



Flood Risk Assessment & Drainage Strategy

Proposed Commercial Units

Land Adjacent Kirkby Bank Road & Acornfield Road

Kirkby | Knowsley | Liverpool | L33 7BJ

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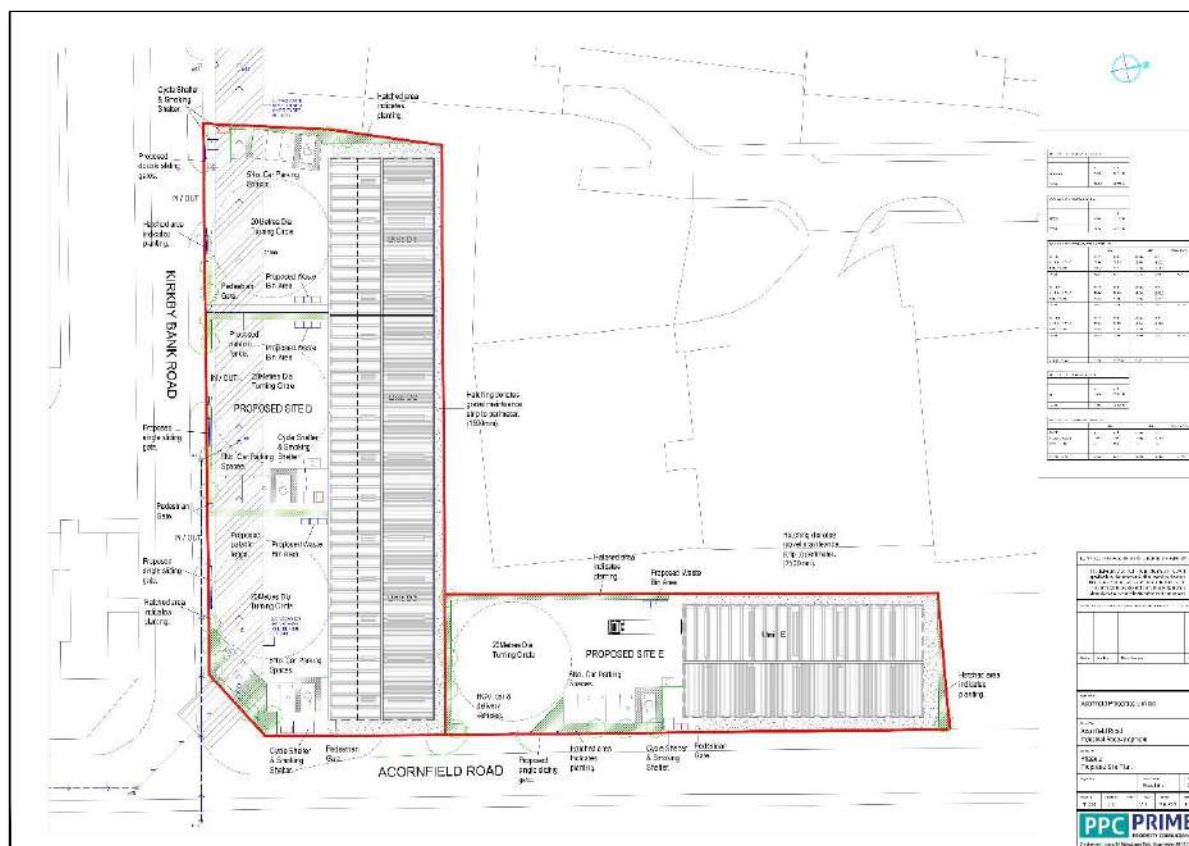
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It is proposed to construct 2no commercial buildings to provide 4no units and associated external hardstandings on land adjacent to Kirkby Bank Road and Acornfield Road in Kirkby, Knowsley as shown on the proposed site plan below (figure 1). The proposed site plan is also appended for reference. The units would be steel framed with lightweight cladding and roofs, whilst external areas would predominantly be hard landscaped with parking areas and service yards.



The development area is split into two areas labelled site D and site E. Site D to the south alongside Kirkby Bank Road has a red line area of 0.400ha and proposed building footprint of 1600sqm, whilst site E to the east alongside Acornfield Road has a red line area of 0.196ha and proposed building footprint of 760sqm. Site D is used for the storage of pallets, whilst site E has previously formed part of a larger car park area.

¹ PPC drawing reference PPC59-F010, no revision, Aug 2022

2.0 Flood Risk Assessment

2.1 Fluvial Sources

The overall area of development land considered in this report is approximately 0.596ha (shown edged in purple on the below figure). As the site is both remote from and elevated above the nearest main watercourse (statutory main river extents highlighted in yellow) it is considered to be in flood zone 1 with less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).

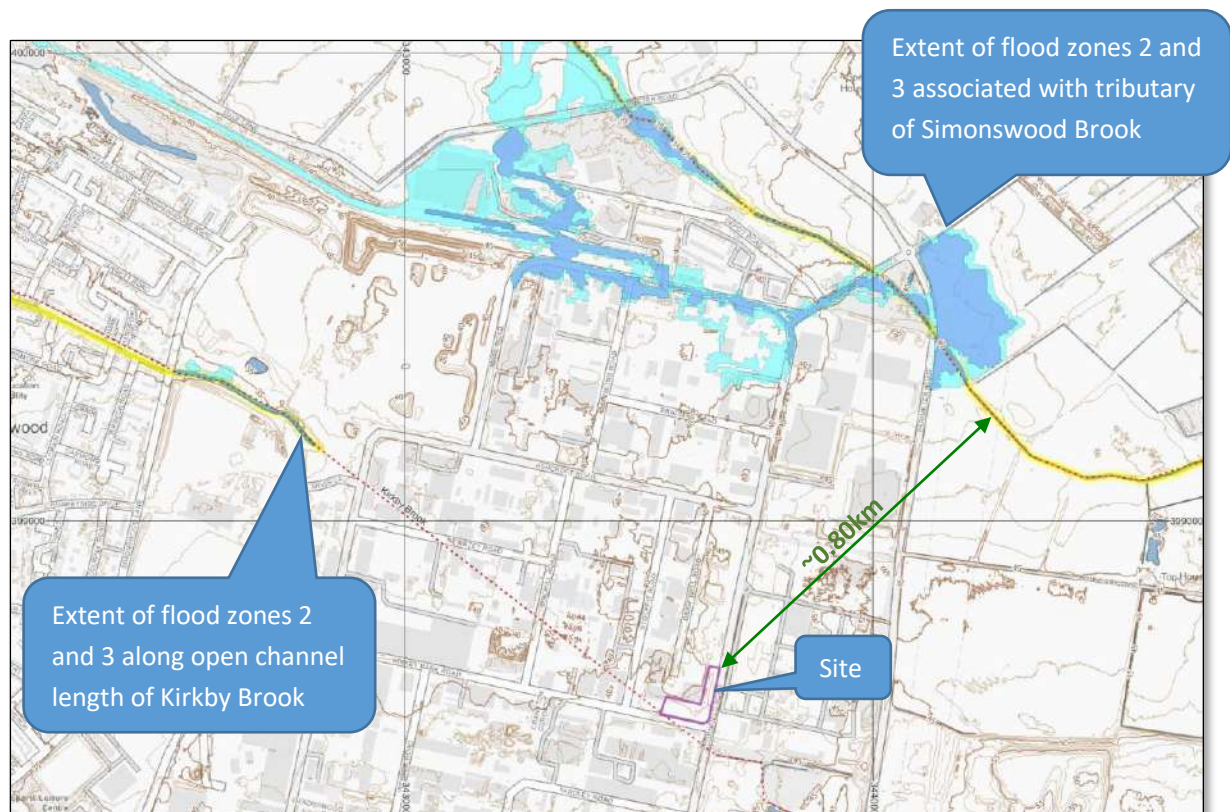


FIGURE 2 FLOODING FROM RIVERS

The red dotted line indicates the line of watercourse based on the OS Open Rivers dataset and suggests the Kirkby Brook crosses through the western corner of the site. Based on United Utilities mapping, the watercourse appears to have been culverted and classified as a surface water sewer as discussed later.

2.2 Reservoir Sources

The site is not shown to be within the zone of influence of flooding associated with reservoir failure.

2.3 Pluvial Sources

The Risk of Flooding from Surface Water (RoFSW) Map provides a graphical representation of how rainfall will flow across the terrain. It shows where areas of ponding can occur and secondary maps are also

provided that identify flow velocities and depths of flood water for three key return period scenarios (ie due to rainfall with a 3.3, 1 and 0.1 percent chance of occurring each year shown in light, medium and dark blue shading respectively). Figure 3 below shows the extents of low, medium and high risk of surface water flooding in the vicinity of the proposed development.

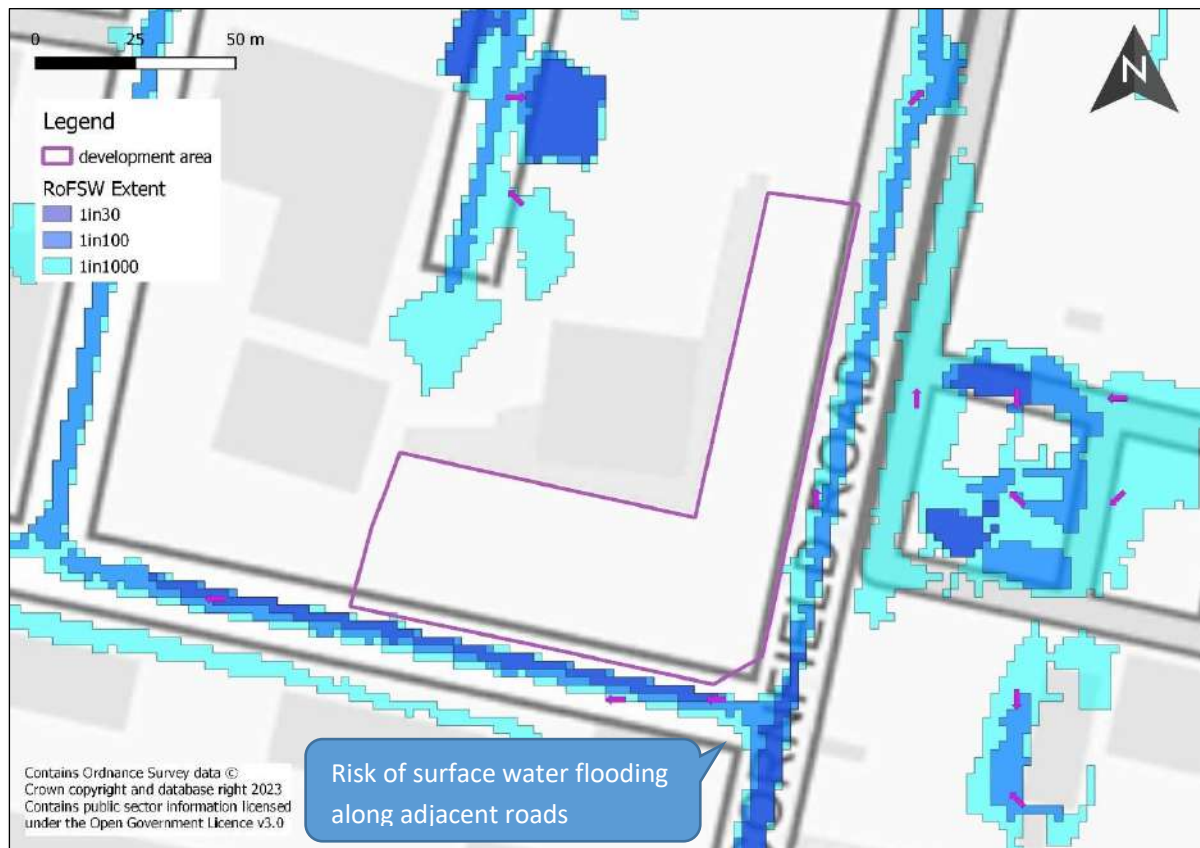


FIGURE 3 RISK OF FLOODING FROM SURFACE WATER EXTENTS

The development area is not shown in blue shading and so is considered to have a very low risk of surface water flooding, defined by the Environment Agency as land with a chance of flooding of less than 0.1% each year (1 in 1000 year return period).

The roads adjacent to the site are at risk of flooding from surface water and the flow direction arrows show that exceedance runoff in the vicinity will generally be carried via the surrounding highways acting as a shallow channel.

Using the current surface water flood map dataset, the hazard associated with the low-risk flood extents is shown below (figure 4). With reference to the Flood Hazard Rating Table extracted from DEFRA guidance FD2321 (see below) the Hazard to people classification for areas shaded in green are deemed to be 'very low hazard - caution'.



FIGURE 4 RISK OF FLOODING FROM SURFACE WATER HAZARD

This table is recommended for development planning and control use.

Table 4 – Hazard to People Classification using Hazard Rating ($HR = d \times (v + 0.5) + DF$) for (Source Table 13.1 of FD2320/TR2 - Extended version)

HR	Depth of flooding - d (m)												
	DF = 0.5				DF = 1								
Velocity v (m/s)	0.05	0.10	0.20	0.25	0.30	0.40	0.50	0.60	0.80	1.00	1.50	2.00	2.50
0.0	0.03+0.5= 0.53	0.05+0.5= 0.55	0.10+0.5= 0.60	0.13+0.5= 0.63	0.15+1.0= 1.15	0.20+1.0= 1.20	0.25+1.0= 1.25	0.30+1.0= 1.30	0.40+1.0= 1.40	0.50+1.0= 1.50	0.75+1.0= 1.75	1.00+1.0= 2.00	1.25+1.0= 2.25
0.1	0.03+0.5= 0.53	0.06+0.5= 0.56	0.12+0.5= 0.62	0.15+0.5= 0.65	0.18+1.0= 1.18	0.24+1.0= 1.24	0.30+1.0= 1.30	0.36+1.0= 1.36	0.48+1.0= 1.48	0.60+1.0= 1.60	0.90+1.0= 1.90	1.20+1.0= 2.20	1.30+1.0= 2.30
0.3	0.04+0.5= 0.54	0.08+0.5= 0.58	0.15+0.5= 0.65	0.19+0.5= 0.69	0.23+1.0= 1.23	0.30+1.0= 1.30	0.38+1.0= 1.38	0.45+1.0= 1.45	0.60+1.0= 1.60	0.75+1.0= 1.75	1.13+1.0= 2.13	1.30+1.0= 2.30	1.83+1.0= 2.83
0.5	0.05+0.5= 0.55	0.10+0.5= 0.60	0.20+0.5= 0.70	0.25+0.5= 0.75	0.30+1.0= 1.30	0.40+1.0= 1.40	0.50+1.0= 1.50	0.60+1.0= 1.60	0.80+1.0= 1.80	1.00+1.0= 2.00	1.50+1.0= 2.50	2.00+1.0= 3.00	2.50+1.0= 3.50
1.0	0.08+0.5= 0.58	0.15+0.5= 0.65	0.30+0.5= 0.80	0.38+0.5= 0.88	0.45+1.0= 1.45	0.60+1.0= 1.60	0.75+1.0= 1.75	0.90+1.0= 1.90	1.20+1.0= 2.20	1.50+1.0= 2.50	2.23+1.0= 3.23	3.00+1.0= 4.00	3.75+1.0= 4.75
Flood Hazard Rating (HR)	Colour Code		Hazard to People Classification										
Less than 0.75			Very low hazard - Caution										
0.75 to 1.25			Danger for some – includes children, the elderly and the infirm										
1.25 to 2.0			Danger for most – includes the general public										
More than 2.0			Danger for all – includes the emergency services										

2.4 Groundwater Sources

A desk top study reveals the following key points that are relevant to surface water and groundwater conditions:

- The site is located in groundwater source protection zone 3 (total catchment). This zone is defined as the total area needed to support the abstraction or discharge from the protected groundwater source.
- Bedrock Geology is described as '*Chester Formation - Sandstone*' and is classified as a '*Principal*' aquifer which is therefore considered to comprise '*layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifers*'.
- Superficial Geology is recorded as '*Shirdley Hill Sand Formation - Sand*' and is classified as a '*Secondary A*' aquifer considered to comprise '*Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers*'.
- A '*medium - high*' vulnerability class has been assigned to groundwater resources.
- The Soilscape Soil Map records '*naturally wet very acid sandy and loamy soils*' at and in the vicinity of the site which are '*naturally wet*' and drain to '*shallow groundwater*'.
- British Geological Survey (BGS) mapping also shows the site to be within an area of artificial ground, described as '*made ground (undivided) – artificial deposit*'.

The nearest BGS borehole records² are situated within 20m to the east of the site area as shown below on figure 5. These form part of an investigation that included ten other boreholes on land to the east of Acornfield Road by Conestoga-Rovers & Associates Ltd in June 2003 for Kodak Ltd. Made ground was recorded between 0.50m and 0.55m below ground level. SAND and SAND with occasional gravels was then recorded to 2.4m bgl and 3.6m bgl in 1027 and 1028 respectively. This is also described as fill and probably fill in each log by the driller. Subsequently 'boulder clay' is recorded to 4.3m bgl and 4.4m bgl over SANDSTONE to the base of each borehole at 4.5m bgl and 25m bgl respectively. Ground water is not recorded in 1027 but is found at approx. 8m bgl and rising to a static level of approx. 5m bgl in 1028.

