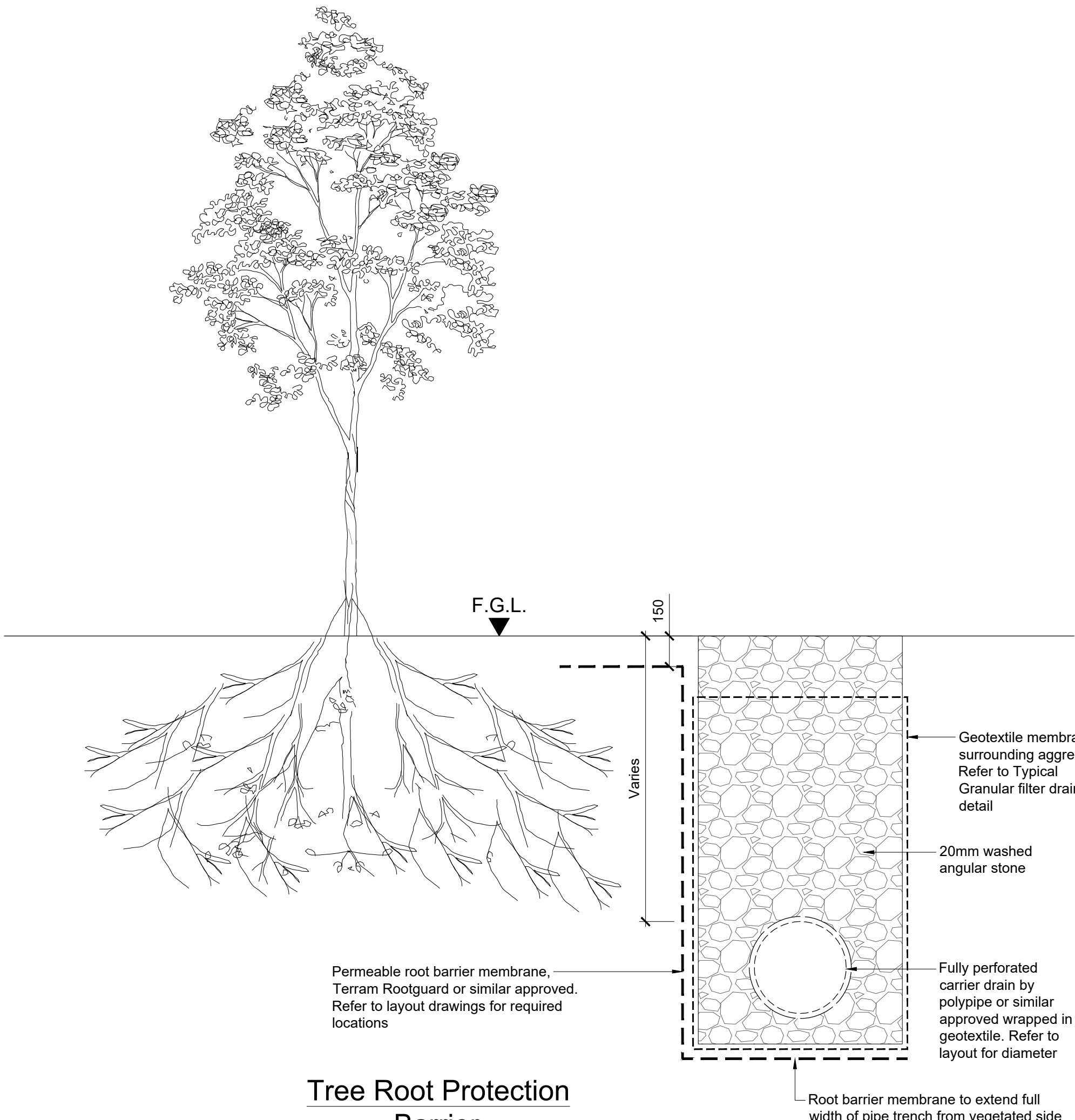
Pipe Protection Detail 1
Scale 1:20



Pipe Crossover Detail (Plan)
Scale 1:20



Pipe Crossover Detail Section A-A
Scale 1:20



Tree Root Protection Barrier
Scale 1:20

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Issued for Information (Status S2)				
Rev	Date	By	Chkd	Appd

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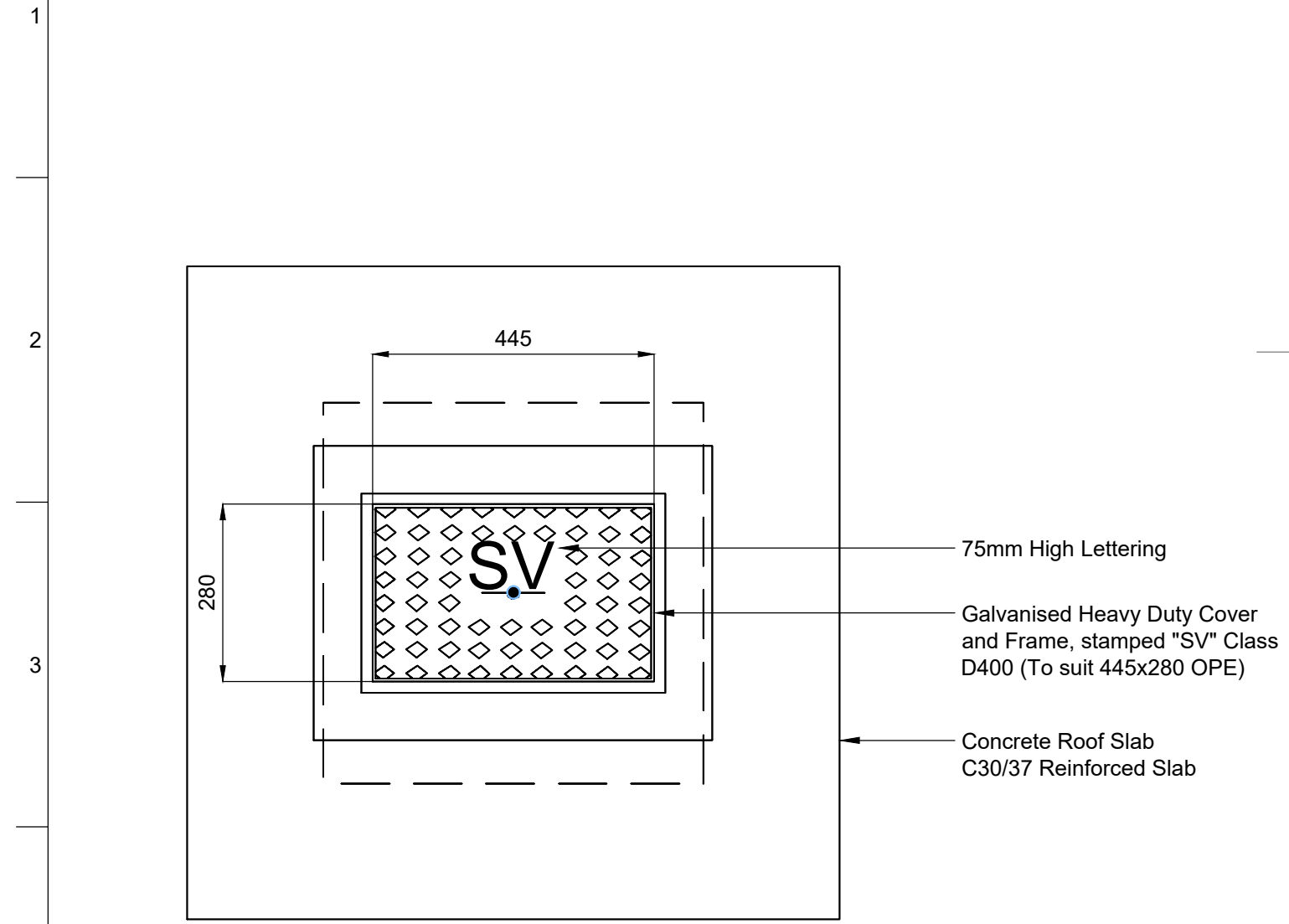
Client
Limerick Twenty Thirty

Project Title
Cleevs Riverside Quarter Masterplan

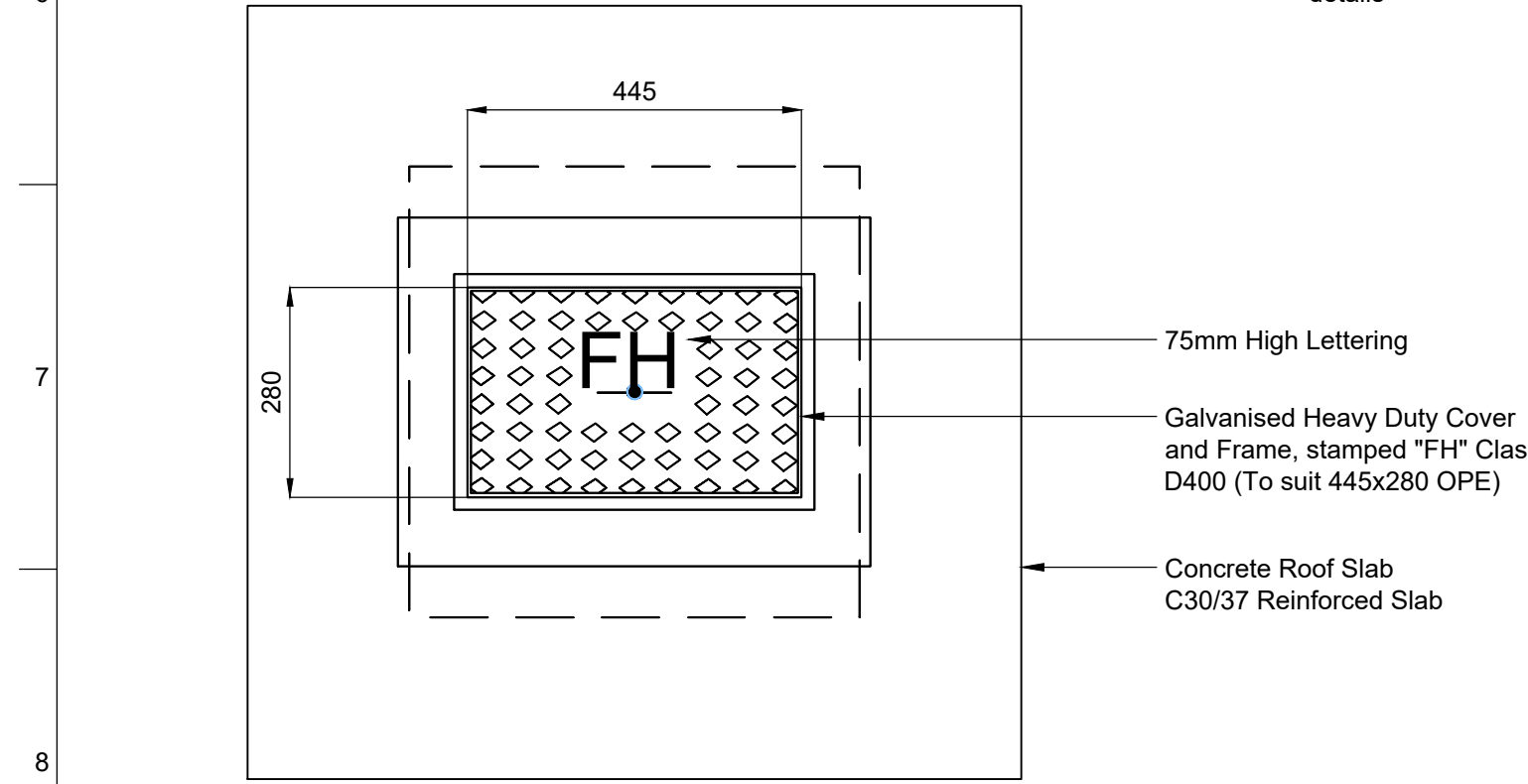
Drawing Title
Proposed Details Sheet 3

Scale at A1	1:20
Role	Civil Drainage
Suitability	A2 - Issued for Planning
Arup Job No	277975-00
Name	CRQMP-ARUP-XX-00-DR-CE-4403
Rev	C01

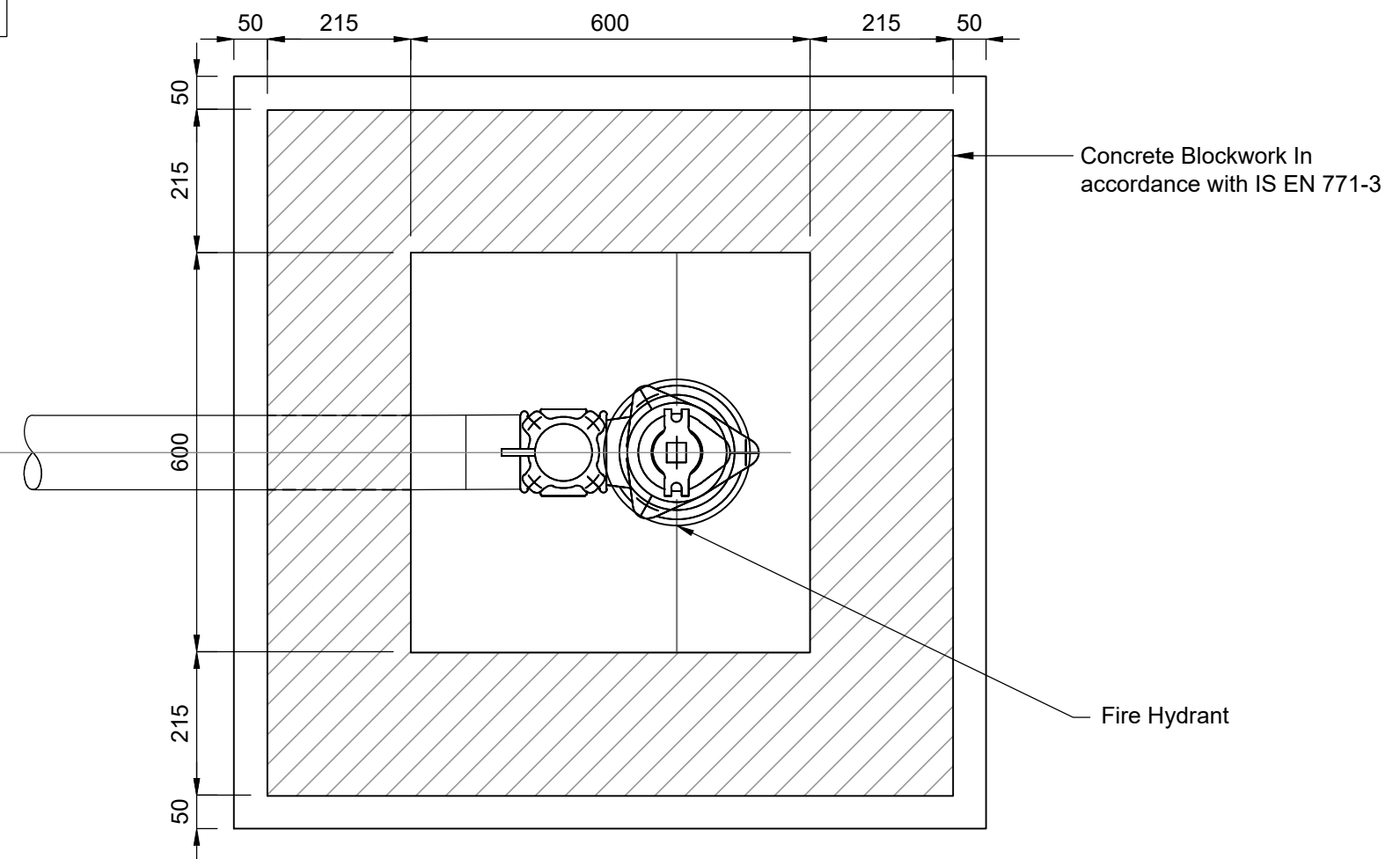
Note: Use class B125 surface boxes in grassed areas, class D400 in trafficked areas



