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NORTHERN GROUP DEVELOPMENTS LIMITED

LAND AT STATION ROAD

FLOOD RISK ASSESSMENT

AUGUST 2025

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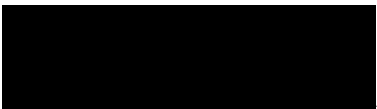
LAND AT STATION ROAD

FLOOD RISK ASSESSMENT

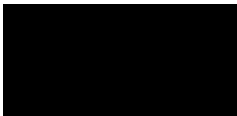
AUGUST 2025

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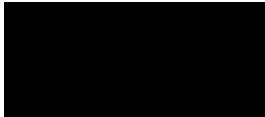
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TITLE

GM13736-105	Indicative Surface Water Management Plan (Eastern Parcel)
GM13736-106	Indicative Surface Water Management Plan (Central and Western Parcels)
GM13736-107	Drainage Catchment Plan (Eastern Parcel)
GM13736-108	Drainage Catchment Plan (Western Parcel)
GM13736-109	Indicative Exceedance Routes
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PR1889-HFR-XX-ZZ-DR-A-9003	Proposed Site Plan – Western & Central Parcel
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PR1889-HFR-XX-ZZ-DR-A-9005	Proposed Site Plan – Eastern Parcel
BH062/T00 (Sheet 1 to 3)	Topographical Survey

1 INTRODUCTION

1.1.1 Wardell Armstrong LLP (WA) has been commissioned by Northern Group Developments Limited (the Client) to prepare a Flood Risk Assessment (FRA) for a proposed residential development located on land to the south of Station Road, Reddish, Stockport.

1.1.2 As part of the site appraisal process it is necessary to demonstrate that the proposed development has an acceptable risk of flooding over the development's lifetime, taking climate change into account.

1.1.3 This FRA assesses the risk of flooding from all sources, including fluvial, tidal, surface water, groundwater, existing and proposed drainage infrastructure and other artificial sources in accordance with the National Planning Policy Framework and Planning Practice Guidance.

1.2 Methodology

1.2.1 The methodology for this FRA has comprised a desktop study, reviewing site information and relevant local and national planning policy reports.

1.2.2 Reference has been made to relevant plans and documents including:

- Greater Manchester Combined Authority (2019) – Level 1 Strategic Flood Risk Assessment;
- Greater Manchester Combined Authority (2021) – Level 2 Strategic Flood Risk Assessment;
- Stockport Metropolitan Borough Council (2017) – Preliminary Flood Risk Assessment Addendum;
- LK Consult (2022) – Station Road, Reddish, Stockport Flood Risk Assessment (2022);
- LK Consult (2024) – Land at Station Road (Secret Lake), Reddish – Technical Note;
- United Utilities public sewer records;
- Historical Ordnance Survey mapping.

2 SITE SETTING

2.1 Site Location

2.1.1 A summary of the site and its characteristics is provided in Table 2.

Table 2: Site Location Summary	
Site Name	Secret Lake
Site Address	Land to the south of Station Road, Reddish, Stockport, SK5 6ND
Site Area (ha)	Approximately 5.85 ha
National Grid Reference	SJ 88969 94730
Existing Land Use	Public open space
Proposed Land Use	Residential Development
Lead Local Flood Authority	Stockport Metropolitan Borough Council
Local Planning Authority	Stockport Metropolitan Borough Council
Sewerage Undertaker	United Utilities

2.1.2 The site is located on land to the south of Station Road, Reddish, Stockport, SK5 6ND, approximately 4km to the north of the centre of Stockport. A National Grid Reference of the site is SJ 88969 94730.

2.1.3 For the purposes of this FRA, the site can be divided into three areas. The Eastern Parcel comprises an unnamed mill pond, areas of woodland and marshland, bushes and shrubs. The Central Parcel comprises a mill pond, commonly referred to as the Secret Lake along with marshland, bushes and shrubs. The Eastern and Central Parcels are divided by a public footpath and cycle route (the Fallowfield Loop) running from north to the south. This follows the route of a former railway line. The Western Parcel comprises areas of rough vegetation.

2.2 The Eastern Parcel is bound to the north by an industrial estate, to the south by playing fields and to the east by residential development. The Central Parcel is bounded to the north by residential development and playing fields, to the south by residential development and to the west by an industrial estate. The Western Parcel is bounded to the south and west by industrial units and to the east by residential development.

2.3 The site topography is shown on Drawing No. BH062/T00 (Sheet 1 to 3) 'Topographical Survey'. The majority of the Eastern Parcel is relatively flat with ground levels typically between approximately 70 – 71mAOD. Ground levels increase to approximately 72.1mAOD in the north-west. The pond has a water level of approximately 69mAOD.

- 2.4 The eastern pond is separated from the Fallowfield Loop footpath by a stone retaining wall, with the land around the pond approximately 1.5 – 2m higher than the pathway. Station Road to the north of the site crosses the Fallowfield Loop via a bridge.
- 2.5 Ground levels rise steeply from the Fallowfield Loop to the boundary of the Central Parcel at gradients of up to approximately 1 in 3. Ground levels within the Central Parcel fall generally south-westwards from a maximum of approximately 74.1mAOD in the north-eastern corner, to a minimum of approximately 65.2mAOD in the south-western corner. The water level of the lake is approximately 66.6mAOD.
- 2.6 Embankments extend along the northern and southern banks of the Secret Lake with a crest height of up to 67.0mAOD. In the south-western corner, the ground levels on land side of the embankment are approximately 0.8m lower than the water level of the lake.
- 2.7 Ground levels rise between the Central Parcel and the Western Parcel, with ground levels in the north-eastern corner of the Western Parcel approximately 1m higher than in the south-western corner of the Central Parcel. Ground levels within the Western Parcel fall south-westwards from a maximum of approximately 66.2mAOD in the north-eastern corner to a minimum of approximately 65.3mAOD in the south-western corner.
- 2.8 Existing Watercourses and Waterbodies
- 2.8.1 The closest watercourse to the site is an unnamed Ordinary Watercourse immediately adjacent to the Secret Lake. This short section of watercourse enters into a culvert beneath the industrial estate to the west. It is understood that this continues to flow westwards to emerge in an open channel approximately 3.5km to the west of the site, referred to as the Fallowfield Brook.
- 2.8.2 Historical mapping shows that the two ponds within the site area formed part of a group of manmade ‘reservoirs’ which extended along Station Road and Sandfold Lane. These pre-date the earliest Ordnance Survey mapping (1848). Based on the 1848 mapping (see Figure 1), taken from the National Library of Scotland website, it is assumed that the ponds were fed by an unnamed watercourse flowing westwards towards the site from springs approximately 1km to the east. This crossed under roads and a section of the Manchester and Stockport canal in culvert and discharged to the eastern unnamed pond within the Site. Mapping shows no apparent connection between the eastern pond and the Secret Lake. The ponds at the western extent of the group were assumed to provide a water supply to an adjacent printworks.



Figure 1. 1848 Ordnance Survey Mapping (modified to include site boundary, approximate source location and approximate route of watercourses)

- 2.8.3 More detailed mapping from 1938 (see Figure 2) shows an additional pond to the north, and sluices on all ponds, indicating that some or all of these were interlinked. The sluice from the Secret Lake pond appears to discharge via a weir to a watercourse extending along the northern edge of the adjacent pond to the west.
- 2.8.4 The area is more industrialised, and it is assumed that some of the ponds provide a water supply and/or drainage for industrial developments.



Figure 2. 1938 Ordnance Survey Mapping (modified to show site boundary and approximate route of downstream watercourse)

2.8.5 Mapping from 1956 (Figure 3) suggests that the watercourse to the eastern pond acts as an overflow from the canal approximately 0.5km to the east only, with the upstream extents of the watercourse no longer shown. The pond to the north of the site has also been removed. The outfall arrangement from the Secret Lake to the downstream watercourse is also more clearly defined (see Figure 4)

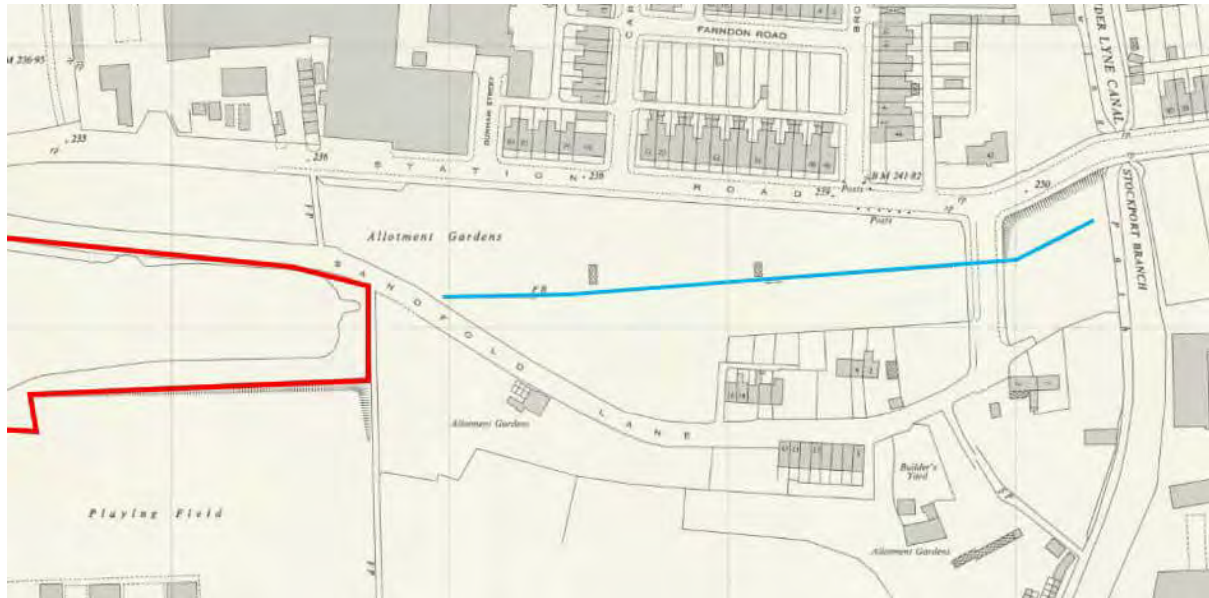


Figure 3. 1956 Ordnance Survey Mapping (modified to show eastern site boundary and approximate route of upstream watercourse)

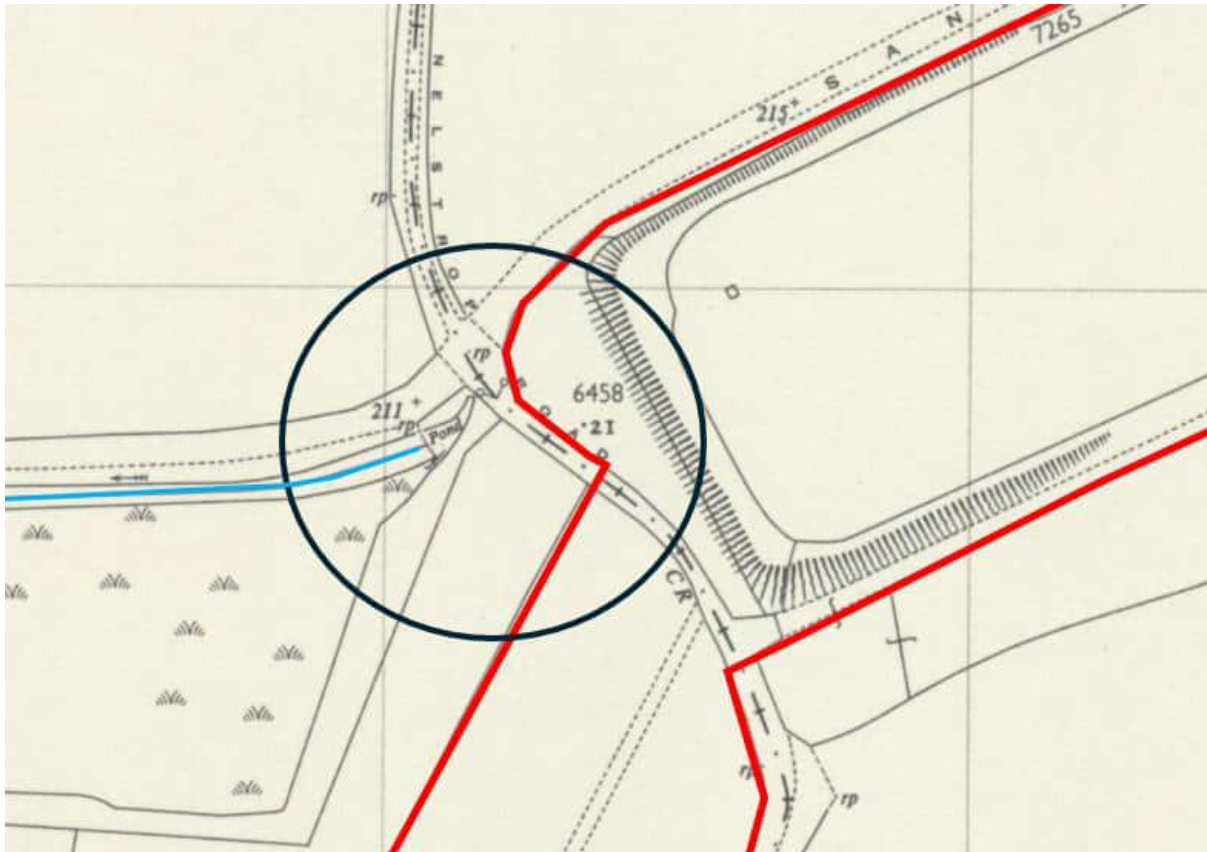


Figure 4 1956 Ordnance Survey Mapping (modified to show site boundary, approximate route of watercourse and outfall location)

- 2.8.6 Present day mapping shows that the railway between the ponds has been removed and replaced by a footpath/cycleway (the 'Fallowfield Loop'). The canal to the east and all other waterbodies have also been removed, leaving Secret Lake and the eastern pond within the site as the only remaining waterbodies.
- 2.8.7 These ponds remain interlinked, with water from the eastern pond flowing via a pipe beneath the Fallowfield Loop to a marshy area along the eastern bank of Secret Lake. It is understood from the 2022 study by LK Consult that this system incorporated a hydraulic syphon beneath the water level of the eastern pond, but that this is no longer operational and water now overflows into a well chamber (see Figure 5).