² Record references SJ49NW1027 and SJ49NW1028

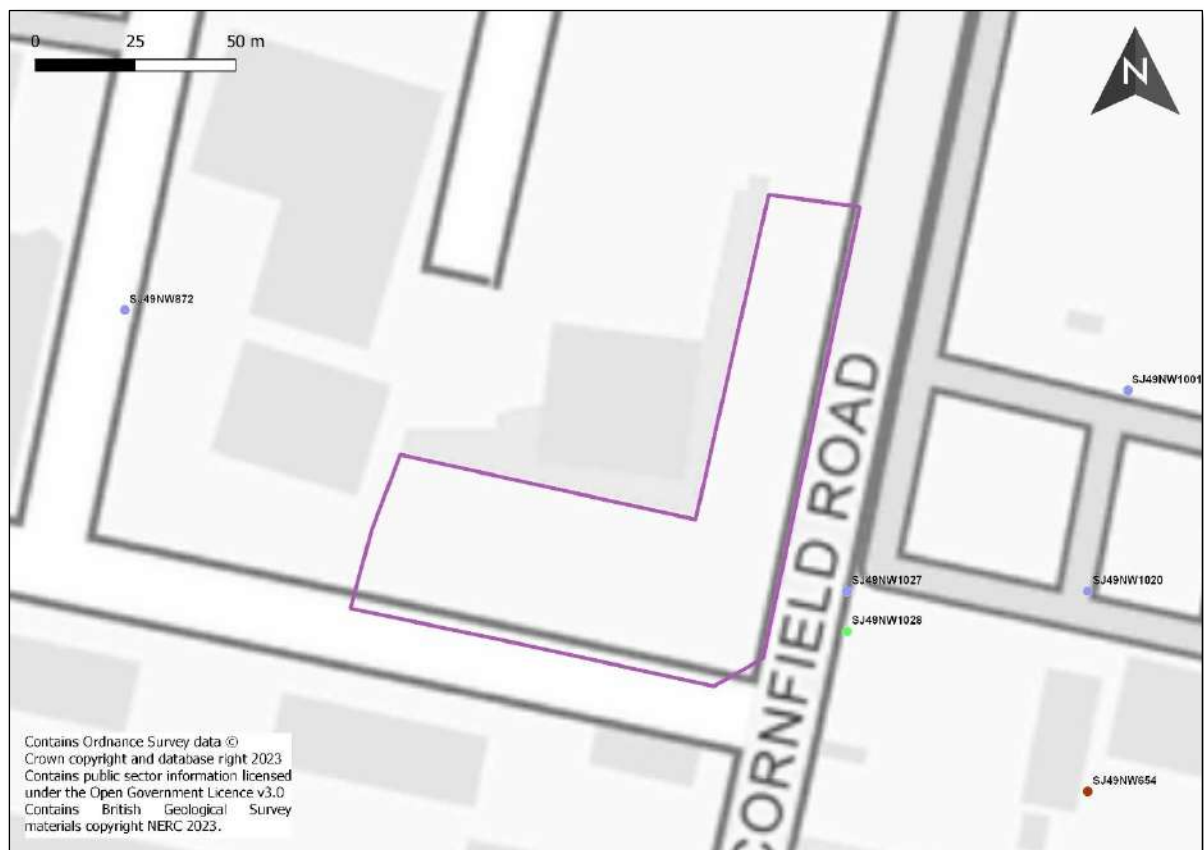


FIGURE 5 BGS BOREHOLE RECORD LOCATIONS

Intrusive ground investigation has been undertaken for the area of development that is the subject of this report as part of a wider area of development that includes land to the north which has now been implemented. The ground investigation report³ has been reviewed and the following ground conditions are noted:

MADE GROUND – The majority of Made Ground identified across the site was a gravelly sand that consisted of brick, asphalt and concrete, also localised reworked clay was identified in a number of locations to a maximum proven depth of 1.50m bgl.

DRIFT – Drift deposits were fairly varied across the site, comprising of a dark brown slightly gravelly clayey fine to medium SAND overlaying a; stiff, high-strength, brown mottled grey, slightly gravelly CLAY with sandstone and mudstone gravel at 3.00m bgl. A firm light grey sandy CLAY was identified in a small number of exploratory holes above 2.00 m bgl.

PEAT was identified in several location mainly within the north east of the site with a maximum depth of 1.4 m bgl.

Stiff boulder CLAY was identified within Cable Percussive location at a maximum depth of 8.5 m bgl. Occasional fine to course gravel of Sandstone and Mudstone was identified within the cohesive deposits.

³ Phase I and Phase II Geoenvironmental Site Assessment, E3P, Report Ref: 12-969-r1-1, October 2019

SOLID – Reddish brown weathered SANDSTONE was encountered within CP103 and CP104 at 6.0 m bgl and inferred in CP101 and CP102 at 7.50m bgl, this sandstone is found underlaying stiff bolder CLAY identified within cable percussive holes.

GROUNDWATER – Groundwater was encountered between 2 m bgl and 4 m bgl across the site.

Section 10.8 of E3P's report advises that: *'The site is underlain by permeable SAND and low permeability CLAY forming a barrier between the SAND and underlying BEDROCK. If soakaway drainage is to be considered, full BRE 365 testing must be completed to inform the detailed design'.*

The following plan shows the investigation holes that are relevant to the development area that is the subject of this FRA&DS:

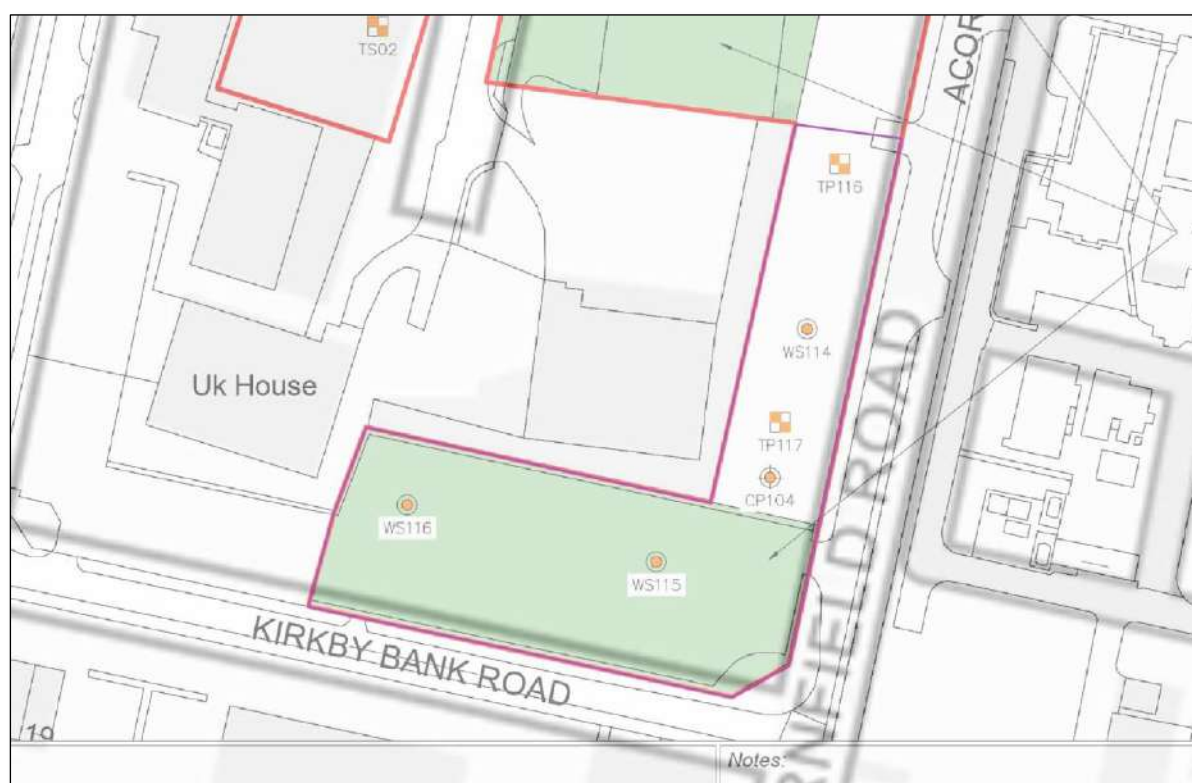


FIGURE 6 EXTRACT E3P EXPLORATORY HOLE LOCATION PLAN⁴

The relevant borehole and trial pit logs are appended and show that the depth of made ground across the development area varies between 0.5m (CP104) and 2.2m (WS114) from ground level. A thin band of PEAT is recorded below the made ground in WS115 from 0.6m to 1.0m bgl. Subsequently slightly clayey and clayey fine to medium SAND is recorded in all holes to depths between 2.6m to 3.9m bgl (terminating at the base of the trial pits at 2.0m and 2.1m depth. The three boreholes terminate in sandy CLAY at 5.45m depth with a band of clayey SAND present between sandy CLAY stratum between 4.0m and 4.7m bgl. CP104 extended through the sandy CLAY below which weathered SANDSTONE is recorded from 6.0m to the base of borehole at 7.5m bgl. A water strike was encountered at 4.00m bgl in WS116. It is noted

⁴ E3P drawing 12-969-004, rev R1, 04.07.2019

that a strong strong sulphur odour is attributed to the sand recorded in TP116 and WS116, whilst a strong organic odour is attributed to sand recorded in WS115.

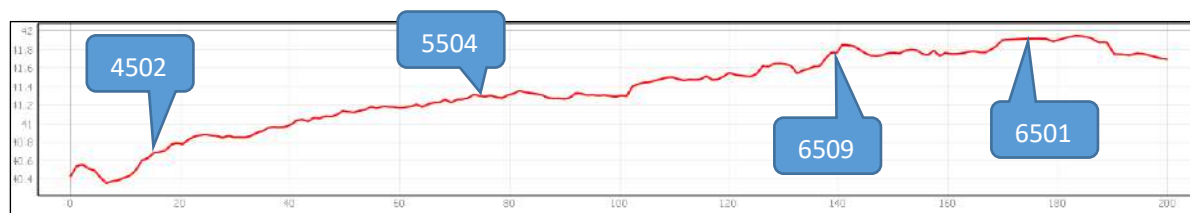
Given that a water strike was only recorded at one borehole location within the development area, this is not considered to be representative of the groundwater table which is likely to occur within the solid sandstone geology at depth. The low permeability nature of the superficial boulder sandy CLAY deposits will act as an aquitard limiting the movement of groundwater from rising and issuing at the surface. This aquitard will also effectively prevent the vertical movement of groundwater arising from infiltrated surface water and so it is expected that groundwater in the superficial SAND deposits will flow laterally following the surface of the CLAY layer assumed to be at a consistent depth and therefore mirroring the natural fall of the local terrain.

2.5 Artificial Sources

With reference to the extract of United Utilities sewer map below (figure 7), there are public sewers crossing through the site boundary and land surrounding the site. The surface water sewers crossing the southern part of site D are assumed to convey flows from the local watercourse (Kirkby Brook) after passing through Charley Wood and are therefore of significant size between 600mm and 900mm diameter. Whilst the pipe invert and cover levels at 6501 are available on the sewer records, the downstream chambers do not have levels recorded but are expected to be laid with a shallow fall. As such the surface water sewer depth is likely to generally be within 3m of ground level.



The fall of ground levels between 6501-6509-5504-4502 is illustrated graphically below based on LiDAR data with levels at each chamber as 41.91, 41.76, 41.29 and 40.69 respectively.



The sewer to the west of 4502 also increases from 900mm to 1500mm. It is therefore considered that due to the fall of sewer and change in size, the risk of sewer flooding to the proposed development is low.

3.0 Flood Risk Avoidance & Compatibility

3.1 Development Vulnerability

According to annexe 3⁵ of the NPPF '*buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution*' are classified as '*less vulnerable*' with respect to flood risk. The matrix in table 2⁶ of PPG-FRCC⁷ confirms that the exception test is not required for this type of land use in flood zones 1, 2 or 3a. This is subject to passing the Sequential Test, which requires land in flood zone 1 to be considered in preference to flood zones 2 or 3. It is noted in the guidance that table 2 also does not reflect the need to avoid flood risk from sources other than rivers and the sea.

As the site area is entirely in flood zone 1, it would not be necessary to apply the sequential or exception tests in respect of fluvial sources for development.

The interaction of all areas of the proposed development for other potential flood mechanisms needs to be considered as recommended by Paragraph 23 of PPG-FRCC: '*Other forms of flooding need to be treated consistently with river and tidal flooding in mapping probability and assessing vulnerability, so that the sequential approach can be applied across all areas of flood risk*'.

3.2 Flood Risk Management

Where it is not possible to avoid sources of flooding, the consequences of flooding to or as a result of a development can be mitigated by site and building design. For example, flood resilience measures can be

⁵ <https://www.gov.uk/guidance/national-planning-policy-framework/annex-3-flood-risk-vulnerability-classification>

⁶ <https://www.gov.uk/guidance/flood-risk-and-coastal-change#table2>

⁷ Planning Practice Guidance for Flood Risk and Coastal Change

integrated into the building design if a flood avoidance strategy is not viable. This process needs to be considered in relation to the expected depth and speed of onset of flooding, with the site and building made safe for their lifetime by taking into account the effects of climate change.

Paragraph 37 of PPG-FRCC directs developers to *'refer to the Strategic Flood Risk Assessments and site-specific Flood Risk Assessments to identify opportunities to reduce flood risk overall and to demonstrate that the measures go beyond just managing the flood risk resulting from the development'*. It advises that *'Reductions could be achieved, for example by:*

- *Incorporating green infrastructure within the layout and form of development to make additional space for the flow and storage of flood water;*
- *Providing Sustainable Drainage Systems, that manage flood risk beyond the proposed site and above the usual standard, such as by removing surface water from existing combined sewers;*
- *Providing or making contributions to flood risk management infrastructure that will provide additional benefits to existing communities and/or by safeguarding the land that would be needed to deliver it'.*

A drainage strategy is considered later in this document.

4.0 The Impact of Climate Change

The effect of changes in the climate has to be considered in respect of flood risk. Principally the effect of changes to rainfall intensity, duration and frequency is critical for surface water flood risk, rate of rise in river and minor watercourse water levels together with the extent of flooding when watercourse banksides and drainage system capacities are exceeded.

The Environment Agency provide advice⁸ for climate change allowances that should be considered in flood risk assessments for both river flows and rainfall intensities. The development area falls within the Alt and Crossens Management Catchment. The site is in flood zone 1 and so for 'less vulnerable' development, the central allowance categories for river flow increase are appropriate and the guidance suggests that the total potential change anticipated for the '2080s' (2070 to 2125) is 44%.

The EA's climate change allowance guidance also provides anticipated changes in extreme rainfall intensity in small and urban catchments and advises that:

'For flood risk assessments and strategic flood risk assessments assess the upper end allowances. You must do this for both the 1% and 3.3% annual exceedance probability events for the 2070s epoch (2061 to 2125). Design your development so that for the upper end allowance in the 1% annual exceedance probability event:

- *there is no increase in flood risk elsewhere*
- *your development will be safe from surface water flooding'.*

⁸ <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

In the Alt and Crossens Management Catchment, the following allowances apply for the 2070s epoch:

Annual Exceedance Rainfall Event	Central Allowance	Upper End Allowance
3.3% (1in30year return period)	30%	40%
1% (1in100year return period)	30%	45%

The climate change increases for rainfall are considered as part of the drainage design for the development.

5.0 Flooding – Development Interaction

5.1 The Impact of Flooding on The Development

Sources of flooding have been considered in section 2 above. It is clear there is a low risk of flooding from all sources to the development area. Therefore, no special precautions are deemed necessary to protect the site from existing sources of flooding.

5.2 The Impact of Development on Flood Risk

The current use of the land is mixed with site D being used for the storage of pallets, whilst site E is currently vacant but has previously formed part of a larger car park area. The runoff characteristics of the development areas are mixed but will be changed via the introduction of new structures and associated paving. As such it is important that the management of surface water runoff should not increase the rate of runoff and the use of sustainable drainage systems (SuDS) is the preferred mechanism for achieving this goal.

5.3 Mitigation Measures

5.3.1 SuDS

To mitigate the potential increase in the rate and volume of runoff that will be drained from the development area, the use of Sustainable Drainage Systems (SuDS) should be implemented in line with local and national planning policy as far as reasonably practicable with a view to managing runoff and where possible improving them towards greenfield characteristics.

SuDS will typically manage peak flow rates and volumes and offer water quality benefits. Ideally SuDS should also provide biodiversity and amenity benefits, but unfortunately there is limited scope for drainage techniques that can deliver these within the development area given the proposed built form with limited soft landscaping provision.

The lightweight form of roof finishes that are to be used to cover the steel framed buildings are not compatible for the use of green roofing. However, the roof areas are extensive relative to the building occupancy and so would provide an adequate catchment for efficient rainwater harvesting allowing rainwater re-use for toilet flushing for example. This is an aspect of the building design that can be considered further by the developer as part of detailed design and if used would provide overall benefit in terms of rainwater interception for regular rainfall events together with a reduction of potable water consumption but would not be considered to form adequate capacity for extreme rainwater management.

The potential for use of other SuDS techniques in addition to rainwater harvesting and green roofs is considered in more detail in section 6 below.

5.3.2 Building Design

Finished floor levels to properties should be sufficiently elevated above areas that may convey or accumulate flood water so that the risk of inundation is low. As described in the foregoing, there is not considered to be a risk of surface water flooding at the site. Therefore, finished floor levels will typically be provided to the proposed buildings to achieve at least a nominal 150mm above perimeter ground levels. The exception to this is locally at vehicle and pedestrian access to the buildings where a level threshold is needed. However, finished ground levels are to fall away from the buildings for at least 1m in all directions.

5.3.3 Access and Egress

Where possible, safe access and escape routes should be available to and from properties under flood conditions. It is preferable that self-evacuation can be undertaken whereby occupants of buildings that can be affected by flooding can act upon flood warnings before critical flood water levels are reached. This avoids the need for assisted evacuation / rescue by trained personnel. However, the vulnerability of occupants (older, young, ill and other less abled persons) may mean that refuge must be sought until assistance is available.

To be safe, the access/egress route should be dry and therefore needs to be located above the design flood level. Given the foregoing assessment of flood risk, whilst there is the potential for flood water along the adjacent highways under extreme flooding conditions, the low depth and velocity of flooding for the low risk (1in1000year) scenario represents a very low hazard as shown on figure 4 in section 2.3. Therefore, it is not considered that there is a special requirement to adjust ground levels, re-site buildings or similar to provide mitigation.

6.0 Drainage Strategy

6.1 Foul Water Drainage

It is intended to connect new foul water drainage to the existing foul water sewers that are located to the south of the development area, subject to formal agreement with UU under section 106 of the Water Industry Act. A logical connection point would be at chamber 6503 at the junction of Kirkby Bank Road and Acornfield Road as indicated on the appended drainage strategy plan.

6.2 Surface Water Drainage

6.2.1 Outfall destination hierarchy

The underlying ground conditions described in section 2.4 are not appropriate for the disposal of surface water runoff via infiltration due to variable depths of made ground and natural soils being potentially impacted by low-level inorganic and PAH compounds.

A positive outfall will be required. As noted in section 2.5, there are surface water sewers crossing the southern part of site D and these are assumed to convey flows from Kirkby Brook.

Therefore, it is proposed that surface water runoff from sites D and E will discharge to the local watercourse via the existing surface water sewer system at controlled rates as determined below.

6.2.2 Discharge rate

In the absence of a detailed drainage survey, runoff rates from the previously developed sites have been estimated using the urbanisation methods in the ReFH2 software as per the guidance of section 24.5, part 2b of The SuDS Manual (CIRIA C753).