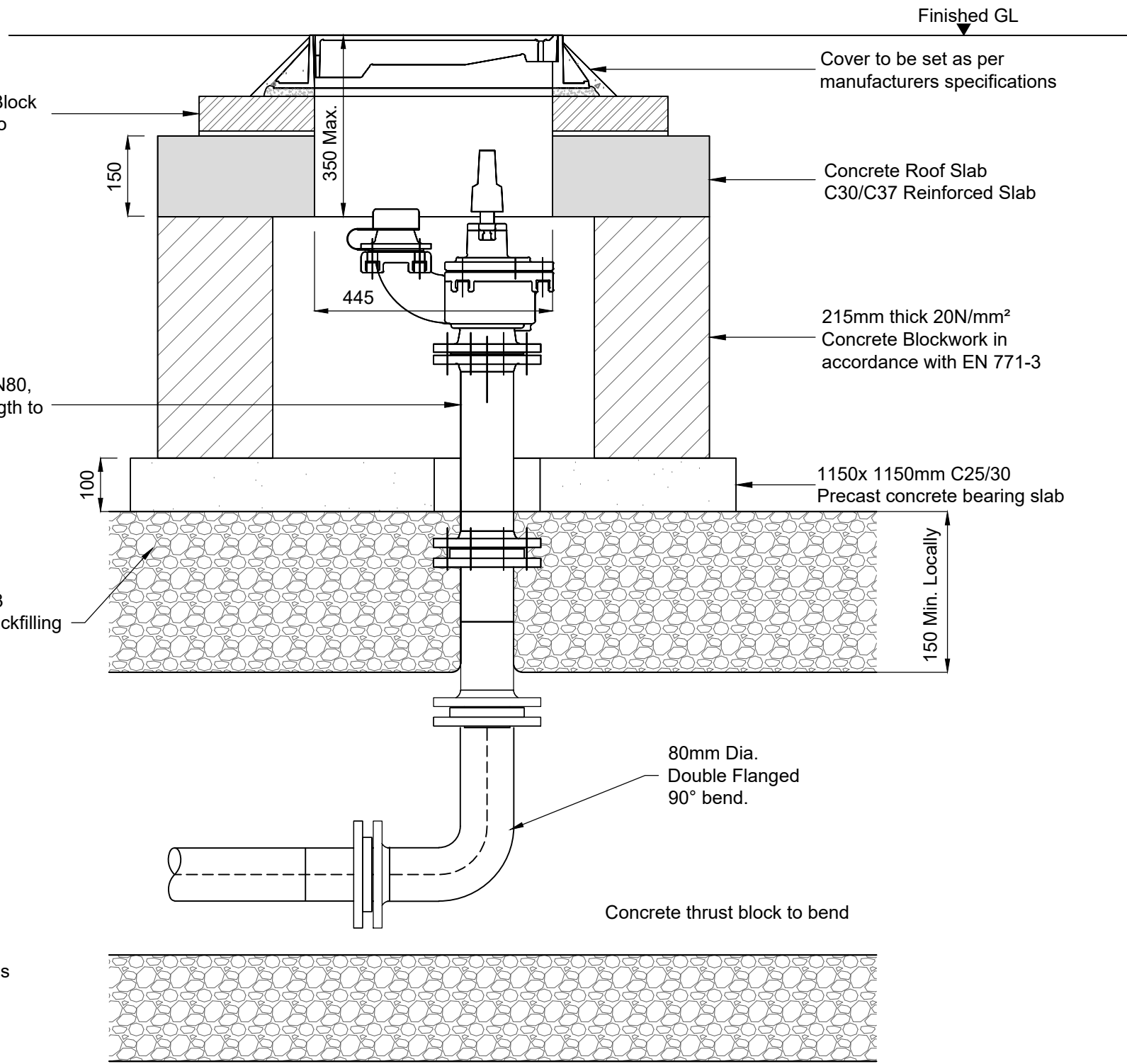
Sluice Valve Roof Plan
Scale 1:10



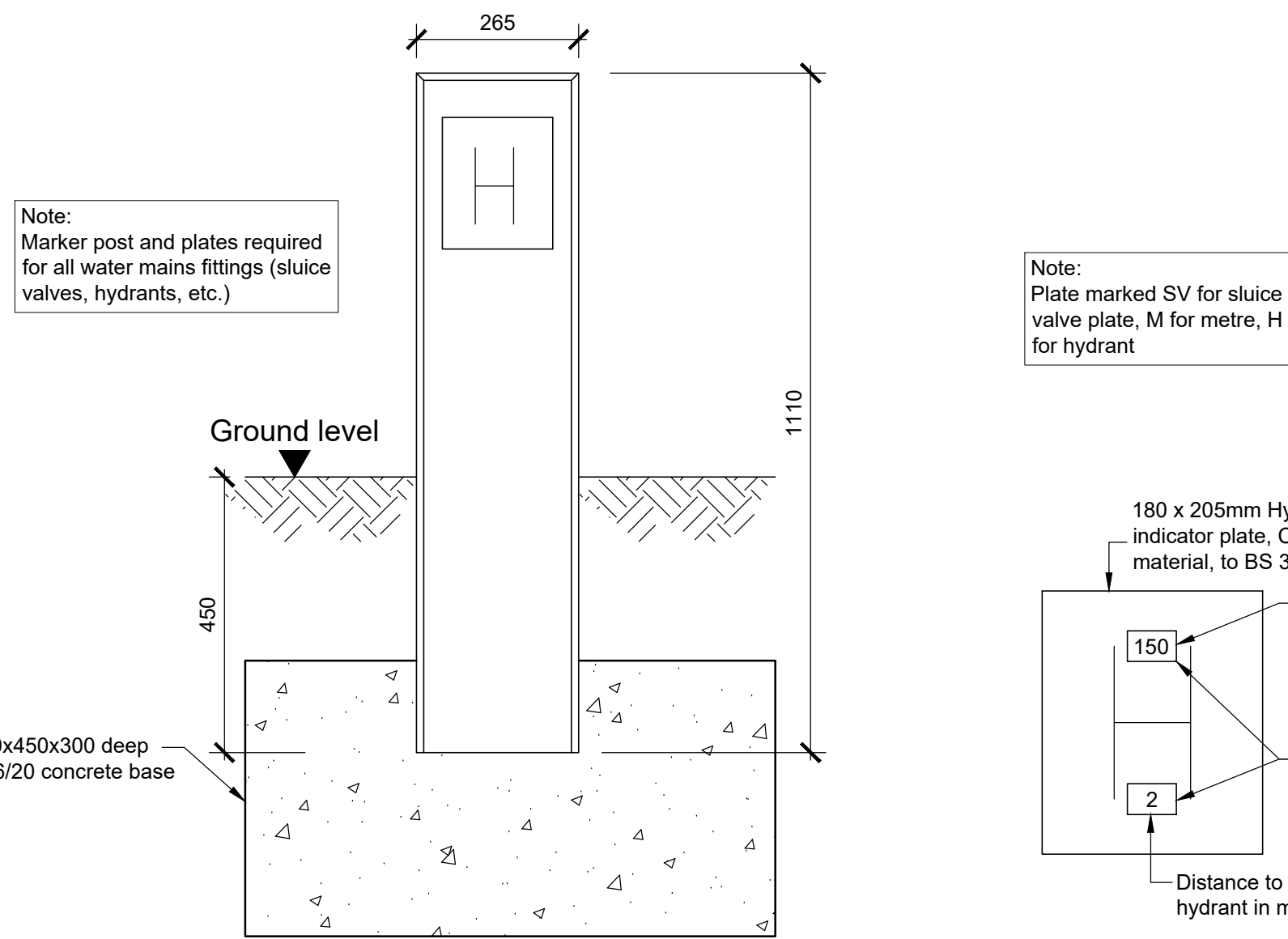
Fire Hydrant Roof Plan
Scale 1:10



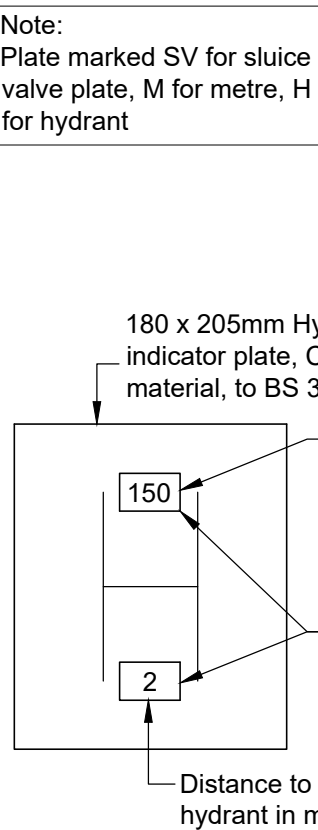
Fire Hydrant Floor Plan
Scale 1:10



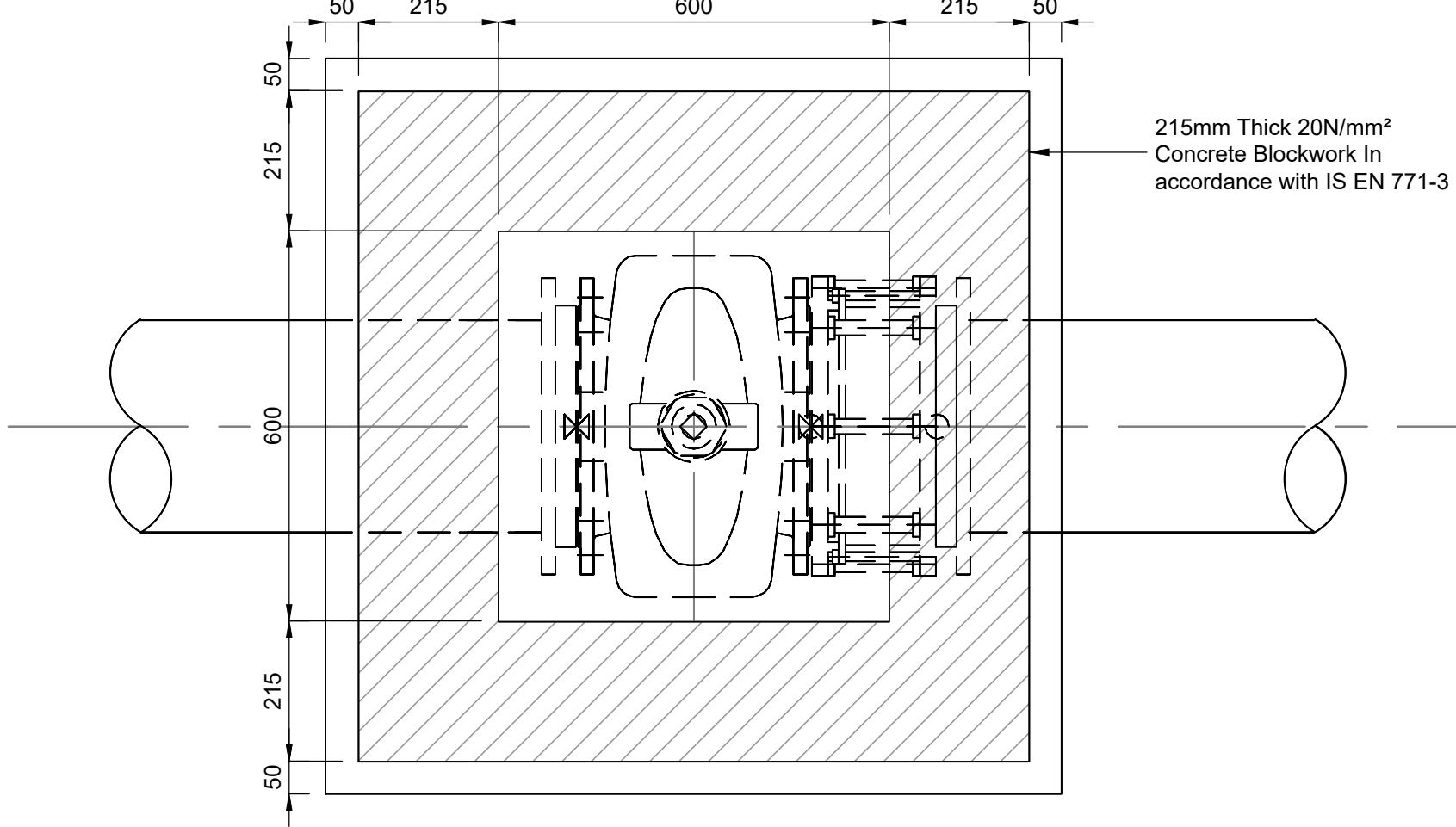
Fire Hydrant Section
Scale 1:10



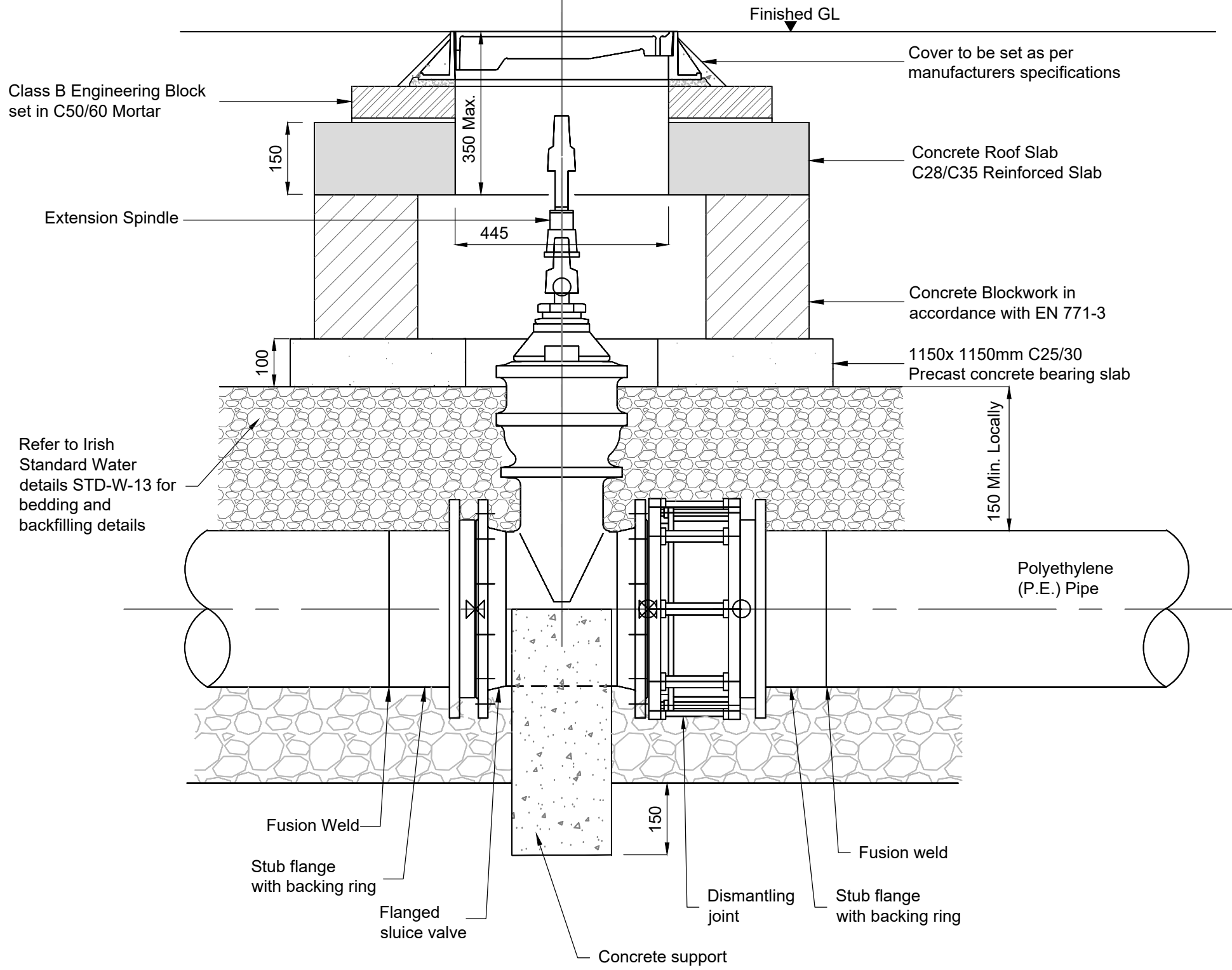
Concrete Indicator Post Detail
Scale 1:10



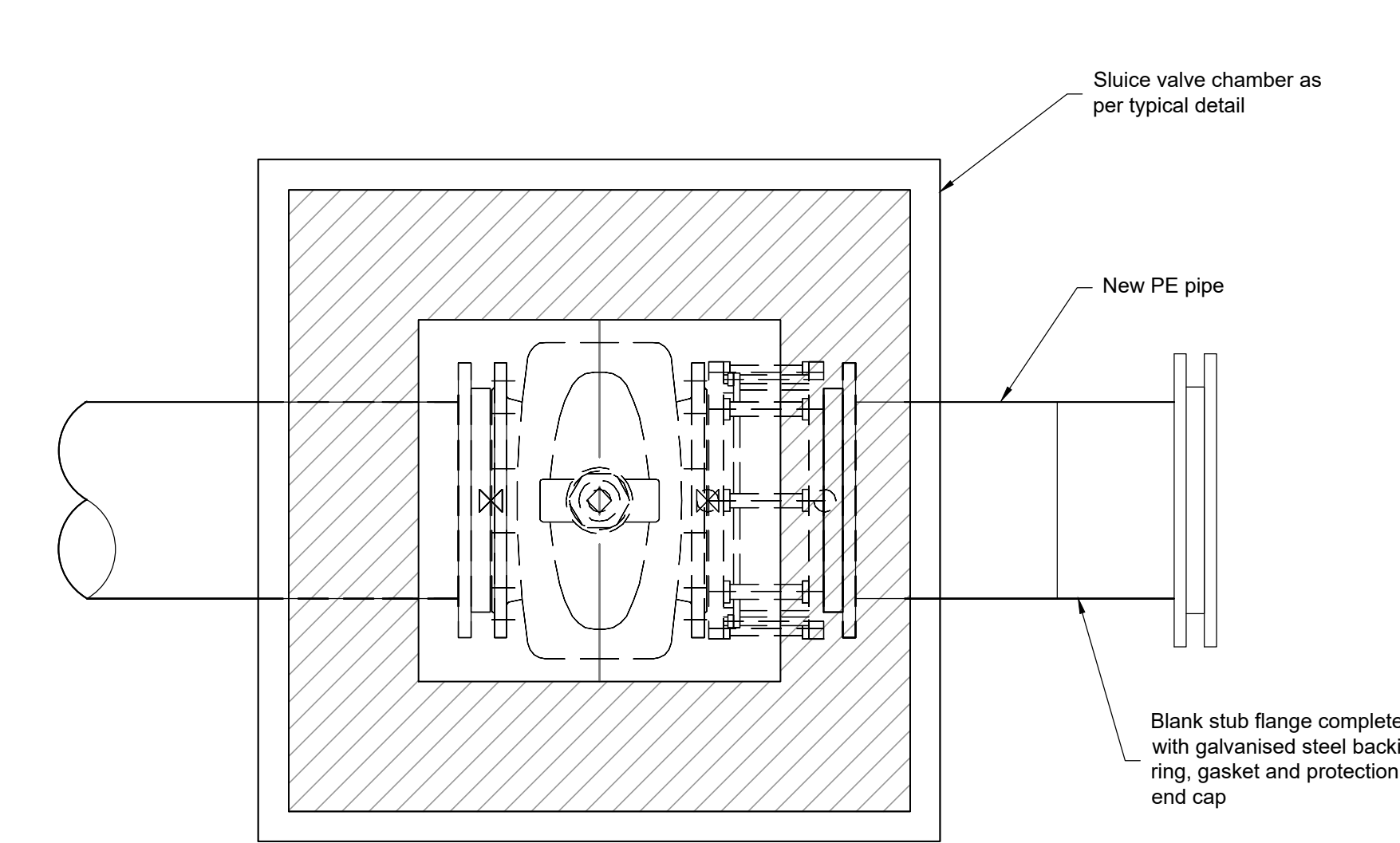
Hydrant Plate Detail
Scale 1:10



Sluice Valve Floor Plan
Scale 1:10



Sluice Valve Section
Scale 1:10



Battery Limit Sluice Valve with Blank Stub Flange
Scale 1:10

C01	03/10/25	DB	AS	GS
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Issued for Information (Status S2)				
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Project Title
Cleaves Riverside Quarter
Masterplan

Drawing Title
Proposed Details
Sheet 4

Scale at A1	1:10
Role	Civil Drainage
Suitability	A2 - Issued for Planning
Arup Job No	277975-00
Name	CRQMP-ARUP-XX-00-DR-CE-4404
Rev	C01

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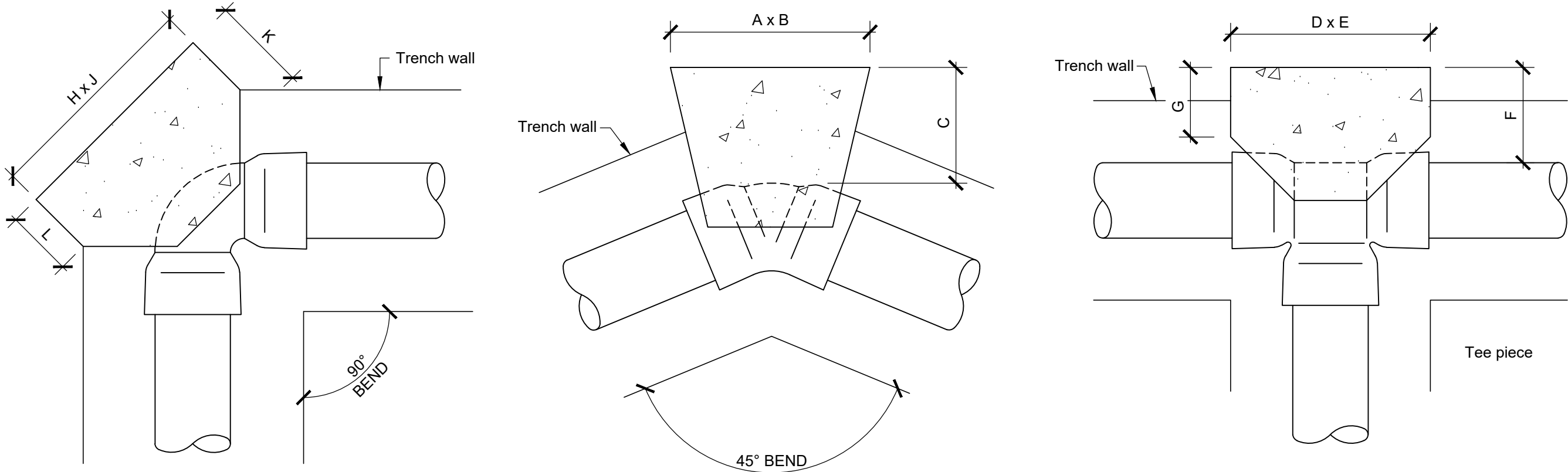
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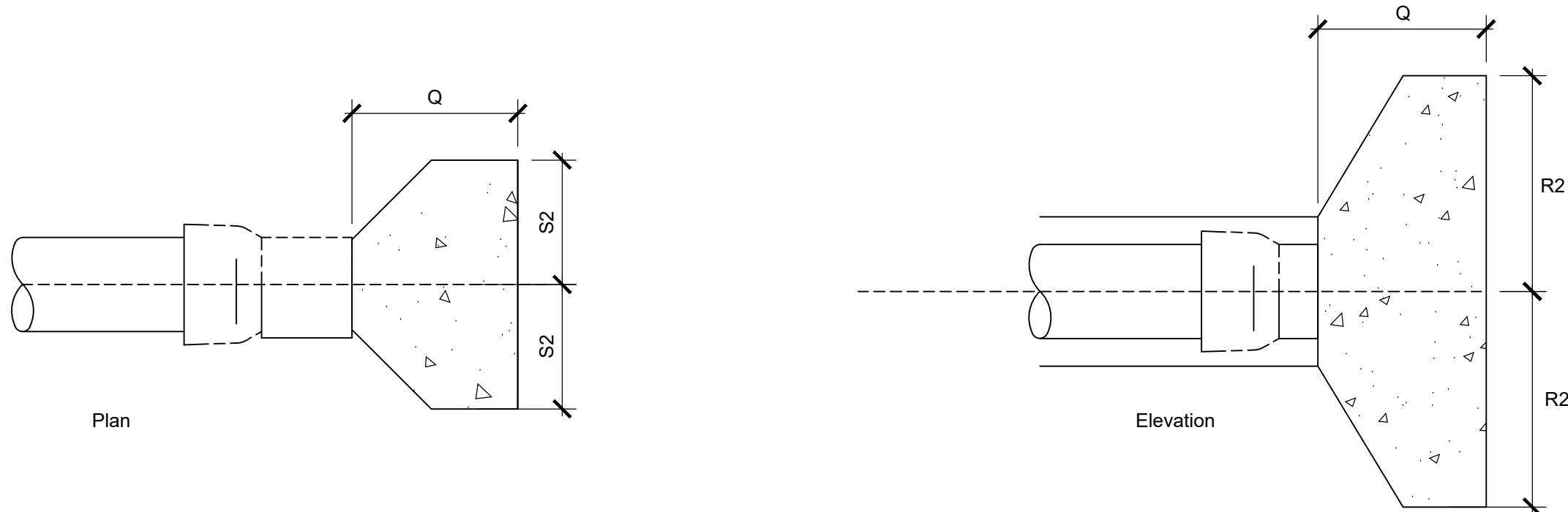
11

Note:
Thrust blocks are designed for an average ground bearing pressure of 100kn/m² (typical for soft clay). For other ground conditions actual dimensions may be altered on instructions from the Employer's Representative.

Pipe Dia.	45° Bend		Tee piece			90° Bend		
12.5 Bar pressure	A x B	C	D x E	F	G	H x J	K	L
100	330x350	200	390x350	200	50 Min.	600x350	200	50 Min.
150	510x450	225	660x450	225	50 Min.	950x450	225	50 Min.
200	600x650	225	790x650	300	50 Min.	1150x650	300	50 Min.

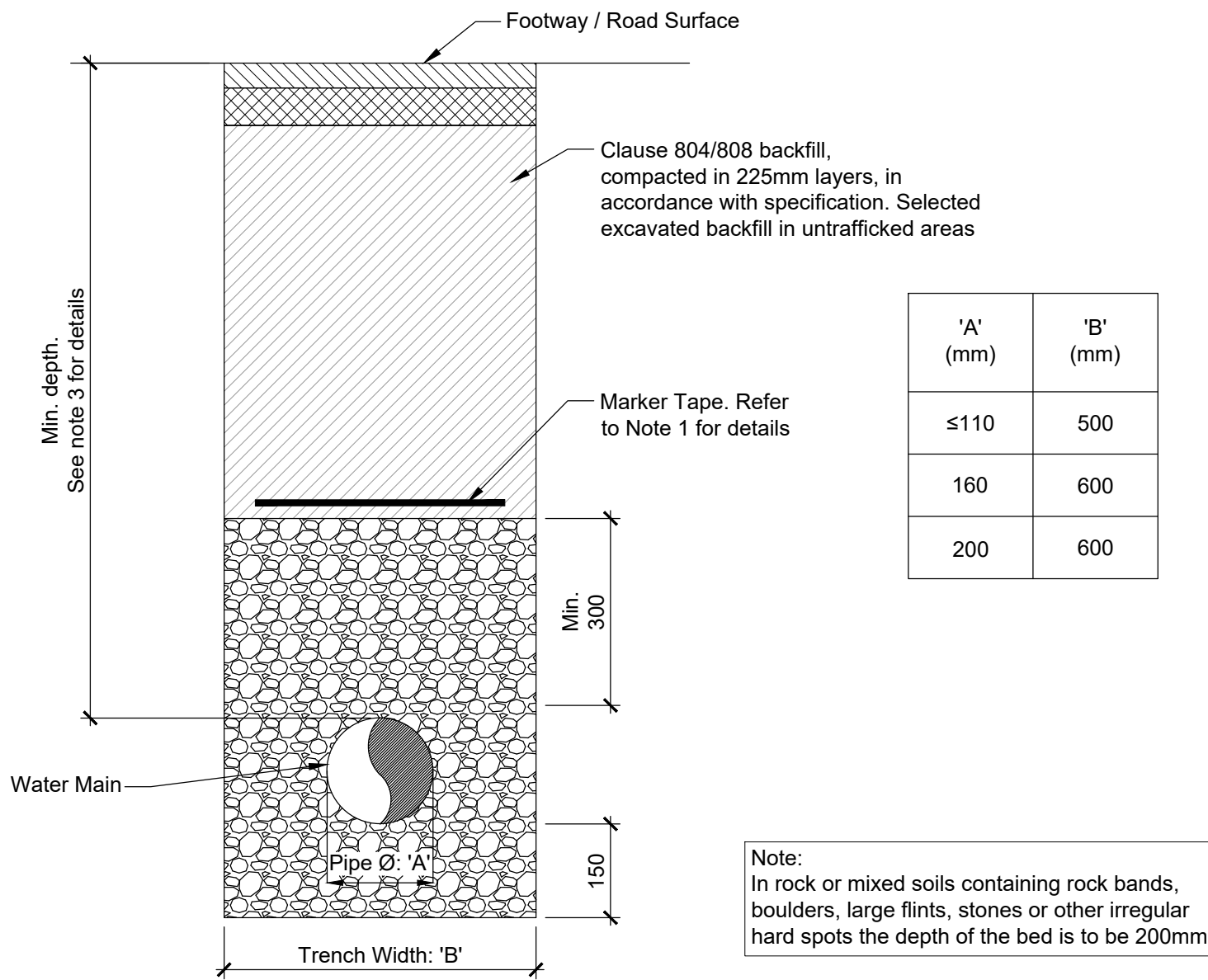


Nom. Dia. (mm)	Dimensions									
	M	N	O	P	Q	R	S	T	U	V
110	600	330	160	80	200	350	390	700	600	400
160	950	510	260	130	225	450	660	900	750	600
200	1150	600	310	160	300	650	790	1050	900	700



Thrust Block Details

Scale: 1:10



Watermain & White Water Main Trench Detail

Scale 1:10

C01	03/10/25	DB	AS	GS
Issued for Planning (Status A2)				
P01	02/07/25	DB	AS	GS
Issued for Information (Status S2)				
Rev	Date	By	Chkd	Appd

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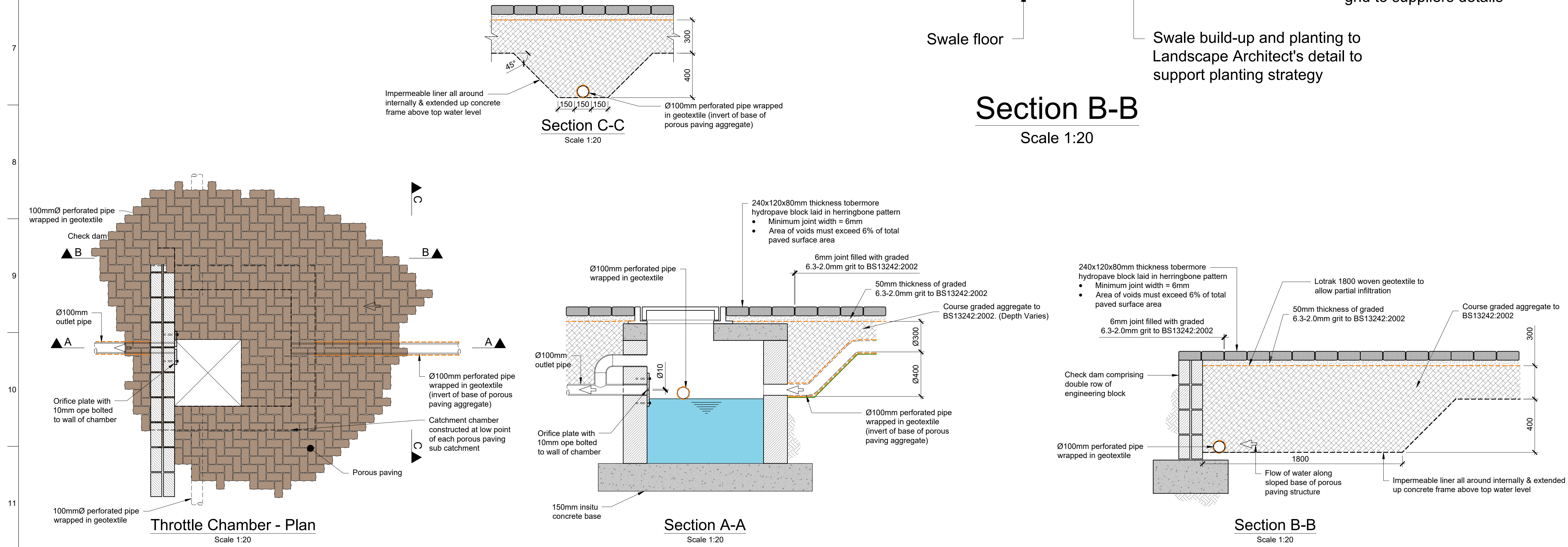
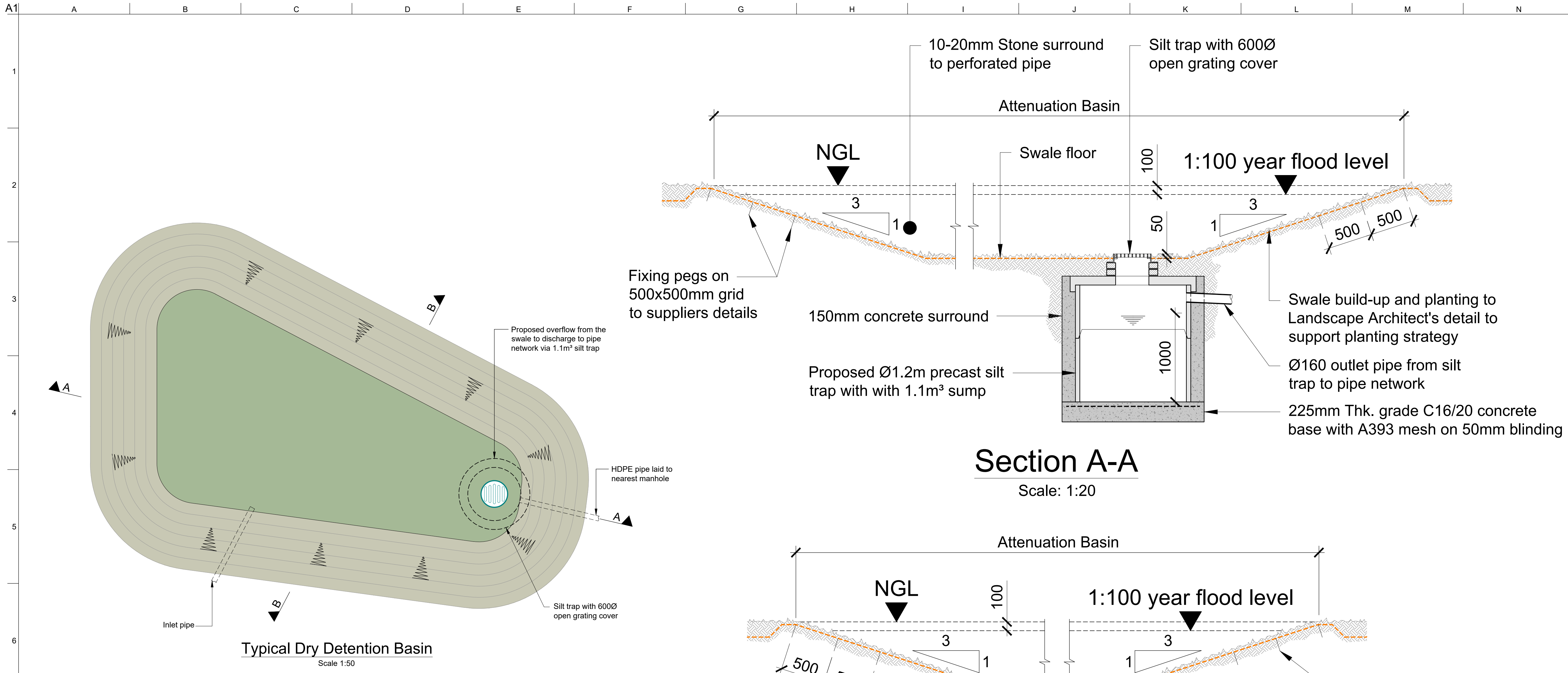
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Client
Limerick Twenty Thirty