[illegible]

Figure 6. Existing Outfall Arrangement (Western Pond)

2.8.9 It is understood from the 2024 investigation by LK Consult that the eastern pond is heavily silted, with the majority of the eastern portion now covered by wetland vegetation. The Secret Lake was dredged as part of a community project removing a portion of the accumulated sediment. Based on online articles, this was undertaken approximately 7 years ago.

2.9 Existing Drainage

2.9.1 United Utilities public sewer records (see Appendix 1) show the following public sewers within the site and immediate vicinity.

- A 525mm diameter brick structure discharging to the north-eastern corner of the eastern pond. Mapping does not show any incoming connections from the surrounding residential developments and it is considered that this is the remnants of the historical watercourse upstream of the pond network. The upstream route of the culvert is shown on Figure 7 below. This follows the general route of the historical canal overflow/watercourse shown in Figure 3 (it is noted that the assumed route linking the eastern pond and Secret Lake is not shown on the mapping). It is understood that this serves residential areas at the upstream end of the culvert, as indicated by the lack of public combined sewers shown on the sewer records (see Figure 7).
- A 1500mm diameter public combined sewer flowing south-eastwards beneath the eastern pond. The upstream network includes a number of public foul and combined sewer runs serving the residential and industrial developments to the north and east of the site.
- A 525mm diameter combined sewer flowing south-eastwards along the northern boundary of the Central Parcel. This then diverts south-eastwards between the Central Parcel and Western Parcel, before diverting south-westwards along the western boundary of the Western Parcel. The upstream catchment includes public surface water and foul sewers serving the residential development to the north.

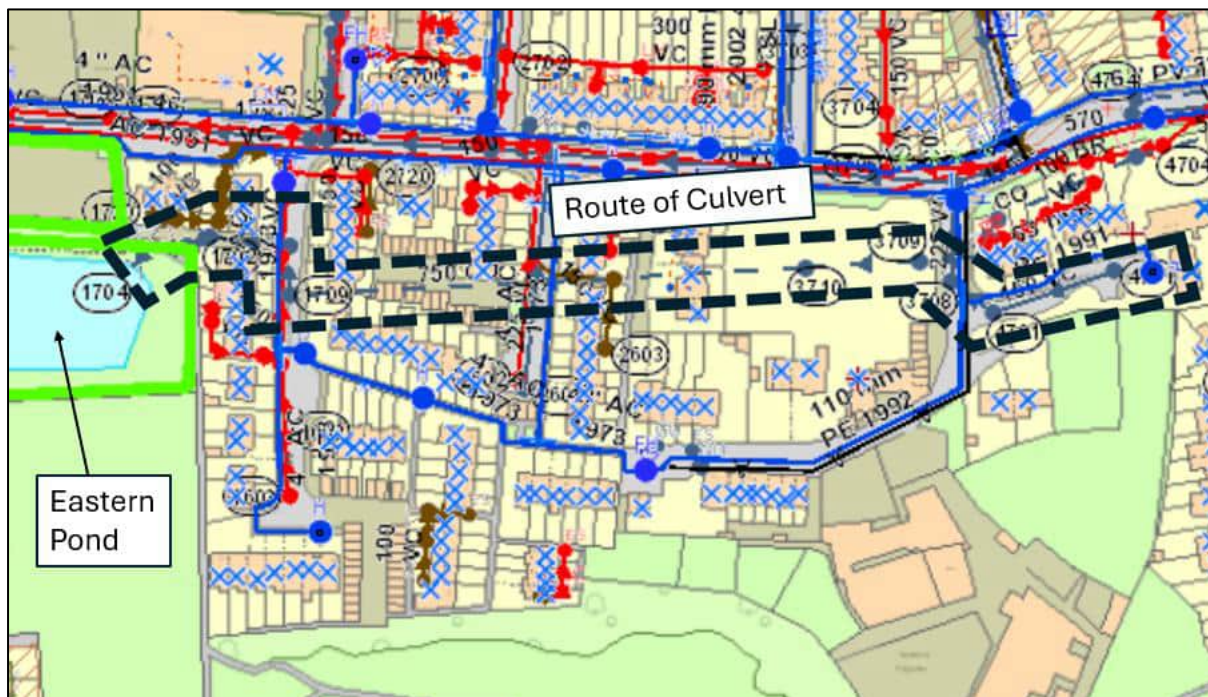


Figure 7. Upstream Route of Culvert (taken from United Utilities Public Sewer Records)

2.9.2 The site primarily comprises brownfield land, with the existing ponds historically forming part of a network of reservoirs designed to provide water to industrial developments. Other than footpaths and tracks, the ponds are the only remaining feature within the site area. It is considered, therefore, that aside from the infrastructure connecting the ponds to the upstream/downstream watercourses, there are no operational private sewers within the site.

2.10 Ground Conditions

2.10.1 The online British Geological Survey (BGS) 'Geology Viewer' shows that the site is underlain by sandstone bedrock of the Chester Formation. The online DEFRA 'Magic' mapping classifies this as a 'Principal' aquifer defined by the EA as '*layers of rock or drift deposits that have a 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*'.

2.10.2 BGS mapping shows the majority of the site is underlain by superficial Devensian 'Till' comprised of Diamicton, boulder clay and sand. The northern corner of the Eastern Parcel is underlain by Devensian Glaciofluvial Ice Contact Deposits comprised of sand and gravel. These are both classified as a 'Secondary Undifferentiated' aquifer which is used in instances where the variable nature of the deposits means it is not possible to apply a more-permeable Secondary A, or less-permeable Secondary B classification.

- 2.10.3 The Cranfield University 'Soilscales' Viewer records the soil underlying the entire site as '*Slowly permeable seasonally wet acid loamy and clayey soils*'. Due to the brownfield nature of the site, it is assumed that portions of the site are also underlain by Made Ground, primarily in the Western Parcel which is located within the boundaries of a historical landfill site.
- 2.10.4 DEFRA '*Magic*' mapping shows the site is not located within a groundwater Source Protection Zone (SPZ).

3 FLOOD RISK AND PLANNING POLICY

3.1 National Planning Policy and Guidance

3.2 The National Planning Policy Framework (NPPF) was published in 2012 and last revised by the Department for Levelling Up, Housing and Communities (DLUHC) in December 2024. It sets out the Government's national policies on flood risk management in relation to land use planning in England.

3.2.1 NPPF is accompanied by Planning Practice Guidance (PPG) 'Flood Risk and Coastal Change' which was published in March 2014 and last updated in August 2022. PPG is a web-based resource which advises how planning can take account of the risks associated with flooding and coastal change, both in plan making and the planning application process.

3.2.2 The NPPF and the accompanying Planning Practice Guidance (PPG) aim to ensure that flood risk is taken into consideration at all stages of the planning process and advocates the use of a risk-based 'Sequential Test' to preferentially locate development in areas with a low risk of flooding. Where development is necessary in high-risk areas, the NPPF aims to ensure that the development is safe without increasing flood risk through the application of the Exception Test.

3.2.3 The PPG defines the levels of flood risk within England as follows.

- Flood Zone 1 – Low Probability – Land having less than a 1 in 1,000 annual probability of river or sea flooding.
- Flood Zone 2 – Medium Probability – Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.
- Flood Zone 3a – High Probability – Land having a 1 in 100 or greater annual probability of river flooding; or having a 1 in 200 or greater annual probability of sea flooding.
- Flood Zone 3b – Functional Floodplain – Land where water has to flow or be stored in times of flood.

3.2.4 The PPG states that a site-specific FRA is required for all new development proposals located in Flood Zones 2 and 3, and for any proposal of 1 hectare or greater regardless of its flood zone classification. The flood zones as described above are shown on the Environment Agency's Flood Map for Planning, available online.

3.3 Local Planning Policy and Guidance

3.3.1 The Stockport Metropolitan Borough Council Core Strategy is the current adopted development plan and includes Development Management Policy SIE-3 (Protecting, Safeguarding and Enhancing the Environment), which requires developments within flood risk areas to have appropriate protection and mitigation measures. Enhanced flood risk management through water storage, runoff protection and the use of SuDS as mitigation measures.

3.3.2 Policy SD-6 'Adapting to the Impacts of Climate Change' which requires:

- developments to incorporate Sustainable Drainage Systems to manage runoff;
- areas of hardstanding should be of permeable construction or drain to alternative SuDS features;
- developments on brownfield land to reduce rates of runoff by 50%;
- developments on greenfield land to ensure that the rate of runoff is not increased.

3.3.3 Stockport Metropolitan Borough Council planning guidance includes the 2012 'Sustainable Design and Construction' Supplementary Planning Document and accompanying Sustainability Checklist. This promotes the inclusion of Green Infrastructure Networks within development to improve water quality and manage flood risk, and favours developments which have sustainable drainage systems and use landscaping to contribute to the provision of sustainable drainage.

4 DEVELOPMENT PROPOSALS

4.1 Description of the Proposed Development

- 4.1.1 The development will comprise 208 residential dwellings with associated internal roads, driveways, car parking and soft landscaping as shown on Drawing Nos PR1889-HFR-XX-ZZ-DR-A-9003 'Proposed Site Plan – Western & Central Parcel', PR1889-HFR-XX-ZZ-DR-A-9004 'Proposed Site Plan – Central Parcel' and PR1889-HFR-XX-ZZ-DR-A-9005 'Proposed Site Plan – Eastern Parcel'.

Eastern Parcel

- 4.1.2 This area of the site will comprise 24 two-bed houses, 16 three-bed houses and two apartment buildings. It is proposed to fully infill the eastern pond, to create land for properties.
- 4.1.3 Properties will have driveways with separate areas of parking for the apartments. There will also be four parcels of land used for landscaping and play areas.
- 4.1.4 The area will be accessible by vehicle from Station Road to the north, with footpath access from the north and south along the eastern boundary.

Central Parcel

- 4.1.5 This area of the site will comprise 34 two-bed houses, 4 three-bed houses and one apartment building. Properties will have driveways with separate areas of parking for the apartments. There will also be two parcels of land used for landscaping and play areas, one area of public open space and one additional area of landscaping.
- 4.1.6 The Secret Lake will be partially retained, with the narrow section in the north-west separated from the main waterbody.
- 4.1.7 The area is accessible off Station Road to the north, with footpath access off the public footpath/cycle route to the east, and existing footpaths to the north and west. A footpath will also extend around the Secret Lake.

Western Parcel

- 4.1.8 This will comprise 15 two-bed houses and 4 three-bed houses plus driveways. The area will be accessible to vehicles and on foot via a bridge crossing from the south-western corner of the Central Parcel.
- 4.2 Development Lifetime
- 4.2.1 The proposed residential development is considered to have a long term/permanent lifespan of 100 year plus.

4.3 Occupants and Users

- 4.3.1 The proposed development is for residential use and therefore the occupants will be permanent residents/homeowners, with the site in constant use throughout the year.

4.4 Flood Risk Vulnerability

- 4.4.1 Table 2 of the PPG classifies development types based on their vulnerability to flooding, ranging from 'Essential Infrastructure' which has to be operational in times of flood, through 'Highly Vulnerable' (e.g. emergency service stations), 'More Vulnerable' (e.g. residential dwellings and establishments), 'Less Vulnerable' (e.g. offices/retail), to 'Water Compatible' development (e.g. open space, docks, marinas and wharves).

- 4.4.2 Based on Table 2 of the NPPG, the proposed residential development is classified as 'More Vulnerable' development.

4.5 Sequential Test Requirements

- 4.5.1 NPPF December 2024 states the Sequential Test should *"be used in areas known to be at risk now or in the future from any form of flooding, except in situations where a site-specific flood risk assessment demonstrates that no built development within the site boundary, including access or escape routes, land raising or other potentially vulnerable elements, would be located on an area that would be at risk of flooding from any source, now and in the future (having regard to potential changes in flood risk)."*

- 4.5.2 The proposed development will be located within fluvial Flood Zone 1 (see Figure 8), however, areas of the proposed development are at risk of surface water flooding from overland flow routes from off-site and the accumulation of runoff within topographical depressions (see Figure 9). On this basis a Sequential Test would be required. However, mitigation measures that are embedded into the proposed development layout and site design will ensure that all properties are away from potential overland flow routes, and that safe access and egress routes, between the development and off site, will not cross areas of high flood risk. This will be demonstrated as part of this Flood Risk Assessment.

4.6 The Exception Test

- 4.6.1 The Exception Test is a method to demonstrate and help ensure that flood risk to people and property will be managed satisfactorily, while allowing necessary development to go ahead in situations where suitable sites at lower risk of fluvial flooding are not available. Table 3 of the PPG indicates which 'vulnerability classes'

are acceptable in each of the Flood Zones, and when the Exception Test should be applied. This is reproduced as Table 3 below.

- 4.6.2 As the development is classified as 'More Vulnerable' development and will be located in Flood Zone 1, the Exception Test does not need to be applied.

Table 1: Flood Risk Vulnerability and Flood Zone 'Compatibility'					
Flood Zone	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
1 (>0.1%)	✓	✓	✓	✓	✓
2 (0.1 – 0.5%)	✓	Exception Test	✓	✓	✓
3a (>0.5%)	Exception Test	✗	Exception Test	✓	✓
3b (>5%)	Exception Test	✗	✗	✗	✓
Key: ✓ Development is appropriate ✗ Development should not be permitted					

5 BASELINE FLOOD RISK ASSESSMENT

5.1 Sources of Flooding

- 5.1.1 The main sources of potential flooding are from rivers, tidal waters, surface water, groundwater, sewers and drains, and artificial sources such as canals and reservoirs.
- 5.1.2 The presence of a potential flooding source within the vicinity of the site does not necessarily translate into a high risk of flooding. Table 4 below summarises the potential flood sources and the related flood risk posed to the site.