A point descriptors XML file was purchased from the FEH Web Service for the site location (343576,398630) and loaded into ReFH2 software. The Areal Reduction Factor (ARF) was set to 1 and the default model parameters for an area of 0.5km² (50ha) for time to peak ($T_p = 1.573$ hrs) and baseflow lag ($BL = 46.51$) were noted.

ReFH2 was then configured for the actual areas of site D = 0.4ha (0.004km²) and site E = 0.196ha (0.00196km²) with T_p and BL reset to suit the 50ha catchment values. Both greenfield and brownfield runoff rates for summer and winter seasons have been determined using ReFH with the above parameters but with an urban area set to the site area for the brownfield scenarios.

From a review of Google Earth imagery, it is apparent that both sites are previously developed to their full extents and so for the brownfield scenario the Imperviousness factor (IF) has been set to 1. Site E has

evidently had a tarmac finish, whilst site D appears to be a mixture of finishes and so Impervious runoff factor (IRF) has been set at 0.9 for site E and 0.5 for site D.

The following tables summarise the results of the flow rates calculated by ReFH for each site:

SITE D 0.40ha	greenfield				brownfield			
	l/s			l/s/ha	l/s			l/s/ha
	summer	winter	average		summer	winter	average	
1 year	0.501	0.541	0.521	1.302	3.750	2.684	3.217	8.043
2 year	0.568	0.606	0.587	1.467	4.225	3.023	3.624	9.061
qbar	0.608	0.648	0.628	1.570	4.521	3.235	3.878	9.695
5 year	0.794	0.820	0.807	2.018	5.740	4.103	4.922	12.305
10 year	0.965	0.976	0.971	2.427	6.804	4.860	5.832	14.581
30 year	1.263	1.238	1.251	3.127	8.530	6.084	7.307	18.267
50 year	1.420	1.372	1.396	3.489	9.383	6.688	8.035	20.088
75 year	1.555	1.486	1.520	3.801	10.097	7.193	8.645	21.611
100 year	1.660	1.572	1.616	4.040	10.632	7.571	9.101	22.754
200 year	1.951	1.810	1.881	4.702	12.070	8.584	10.327	25.817
1000 year	3.060	2.670	2.865	7.162	16.947	12.005	14.476	36.190

SITE E 0.196ha	greenfield				brownfield			
	l/s			l/s/ha	l/s			l/s/ha
	summer	winter	average		summer	winter	average	
1 year	0.246	0.265	0.255	0.639	3.100	2.150	2.625	6.562
2 year	0.278	0.297	0.288	0.719	3.488	2.419	2.953	7.383
qbar	0.298	0.318	0.308	0.770	3.732	2.588	3.160	7.900
5 year	0.390	0.402	0.396	0.990	4.719	3.272	3.996	9.989
10 year	0.474	0.479	0.476	1.190	5.578	3.868	4.723	11.807
30 year	0.620	0.607	0.613	1.534	6.961	4.826	5.894	14.735
50 year	0.696	0.673	0.685	1.711	7.641	5.297	6.469	16.173
75 year	0.763	0.729	0.746	1.864	8.208	5.690	6.949	17.372
100 year	0.814	0.771	0.793	1.982	8.632	5.983	7.308	18.269
200 year	0.957	0.888	0.923	2.306	9.764	6.768	8.266	20.665
1000 year	1.501	1.310	1.405	3.513	13.552	9.389	11.470	28.676

Therefore, the design flow rate proposed for site D is $q_{bar} = 3.9\text{l/s}$ and for site E is $q_{bar} = 3.2\text{l/s}$.

6.2.3 Water Quality

The 2015 SuDS Manual provides best practice for surface water drainage including water quality aspects. In accordance with table 4.3 of the SuDS Manual (CIRIA C753) a 'medium' pollution hazard level is attributed to 'commercial yard and delivery areas'. The corresponding water quality management requirements for discharge to surface waters may be addressed by following the simple index approach.

To manage runoff from the service yard areas where a medium pollution hazard level applies, the suitable single stage SuDS treatment components are: bioretention system, permeable paving and wetland. None of these are appropriate due to lack of space or incompatibility with usage. Therefore, a two-stage treatment system could be implemented such as a swale in combination with a filter drain. However, there is insufficient space available for a swale to be provided given the proposed site layout.

Therefore, it is proposed that a proprietary treatment system is to be provided via the use of SPEL's ESR Stormceptors at each site in the development area. SPEL's literature (appended for reference) shows that these separators have mitigation indices of 0.8 TSS, 0.6 Metals and 0.9 Hydrocarbons. The paved area of Site D is 0.195ha and so model 215C1/ESR is suitable with capacity for an overall drainage area of 0.200ha. The paved area of Site E is 0.084ha and so model 210C1/ESR is suitable with capacity for an overall drainage area of 0.133ha.

6.2.4 Rainfall Intensity

It is necessary to provide capacity in the drainage system for runoff due to 1in30year return period rainfall with runoff exceeding this up to and including 1in100year return period intensities increased for climate change managed safely on site. It is recommended that for a robust system, the below ground attenuation capacity is sized for the 1in100year+cc scenario as this maximises ground level capacity for exceedance storage and flows.

6.2.5 Climate Change

As noted in section 4.0, the climate change allowance to be applied to peak rainfall intensity varies depending on the return period with +40% for 1in30year and +45% for 1in100year to be considered to suit the 2070s epoch and upper end allowances in line with EA guidance.

6.2.6 Urban Creep

Once established the owners of individual properties on a development may decide to extend roof and paved areas, which would add runoff to the drainage system. LASOO⁹ guidance advises a range of urban creep values that are to be applied to development runoff areas. It is not necessary to apply an urban creep allowance for non-residential development, which typically have a high percentage of impermeable area and little scope for building extension of paved area increases, which is the case for the subject site.

6.2.7 Attenuation Sizing

The attenuation tanks to each site in the development area have been sized to suit the catchments identified on the appended proposed drainage areas plan and the limiting rates identified in section 6.2.2 above. Therefore, the tank capacity for site D allows for 0.355ha runoff area and 3.9l/s discharge rate under 1in100yr+45% rainfall intensities as demonstrated via appended MD pages 1-4. Similarly, the tank

⁹ Local Authority SuDS Officer Organisation

capacity for site E allows for 0.160ha runoff area and 3.2l/s discharge rate under 1in100yr+45% rainfall intensities as demonstrated via appended MD pages 5-8.

6.2.8 Network Simulation

The crated tank attenuation sized in section 6.2.7 needs to be checked within the proposed drainage network to allow for surcharging and backwater effects. Therefore, the proposed drainage network shown on the appended drainage strategy plan has been modelled in MicroDrainage. Details of the proposed surface water drainage network model are shown on appended MicroDrainage pages 9-16. The final flow control upstream of the outfall is set with a flow rate that allows for the cascading drainage system (ie $3.2+3.9 = 7.1\text{l/s}$).

It can be seen from the summary of results on MicroDrainage pages 17-19 that flooding will not occur for 1in1year or 1in30year+40% rainfall events. The peak flow rate from the proposed drainage system does not exceed 7.1l/s for any of the simulated rainfall events. There is also no flooding for the 1in100year+45% rainfall events.

As the outfall is to a surface water sewer that is assumed to convey watercourse flows, UU's advice regarding a surcharged outfall has been followed. This requires that the outfall should be set to achieve a soffits level connection and that hydraulic simulations are undertaken for a 1 in 30 year storm taken against a surcharged outfall level of 1 metre above the soffit level of the receiving culvert, unless accurate modelling information can be supplied.

The level of 900mm diameter sewer at the proposed point of connection has been estimated to be 38.65m. Therefore, the soffit level of this pipe and the new 300mm pipe from the proposed drainage system is 39.55m. Appended MicroDrainage pages 20-21 show the surcharged outfall details and summary of simulation results for 1in30yr+40% rainfall events. The surcharged outfall limits flow out from the proposed drainage which takes longer to drain down and it can therefore be seen that the critical duration event is extended and the peak water level in the proposed drainage system is higher. However, no flooding occurs for the rainfall events modelled which have been checked up to 2880mins (48hrs) which is greater than the critical duration of 2160mins (36hrs).

6.2.9 Exceedance

The potential for flood water to adversely affect the proposed development has been considered via a deluge of rainfall applied across the proposed site terrain. A 15minute duration event of 1in100year return period with +45% increase for climate change has been used to allow for a flash rainfall event and complete blockage of the drainage system (ie the drainage system capacity is not modelled).

The resulting locations where flood water would pond on the site are shown graphically on the appended exceedance plan. The proposed buildings would not be flooded as ground levels fall away from them. An area of water accumulation would occur to the service yard in site D, but the depth of water would not cause a hazard and so is deemed to be acceptable.

6.2.10 Construction, Operation & Maintenance

Paragraphs 057-060 of the PPG-FRCC refer to the need for adequate maintenance arrangements to be in place for drainage systems. The drainage design should allow for maintenance to be undertaken and a plan should be in place to ensure an acceptable standard of operation and maintenance will be in place for the lifetime of the development.

The foregoing sections of this report have considered lifetime capacity aspects in terms of climate change and urban creep allowances. Aside from the final built form, it is important that the temporary conditions and/or timing of the pipe and storage facility installations are considered both by drainage designer and contractor to ensure that adequate cover or other protection is available to prevent damage by construction vehicle or material loadings. This should be addressed in line with standard CDM practice at construction stage and/or via risk assessment documentation.

The timing of installation for the crated tanks should therefore be considered to prevent unnecessary damage to this component. Details of attenuation tank construction are included on the drainage strategy plan. These are to be developed further via the detailed design process where required if alternative tank units are considered and assuming planning permission is granted, with final construction details included in the Health and Safety File in accordance with the CDM Regulations.

The location of all other underground drainage components shown on the appended drainage strategy plan such as pipes and chambers has been considered in cognisance of construction, operation and maintenance aspects of both temporary and permanent conditions. Therefore, pipes and chambers have been placed where anticipated loadings will be compatible with the depth of cover available. Again, it may be necessary for the contractor to sequence works on site so that the temporary loading conditions (eg plant, materials, scaffolding, etc) and potentially reduced cover (before final site levels are made up) do not compromise the placing of such drainage.

Apart from the proposed attenuation tank and pipes and chambers to the eastern end of the building on site D, it is unlikely that the depth of drainage will be an influencing factor on depth and form of foundation design given the nominal depth of pipes that would be provided around the perimeter of the proposed units. A note has been provided on the appended drainage strategy plan to highlight the need to consider foundation design in proximity to the tank and to the eastern end of unit D.

Once installed the system must be accessible for inspection and maintenance in line with current good practice. A good benchmark is that for adoptable drainage systems which should comply with Appendix C of Sewerage Sector Guidance which has now replaced the 'Sewers for Adoption' design and construction guide. The new guidance is referred to as 'Design and Construction Guidance'¹⁰. DEFRA Standards S10 to S14 inclusive provide more guidance in relation to structural integrity, designing for maintenance considerations and construction of sustainable drainage systems.

¹⁰ <https://www.water.org.uk/sites/default/files/2023-04/SSG%20Appendix%20C%20-%20Design%20and%20Construction%20Guidance%20v2-2.pdf>
<https://www.water.org.uk/policy-topics/managing-sewage-and-drainage/sustainable-drainage/>

It is important that all of the drainage system is regularly inspected and cleansed as necessary including above ground elements (eg gutters). The most important below ground items are the flow controls. These should be inspected on a monthly basis and after significant rainfall events. The following schedule of activities is provided for guidance in relation to the likely principal components of the drainage system that have been discussed in the foregoing.

Drainage Component	Comments	Operation & Maintenance Activity		
		Regular	Occasional	Remedial
Flow Controls (Hydrobrakes)	<i>Chambers S5 FC & S13 FC have been sited in open areas to ensure 24/7/365 access is available.</i>	Inspect monthly and after every significant rainfall event.	Check functionality of pivoting by-pass door facility and ensure steel operating rope is adequately secured within reach of chamber opening.	Cleansing of the chamber sump will be required possibly annually, but this can be assessed when the by-pass facility is inspected.
Attenuation Tank (crated)	<i>The tanks are online with upstream facilities to manage silt (catch pits, proprietary treatment systems)</i>	Inspect inlets (catch pit chambers) and outlets (flow control chambers) monthly for signs of silt build up. Check for signs of settlement over the footprints of the tanks annually.	Remove silts from inlet and outlet chambers as necessary.	If settlement occurs, monitor and consider trial pit excavation to verify structural adequacy of tanks.
Proprietary Treatment Systems (SPeL Stormceptor ESR Separators)	<i>Maintenance to be in accordance with manufacturer's guidance.</i>	Check at 3, 6 or 12 monthly intervals to determine the depth of silt in the primary chamber as recommended by manufacturer.	Removal of silt and light liquids as informed by regular inspection.	Investigate in the event of automatic alarm/monitoring system being triggered.

Once the drainage system has been constructed, a record plan of the as built information (if varied from the design layout and details) should be created that can be used as a reference for those who will manage and maintain the system.

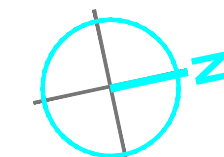
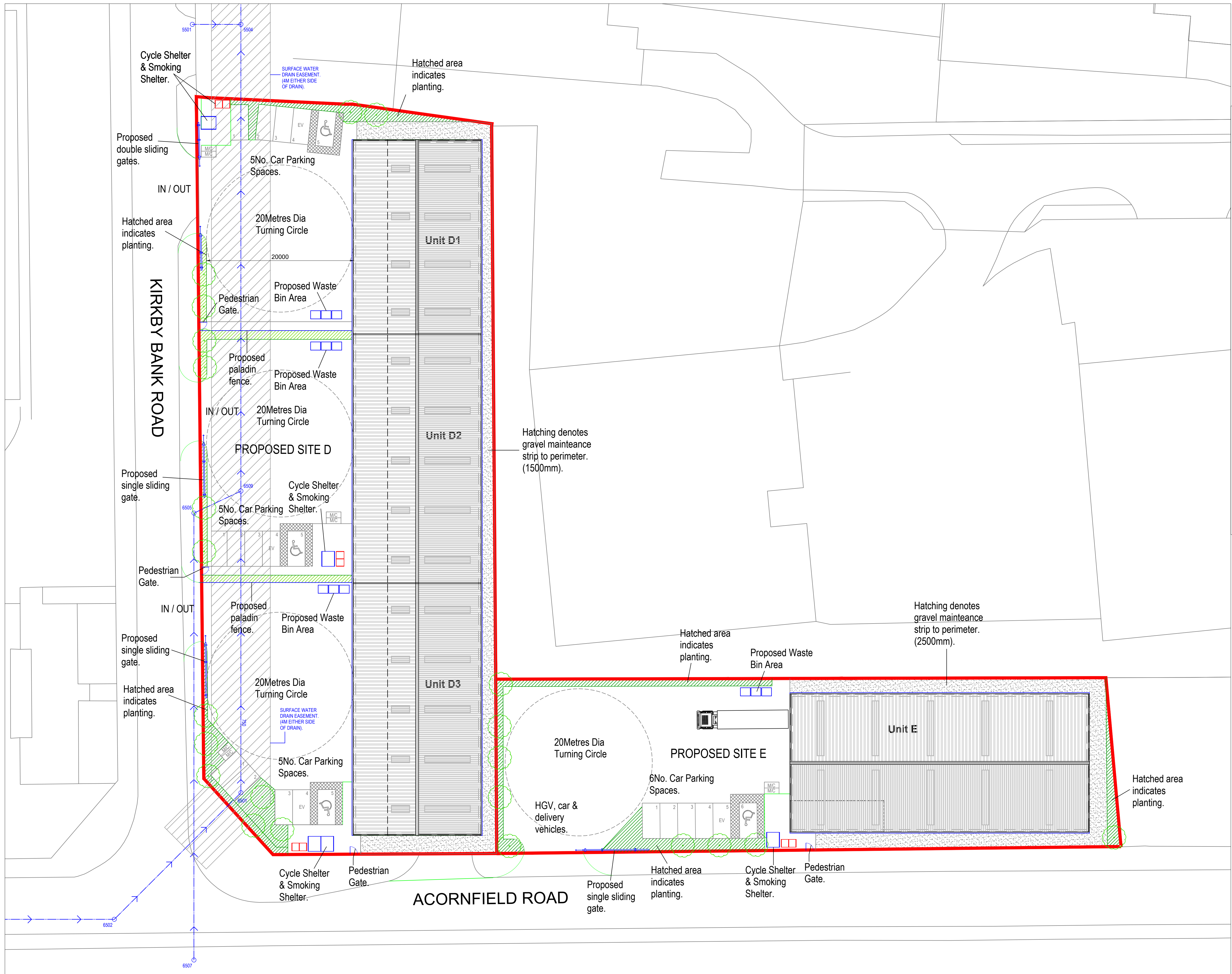
It is also recommended that an initial survey of the system should be undertaken (eg camera survey of pipes, removal and replacing chamber covers, ground level survey of basin, etc) to verify the condition and accessibility of the system as a baseline condition for further inspection and maintenance works.

7.0 Conclusion

This Flood Risk Assessment and Drainage Strategy report has reviewed all readily available information to determine the sources of flooding that could affect the site. The proposed development area is considered to be at low risk of flooding from groundwater, reservoir, sewer and surface water sources.

The proposed development has the potential to increase flood risk due to the introduction of new roof and paved areas, however the management of surface water at the site through the application of sustainable drainage principles will provide mitigation. This involves the use of proprietary treatment systems, attenuation tanks and flow controls to provide water quality and quantity benefits.