Project Title
Cleevs Riverside Quarter
Masterplan

Drawing Title
Proposed Details
Sheet 5

Scale at A1	1:10
Role	Civil Drainage
Suitability	A2 - Issued for Planning
Arup Job No	277975-00
Name	CRQMP-ARUP-XX-00-DR-CE-4405
Rev	C01



C01	03/10/25	DB	AS	GS
Issued for Planning (Status A2)				
P01	04/07/25	DB	AS	GS
Issued for Information (Status S2)				
Rev	Date	By	Chkd	Appd

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Client
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Project Title
Cleeves Riverside Quarter Masterplan

Drawing Title
SuDS Elements Proposed Details

Scale at A1
As Shown

Role
Civil Drainage

Suitability
A2 - Issued for Planning

Arup Job No
277975-00

Name
CRQMP-ARUP-XX-00-DR-CE-4406

Rev
C01

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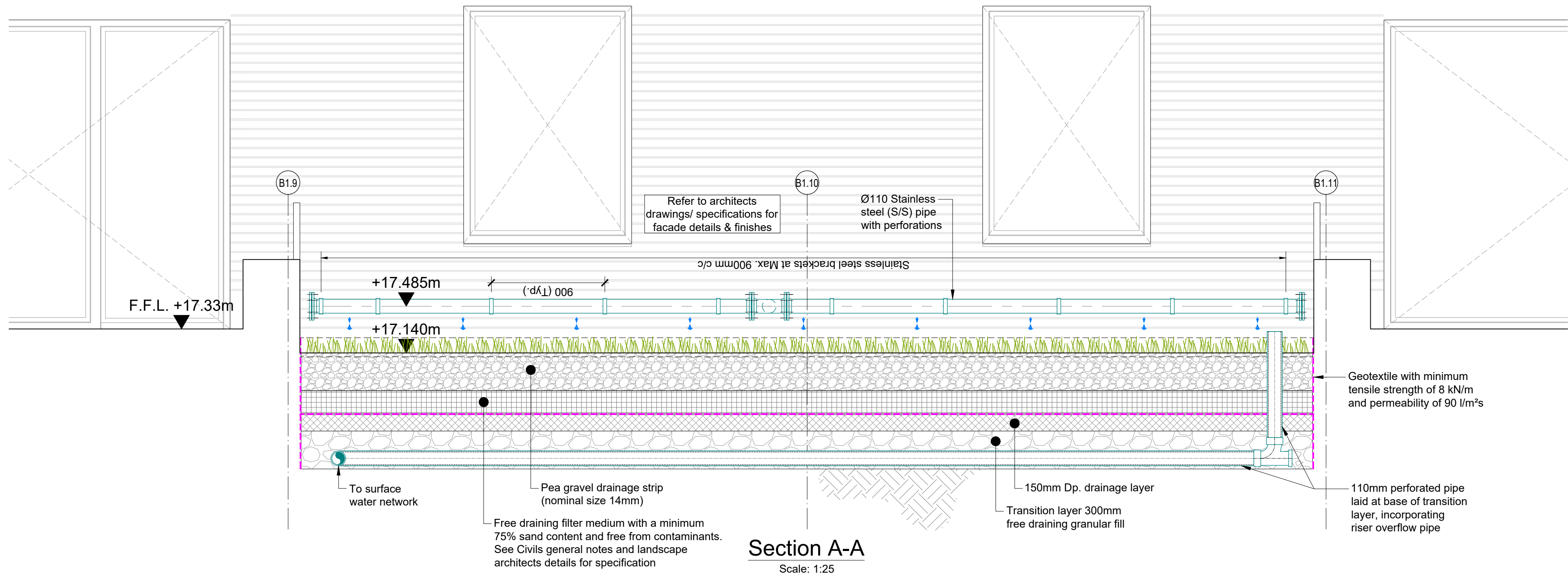
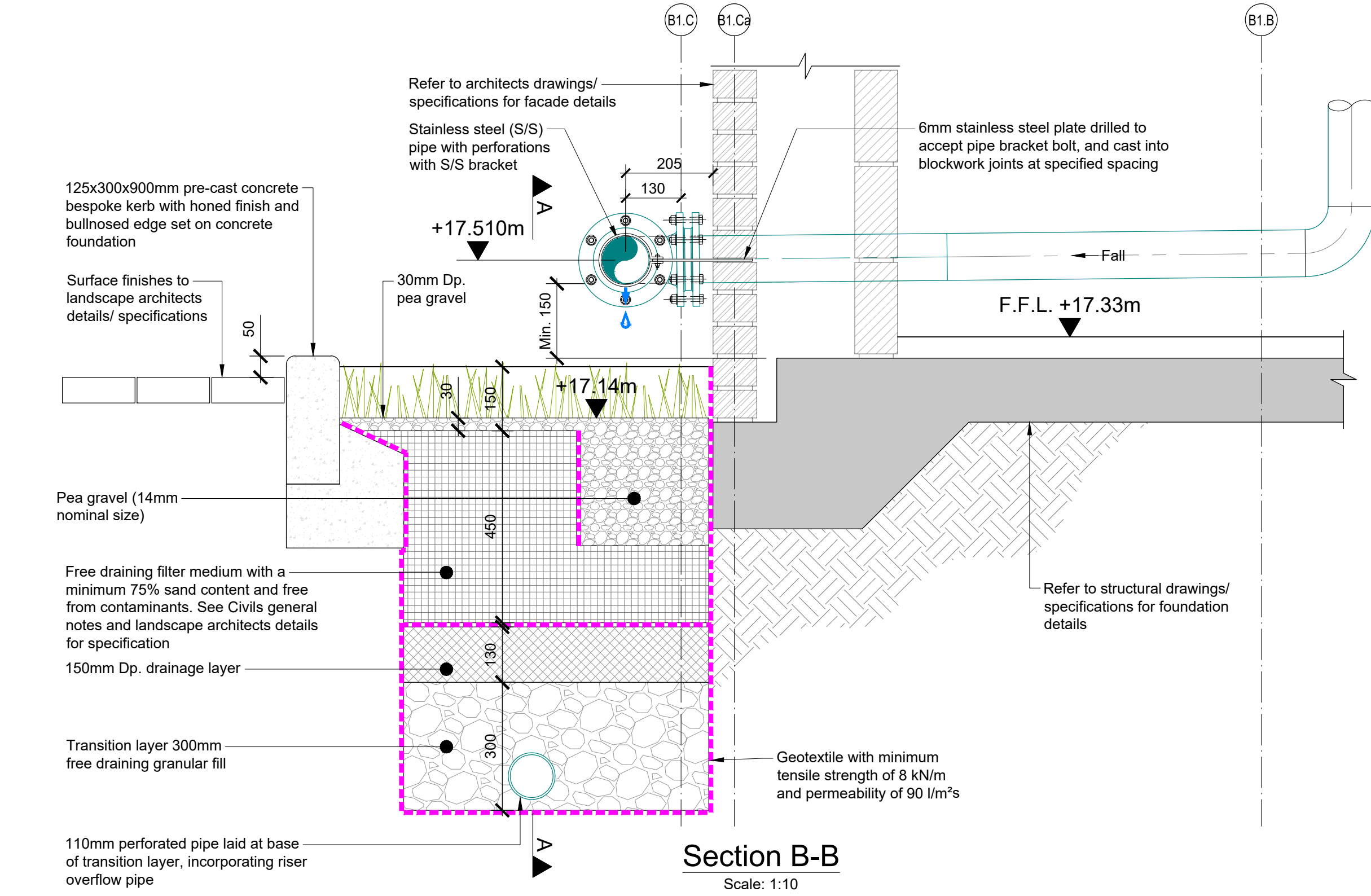
8

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Do not scale



C01	03/10/25	DB	AS	GS
Issued for Planning (Status A2)				
P01	04/07/25	DB	AS	GS
Issued for Information (Status S2)				
Rev	Date	By	Chkd	Appd

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Project Title
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Masterplan

Drawing Title
SuDS Elements
Proposed Details

Scale at A1
As Shown

Role
Civil Drainage

Suitability
A2 - Issued for Planning

Arup Job No 277975-00	Rev C01
Name CRQMP-ARUP-XX-00-DR-CE-4407	

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Appendix B

B.1 Critical Storm Calculation

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 156985, Northing: 157075,

DURATION	Interval		Years										
	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	120,
5 mins	2.8,	3.9,	4.6,	5.5,	6.2,	6.7,	8.4,	10.3,	11.6,	13.4,	15.0,	16.2,	17.0,
10 mins	3.9,	5.5,	6.4,	7.7,	8.6,	9.3,	11.7,	14.3,	16.1,	18.6,	20.8,	22.6,	23.8,
15 mins	4.5,	6.5,	7.5,	9.1,	10.2,	11.0,	13.7,	16.9,	19.0,	21.9,	24.5,	26.6,	27.9,
30 mins	5.9,	8.2,	9.4,	11.3,	12.5,	13.5,	16.7,	20.2,	22.6,	25.9,	28.8,	31.0,	32.5,
1 hours	7.6,	10.4,	11.9,	14.0,	15.5,	16.6,	20.2,	24.3,	26.9,	30.6,	33.8,	36.3,	37.9,
2 hours	9.8,	13.2,	14.9,	17.5,	19.1,	20.4,	24.6,	29.1,	32.0,	36.1,	39.6,	42.4,	44.2,
3 hours	11.4,	15.1,	17.1,	19.8,	21.7,	23.1,	27.5,	32.4,	35.5,	39.8,	43.5,	46.4,	48.3,
4 hours	12.7,	16.7,	18.8,	21.7,	23.6,	25.1,	29.8,	34.9,	38.2,	42.7,	46.5,	49.5,	51.4,
6 hours	14.8,	19.2,	21.4,	24.7,	26.8,	28.4,	33.4,	38.8,	42.3,	47.0,	51.1,	54.2,	56.2,
9 hours	17.2,	22.1,	24.5,	28.0,	30.3,	32.0,	37.4,	43.2,	46.9,	51.8,	56.1,	59.4,	61.5,
12 hours	19.2,	24.4,	26.9,	30.7,	33.0,	34.9,	40.5,	46.6,	50.4,	55.5,	60.0,	63.3,	65.5,
18 hours	22.3,	28.0,	30.8,	34.8,	37.4,	39.3,	45.4,	51.8,	55.8,	61.2,	65.9,	69.3,	71.6,
24 hours	24.8,	30.9,	33.9,	38.1,	40.8,	42.9,	49.2,	55.9,	60.0,	65.6,	70.4,	74.0,	76.3,
2 days	31.8,	38.8,	42.2,	47.0,	50.1,	52.3,	59.4,	66.7,	71.2,	77.2,	82.3,	86.1,	88.6,
3 days	37.9,	45.7,	49.5,	54.8,	58.2,	60.7,	68.3,	76.2,	81.1,	87.5,	93.0,	97.0,	99.7,
4 days	43.5,	52.1,	56.2,	61.9,	65.6,	68.3,	76.5,	84.9,	90.1,	97.0,	102.8,	107.1,	109.9,
6 days	53.8,	63.7,	68.5,	75.0,	79.1,	82.2,	91.5,	100.9,	106.7,	114.3,	120.7,	125.4,	128.5,
8 days	63.5,	74.6,	79.9,	87.1,	91.7,	95.0,	105.2,	115.6,	121.9,	130.2,	137.1,	142.2,	145.5,
10 days	72.7,	84.9,	90.7,	98.6,	103.6,	107.2,	118.3,	129.4,	136.2,	145.1,	152.5,	158.0,	161.5,
12 days	81.6,	94.9,	101.1,	109.7,	115.0,	118.9,	130.7,	142.7,	149.9,	159.4,	167.2,	173.0,	176.8,
16 days	99.0,	114.1,	121.2,	130.9,	136.9,	141.3,	154.6,	167.9,	176.0,	186.5,	195.2,	201.6,	205.7,
20 days	115.8,	132.7,	140.6,	151.3,	157.9,	162.8,	177.4,	192.0,	200.8,	212.3,	221.8,	228.7,	233.2,
25 days	136.4,	155.4,	164.2,	176.1,	183.5,	188.9,	205.0,	221.1,	230.8,	243.4,	253.7,	261.3,	266.2,

Add 30% CC = 70.46
Add 10% Urban Creep =
77.53mm - Critical Rainfall Depth

NOTES:

These values are derived from a Depth Duration Frequency (DDF) Model update 2023

For details refer to:

'Mateus C., and Coonan, B. 2023. Estimation of point rainfall frequencies in Ireland. Technical Note No. 68. Met Eireann',

Available for download at:

<http://hdl.handle.net/2262/102417>

B.2 Zone 1 & 2 Delineated



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Status	A2 - Issued for Planning		
Job Title	Cleaves Riverside Quarter Masterplan		
Drawing Title	Zone 1 and 2 Deliniation		
Scales	N/A	File Ref.	
Dwn	JL	Date	03/09/2025
		Chk'd	AS
Job No.	277975-00	Sketch No.	
		Rev.	4

Legend:

Zone 1 Catchments

Zone 2 Catchments

Red Line Boundary

B.3 Zone 1 SuDS Catchments



Legend:

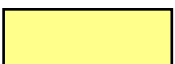
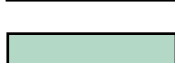
- Hard Standing Concrete
- Gravel
- Porous Parking Trafficked
- Hard Standing Roof
- Green Space
- Roads Hard Trafficked
- Rain Garden
- Permeable Paving
- Temporary Green Space
- Tree Pit
- Grassed Area
- Green Roof
- Raised Planter
- Safety Surface
- Red Line Boundary
- Site Catchment Boundary

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Status	A2 - Issued for Planning		
Job Title	Cleaves Riverside Quarter Masterplan		
Drawing Title	Catchments on Shipyard, The Flaxmill Plaza & O'Callaghan Strand		
Scales	N/A	File Ref.	
Drm	JL	Date	03/09/2025 Chk'd AS
Job No.	277975-00	Sketch No.	Rev. 4



Legend:

- | | |
|---|---------------------------|
|  | Hard Standing Concrete |
|  | Gravel |
|  | Porous Parking Trafficked |
|  | Hard Standing Roof |
|  | Green Space |
|  | Roads Hard Trafficked |
|  | Rain Garden |
|  | Permeable Paving |
|  | Temporary Green Space |
|  | Tree Pit |
|  | Grassed Area |
|  | Green Roof |
|  | Raised Planter |
|  | Safety Surface |
|  | Red Line Boundary |
|  | Site Catchment Boundary |

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Status	A2 - Issued for Planning
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Job Title	Cleeves Riverside Quarter Masterplan
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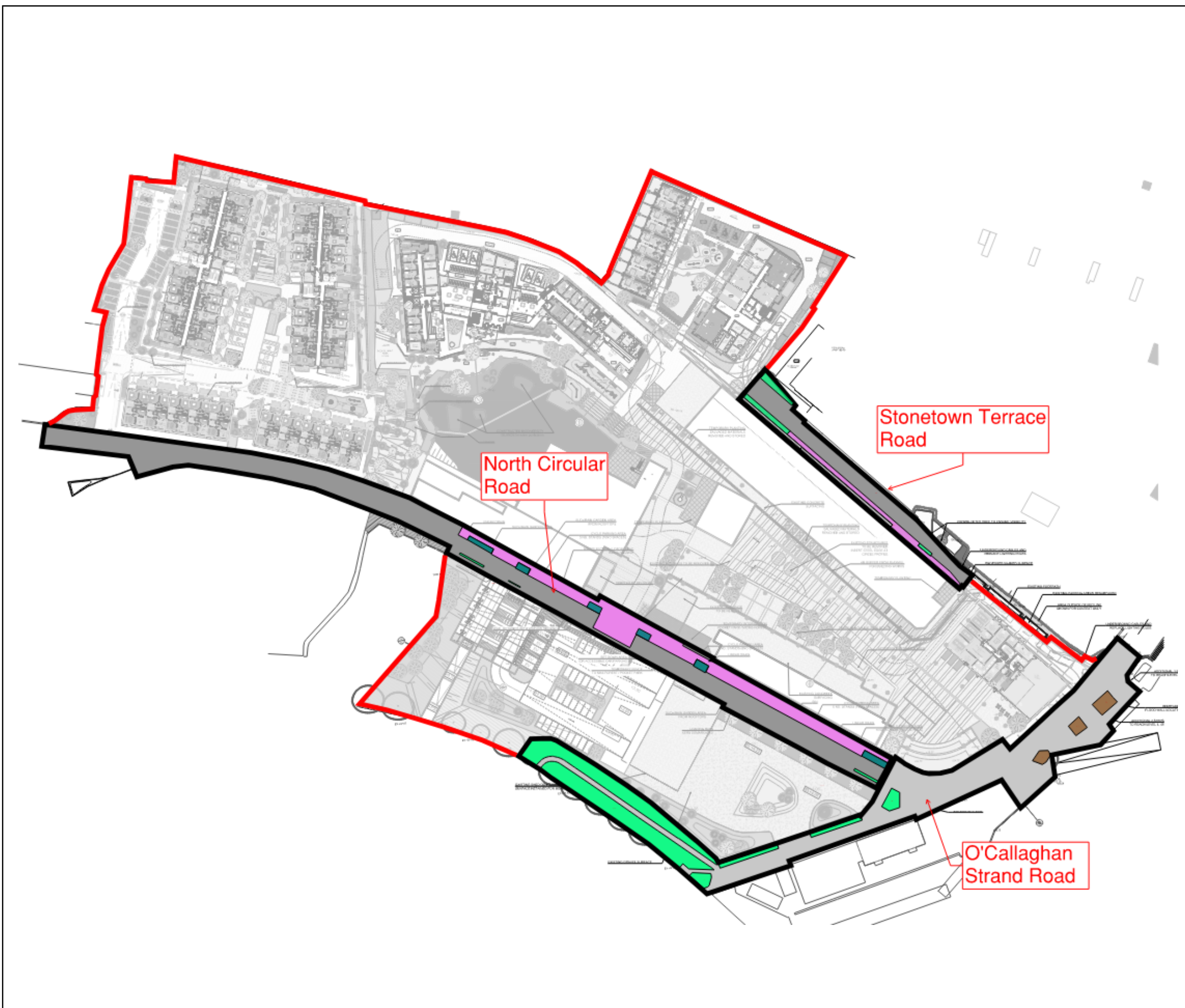
Drawing Title	Catchments on Stonetown Terrace & PBSA
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Scales	N/A	File Ref.
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Drn JL Date 03/09/2025 Chk'd AS

Job No. 277975-00	Sketch No.	Rev. 4
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B.4 Zone 2 SuDS Catchments



- Legend:**
- Hard Standing Concrete
 - Hard Standing Roof
 - Roads Hard Trafficked
 - Gravel
 - Green Space
 - Temporary Green Space
 - Grassed Area
 - Safety Surface
 - Rain Garden
 - Permeable Paving
 - Tree Pit
 - Green Roof
 - Raised Planter
 - Porous Parking Trafficked
 - Swale
 - Red Line Boundary
 - Site Catchment Boundary

ARUP

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Status	A2 - Issued for Planning		
Job Title	Cleeves Riverside Quarter Masterplan		
Drawing Title	Catchments on O'Callaghan Strand, Stonetown & North Circular Roads		
Scales	N/A	File Ref.	
Drm	JL	Date	03/09/2025 Chk'd AS
Job No.	277975-00	Sketch No.	Rev. 4

B.5 Qbar Calculation

CALCULATION SHEET		Ref No.	1
Project	Cleeves Riverside Quarter	Sheet No.	1 of 1
Element	Greenfield runoff estimation and attenuation tank sizing	Designer.	AS
		Date	19/08/2025

Designed in accordance with the Greater Dublin Strategic Drainage Study (GSDSDS)

Runoff Estimation

$Q_{bar} = 0.00108 * (AREA)^{0.89} * (SAAR)^{1.17} * (SOIL)^{2.17}$
 SAAR = 720 Taken from Met Eireann records
 SOIL = 0.3 Soil type 2 Taken from the winter rain acceptance potential map
 take 0.3

AREA $1km^2 = 100 \text{ ha}$
 $1 \text{ ha} = 10,000m^2$

*Note: Q_{bar} formula only suitable for sites greater than / equal to 50 hectares

Total Site Area	5.099	Hectares
Take	50	Hectares
	0.50	km ²
*Qbar	0.094	(m ³ /s)

** Note min allowable runoff per site is 2 l/s/ha

Area	Area	Calc. Allowable	Calc. Allowable	Calc. Allowable	**Actual	Actual
Reference		Runoff	Runoff	Runoff	Allowable runoff	Allowable runoff
	(ha)	(m ³ /s)	(l/s)	(l/s/ha)	(l/s/ha)	(l/s)
Site	5.10	0.00960	9.604	1.884	2.000	10.198

T	Multiplier	Flow
1	0.85	1.700
2	0.92	1.840
10	1.67	3.340
20	1.96	3.920
30	2.10	4.200
50	2.33	4.660
100	2.60	5.200

	Flow	Storage	Cumulative Storage
1 Yr Throttle	1.700	-1	-1
30 - 1Yr Throttle	2.220	532	531
100 - 30 Yr Throttle	1.280	3613	4144

****Note Multiplier taken from GSDSDS Appendix C

```

graph LR
    A([Development site]) --- B[ ]
    B --- C[1 Year throttle]
    B --- D[30 - 1Year Throttle]
    B --- E[100 - 30]
    style B width:0px,height:0px
    
```


CALCULATION SHEET		Ref No.	1
Project	Cleeves Riverside Quarter	Sheet No.	1 of 1
Element	Greenfield runoff estimation and attenuation tank sizing	Designer.	AS
		Date	19/08/2025

Designed in accordance with the Greater Dublin Strategic Drainage Study (GDSDS)

Runoff Estimation

$Q_{bar} = 0.00108 * (AREA)^{0.89} * (SAAR)^{1.17} * (SOIL)^{2.17}$
 SAAR = 720 Taken from Met Eireann records
 SOIL = 0.3 Soil type 2 Taken from the winter rain acceptance potential map
 take 0.3

AREA $1km^2 = 100 \text{ ha}$
 $1 \text{ ha} = 10,000m^2$

*Note: Q_{bar} formula only suitable for sites greater than / equal to 50 hectares

Total Site Area	4.438	Hectares
Take	50	Hectares
	0.50	km ²
*Qbar	0.094	(m ³ /s)

** Note min allowable runoff per site is 2 l/s/ha

Area	Area	Calc. Allowable	Calc. Allowable	Calc. Allowable	**Actual	Actual
Reference		Runoff	Runoff	Runoff	Allowable runoff	Allowable runoff
	(ha)	(m ³ /s)	(l/s)	(l/s/ha)	(l/s/ha)	(l/s)
Site	4.44	0.00836	8.359	1.884	2.000	8.876

T	Multiplier	Flow
1	0.85	1.700
2	0.92	1.840
10	1.67	3.340
20	1.96	3.920
30	2.10	4.200
50	2.33	4.660
100	2.60	5.200

	Flow	Storage	Cumulative Storage
1 Yr Throttle	1.700	-1	-1
30 - 1Yr Throttle	2.220	466	465
100 - 30 Yr Throttle	1.280	3679	4144

****Note Multiplier taken from GDSDS Appendix C

```

graph LR
    A([Development site]) --- B[ ]
    B --- C[1 Year throttle]
    B --- D[30 - 1Year Throttle]
    B --- E[100 - 30]
    style B width:0px,height:0px
    
```


CALCULATION SHEET		Ref No.	1
Project	Cleeves Riverside Quarter	Sheet No.	1 of 1
Element	Greenfield runoff estimation and attenuation tank sizing	Designer.	AS
		Date	19/08/2025

Designed in accordance with the Greater Dublin Strategic Drainage Study (GSDSDS)

Runoff Estimation

$Q_{bar} = 0.00108 * (AREA)^{0.89} * (SAAR)^{1.17} * (SOIL)^{2.17}$

SAAR = 720 Taken from Met Eireann records

SOIL = 0.3 Soil type 2 Taken from the winter rain acceptance potential map

take 0.3

AREA $1km^2 = 100 \text{ ha}$
 $1 \text{ ha} = 10,000m^2$

*Note: Q_{bar} formula only suitable for sites greater than / equal to 50 hectares

Total Site Area	0.732	Hectares
Take	50	Hectares
	0.50	km ²
*Qbar	0.094	(m ³ /s)

** Note min allowable runoff per site is 2 l/s/ha

Area	Area	Calc. Allowable	Calc. Allowable	Calc. Allowable	**Actual	Actual
Reference		Runoff	Runoff	Runoff	Allowable runoff	Allowable runoff
	(ha)	(m ³ /s)	(l/s)	(l/s/ha)	(l/s/ha)	(l/s)
Site	0.73	0.00138	1.379	1.884	2.000	1.464

T	Multiplier	Flow
1	0.85	1.700
2	0.92	1.840
10	1.67	3.340
20	1.96	3.920
30	2.10	4.200
50	2.33	4.660
100	2.60	5.200

	Flow	Storage	Cumulative Storage
1 Yr Throttle	1.700	2	2
30 - 1Yr Throttle	2.220	90	92
100 - 30 Yr Throttle	1.280	4052	4144

****Note Multiplier taken from GSDSDS Appendix C

```

graph LR
    A([Development site]) --- B[ ]
    B --- C[1 Year throttle]
    B --- D[30 - 1Year Throttle]
    B --- E[100 - 30]
    style B width:0px,height:0px
    
```