Table 4: Sources of Flood Risk			
Flood Source	Presence at Site	Potential Risk to the Development	Description
Rivers (<i>Fluvial flooding</i>)	Y	Low	Site is within Flood Zone 1. Short section of open watercourse adjacent to the site is located at a lower elevation
Tidal	N	-	-
Surface Water Flooding (<i>Pluvial flooding</i>)	Y	Low/Medium	Overland flow route through eastern portion of site (Low risk). Isolated topographical depressions at risk of flooding/ ponding.
Groundwater	Y	Very Low	Clayey superficial deposits. Groundwater over 7m deep in nearby borehole log. Ponds are assumed to be clay-lined and water level is not indicative of groundwater level
Sewer	Y	Low/Medium	No manhole chambers within site area. Potential flood route into the site from culvert to the east/combined sewer to the north
Artificial	Y	Medium	Ponds are raised impounded waterbodies

5.2 Historical Flooding Incidents

- 5.2.1 The Stockport Borough Preliminary Flood Risk Assessment and the Manchester Combined Authority Strategic Flood Risk Assessment do not refer to any historic flood risk incidents within the vicinity of the site.

5.2.2 Section 19 reports for June 2016, September 2016 and July 2019 flooding events, available on the Stockport Metropolitan Borough Council website do not show any flooding impacting the proposed site, or areas in the near vicinity.

5.3 Fluvial Flooding

5.3.1 The EA 'Flood Map for Planning' (see Figure 8) shows that the site is located wholly within fluvial Flood Zone 1 with an annual probability of flooding from rivers of less than 1 in 1,000 years (<0.1%). The closest area of Flood Zone 3 is located approximately 1.1km to the north of the site associated with Gore Brook.

5.3.2 There is a short section of open channel downstream of the outfall from Secret Lake. This is at a lower elevation than the site with no pathway for any overtopping to enter the site area. There are no other open sections of watercourse in the vicinity of the site.

5.3.3 Based on the available information, the risk of fluvial flooding is, therefore, considered to be **LOW**.

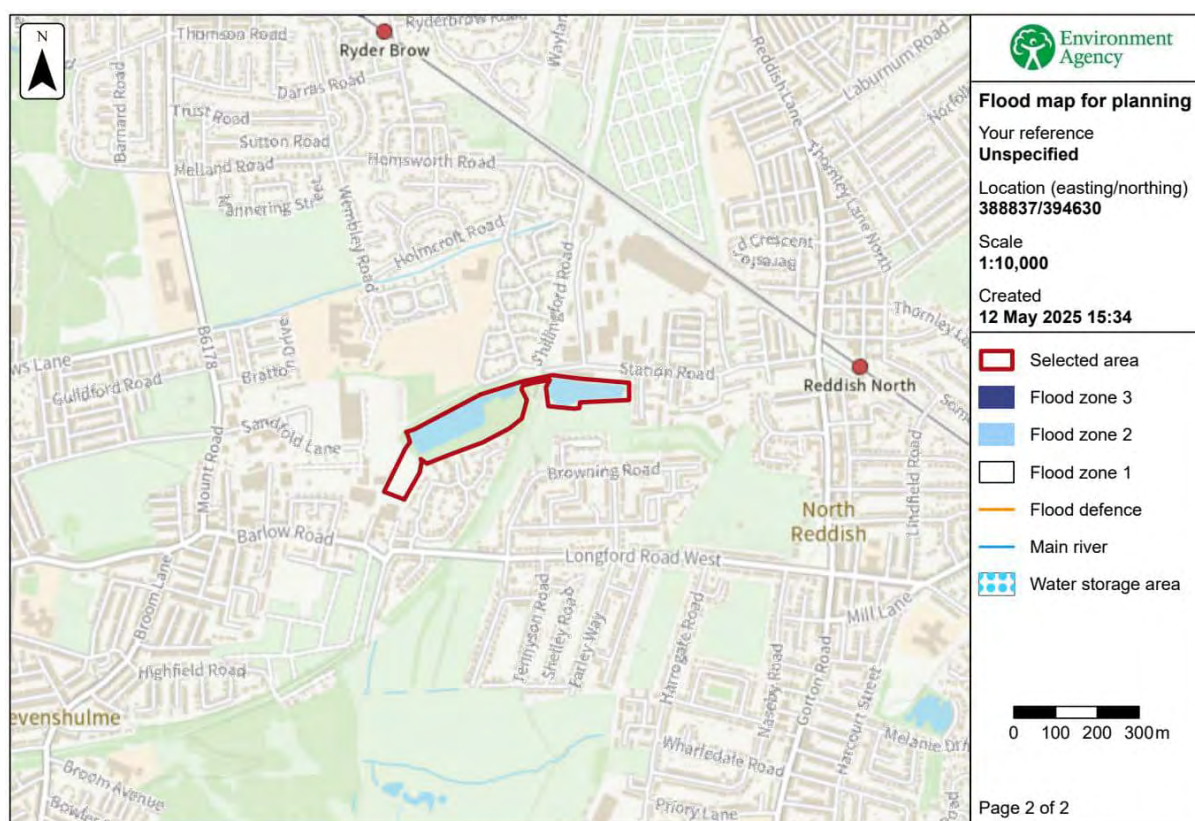


Figure 8. Environment Agency Flood Map for Planning

5.4 Tidal Flooding

5.4.1 The risk of tidal flooding is **DISCOUNTED** due to the distance of the site from any tidally influenced watercourses.

5.5 Surface Water Flooding (Pluvial Flooding)

5.5.1 Surface water flooding is most likely to occur during intense rainfall when water is unable to infiltrate into the ground or enter the local drainage network, resulting in increased surface runoff and localised flooding.

5.5.2 The EA classifies the risk of surface water flooding as follows:

- Very Low – an annual probability of less than 1 in 1,000 (<0.1%);
- Low – an annual probability of between 1 in 1,000 and 1 in 100 (0.1% - 1.0%);
- Medium – an annual probability of between 1 in 100 and 1 in 33 (1.0% - 3.3%); and
- High – an annual probability of greater than 1 in 30 (>3.3%).

5.5.3 The EA 'Extent of Flooding from Surface Water' map (see Figure 9) shows that surface water flood risk is 'Very Low' in the majority of the site, with a less than 1 in 1000 annual probability of flooding.

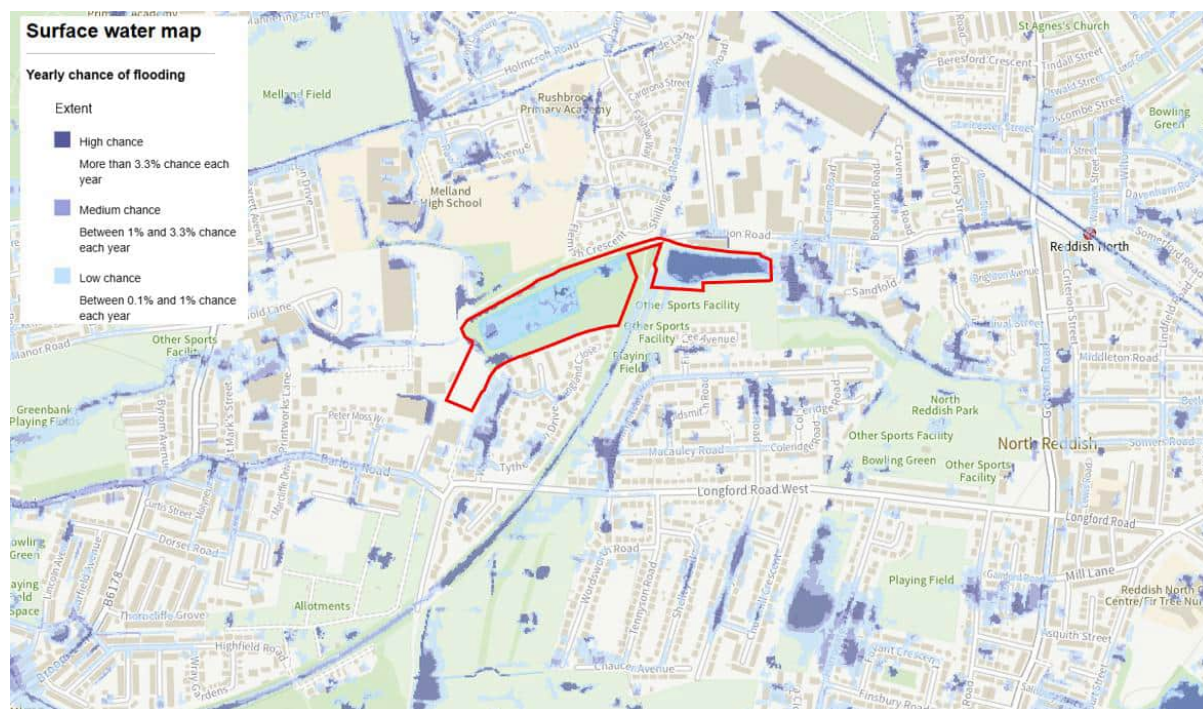


Figure 9. Environment Agency Surface Water Flood Extent Mapping

- 5.5.4 The large area of High risk in the Eastern Parcel corresponds with the footprint of the eastern pond, however, ground to the south-west and east of the pond are shown to be at a Medium to Low risk of flooding. It is assumed that this represents an overland flow route extending from the residential areas to the east of the site, across the Eastern Parcel and then south-west to the Fallowfield Loop footpath/cycleway. Flows then continue south-westwards along the Fallowfield Loop. Figure 10 shows an enlargement of the EA surface water flood mapping showing the potential overland flow route.



Figure 10. Potential Overland Flow Route

- 5.5.5 Areas adjacent to the northern and western banks of the Secret Lake in the Central Parcel are shown to be at a High risk of flooding. It is considered that to the north of the waterbody, these are isolated topographical depressions between the embankment and a raised footpath. Land at risk of flooding to the west is coincident with a larger topographical depression.
- 5.5.6 The Western Parcel is not at risk of surface water flooding.
- 5.5.7 Based on the available information, the land in the Eastern Parcel adjacent to the eastern pond would be considered at a **LOW** to **MEDIUM** risk of flooding due to the off-site overland flow risk. As the Central Parcel is only affected by flooding in topographical depressions and the Western Parcel is unaffected, the risk is considered to be **VERY LOW** in these areas.

5.6 Groundwater Flooding

- 5.6.1 Groundwater flooding can occur anywhere where groundwater levels rise above the ground surface. Groundwater flooding can be difficult to predict and identify and is often associated with surface water flooding.
- 5.6.2 The online BGS viewer does not contain boreholes records within the site area. A borehole record for a 7m deep borehole to the north of the Eastern Parcel states that the groundwater was not encountered.
- 5.6.3 Due to the underlying clayey soils and superficial deposits it is considered unlikely that groundwater would be present in significant quantities and that there would be few pathways where any groundwater could emerge above ground level.
- 5.6.4 It is assumed that the manmade ponds are clay lined and essentially separated from the surrounding geology. The water level within the ponds is unlikely, therefore, to be in continuity with the water table and the approximate water levels of 69mAOD in the eastern pond and 66.6mAOD in the Secret Lake are not indicative of groundwater levels.
- 5.6.5 Based on the available information, the risk of groundwater flooding is considered to be **VERY LOW**.

5.7 Sewer Flooding

- 5.7.1 Sewer flooding can occur from localised, high intensity storms of a relatively short duration that have the potential to exceed the capacity of the local drainage network. Surface water and combined sewers in particular are at risk of exceedance during extreme rainfall events.
- 5.7.2 United Utilities public sewer records show that there are no manhole chambers within the site area and, therefore, no risk of sewer surcharging emerging at the surface. Ground levels around the 525mm diameter sewer within the footpath beyond the northern boundary of the Central Parcel are higher than levels within the site area. and surcharging emerging above ground level would have a potential pathway southwards from the raised footpath into the site. Flood flows would then enter Secret Lake and would be managed within the waterbody.
- 5.7.3 It is considered, however, that the sewer will be at significant depth below ground level in order for the network within the residential area to north to discharge via gravity. The risk of surcharging emerging above ground level in this section of sewer is considered to be low.

- 5.7.4 United Utilities sewer records show a culvert discharging to the eastern pond, assumed to be a remnant of a historical watercourse which was culverted as the area was urbanised. It is assumed that this serves two areas of residential development approximately 150m to the east of the site, based on an absence of public combined sewers in this area which are typically prevalent in the wider vicinity.
- 5.7.5 The closest manhole chamber to the site along the route of the culvert is within an unnamed road adjacent to the north-eastern corner of the Eastern Parcel. Ground levels in this area fall southwards and slightly south-eastwards giving a potential pathway for flooding to enter the Eastern Parcel. It is assumed that any flood flows would follow the existing overland flow route south-westwards with no risk to the adjacent land.
- 5.7.6 Based on the available information the risk of sewer flooding is considered to be **LOW** for the majority of site areas, with land to the north of Secret Lake and the eastern boundary of the Eastern Parcel at a **MEDIUM** risk.
- 5.8 Artificial Flooding
- 5.8.1 Artificial sources of flooding include reservoirs, canals and any other impounded water body which is elevated above the site. Flooding can occur when the impounding structures such as dams and embankments fail, when culverts become blocked, or during extreme rainfall events when the waterbodies overflow.
- 5.8.2 The EA's 'Extent of Flooding from Reservoirs' mapping shows that the site is not at risk of reservoir flooding and there are no raised canals in the vicinity of the site.
- 5.8.3 The potential impact of flooding from the culvert to the east of the site is discussed in the sewer flooding section above.
- 5.8.4 The Secret Lake and eastern pond are both impounded waterbodies. The water level in the Secret Lake is higher than land to the south and is retained behind a bund. The water level of eastern pond is higher than the adjacent Fallowfield Loop and is retained behind a concrete wall.
- 5.8.5 A breach at the eastern pond would affect the Fallowfield Loop rather than affect the site area, due to relative levels.
- 5.8.6 A breach of the bund along the Secret Lake would, however, affect the site area. The integrity of the bunds/retaining walls and what upgrades have been carried out since the ponds were constructed is not known.
- 5.8.7 Due to potential risks of flooding from the culvert and the impounded waterbodies, the overall risk of flooding from artificial sources is considered to be **MEDIUM**.

6 IMPACT OF THE PROPOSED DEVELOPMENT ON FLOOD RISK

6.1.1 New development can pose a risk of flooding to neighbouring properties and areas downstream of the site, often as a result of an increase in impermeable area which has the effect of increasing the rate and volume of surface water runoff. In addition, climate change can be expected to cause an increase in rainfall intensity and surface water runoff over the lifetime of the development.