Appendix A – Proposed Site Plan



SCHEDULE OF SITE AREAS (SITE D & E)			
	sq. m.	sq. ft.	
SITE D & E	5960.0	63,772.0	
TOTAL	5960.0	63,772.0	

SCHEDULE OF SITE AREAS (SITE D)			
	sq. m.	sq. ft.	
SITE D	3995.0	42,745.0	
TOTAL	3995.0	42,745.0	

SCHEDULE OF ACCOMMODATION UNITS D1 - D3					
	GFA		GFA		Massw/m ² %
	sq. m.	sq. ft.	sq. m.	sq. ft.	
UNIT D1	434.0	4644.0	437.0	4690.0	
GROUND FLOOR	110.0	1177.0	123.0	1321.0	
TOTAL	544.0	5821.0	560.0	6011.0	27%
UNIT D2	592.0	6313.5	586.0	6270.0	
GROUND FLOOR	114.0	1220.0	126.0	1353.0	
TOTAL	676.0	7233.5	712.0	7623.0	24.5%
UNIT D3	565.0	6045.5	565.0	6045.5	
GROUND FLOOR	114.0	1225.0	126.0	1350.0	
TOTAL	679.0	7270.5	724.0	7745.5	21.5%
GRAND TOTAL	1899.0	20325.0	2017.0	21581.5	

SCHEDULE OF SITE AREAS (SITE E)			
	sq. m.	sq. ft.	
SITE E	1965.0	21,025.0	
TOTAL	1965.0	21,025.0	

SCHEDULE OF ACCOMMODATION UNIT E					
	GFA		GFA		Massw/m ² %
	sq. m.	sq. ft.	sq. m.	sq. ft.	
UNIT E	324.0	3474.0	324.0	3474.0	
GROUND FLOOR	48	514	56	599	
TOTAL	772.0	8281.0	821.0	8794.0	7.5%

DO NOT SCALE OFF DRAWING - PLEASE CHECK ALL DIMENSIONS ON SITE.

This drawing is to be read in conjunction with all relevant specifications, documents and other issued job drawings. Discrepancies or omissions must be reported to the client. The contractor is to check and verify all building and site dimensions and to check levels before work commences.

ALL INFORMATION CONTAINED ON THIS DRAWING REMAINS COPYRIGHT OF PRIME PROPERTY LIMITED ©

Revision	Issue Date	Revision Comments	By

Client Details:
Acornfield Properties Limited

Project Title:
Acornfield Road Industrial Redevelopment

Drawing Title:
Phase 2 Proposed Site Plan.

Project Stage	Work Package	A1 Scale
	Feasibility	1:250

Project No.	Drawing No.	Revision	Drawn	Created	Authorised
PPC59	F010	VSL	Aug 2022	JP	

Appendix B – Ground Investigation Logs

Project Name: Draw Well Road

Project No.
12969

Co-ords:

Hole Type
CP

Location: Knowsley

Level:

Scale
1:50

Client: Prime Property Consultancy Ltd

Dates: 29/06/2019

Logged By
A.AHMED

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10			MADE GROUND: Asphalt.	
		0.50	B		0.50			MADE GROUND: Dark brown gravelly fine to medium sand. Gravel is sub-rounded to angular brick concrete and ash.	
								Medium dense brown slightly clayey SAND.	
		1.00	B						1
		1.00	D						
		1.00	SPT	N=20 (3,4/5,5,5,5)					
		2.00	D		2.00			Loose brown slightly clayey SAND.	2
		2.00	SPT	N=4 (1,0/1,1,1,1)					
		3.00	D		3.20			Firm medium strength grey silty CLAY.	3
		3.00	SPT	N=6 (1,1/1,2,1,2)					
		4.00	U		4.00			Stiff high strength brown sandy CLAY.	4
		5.00	D						5
		5.00	SPT	N=14 (1,3/3,3,4,4)					
		6.00	D		6.00			Dense reddish brown weathered SANDSTONE.	6
		6.00	SPT	50 (3,7/50 for 235mm)					
		7.50	D		7.50			End of Borehole at 7.50m	8
		7.50	SPT	50 (20,5/50 for 105mm)					9
									10

Remarks

1.Chiseling from 6.00m to 7.50m bgl for 1 hour. 2. Monitoring well installed.

Trial Pit Log

TrialPit No
TP116
Sheet 1 of 1

Project Name: Draw Well Road

Project No.
12969

Co-ords: -
Level:

Date
27/06/2019

Location: Knowsley

Dimensions
(m):

2.00

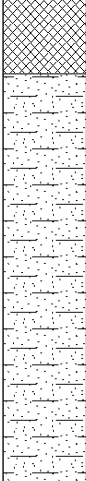
Scale
1:24

Client: Prime Property Consultancy Ltd

Depth
2.00

0.60

Logged
A.AHMED

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.40	ES		0.20			MADE GROUND: Asphalt.	
				0.70			MADE GROUND: Dark brown gravelly fine to medium sand with frequent cobbles. Gravel is fine to coarse sub-angular to angular asphalt concrete and brick cobbles are angular brick.	
				2.00			Dark brown fine to medium clayey SAND. (Strong sulphur odour).	1
							End of Pit at 2.00m	2
								3
								4
								5

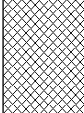
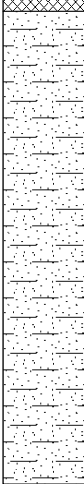
Remarks: 1. Complete

Stability: Stable.

Project Name: Draw Well Road Project No. 12969 Co-ords: - Level: Date 27/06/2019

Location: Knowsley Dimensions (m): 1.80 Scale 1:24

Client: Prime Property Consultancy Ltd Depth 2.10 Logged A.AHMED

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.30	ES		0.20			MADE GROUND: Asphalt.	
				0.60			MADE GROUND: Dark brown gravelly fine to medium sand with frequent cobbles. Gravel is fine to coarse sub-angular to angular asphalt concrete and brick cobbles are angular brick.	
	1.00	ES					Orangish brown slightly clayey fine to medium SAND.	1
				2.10			End of Pit at 2.10m	2
								3
								4
								5

Remarks: 1. Complete Stability: Stable.



Borehole Log

Borehole No.

WS114

Sheet 1 of 1

Project Name: Draw Well Road

Project No.
12969

Co-ords:

Hole Type
WS

Location: Knowsley

Level:

Scale
1:50

Client: Prime Property Consultancy Ltd

Dates: 28/06/2019

Logged By
A.AHMED

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30			MADE GROUND: Asphalt.	
		0.50	ES		0.70			MADE GROUND: Dark brown gravelly fine to medium sand. Gravel is fine to coarse sub-angular to angular asphalt concrete and brick.	1
		1.00	SPT	N=2 (1,0/0,1,0,1)				MADE GROUND: Dark brown clayey slightly gravelly fine to medium SAND. Gravel is fine to coarse asphalt and brick.	
		1.70	ES						2
		2.00	SPT	N=11 (2,3/3,3,3,2)	2.20				
		3.00	SPT	N=4 (2,2/1,1,1,1)				Loose light brown slightly clayey fine to medium SAND.	3
					3.70				
		4.00	D		4.00			Very stiff extremely high strength greyish brown slightly sandy CLAY.	4
		4.00	SPT	N=50 (4,4/12,12,13,13)				Dense light brown very clayey SAND.	
					4.70				
		5.00	D					Very stiff very high strength greyish brown sandy CLAY.	5
		5.00	SPT	N=49 (6,9/10,11,14,14)	5.45				
								End of Borehole at 5.45m	6
									7
									8
									9
									10

Remarks

1. Complete



				Borehole Log				Borehole No. WS115 Sheet 1 of 1		
Project Name: Draw Well Road				Project No. 12969		Co-ords:		Hole Type WS		
Location: Knowsley				Level:		Scale 1:50				
Client: Prime Property Consultancy Ltd				Dates: 28/06/2019		Logged By A.AHMED				
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
		0.30	ES	N=14 (3,2/3,3,4,4)	0.20			MADE GROUND: Asphalt.	1 2 3 4 5 6 7 8 9 10	
					0.60			MADE GROUND: Dark brown gravelly fine to medium sand. Gravel is fine to coarse sub-angular to angular asphalt concrete and brick.		
		1.00	SPT	N=12 (4,4/3,3,3,3)	1.00			Dark brown amorphous spongy PEAT.		
		1.20	ES		1.80			Dark brown clayey fine to medium SAND. (Strong Organic odour).		
		2.00	SPT	N=11 (1,2/2,3,3,3)	2.60			Medium dense light yellow slightly clayey fine to medium SAND.		
		3.00	D		3.40			Stiff high strength light grey slightly sandy slightly gravelly CLAY. Gravel is fine sub-rounded to round mudstone.		
		3.00	SPT	N=38 (5,6/7,8,12,11)				Stiff high strength brown slightly sandy CLAY.		
		4.00	D							
		4.00	SPT	N=48 (8,7/12,12,12,12)						
		5.00	D							
5.00	SPT		5.45			End of Borehole at 5.45m				
Remarks 1. Complete										

Project Name: Draw Well Road

Project No.
12969

Co-ords:

Hole Type
WS

Location: Knowsley

Level:

Scale
1:50

Client: Prime Property Consultancy Ltd

Dates: 28/06/2019

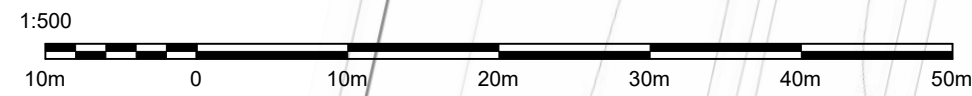
Logged By
A.AHMED

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.40	ES		0.20			MADE GROUND: Asphalt.	
		1.00	SPT	N=25 (6,5/5,7,7,6)	1.20			MADE GROUND: Black gravelly fine to medium sand. Gravel is fine to coarse sub-angular to angular asphalt concrete and brick.	1
		1.50	ES					Medium dense light brown clayey fine to medium SAND. (Strong sulphur odour).	
		2.00	SPT	N=15 (3,4/5,3,4,3)					2
		3.00	D SPT	N=9 (2,3/2,2,2,3)					3
		4.00	D SPT	N=15 (2,3/3,3,4,5)	3.90			Very stiff high strength dark brown sandy CLAY.	4
		5.00	D SPT	50 (9,9/50 for 255mm)	5.45			End of Borehole at 5.45m	5
									6
									7
									8
									9
									10

Remarks

1. Complete 2. Water strike encountered at 4.00m bgl.

Appendix C – Proposed Drainage Areas Plan, MicroDrainage Calculations & Exceedance Plan



LAND ADJACENT KIRKBY BANK ROAD AND
ACORNFIELD ROAD, KNOWSLEY INDUSTRIAL
PARK, KIRKBY, KNOWSLEY, LIVERPOOL, L33 7BJ

PROPOSED DRAINAGE AREAS PLAN

<u>PROPOSED SITE E AREAS</u>		
	ROOF	0.076HA
	PAVING	0.084HA
	TOTAL	<u>0.160HA</u>

<u>PROPOSED SITE D AREAS</u>		
	ROOF	0.160HA
	PAVING	0.195HA
	TOTAL	<u>0.355HA</u>



C J EMM Limited		Page 1
Hillside Metal Bridge Durham, DH6 5NX	Land adj Kirkby Bank Road & Acornfield Road, Kirkby T A N K D	
Date 30/10/2023 File site D.SRCX	Designed by cje Checked by	
Innovyze	Source Control 2020.1.3	

Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 448 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	39.795	0.445	0.0	3.9	3.9	88.7	O K
30 min Summer	39.929	0.579	0.0	3.9	3.9	115.4	O K
60 min Summer	40.060	0.710	0.0	3.9	3.9	141.6	O K
120 min Summer	40.170	0.820	0.0	3.9	3.9	163.6	O K
180 min Summer	40.213	0.863	0.0	3.9	3.9	172.1	O K
240 min Summer	40.227	0.877	0.0	3.9	3.9	174.9	O K
360 min Summer	40.220	0.870	0.0	3.9	3.9	173.5	O K
480 min Summer	40.200	0.850	0.0	3.9	3.9	169.5	O K
600 min Summer	40.179	0.829	0.0	3.9	3.9	165.4	O K
720 min Summer	40.158	0.808	0.0	3.9	3.9	161.1	O K
960 min Summer	40.115	0.765	0.0	3.9	3.9	152.7	O K
1440 min Summer	40.029	0.679	0.0	3.9	3.9	135.5	O K
2160 min Summer	39.890	0.540	0.0	3.9	3.9	107.8	O K
2880 min Summer	39.779	0.429	0.0	3.9	3.9	85.5	O K
4320 min Summer	39.618	0.268	0.0	3.9	3.9	53.4	O K
5760 min Summer	39.524	0.174	0.0	3.7	3.7	34.7	O K
7200 min Summer	39.472	0.122	0.0	3.5	3.5	24.2	O K
8640 min Summer	39.444	0.094	0.0	3.3	3.3	18.7	O K
10080 min Summer	39.431	0.081	0.0	2.9	2.9	16.1	O K
15 min Winter	39.850	0.500	0.0	3.9	3.9	99.7	O K
30 min Winter	40.002	0.652	0.0	3.9	3.9	130.1	O K
60 min Winter	40.151	0.801	0.0	3.9	3.9	159.8	O K
120 min Winter	40.279	0.929	0.0	3.9	3.9	185.3	O K
180 min Winter	40.332	0.982	0.0	3.9	3.9	195.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	137.944	0.0	91.7	19
30 min Summer	91.005	0.0	121.0	33
60 min Summer	57.224	0.0	152.3	64
120 min Summer	34.767	0.0	185.0	122
180 min Summer	25.626	0.0	204.6	182
240 min Summer	20.513	0.0	218.4	242
360 min Summer	14.928	0.0	238.4	360
480 min Summer	11.917	0.0	253.7	414
600 min Summer	9.998	0.0	266.1	476
720 min Summer	8.658	0.0	276.5	542
960 min Summer	6.894	0.0	293.6	674
1440 min Summer	4.993	0.0	318.9	954
2160 min Summer	3.610	0.0	345.9	1324
2880 min Summer	2.864	0.0	366.0	1700
4320 min Summer	2.065	0.0	395.7	2380
5760 min Summer	1.635	0.0	417.8	3064
7200 min Summer	1.364	0.0	435.6	3744
8640 min Summer	1.175	0.0	450.4	4408
10080 min Summer	1.036	0.0	463.4	5144
15 min Winter	137.944	0.0	102.7	18
30 min Winter	91.005	0.0	135.6	33
60 min Winter	57.224	0.0	170.5	62
120 min Winter	34.767	0.0	207.3	120
180 min Winter	25.626	0.0	229.1	178

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Hillside Metal Bridge Durham, DH6 5NX	Land adj Kirkby Bank Road & Acornfield Road, Kirkby T A N K D	
Date 30/10/2023 File site D.SRCX	Designed by cje Checked by	
Innovyze	Source Control 2020.1.3	

Summary of Results for 100 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	40.353	1.003	0.0	3.9	3.9	200.1	O K
360 min Winter	40.356	1.006	0.0	3.9	3.9	200.6	O K
480 min Winter	40.336	0.986	0.0	3.9	3.9	196.8	O K
600 min Winter	40.307	0.957	0.0	3.9	3.9	190.9	O K
720 min Winter	40.281	0.931	0.0	3.9	3.9	185.8	O K
960 min Winter	40.226	0.876	0.0	3.9	3.9	174.7	O K
1440 min Winter	40.106	0.756	0.0	3.9	3.9	150.8	O K
2160 min Winter	39.895	0.545	0.0	3.9	3.9	108.7	O K
2880 min Winter	39.728	0.378	0.0	3.9	3.9	75.3	O K
4320 min Winter	39.529	0.179	0.0	3.7	3.7	35.7	O K
5760 min Winter	39.448	0.098	0.0	3.3	3.3	19.6	O K
7200 min Winter	39.427	0.077	0.0	2.8	2.8	15.3	O K
8640 min Winter	39.414	0.064	0.0	2.4	2.4	12.8	O K
10080 min Winter	39.406	0.056	0.0	2.2	2.2	11.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	20.513	0.0	244.6	236
360 min Winter	14.928	0.0	267.0	346
480 min Winter	11.917	0.0	284.2	452
600 min Winter	9.998	0.0	298.0	506
720 min Winter	8.658	0.0	309.7	568
960 min Winter	6.894	0.0	328.8	722
1440 min Winter	4.993	0.0	357.3	1038
2160 min Winter	3.610	0.0	387.4	1432
2880 min Winter	2.864	0.0	410.0	1788
4320 min Winter	2.065	0.0	443.2	2424
5760 min Winter	1.635	0.0	468.0	3008
7200 min Winter	1.364	0.0	487.9	3680
8640 min Winter	1.175	0.0	504.6	4408
10080 min Winter	1.036	0.0	519.0	5136

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Hillside Metal Bridge Durham, DH6 5NX	Land adj Kirkby Bank Road & Acornfield Road, Kirkby T A N K D	
Date 30/10/2023 File site D.SRCX	Designed by cje Checked by	
Innovyze	Source Control 2020.1.3	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.500	Shortest Storm (mins)	15
Ratio R	0.390	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.355

Time (mins) Area
From: To: (ha)

0 4 0.355

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Hillside Metal Bridge Durham, DH6 5NX	Land adj Kirkby Bank Road & Acornfield Road, Kirkby T A N K D	
Date 30/10/2023 File site D.SRCX	Designed by cje Checked by	
Innovyze	Source Control 2020.1.3	

Model Details

Storage is Online Cover Level (m) 41.600

Cellular Storage Structure

Invert Level (m) 39.350 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	210.0	0.0	1.075	210.0	0.0	1.085	0.0	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0092-3900-1100-3900
Design Head (m) 1.100
Design Flow (l/s) 3.9
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 92
Invert Level (m) 39.330
Minimum Outlet Pipe Diameter (mm) 150
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.100	3.9	Kick-Flo®	0.684	3.1
Flush-Flo™	0.327	3.9	Mean Flow over Head Range	-	3.4

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.9	0.800	3.4	2.000	5.1	4.000	7.1	7.000	9.3
0.200	3.7	1.000	3.7	2.200	5.4	4.500	7.5	7.500	9.6
0.300	3.9	1.200	4.1	2.400	5.6	5.000	7.9	8.000	9.9
0.400	3.9	1.400	4.4	2.600	5.8	5.500	8.3	8.500	10.2
0.500	3.8	1.600	4.6	3.000	6.2	6.000	8.6	9.000	10.5
0.600	3.5	1.800	4.9	3.500	6.7	6.500	9.0	9.500	10.7

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Hillside Metal Bridge Durham, DH6 5NX	Land adj Kirkby Bank Road & Acornfield Road, Kirkby T A N K E	
Date 30/10/2023 File site E.SRCX	Designed by cje Checked by	
Innovyze	Source Control 2020.1.3	

Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 204 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	40.264	0.274	0.0	3.2	3.2	39.0	O K
30 min Summer	40.342	0.352	0.0	3.2	3.2	50.2	O K
60 min Summer	40.412	0.422	0.0	3.2	3.2	60.2	O K
120 min Summer	40.456	0.466	0.0	3.2	3.2	66.4	O K
180 min Summer	40.459	0.469	0.0	3.2	3.2	66.8	O K
240 min Summer	40.451	0.461	0.0	3.2	3.2	65.6	O K
360 min Summer	40.430	0.440	0.0	3.2	3.2	62.6	O K
480 min Summer	40.407	0.417	0.0	3.2	3.2	59.5	O K
600 min Summer	40.383	0.393	0.0	3.2	3.2	56.0	O K
720 min Summer	40.356	0.366	0.0	3.2	3.2	52.2	O K
960 min Summer	40.308	0.318	0.0	3.2	3.2	45.3	O K
1440 min Summer	40.227	0.237	0.0	3.2	3.2	33.7	O K
2160 min Summer	40.140	0.150	0.0	3.2	3.2	21.4	O K
2880 min Summer	40.092	0.102	0.0	3.1	3.1	14.5	O K
4320 min Summer	40.059	0.069	0.0	2.6	2.6	9.9	O K
5760 min Summer	40.045	0.055	0.0	2.1	2.1	7.8	O K
7200 min Summer	40.036	0.046	0.0	1.8	1.8	6.6	O K
8640 min Summer	40.030	0.040	0.0	1.5	1.5	5.8	O K
10080 min Summer	40.026	0.036	0.0	1.3	1.3	5.1	O K
15 min Winter	40.298	0.308	0.0	3.2	3.2	43.9	O K
30 min Winter	40.388	0.398	0.0	3.2	3.2	56.7	O K
60 min Winter	40.469	0.479	0.0	3.2	3.2	68.2	O K
120 min Winter	40.523	0.533	0.0	3.2	3.2	75.9	O K
180 min Winter	40.531	0.541	0.0	3.2	3.2	77.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	137.944	0.0	41.3	18
30 min Summer	91.005	0.0	54.5	33
60 min Summer	57.224	0.0	68.6	62
120 min Summer	34.767	0.0	83.4	120
180 min Summer	25.626	0.0	92.2	174
240 min Summer	20.513	0.0	98.4	202
360 min Summer	14.928	0.0	107.4	264
480 min Summer	11.917	0.0	114.3	334
600 min Summer	9.998	0.0	119.9	404
720 min Summer	8.658	0.0	124.6	466
960 min Summer	6.894	0.0	132.3	596
1440 min Summer	4.993	0.0	143.7	840
2160 min Summer	3.610	0.0	155.8	1188
2880 min Summer	2.864	0.0	164.9	1524
4320 min Summer	2.065	0.0	178.3	2208
5760 min Summer	1.635	0.0	188.3	2936
7200 min Summer	1.364	0.0	196.3	3672
8640 min Summer	1.175	0.0	203.0	4408
10080 min Summer	1.036	0.0	208.8	5136
15 min Winter	137.944	0.0	46.3	18
30 min Winter	91.005	0.0	61.1	32
60 min Winter	57.224	0.0	76.8	62
120 min Winter	34.767	0.0	93.4	118
180 min Winter	25.626	0.0	103.2	174

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Hillside Metal Bridge Durham, DH6 5NX	Land adj Kirkby Bank Road & Acornfield Road, Kirkby T A N K E	
Date 30/10/2023 File site E.SRCX	Designed by cje Checked by	
Innovyze	Source Control 2020.1.3	

Summary of Results for 100 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	40.521	0.531	0.0	3.2	3.2	75.7	O K
360 min Winter	40.493	0.503	0.0	3.2	3.2	71.7	O K
480 min Winter	40.463	0.473	0.0	3.2	3.2	67.4	O K
600 min Winter	40.430	0.440	0.0	3.2	3.2	62.7	O K
720 min Winter	40.395	0.405	0.0	3.2	3.2	57.7	O K
960 min Winter	40.316	0.326	0.0	3.2	3.2	46.5	O K
1440 min Winter	40.193	0.203	0.0	3.2	3.2	28.9	O K
2160 min Winter	40.089	0.099	0.0	3.1	3.1	14.1	O K
2880 min Winter	40.062	0.072	0.0	2.6	2.6	10.2	O K
4320 min Winter	40.041	0.051	0.0	1.9	1.9	7.2	O K
5760 min Winter	40.031	0.041	0.0	1.5	1.5	5.8	O K
7200 min Winter	40.024	0.034	0.0	1.3	1.3	4.9	O K
8640 min Winter	40.020	0.030	0.0	1.1	1.1	4.2	O K
10080 min Winter	40.016	0.026	0.0	1.0	1.0	3.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	20.513	0.0	110.2	226
360 min Winter	14.928	0.0	120.3	280
480 min Winter	11.917	0.0	128.1	358
600 min Winter	9.998	0.0	134.3	436
720 min Winter	8.658	0.0	139.6	514
960 min Winter	6.894	0.0	148.2	644
1440 min Winter	4.993	0.0	161.0	882
2160 min Winter	3.610	0.0	174.6	1188
2880 min Winter	2.864	0.0	184.7	1504
4320 min Winter	2.065	0.0	199.7	2208
5760 min Winter	1.635	0.0	210.9	2936
7200 min Winter	1.364	0.0	219.8	3672
8640 min Winter	1.175	0.0	227.4	4400
10080 min Winter	1.036	0.0	233.9	5136

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Hillside Metal Bridge Durham, DH6 5NX	Land adj Kirkby Bank Road & Acornfield Road, Kirkby T A N K E	
Date 30/10/2023	Designed by cje	
File site E.SRCX	Checked by	
Innovyze	Source Control 2020.1.3	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.500	Shortest Storm (mins)	15
Ratio R	0.390	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.160

Time (mins) Area
From: To: (ha)

0 4 0.160

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Hillside Metal Bridge Durham, DH6 5NX	Land adj Kirkby Bank Road & Acornfield Road, Kirkby T A N K E	
Date 30/10/2023 File site E.SRCX	Designed by cje Checked by	
Innovyze	Source Control 2020.1.3	

Model Details

Storage is Online Cover Level (m) 41.770

Cellular Storage Structure

Invert Level (m) 39.990 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	150.0	0.0	0.550	150.0	0.0	0.560	0.0	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0091-3200-0600-3200
Design Head (m) 0.600
Design Flow (l/s) 3.2
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 91
Invert Level (m) 39.970
Minimum Outlet Pipe Diameter (mm) 150
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	3.2	Kick-Flo®	0.413	2.7
Flush-Flo™	0.183	3.2	Mean Flow over Head Range	-	2.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.9	0.800	3.7	2.000	5.6	4.000	7.7	7.000	10.1
0.200	3.2	1.000	4.0	2.200	5.8	4.500	8.2	7.500	10.5
0.300	3.1	1.200	4.4	2.400	6.1	5.000	8.6	8.000	10.8
0.400	2.8	1.400	4.7	2.600	6.3	5.500	9.0	8.500	11.1
0.500	2.9	1.600	5.0	3.000	6.8	6.000	9.4	9.000	11.5
0.600	3.2	1.800	5.3	3.500	7.3	6.500	9.7	9.500	11.8

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Hillside Metal Bridge Durham, DH6 5NX	Land adj Kirkby Bank Road & Acornfield Road, Kirkby	
Date 30/10/2023 File 021B42.MDX	Designed by cje Checked by	
Innovyze	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Network 1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales			
Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	19.500	Add Flow / Climate Change (%)	0
Ratio R	0.390	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Surface Network 1

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.210	4-8	0.294	8-12	0.011

Total Area Contributing (ha) = 0.515

Total Pipe Volume (m³) = 23.934

Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	41.531	0.730	56.9	0.038	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	12.188	0.220	55.4	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	2.787	0.020	139.4	0.084	5.00	0.0	0.600	o	300	Pipe/Conduit	
2.001	3.593	0.020	179.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	7.205	0.040	180.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.000	41.531	0.880	47.2	0.038	5.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	5.319	0.110	48.4	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.52	41.250	0.038	0.0	0.0	0.0	1.34	23.6	5.2
1.001	50.00	5.67	40.520	0.038	0.0	0.0	0.0	1.35	23.9	5.2
2.000	50.00	5.03	40.240	0.084	0.0	0.0	0.0	1.33	94.0	11.3
2.001	50.00	5.09	40.170	0.084	0.0	0.0	0.0	1.17	82.7	11.3
1.002	50.00	5.77	40.150	0.122	0.0	0.0	0.0	1.17	82.6	16.5
3.000	50.00	5.47	41.250	0.038	0.0	0.0	0.0	1.47	25.9	5.2
3.001	50.00	5.53	40.370	0.038	0.0	0.0	0.0	1.45	25.6	5.2

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Hillside Metal Bridge Durham, DH6 5NX	Land adj Kirkby Bank Road & Acornfield Road, Kirkby	
Date 30/10/2023 File 021B42.MDX	Designed by cje Checked by	
Innovyze	Network 2020.1.3	

Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.003	27.500	0.128	214.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	2.500	0.012	214.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	5.233	0.030	174.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.000	75.975	1.155	65.8	0.064	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.006	19.656	0.090	218.4	0.016	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.007	18.481	0.090	205.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.008	48.440	0.220	220.2	0.040	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.000	47.190	1.200	39.3	0.040	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.009	3.500	0.025	140.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.000	27.926	0.210	133.0	0.064	5.00	0.0	0.600	o	225	Pipe/Conduit	
6.001	19.862	0.090	220.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.002	2.421	0.020	121.1	0.131	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.003	3.663	0.030	122.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.010	37.500	0.103	363.6	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.011	2.500	0.007	363.6	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.012	15.876	0.080	198.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.003	50.00	6.20	40.110	0.160	0.0	0.0	0.0	1.07	75.6	21.7
1.004	50.00	6.24	39.982	0.160	0.0	0.0	0.0	1.07	75.6	21.7
1.005	50.00	6.31	39.970	0.160	0.0	0.0	0.0	1.19	83.9	21.7
4.000	50.00	5.78	41.170	0.064	0.0	0.0	0.0	1.61	64.2	8.7
1.006	50.00	6.62	39.940	0.240	0.0	0.0	0.0	1.06	74.9	32.5
1.007	50.00	6.90	39.850	0.240	0.0	0.0	0.0	1.09	77.3	32.5
1.008	50.00	7.67	39.760	0.280	0.0	0.0	0.0	1.06	74.6	37.9
5.000	50.00	5.49	40.890	0.040	0.0	0.0	0.0	1.61	28.4	5.4
1.009	50.00	7.71	39.540	0.320	0.0	0.0	0.0	1.33	93.8	43.3
6.000	50.00	5.41	40.255	0.064	0.0	0.0	0.0	1.13	45.0	8.6
6.001	50.00	5.73	39.970	0.064	0.0	0.0	0.0	1.05	74.5	8.6
6.002	50.00	5.75	39.880	0.195	0.0	0.0	0.0	1.43	100.9	26.4
6.003	50.00	5.80	39.810	0.195	0.0	0.0	0.0	1.42	100.5	26.4
1.010	50.00	8.37	39.440	0.515	0.0	0.0	0.0	0.94	104.3	69.7
1.011	50.00	8.42	39.337	0.515	0.0	0.0	0.0	0.94	104.3	69.7
1.012	50.00	8.65	39.330	0.515	0.0	0.0	0.0	1.11	78.6	69.7

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PIPELINE SCHEDULES for Surface Network 1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	RE1	41.970	41.250	0.570	Open Manhole	150
1.001	o	150	S1	41.950	40.520	1.280	Open Manhole	1350
2.000	o	300	CH_E	41.700	40.240	1.160	Open Manhole	300
2.001	o	300	PI_E	41.770	40.170	1.300	Open Manhole	750
1.002	o	300	S2	41.880	40.150	1.430	Open Manhole	1350
3.000	o	150	RE2	42.000	41.250	0.600	Open Manhole	150
3.001	o	150	S3	41.970	40.370	1.450	Open Manhole	1350
1.003	o	300	S4 CP	41.930	40.110	1.520	Open Manhole	1200
1.004	o	300	TANK_E	41.770	39.982	1.488	Open Manhole	100
1.005	o	300	S5 FC	41.930	39.970	1.660	Open Manhole	1200
4.000	o	225	RE3	42.000	41.170	0.605	Open Manhole	225
1.006	o	300	S6	41.980	39.940	1.740	Open Manhole	1200
1.007	o	300	S7	41.860	39.850	1.710	Open Manhole	1200
1.008	o	300	S8	41.980	39.760	1.920	Open Manhole	1200
5.000	o	150	RE4	41.940	40.890	0.900	Open Manhole	150
1.009	o	300	S9	41.970	39.540	2.130	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	41.531	56.9	S1	41.950	40.520	1.280	Open Manhole	1350
1.001	12.188	55.4	S2	41.880	40.300	1.430	Open Manhole	1350
2.000	2.787	139.4	PI_E	41.770	40.220	1.250	Open Manhole	750
2.001	3.593	179.6	S2	41.880	40.150	1.430	Open Manhole	1350
1.002	7.205	180.1	S4 CP	41.930	40.110	1.520	Open Manhole	1200
3.000	41.531	47.2	S3	41.970	40.370	1.450	Open Manhole	1350
3.001	5.319	48.4	S4 CP	41.930	40.260	1.520	Open Manhole	1200
1.003	27.500	214.3	TANK_E	41.770	39.982	1.488	Open Manhole	100
1.004	2.500	214.3	S5 FC	41.930	39.970	1.660	Open Manhole	1200
1.005	5.233	174.4	S6	41.980	39.940	1.740	Open Manhole	1200
4.000	75.975	65.8	S6	41.980	40.015	1.740	Open Manhole	1200
1.006	19.656	218.4	S7	41.860	39.850	1.710	Open Manhole	1200
1.007	18.481	205.3	S8	41.980	39.760	1.920	Open Manhole	1200
1.008	48.440	220.2	S9	41.970	39.540	2.130	Open Manhole	1200
5.000	47.190	39.3	S9	41.970	39.690	2.130	Open Manhole	1200
1.009	3.500	140.0	S12 CP	41.880	39.515	2.065	Open Manhole	1350

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PIPELINE SCHEDULES for Surface Network 1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
6.000	o	225	CH_D	41.230	40.255	0.750	Open Manhole	150
6.001	o	300	S10	41.660	39.970	1.390	Open Manhole	1350
6.002	o	300	S11	41.720	39.880	1.540	Open Manhole	1200
6.003	o	300	PI_D	41.790	39.810	1.680	Open Manhole	750
1.010	o	375	S12 CP	41.880	39.440	2.065	Open Manhole	1350
1.011	o	375	TANK_D	41.670	39.337	1.958	Open Manhole	100
1.012	o	300	S13 FC	41.830	39.330	2.200	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
6.000	27.926	133.0	S10	41.660	40.045	1.390	Open Manhole	1350
6.001	19.862	220.7	S11	41.720	39.880	1.540	Open Manhole	1200
6.002	2.421	121.1	PI_D	41.790	39.860	1.630	Open Manhole	750
6.003	3.663	122.1	S12 CP	41.880	39.780	1.800	Open Manhole	1350
1.010	37.500	363.6	TANK_D	41.670	39.337	1.958	Open Manhole	100
1.011	2.500	363.6	S13 FC	41.830	39.330	2.125	Open Manhole	1350
1.012	15.876	198.5	S14	41.270	39.250	1.720	Open Manhole	1800

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Area Summary for Surface Network 1

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.038	0.038	0.038
1.001	-	-	100	0.000	0.000	0.000
2.000	User	-	100	0.084	0.084	0.084
2.001	-	-	100	0.000	0.000	0.000
1.002	-	-	100	0.000	0.000	0.000
3.000	User	-	100	0.038	0.038	0.038
3.001	-	-	100	0.000	0.000	0.000
1.003	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.000	0.000	0.000
4.000	User	-	100	0.064	0.064	0.064
1.006	User	-	100	0.016	0.016	0.016
1.007	-	-	100	0.000	0.000	0.000
1.008	User	-	100	0.040	0.040	0.040
5.000	User	-	100	0.040	0.040	0.040
1.009	-	-	100	0.000	0.000	0.000
6.000	User	-	100	0.064	0.064	0.064
6.001	-	-	100	0.000	0.000	0.000
6.002	User	-	100	0.066	0.066	0.066
	User	-	100	0.065	0.065	0.131
6.003	-	-	100	0.000	0.000	0.000
1.010	-	-	100	0.000	0.000	0.000
1.011	-	-	100	0.000	0.000	0.000
1.012	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.515	0.515	0.515

Free Flowing Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.012	S14	41.270	39.250	38.650	1800	0

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Online Controls for Surface Network 1

Non Return Valve Manhole: PI_E, DS/PN: 2.001, Volume (m³): 0.9

Hydro-Brake® Optimum Manhole: S5 FC, DS/PN: 1.005, Volume (m³): 2.3

Unit Reference	MD-SHE-0091-3200-0600-3200
Design Head (m)	0.600
Design Flow (l/s)	3.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	91
Invert Level (m)	39.970
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	3.2	Kick-Flo®	0.413	2.7
Flush-Flo™	0.183	3.2	Mean Flow over Head Range	-	2.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.9	0.800	3.7	2.000	5.6	4.000	7.7	7.000	10.1
0.200	3.2	1.000	4.0	2.200	5.8	4.500	8.2	7.500	10.5
0.300	3.1	1.200	4.4	2.400	6.1	5.000	8.6	8.000	10.8
0.400	2.8	1.400	4.7	2.600	6.3	5.500	9.0	8.500	11.1
0.500	2.9	1.600	5.0	3.000	6.8	6.000	9.4	9.000	11.5
0.600	3.2	1.800	5.3	3.500	7.3	6.500	9.7	9.500	11.8

Non Return Valve Manhole: PI_D, DS/PN: 6.003, Volume (m³): 1.0

Hydro-Brake® Optimum Manhole: S13 FC, DS/PN: 1.012, Volume (m³): 3.8

Unit Reference	MD-SHE-0123-7100-1100-7100
Design Head (m)	1.100
Design Flow (l/s)	7.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	123
Invert Level (m)	39.330
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.100	7.1	Kick-Flo®	0.711	5.8
Flush-Flo™	0.329	7.1	Mean Flow over Head Range	-	6.2

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

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Hydro-Brake® Optimum Manhole: S13 FC, DS/PN: 1.012, Volume (m³): 3.8

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.4	0.800	6.1	2.000	9.4	4.000	13.1	7.000	17.1
0.200	6.8	1.000	6.8	2.200	9.8	4.500	13.8	7.500	17.6
0.300	7.1	1.200	7.4	2.400	10.2	5.000	14.5	8.000	18.2
0.400	7.1	1.400	7.9	2.600	10.6	5.500	15.2	8.500	18.7
0.500	6.9	1.600	8.5	3.000	11.4	6.000	15.8	9.000	19.2
0.600	6.6	1.800	8.9	3.500	12.3	6.500	16.5	9.500	19.8