B.6 Zone 1 runoff volumes and destinations

Cleeves Catchment SuDS volumes

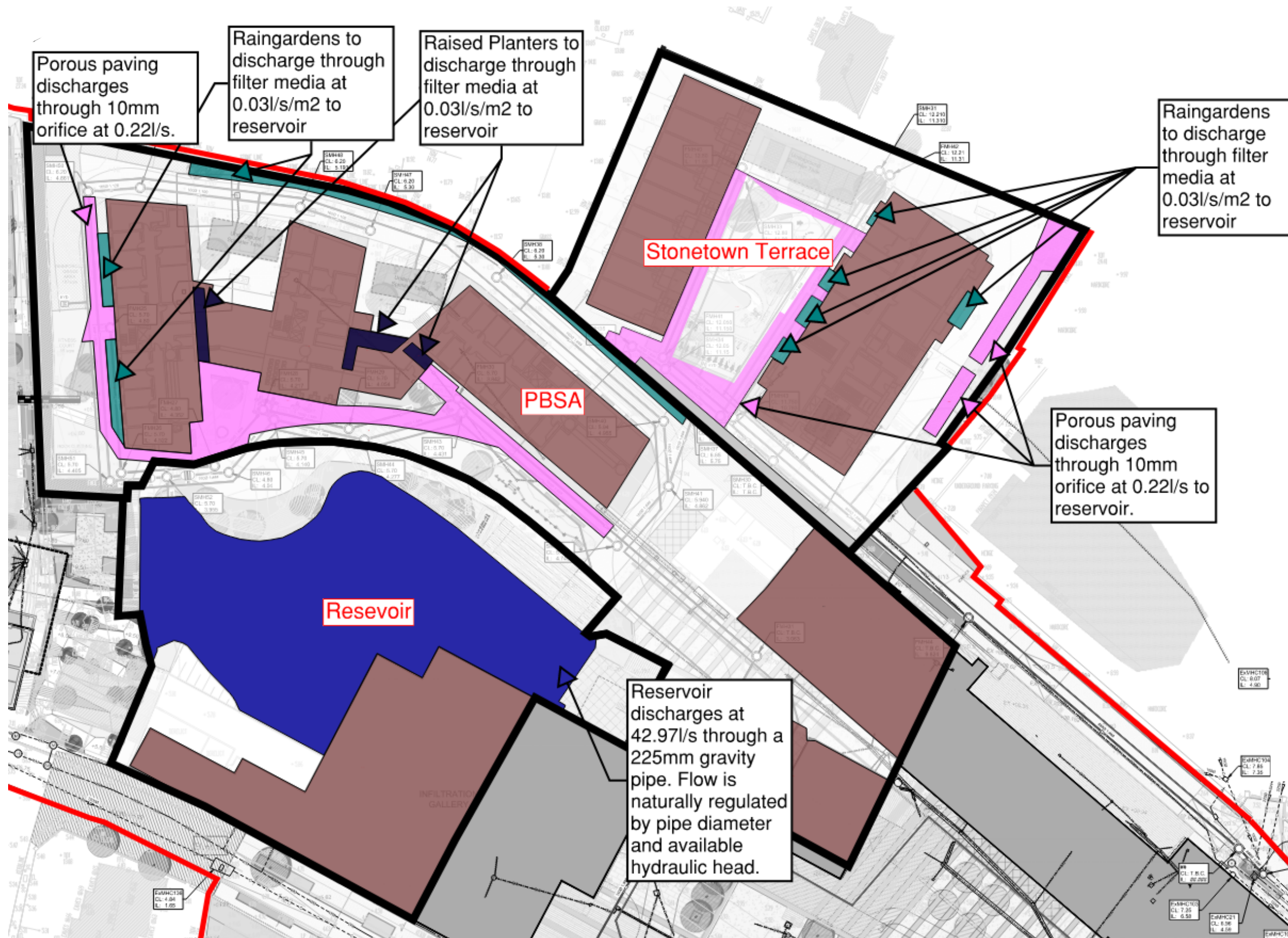
Site	Catchment	Zone	Details	Rainfall depth	Area	Destination	Rainfall volume	Runoff factor	Runoff volume	Discharge Rate	Controlled Discharge Rate after SuDS	Runoff destination (m3)								
				mm	m2	Zone Name	m3	C Coeff	m3	l/s	l/s	Attenuated on-site	Raingarden/Planters /Raised Garden /Tree Pits	Swale	Porous Paving	Reservoir	Existing Network			
Salesians	Catchment 1: Surface Network	GS43	Green space	77.53	103.5	Reservoir	8.0	0.2	1.6	0.4	0.4	6.4					1.6	0.0		
		GS44	Green space	77.53	3.5	Reservoir	0.3	0.2	0.1	0.0	0.0	0.2					0.1	0.0		
		GS46	Green space	77.53	147.9	Reservoir	11.5	0.2	2.3	0.6	0.6	9.2					2.3	0.0		
		GS47	Green space	77.53	46.2	Reservoir	3.6	0.2	0.7	0.2	0.2	2.9					0.7	0.0		
		GS48	Green space	77.53	7.5	Reservoir	0.6	0.2	0.1	0.0	0.0	0.5					0.1	0.0		
		GS49	Green space	77.53	23.7	Reservoir	1.8	0.2	0.4	0.1	0.1	1.5					0.4	0.0		
		GS50	Green space	77.53	9.6	Reservoir	0.7	0.2	0.1	0.0	0.0	0.6					0.1	0.0		
		GS51	Green space	77.53	7.3	Reservoir	0.6	0.2	0.1	0.0	0.0	0.5					0.1	0.0		
		GS52	Green space	77.53	7.3	Reservoir	0.6	0.2	0.1	0.0	0.0	0.4					0.1	0.0		
		GS53	Green space	77.53	7.3	Reservoir	0.6	0.2	0.1	0.0	0.0	0.5					0.1	0.0		
		GS54	Green space	77.53	7.4	Reservoir	0.6	0.2	0.1	0.0	0.0	0.5					0.1	0.0		
		GS90	Green space	77.53	14.9	Reservoir	1.2	0.2	0.2	0.1	0.1	0.9					0.2	0.0		
		GS91	Green space	77.53	10.5	Reservoir	0.8	0.2	0.2	0.0	0.0	0.7					0.2	0.0		
		GS92	Green space	77.53	14.9	Reservoir	1.2	0.2	0.2	0.1	0.1	0.9					0.2	0.0		
		RG26	Rain garden	77.53	10.6	RG26	0.8	0.7	0.6	0.2	0.3	0.2	0.6						0.0	
		RG27	Rain garden	77.53	10.8	RG27	0.8	0.7	0.6	0.2	0.3	0.3	0.6						0.0	
		RG28	Rain garden	77.53	10.6	RG28	0.8	0.7	0.6	0.2	0.3	0.2	0.6						0.0	
		RG34	Rain garden	77.53	10.4	RG27	0.8	0.7	0.6	0.2	0.3	0.2	0.6						0.0	
		RG35	Rain garden	77.53	9.5	RG28	0.7	0.7	0.5	0.1	0.3	0.2	0.5						0.0	
		RG29	Rain garden	77.53	53.6	RG29	4.2	0.7	2.9	0.8	1.6	1.2	2.9						0.0	
		G3	Gravel	77.53	63.3	Reservoir	4.9	0.8	3.9	1.1	1.1	1.0						3.9	0.0	
		G4	Gravel	77.53	140.9	Reservoir	10.9	0.8	8.7	2.4	2.4	2.2						8.7	0.0	
		G6	Gravel	77.53	97.3	Reservoir	7.5	0.8	6.0	1.7	1.7	1.5						6.0	0.0	
		G7	Gravel	77.53	10.2	Reservoir	0.8	0.8	0.6	0.2	0.2	0.2						0.6	0.0	
		H8.1	Hard	77.53	619.6	RG29	48.0	1	48.0	13.4	N/A	0.0	48.0						0.0	
		H8.2	Hard	77.53	170.9	Reservoir	13.3	1	13.3	3.7	3.7	0.0						13.3	0.0	
		GR5	Green Roof	77.53	339.5	Reservoir	26.3	0.6	15.8	4.4	4.4	10.5							15.8	0.0
		SS4	Safety Surfacing	77.53	83.9	Reservoir	6.5	0.7	4.6	1.3	1.3	2.0							4.6	0.0
		CHS7	Concrete Hard Standing	77.53	607.9	Reservoir	47.1	1	47.1	13.1	13.1	0.0							47.1	0.0
		Total for Catchment 1 Salesians					2650.0		205.5		160.2	44.5	32.8	45.3	53.8	0.0	0.0		106.4	0.0
		Catchment 2: Underground Network - N	H9	Hard	77.53	1032.5	RG29/RG30	80.1	1	80.1	22.3	N/A	0.0		80.1					0.0
			GR6	Green Roof	77.53	90.6	Reservoir	7.0	0.6	4.2	1.2	1.2	2.8						4.2	0.0
			RG29	Rain garden	77.53	69.0	RG29	5.3	0.7	3.7	1.0	2.1	1.6		3.7					0.0
			RG30	Rain garden	77.53	59.5	RG30	4.6	0.7	3.2	0.9	1.8	1.4		3.2					0.0
			RG31	Rain garden	77.53	10.6	RG31	0.8	0.7	0.6	0.2	0.3	0.2		0.6					0.0
			RG32	Rain garden	77.53	10.5	RG32	0.8	0.7	0.6	0.2	0.3	0.2		0.6					0.0
			RG33	Rain garden	77.53	10.0	RG33	0.8	0.7	0.5	0.2	0.3	0.2		0.5					0.0
			RG36	Rain garden	77.53	10.7	RG34	0.8	0.7	0.6	0.2	0.3	0.2		0.6					0.0
			RG37	Rain garden	77.53	9.4	RG35	0.7	0.7	0.5	0.1	0.3	0.2		0.5					0.0
			GS55	Green space	77.53	68.0	Reservoir	5.3	0.2	1.1	0.3	0.3	4.2						1.1	0.0
	GS57		Green space	77.53	7.8	Reservoir	0.6	0.2	0.1	0.0	0.0	0.5						0.1	0.0	
	GS58		Green space	77.53	7.8	Reservoir	0.6	0.2	0.1	0.0	0.0	0.5						0.1	0.0	
	GS59		Green space	77.53	7.8	Reservoir	0.6	0.2	0.1	0.0	0.0	0.5						0.1	0.0	
	GS60		Green space	77.53	7.8	Reservoir	0.6	0.2	0.1	0.0	0.0	0.5						0.1	0.0	
	GS61		Green space	77.53	7.8	Reservoir	0.6	0.2	0.1	0.0	0.0	0.5						0.1	0.0	
	GS62		Green space	77.53	17.8	Reservoir	1.4	0.2	0.3	0.1	0.1	1.1						0.3	0.0	
	GS63		Green space	77.53	52.4	Reservoir	4.1	0.2	0.8	0.2	0.2	3.2						0.8	0.0	
	GS64		Green space	77.53	8.9	Reservoir	0.7	0.2	0.1	0.0	0.0	0.5						0.1	0.0	
	GS65		Green space	77.53	153.1	Reservoir	11.9	0.2	2.4	0.7	0.7	9.5						2.4	0.0	
	GS66		Green space	77.53	12.3	Reservoir	1.0	0.2	0.2	0.1	0.1	0.8						0.2	0.0	
	GS67		Green space	77.53	72.7	Reservoir	5.6	0.2	1.1	0.3	0.3	4.5						1.1	0.0	
	GS68		Green space	77.53	12.4	Reservoir	1.0	0.2	0.2	0.1	0.1	0.8						0.2	0.0	
	GS69		Green space	77.53	5.0	Reservoir	0.4	0.2	0.1	0.0	0.0	0.3						0.1	0.0	
	GS71		Green space	77.53	5.3	Reservoir	0.4	0.2	0.1	0.0	0.0	0.3						0.1	0.0	
	GS72		Green space	77.53	3.3	Reservoir	0.3	0.2	0.1	0.0	0.0	0.2						0.1	0.0	
	GS73		Green space	77.53	12.1	Reservoir	0.9	0.2	0.2	0.1	0.1	0.8						0.2	0.0	
	GS74		Green space	77.53	23.8	Reservoir	1.8	0.2	0.4	0.1	0.1	1.5						0.4	0.0	
	GS75		Green space	77.53	75.9	Reservoir	5.9	0.2	1.2	0.3	0.3	4.7						1.2	0.0	
	GS76		Green space	77.53	14.6	Reservoir	1.1	0.2	0.2	0.1	0.1	0.9						0.2	0.0	
	GS93		Green space	77.53	30.0	Reservoir	2.3	0.2	0.5	0.1	0.1	1.9						0.5	0.0	
	GS94		Green space	77.53	38.7	Reservoir	3.0	0.2	0.6	0.2	0.2	2.4						0.6	0.0	
	GS95		Green space	77.53	8.6	Reservoir	0.7	0.2	0.1	0.0	0.0	0.5						0.1	0.0	
	GS96		Green space	77.53	38.3	Reservoir	3.0	0.2	0.6	0.2	0.2	2.4						0.6	0.0	
	GS97		Green space	77.53	79.9	Reservoir	6.2	0.2	1.2	0.3	0.3	5.0						1.2	0.0	
	GS98		Green space	77.53	14.4	Reservoir	1.1	0.2	0.2	0.1	0.1	0.9						0.2	0.0	
	GS99		Green space	77.53	12.7	Reservoir	1.0	0.2	0.2	0.1	0.1	0.8						0.2	0.0	
	GS100		Green space	77.53	7.4	Reservoir	0.6	0.2	0.1	0.0	0.0	0.5						0.1	0.0	
	GS101		Green space	77.53	3.2	Reservoir	0.3	0.2	0.1	0.0	0.0	0.2						0.1	0.0	
	GS102		Green space	77.53	15.1	Reservoir	1.2	0.2	0.2	0.1	0.1	0.9						0.2	0.0	
	GS103		Green space	77.53	4.1	Reservoir	0.3	0.2	0.1	0.0	0.0	0.3						0.1	0.0	
	GS104		Green space	77.53	3.6	Reservoir	0.3	0.2	0.1	0.0	0.0	0.2						0.1	0.0	
	GS105		Green space	77.53	52.4	Reservoir	4.1	0.2	0.8	0.2	0.2	3.2						0.8	0.0	

Site	Catchment	Zone	Details	Rainfall depth	Area	Destination	Rainfall volume	Runoff factor	Runoff volume	Discharge Rate	Controlled Discharge Rate after SuDS	Runoff destination (m3)							
				mm	m2	Zone Name	m3	C Coeff	m3	l/s	l/s	Attenuated on-site	Raingarden/Planters /Raised Garden /Tree Pits	Swale	Porous Paving	Reservoir	Existing Network		
		GS14	Green space	77.53	25.5	Reservoir	2.0	0.2	0.4	0.1	0.1	1.6				0.4	0.0		
		CHS1	Concrete Hard Standing	77.53	616.5	Reservoir	47.8	1.0	47.8	13.3	13.3	0.0				47.8	0.0		
		Total for Catchment 2				1983.3		153.8		141.8	39.4	39.4	12.0	0.0	0.0	141.8	0.0		
	Total		Total for PBSA - Post Development *Total for PBSA - Pre Development				6895.5		532.0		441.0	123.1	91.0	106.8	0.0	0.0	334.2	0.0	
Stonetown Terrace		GA1	Grassed Area	77.53	255.6	Reservoir	19.8	0.2	4.0	1.1	1.1	15.9				4.0	0.0		
		GA2	Grassed Area	77.53	146.8	Reservoir	11.4	0.2	0.4	0.6	0.6	1.6				0.4	0.0		
		GA3	Grassed Area	77.53	46.0	Reservoir	3.6	0.2	0.1	0.2	0.2	0.5				0.1	0.0		
		GA4	Grassed Area	77.53	96.7	Reservoir	7.5	0.2	0.1	0.4	0.4	0.3				0.1	0.0		
		RG18	Rain garden	77.53	10.6	RG18	0.8	0.7	0.6	0.2	0.3	0.2	0.6					0.0	
		RG19	Rain garden	77.53	6.7	RG19	0.5	0.7	0.4	0.1	0.2	0.2	0.4					0.0	
		RG20	Rain garden	77.53	14.8	RG20	1.1	0.7	0.8	0.2	0.4	0.3	0.8					0.0	
		RG21	Rain garden	77.53	2.3	RG21	0.2	0.7	0.1	0.0	0.1	0.1	0.1					0.0	
		GS18	Green space	77.53	17.6	Reservoir	1.4	0.2	0.3	0.1	0.1	1.1					0.3	0.0	
		GS19	Green space	77.53	38.6	Reservoir	3.0	0.2	0.6	0.2	0.2	2.4					0.6	0.0	
		GS20	Green space	77.53	26.3	Reservoir	2.0	0.2	0.4	0.1	0.1	1.6					0.4	0.0	
		GS21	Green space	77.53	7.8	Reservoir	0.6	0.2	0.1	0.0	0.0	0.5					0.1	0.0	
		GS22	Green space	77.53	4.4	Reservoir	0.3	0.2	0.1	0.0	0.0	0.3					0.1	0.0	
		GS23	Green space	77.53	45.4	Reservoir	3.5	0.2	0.7	0.2	0.2	2.8					0.7	0.0	
		GS24	Green space	77.53	9.4	Reservoir	0.7	0.2	0.1	0.0	0.0	0.6					0.1	0.0	
		GS25	Green space	77.53	4.0	Reservoir	0.3	0.2	0.1	0.0	0.0	0.2					0.1	0.0	
		GS26	Green space	77.53	17.9	Reservoir	1.4	0.2	0.3	0.1	0.1	1.1					0.3	0.0	
		GS27	Green space	77.53	107.4	Reservoir	8.3	0.2	1.7	0.5	0.5	6.7					1.7	0.0	
		GS28.1	Green space	77.53	41.7	Reservoir	3.2	0.2	0.6	0.2	0.2	2.6					0.6	0.0	
		GS29.1	Green space	77.53	21.9	Reservoir	1.7	0.2	0.3	0.1	0.1	1.4					0.3	0.0	
		GS32	Green space	77.53	3.9	Reservoir	0.3	0.2	0.1	0.0	0.0	0.2					0.1	0.0	
		GS70	Green space	77.53	94.3	Reservoir	7.3	0.2	1.5	0.4	0.4	5.9					1.5	0.0	
		G2	Gravel	77.53	64.2	Reservoir	5.0	0.8	4.0	1.1	1.1	1.0					4.0	0.0	
		GR1	Green Roof	77.53	151.9	Reservoir	11.8	0.6	7.1	2.0	2.0	4.7					7.1	0.0	
		GR2	Green Roof	77.53	173.7	Reservoir	13.5	0.6	8.1	2.2	2.2	5.4					8.1	0.0	
		H6	Hard	77.53	549.0	Reservoir	42.6	1	42.6	11.8	11.8	0.0					42.6	0.0	
		H7.1	Hard	77.53	258.0	RG17/RG18/RG19	20.0	1	20.0	5.6	N/A	0.0	20.0		20.0			0.0	0.0
		H7.2	Hard	77.53	25.3	RG17/RG18/RG19	2.0	1	2.0	0.5	N/A	0.0	2.0		2.0			0.0	0.0
		H7.3	Hard	77.53	200.4	RG20	15.5	1	15.5	4.3	N/A	0.0	15.5		15.5			0.0	0.0
		PP4	Porous Paving	77.53	291.5	PP4	22.6	0.6	13.6	3.8	0.2	9.0					13.6		0.0
		PP6	Porous Paving	77.53	30.3	PP6	2.3	0.6	1.4	0.4	0.2	0.9					1.4		0.0
		PP7	Porous Paving	77.53	78.4	PP7	6.1	0.6	3.6	1.0	0.2	2.4					3.6		0.0
		RHT2.1	Roads - Hard Trafficked	77.53	865.8	Reservoir	67.1	1	67.1	18.7	18.7	0.0						67.1	0.0
		CHS4	Concrete Hard Standing	77.53	82.6	Reservoir	6.4	1	6.4	1.8	1.8	0.0						6.4	0.0
	Total		Total for Stonetown Terrace - Post Development *Total for Stonetown Terrace - Pre Development				3791.0		293.9		204.6	58.0	43.5	69.9	39.4	0.0	18.6	146.6	0.0
	Reservoir		GS90	Green space	77.53	10.5	Reservoir	0.8	0.2	0.2	0.0	0.0	0.6					0.2	0.0
			GS91	Green Space	77.53	41.4	Reservoir	3.2	0.2	0.6	0.2	0.2	2.6					0.6	0.0
			GS92	Green Space	77.53	12.9	Reservoir	1.0	0.2	0.2	0.1	0.1	0.8					0.2	0.0
			GS93	Green Space	77.53	32.3	Reservoir	2.5	0.2	0.5	0.1	0.1	2.0					0.5	0.0
			GS94	Green Space	77.53	257.9	Reservoir	20.0	0.2	4.0	1.1	1.1	16.0					4.0	0.0
			TGS21	Temporary Green Space	77.53	132.6	Reservoir	10.3	0.2	2.1	0.6	0.6	8.2					2.1	0.0
			RES1	Reservoir Water Body	77.53	2763.1	Reservoir	214.2	1	214.2	59.6	64.1	0.0					214.2	0.0
H13.2			Hard	77.53	1197.7	Reservoir	92.9	1	92.9	25.8	25.8	0.0					92.9	0.0	
CHS10			Concrete Hard Standing	77.53	344.4	Reservoir	26.7	1	26.7	7.4	7.4	0.0					26.7	0.0	
CHS11			Concrete Hard Standing	77.53	76.3	Reservoir	5.9	1	5.9	1.6	1.6	0.0					5.9	0.0	
CHS12			Concrete Hard Standing	77.53	485.2	Reservoir	37.6	1	37.6	10.5	10.5	0.0					37.6	0.0	
Total				Total for Reservoir - Post Development *Total for Reservoir - Pre Development				5354.2		344.9		314.6	87.5	92.0	30.2	0.0	0.0	314.6	0.0
The Flaxmill Plaza			H3.2	Hard Roof	77.53	1693.9	RG1/RG2	131.3	1	131.3	36.5	N/A	0.0	131.3					0.0
			H4.2	Hard Roof	77.53	435.5	RG1/RG2	33.8	1	33.8	9.4	N/A	0.0	33.8					0.0
			H13.1	Hard	77.53	954.4	Existing Network	74.0	1	74.0	20.6	20.6	0.0					74.0	0.0
			TGS5	Temporary Green space	77.53	5.6	RG1/RG2	0.4	0.2	0.1	0.0	N/A	0.3	0.1					0.0
			TGS6	Temporary Green space	77.53	5.6	RG1/RG2	0.4	0.2	0.1	0.0	N/A	0.3	0.1					0.0
			TGS7	Temporary Green space	77.53	5.6	RG1/RG2	0.4	0.2	0.1	0.0	N/A	0.3	0.1					0.0
			TGS8	Temporary Green space	77.53	5.6	RG1/RG2	0.4	0.2	0.1	0.0	N/A	0.3	0.1					0.0
	TGS9		Temporary Green space	77.53	5.6	RG1/RG2	0.4	0.2	0.1	0.0	N/A	0.3	0.1					0.0	
	TGS10		Temporary Green space	77.53	5.6	RG1/RG2	0.4	0.2	0.1	0.0	N/A	0.3	0.1					0.0	
	TGS11		Temporary Green space	77.53	5.6	RG1/RG2	0.4	0.2	0.1	0.0	N/A	0.3	0.1					0.0	
	TGS12		Temporary Green space	77.53	5.6	RG1/RG2	0.4	0.2	0.1	0.0	N/A	0.3	0.1					0.0	
	RG1		Rain garden	77.53	59.0	RG1	4.6	1	4.6	1.3	1.8	0.0	4.6					0.0	
	RG2		Rain garden	77.53	61.5	RG2	4.8	1	4.8	1.3	1.8	0.0	4.8					0.0	
	CHS2.1		Concrete Hard Standing	77.53	313.2	RG1/RG2	24.3	1.0	24.3	6.8	N/A	0.0	24.3					0.0	
	CHS2.2		Concrete Hard Standing	77.53	1189.5	Existing Network	92.2	1.0	92.2	25.6	25.6	0.0					92.2	0	