6.1.2 Flood risk can also be increased as a result of new development if the development reduces the floodplain storage area or alters flood flow paths, ultimately displacing flood water and resulting in an increased risk to the surrounding area.

6.2 Receptors

6.2.1 Potential receptors include residential developments and industrial developments to south and west situated downslope of the site, and the industrial and residential developments to the north and east served by the public sewer network upstream of the site. Properties to the east of the site are also situated at the upstream end of an overland flow route extending through the site.

6.3 Fluvial Flooding

6.3.1 The site is entirely located in Flood Zone 1 (see Figure 8). The closest watercourse to the site is the open section of watercourse beyond the north-western corner of the site. This is at a lower elevation than the site and, therefore, there will be no impact on fluvial flood flow routes or loss of flood plain storage.

6.4 Surface Water Flooding (Pluvial Flooding)

6.4.1 The Eastern Parcel of the site is situated along an overland flow route following the topography from the residential development to the east, to the Fallowfield Loop footpath/cycleway to the west. As part of the proposed development ground levels within this area will be extensively modified. The eastern pond will be infilled and ground levels around the pond will be modified to create a flat platform for the proposed development.

6.4.2 There is the potential, therefore, that the overland flow route will be impeded or diverted by the modified ground levels, increasing the risk of flooding to off-site areas.

6.4.3 Mitigation measures are incorporated into the design of the site which will minimise surface water flood risk. The layout of the proposed road network and green infrastructure will ensure that existing overland flow routes crossing the development from off-site will be retained but diverted away from new properties.

- 6.4.4 Isolated topographical depressions close to proposed properties where surface water runoff could accumulate will be infilled to create flat ground on which to situate the properties. This will, by its nature, remove the risk of flooding in these isolated areas without impacting off-site areas.
- 6.4.5 Ground levels will also be modified within the Central Portion of the site around the Secret Lake. There are no existing overland flow routes within this area and changes to ground levels will have no impact on the risk of flooding off-site.
- 6.5 Surface Water Runoff
- 6.5.1 New developments can pose a risk of flooding to neighbouring properties and areas downstream of the site, as a result of an increase in impermeable area which has the effect of increasing the rate and volume of surface water runoff.
- 6.5.2 The existing site comprises areas of vegetated open ground, areas of woodland and two ponds with minimal areas of hardstanding. Runoff within the open ground and woodland is assumed to disperse naturally by a combination of infiltration and evapotranspiration.
- 6.5.3 The proposed development will comprise building roofs, carparking and access roads with a total impermeable area of approximately 1.99 ha. This would increase the impermeable area within the site, and the rate and volume of surface water runoff generated within the site is, therefore, likely to increase as a result of the proposed development.
- 6.5.4 Mitigation will be required to ensure that the risk of surface water flooding to downstream areas is not increased as a result of the proposed development.
- 6.6 Artificial Flooding
- 6.6.1 Based on historical mapping, the eastern pond and Secret Lake were part of a number of water bodies situated along the route of a watercourse and were linked by a system of weirs and overflows to supply a source of water to industrial developments. This is considered to be an artificial drainage system. Over time, the other water bodies were infilled, and the majority of the watercourse was culverted.
- 6.6.2 As part of the proposed development, the eastern pond will be infilled, however the link between the upstream and downstream sections of the culverted watercourse will be retained. The design will ensure that incoming flows are not impeded, such that there is no risk of surcharging and flooding off-site within the upstream sections of the culvert.

6.6.3 Historically, the eastern pond and Secret Lake were designed to store some of the incoming flows. In the present day it is understood that the eastern pond is heavily silted and the original siphonic drainage system connecting the two waterbodies is understood to no longer be operational, with the penstock also damaged. This prevents discharge from the pond under low flow conditions resulting in higher water levels. It is considered, therefore, that the pond has a reduced capacity for the storage of incoming flows during storm events than it had historically. Any loss of storage for storm events resulting from the proposed infilling of the pond, will therefore be relatively minor by comparison.

6.7 Climate Change

6.7.1 It is necessary to take account of climate change for the lifetime of the development when assessing future flood risk. New climate change guidance was published by the Environment Agency in February 2016, and most recently updated in May 2022. The guidance provides predictions of anticipated increases to peak rainfall intensity. In assessing surface water runoff from the proposed development, the climate change predictions for peak rainfall intensity for the lifetime of the development need to be taken into account.

6.7.2 For developments within the Upper Mersey Catchment with a design life extending beyond the year 2070, climate change upper end allowances of 40% for the 1 in 30 year return period and 45% for the 1 in 100 year return period would apply. It is considered, therefore, that the risk of surface water flooding could increase as a result of climate change, and that mitigation measures are required.

7 FLOOD RISK MITIGATION MEASURES

7.1 Introduction

- 7.1.1 The layout of the proposed development and the proposed surface water drainage strategy will ensure that there is no increase on the risk of flooding on-site or to off-site areas.

7.2 Mitigation for Fluvial Flooding

- 7.2.1 To ensure that there is no impact on the downstream watercourse network as a result dewatering the eastern pond, this will be actively pumped to the downstream network at a restricted rate prior to infilling work.

7.3 Mitigation for Pluvial (Surface Water) Flooding

- 7.3.1 The existing potential overland flow route into the site area from land to the east (see Figure 10) will be retained within the layout of the road network within the Eastern Parcel, with flows directed generally westwards and south-westwards to the south-western corner of the area. This is shown on Drawing No. GM13736-109 'Indicative Exceedance Routes'.

7.4 Mitigation for Surface Water Runoff

- 7.4.1 To mitigate the potential increase in flood risk due to increased surface water runoff from the development, it is proposed to implement a surface water management plan that mimics the greenfield performance of the site.
- 7.4.2 Discharge of surface water runoff off-site will be restricted to the pre-development greenfield rate. For flows in excess of this rate, sufficient attenuation will be provided up to and including the 1 in 100 year event plus 45% climate change allowance.
- 7.4.3 The surface water management proposals are discussed in further detail in Section 9 below.

7.5 Mitigation for Sewer Flooding

- 7.5.1 To mitigate any incoming flooding from the public combined sewer to the north, flows would be retained within landscaping to the north of Secret Lake and directed towards the waterbody. Flows would be managed within the waterbody as per the existing scenario with no risk to the built development or downstream areas previously unaffected.
- 7.5.2 Any flooding from the culvert to the east of the site would be directed westwards along the road network within the development to flow off-site at the south-western corner of the area as per the scenario to mitigate pluvial flooding in this area.

7.6 Mitigation for Artificial Flooding

- 7.6.1 It is proposed that incoming flows from the culvert upstream of the eastern pond will be diverted along the southern site boundary to discharge to the Secret Lake. Flows would then enter the downstream culvert via the existing overflow arrangement from Secret Lake.
- 7.6.2 The capacity of the new pipe will be sufficient to convey flows to the downstream network with no risk of surcharging upstream. The existing rate of flow from the upstream catchment to the eastern pond will be confirmed as part of future detailed design works.
- 7.6.3 To prevent debris from discharging to the culvert, a trash screen could be included at the final outfall from the lake.
- 7.6.4 Presently the Secret Lake has an elevated situation above ground levels in the south-western corner of the Central Parcel, with a water level of approximately 66.6mAOD compared to a minimum ground level of 64.8mAOD. A bund extends along the southern bank of the pond, up to approximately 1.7m higher than the adjacent ground. Any breach of this bund could potentially cause flooding to adjacent properties.
- 7.6.5 In order to mitigate against this risk, the Finished Floor Levels of properties in this area of the site should be set 300mm above the water level of Secret Lake. The bund should also be well maintained and regularly inspected to minimise the risk of any breach.

7.7 Mitigation of Downstream Water Quality

- 7.7.1 Water quality treatment will be incorporated into the proposed sustainable drainage network within the site which will ensure that flows discharged from the site are free from sediment. It is understood that the eastern pond acts as a 'settlement pond' for incoming flows from the upstream network to the east of the site allowing sediments to settle prior to discharge. It is considered that post development, the Secret Lake will also act as the settlement pond for these flows and there will be no negative impact on downstream water quality as a result.

8 RESIDUAL RISK

8.1 Introduction

8.1.1 There is always a possibility of a storm event that exceeds the design standards of the proposed flood risk management measures for new developments. Potential risks include the exceedance of the surface water attenuation facilities during extreme storm events.

8.2 Design Standards

8.2.1 The proposed development will be designed for the 1 in 100 year +45% climate change return period. The site layout will be designed to minimise the risk of flooding to the built development for all storm events up to and including this return period.

8.2.2 The capacity of the on-site surface water drainage network and attenuation will be sufficiently sized to manage all runoff for all storm events up to and including this return period.

8.3 Designing for Exceedance

8.3.1 The surface water drainage system will be designed to minimise the risk of flooding to offsite areas in the event of exceedance of the system capacity during storm events greater than the design storm of 1 in 100 years including an allowance for climate change.

8.3.2 If the capacity of the attenuation features is exceeded by an extreme storm event, exceedance flows will follow the existing overland flow routes off-site.

- Eastern Parcel – there is no above ground attenuation within the eastern parcel. Any flooding from the drainage network within this area would be retained within the road network and discharge off site via the south-western corner of the area as per the existing scenario.
- Central Parcel – exceedance flows from the detention basin will overflow northwards to landscaping adjacent to the northern boundary and will be directed westwards into Secret Lake. Flows will be managed within Secret Lake and will discharge to the downstream watercourse via the existing outfall.
- Western Parcel – exceedance flows from the detention basins will overflow north-eastwards to an unmade footway referred to on mapping as Nelstrop Road as per the existing scenario. Exceedance flows will flow north-westwards and south-westwards along Nelstrop Road with no risk to areas previously unaffected by surface water flooding.

8.3.3 Exceedance routes are shown indicatively on Drawing No. GM13736-109 'Indicative Exceedance Routes'.

8.4 Finished Floor Levels

8.4.1 In accordance with Building Regulations, Finished Floor Levels (FFL's) of new residential properties should be set at least 150mm above surrounding ground levels. This will provide some protection to properties from extreme fluvial flood events or flooding of the drainage system due to blockages or collapse etc. It is recommended that finished floor levels of the proposed dwellings in the immediate vicinity of open attenuation features are set a minimum of 300mm above finished ground levels.

9 SURFACE WATER DRAINAGE STRATEGY

9.1.1 Surface water runoff from the development will be controlled on site to ensure that there is no increase in the risk of flooding to areas downstream of the site and to the development itself.

9.2 Discharge Location

9.2.1 The Planning Practice Guidance (PPG) stipulates a hierarchy for the disposal of surface water which should be followed as part of any surface water drainage design. This hierarchy is as follows:

1. into the ground (infiltration);
2. to a surface watercourse or waterbody;
3. to a surface water sewer, highway drain or another drainage system;
4. to a combined sewer.

9.2.2 The underlying bedrock is classified as a Principal aquifer and is also underlain by Secondary Undifferentiated superficial deposits and will allow for some infiltration. The soils within the site are, however, clayey with impeded drainage and due to the historical industrial land use, particularly within the Western Parcel, there is likely to be a presence of Made Ground. Due to the low rates of infiltration drainage and the risk of mobilising contaminants within the Made Ground, it is considered unlikely that infiltration drainage will be viable within the site.

9.2.3 Infiltration rates will be confirmed by BRE365 soakaway testing undertaken as part of future works.

9.2.4 On the assumption that infiltration drainage will not be suitable, it is proposed to discharge surface water runoff from the development to the downstream culvert to the north-west of Secret Lake as per the existing scenario. This is in accordance with item 2 of the PPG hierarchy.

9.3 Drainage Rationale

9.3.1 The proposed Surface Water Management Plan is shown on Drawing No. GM13736-105 'Indicative Surface Water Management Plan (Eastern Parcel)' and GM13736-106 'Indicative Surface Water Management Plan (Central and Western Parcels)'. The three proposed land parcels will be drained via four separate surface water drainage networks forming two catchments. Each catchment will have a separate outfall point and attenuation features.

Eastern Parcel

- 9.3.2 Surface water runoff is drained via gravity generally westwards and then northwards towards the north-western corner of the parcel. The surface water drain then diverts westwards along the route of the unnamed track off Station Road, beneath the Fallowfield Loop. This will discharge to the former area of marshy ground adjacent to the main body of the Secret Lake. This area will be repurposed to create a vegetated detention basin separate from Secret Lake. Flows from the detention basin will discharge to Secret Lake via a flow control chamber at a restricted rate. Water within Secret Lake will discharge to the downstream culvert via the existing outfall point.
- 9.3.3 The existing culvert upstream of the Eastern Parcel will be diverted southwards around the eastern pond and will discharge to the main Secret Lake waterbody at an unrestricted rate.

Central Parcel

- 9.3.4 Surface water runoff from the eastern portion of the parcel will drain westwards and then northwards to discharge to the detention basin upstream of Secret Lake. Areas to the south of Secret Lake will drain south-westwards to the south-western corner of the parcel to a detention basin located at the corner of the Western Parcel. Flows will then discharge north-westwards, via a flow control chamber, along the western bank of Secret Lake to the unnamed watercourse downstream of Secret Lake.

Western Parcel

- 9.3.5 Surface water runoff drains north-eastwards to discharge to the detention basin shared with the Central Parcel.

9.4 Greenfield Runoff Rate

- 9.4.1 Following DEFRA and CIRIA guidance, greenfield runoff rates (QBAR) were calculated using the online HR Wallingford 'Greenfield Runoff' tool. Table 6 below shows a summary of the calculated greenfield runoff rates, with full calculations contained in Appendix 3.

Table 6. Greenfield Runoff Rates		
Return Period	Greenfield Runoff Rate (l/s/ha)	Greenfield Runoff Rate (l/s) for Impermeable Area of the Development (1.99ha)
QBAR	6.37	12.70
1-year	5.54	11.02
30-year	10.83	21.55
100-year	13.25	26.37

9.4.2 The discharge rate from the proposed development will be restricted to the greenfield QBAR runoff rate of 6.37 l/s/ha for all storm events up to and including the 1 in 100 year +45% event. Based on a total proposed impermeable area of 1.99ha, the final discharge rate from the site will be restricted to 12.70 l/s.