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Storage Structures for Surface Network 1

Cellular Storage Manhole: TANK_E, DS/PN: 1.004

Invert Level (m) 39.990 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	150.0	0.0	0.550	150.0	0.0	0.560	0.0	0.0

Cellular Storage Manhole: TANK_D, DS/PN: 1.011

Invert Level (m) 39.350 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	210.0	0.0	1.075	210.0	0.0	1.085	0.0	0.0

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 4 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.500 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.390 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 40, 45

PN	US/MH Name	Duration (mins)	First (X) Surcharge	Water Surcharged			Flooded Volume (m ³)	Flow / Cap.	Half Drain Time (mins)	Pipe Flow (l/s)	Status
				Level (m)	Depth (m)	Flow (m ³ /s)					
1.000	RE1	15	100/15 Summer	41.298	-0.102	0.000	0.22			5.0	OK
1.001	S1	15	100/15 Summer	40.569	-0.101	0.000	0.23			5.1	OK
2.000	CH_E	15	100/15 Summer	40.335	-0.205	0.000	0.22			11.3	OK
2.001	PI_E	15	100/15 Summer	40.268	-0.202	0.000	0.22			11.1	OK
1.002	S2	15	100/15 Summer	40.256	-0.194	0.000	0.27			16.2	OK
3.000	RE2	15		41.296	-0.104	0.000	0.20			5.0	OK
3.001	S3	15	100/15 Summer	40.421	-0.099	0.000	0.24			5.1	OK
1.003	S4 CP	15	100/15 Summer	40.224	-0.186	0.000	0.31			21.1	OK
1.004	TANK_E	120	30/60 Winter	40.080	-0.202	0.000	0.05		77	2.6	OK
1.005	S5 FC	120	30/30 Winter	40.082	-0.188	0.000	0.04			2.4	OK
4.000	RE3	15		41.226	-0.169	0.000	0.14			8.6	OK
1.006	S6	15	100/15 Summer	40.019	-0.221	0.000	0.16			10.3	OK
1.007	S7	15	100/15 Summer	39.929	-0.221	0.000	0.15			10.2	OK
1.008	S8	15	100/15 Summer	39.852	-0.208	0.000	0.20			14.1	OK
5.000	RE4	15	100/15 Winter	40.935	-0.105	0.000	0.19			5.3	OK
1.009	S9	15	30/15 Summer	39.659	-0.181	0.000	0.33			18.6	OK
6.000	CH_D	15	100/15 Summer	40.324	-0.156	0.000	0.20			8.4	OK
6.001	S10	15	30/15 Summer	40.055	-0.215	0.000	0.13			8.5	OK
6.002	S11	15	30/15 Summer	40.020	-0.160	0.000	0.44			23.3	OK
6.003	PI_D	15	30/15 Summer	39.938	-0.172	0.000	0.38			23.3	OK
1.010	S12 CP	15	30/15 Summer	39.613	-0.202	0.000	0.43			40.6	OK
1.011	TANK_D	120	30/30 Summer	39.493	-0.219	0.000	0.09		89	7.5	OK
1.012	S13 FC	120	30/15 Summer	39.507	-0.123	0.000	0.10			6.6	OK

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 4 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.500 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.390 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 40, 45

PN	US/MH Name	Duration (mins)	First (X) Surcharge	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap.	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	RE1	15	100/15 Summer	41.350	-0.050	0.000	0.75		17.2	OK
1.001	S1	15	100/15 Summer	40.623	-0.047	0.000	0.80		17.4	OK
2.000	CH_E	15	100/15 Summer	40.463	-0.077	0.000	0.75		38.7	OK
2.001	PI_E	15	100/15 Summer	40.453	-0.017	0.000	0.76		37.7	OK
1.002	S2	15	100/15 Summer	40.442	-0.008	0.000	0.87		52.6	OK
3.000	RE2	15		41.344	-0.056	0.000	0.69		17.3	OK
3.001	S3	15	100/15 Summer	40.480	-0.040	0.000	0.83		17.3	OK
1.003	S4 CP	15	100/15 Summer	40.410	0.000	0.000	1.01		68.7	OK
1.004	TANK_E	120	30/60 Winter	40.343	0.061	0.000	0.11	150	5.6	SURCHARGED
1.005	S5 FC	120	30/30 Winter	40.433	0.163	0.000	0.06		3.2	SURCHARGED
4.000	RE3	15		41.280	-0.115	0.000	0.46		28.8	OK
1.006	S6	15	100/15 Summer	40.117	-0.123	0.000	0.53		34.5	OK
1.007	S7	15	100/15 Summer	40.079	-0.071	0.000	0.49		33.0	OK
1.008	S8	15	100/15 Summer	40.048	-0.012	0.000	0.64		44.7	OK
5.000	RE4	15	100/15 Winter	40.980	-0.060	0.000	0.65		18.0	OK
1.009	S9	240	30/15 Summer	39.991	0.151	0.000	0.29		16.2	SURCHARGED
6.000	CH_D	15	100/15 Summer	40.460	-0.020	0.000	0.69		28.8	OK
6.001	S10	15	30/15 Summer	40.354	0.084	0.000	0.49		32.0	SURCHARGED
6.002	S11	15	30/15 Summer	40.326	0.146	0.000	1.65		87.0	SURCHARGED
6.003	PI_D	15	30/15 Summer	40.195	0.085	0.000	1.44		87.6	SURCHARGED
1.010	S12 CP	240	30/15 Summer	39.990	0.175	0.000	0.35		33.3	SURCHARGED
1.011	TANK_D	240	30/30 Summer	39.985	0.273	0.000	0.13	299	10.8	SURCHARGED
1.012	S13 FC	240	30/15 Summer	40.121	0.491	0.000	0.11		7.1	SURCHARGED

C J EMM Limited		Page 19
Hillside Metal Bridge Durham, DH6 5NX	Land adj Kirkby Bank Road & Acornfield Road, Kirkby	
Date 30/10/2023 File 021B42.MDX	Designed by cje Checked by	
Innovyze	Network 2020.1.3	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 4 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.500 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.390 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 40, 45

PN	US/MH Name	Duration (mins)	First (X) Surcharge	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap.	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	RE1	15	100/15 Summer	41.526	0.126	0.000	1.00		23.0	SURCHARGED
1.001	S1	15	100/15 Summer	40.805	0.135	0.000	1.02		22.2	SURCHARGED
2.000	CH_E	15	100/15 Summer	40.621	0.081	0.000	1.00		51.6	SURCHARGED
2.001	PI_E	15	100/15 Summer	40.602	0.132	0.000	1.01		50.2	SURCHARGED
1.002	S2	15	100/15 Summer	40.583	0.133	0.000	1.16		70.0	SURCHARGED
3.000	RE2	15		41.391	-0.009	0.000	0.92		23.2	OK
3.001	S3	15	100/15 Summer	40.634	0.114	0.000	1.07		22.3	SURCHARGED
1.003	S4 CP	15	100/15 Summer	40.503	0.093	0.000	1.34		91.7	SURCHARGED
1.004	TANK_E	120	30/60 Winter	40.500	0.218	0.000	0.11	213	5.8	SURCHARGED
1.005	S5 FC	120	30/30 Winter	40.601	0.331	0.000	0.06		3.2	SURCHARGED
4.000	RE3	15		41.302	-0.093	0.000	0.62		38.6	OK
1.006	S6	15	100/15 Summer	40.417	0.177	0.000	0.63		40.7	SURCHARGED
1.007	S7	15	100/15 Summer	40.376	0.226	0.000	0.63		42.2	SURCHARGED
1.008	S8	15	100/15 Summer	40.338	0.278	0.000	0.80		56.0	SURCHARGED
5.000	RE4	15	100/15 Winter	41.102	0.062	0.000	0.87		24.1	SURCHARGED
1.009	S9	360	30/15 Summer	40.271	0.431	0.000	0.28		15.4	SURCHARGED
6.000	CH_D	15	100/15 Summer	40.786	0.306	0.000	0.92		38.6	SURCHARGED
6.001	S10	15	30/15 Summer	40.599	0.329	0.000	0.63		40.8	SURCHARGED
6.002	S11	15	30/15 Summer	40.560	0.380	0.000	2.25		118.8	SURCHARGED
6.003	PI_D	15	30/15 Summer	40.320	0.210	0.000	1.94		117.5	SURCHARGED
1.010	S12 CP	360	30/15 Summer	40.270	0.455	0.000	0.34		32.3	SURCHARGED
1.011	TANK_D	360	30/30 Summer	40.265	0.553	0.000	0.13	459	10.8	SURCHARGED
1.012	S13 FC	360	30/15 Summer	40.397	0.767	0.000	0.11		7.1	SURCHARGED

Surcharged Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.012	S14	41.270	39.250	38.650	1800	0
Datum (m) 39.550 Offset (mins) 0						

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
720	1.000	1440	1.000	2160	1.000	2880	1.000

C J EMM Limited		Page 21
Hillside Metal Bridge Durham, DH6 5NX	Land adj Kirkby Bank Road & Acornfield Road, Kirkby SURCHARGED OUTFALL	
Date 30/10/2023 File 021B42.mdx	Designed by cje Checked by	
Innovyze	Network 2020.1.3	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 4 Number of Storage Structures 2 Number of Real Time Controls 0

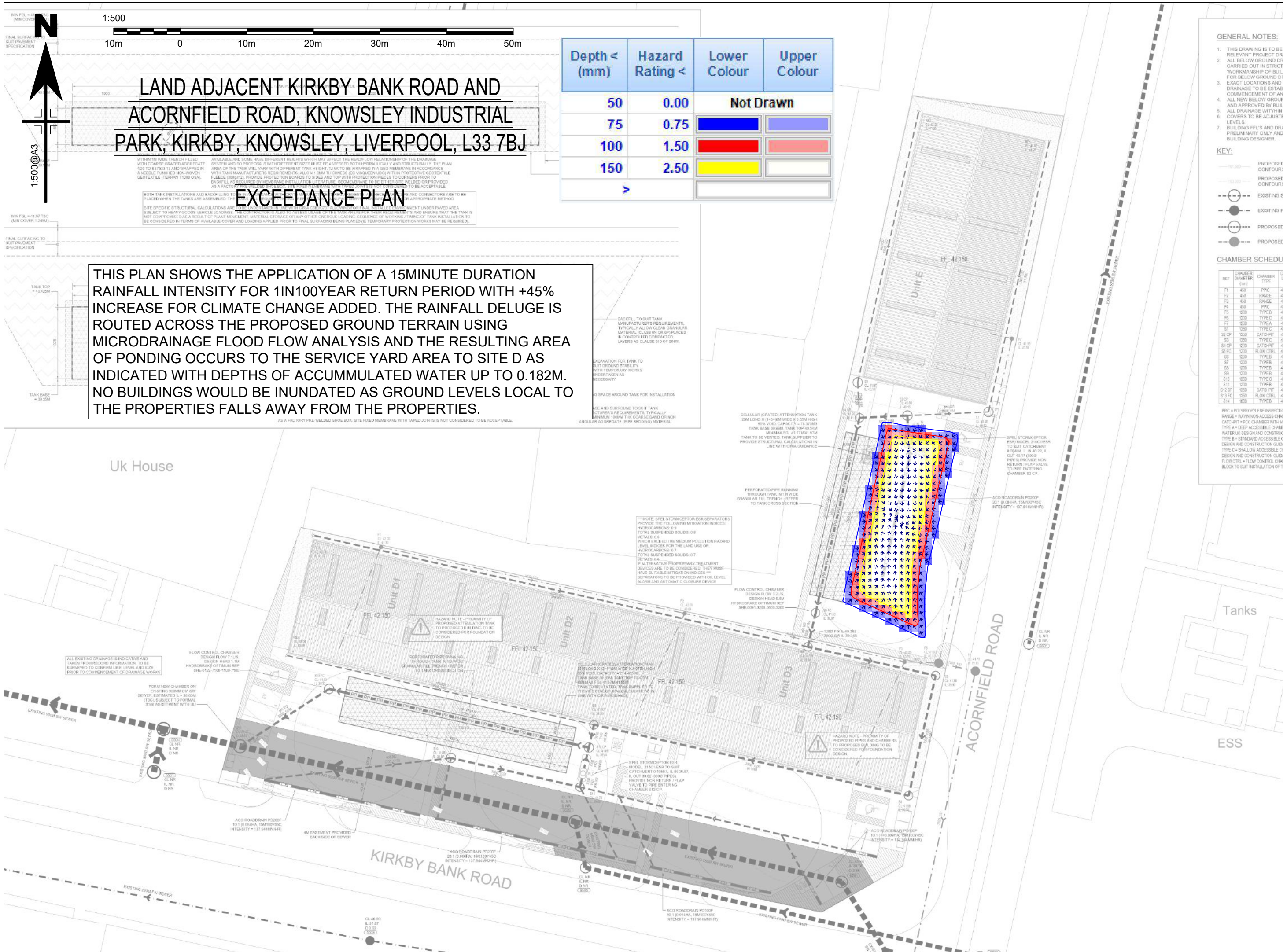
Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.500 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.390 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440, 2160, 2880
 Return Period(s) (years) 30
 Climate Change (%) 40

PN	US/MH Name	Duration (mins)	First (X) Surcharge	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	RE1	15		41.350	-0.050	0.000	0.75		17.2	OK
1.001	S1	2880	30/1440 Winter	40.733	0.063	0.000	0.02		0.5	SURCHARGED
2.000	CH_E	2160	30/960 Winter	40.734	0.194	0.000	0.03		1.4	SURCHARGED
2.001	PI_E	2160	30/960 Summer	40.734	0.264	0.000	0.03		1.4	SURCHARGED
1.002	S2	2160	30/960 Summer	40.734	0.284	0.000	0.03		2.0	SURCHARGED
3.000	RE2	15		41.344	-0.056	0.000	0.69		17.3	OK
3.001	S3	2160	30/960 Summer	40.733	0.213	0.000	0.03		0.6	SURCHARGED
1.003	S4 CP	2160	30/960 Summer	40.734	0.324	0.000	0.04		2.6	SURCHARGED
1.004	TANK_E	2880	30/60 Winter	40.735	0.454	0.000	0.10	1378	5.4	SURCHARGED
1.005	S5 FC	2880	30/30 Winter	40.735	0.465	0.000	0.05		2.8	SURCHARGED
4.000	RE3	15		41.280	-0.115	0.000	0.46		28.8	OK
1.006	S6	2160	30/480 Winter	40.673	0.433	0.000	0.07		4.8	SURCHARGED
1.007	S7	2160	30/360 Winter	40.671	0.521	0.000	0.07		4.4	SURCHARGED
1.008	S8	2160	30/240 Summer	40.669	0.609	0.000	0.07		4.9	SURCHARGED
5.000	RE4	15		40.980	-0.060	0.000	0.65		18.0	OK
1.009	S9	2160	30/15 Summer	40.665	0.825	0.000	0.09		4.9	SURCHARGED
6.000	CH_D	2160	30/960 Summer	40.667	0.187	0.000	0.02		1.0	SURCHARGED
6.001	S10	2160	30/15 Summer	40.666	0.396	0.000	0.02		1.5	SURCHARGED
6.002	S11	2160	30/15 Summer	40.665	0.485	0.000	0.06		3.0	SURCHARGED
6.003	PI_D	2160	30/15 Summer	40.665	0.555	0.000	0.05		3.0	SURCHARGED
1.010	S12 CP	2160	30/15 Summer	40.664	0.849	0.000	0.07		7.0	SURCHARGED
1.011	TANK_D	2160	30/15 Summer	40.661	0.949	0.000	0.13	1967	11.0	SURCHARGED
1.012	S13 FC	2160	30/15 Summer	40.660	1.030	0.000	0.11		7.1	SURCHARGED



LAND ADJACENT KIRKBY BANK ROAD AND ACORNFIELD ROAD, KNOWSLEY INDUSTRIAL PARK, KIRKBY, KNOWSLEY, LIVERPOOL, L33 7BJ

WITHIN 1M WIDE TRENCH FILLED WITH COARSE GRADED AGGREGATE 425 TO BS7535.5 AND WRAPPED IN A NEEDLE PUNCHED NON-WOVEN GEOTEXTILE (TERRAN T1000 05AL).

AVAILABLE AND SOME HAVE DIFFERENT HEIGHTS WHICH MAY AFFECT THE HEADFLOW RELATIONSHIP OF THE DRAINAGE SYSTEM AND SO PROPOSALS WITH DIFFERENT SIZES MUST BE ASSESSED BOTH HYDRAULICALLY AND STRUCTURALLY. THE PLAN AREA OF THE TANK WILL VARY WITH DIFFERENT TANK HEIGHT. TANK TO BE WRAPPED IN A SECURE MEMBRANE PLAC CONFORMANCE WITH TANK MANUFACTURERS REQUIREMENTS. ALLOW 10MM THICKNESS (EQ. V/SQUEEN U/D) WITHIN PROTECTIVE GEOTEXTILE FLEECES 300MM; PROVIDE PROTECTION BOARD TO SURFACE AND TOP WITH PROTECTION PILES TO CORNERS PRIOR TO BACKFILL AS REQUIRED BY MEMBRANE INSTALLATION LITERATURE. GEOMEMBRANE TO BE EITHER SITE WELDED OR PROVIDED AS A FACTORY PRE-WELDED SHEET. SHEET JOINTS MUST BE CONSIDERED TO BE NOT TO BE ACCEPTABLE.

BOTH TANK INSTALLATIONS AND BACKFILLING TO BE PLACED WHEN THE TANKS ARE ASSEMBLED. THE SITE SPECIFIC STRUCTURAL CALCULATIONS ARE THE RESPONSIBILITY OF THE TANK MANUFACTURER AND ENSURE THAT THE TANK IS NOT COMPROMISED AS A RESULT OF PLANT MOVEMENT, MATERIAL STORAGE OR ANY OTHER ONEROUS LOADING. SEQUENCE OF WORKING/TIMING OF TANK INSTALLATION TO BE CONSIDERED IN TERMS OF AVAILABLE COVER AND LOADING APPLIED PRIOR TO FINAL SURFACING BEING PLACED (I.E. TEMPORARY PROTECTION WORKS MAY BE REQUIRED).