B.7 Zone 2 runoff volumes and destinations

Cleaves Peripheral Catchment Volumes																																																																																																											
Site	Catchment	Zone	Details	Rainfall depth	Area	Destination	Rainfall volume	Runoff factor	Runoff volume	Discharge Rate	Controlled Discharge Rate SuDS	Runoff destination (m3)																																																																																															
				mm	m2	Zone Name	m3	C Coeff	m3	l/s	l/s	Attenuated on-site	Raingarden/Planters/Raised Garden /Tree Pits	Porous Paving	Existing Network																																																																																												
ROAD NCR		GS3	Green space	77.53	10.1	RG5/6/9/10/11/13/14	0.8	0.2	0.2	0.0	N/A	0.6	0.2	36.5																																																																																													
		GS4	Green space	77.53	10.5	RG5/6/9/10/11/13/14	0.8	0.2	0.2	0.0	N/A	0.6	0.2																																																																																														
		GS5	Green space	77.53	40.2	RG5/6/9/10/11/13/15	3.1	0.2	0.6	0.2	N/A	2.5	0.6																																																																																														
		GS6	Green space	77.53	3.8	RG5/6/9/10/11/13/16	0.3	0.2	0.1	0.0	N/A	0.2	0.1																																																																																														
		GS7	Green space	77.53	11.6	RG5/6/9/10/11/13/17	0.9	0.2	0.2	0.0	N/A	0.7	0.2																																																																																														
		PP1	Porous Paving	77.53	784.2	PP1	60.8	0.6	36.5	10.1	0.2	24.3																																																																																															
		RG5	Rain Garden	77.53	19.7	RG5	1.5	0.7	1.1	0.3	0.6	0.5	1.1																																																																																														
		RG6	Rain Garden	77.53	11.6	RG6	0.9	0.7	0.6	0.2	0.3	0.3	0.6																																																																																														
		RG7	Rain Garden	77.53	17.3	RG7	1.3	0.7	0.9	0.3	0.5	0.4	0.9																																																																																														
		RG8	Rain Garden	77.53	14.1	RG8	1.1	0.7	0.8	0.2	0.4	0.3	0.8																																																																																														
		RG9	Rain Garden	77.53	13.0	RG9	1.0	0.7	0.7	0.2	0.4	0.3	0.7																																																																																														
		RG10	Rain Garden	77.53	11.4	RG10	0.9	0.7	0.6	0.2	0.3	0.3	0.6																																																																																														
		RG11	Rain Garden	77.53	11.6	RG11	0.9	0.7	0.6	0.2	0.3	0.3	0.6																																																																																														
		RG12	Rain Garden	77.53	24.6	RG12	1.9	0.7	1.3	0.4	0.7	0.6	1.3																																																																																														
		RG13	Rain Garden	77.53	13.7	RG13	1.1	0.7	0.7	0.2	0.4	0.3	0.7																																																																																														
		RG14	Rain Garden	77.53	25.0	RG14	1.9	0.7	1.4	0.4	0.8	0.6	1.4																																																																																														
		RHT1	Roads - Hard trafficked	77.53	1212	RG5/6/9/10/11/13/17	93.9	1	93.9	26.1	N/A	0.0	93.9																																																																																														
		RHT3	Roads - Hard trafficked	77.53	1082	Existing Network	83.9	1	83.9	23.3	23.3	0.0				83.9																																																																																											
	Total		Total for NCR - Post Development		3315.9		257.1	10.6	224.3	62.3	28.4	32.8	103.9	36.5	83.9																																																																																												
			*Total for NCR - Pre Development						257.1	71.5																																																																																																	
ROAD OCS		GS84	Green Space	77.53	373.5	Existing Network	29.0	0.2	5.8	1.6	1.6	23.2			5.8																																																																																												
		GS85	Green Space	77.53	403.9	Existing Network	31.3	0.2	6.3	1.7	1.7	25.1			6.3																																																																																												
		GS86	Green Space	77.53	30.1	Existing Network	2.3	0.2	0.5	0.1	0.1	1.9			0.5																																																																																												
		GS87	Green Space	77.53	33.1	Existing Network	2.6	0.2	0.5	0.1	0.1	2.1			0.5																																																																																												
		GS88	Green Space	77.53	28.4	Existing Network	2.2	0.2	0.4	0.1	0.1	1.8			0.4																																																																																												
		GS89	Green Space	77.53	34.4	Existing Network	2.7	0.2	0.5	0.1	0.1	2.1			0.5																																																																																												
		TP7	Tree Pit	77.53	21.5	TP7	1.7	0.7	1.2	0.3	0.6	0.5	1.2																																																																																														
		TP8	Tree Pit	77.53	23.4	TP8	1.8	0.7	1.3	0.4	0.7	0.5	1.3																																																																																														
		TP9	Tree Pit	77.53	38.4	TP9	3.0	0.7	2.1	0.6	1.2	0.9	2.1																																																																																														
		CHS14	Concrete Hard Standing	77.53	1941.0	Existing Network	150.5	1	150.5	41.8	41.8	0.0			150.5																																																																																												
	Total		Total for Road OCS - Post Development		2927.5		227.0		169.0	47.0	48.2	58.0	4.5	0.0	164.5																																																																																												
			*Total for Road OCS - Pre Development						197.3	54.8																																																																																																	
ROAD Stonetown Terrace		PP3	Porous Paving	77.53	163.6	PP3	12.7	0.6	7.6	2.1	0.2	5.1		7.6																																																																																													
		GS31	Green Space	77.53	8.3	Existing Network	0.6	0.2	0.1	0.0	0.0	0.5			0.1																																																																																												
		GS32	Green Space	77.53	3.9	Existing Network	0.3	0.2	0.1	0.0	0.0	0.2			0.1																																																																																												
		GS30	Green Space	77.53	27.7	Existing Network	2.2	0.2	0.4	0.1	0.1	1.7			0.4																																																																																												
		GS29.2	Green Space	77.53	37.0	Existing Network	2.9	0.2	0.6	0.2	0.2	2.3			0.6																																																																																												
		GS28.2	Green Space	77.53	41.0	Existing Network	3.2	0.2	0.6	0.2	0.2	2.5			0.6																																																																																												
		CHS5	Concrete Hard Standing	77.53	77.2	Existing Network	6.0	1	6.0	1.7	1.7	0.0			6.0																																																																																												
		CHS4.2	Concrete Hard Standing	77.53	60.0	Existing Network	4.7	1	4.7	1.3	1.3	0.0			4.7																																																																																												
		RHT2.2	Roads - Hard trafficked	77.53	540	Existing Network	41.9	1	41.9	11.6	11.6	0.0			41.9																																																																																												
	Total		Total for Road Stonetown Terrace - Post Development		958.8		74.3	4.6	61.9	17.2	15.3	12.4	0.0	7.6	54.3																																																																																												
			*Total for Road Stonetown Terrace - Pre Development						76.8	21.4																																																																																																	
* Note that Pre Development Volumes and Discharge Rate calculations are not shown here, totals are shown for comparison purposes																																																																																																											
<table><tr><th colspan="4">Summary</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th></tr><tr><th colspan="4">Details</th><th>Area</th><th>Rainfall Depth</th><th>Runoff volume</th><th>Unattenuated Discharge Rate</th><th>Controlled Discharge Rate SuDS</th><th colspan="4">Runoff Destination (m3)</th><th></th><th></th><th></th></tr><tr><th colspan="4"></th><th>m2</th><th>mm</th><th>m3</th><th>l/s</th><th>l/s</th><th>Raingarden/Planters/Raised Garden /Tree Pits</th><th>Porous Paving</th><th>Existing Network</th><th></th><th></th><th></th></tr><tr><td colspan="4">Road NCR</td><td>3315.9</td><td>77.5</td><td>224.3</td><td>62.3</td><td>28.4</td><td></td><td>103.9</td><td>36.5</td><td>83.9</td><td></td><td></td><td></td></tr><tr><td colspan="4">Road OCS</td><td>2927.5</td><td>77.5</td><td>169.0</td><td>47.0</td><td>48.2</td><td>4.5</td><td>0.0</td><td>164.5</td><td></td><td></td><td></td></tr><tr><td colspan="4">Road Stonetown Terrace</td><td>958.8</td><td>77.5</td><td>61.9</td><td>17.2</td><td>15.3</td><td>0.0</td><td>7.6</td><td>54.3</td><td></td><td></td><td></td></tr></table>																Summary															Details				Area	Rainfall Depth	Runoff volume	Unattenuated Discharge Rate	Controlled Discharge Rate SuDS	Runoff Destination (m3)											m2	mm	m3	l/s	l/s	Raingarden/Planters/Raised Garden /Tree Pits	Porous Paving	Existing Network				Road NCR				3315.9	77.5	224.3	62.3	28.4		103.9	36.5	83.9				Road OCS				2927.5	77.5	169.0	47.0	48.2	4.5	0.0	164.5				Road Stonetown Terrace				958.8	77.5	61.9	17.2	15.3	0.0	7.6	54.3			
Summary																																																																																																											
Details				Area	Rainfall Depth	Runoff volume	Unattenuated Discharge Rate	Controlled Discharge Rate SuDS	Runoff Destination (m3)																																																																																																		
				m2	mm	m3	l/s	l/s	Raingarden/Planters/Raised Garden /Tree Pits	Porous Paving	Existing Network																																																																																																
Road NCR				3315.9	77.5	224.3	62.3	28.4		103.9	36.5	83.9																																																																																															
Road OCS				2927.5	77.5	169.0	47.0	48.2	4.5	0.0	164.5																																																																																																
Road Stonetown Terrace				958.8	77.5	61.9	17.2	15.3	0.0	7.6	54.3																																																																																																

B.8 Zone 1 proposed SuDS controls



Legend:

- Building Footprint
- Rain Garden
- Permeable Paving
- Reservoir
- Raised Planter
- Red Line Boundary
- Site Catchment Boundary

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ARUP
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 Fax: +353(0)1 668 3169

Status **A2 - Issued for Planning**

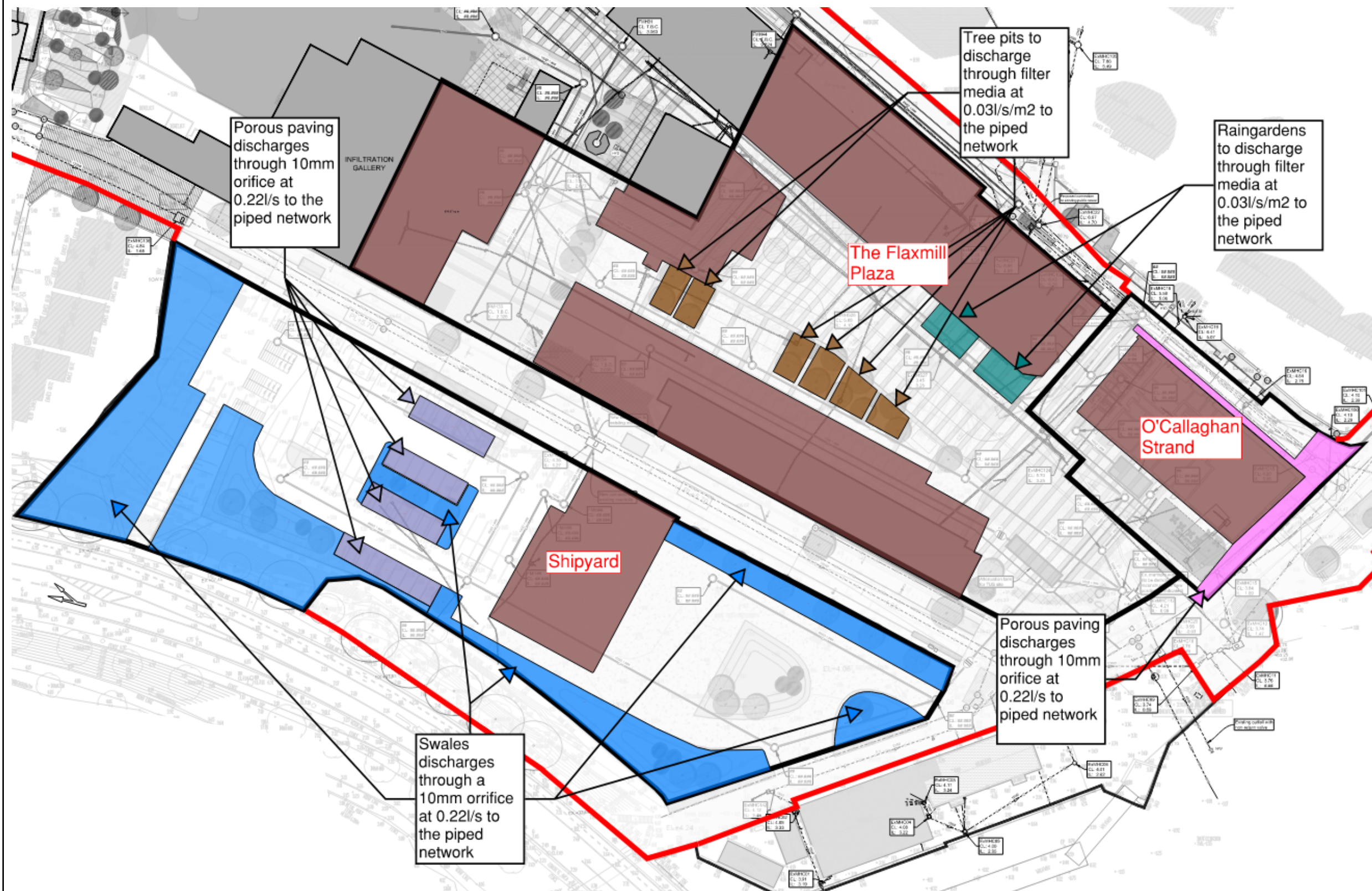
Job Title **Cleeves Riverside Quarter Masterplan**

Drawing Title **Proposed SuDs Controls on Stonetown Terrace, PBSA and Reservoir**

Scales **N/A** File Ref.

Drm **JL** Date **03/09/2025** Chk'd **AS**

Job No. **277975-00** Sketch No. Rev. **4**



Legend:

- Building Footprint
- Rain Garden
- Permeable Paving
- Permeable Paving Trafficked
- Tree Pit
- Swale
- Red Line Boundary
- Site Catchment Boundary

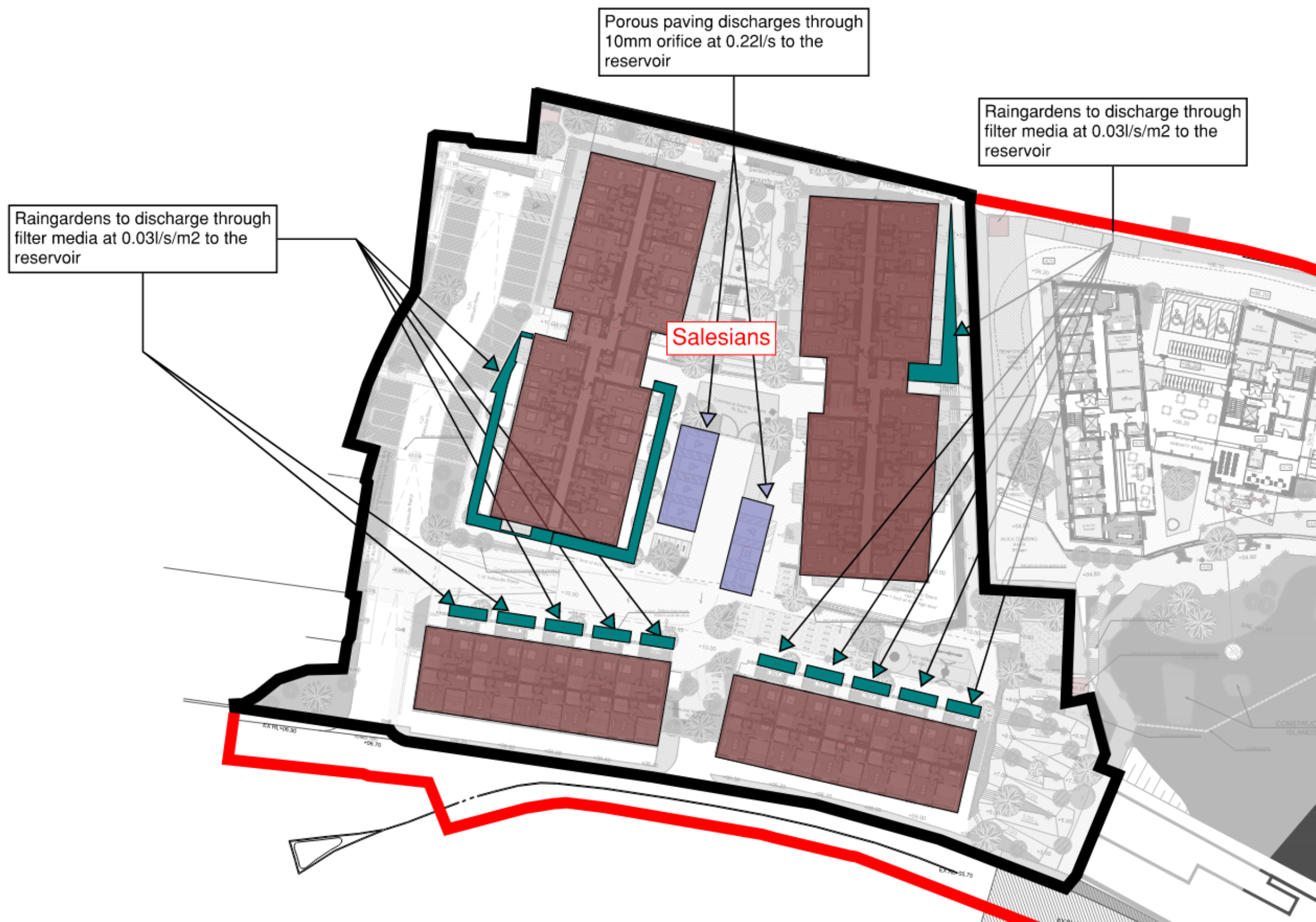
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Status	A2 - Issued for Planning		
Job Title	Cleeves Riverside Quarter Masterplan		
Drawing Title	Proposed SuDs Controls on Shipyard, The Flaxmill Plaza & O'Callaghan Strand		
Scales	N/A	File Ref.	
Drm	JL	Date	03/09/2025 Chk'd AS
Job No.	277975-00	Sketch No.	Rev. 4

Legend:

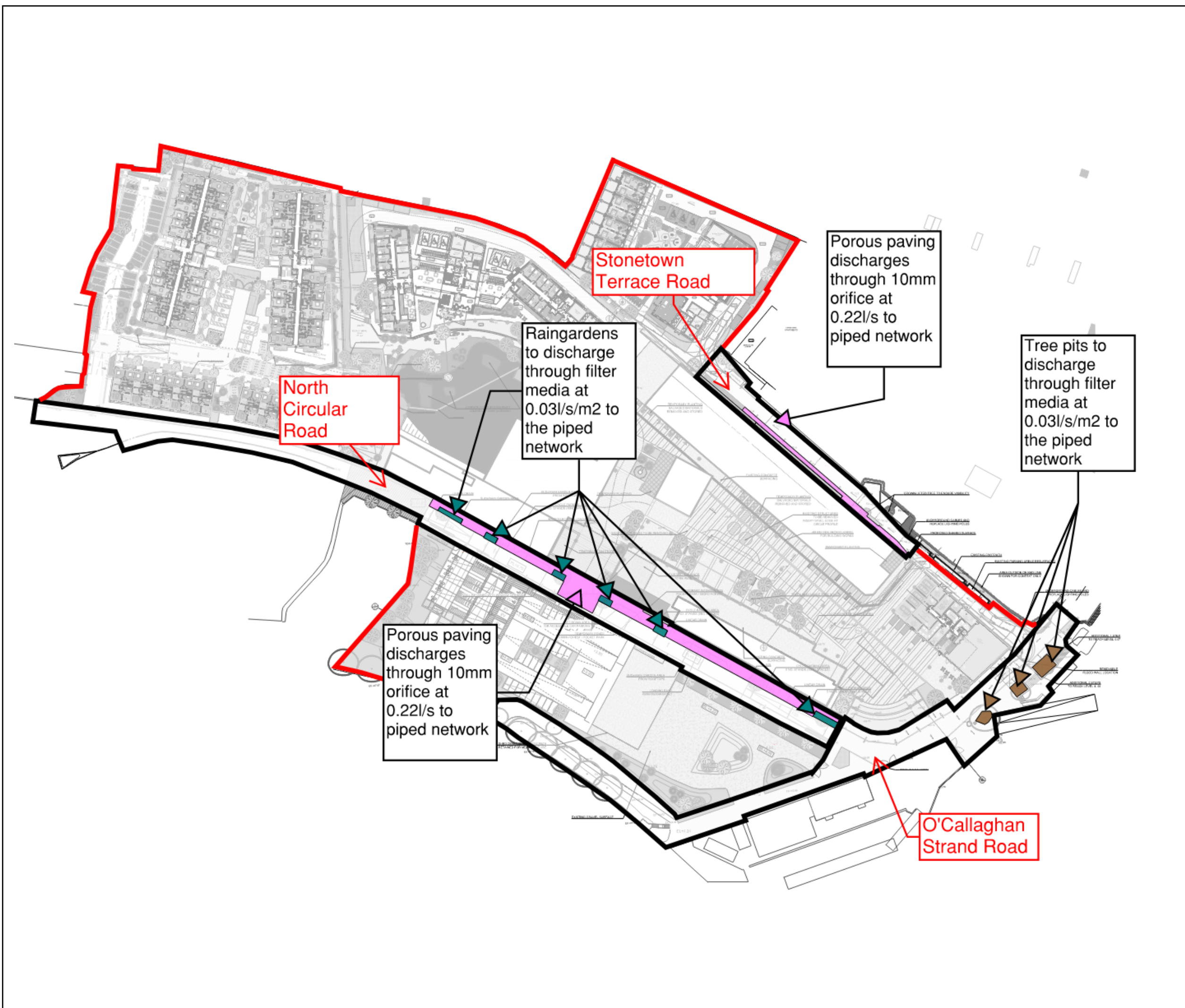
- Building Footprint
- Rain Garden
- Permeable Paving Trafficked
- Red Line Boundary
- Site Catchment Boundary



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Status	A2 - Issued for Planning		
Job Title	Cleeves Riverside Quarter Masterplan		
Drawing Title	Proposed SuDs Controls on Salesians		
Scales	N/A	File Ref.	
Drm	JL	Date	03/09/2025 Chk'd AS
Job No.	277975-00	Sketch No.	Rev. 4

B.9 Zone 2 proposed SuDS controls



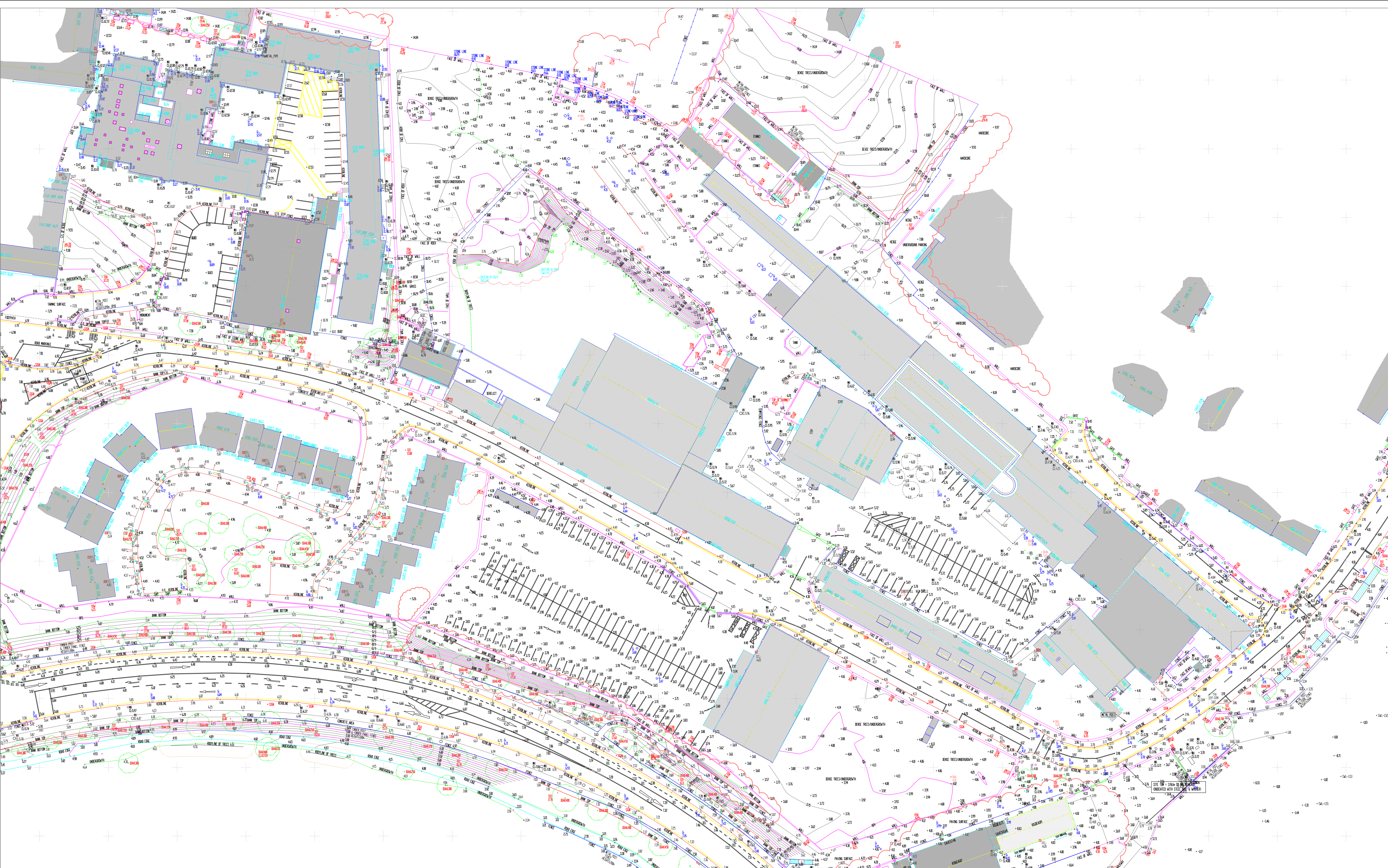
Legend:

-  Rain Garden
-  Permeable Paving
-  Raised Planter
-  Red Line Boundary
-  Site Catchment Boundary

ARUP 50 Ringsend Road, Dublin 4 Tel: +353(0)1 233 4455 Fax: +353(0)1 668 3169		
Status	A2 - Issued for Planning	
Job Title	Cleeves Riverside Quarter Masterplan	
Drawing Title	Proposed SuDs Controls on OCS Road, Stonetown Terrace Road and NCR Road	
Scales	N/A	File Ref.
Drm	JL	Date 03/09/2025 Chk'd AS
Job No.	277975-00	Sketch No. Rev. 4

Appendix C

C.1 Topographical Survey



Topographical Survey
Scale 1:500

ITM Grid

010m20m30m

1:500

SURVEY NOTES

1. All levels are related to Malin Head Datum (OSGM15)

2. All dimensions are in meters unless otherwise stated.

3. any discrepancies in the survey should be reported to Geodata Surveying Ltd immediately.