9.5 Attenuation Requirements

9.5.1 Sufficient attenuation will be provided for all storm events up to and including the 1 in 100 year +45% event this will be provided primarily within two detention basin features within the Central and Western Parcels (see Table 7 below). Detention Basin 1 will provide attenuation for the Eastern Parcel and the north-eastern portion of the Central Parcel (Catchment A). Detention Basin 2 will provide attenuation for the Western Parcel and the remainder of the Central Parcel (Catchment B).

Table 7: Surface Water Attenuation Calculations					
Catchment	Total Impermeable Area (ha)	Discharge Rate (l/s)	Detention Basin	Estimated Attenuation Requirement (Average)	
				1 in 30 year (+40% climate change)	1 in 100 year (+45% climate change)
Catchment A	1.225	7.80	1	695m ³	1,026m ³
Catchment B	0.764	4.87	2a and 2b	434m ³	640m ³
Note: Calculations based on no infiltration to ground. Calculations based on a QBAR discharge rate of 6.37 l/s/ha.					

9.5.2 The proposed surface water drainage network was modelled using Flow software and confirms that the proposed drainage network would be sufficient to manage surface water runoff in all storm events up to and including the 1 in 100 year +40% event (see Appendix 5). The manhole reference numbers and pipe numbering used in the model, along with the contributing catchment areas are shown on Drawing No. GM13736-107 'Drainage Catchment Plan (Eastern Parcel)' and GM13736-108 'Drainage Catchment Plan (Western Parcel)'.

9.5.3 The modelling confirms that the proposed surface water drainage networks will not flood during the 1 in 30 year +40% event. Whilst Catchment B does not flood in the 1 in 100 year +45%, there would be minor flooding at two points within the upper sections of Catchment A. It is considered that this could be safely managed within the

layout of the site with additional upstream attenuation or storing temporary flooding away from properties.

- 9.5.4 Whilst it is proposed to provide the majority of attenuation within detention basins, smaller SuDS options can be incorporated into the surface water drainage to provide source control, water treatment and additional attenuation. Options for further SuDS options and source control features are shown in Table 8 below.

Table 8. Sustainable Drainage System (SuDS) Options and Suitability			
Type	Device	Description	Suitability
Source Control	Green roof	Green roofs are systems which cover a building's roof with vegetation. They are laid over a drainage layer, with other layers providing protection, waterproofing and insulation.	Green roofs are generally not suitable for individual residential properties with sloped roof
	Infiltration devices	Infiltration devices temporarily store runoff from a development and allow it to percolate into the ground.	Due to soil type and potential made ground within the site, the ground conditions are unlikely to be suitable for infiltration drainage.
	Pervious surfaces	Pervious surfaces allow rainwater to infiltrate through the surface into an underlying storage layer, where water is stored before infiltration to the ground, reusing, or release to surface water or sewers.	Permeable paving would be suitable for areas of car parking or private driveways within this site. This would allow surface water to be filtered through the paving before being collected underground and connected to attenuation areas.
	Bioretention systems	Shallow landscaped depressions (e.g. tree pits, rain gardens) generally used for intercepting, managing and treating runoff from frequent rainfall events.	Suitable for use in open space. Runoff would be filtered through soils and vegetation and collected in an underdrain system and discharged to attenuation areas.
	Rainwater harvesting	Rainwater harvesting reduces the amount of runoff from a site by re-using the water for non-potable uses.	Rainwater harvesting may potentially be suitable for use within the development.
Permeable Conveyance	Filter strips	These are wide, gently sloping areas of grass or other dense vegetation that treat runoff from adjacent impermeable areas.	Filter strips may potentially be suitable for use within the development adjacent to access roads.
	Swales	Swales are broad, shallow channels covered by grass or other suitable vegetation. They are designed to convey and/or store runoff and can infiltrate the water into the	Swales may potentially be suitable for use within land parcels as conveyance and storage. Site ground conditions may facilitate ground infiltration.

Table 8. Sustainable Drainage System (SuDS) Options and Suitability			
Type	Device	Description	Suitability
		ground (if ground conditions allow).	
Passive treatment/ end of pipe treatment	Infiltration basins	Infiltration basins are depressions in the surface that are designed to store runoff and infiltrate the water to the ground. They may also be landscaped to provide aesthetic and amenity value.	Due to soil type and potential made ground within the site, the ground conditions are unlikely to be suitable for infiltration drainage.
	Detention basins	Detention basins are depressions which are designed to store runoff prior to discharge to a watercourse or sewer. They may also be landscaped to provide aesthetic and amenity value.	Detention basins are considered to be suitable within areas of open space at the site.
	Wet ponds	Wet ponds are basins that have a permanent pool of water for water quality treatment. They provide temporary storage for additional storm runoff above the permanent water level. Wet ponds may provide amenity and wildlife benefits.	Wet ponds may potentially be suitable for use within areas of open space at the site.
	Constructed wetlands	Constructed wetlands are ponds with shallow areas and wetland vegetation to improve pollutant removal and enhance wildlife habitat.	Constructed wetlands may potentially be suitable for use on the site.
	Underground attenuation	Underground attenuation can be used where other forms of SuDS are not appropriate for the site. Underground attenuation stores water for volumes above the allowable discharge rate and releases the water at the restricted discharge rate.	Underground attenuation would be suitable for use on the site and could be used in conjunction with permeable paving.

9.6 Water Quality

9.6.1 The surface water drainage system, which will incorporate SuDS, will ensure that a sufficient level of water quality treatment is provided to ensure that the proposed development does not have any adverse impact on of the receiving network.

9.6.2 The Simple Index Approach outlined in the CIRIA SuDS Manual is used to demonstrate that appropriate treatment will be provided within a proposed development to ensure that there is no negative impact on water quality.

9.6.3 The Simple Index Approach assigns 'Pollution Hazard Indices' for suspended solids, metals and hydrocarbons, and an overall 'pollution hazard level' to different types of land use. These are summarised in Table 9 below (based on Table 26.2 of the SuDS Manual).

Table 9. Pollution Hazard Indices for Land Use Classifications				
Land Use	Pollution Hazard Level	Total Suspended Solids	Metals	Hydrocarbons
Residential roofs	Very Low	0.2	0.2	0.05
Commercial/ industrial roofs	Low	0.3	0.2	0.05
Individual property driveways, residential car parks, non-residential car parks with infrequent change (ie schools, offices), low traffic roads (ie homezones and general access roads) ie less than 300 traffic movements per day	Low	0.5	0.4	0.4
Commercial yard/delivery areas, non-residential car parking with frequent changes (ie retail, hospitals), all roads (except low traffic/trunk roads/motorways).	Medium	0.7	0.6	0.7
Haulage yards, industrial estates, areas, trunk roads, motorways.	High	0.8	0.8	0.9

9.6.4 Based on Table 10, the following land uses would be applicable within the proposed residential development:

- Residential roofs: 'Low' Pollution Hazard Level;
- Individual property driveways, residential car parks, low traffic roads (ie homezones and general access roads)

9.6.5 SuDS features provide treatment by 'velocity control' (sediment deposition and filtration by the control of velocities within SuDS components) and 'retention time'

(removal of contaminants through settling, adsorption and other treatment over the time that the water is in contact with the ‘treatment media’ within the SuDS components).

- 9.6.6 The Simple Index Approach then assigns mitigation indices for suspended solids, metals and hydrocarbons for various SuDS features. To ensure that water quality standards are met, the Pollution Mitigation Indices provided by the sustainable drainage features need to be greater than or equal to the Pollution Hazard Indices for the proposed land use. The Mitigation Indices for a range of SuDS features, based on Table 26.3 of the SuDS Manual are summarised in Table 11.

Table 11. Mitigation Indices for Discharges to Surface Waters			
Land Use Pollution Hazard Level	Total Suspended Solids	Metals	Hydrocarbons
Filter Strip	0.4	0.4	0.5
Filter Drain	0.4	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	0.7	0.7	0.5
Wetland	0.8	0.8	0.8
Proprietary Treatment Systems (eg oil interceptors, vortex separators)	TBC by manufacturer		

- 9.6.7 Whilst Tables 10 and 11 confirm that the proposed detention basins would provide sufficient treatment for runoff from the development, SuDS features can be linked to provide a ‘treatment train’.
- 9.6.8 The Simple Index Approach accounts for the reduced performance of secondary SuDS features associated with already reduced inflow concentrations, a factor of 0.5 should be applied to the second stage of treatment within a ‘treatment train’, following the below formula taken from the CIRIA SuDS manual.

$$\text{Total SuDS mitigation index} = \text{mitigation index} + 0.5 (\text{mitigation index})$$

- 9.6.9 Whilst the SuDS features within the proposed development will be confirmed as part of future works, an example of a potential ‘treatment train’ for a residential plot following the Simple Index Approach is shown in Table 12 below.

Table 12. CIRIA Simple Index Approach Assessment			
	Treatment Indices¹		
	Total Suspended Solids	Metals	Hydrocarbons
Pollution Hazard Indices – Residential Roofs (Very Low)	0.2	0.2	0.05
Pollution Hazard Indices – Property Driveways (Low)	0.5	0.4	0.4
Pollution Mitigation Indices – Permeable Paving (driveway)	0.7	0.6	0.7
Pollution Mitigation Indices – Detention Basin	0.25 ²	0.25 ²	0.3 ²
Total Mitigation Indices	0.95	0.85	1.0
Sufficient or Additional Treatment Required	Sufficient	Sufficient	Sufficient
1. Treatment indices are based on Table 26.3 of the SuDS Manual			
2. Treatment indices are halved for the second stage of treatment in a 'treatment train'			

9.6.10 The SuDS treatment train within the network would, therefore, provide sufficient treatment for runoff from the roofs and driveways to ensure that there is no impact on the water quality downstream as a result of the proposed development.

9.7 Management and Maintenance Plan

9.7.1 Tables 13 and 14 outlines the required management and maintenance for the proposed detention basins and permeable paving as detailed within the CIRIA SuDS Manual.

Table 13. Operation and Maintenance Requirements for Detention Basin (from SuDS Manual Table 22.1)		
Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter and debris	Monthly
	Cut grass – for spillways and access routes	Monthly (during growing season) or as required
	Cut grass- meadow grass in and around basin	Half yearly; Spring (before nesting season, and Autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages and clear if required	Monthly

Table 13. Operation and Maintenance Requirements for Detention Basin (from SuDS Manual Table 22.1)		
Maintenance Schedule	Required Action	Typical Frequency
	Inspect banksides, structures, pipework for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required
	Check any penstock and other mechanical devices	Annually
	Tidy all dead grass growth before growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool- were provided	Annually (as set out in chapter 23)
Occasional Maintenance	Reseed areas of poor vegetative growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebays and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial Actions	Repair erosion or other damage by reseedling or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/ rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels.	As required

Table 14. Operation and Maintenance Requirements for Pervious Paving (from SuDS Manual Table 20.15)		
Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site specific observations of clogging or manufacturer's recommendations- pay particular attention to areas where water runs onto pervious surfaces from adjacent impermeable areas as this area is most likely to collect the most sediment.
Occasional Maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into weeds by and applicator rather than spraying	As required- once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving	As required
	Remedial work to and depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth- if required, take remedial actions	Three-monthly, 48 hrs after large storms for first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitoring inspection chambers	Annually

- 9.7.2 The management of the SuDS features should be undertaken by the property developer or a third-party maintenance contractor. An example SuDS maintenance checklist is included as Appendix 6 and can be used during each maintenance visit.

10 FOUL WATER DRAINAGE

- 10.1.1 It is proposed that foul water flows from the development discharge to the 525mm diameter public combined sewer running adjacent to the northern boundary of Secret Lake. This is as requested by United Utilities in their pre-development enquiry response (see Appendix 2). United Utilities state that discharge to the public sewer can be at an unrestricted rate.
- 10.1.2 The indicative foul drainage strategy is shown on Drawing No. GM13736-110 'Indicative Foul Drainage Strategy (Eastern Parcel)' and GM13736-111 'Indicative Foul Drainage Strategy (Western Parcel)'.