EXCEEDANCE PLAN

THIS PLAN SHOWS THE APPLICATION OF A 15MINUTE DURATION RAINFALL INTENSITY FOR 1IN100YEAR RETURN PERIOD WITH +45% INCREASE FOR CLIMATE CHANGE ADDED. THE RAINFALL DELUGE IS ROUTED ACROSS THE PROPOSED GROUND TERRAIN USING MICRODRAINAGE FLOOD FLOW ANALYSIS AND THE RESULTING AREA OF PONDING OCCURS TO THE SERVICE YARD AREA TO SITE D AS INDICATED WITH DEPTHS OF ACCUMMULATED WATER UP TO 0.182M. NO BUILDINGS WOULD BE INUNDATED AS GROUND LEVELS LOCAL TO THE PROPERTIES FALLS AWAY FROM THE PROPERTIES.

Depth < (mm)	Hazard Rating <	Lower Colour	Upper Colour
50	0.00	Not Drawn	
75	0.75		
100	1.50		
150	2.50		
>			

GENERAL NOTES:

- THIS DRAWING IS TO BE RELEVANT PROJECT DR
- ALL BELOW GROUND DR CARRIED OUT IN STRICT WORKMANSHIP OF BUIL FOR BELOW GROUND DR
- EXACT LOCATIONS AND DRAINAGE TO BE ESTAB COMMENCEMENT OF AN
- ALL NEW BELOW GROUND AND APPROVED BY BUIL
- ALL DRAINAGE WITHIN CONVERS TO BE ADJUST LEVELS.
- BUILDING FFL'S AND DR PRELIMINARY ONLY AND BUILDING DESIGNER.

KEY:

- PROPOSED CONTOUR
- PROPOSED CONTOUR
- EXISTING CONTOUR
- EXISTING CONTOUR
- PROPOSED CONTOUR
- PROPOSED CONTOUR

CHAMBER SCHEDULE

REF	CHAMBER DIAMETER (mm)	CHAMBER TYPE
F1	450	PPC
F2	450	RANGE
F3	450	RANGE
F4	450	PPC
F5	200	TYPE C
F6	200	TYPE C
F7	200	TYPE A
S1	1050	TYPE C
S2 CP	1050	CATCH-PT
S3	1050	TYPE C
S4 CP	1050	CATCH-PT
S5 CP	1050	FLOW CTRL
S6	1050	TYPE C
S7	1050	TYPE B
S8	1050	TYPE B
S9	1050	TYPE B
S10	1050	TYPE C
S11	1050	TYPE B
S12 CP	1050	CATCH-PT
S13 CP	1050	FLOW CTRL
S14	1050	TYPE B

PPC = POLYPROPYLENE INSPECT RANGE - MAIN NON-ACCESS DIA CATCH-PT = PPC CHAMBER WITH TYPE A - DEEP ACCESSIBLE CHAMBER WATER UK DESIGN AND CONSTRUCTION TYPE B - STANDARD ACCESSIBLE DESIGN AND CONSTRUCTION GUID TYPE C - SHALLOW ACCESSIBLE DESIGN AND CONSTRUCTION GUID FLOW CTRL = FLOW CONTROL CHAMBER BLOCK TO SUIT INSTALLATION OF

Appendix D – Manufacturer’s Literature

Protecting our Environment for Over 45 Years

The SuDS Manual is leading good practise in drainage design, SPEL are endorsing this with the release of the new SPEL Stormceptor ESR range.

Total Suspended Solids (TSS)	Metals	Hydrocarbons
0.8	0.6	0.9*

Added to these class-leading Mitigation Indices, the ESR range benefits from:

- British/European Standard BS EN 858-1 2002 certification.
- The SPEL 25 year shell Warranty.
- 50 year+ life expectancy.
- ISO9001 quality assurance.
- ISO14001 committed to environmental improvement

*H R Wallingford test results to BS EN 858

26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads and trunk roads/motorways ¹	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways ¹	High	0.8 ²	0.8 ²	0.9 ²

26.3 Indicative SuDS mitigation indices for discharges to surface waters

Type of SuDS component	Mitigation Indices		
	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4 ²	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond ⁴	0.7 ³	0.7	0.5
Wetland	0.8 ³	0.8	0.8
Proprietary treatment systems ^{5,6}	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Tables from The SuDS Manual (C753), p568-569

For reference notes, please see the full manual: https://www.ciria.org/Memberships/The_SuDs_Manual_C753_Chapters.aspx

SPEL Stormceptor ESR Range By-Pass System

ESR Specification Chart

Model	Series	Treated Flow Rate - l/s	Maximum Flow	Catchment area (m ²)*	Oil storage (litres)	Silt capacity (litres)	Overall length* (mm) L	Overall diameter (mm)	Inlet Invert (mm) A	Base to Inlet (mm) B	Base to outlet (mm) C	Max in/ out pipe diameter** (mm)	Number of access shafts (dia. mm)			
													600	750	900	1200
210C1/ESR	200	10	100	1,333	150	1,000	2,920	1,225	560	1,350	1,300	300	-	1	-	-
212C1/ESR	200	12	120	1,600	180	1200	3,570	1,225	560	1,350	1,300	300	-	1	-	-
215C1/ESR	200	15	150	2,000	225	1,500	4,237	1,225	560	1,350	1,300	300	-	1	-	-
320C1/ESR	300	20	200	2,665	300	2,000	3,200	1,875	700	1,450	1,350	450	2	-	-	-
325C1/ESR	300	25	250	3,333	375	2,500	3,540	1,875	700	1,450	1,350	450	2	-	-	-
330C1/ESR	300	30	300	4,000	450	3,000	4,420	1,875	700	1,450	1,350	450	-	1	1	-
340C1/ESR	300	40	400	5,333	600	4,000	5,760	1,875	740	1,410	1,310	450	1	1	-	-
345C1/ESR	300	45	450	6,000	675	4,500	6,570	1,875	740	1,410	1,310	450	1	1	-	-
350/C1/ESR	300	50	500	6,665	750	5,000	7,060	1,875	740	1,410	1,310	450	1	1	-	-
460C1/ESR	400	60	600	8,000	900	6,000	4,400	2,700	950	2,100	2,000	600	1	-	1	-
470C1/ESR	400	70	700	9,333	1,050	7,000	5,250	2,700	950	2,100	2,000	600	1	-	1	-
480C1/ESR	400	80	800	10,665	1,200	8,000	6,170	2,700	950	2,100	2,000	600	1	-	1	-
4100C1/ESR	400	100	1000	13,333	1,500	10,000	7,400	2,700	1,100	1,950	1,850	750	1	-	1	-
4125C1/ESR	400	125	1250	16,665	1,875	12,500	9,050	2,700	1,100	1,950	1,850	750	1	-	1	-
4150C1/ESR	400	150	1500	20,000	2,250	15,000	9,950	2,700	1,100	1,950	1,850	750	-	-	2	-
4160C1/ESR	400	160	1600	21,333	2,400	16,000	11,830	2,700	1,250	1,800	1,700	750	1	1	1	-
5180C1/ESR	500	180	1800	24,000	2,700	18,000	7,470	3,650	1,185	2,690	2,550	900	Access shafts dependent on orientation of pipework (see page 7 for orientation options).			
5200C1/ESR	500	200	2000	26,665	3,000	20,000	8,530	3,650	1,185	2,690	2,355	1,200				
5250C1/ESR	500	250	2500	33,333	3,750	25,000	10,040	3,650	1,185	2,690	2,355	1,200				
6300C1/ESR	600	300	3000	40,000	4,500	30,000	10,310	4,150	1,325	2,850	2,675	1,200				
6350C1/ESR	600	350	3500	46,665	5,250	35,000	11,470	4,150	1,325	2,850	2,675	1,200				
6400C1/ESR	600	400	4000	53,333	6,000	40,000	12,690	4,150	1,325	2,850	2,675	1,200				
6500C1/ESR	600	500	5000	66,665	7,500	50,000	15,870	4,150	1,325	2,850	2,675	1,200				
6600C1/ESR	600	600	6000	80,000	9,000	60,000	18,260	4,150	1,325	2,850	2,675	1,200				
6700C1/ESR	600	700	7000	93,333	10,500	70,000	22,250	4,150	2,850	2,850	2,675	1,200				

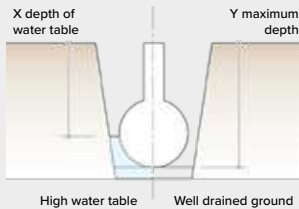
*These catchment areas are based on the SuDS Manual requirement for By-Pass devices to treat the 1 in 1 year storm event (27mm).
**This dimension is for A-C inlet/outlet options, larger pipe sizes are available for D-I inlet/outlet options.

Tank Shell Specifications

The 'standard' specification is normally adequate for most installations but Heavy, Extra Heavy and Special specifications are available depending upon the burial depth and water table level, in winter. The concern is when the system is emptied completely and remains empty for a period of time.

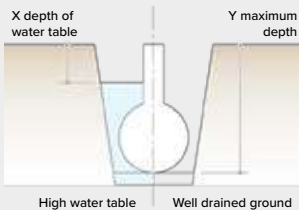
Standard tanks

Series	WT (m)	D (m)
200	1.0	4.0
300	0.9	4.0
400	1.3	5.0
500	1.9	5.7
600	2.4	6.2



Heavy tanks

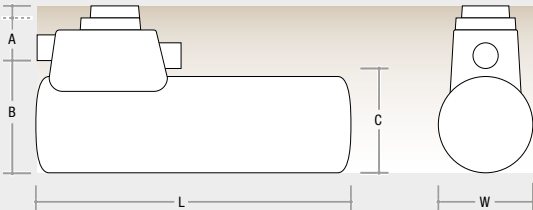
Series	WT (m)	D (m)
200	2.0	6.0
300	2.8	5.6
400	3.5	6.0
500	4.5	7.25
600	4.7	7.3



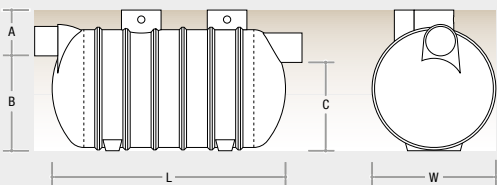
Based on installation in concrete with concrete surround.
For pea gravel surround, see SPEL Data Manual p13.5

- 200 Series ESR** – Inside diameter 1200mm, outside diameter 1225mm.
- 300 series ESR** – Inside diameter 1800mm, outside diameter 1875mm.
- 400 series ESR** – Inside diameter 2600mm, outside diameter 2700mm.
- 500 series ESR** – Inside diameter 3500mm, outside diameter 3650mm.
- 600 series ESR** – Inside diameter 4000mm, outside diameter 4150mm.

200 series



300/400/500 & 600 series



Technical Specification

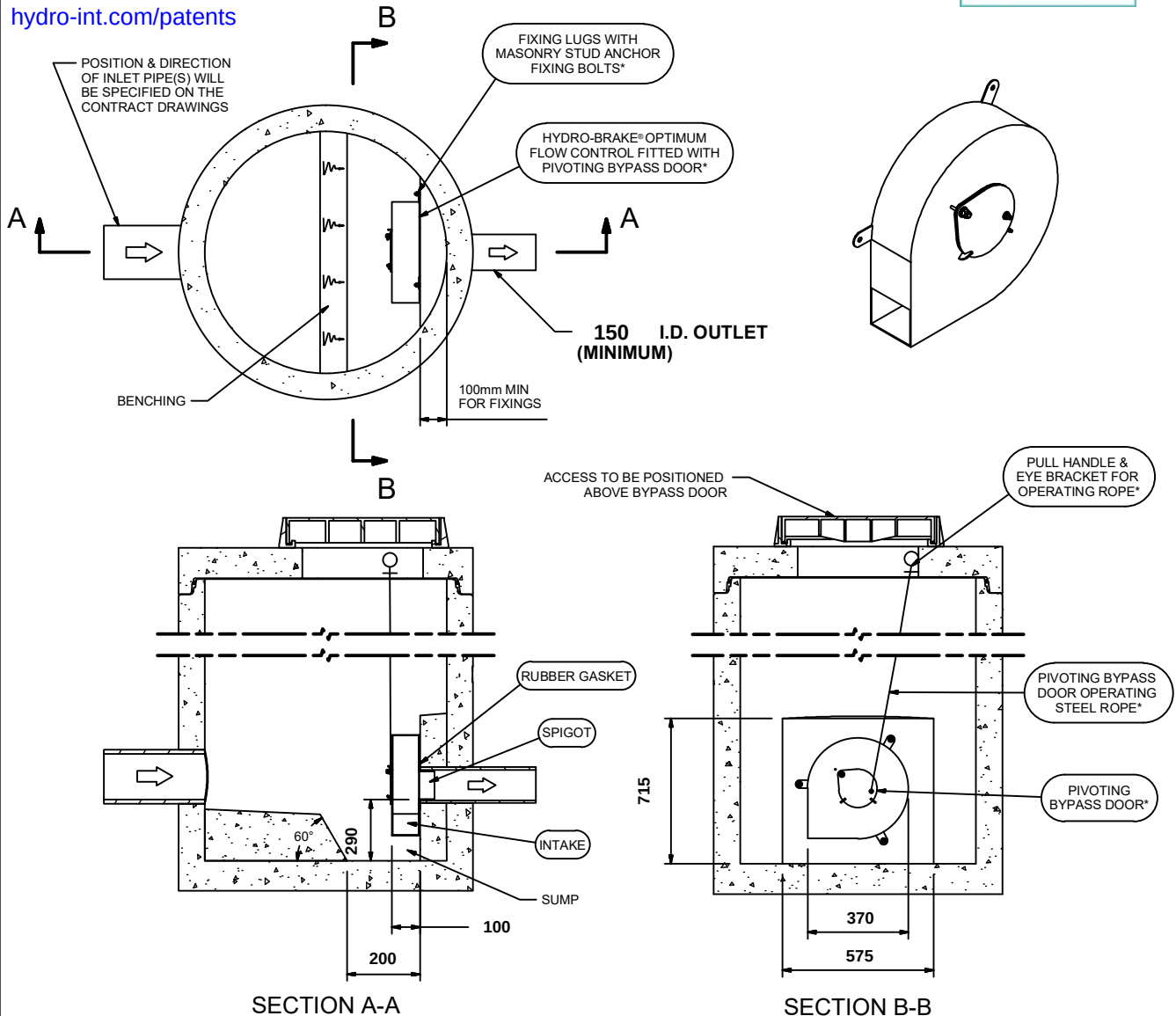
Control Point	Head (m)	Flow (l/s)
Primary Design	0.600	3.200
Flush-Flo™	0.183	3.199
Kick-Flo®	0.413	2.701
Mean Flow		2.736

Hydro-Brake® Optimum Flow Control including:

- 3 mm grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet
- Indicative Weight: 10 kg



hydro-int.com/patents



IMPORTANT:

○ LIMIT OF HYDRO INTERNATIONAL SUPPLY

THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
ALL CIVIL AND INSTALLATION WORK BY OTHERS

* WHERE SUPPLIED

HYDRO-BRAKE® FLOW CONTROL & HYDRO-BRAKE® OPTIMUM FLOW CONTROL ARE REGISTERED TRADEMARKS FOR FLOW CONTROLS DESIGNED AND MANUFACTURED EXCLUSIVELY BY HYDRO INTERNATIONAL

THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.

**DESIGN
ADVICE**



The head/flow characteristics of this SHE-0091-3200-0600-3200 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

**Hydro
International**

DATE 07/09/2023 18:56

SITE Acornfield

DESIGNER Chris Emm

REF 021B42

SHE-0091-3200-0600-3200

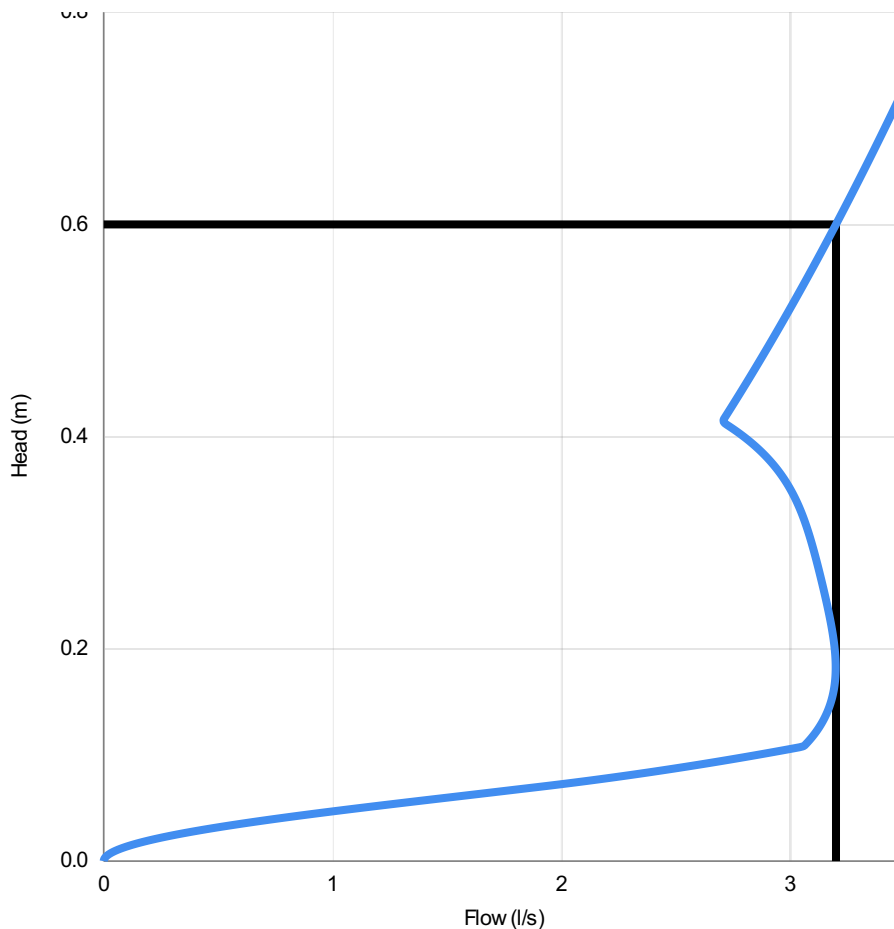
Hydro-Brake® Optimum

Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	0.600	3.200
Flush-Flo	0.183	3.199
Kick-Flo®	0.413	2.701
Mean Flow		2.736