4. Do not scale, this shall only be permitted in digital form.

5. Grid is 20m x 20m

KEY PLAN

ABBREVIATIONS

AI ARMSTRONG JUNCTION
AR ASSUMED ROUTE
AV AIR VALVE
AN ANTENNA
BD BACKDROP
BL BED LEVEL
BH BOREHOLE
Bin LITTER / GRIT SALT BIN
BO BOLLARD
BP BOUNDARY POST
BS BUS STOP

CATV CABLE TV COVER
CB CONTROL BOX
CL COVER LEVEL
CL: CEILING SOFFIT OS DATUM
CPT CAMERA POST
CUP CURVED PIPE
D DEPTH
DH DOOR HEIGHT
DI LITTER / GRIT SALT BIN
BO BOLLARD
BP BOUNDARY POST
BS BUS STOP

ESB ELECTRIC INSP COVER
EP ELECTRICITY STANDARD
ER EARTH ROD
FA FIRE ALARM SYSTEM
FB FOOTBRIDGE
F/C FLOOR TO CILL HEIGHT
F/H FLOOR TO HEAD HEIGHT
LP LAMP STANDARD
ME MECHANICAL EQUIP
NH MANHOLE
MP MINI PILLAR

G= GIRTH
GIP GAS INLET PIPE
GAS GAS VALVE
IC INSP CHAMBER
IL INVERT LEVEL
IP INLET PIPE
LFT LIGHT FITTING
LP LAMP STANDARD
ME MECHANICAL EQUIP
NH MANHOLE
MP MINI PILLAR

O/H OVER HEAD LINE
OS OUTSIDE SURVEY AREA
OTM TOP OF TOWER
PI METAL PIN/POST
RWOP RAIN WATER DOWN PIPE
RO ROCK OUTCROP
SWL SURFACE WATER LEVEL
STN CONTROL STATION
SV SLUICE VALVE
SC STOP COCK

SS SECURITY SYSTEM
ST STAY WIRE
UT UTILITY INSP CHAMBER
VP VENT PIPE
TELE TELECOM POLE
TL TRAFFIC LIGHT
INLET INLET PIPE
NO ROCK OUTCROP
TOP TOP OF FENCE
TOT TOP OF TREE
TOW TOP OF WALL
TPT TOP OF TOWER
UB BEAM SOFFIT OS DATUM

U/G UNDERGROWTH
UT UTILITY INSP CHAMBER
VP VENT PIPE
TELE TELECOM POLE
TL TRAFFIC LIGHT
INLET INLET PIPE
NO ROCK OUTCROP
TOP TOP OF FENCE
TOT TOP OF TREE
TOW TOP OF WALL
TPT TOP OF TOWER
UB BEAM SOFFIT OS DATUM

1. METAL CLADDING
2. ROOF SLATE
3. ROOF TILES
4. ASBESTOS
5. MEMBRANE
6. RENDER
7. STONE
8. BRICK
9. TIMBER
10. DASHED RENDER
11. BLOCKWORK
12. CONCRETE

06 25-10-24 Topographical detail ML KOB
05 31-07-24 Topographical detail ML KOB
04 23-02-21 Topographical detail ML KOB
03 20-01-21 Chimney Stack ML KOB
02 15-11-20 Topographical detail ML KOB
01 24-09-20 Topographical detail ML KOB

Rev Date Description Dwn By Cld By

Client: Limerick 2030
Project: Cleeves, Limerick City.
Title: Topographical Survey 3D
Date: 25-10-24 Sheet: A1 Scale: 1-500

Job No.: 18885 200
Dwg. No.:
Drawn By: KD
Checked By: ML
Approved By: KOB

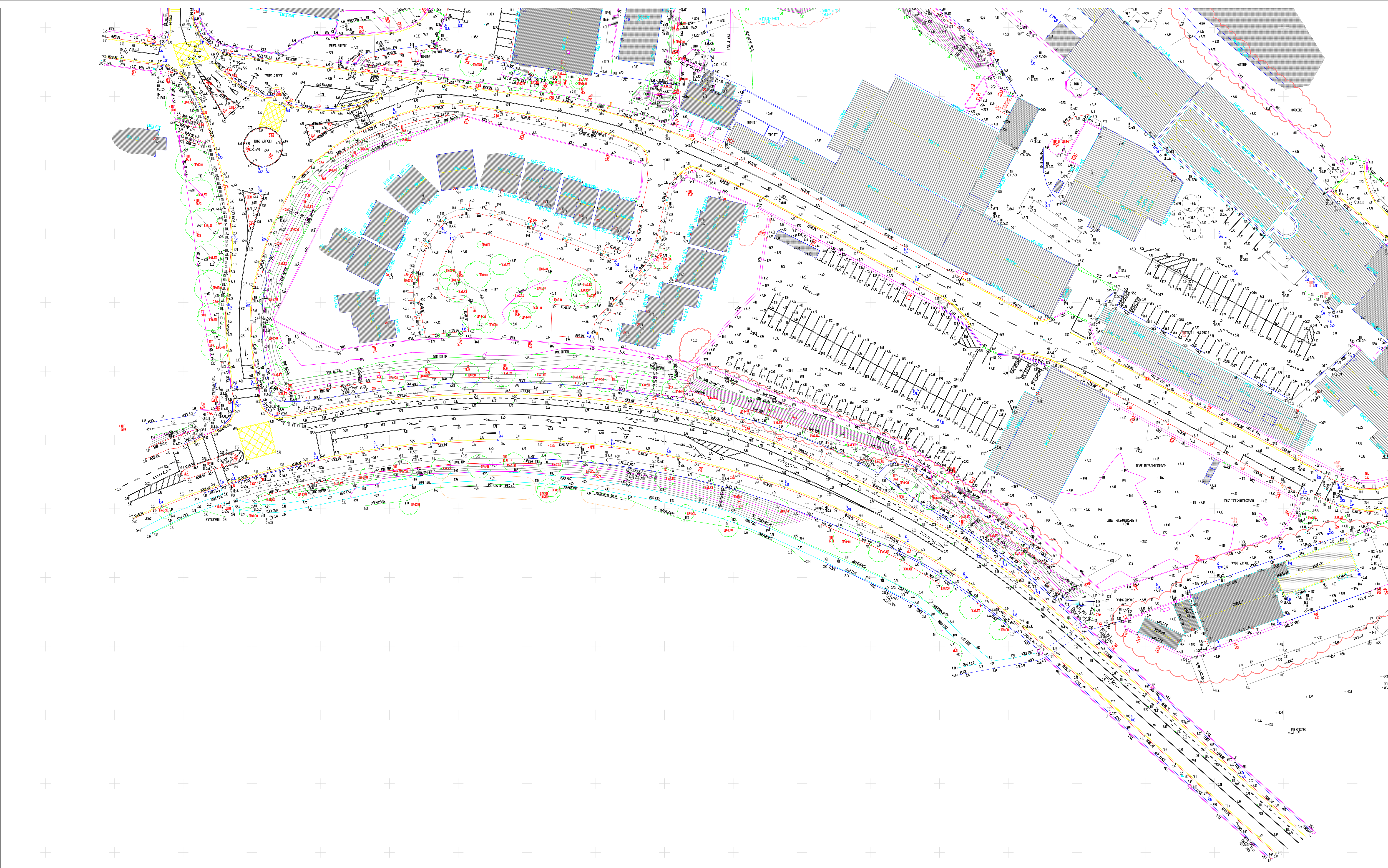
Rev. 06

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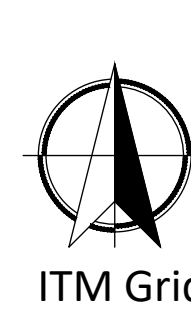
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Topographical Survey
Scale 1:500



SURVEY NOTES

1. All levels are related to Malin Head Datum (OSGM15)
2. All dimensions are in meters unless otherwise stated.
3. any discrepancies in the survey should be reported to Geodata Surveying Ltd immediately.
4. Do not scale, this shall only be permitted in digital form.
5. Grid is 20m x 20m



ABBREVIATIONS

AJ	ARMSTRONG JUNCTION	CATV	CABLE TV COVER	ESB	ELECTRIC INSP COVER	G=	GIRTH	O/H	OVER HEAD LINE	SS	SECURITY SYSTEM	U/G	UNDERGROWTH
AR	ASSUMED ROUTE	CB	CONTROL BOX	EP	ELECTRICITY STANDARD	GIP	GAS INLET PIPE	OS	OUTSIDE SURVEY AREA	ST	STAY WIRE	UT	UTILITY INSP CHAMBER
AV	AIR VALVE	CL	COVER LEVEL	ER	EARTH ROD	GAS	GAS VALVE	PG	SKATE OUT PEG	TD	TEMPORARY BENCH MARK	VP	VENT PIPE
AN	ANTENNA	CL	CEILING SOFFIT OS DATUM	FA	FIRE ALARM SYSTEM	IC	INSP CHAMBER	PI	METAL PIN/POST	TEL	TELECOM	VT	VENT
BD	BACKDROP	CM	CAMERA POST	FB	FOOTBRIDGE	IL	INVERT LEVEL	RWOP	RAIN WATER DOWN PIPE	TL	TRAFFIC LIGHT	UTL	UNABLE TO LIFT
BL	BED LEVEL	CUP	CULVERT PIPE	F/C	FLOOR TO CILL HEIGHT	IP	INLET PIPE	RO	ROCK OUTCROP	TP	TELECOM POLE	UTR	UNABLE TO ROD
BH	BORERHOLE	D	DEPTH	F/H	FLOOR TO HEAD HEIGHT	IP	INLET PIPE	SWL	SURFACE WATER LEVEL	TOP	TOP OF FENCE	UTS	UNABLE TO SURVEY
Bin	LITTER / GRIT SALT BIN	DH	DOOR HEIGHT	FH	FIRE HYDRANT	LP	LAMP STANDARD	STN	CONTROL STATION	TOD	TOP OF DITCH	UTT	UNABLE TO TRACE
BO	BOLLARD	DIA	DIAMETER	FFL	FIRE FLOOR	ME	MECHANICAL EQUIP	STP	SOIL STACK	TOW	TOP OF WALL	U/S	UPSTAND
BP	BOUNDARY POST	DS	DIRECTION SIGN	F/S	FLAG STAFF/POLE	MH	MANHOLE	SV	SLUICE VALVE	TOT	TOP OF TREE	WM	WATER METER
BS	BUS STOP	EE	ELECTRICAL EQUIPMENT	G	GULLY	MP	MINI PILLAR	SC	STOP COCK	UB	BEAM SOFFIT OS DATUM	WO	WASH OUT VALVE

ABBREVIATIONS

ESB	ELECTRIC INSP COVER	G=	GIRTH	O/H	OVER HEAD LINE	SS	SECURITY SYSTEM	U/G	UNDERGROWTH
EP	ELECTRICITY STANDARD	GIP	GAS INLET PIPE	OS	OUTSIDE SURVEY AREA	ST	STAY WIRE	UT	UTILITY INSP CHAMBER
ER	EARTH ROD	GAS	GAS VALVE	PG	SKATE OUT PEG	TD	TEMPORARY BENCH MARK	VP	VENT PIPE
FA	FIRE ALARM SYSTEM	IC	INSP CHAMBER	PI	METAL PIN/POST	TEL	TELECOM	VT	VENT
FB	FOOTBRIDGE	IL	INVERT LEVEL	RWOP	RAIN WATER DOWN PIPE	TL	TRAFFIC LIGHT	UTL	UNABLE TO LIFT
F/C	FLOOR TO CILL HEIGHT	IP	INLET PIPE	RO	ROCK OUTCROP	TP	TELECOM POLE	UTR	UNABLE TO ROD
F/H	FLOOR TO HEAD HEIGHT	IP	INLET PIPE	SWL	SURFACE WATER LEVEL	TOP	TOP OF FENCE	UTS	UNABLE TO SURVEY
FH	FIRE HYDRANT	LP	LAMP STANDARD	STN	CONTROL STATION	TOD	TOP OF DITCH	UTT	UNABLE TO TRACE
FFL	FIRE FLOOR	ME	MECHANICAL EQUIP	STP	SOIL STACK	TOW	TOP OF WALL	U/S	UPSTAND
F/S	FLAG STAFF/POLE	MH	MANHOLE	SV	SLUICE VALVE	TOT	TOP OF TREE	WM	WATER METER
G	GULLY	MP	MINI PILLAR	SC	STOP COCK	UB	BEAM SOFFIT OS DATUM	WO	WASH OUT VALVE

ABBREVIATIONS

ESB	ELECTRIC INSP COVER	G=	GIRTH	O/H	OVER HEAD LINE	SS	SECURITY SYSTEM	U/G	UNDERGROWTH
EP	ELECTRICITY STANDARD	GIP	GAS INLET PIPE	OS	OUTSIDE SURVEY AREA	ST	STAY WIRE	UT	UTILITY INSP CHAMBER
ER	EARTH ROD	GAS	GAS VALVE	PG	SKATE OUT PEG	TD	TEMPORARY BENCH MARK	VP	VENT PIPE
FA	FIRE ALARM SYSTEM	IC	INSP CHAMBER	PI	METAL PIN/POST	TEL	TELECOM	VT	VENT
FB	FOOTBRIDGE	IL	INVERT LEVEL	RWOP	RAIN WATER DOWN PIPE	TL	TRAFFIC LIGHT	UTL	UNABLE TO LIFT
F/C	FLOOR TO CILL HEIGHT	IP	INLET PIPE	RO	ROCK OUTCROP	TP	TELECOM POLE	UTR	UNABLE TO ROD
F/H	FLOOR TO HEAD HEIGHT	IP	INLET PIPE	SWL	SURFACE WATER LEVEL	TOP	TOP OF FENCE	UTS	UNABLE TO SURVEY
FH	FIRE HYDRANT	LP	LAMP STANDARD	STN	CONTROL STATION	TOD	TOP OF DITCH	UTT	UNABLE TO TRACE
FFL	FIRE FLOOR	ME	MECHANICAL EQUIP	STP	SOIL STACK	TOW	TOP OF WALL	U/S	UPSTAND
F/S	FLAG STAFF/POLE	MH	MANHOLE	SV	SLUICE VALVE	TOT	TOP OF TREE	WM	WATER METER
G	GULLY	MP	MINI PILLAR	SC	STOP COCK	UB	BEAM SOFFIT OS DATUM	WO	WASH OUT VALVE

ABBREVIATIONS

ESB	ELECTRIC INSP COVER	G=	GIRTH	O/H	OVER HEAD LINE	SS	SECURITY SYSTEM	U/G	UNDERGROWTH
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ER	EARTH ROD	GAS	GAS VALVE	PG	SKATE OUT PEG	TD	TEMPORARY BENCH MARK	VP	VENT PIPE
FA	FIRE ALARM SYSTEM	IC	INSP CHAMBER	PI	METAL PIN/POST	TEL	TELECOM	VT	VENT
FB	FOOTBRIDGE	IL	INVERT LEVEL	RWOP	RAIN WATER DOWN PIPE	TL	TRAFFIC LIGHT	UTL	UNABLE TO LIFT
F/C	FLOOR TO CILL HEIGHT	IP	INLET PIPE	RO	ROCK OUTCROP	TP	TELECOM POLE	UTR	UNABLE TO ROD
F/H	FLOOR TO HEAD HEIGHT	IP	INLET PIPE	SWL	SURFACE WATER LEVEL	TOP	TOP OF FENCE	UTS	UNABLE TO SURVEY
FH	FIRE HYDRANT	LP	LAMP STANDARD	STN	CONTROL STATION	TOD	TOP OF DITCH	UTT	UNABLE TO TRACE
FFL	FIRE FLOOR	ME	MECHANICAL EQUIP	STP	SOIL STACK	TOW	TOP OF WALL	U/S	UPSTAND
F/S	FLAG STAFF/POLE	MH	MANHOLE	SV	SLUICE VALVE	TOT	TOP OF TREE	WM	WATER METER
G	GULLY	MP	MINI PILLAR	SC	STOP COCK	UB	BEAM SOFFIT OS DATUM	WO	WASH OUT VALVE

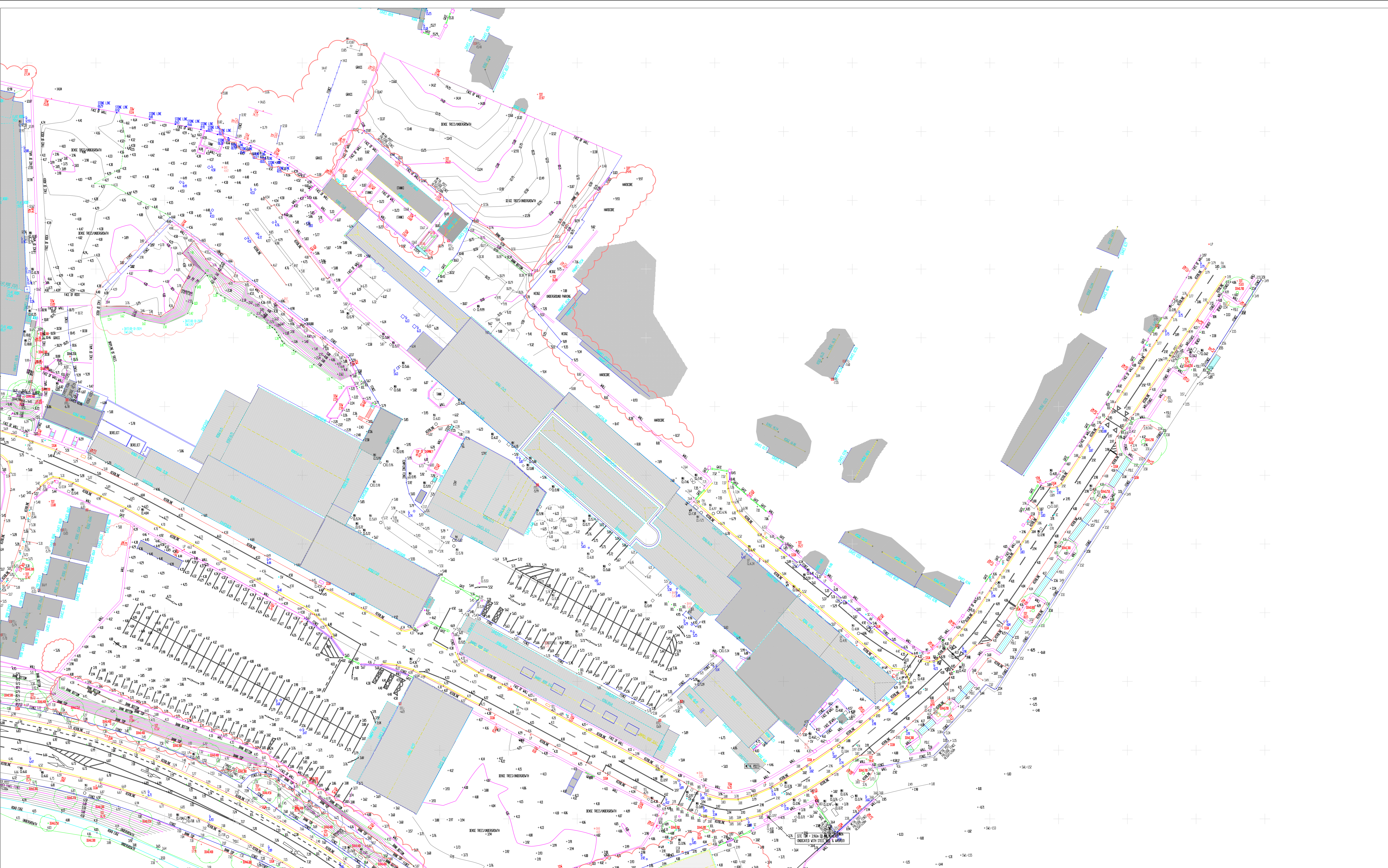
ABBREVIATIONS

ESB	ELECTRIC INSP COVER	G=	GIRTH	O/H	OVER HEAD LINE	SS	SECURITY SYSTEM	U/G	UNDERGROWTH
EP	ELECTRICITY STANDARD	GIP	GAS INLET PIPE	OS	OUTSIDE SURVEY AREA	ST	STAY WIRE	UT	UTILITY INSP CHAMBER
ER	EARTH ROD	GAS	GAS VALVE	PG	SKATE OUT PEG	TD	TEMPORARY BENCH MARK	VP	VENT PIPE
FA	FIRE ALARM SYSTEM	IC	INSP CHAMBER	PI	METAL PIN/POST	TEL	TELECOM	VT	VENT
FB	FOOTBRIDGE	IL	INVERT LEVEL	RWOP	RAIN WATER DOWN PIPE	TL	TRAFFIC LIGHT	UTL	UNABLE TO LIFT
F/C	FLOOR TO CILL HEIGHT	IP	INLET PIPE	RO	ROCK OUTCROP	TP	TELECOM POLE	UTR	UNABLE TO ROD
F/H	FLOOR TO HEAD HEIGHT	IP	INLET PIPE	SWL	SURFACE WATER LEVEL	TOP	TOP OF FENCE	UTS	UNABLE TO SURVEY
FH	FIRE HYDRANT	LP	LAMP STANDARD	STN	CONTROL STATION	TOD	TOP OF DITCH	UTT	UNABLE TO TRACE
FFL	FIRE FLOOR	ME	MECHANICAL EQUIP	STP	SOIL STACK	TOW	TOP OF WALL	U/S	UPSTAND
F/S	FLAG STAFF/POLE	MH	MANHOLE	SV	SLUICE VALVE	TOT	TOP OF TREE	WM	WATER METER
G	GULLY	MP	MINI PILLAR	SC	STOP COCK	UB	BEAM SOFFIT OS DATUM	WO	WASH OUT VALVE

06	25-10-24	Topographical detail	ML	KOB
05	31-07-24	Topographical detail	ML	KOB
04	23-02-21	Topographical detail	ML	KOB
03	20-01-21	Chimney Stack	ML	KOB
02	15-11-20	Topographical detail	ML	KOB
01	24-09-20	Topographical detail	ML	KOB
Rev	Date	Description	Drn By	Cld By
1.		METAL CLADDING		
2.		ROOF SLATE		
3.		ROOF TILES		
4.		ASBESTOS		
5.		MEMBRANE		
6.		RENDER		
7.		STONE		
8.		BRICK		
9.		TIMBER		
10.		DASHED RENDER		
11.		BLOCKWORK		
12.		CONCRETE		

Client: Limerick 2030
Project: Cleeves, Limerick City.
Job No.: 18885 202
Dwg No.:
Title: Topographical Survey 3D
Scale: 1:500
Date: 25-10-24 Sheet: A1
Approved By: KOB

Geodata
Chartered Land Surveyors
47 Oliver Plunkett Street, Bandon, Co. Cork, P72 A443, Ireland
Tel: +353 (0)23 88 52798 | Email: info@geodatasurveying.ie



Topographical Survey
Scale 1:500



ITM Grid

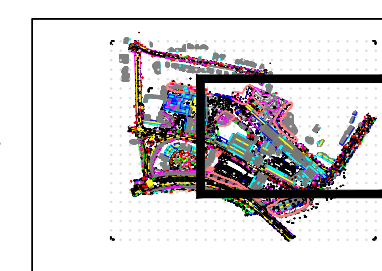


0 10m 20m 30m
1:500

SURVEY NOTES

1. All levels are related to Malin Head Datum (OSGM15)
2. All dimensions are in meters unless otherwise stated.
3. any discrepancies in the survey should be reported to Geodata Surveying Ltd immediately
4. Do not scale, this shall only be permitted in digital form.
5. Grid is 20m x 20m

KEY PLAN



ABBREVIATIONS

AJ ARMSTRONG JUNCTION	CATV CABLE TV COVER	ESB ELECTRIC INSP COVER	G= GIRTH	O/H OVER HEAD LINE	SS SECURITY SYSTEM	U/G UNDERGROWTH	1. METAL CLADDING
AR ASSUMED ROUTE	CB CONTROL BOX	EP ELECTRICITY STANDARD	GIP GAS INLET PIPE	OS OUTSIDE SURVEY AREA	ST STAY WIRE	UT UTILITY INSP CHAMBER	2. ROOF SLATE
AV AIR VALVE	CL COVER LEVEL	ER EARTH ROD	PG GAS VALVE	PS SKATE OUT PEG	TD TEMPORARY BENCH MARK	VP VENT PIPE	3. ROOF TILES
AN ANTENNA	CL: CEILING SOFFIT OS DATUM	FA FIRE ALARM SYSTEM	IC INSP CHAMBER	PI METAL PIN/POST	TEL TELECOM INSP	VT VENT	4. ASBESTOS
BD BACKDROP	CPST CAMERA POST	FB FOOTBRIDGE	IL INVERT LEVEL	RWOP RAIN WATER DOWN PIPE	TL TRAFFIC LIGHT	UTF UNABLE TO LIFT	5. MEMBRANE
BL BED LEVEL	CUIP CULVERT PIPE	FC FLOOR TO CELL HEIGHT	IP INLET PIPE	RO ROCK OUTCROP	TP TELECOM POLE	UTR UNABLE TO ROD	6. RENDER
BH BORHOLE	QIP QUANTITY	F/H FLOOR TO HEAD HEIGHT	IP INLET PIPE	SWL SURFACE WATER LEVEL	TOF TOP OF FENCE	UTS UNABLE TO SURVEY	7. STONE
Bin LITTER / GRIT SALT BIN	DH DOOR HEIGHT	LP LAMP STANDARD	IP INLET PIPE	STN CONTROL STATION	TOT TOP OF DITCH	UTT UNABLE TO TRACE	8. BRICK
BO BOLLARD	DIA DIAMETER	ME MECHANICAL EQUIP	IP INLET PIPE	STP SOIL STACK	TOW TOP OF WALL	UJS UNABLE TO JUMP	9. TIMBER
BP BOUNDARY POST	DS DIRECTION SIGN	MH MANHOLE	IP INLET PIPE	SV SLUICE VALVE	TOT TOP OF TREE	WJM WATER METER	10. DASHED RENDER
BS BUS STOP	EE ELECTRICAL EQUIPMENT	MP MINI PILLAR	IP INLET PIPE	SC STOP COCK	UB BEAM SOFFIT OS DATUM	WO WASH OUT VALVE	11. BLOCKWORK
							12. CONCRETE

06	25-10-24	Topographical detail	ML	KOB
05	31-07-24	Topographical detail	ML	KOB
04	23-02-21	Topographical detail	ML	KOB
03	20-01-21	Chimney Stack	ML	KOB
02	15-11-20	Topographical detail	ML	KOB
01	24-03-20	Topographical detail	ML	KOB
Rev	Date	Description	Drn By	Old By

Materials

1. METAL CLADDING
2. ROOF SLATE
3. ROOF TILES
4. ASBESTOS
5. MEMBRANE
6. RENDER
7. STONE
8. BRICK
9. TIMBER
10. DASHED RENDER
11. BLOCKWORK
12. CONCRETE



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Geodata Surveyors

Client: Limerick 2030

Project: Cleeves, Limerick City.