11 CONCLUSIONS

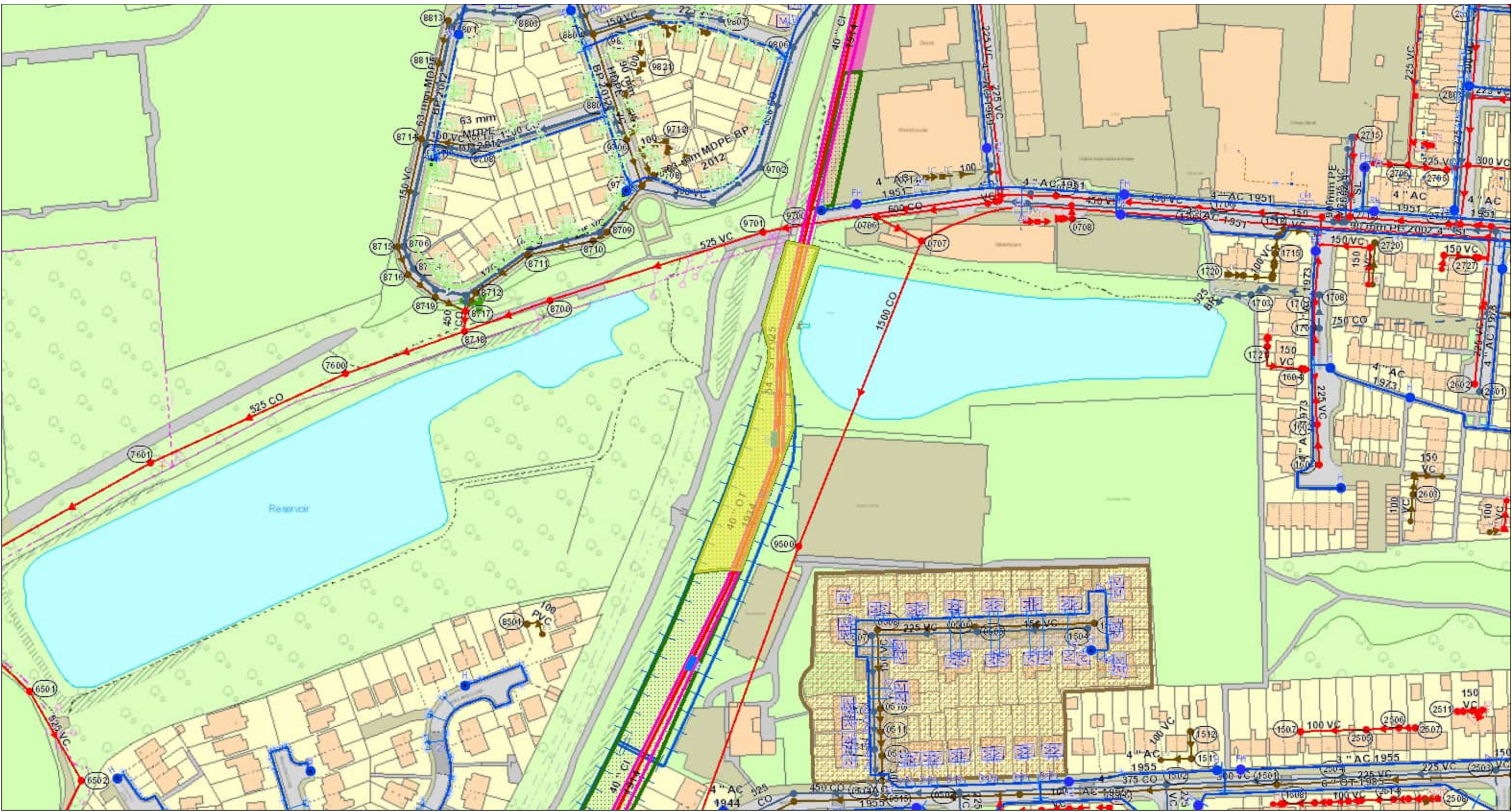
- 11.1.1 This report gives details of the Flood Risk Assessment, which has been conducted in accordance with the National Planning Policy Framework for the proposed residential development of Station Road, Standish. The proposed development comprises new properties, driveways, access roads and areas of open space. As part of the proposed development, the easternmost historical 'mill pond' will be infilled to create an area for residential development.
- 11.1.2 The Environment Agency fluvial Flood Map for Planning shows that the site is located within Flood Zone 1 with a 'Low' probability of flooding. The proposed residential development is defined as a 'More Vulnerable' development in Table 2 of the NPPG and is an appropriate development type within Flood Zone 1.
- 11.1.3 The risk of flooding from surface water is considered to be Very Low to Medium. Areas of Medium risk are present along an existing overland flow route in the east of the site and isolated topographical depressions across the site area. The risk of groundwater flooding is considered to be Very Low. The risk of flooding from sewers is considered to be Low to Medium.
- 11.1.4 The two ponds are impounded manmade waterbodies linked hydraulically with incoming flows from a former culverted watercourse and a final outfall to a second culverted watercourse. Due to this complex arrangement, the risk of artificial flooding is considered to be Medium.
- 11.1.5 To ensure that the risk of flooding to areas downstream of the site is not increased as a result of the proposed development, sustainable flood risk management measures will be put in place including a surface water drainage strategy which will mimic greenfield performance in accordance with the NPPF, Environment Agency requirements and local planning policy.
- 11.1.6 Surface water runoff will be managed in a sustainable manner with surface water runoff discharged to the downstream culvert as per the existing scenario. Incoming flows from the surface water drainage network upstream of the site will continue to discharge to Secret Lake and into the downstream culvert via the existing outfall and, therefore, retaining the existing drainage regime for the wider area.
- 11.1.7 Surface water runoff from the proposed development will be discharged at a restricted pre-development greenfield rate for all storm events up to and including the 1 in 100 year event (including an allowance of 45% for climate change), with sufficient attenuation provided within the development for flows in excess of this for events up to and including this 1 in 100 year +45% scenario.

- 11.1.8 Attenuation will be provided primarily within vegetated detention basins, with additional attenuation provided within smaller SuDS features such as permeable paving and source control features. The SuDS features will also provide treatment to the runoff to ensure that water quality is not impacted as a result of the proposed development.
- 11.1.9 To ensure that there is no impact on the downstream watercourse network as a result dewatering the eastern pond, this will be actively pumped to the downstream network at a restricted rate prior to infilling work.
- 11.1.10 This will ensure that the risk of surface water flooding will not increase within the existing upstream drainage network or downstream network as a result of the proposed development.
- 11.1.11 The layout and landscaping of the proposed development will be designed to ensure that exceedance flood flow paths are routed away from vulnerable development and toward either landscaped areas or areas of open attenuation. This will also ensure that existing overland flow routes from off-site areas are retained and not obstructed or diverted to areas previously unaffected.
- 11.1.12 Overall, the risk of flooding to the site is generally considered to be Low. There will be minimal impact on the existing drainage regime in surrounding areas as a result of infilling the eastern pond, and the existing flood risk within the site area will be managed safely with no risk to on site or off-site areas. Surface water drainage from the proposed development will be managed sustainably and discharged at a restricted rate via the existing outfall point.
- 11.1.13 It is considered, therefore, from a flood risk and drainage perspective the site is suitable for the proposed development.

APPENDICES

APPENDIX 1

United Utilities Sewer Plans



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

APPENDIX 2

United Utilities Wastewater Pre-Development Enquiry

United Utilities Grasmere House, 2nd Floor
Lingley Mere Business Park
Great Sankey
Warrington
WA5 3LP

18.02.25

Dear Luke Imber,

Pre-Development Enquiry for UU Reference Number: **07021047**

We have assessed your application based on the information provided. This pre-development advice on your drainage strategy will be valid for 12 months. Your strategy will need review by other authorities as part of the planning process. We advise conducting necessary site investigations to confirm viability of your proposals.

Modelled Flood Risk

[Please see the image on page 3 for details](#)

I can confirm that we do not have modelled flood risk within the vicinity of the proposed development.

Please note that our modelling data is indicative, and only representative of the 1:100year storm event.

[Please see comment 2 of the attached guidance sheet](#)

Asset Protection

1. We have significant assets crossing this site that cannot realistically be diverted, Thirlmere Aquaduct crosses the site from north to south, please contact Graham Perry on WaterMains@uuplc.co.uk who will give advice on easements and asset protection.
2. There is a surface water outfall to the pond in the east of the site where surface water from United Utilities surface water sewer discharges, there is a duty to maintain flows from this asset.
3. According to our public sewer records, there are public sewers located within your site boundary. This requires an easement of 6.5m from centre line of pipe either side. If you cannot achieve the required clearance, you may wish to consider diverting and or abandoning the public sewer.

[Please see comment 3 of the attached guidance sheet and Working Near Our Pipelines Guidance document](#)

Foul Water

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

Our preferred point of discharge would be to the 525mm combined sewer north of your proposed development at an unrestricted rate.

Grid reference 388788 394693

[Please see the images on page 3 for clarification](#)

Surface Water

Follow the National Planning Policy Guidance drainage hierarchy and provide evidence for discounting higher options before considering public sewer discharge. Consult the Lead Local Flood Authority regarding surface water concerns.

[Please see comment 4 within the guidance sheet](#)

Infiltration

[Please see comment 4 within the guidance sheet](#)

Waterbody

If an evidence based assessment has been carried out and confirms that infiltration is not feasible, we recommend that you contact the Lead Local Flood Authority and/or Environment Agency to discuss a point of discharge to the reservoir located in the site boundary of the proposed site.

We would encourage you to engage with any third-party landowner and riparian owner to agree access and discharge rights to the water body if this is not in your ownership.

Public Sewer

No connection to the public sewer will be permitted at this time. This is because there are 2 large reservoirs within the site.

[Please see images on page 3 for clarification](#)

Site Images

WASTEWATER PRE-DEVELOPMENT ENQUIRY



Pre Development Enquiry Guidance

Version 1 (September 24)

(This document should be read in conjunction with PDE response letter)



Water for the North West

Comment no.	Technical Guidance
General Guidance	
1	Sewer Access If your investigations require access to our public sewer network, we ask that you contact our network engineers with a request for an access certificate via our main contact telephone number 0345 6723 723 or refer to the link below: https://www.unitedutilities.com/builders-developers/working-near-our-assets/ Sewer Adoption Under S104 If you intend to offer sewers for adoption, design per current Design and Construction and local practices which have now replaced Sewers for Adoption 6th Edition.. S104 Pre-Design Assessment We recommend submitting a pre-design assessment. This is a free service to discuss the high level design and potential challenges. Please see link to application form in guidance sheet. Adoption of Sewers • Designs must comply with current Design & Construction Guidance. • S104 1b Pre-design assessment, and S104 for adoption of new sewers applications can be found at Sewer adoptions - United Utilities • Submit pre-design assessment to SewerAdoptions@uuplc.co.uk. • No construction should commence until detailed design is approved in writing. Sewer Connections: • Formal S106 application required for sewer connections. Application details available at: www.unitedutilities.com/builders-developers/wastewater-services/sewer-connections/ Water Assets • Contact DeveloperServicesWater@uuplc.co.uk regarding clean water assets on site. • Further information: Water pre-development - United Utilities Additional Considerations • Land drainage, overland flows, and track drainage are not accepted into public sewer network. Useful Resources: • Codes for Adoption: www.water.org.uk/technical-guidance/developers-services/codes-for-adoption/ • Design & Construction Guidance: www.water.org.uk/sewerage-sector-guidance-approved-documents/ • United Utilities website: www.unitedutilities.com/builders-developers/ Contact Information: • Main contact number: 0345 6723 723 • Sewer Adoptions and Pre-Development: SewerAdoptions@uuplc.co.uk
2	Flooding Events Please note that United Utilities Water Limited (Uuw) can only record and check flooding events which are reported to us, and we must comply with our Regulators instructions on the qualification of flooding events. Our response does not include: • any sewer flooding events caused by blockages or collapses which are the result of third-party actions, natural events, or other actions over which Uuw has no control and not a facet of sewer capacity; or • any historical sewer flooding events that have been resolved from investment in our infrastructure.

	Further consideration. - For low-lying sites, care should be taken to ensure that the property is not at increased risk of flooding. It could affect the detailed design of your site and result in the need to incorporate appropriate mitigating measures in your drainage scheme. - Consult Lead Local Flood Authority (LLFA) for surface water drainage concerns. - Check Environment Agency guidelines if site is in a Groundwater Source Protection Zone.
3	Asset Protection - Due to the accuracy of the records and the public sewer transfer legislation in 2011, not all public sewers are shown on our records. We ask that you proceed with caution and conduct adequate site investigation works. If any uncharted sewers are identified while conducting your investigation, we ask that you contact United Utilities at the earliest opportunity so that we can offer guidance and update our records. - Obtain asset data records before planning development United Utilities - Property Search : - Please be aware that any proposed diversion may require modelling. This process may take up to 6 months to reach an acceptable design. - Maintain minimum easement in line with our easement local practice, unless there is a formal easement in place, in which case the specified easement width would apply. easement-local-practice.pdf (unitedutilities.com) - Contact United Utilities for guidance on work near assets or if diversion is necessary.
4	Surface Water Drainage Hierarchy Follow the hierarchy as per National Planning Practice Guidance: 1. Infiltration 2. Discharge to waterbody 3. Discharge to surface water sewer or highway drain 4. Discharge to combined sewer (last resort) For guidance, The Northwest SuDS Pro-Forma provides information on the appropriate evidence required at each stage of the hierarchy, to demonstrate how each level has been discounted. The Lead Local Flood Authority has responsibility for all surface water drainage concerns and their input to your proposal is critical. You should also consider whether it is necessary to discuss your proposal with the Environment Agency, or Internal Drainage Board (if operating in your area). The Local Planning Authority are the determining authority for any application for planning permission and the appropriate authority for determining the cost viability of a proposed drainage scheme, such assessments are outside of the jurisdiction of United Utilities. SuDS (Sustainable Drainage Systems) - Prioritise multi-functional SuDS in accordance with national planning policy. - Design SuDS components as per CIRIA SuDS Manual (C753). - Consult the North West SuDS Pro-Forma for required evidence at each stage of the drainage hierarchy. Infiltration Surface water runoff generated from this development should discharge to the ground via infiltration system where feasible. A detailed evidence-based feasibility assessment must be carried out in line with Chapter 25 of the CIRIA SuDS Manual 2015 to determine whether infiltration is a suitable method of surface water disposal. Particular attention must be paid to Ground Water Source Protection Zones to ensure that the risk of pollution to these valuable resources is not compromised. Details can be obtained from the government website: https://www.gov.uk/guidance/groundwater-source-protection-zones-spzs#find-groundwater-spzs If your site is in a Groundwater Source Protection Zone, you should have regard to the Environment Agency's approach to Groundwater Protection. Information on this is available via the link below: https://www.gov.uk/government/publications/groundwater-protection-position-statements Please note that such a location could have implications for the principle of your development and the need for additional mitigating measures to protect the groundwater environment and public water supply in the detailed design of your site. Surface Water Discharge Rates Please note the given discharge rate is based on the site area believed to be developed. If there are significant areas of the site that will not be developed, the discharge rate should be reduced accordingly.
5	Please note that this guidance is current as of the date of issue. Always check for the most up-to-date regulations and guidelines when planning your development.