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Head (m)	Flow (l/s)
0.000	0.000
0.021	0.221
0.041	0.804
0.062	1.591
0.083	2.354
0.103	2.943
0.124	3.121
0.145	3.170
0.166	3.194
0.186	3.198
0.207	3.191
0.228	3.175
0.248	3.154
0.269	3.131
0.290	3.107
0.310	3.079
0.331	3.044
0.352	2.997
0.372	2.931
0.393	2.836
0.414	2.710
0.434	2.762
0.455	2.821
0.476	2.879
0.497	2.935
0.517	2.990
0.538	3.044
0.559	3.097
0.579	3.149
0.600	3.200

DESIGN ADVICE



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SHE-0091-3200-0600-3200

Hydro-Brake Optimum®

Technical Specification

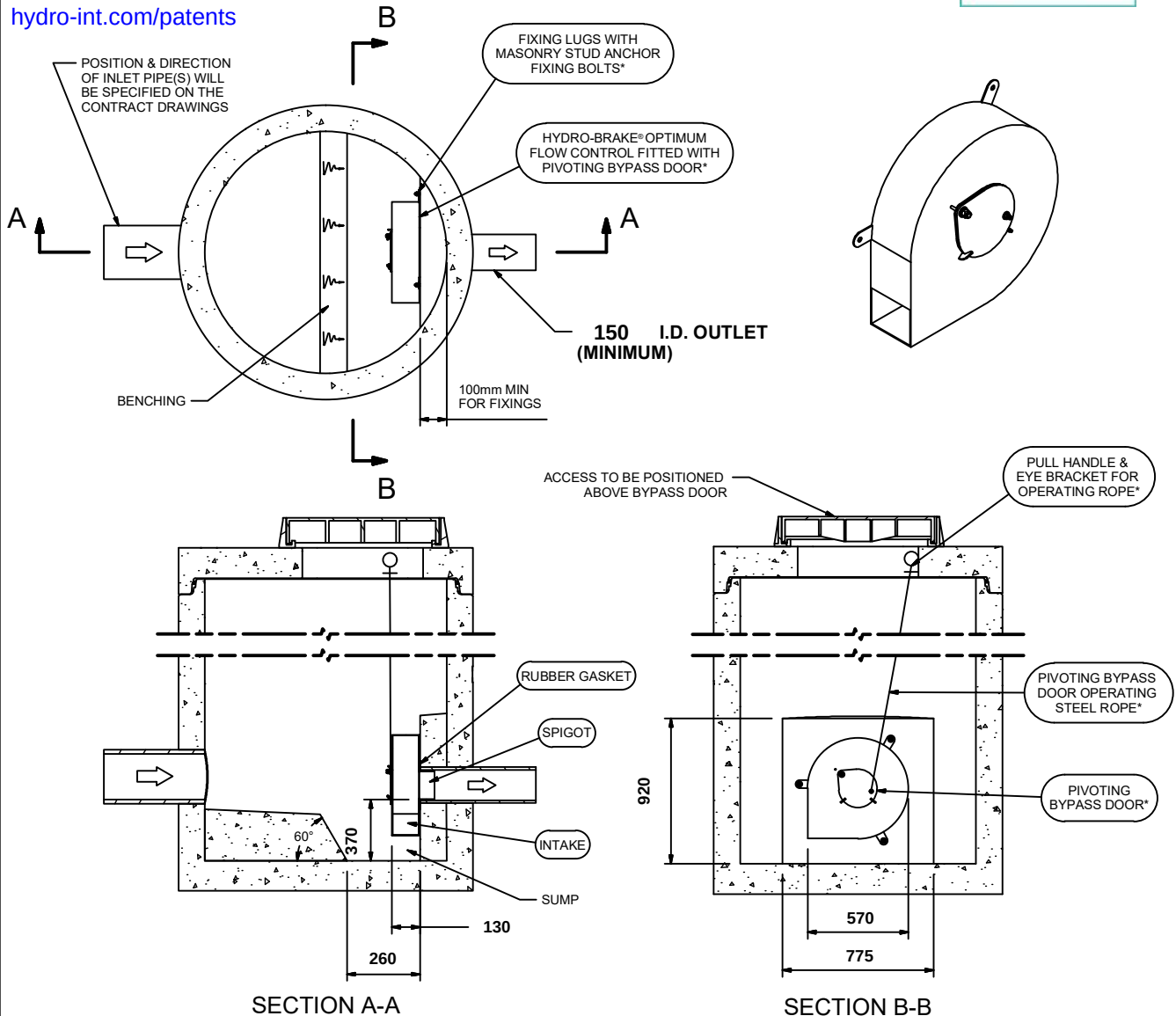
Control Point	Head (m)	Flow (l/s)
Primary Design	1.100	7.100
Flush-Flo™	0.329	7.099
Kick-Flo®	0.711	5.794
Mean Flow		6.166

Hydro-Brake® Optimum Flow Control including:

- 3 mm grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet
- Indicative Weight: 20 kg



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IMPORTANT:

○ LIMIT OF HYDRO INTERNATIONAL SUPPLY

THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
ALL CIVIL AND INSTALLATION WORK BY OTHERS

* WHERE SUPPLIED

HYDRO-BRAKE® FLOW CONTROL & HYDRO-BRAKE® OPTIMUM FLOW CONTROL ARE REGISTERED TRADEMARKS FOR FLOW CONTROLS DESIGNED AND MANUFACTURED EXCLUSIVELY BY HYDRO INTERNATIONAL

THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.

DESIGN ADVICE



The head/flow characteristics of this SHE-0123-7100-1100-7100 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro
International®

DATE 07/09/2023 18:57

SITE Acornfield

DESIGNER Chris Emm

REF 021B42

SHE-0123-7100-1100-7100

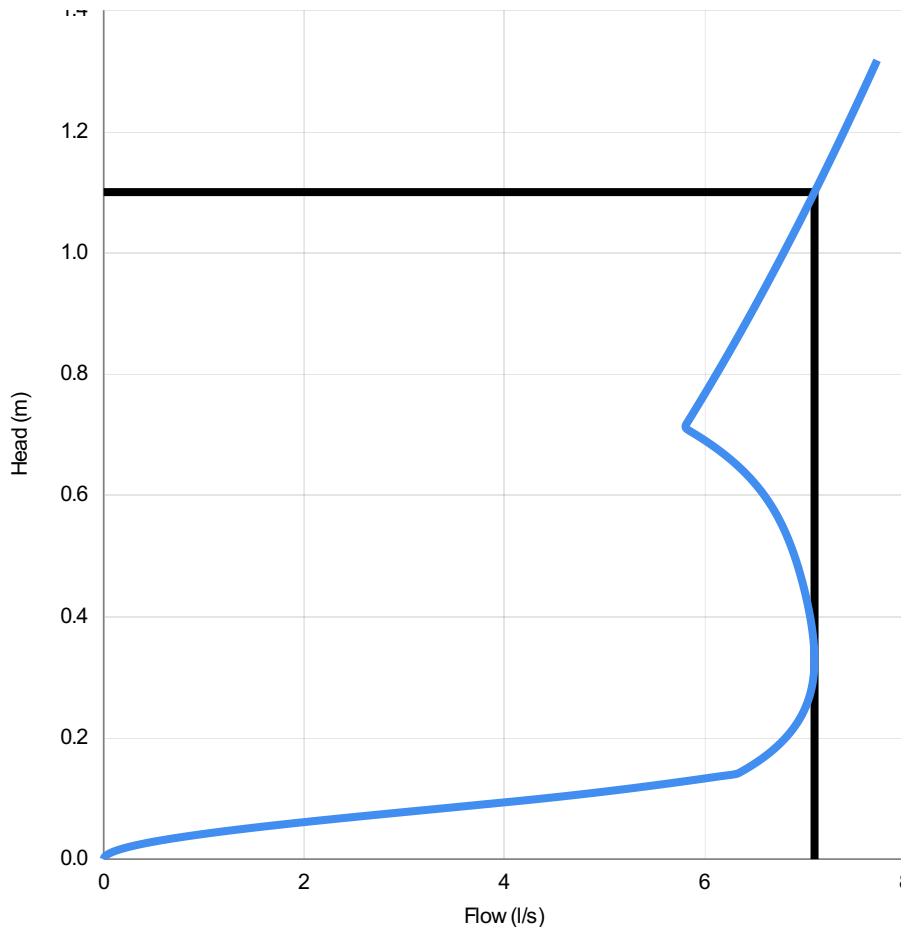
Hydro-Brake® Optimum

Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	1.100	7.100
Flush-Flo	0.329	7.099
Kick-Flo®	0.711	5.794
Mean Flow		6.166



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Head (m)	Flow (l/s)
0.000	0.000
0.038	0.843
0.076	2.895
0.114	5.125
0.152	6.446
0.190	6.750
0.228	6.938
0.266	7.044
0.303	7.091
0.341	7.098
0.379	7.076
0.417	7.035
0.455	6.981
0.493	6.914
0.531	6.829
0.569	6.718
0.607	6.566
0.645	6.358
0.683	6.074
0.721	5.832
0.759	5.972
0.797	6.109
0.834	6.242
0.872	6.373
0.910	6.500
0.948	6.625
0.986	6.747
1.024	6.867
1.062	6.985
1.100	7.100

DESIGN ADVICE



The head/flow characteristics of this SHE-0123-7100-1100-7100 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.

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

Hydro
International

DATE 07/09/2023 18:57

Site Acornfield

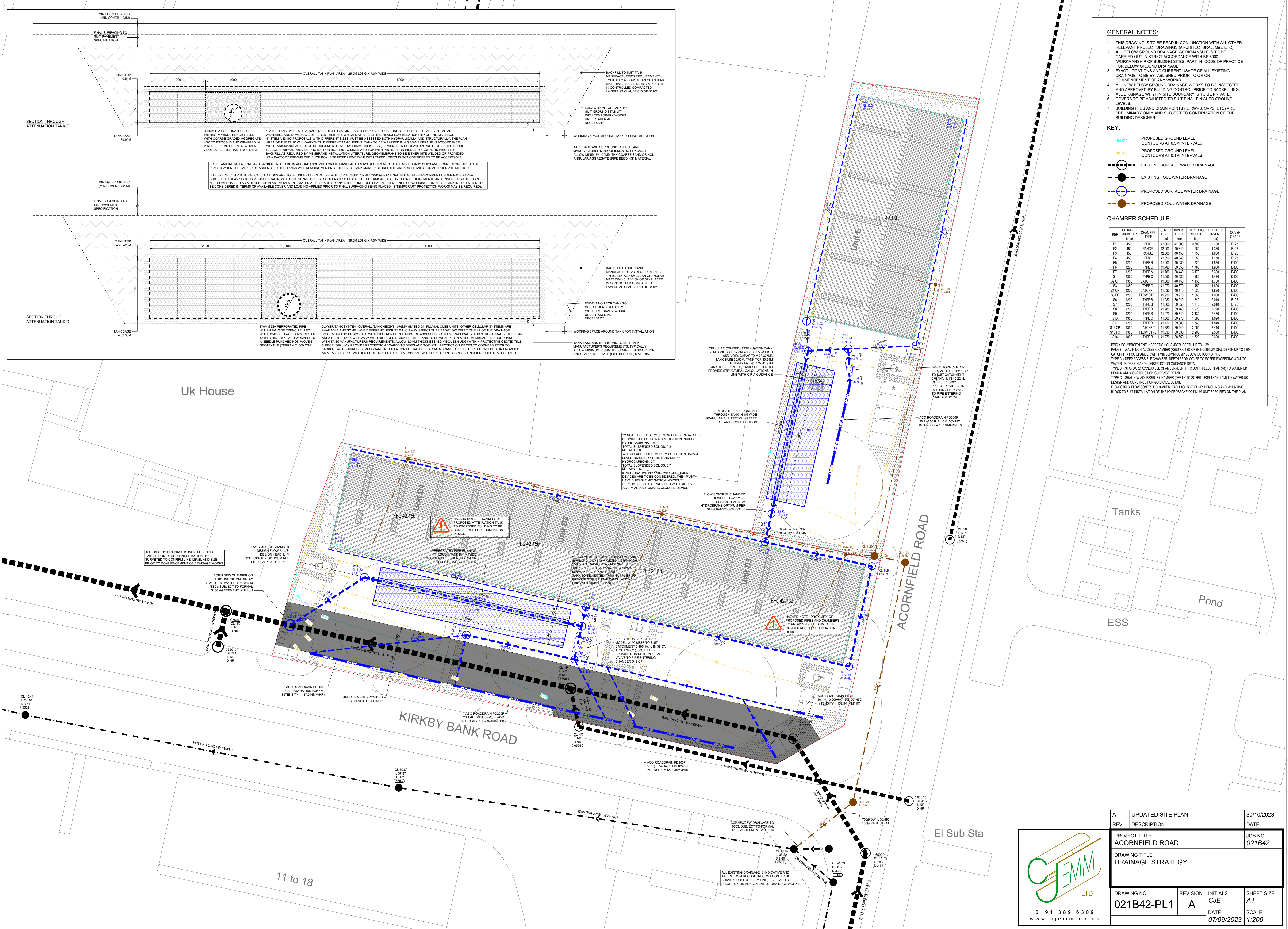
DESIGNER Chris Emm

Ref 021B42

SHE-0123-7100-1100-7100

Hydro-Brake Optimum®

Appendix E – Drainage Strategy Plan



- GENERAL NOTES:
- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT PROJECT DRAWINGS (ARCHITECTURAL, M&E ETC).
 - ALL BELOW GROUND DRAINAGE WORKMANSHIP IS TO BE CARRIED OUT IN STRICT ACCORDANCE WITH BS 8000 "WORKMANSHIP OF BUILDING SITES: PART 14: CODE OF PRACTICE FOR BELOW GROUND DRAINAGE".
 - EXACT LOCATIONS AND CURRENT USAGE OF ALL EXISTING DRAINAGE TO BE ESTABLISHED PRIOR TO OR ON COMMENCEMENT OF ANY WORKS.
 - ALL NEW BELOW GROUND DRAINAGE WORKS TO BE INSPECTED AND APPROVED BY BUILDING CONTROL PRIOR TO BACKFILLING.
 - ALL DRAINAGE WITHIN SITE BOUNDARY IS TO BE PRIVATE.
 - COVERS TO BE ADJUSTED TO SUIT FINAL FINISHED GROUND LEVELS.
 - BUILDING FFL'S AND DRAIN POINTS (IE RWPS, SVPS, ETC) ARE PRELIMINARY ONLY AND SUBJECT TO CONFIRMATION OF THE BUILDING DESIGNER.

- KEY:
- PROPOSED GROUND LEVEL CONTOURS AT 0.5M INTERVALS
 - PROPOSED GROUND LEVEL CONTOURS AT 0.1M INTERVALS
 - EXISTING SURFACE WATER DRAINAGE
 - EXISTING FOUL WATER DRAINAGE
 - PROPOSED SURFACE WATER DRAINAGE
 - PROPOSED FOUL WATER DRAINAGE

CHAMBER SCHEDULE:

REF	CHAMBER DIAMETER (mm)	CHAMBER TYPE	COVER LEVEL (m)	INVERT LEVEL (m)	DEPTH TO SOFFIT (m)	DEPTH TO INVERT (m)	COVER GRADE
F1	450	PPC	42.00	41.300	0.600	0.700	B125
F2	450	RANGE	42.00	40.540	1.260	1.360	B125
F3	450	RANGE	42.00	40.150	1.750	1.850	B125
F4	450	PPC	41.990	40.840	1.050	1.150	B125
F5	1200	TYPE B	41.900	41.030	1.720	1.870	D400
F6	1200	TYPE C	41.780	39.850	1.780	1.830	D400
F7	1200	TYPE A	41.780	38.440	3.170	3.220	D400
S1	1350	TYPE C	41.950	41.520	1.260	1.430	D400
S2 CP	1350	CATCHPIT	41.880	40.150	1.430	1.730	D400
S3	1350	TYPE C	41.970	40.370	1.450	1.600	D400
S4 CP	1200	CATCHPIT	41.830	40.110	1.520	1.820	D400
S5 FC	1200	FLOW CTRL	41.930	39.970	1.660	1.960	D400
S6	1200	TYPE B	41.980	39.540	1.740	2.240	B125
S7	1200	TYPE B	41.880	39.850	1.710	2.010	B125
S8	1200	TYPE B	41.980	39.760	1.920	2.220	D400
S9	1200	TYPE B	41.970	39.540	2.130	2.430	D400
S10	1350	TYPE C	41.660	39.970	1.390	1.690	D400
S11	1200	TYPE B	41.720	39.880	1.540	1.840	D400
S12 CP	1350	CATCHPIT	41.880	39.440	2.660	2.440	D400
S13 FC	1350	FLOW CTRL	41.830	39.330	2.200	2.500	D400
S14	1800	TYPE B	41.270	38.650	1.720	2.620	D400

PPC = POLYPROPYLENE INSPECTION CHAMBER, DEPTH UP TO 1.2M
RANGE = MIN/IN NON-ACCESS CHAMBER RESTRICTED OPENING 300MM DIA, DEPTH UP TO 3.0M
CATCHPIT = PPC CHAMBER WITH MIN 300MM SUMP BELOW OUTGOING PIPE
TYPE A = DEEP ACCESSIBLE CHAMBER, DEPTH FROM COVER TO SOFFIT EXCEEDING 3.0M, TO WATER UK DESIGN AND CONSTRUCTION GUIDANCE DETAIL
TYPE B = STANDARD ACCESSIBLE CHAMBER, DEPTH TO SOFFIT LESS THAN 1.5M TO WATER UK DESIGN AND CONSTRUCTION GUIDANCE DETAIL
TYPE C = SHALLOW ACCESSIBLE CHAMBER, DEPTH TO SOFFIT LESS THAN 1.5M TO WATER UK DESIGN AND CONSTRUCTION GUIDANCE DETAIL
FLOW CTRL = FLOW CONTROL CHAMBER, EACH TO HAVE SUMP, BENCHING AND MOUNTING BLOCK TO SUIT INSTALLATION OF THE HYDROBRAKE OPTIMUM UNIT SPECIFIED ON THE PLAN

A

UPDATED SITE PLAN

30/10/2023

REV

DESCRIPTION

DATE

PROJECT TITLE

ACORNFIELD ROAD

JOB NO.

021B42

DRAWING TITLE

DRAINAGE STRATEGY

DRAWING NO.

021B42-PL1

REVISION

A

INITIALS

CJE

SHEET SIZE

A1

DATE

07/09/2023

SCALE

1:200