Title: Topographical Survey 3D

Date: 25-10-24 Sheet: A1 Scale: 1-500

Rev. 06

Job No. 18885 203

Dwg. No. 18885 203

Drawn By: KD

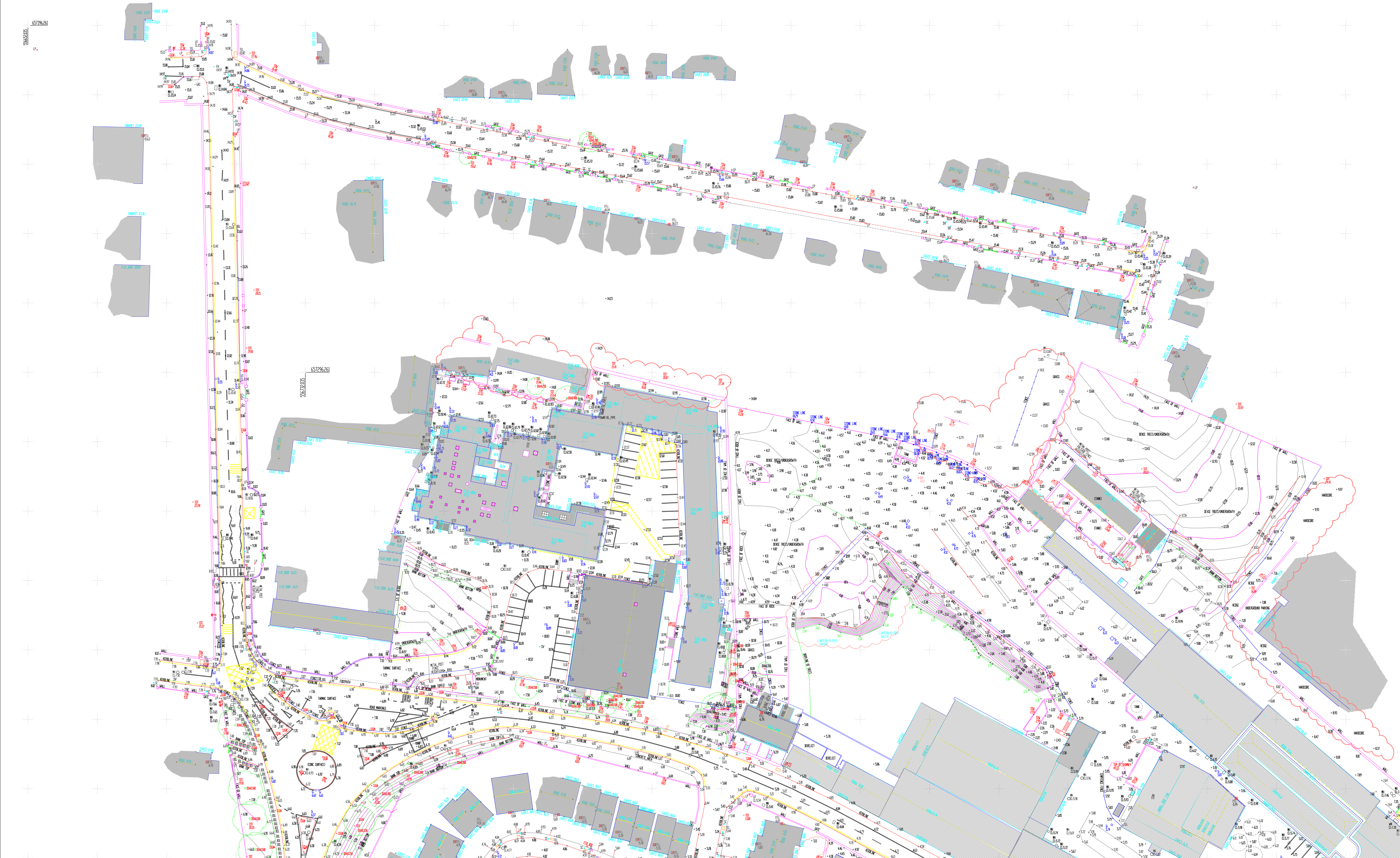
Checked By: ML

Approved By: KOB



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Chartered Land Surveyors

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Topographical Survey
Scale 1:500

ITM Grid

010m20m30m

1:500

SURVEY NOTES

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2. All dimensions are in meters unless otherwise stated.
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5. Grid is 20m x 20m

KEY PLAN

ABBREVIATIONS

AJ ARMSTRONG JUNCTION
AR ASSUMED ROUTE
AV AIR VALVE
AN ANTENNA
BD BACKDROP
BL BED LEVEL
BH BOREHOLE
Bin LITTER / GRIT SALT BIN
BO BOLLARD
BP BOUNDARY POST
BS BUS STOP

CATV CABLE TV COVER
CB CONTROL BOX
CL COVER LEVEL
CL: CEILING SOFFIT OS DATUM
CPT CAMERA POST
CUP CULVERT PIPE
D DEPTH
DH DOOR HEIGHT
DIA DIAMETER
DS DIRECTION SIGN
EE ELECTRICAL EQUIPMENT

ESB ELECTRIC INSP COVER
EP ELECTRICITY STANDARD
ER EARTH ROD
FA FIRE ALARM SYSTEM
FB FOOTBRIDGE
F/C FLOOR TO CILL HEIGHT
F/H FLOOR TO HEAD HEIGHT
FH FIRE HYDRANT
FLL FLOOR LEVEL
FS FLAG STAFF/POLE
G GULLY

G= GIRTH
GIP GAS INLET PIPE
GAS GAS VALVE
IC INSP CHAMBER
IL INVERT LEVEL
IP INLET PIPE
IP INLET PIPE
L LAMP STANDARD
ME MECHANICAL EQUIP
MH MANHOLE
MP MINI PILLAR

O/H OVER HEAD LINE
OS OUTSIDE SURVEY AREA
PE PEDESTAL
PI METAL PIN/POST
RWOP RAIN WATER DOWN PIPE
RO ROCK OUTCROP
SWL SURFACE WATER LEVEL
STN CONTROL STATION
STP SOIL STACK
SV SLUICE VALVE
SC STOP COCK

SS SECURITY SYSTEM
ST STAY WIRE
TD TELECOM BENCH MARK
TEL TELECOM
TL TRAFFIC LIGHT
TEL COM POLE
TOP TOP OF FENCE
TOT TOP OF TREE
TOW TOP OF WALL
TOT TOP OF TREE
UB BEAM SOFFIT OS DATUM

U/G UNDERGROWTH
UT UTILITY INSP CHAMBER
UT VENT
UTF UNABLE TO LIFT
UTR UNABLE TO ROD
UTS UNABLE TO SURVEY
UTT UNABLE TO TRACE
U/S UPSTAND
WM WATER METER
WO WASH OUT VALVE

1. METAL CLADDING
2. ROOF SLATE
3. ROOF TILES
4. ASBESTOS
5. MEMBRANE
6. RENDER
7. STONE
8. BRICK
9. TIMBER
10. DASHED RENDER
11. BLOCKWORK
12. CONCRETE

06 25-10-24 Topographical detail ML KOB

05 31-07-24 Topographical detail ML KOB

04 23-02-21 Topographical detail ML KOB

03 20-01-21 Chimney Stack ML KOB

02 15-11-20 Topographical detail ML KOB

01 24-03-20 Topographical detail ML KOB

Rev Date Description Dwn By Cld By

Client: Limerick 2030

Job No: 18885 201

Drawn By: KD

Checked By: ML

Approved By: KOB

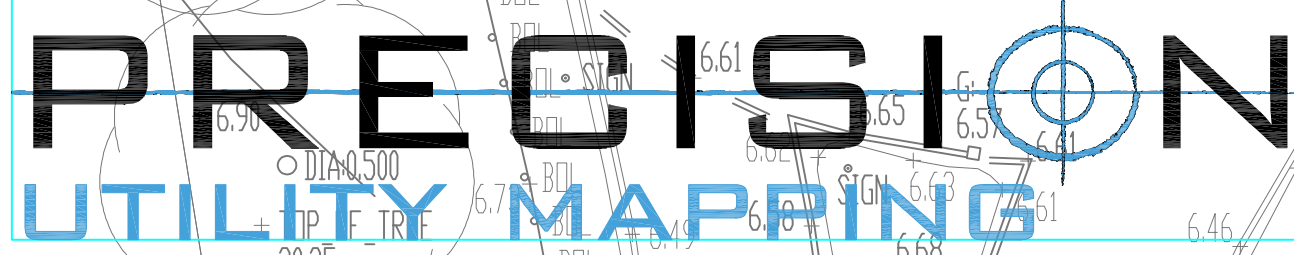
Scale: 1-500

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Chartered Land Surveyors

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Tel: +353 (0)23 88 52798 | Email: info@geodatasurveying.ie

C.2 Utility Survey

[illegible]

M1P - EM1: SEARCH TRIGGERED AT 20 INTERVALS - TRIGGERED AT 0.5m INTERVALS - GPS SURVEY GRID AT 2.0m INTERVALS OR HIGH DENSITY AREA* - GPS SURVEY GRID PROCESSING OF GPR DATA.	M4 - EM1: SEARCH TRIGGERED AT 20 INTERVALS - TRIGGERED AT 0.5m INTERVALS - GPS SURVEY GRID AT 0.5m INTERVALS - GPR MARK-UP ON SITE.
M2P - EM1: SEARCH TRIGGERED AT 20 INTERVALS - TRIGGERED AT 1m INTERVALS - GPS SURVEY GRID AT 2.0m INTERVALS OR HIGH DENSITY AREA* - GPS SURVEY GRID PROCESSING OF GPR DATA.	M3 - EM1: SEARCH TRIGGERED AT 10 INTERVALS - TRIGGERED AT 1m INTERVALS - GPS SURVEY GRID AT 1m INTERVALS - GPR MARK-UP ON SITE.
M3P - EM1: SEARCH TRIGGERED AT 10 INTERVALS - TRIGGERED AT 2m INTERVALS - GPS SURVEY GRID AT 2.0m INTERVALS OR HIGH DENSITY AREA* - GPS SURVEY GRID PROCESSING OF GPR DATA.	M2 - EM1: SEARCH TRIGGERED AT 10 INTERVALS - TRIGGERED AT 2m INTERVALS - GPS SURVEY GRID AT 2m INTERVALS - GPR MARK-UP ON SITE.
M1 - EM1: SEARCH TRIGGERED AT 10 INTERVALS - TRIGGERED AT 5m INTERVALS - GPS SURVEY AS APPROPRIATE - PROCESSING OF GPR DATA.	M1 - EM1: SEARCH TRIGGERED AT 10 INTERVALS - TRIGGERED AT 5m INTERVALS - GPS SURVEY AS APPROPRIATE - GPR MARK-UP ON SITE.

47 SUB-SURFACE KEY

UTILITY CONFIDENCE LEVELS (Listed from High to Low)

- (A) HORIZONTAL AND VERTICAL POSITIONS VERIFIED USING A
(Accuracy: Horizontal (200mm) / Vertical(40mm))
- (B1) HORIZONTAL AND VERTICAL POSITIONS DETECTED BY MULTIPLE METHODS
WITHOUT PROCESSING ORN
(Estimated Accuracy: ±100mm OR less of double depth)
- (B2) HORIZONTAL AND VERTICAL POSITIONS DETECTED BY MULTIPLE METHODS
(Estimated Accuracy: ±100mm OR less of double depth)
- (B3) HORIZONTAL AND VERTICAL POSITIONS DETECTED VIA POST-PROCESSING ORN
(Estimated Accuracy: ±200mm OR less of double depth)
- (B4) HORIZONTAL POSITIONS DETECTED BY A SINGLE METHOD
(Estimated Accuracy: ±200mm OR less of double depth)
- (B5) HORIZONTAL POSITIONS DETECTED BY A SINGLE METHOD
(Estimated Accuracy: ±200mm in the Horizontal / Depth is undetectable)
- (B6) HORIZONTAL POSITIONS DETECTED BY A SINGLE METHOD
(Estimated Accuracy: ±200mm in the Horizontal / Depth is undetectable)
- (B7) A fully completed wall or structure is made but has not been detected and is therefore shown as an assumed line. (Accuracy Undetectable)

Utility Survey
Sheet 1 of 4

Surveyor	K. Beirne	K.B.	Eng check	–	–
Drawn	C. Daus	C.D.	Coordination	–	–
Dwg check	K. Sheehan	K.S.	Approved	J. Markham	J.M.
Scale at A0	Status			Rev	
1:200	Complete			01	
Drawing Number					
PUM-10801-Ug-DR-0001-Draft					



PA3128 SURVEY METHODOLOGY KEY

THIS SURVEY HAS BEEN CARRIED OUT IN ACCORDANCE WITH THE PA3128 SPECIFICATION FOR UNDERGROUND UTILITY DETECTION, VERIFICATION & LOCATION. THE SPECIFICATION ALLOWS FOR A RANGE OF TECHNIQUES AND METHODS OF VARYING INTENSITY TO BE DEPLOYED. THE COLOUR CODED SCHEMATIC INDICATES WHICH DIFFERENT SURVEY METHODOLOGIES HAVE BEEN USED ON SITE, AND THE LIST BELOW IDENTIFIES EQUIPMENT USED TO OBTAIN THE SURVEY RESULTS. NB: PLEASE SEE ACCOMPANYING REPORT FOR FULL DETAILS.

ELECTROMAGNETIC DETECTION	GROUND PENETRATING RADAR	TOTAL STATION	GPS/GNSS
Visible above	R20 Open Data		Triangulation

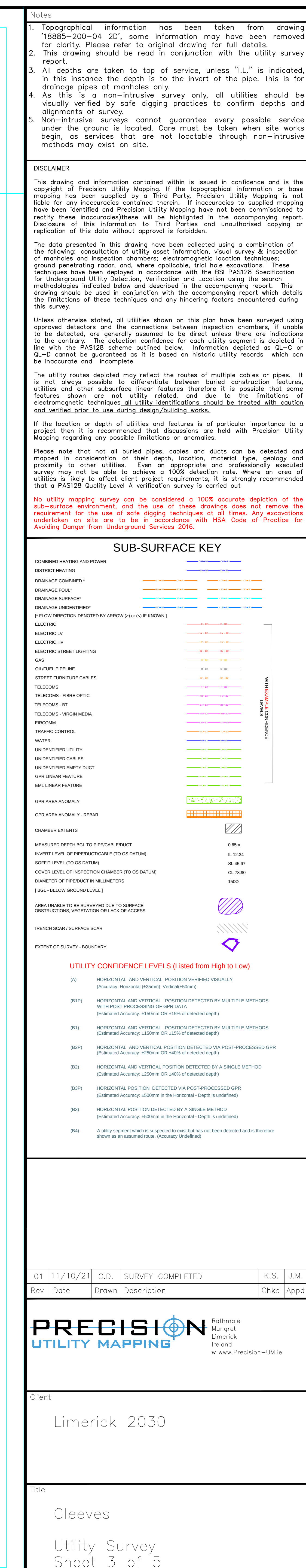
Drawn	C. Datta	C.D.	Coordination	-	-
Weight check	K. Sheehan	K.S.	Approved	J. Markham	J.M.
Scale at A0		Status		Rev	
1:200		Complete		01	
Drawing Number					
PUM-10801-U-DR-0001-Draft					

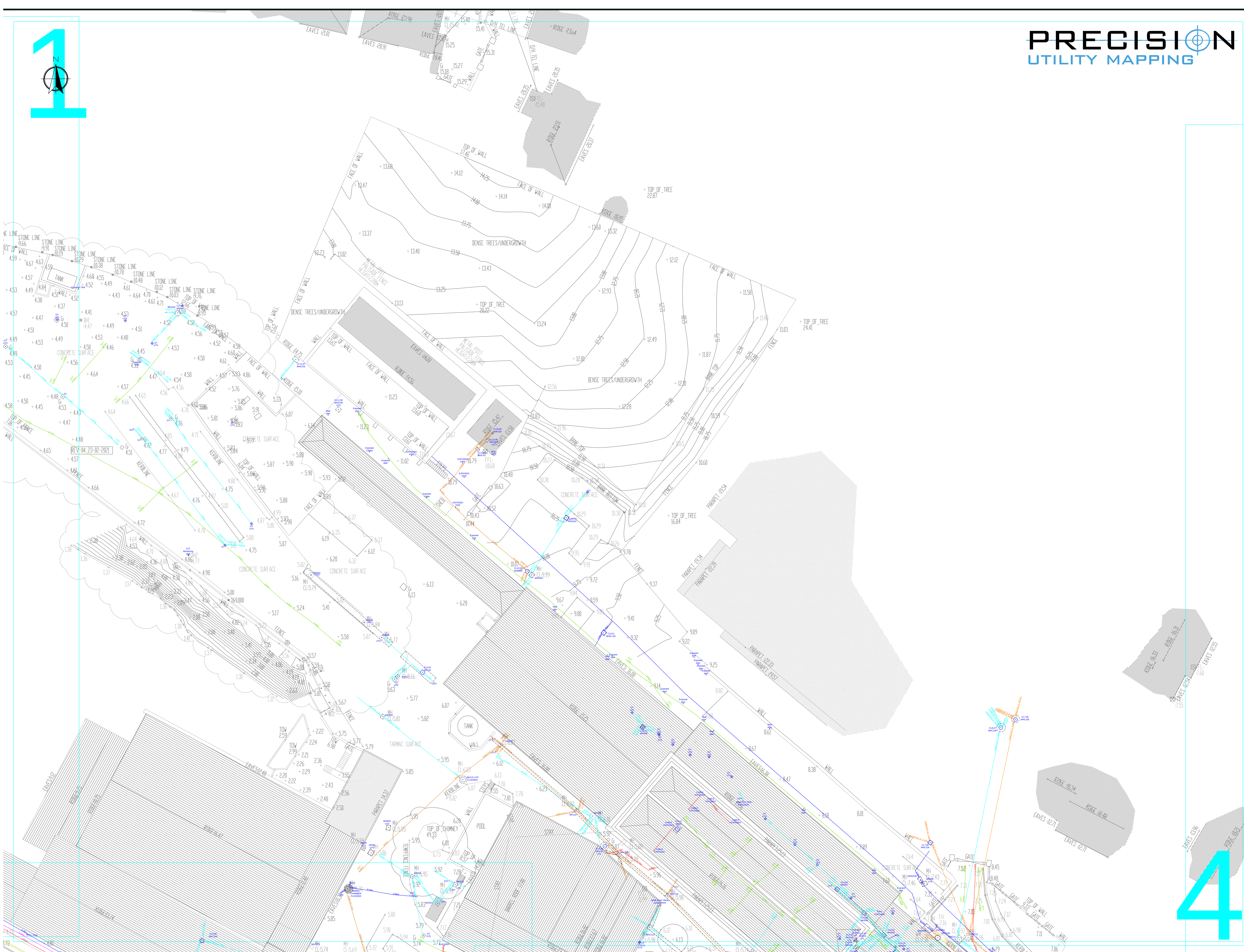
UTILITY CONFIDENCE LEVELS (Listed from High to Low)

(A)	HORIZONTAL, AND VERTICAL POSITION VERIFIED VISUALLY (Estimated Accuracy: $\pm 100\text{mm}$ or $\pm 10\%$ of detected depth)
(B)(P)	HORIZONTAL, AND VERTICAL POSITION DETECTED BY MULTIPLE METHODS WITH POST-PROCESSING OF USER DATA (Estimated Accuracy: $\pm 150\text{mm}$ or $\pm 15\%$ of detected depth)
(C)	HORIZONTAL, AND VERTICAL POSITION DETECTED BY MULTIPLE METHODS (Estimated Accuracy: $\pm 150\text{mm}$ or $\pm 15\%$ of detected depth)
(B)(P)	HORIZONTAL, AND VERTICAL POSITION DETECTED VIA POST-PROCESSED GPS (Estimated Accuracy: $\pm 150\text{mm}$ or $\pm 15\%$ of detected depth)
(C)	HORIZONTAL, AND VERTICAL POSITION DETECTED BY A SINGLE METHOD (Estimated Accuracy: $\pm 250\text{mm}$ or $\pm 25\%$ of detected depth)
(B)(P)	HORIZONTAL POSITION DETECTED VIA POST-PROCESSED GPS (Estimated Accuracy: $\pm 50\text{mm}$ in the Horizontal, Depth is unknown)
(C)	HORIZONTAL POSITION DETECTED BY A SINGLE METHOD (Estimated Accuracy: $\pm 50\text{mm}$ in the Horizontal, Depth is unknown)
(E)(A)	A Utility segment which is suspected to exist but has not been detected and is therefore shown as an assumed route. (Accuracy: Unknown)

Cleeves

Utility Survey
Sheet 2 of 4



The logo for Precision Utility Mapping features the word "PRECISION" in a large, bold, black sans-serif font. A blue horizontal line with a crosshair at its right end passes through the letters. Below "PRECISION", the words "UTILITY MAPPING" are written in a smaller, blue, all-caps sans-serif font.

Notes:

1. Topographical information has been taken from drawing "18885-200-04 2D", some information may have been removed for clarity. Please refer to original drawing for full details.
2. This drawing should be read in conjunction with the utility survey report.
3. All depths are taken to top of service, unless "I.L." is indicated, in this instance the depth is to the invert of the pipe. This is for drainage pipes at manholes only.
4. As this is a non-intrusive survey only, all utilities should be visually verified by safe digging practices to confirm depths and alignments of survey.
5. Non-intrusive surveys cannot guarantee every possible service under the ground is located. Care must be taken when site works are undertaken as there may be services not locatable through non-intrusive methods may exist on site.

DISCLAIMER

This drawing and information contained within is issued in confidence and is the copyright of Precision Utility Mapping. If topographical information or base mapping has been supplied by a Third Party, Precision Utility Mapping is not liable for any inaccuracies contained therein. If inaccuracies to supplied mapping have been identified and Precision Utility Mapping have not been commissioned to rectify these inaccuracies) these will be highlighted in the accompanying report. Disclosure of this information to Third Parties and unauthorised copying or replication of this data without approval is forbidden.

The data presented in this drawing have been collected using a combination of the following: consultation of utility asset information; visual survey; inspection of manholes and inspection chambers; electromagnetic location techniques; ground penetrating radar, and, where applicable, trial hole excavations. These techniques have been deployed in accordance with the BS1 PAS228 Specification for Ground Penetrating Radar Detection and the BS1 PAS229 Specification for Electromagnetic Location methodologies indicated below and described in the accompanying report. This drawing should be used in conjunction with the accompanying report which details the limitations of these techniques and any hindering factors encountered during this survey.

Unless otherwise stated, all utilities shown on this plan have been surveyed using approved detectors and the connections between inspection chambers, if unable to be detected, are generally assumed to be direct unless there are indications to the contrary. The detection confidence for each utility segment is depicted in line with the PAS128 scheme outlined below. Information depicted as QL-C or QL-D cannot be guaranteed as it is based on historic utility records which can be inaccurate and incomplete.

The utility routes depicted may reflect the routes of multiple cables or pipes. It is not always possible to differentiate between buried construction features, utilities and other subsurface linear features therefore it is possible that some features shown are not utility related, and due to the limitations of electromagnetic techniques all utility identifications should be treated with caution and verified prior to use during design/building works.

If the location or depth of utilities and features is of particular importance to a project then it is recommended that discussions are held with Precision Utility Mapping regarding any possible limitations or anomalies.

Please note that not all buried pipes, cables and ducts can be detected and mapped in consideration of their depth, location, material type, geology and proximity to other utilities. Even an appropriate and professionally executed survey may not be able to achieve a 100% detection rate. Where an area of utilities is likely to affect client project requirements, it is strongly recommended that a PAS128 Quality Level A verification survey is carried out

No utility mapping survey can be considered a 100% accurate depiction of the sub-surface environment, and the use of these drawings does not remove the requirement for the use of safe digging techniques at all times. Any excavations undertaken on site are to be in accordance with HSA Code of Practice for Avoiding Danger from Underground Services 2016.

SUB-SURFACE KEY

[illegible]

UTILITY CONFIDENCE LEVELS (Listed from High to Low)

- | | |
|-------|--|
| (V) | HORIZONTAL AND VERTICAL POSITION DETECTED BY SINGLE MEASUREMENT
(Accuracy: Horizontal: 250mm/Vertical:500mm) |
| (H,P) | HORIZONTAL AND VERTICAL POSITION DETECTED BY MULTIPLE MEASUREMENTS
WITH POST-PROCESSING OF GPS DATA
(Estimated Accuracy: 250mm OR 15% of detected depth) |
| (H) | HORIZONTAL POSITION DETECTED BY MULTIPLE MEASUREMENTS
(Estimated Accuracy: 250mm OR 15% of detected depth) |
| (V) | VERTICAL POSITION DETECTED BY MULTIPLE MEASUREMENTS
(Estimated Accuracy: 500mm OR 40% of detected depth) |
| (H,P) | HORIZONTAL AND VERTICAL POSITION DETECTED BY A SINGLE MEASUREMENT
(Estimated Accuracy: 250mm OR 15% of detected depth) |
| (H,P) | HORIZONTAL POSITION DETECTED BY POST-PROCESSED GPS DATA
(Estimated Accuracy: 250mm in the Horizontal / Depth is undefined) |
| (H,P) | HORIZONTAL POSITION DETECTED BY A SINGLE MEASUREMENT
WITH POST-PROCESSED DATA
(Estimated Accuracy: 250mm in the Horizontal / Depth is undefined) |
- A safety segment with a suspected to not be used has not been detected and is not included in the above table.