APPENDIX 3

Greenfield Runoff Rate Estimation

Calculated by:	Holly McIntosh
Site name:	
Site location:	

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

Site Details

Latitude:	53.44891° N
Longitude:	2.1664° W
Reference:	513643864
Date:	Feb 21 2025 16:52

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):	1
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Methodology

Q _{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Notes

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

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

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

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

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

Hydrological characteristics

	Default	Edited
SAAR (mm):	887	887
Hydrological region:	10	10
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	1.7	1.7
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates

Default

Edited

Q_{BAR} (l/s):	6.37	6.37
1 in 1 year (l/s):	5.54	5.54
1 in 30 years (l/s):	10.83	10.83
1 in 100 year (l/s):	13.25	13.25
1 in 200 years (l/s):	15.09	15.09

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

APPENDIX 4

Attenuation Calculations

Calculation Sheet

REF:

CLIENT: Northern Group Developments	PROJECT: Station Road, Reddish	JOB NO.: GM13736	CALC. REF. NO.:			
			PAGE:	1	OF	1
CALCULATION	CALC. BY:	CHECKED BY:	APPROVED BY:			
Surface Water Attenuation Estimates	(NAME AND SIGNATURE)	(NAME AND SIGNATURE)	(NAME AND SIGNATURE)			
	B Galicia-Griffiths					
	DATE: 07/05/2025	DATE:	DATE:			

Causeway 'Flow' Attenuation Volume Estimate

Rainfall Methodology	Load	FEH-22
Rainfall Events		Singular
FEH filename		N:\GM\GM13736 - Station
Summer CV	☒	0.750
Winter CV	☒	0.840

Calculations assume no infiltration as a 'worst case' scenario

Catchment A (Eastern Parcel and Central Parcel)

<u>Storage Estimate</u>	
Return Period (years)	30
Climate Change (%)	40
Impermeable Area (ha)	1.225
Peak Discharge (l/s)	7.800
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	532
to	858

<u>Storage Estimate</u>	
Return Period (years)	100
Climate Change (%)	45
Impermeable Area (ha)	1.225
Peak Discharge (l/s)	7.800
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	790
to	1261

Required attenuation: 532m³ - 858m³ (average 695m³) Required attenuation: 790 - 1261m³ (average 1026m³)

Catchment B (Western Parcel and Central Parcel)

<u>Storage Estimate</u>	
Return Period (years)	30
Climate Change (%)	40
Impermeable Area (ha)	0.764
Peak Discharge (l/s)	4.870
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	332
to	535

<u>Storage Estimate</u>	
Return Period (years)	100
Climate Change (%)	45
Impermeable Area (ha)	0.764
Peak Discharge (l/s)	4.870
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	493
to	786

Required attenuation: 332m³ - 535m³ (average 434m³) Required attenuation: 493m³ - 786m³ (average 640m³)

Calculated by:	Holly McIntosh
Site name:	
Site location:	

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APPENDIX 5

Surface Water Network Drainage Network Model

**Design Settings**

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	1	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	0.800
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.052	5.00	70.481	1200	389143.565	394688.084	2.781
3	0.066	5.00	69.350	1200	389143.515	394704.534	1.900
4	0.070	5.00	70.599	1200	389090.742	394686.115	2.799
5	0.015	5.00	69.233	1200	389090.979	394704.057	1.883
6	0.089	5.00	70.639	1200	389078.337	394730.484	2.639
7			69.567	1200	389073.201	394704.264	2.367
8	0.155	5.00	69.235	1200	389063.836	394704.119	2.085
9	0.070	5.00	71.187	1200	389041.957	394671.432	2.187
10	0.022	5.00	68.991	1200	389001.004	394680.125	0.991
12	0.034	5.00	68.811	1500	388993.538	394702.139	0.961
13	0.015	5.00	68.965	1200	389005.374	394702.788	1.715
14	0.094	5.00	69.148	1200	389007.788	394714.502	2.123
15	0.025	5.00	70.795	1200	388976.174	394721.519	3.945
16	0.005	5.00	73.341	1200	388980.786	394754.372	6.566
17	0.047	5.00	73.563	1200	388972.259	394753.999	6.813
18	0.019	5.00	73.448	1200	388910.314	394735.686	6.748
19			70.732	1200	388915.654	394716.187	4.082
20			70.235	1200	388907.121	394709.376	3.610
21	0.016	5.00	70.337	1200	388917.191	394710.135	2.337
22	0.024	5.00	69.191	1200	388918.042	394692.765	1.891
23	0.037	5.00	68.739	1200	388920.241	394664.519	1.239
24			68.807	1200	388910.198	394667.658	1.557
25	0.024	5.00	68.622	1200	388889.579	394652.002	1.622
26	0.058	5.00	67.907	1200	388899.548	394615.245	1.057
27	0.027	5.00	68.522	1200	388874.494	394627.413	1.722
28	0.011	5.00	68.335	1200	388861.362	394625.135	1.585
30			67.695	1200	388853.855	394680.645	1.045
31			67.857	1200	388849.918	394687.154	1.232
2	0.049	5.00	71.038	1200	389143.407	394725.224	3.038
11	0.036	5.00	70.190	1500	388995.855	394675.612	2.190
29	0.165	5.00	67.927	1200	388853.929	394640.368	1.202
ATTENUATION BASIN			68.100	1200	388862.762	394698.538	1.650
HYDROBRAKE			68.100	1200	388821.539	394687.237	1.700

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	2	3	20.690	0.600	68.000	67.450	0.550	37.6	375	5.12	33.5
2.000	1	3	16.450	0.600	67.700	67.450	0.250	65.8	375	5.12	33.5
1.001	3	5	52.538	0.600	67.450	67.350	0.100	525.4	375	6.24	31.0
3.000	4	5	17.944	0.600	67.800	67.350	0.450	39.9	375	5.10	33.5
1.002	5	7	17.779	0.600	67.350	67.200	0.150	118.5	375	6.42	30.7
4.000	6	7	26.718	0.600	68.000	67.200	0.800	33.4	375	5.14	33.5
1.003	7	8	9.366	0.600	67.200	67.150	0.050	187.3	375	6.54	30.4
1.004	8	14	57.002	0.600	67.150	67.100	0.050	1140.0	375	8.34	26.9
5.000	9	10	41.865	0.600	69.000	68.000	1.000	41.9	450	5.22	33.3
5.001	10	13	23.080	0.600	68.000	67.250	0.750	30.8	450	5.33	33.0
6.000	11	12	26.628	0.600	68.000	67.850	0.150	177.5	450	5.29	33.1
6.001	12	13	11.854	0.600	67.850	67.250	0.600	19.8	450	5.33	33.0
5.002	13	14	11.960	0.600	67.250	67.025	0.225	53.2	450	5.41	32.9
1.005	14	15	32.383	0.600	67.025	66.850	0.175	185.0	450	8.70	26.3
1.006	15	16	33.175	0.600	66.850	66.775	0.075	442.3	450	9.27	25.4
1.007	16	17	8.535	0.600	66.775	66.750	0.025	341.4	450	9.40	25.3
1.008	17	18	64.595	0.600	66.750	66.700	0.050	1291.9	450	11.34	22.7
1.009	18	19	20.217	0.600	66.700	66.650	0.050	404.3	450	11.67	22.4
1.010	19	20	10.918	0.600	66.650	66.625	0.025	436.7	450	11.86	22.1
1.011	20	ATTENUATION BASIN	45.664	0.600	66.625	66.450	0.175	260.9	375	12.54	21.4
7.000	21	22	17.391	0.600	68.000	67.300	0.700	24.8	300	5.09	33.6
7.001	22	24	26.304	0.600	67.300	67.250	0.050	526.1	300	5.74	32.1
8.000	23	24	10.522	0.600	67.500	67.250	0.250	42.1	300	5.07	33.6
7.002	24	25	25.889	0.600	67.250	67.000	0.250	103.6	300	6.02	31.5
7.003	25	27	28.847	0.600	67.000	66.875	0.125	230.8	300	6.48	30.5
9.000	26	27	27.853	0.600	66.850	66.800	0.050	557.1	375	5.61	32.4
7.004	27	28	13.328	0.600	66.800	66.750	0.050	266.6	375	6.68	30.1
7.005	28	29	16.950	0.600	66.750	66.725	0.025	678.0	375	7.10	29.2

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
1.000	2.962	327.1	4.4	2.663	1.525	0.049	0.0
2.000	2.236	247.0	4.7	2.406	1.525	0.052	0.0
1.001	0.783	86.5	14.0	1.525	1.508	0.167	0.0
3.000	2.876	317.7	6.3	2.424	1.508	0.070	0.0
1.002	1.663	183.7	20.9	1.508	1.992	0.252	0.0
4.000	3.144	347.3	8.1	2.264	1.992	0.089	0.0
1.003	1.320	145.8	28.1	1.992	1.710	0.340	0.0
1.004	0.528	58.3	36.2	1.710	1.673	0.495	0.0
5.000	3.149	500.8	6.3	1.737	0.541	0.070	0.0
5.001	3.675	584.4	8.3	0.541	1.265	0.092	0.0
6.000	1.522	242.1	3.2	1.740	0.511	0.036	0.0
6.001	4.590	729.9	6.3	0.511	1.265	0.070	0.0
5.002	2.793	444.2	15.8	1.265	1.673	0.177	0.0
1.005	1.491	237.1	54.7	1.673	3.495	0.766	0.0
1.006	0.960	152.7	54.5	3.495	6.116	0.791	0.0
1.007	1.094	174.1	54.5	6.116	6.363	0.796	0.0
1.008	0.557	88.6	51.9	6.363	6.298	0.843	0.0
1.009	1.005	159.8	52.2	6.298	3.632	0.862	0.0
1.010	0.966	153.7	51.7	3.632	3.160	0.862	0.0
1.011	1.117	123.3	50.1	3.235	1.275	0.862	0.0
7.000	3.167	223.8	1.5	2.037	1.591	0.016	0.0
7.001	0.678	48.0	3.5	1.591	1.257	0.040	0.0
8.000	2.430	171.8	3.4	0.939	1.257	0.037	0.0
7.002	1.544	109.2	6.6	1.257	1.322	0.077	0.0
7.003	1.030	72.8	8.4	1.322	1.347	0.102	0.0
9.000	0.760	84.0	5.1	0.682	1.347	0.058	0.0
7.004	1.105	122.0	15.2	1.347	1.210	0.187	0.0
7.005	0.688	76.0	15.7	1.210	0.827	0.198	0.0

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
7.006	29	30	40.277	0.600	66.725	66.650	0.075	537.0	375	7.96	27.6
7.007	30	31	7.607	0.600	66.650	66.625	0.025	304.3	375	8.08	27.4
7.008	31	ATTENUATION BASIN	17.163	0.600	66.625	66.525	0.100	171.6	375	8.29	27.0
1.012	ATTENUATION BASIN	HYDROBRAKE	42.744	0.600	66.450	66.400	0.050	854.9	450	13.58	20.5

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
7.006	0.775	85.6	27.1	0.827	0.670	0.363	0.0
7.007	1.033	114.1	26.9	0.670	0.857	0.363	0.0
7.008	1.380	152.4	26.6	0.857	1.200	0.363	0.0
1.012	0.687	109.3	67.9	1.200	1.250	1.225	0.0

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	20.690	37.6	375	Circular	71.038	68.000	2.663	69.350	67.450	1.525
2.000	16.450	65.8	375	Circular	70.481	67.700	2.406	69.350	67.450	1.525
1.001	52.538	525.4	375	Circular	69.350	67.450	1.525	69.233	67.350	1.508
3.000	17.944	39.9	375	Circular	70.599	67.800	2.424	69.233	67.350	1.508
1.002	17.779	118.5	375	Circular	69.233	67.350	1.508	69.567	67.200	1.992
4.000	26.718	33.4	375	Circular	70.639	68.000	2.264	69.567	67.200	1.992
1.003	9.366	187.3	375	Circular	69.567	67.200	1.992	69.235	67.150	1.710
1.004	57.002	1140.0	375	Circular	69.235	67.150	1.710	69.148	67.100	1.673
5.000	41.865	41.9	450	Circular	71.187	69.000	1.737	68.991	68.000	0.541
5.001	23.080	30.8	450	Circular	68.991	68.000	0.541	68.965	67.250	1.265
6.000	26.628	177.5	450	Circular	70.190	68.000	1.740	68.811	67.850	0.511
6.001	11.854	19.8	450	Circular	68.811	67.850	0.511	68.965	67.250	1.265
5.002	11.960	53.2	450	Circular	68.965	67.250	1.265	69.148	67.025	1.673
1.005	32.383	185.0	450	Circular	69.148	67.025	1.673	70.795	66.850	3.495
1.006	33.175	442.3	450	Circular	70.795	66.850	3.495	73.341	66.775	6.116
1.007	8.535	341.4	450	Circular	73.341	66.775	6.116	73.563	66.750	6.363
1.008	64.595	1291.9	450	Circular	73.563	66.750	6.363	73.448	66.700	6.298
1.009	20.217	404.3	450	Circular	73.448	66.700	6.298	70.732	66.650	3.632
1.010	10.918	436.7	450	Circular	70.732	66.650	3.632	70.235	66.625	3.160
1.011	45.664	260.9	375	Circular	70.235	66.625	3.235	68.100	66.450	1.275

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	2	1200	Manhole	Adoptable	3	1200	Manhole	Adoptable
2.000	1	1200	Manhole	Adoptable	3	1200	Manhole	Adoptable
1.001	3	1200	Manhole	Adoptable	5	1200	Manhole	Adoptable
3.000	4	1200	Manhole	Adoptable	5	1200	Manhole	Adoptable
1.002	5	1200	Manhole	Adoptable	7	1200	Manhole	Adoptable
4.000	6	1200	Manhole	Adoptable	7	1200	Manhole	Adoptable
1.003	7	1200	Manhole	Adoptable	8	1200	Manhole	Adoptable
1.004	8	1200	Manhole	Adoptable	14	1200	Manhole	Adoptable
5.000	9	1200	Manhole	Adoptable	10	1200	Manhole	Adoptable
5.001	10	1200	Manhole	Adoptable	13	1200	Manhole	Adoptable
6.000	11	1500	Manhole	Adoptable	12	1500	Manhole	Adoptable
6.001	12	1500	Manhole	Adoptable	13	1200	Manhole	Adoptable
5.002	13	1200	Manhole	Adoptable	14	1200	Manhole	Adoptable
1.005	14	1200	Manhole	Adoptable	15	1200	Manhole	Adoptable
1.006	15	1200	Manhole	Adoptable	16	1200	Manhole	Adoptable
1.007	16	1200	Manhole	Adoptable	17	1200	Manhole	Adoptable
1.008	17	1200	Manhole	Adoptable	18	1200	Manhole	Adoptable
1.009	18	1200	Manhole	Adoptable	19	1200	Manhole	Adoptable
1.010	19	1200	Manhole	Adoptable	20	1200	Manhole	Adoptable
1.011	20	1200	Manhole	Adoptable	ATTENUATION BASIN	1200	Manhole	Adoptable