01	11/10/21	C.D.	SURVEY COMPLETED	K.S.	J.M.
Rev	Date	Drawn	Description	Chkd	Appd



Rathmale
Mungret
Limerick
Ireland
www.Precision-UM.ie

Client

Limerick 2030

Title

Cleeves

Utility Survey

Sheet 4 of 5

Surveyor	K. Beirne	K.B.	Eng check	—	—
Drawn	C. Daus	C.D.	Coordination	—	—

Dwg check	K. Sheehan	K.S.	Approved	J. Markham	J.M.
Scale at AO 1:200		Status Complete		Rev 01	

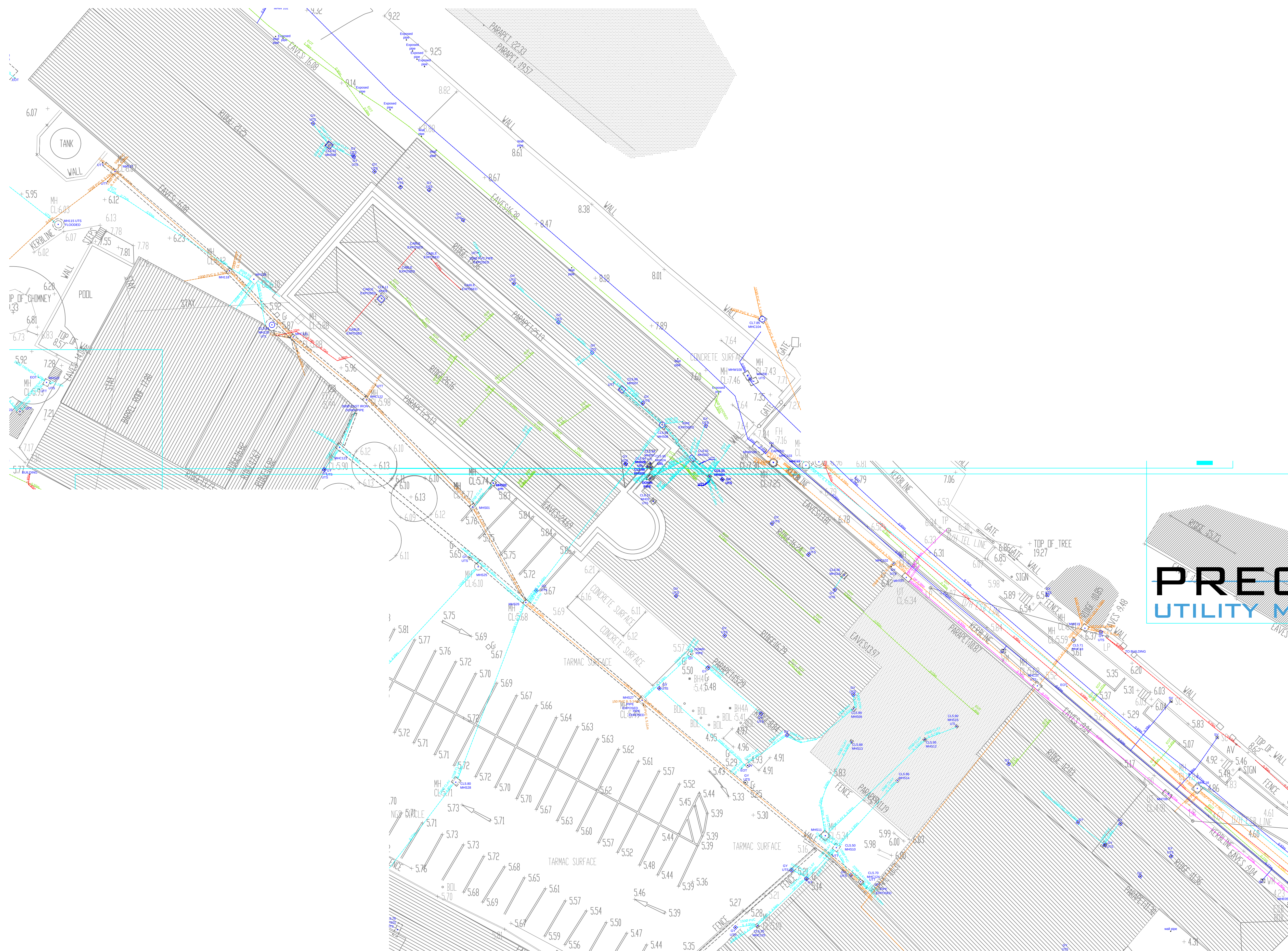
Drawing Number
PUM-10801-U-DR-0001-01

PAS128 SURVEY METHODOLOGY KEY

THIS SURVEY HAS BEEN CARRIED OUT IN ACCORDANCE WITH THE PAS128 SPECIFICATION FOR UNDERGROUND UTILITY DETECTION, VERIFICATION & LOCATION. THE SPECIFICATION ALLOWS A RANGE OF TECHNIQUES AND METHODS OF VARYING INTENSITY TO BE DEPLOYED. THE COLOUR CODED SCHEME INDICATES WHERE DIFFERENT SURVEY METHODOLOGIES HAVE BEEN USED ON SITE, AND THE LIST BELOW IDENTIFIES EQUIPMENT USED TO OBTAIN THE SURVEY RESULTS.

ELECTROMAGNETIC DETECTION	GROUND PENETRATING RADAR	TOTAL STATION	GPS/GNSS
Vibracloc 3	IDS Opera Duo		Trimble RB5

MD - SM - SEARCH TRIGGERED AT 2n INTERVALS - TRACKED AT 5n INTERVALS ON SET.	MD - SM - SEARCH TRIGGERED AT 2n INTERVALS - TRACKED AT 5n INTERVALS ON SET.	Drawn	C. Dous	C.D.	Coordination	-	-
MD - SM - SEARCH TRIGGERED AT 2n INTERVALS - TRACKED AT 5n INTERVALS ON SET.	MD - SM - SEARCH TRIGGERED AT 2n INTERVALS - TRACKED AT 5n INTERVALS ON SET.	bw	gack	K. Sheehan	K.S.	Approved	J. Markham
MD - SM - SEARCH TRIGGERED AT 2n INTERVALS - TRACKED AT 5n INTERVALS ON SET.	MD - SM - SEARCH TRIGGERED AT 2n INTERVALS - TRACKED AT 5n INTERVALS ON SET.	Scale at 0	1:200	Status	Complete	Rev	0
MD - SM - SEARCH TRIGGERED AT 2n INTERVALS - TRACKED AT 5n INTERVALS ON SET.	MD - SM - SEARCH TRIGGERED AT 2n INTERVALS - TRACKED AT 5n INTERVALS ON SET.	Drawing Number	PUM-10801-U-DR-0001-01				



C.3 Irish Water Record Drawings



Legend

Sewer Manholes

Standard

Sewer Mains (Irish Water)

Gravity - Combined

Gravity - Foul



Coordinate System: TM65 Irish Grid
Projection: Transverse Mercator

Scale @ A3: 1:2,000

Drawing No.: IW-AGG-2018-000

Drawn By: RD

Checked By: <Add Name>

Approved By: <Add Name>

Drawn Date 30/07/2025

Checked Date: <dd/mm/yyyy>

Approved Date: <dd/mm/yyyy>



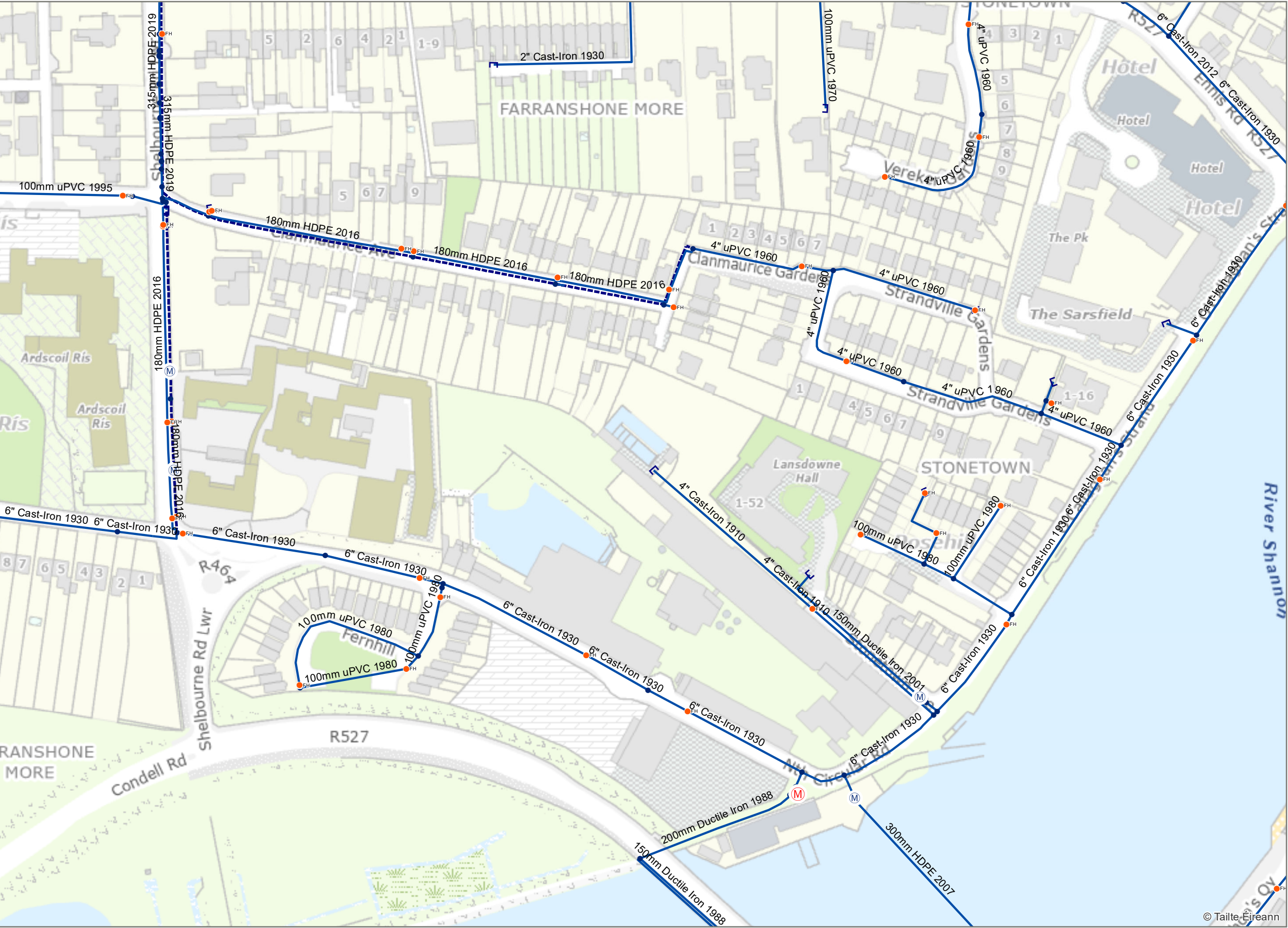
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2. Whilst every care has been taken in its compilation, Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish Water can assume no responsibility for and give no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided and does not accept any liability whatsoever arising from any errors or omissions. This information should not be relied upon in the event of excavations or any other works being carried out in the vicinity of the Irish Water underground network. The onus is on the parties carrying out excavations or any other works to ensure the exact location of the Irish Water underground network is identified prior to excavations or any other works being carried out. Service connection pipes are not generally shown but their presence should be anticipated.

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Sewer Network Cleeves Riverside Quarter



Legend

Non Boundary Meter

M Meter

Boundary Meter

M District (Boundary Meter)

Water Hydrants

FH Fire Hydrant

Water Fittings

Cap

Other Fitting

Water Mains(Irish Water Owned)

Potable Water

Water Abandoned Lines

Water Abandoned Lines



Coordinate System: TM65 Irish Grid
Projection: Transverse Mercator

Scale @ A3: 1:2,000

Drawing No.: IW-AGG-2018-000

Drawn By: RD

Checked By: <Add Name>

Approved By: <Add Name>

Drawn Date 30/07/2025

Checked Date: <dd/mm/yyyy>

Approved Date: <dd/mm/yyyy>



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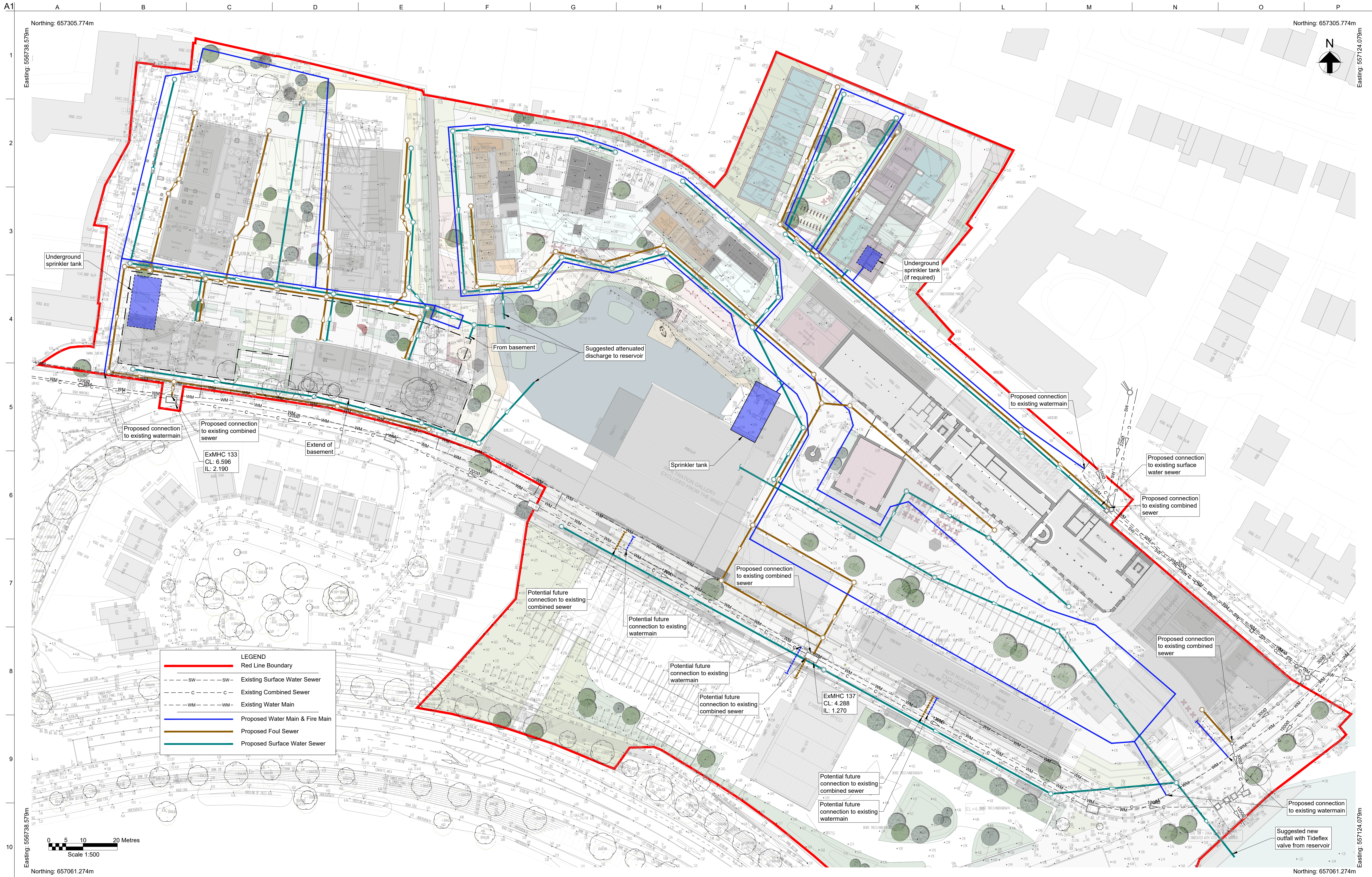
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Water Distribution Cleeves Riverside Quarter

C.4 Confirmation of Feasibility



- Notes:
1. SuDS - Use blue/ green roofs to attenuate surface water flows.
 2. Use permeable paving/ porous surfacing to car parking spaces/ pavements.
 3. Possibly use green areas as attenuation basins, tree pits etc.

P01	13/12/24	DF	AS	GS
Issued for Information (Status S2)				
Rev	Date	By	Chkd	Appd

ARUP

Anup, 50 Ringsend Road
Dublin, D04 T6X0
www.arup.ie
Tel +353(0)1 233 4455 Fax +353(0)1 668 3169

Client
LTT

Project Title
Cleaves Riverside Quarter Masterplan
Limerick

Drawing Title
Site Layout Map

Scale at A1	1:500
Role	Civil Drainage
Suitability	S2 - Suitable for Information
Arup Job No	277975
Name	SK-C-0001
Rev	P01

CONFIRMATION OF FEASIBILITY

Ana Sofijanic

50 Ringsend Road
Dublin
Dublin 4
D04T6X0

17 April 2025

Uisce Éireann
Bosca OP 448
Oifig Sheachadta na
Cathrach Theas
Cathair Chorcaí

Uisce Éireann
PO Box 448
South City
Delivery Office
Cork City

www.water.ie

Our Ref: CDS24010835 Pre-Connection Enquiry
Site at, Cleeves Site, North Circular Road, Limerick

Dear Anna,

We have completed the review of the Pre-Connection Enquiry.

Uisce Éireann has reviewed the pre-connection enquiry in relation to a Water & Wastewater connection for a Multi/Mixed Use Development of 503 unit(s) at Site at, Cleeves Site, North Circular Road, Limerick, (the **Development**).

Based upon the details provided we can advise the following regarding connecting to the networks;

- **Water Connection**
 - Feasible without infrastructure upgrade by Uisce Éireann
 - The 6-inch CI mains adjacent to the development site will have capacity to supply the requested demand
 - No, additional capacity for fire demand, it is recommended to use a storage tank with refill time of 12hrs.
 - It is recommended to minimize number of connections on site plan to two as per attached plan in Section B.
- **Wastewater Connection**
 - Feasible without infrastructure upgrade by Uisce Éireann
 - All existing gullies and downpipes within redline boundary (inclusive of public roads and in particular Euro Car Parks) to be picked up by new storm system and diverted away from UE foul network.

Stiúrthóirí / Directors: Niall Gleeson (POF / CEO), Jerry Grant (Cathaoirleach / Chairperson), Gerard Britchfield, Liz Joyce, Michael Nolan, Patricia King, Eileen Maher, Cathy Mannion, Paul Reid, Michael Walsh.

Oifig Chláraithe / Registered Office: Teach Colvill, 24-26 Sráid Thalbóid, Baile Átha Cliath 1, D01 NP86 / Colvill House, 24-26 Talbot Street, Dublin, Ireland D01NP86

Is cuideachta ghníomhaíochta ainmnithe atá faoi theorainn scaireanna é Uisce Éireann / Uisce Éireann is a designated activity company, limited by shares.

Cláraithe in Éirinn Uimh.: 530363 / Registered in Ireland No.: 530363.

This letter does not constitute an offer, in whole or in part, to provide a connection to any Uisce Éireann infrastructure. Before the Development can be connected to our network(s) you must submit a connection application and be granted and sign a connection agreement with Uisce Éireann.

As the network capacity changes constantly, this review is only valid at the time of its completion. As soon as planning permission has been granted for the Development, a completed connection application should be submitted. The connection application is available at www.water.ie/connections/get-connected/

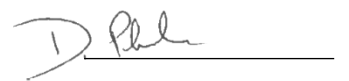
Where can you find more information?

- **Section A** - What is important to know?
- **Section B** - Details of Uisce Éireann's Network(s)

This letter is issued to provide information about the current feasibility of the proposed connection(s) to Uisce Éireann's network(s). This is not a connection offer and capacity in Uisce Éireann's network(s) may only be secured by entering into a connection agreement with Uisce Éireann.

For any further information, visit www.water.ie/connections, email newconnections@water.ie or contact 1800 278 278.

Yours sincerely,

A handwritten signature in blue ink, appearing to read 'D. Phelan', is written over a horizontal line.

Dermot Phelan
Connections Delivery Manager

Section A - What is important to know?

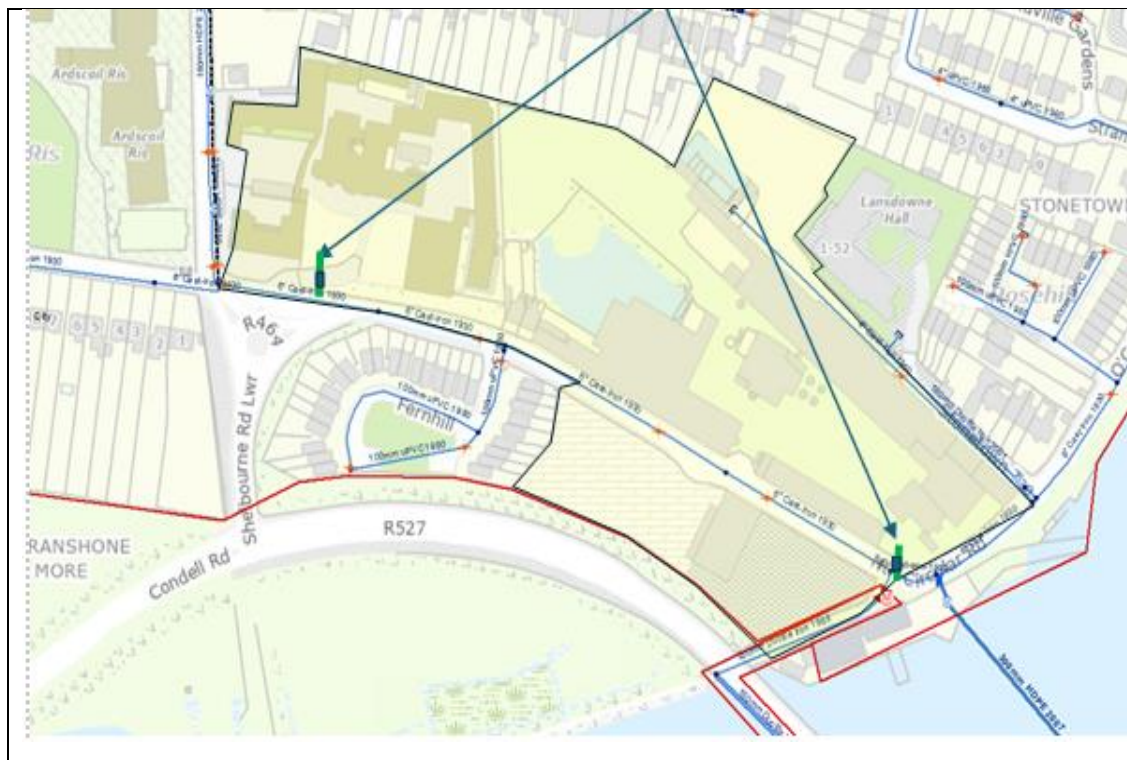
What is important to know?	Why is this important?
Do you need a contract to connect?	• Yes, a contract is required to connect. This letter does not constitute a contract or an offer in whole or in part to provide a connection to Uisce Éireann's network(s). • Before the Development can connect to Uisce Éireann's network(s), you must submit a connection application <u>and be granted and sign</u> a connection agreement with Uisce Éireann.
When should I submit a Connection Application?	• A connection application should only be submitted after planning permission has been granted.
Where can I find information on connection charges?	• Uisce Éireann connection charges can be found at: https://www.water.ie/connections/information/charges/
Who will carry out the connection work?	• All works to Uisce Éireann's network(s), including works in the public space, must be carried out by Uisce Éireann*. *Where a Developer has been granted specific permission and has been issued a connection offer for Self-Lay in the Public Road/Area, they may complete the relevant connection works
Fire flow Requirements	• The Confirmation of Feasibility does not extend to fire flow requirements for the Development. Fire flow requirements are a matter for the Developer to determine. • What to do? - Contact the relevant Local Fire Authority
Plan for disposal of storm water	• The Confirmation of Feasibility does not extend to the management or disposal of storm water or ground waters. • What to do? - Contact the relevant Local Authority to discuss the management or disposal of proposed storm water or ground water discharges.
Where do I find details of Uisce Éireann's network(s)?	• Requests for maps showing Uisce Éireann's network(s) can be submitted to: datarequests@water.ie

What are the design requirements for the connection(s)?	• The design and construction of the Water & Wastewater pipes and related infrastructure to be installed in this Development shall comply with <i>the Uisce Éireann Connections and Developer Services Standard Details and Codes of Practice</i>, available at www.water.ie/connections
Trade Effluent Licensing	• Any person discharging trade effluent** to a sewer, must have a Trade Effluent Licence issued pursuant to section 16 of the Local Government (Water Pollution) Act, 1977 (as amended). • More information and an application form for a Trade Effluent License can be found at the following link: https://www.water.ie/business/trade-effluent/about/ **trade effluent is defined in the Local Government (Water Pollution) Act, 1977 (as amended)

Section B – Details of Uisce Éireann’s Network(s)

The map included below outlines the current Uisce Éireann infrastructure adjacent the Development: To access Uisce Éireann Maps email

datarequests@water.ie



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Note: The information provided on the included maps as to the position of Uisce Éireann’s underground network(s) is provided as a general guide only. The information is based on the best available information provided by each Local Authority in Ireland to Uisce Éireann.

Whilst every care has been taken in respect of the information on Uisce Éireann’s network(s), Uisce Éireann assumes no responsibility for and gives no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided, nor does it accept any liability whatsoever arising from or out of any errors or omissions. This information should not be solely relied upon in the event of excavations or any other works being carried out in the vicinity of Uisce Éireann’s underground network(s). The onus is on the parties carrying out excavations or any other works to ensure the exact location of Uisce Éireann’s underground network(s) is identified prior to excavations or any other works being carried out. Service connection pipes are not generally shown but their presence should be anticipated.