Pipeline Schedule

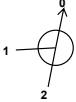
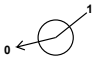
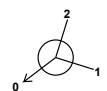
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
7.000	17.391	24.8	300	Circular	70.337	68.000	2.037	69.191	67.300	1.591
7.001	26.304	526.1	300	Circular	69.191	67.300	1.591	68.807	67.250	1.257
8.000	10.522	42.1	300	Circular	68.739	67.500	0.939	68.807	67.250	1.257
7.002	25.889	103.6	300	Circular	68.807	67.250	1.257	68.622	67.000	1.322
7.003	28.847	230.8	300	Circular	68.622	67.000	1.322	68.522	66.875	1.347
9.000	27.853	557.1	375	Circular	67.907	66.850	0.682	68.522	66.800	1.347
7.004	13.328	266.6	375	Circular	68.522	66.800	1.347	68.335	66.750	1.210
7.005	16.950	678.0	375	Circular	68.335	66.750	1.210	67.927	66.725	0.827
7.006	40.277	537.0	375	Circular	67.927	66.725	0.827	67.695	66.650	0.670
7.007	7.607	304.3	375	Circular	67.695	66.650	0.670	67.857	66.625	0.857
7.008	17.163	171.6	375	Circular	67.857	66.625	0.857	68.100	66.525	1.200
1.012	42.744	854.9	450	Circular	68.100	66.450	1.200	68.100	66.400	1.250

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
7.000	21	1200	Manhole	Adoptable	22	1200	Manhole	Adoptable
7.001	22	1200	Manhole	Adoptable	24	1200	Manhole	Adoptable
8.000	23	1200	Manhole	Adoptable	24	1200	Manhole	Adoptable
7.002	24	1200	Manhole	Adoptable	25	1200	Manhole	Adoptable
7.003	25	1200	Manhole	Adoptable	27	1200	Manhole	Adoptable
9.000	26	1200	Manhole	Adoptable	27	1200	Manhole	Adoptable
7.004	27	1200	Manhole	Adoptable	28	1200	Manhole	Adoptable
7.005	28	1200	Manhole	Adoptable	29	1200	Manhole	Adoptable
7.006	29	1200	Manhole	Adoptable	30	1200	Manhole	Adoptable
7.007	30	1200	Manhole	Adoptable	31	1200	Manhole	Adoptable
7.008	31	1200	Manhole	Adoptable	ATTENUATION BASIN	1200	Manhole	Adoptable
1.012	ATTENUATION BASIN	1200	Manhole	Adoptable	HYDROBRAKE	1200	Junction	

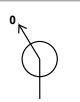
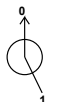
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1	389143.565	394688.084	70.481	2.781	1200				
3	389143.515	394704.534	69.350	1.900	1200		0 2.000 67.700 375 1 2.000 67.450 375 2 1.000 67.450 375 0 1.001 67.450 375		
4	389090.742	394686.115	70.599	2.799	1200				
5	389090.979	394704.057	69.233	1.883	1200		0 3.000 67.800 375 1 3.000 67.350 375 2 1.001 67.350 375 0 1.002 67.350 375		
6	389078.337	394730.484	70.639	2.639	1200				
7	389073.201	394704.264	69.567	2.367	1200		0 4.000 68.000 375 1 4.000 67.200 375 2 1.002 67.200 375 0 1.003 67.200 375		
8	389063.836	394704.119	69.235	2.085	1200		1 1.003 67.150 375 0 1.004 67.150 375		

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
9	389041.957	394671.432	71.187	2.187	1200				
						0	5.000	69.000	450
10	389001.004	394680.125	68.991	0.991	1200		1	5.000	68.000
						0	5.001	68.000	450
12	388993.538	394702.139	68.811	0.961	1500		1	6.000	67.850
						0	6.001	67.850	450
13	389005.374	394702.788	68.965	1.715	1200		1 2	6.001 5.001	67.250 67.250
						0	5.002	67.250	450
14	389007.788	394714.502	69.148	2.123	1200		1 2	5.002 1.004	67.025 67.100
						0	1.005	67.025	450
15	388976.174	394721.519	70.795	3.945	1200		1	1.005	66.850
						0	1.006	66.850	450
16	388980.786	394754.372	73.341	6.566	1200		1	1.006	66.775
						0	1.007	66.775	450
17	388972.259	394753.999	73.563	6.813	1200		1	1.007	66.750
						0	1.008	66.750	450
18	388910.314	394735.686	73.448	6.748	1200		1	1.008	66.700
						0	1.009	66.700	450
19	388915.654	394716.187	70.732	4.082	1200		1	1.009	66.650
						0	1.010	66.650	450
20	388907.121	394709.376	70.235	3.610	1200		1	1.010	66.625
						0	1.011	66.625	375
21	388917.191	394710.135	70.337	2.337	1200		0	7.000	68.000
22	388918.042	394692.765	69.191	1.891	1200		1	7.000	67.300
						0	7.001	67.300	300
23	388920.241	394664.519	68.739	1.239	1200		0	8.000	67.500
						1	8.000	67.250	300
24	388910.198	394667.658	68.807	1.557	1200		2	7.001	67.250
						0	7.002	67.250	300

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
25	388889.579	394652.002	68.622	1.622	1200		1 7.002	67.000	300
						0	7.003	67.000	300
26	388899.548	394615.245	67.907	1.057	1200		0 9.000	66.850	375
						0	9.000	66.800	375
27	388874.494	394627.413	68.522	1.722	1200		1 9.000	66.800	375
						2	7.003	66.875	300
						0	7.004	66.800	375
28	388861.362	394625.135	68.335	1.585	1200		1 7.004	66.750	375
						0	7.005	66.750	375
30	388853.855	394680.645	67.695	1.045	1200		1 7.006	66.650	375
						0	7.007	66.650	375
31	388849.918	394687.154	67.857	1.232	1200		1 7.007	66.625	375
						0	7.008	66.625	375
2	389143.407	394725.224	71.038	3.038	1200		0 1.000	68.000	375
11	388995.855	394675.612	70.190	2.190	1500		0 6.000	68.000	450
						0	6.000	68.000	450
29	388853.929	394640.368	67.927	1.202	1200		1 7.005	66.725	375
						0	7.006	66.725	375
ATTENUATION BASIN	388862.762	394698.538	68.100	1.650	1200		1 7.008	66.525	375
						2	1.011	66.450	375
						0	1.012	66.450	450
HYDROBRAKE	388821.539	394687.237	68.100	1.700	1200		1 1.012	66.400	450

Simulation Settings

Rainfall Methodology	FEH-22	Skip Steady State	x	Check Discharge Rate(s)	x
Rainfall Events	Singular	Drain Down Time (mins)	240	Check Discharge Volume	x
Summer CV	0.750	Additional Storage (m³/ha)	20.0		
Analysis Speed	Normal	Starting Level (m)			

Storm Durations

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

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

Node HYDROBRAKE Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	66.400	Product Number	CTL-SHE-0126-7800-1300-7800
Design Depth (m)	1.300	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	7.8	Min Node Diameter (mm)	1200

Node ATTENUATION BASIN Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	66.500
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	410.0	410.0	1.500	796.6	800.0

**Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 98.82%****No flooding in
1:30yr storm**

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	13	68.530	0.830	43.6	1.2505	0.0000	SURCHARGED
30 minute summer	3	20	68.545	1.095	66.3	1.9956	0.0000	SURCHARGED
15 minute summer	4	12	68.519	0.719	30.9	1.1715	0.0000	SURCHARGED
15 minute summer	5	12	68.528	1.178	97.0	1.5225	0.0000	SURCHARGED
15 minute summer	6	12	68.484	0.484	39.3	0.8737	0.0000	SURCHARGED
15 minute summer	7	13	68.485	1.285	97.0	1.4529	0.0000	SURCHARGED
15 minute summer	8	13	68.443	1.293	133.0	3.3793	0.0000	SURCHARGED
15 minute summer	9	10	69.076	0.076	31.0	0.1343	0.0000	OK
15 minute summer	10	13	68.157	0.157	40.5	0.2475	0.0000	OK
15 minute summer	12	13	68.178	0.328	30.8	0.8130	0.0000	OK
15 minute summer	13	13	68.176	0.926	77.4	1.2097	0.0000	SURCHARGED
15 minute summer	14	13	68.172	1.147	196.4	2.3102	0.0000	SURCHARGED
15 minute summer	15	13	68.026	1.176	189.0	1.4765	0.0000	SURCHARGED
15 minute summer	16	12	67.872	1.097	189.2	1.2571	0.0000	SURCHARGED
15 minute summer	17	12	67.809	1.059	200.0	1.3454	0.0000	SURCHARGED
15 minute summer	18	12	67.512	0.812	203.1	0.9635	0.0000	SURCHARGED
15 minute summer	19	13	67.394	0.744	201.3	0.8409	0.0000	SURCHARGED
15 minute summer	20	13	67.311	0.686	200.2	0.7757	0.0000	SURCHARGED
15 minute summer	21	10	68.037	0.037	7.2	0.0466	0.0000	OK
15 minute summer	22	10	67.429	0.129	17.9	0.1791	0.0000	OK
15 minute summer	23	10	67.562	0.062	16.4	0.1072	0.0000	OK
15 minute summer	24	10	67.365	0.115	33.6	0.1305	0.0000	OK
15 minute summer	25	12	67.351	0.351	43.9	0.5009	0.0000	SURCHARGED
15 minute summer	26	12	67.305	0.455	25.9	1.0172	0.0000	SURCHARGED
15 minute summer	27	12	67.304	0.504	70.4	0.7265	0.0000	SURCHARGED
480 minute summer	28	472	67.302	0.552	12.7	0.7012	0.0000	SURCHARGED
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	2.000	3	-21.6	0.516	-0.088	1.8144	
30 minute summer	3	1.001	5	52.7	0.809	0.610	5.7948	
15 minute summer	4	3.000	5	30.0	0.961	0.094	1.9792	
15 minute summer	5	1.002	7	74.3	0.814	0.405	1.9610	
15 minute summer	6	4.000	7	39.1	1.077	0.113	2.9469	
15 minute summer	7	1.003	8	99.9	0.906	0.685	1.0330	
15 minute summer	8	1.004	14	131.4	1.191	2.252	6.2872	
15 minute summer	9	5.000	10	30.8	1.700	0.061	1.2671	
15 minute summer	10	5.001	13	40.2	1.392	0.069	2.3964	
15 minute summer	12	6.001	13	31.0	1.200	0.042	1.6730	
15 minute summer	13	5.002	14	73.4	0.770	0.165	1.8950	
15 minute summer	14	1.005	15	183.7	1.184	0.775	5.1309	
15 minute summer	15	1.006	16	188.1	1.187	1.232	5.2564	
15 minute summer	16	1.007	17	188.1	1.187	1.081	1.3523	
15 minute summer	17	1.008	18	196.7	1.242	2.221	10.2347	
15 minute summer	18	1.009	19	201.3	1.270	1.260	3.2033	
15 minute summer	19	1.010	20	200.2	1.264	1.303	1.7299	
15 minute summer	20	1.011	ATTENUATION BASIN	202.1	2.123	1.639	5.0366	
15 minute summer	21	7.000	22	7.2	0.461	0.032	0.2947	
15 minute summer	22	7.001	24	17.6	0.661	0.366	0.7097	
15 minute summer	23	8.000	24	16.3	0.966	0.095	0.1866	
15 minute summer	24	7.002	25	33.6	0.993	0.308	1.2250	
15 minute summer	25	7.003	27	42.4	0.819	0.582	2.0314	
15 minute summer	26	9.000	27	21.6	0.373	0.257	3.0721	
15 minute summer	27	7.004	28	71.4	0.647	0.585	1.4700	
480 minute summer	28	7.005	29	11.9	0.365	0.157	1.8695	

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 98.82%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute summer	30	615	67.304	0.654	18.6	0.7396	0.0000	SURCHARGED
480 minute summer	31	480	67.301	0.676	20.9	0.7648	0.0000	SURCHARGED
15 minute summer	2	13	68.567	0.567	21.6	0.8232	0.0000	SURCHARGED
15 minute summer	11	13	68.164	0.164	15.9	0.3431	0.0000	OK
480 minute summer	29	472	67.302	0.577	23.7	2.2345	0.0000	SURCHARGED
480 minute summer	ATTENUATION BASIN	480	67.301	0.851	74.4	412.0071	0.0000	SURCHARGED
412m3 stored within detention basin								
480 minute summer	HYDROBRAKE	480	67.300	0.900	8.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
600 minute summer	30	7.007	31	17.6	0.708	0.155	0.8390	
480 minute summer	31	7.008	ATTENUATION BASIN	20.2	0.593	0.133	1.8930	
15 minute summer	2	1.000	3	21.5	0.550	0.066	2.2820	
15 minute summer	11	6.000	12	19.6	0.976	0.081	2.3425	
480 minute summer	29	7.006	30	22.1	0.612	0.258	4.4424	
480 minute summer	ATTENUATION BASIN	1.012	HYDROBRAKE	8.6	0.240	0.079	6.7725	
480 minute summer	HYDROBRAKE	Hydro-Brake®		7.8				272.0

Discharge restricted to 7.8 l/s

**Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 98.82%**

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	12	69.339	1.639	84.3	2.4679	0.0000	SURCHARGED
15 minute summer	3	12	69.343	1.893	90.1	3.4491	0.0000	FLOOD RISK
30 minute summer	4	21	69.240	1.440	37.2	2.3468	0.0000	SURCHARGED
15 minute summer	5	12	69.233	1.883	115.7	2.4328	3.8863	FLOOD
15 minute summer	6	12	69.263	1.263	98.5	2.2784	0.0000	SURCHARGED
15 minute summer	7	12	69.237	2.037	130.4	2.3035	0.0000	SURCHARGED
15 minute summer	8	12	69.200	2.050	209.2	5.3598	0.0000	FLOOD RISK
15 minute summer	9	10	69.087	0.087	41.0	0.1546	0.0000	OK
30 minute summer	10	20	68.871	0.871	72.0	1.3722	0.0000	FLOOD RISK
15 minute summer	12	13	68.811	0.961	55.7	2.3814	2.2674	FLOOD
30 minute summer	13	20	68.831	1.581	81.0	2.0645	0.0000	FLOOD RISK
30 minute summer	14	20	68.828	1.803	225.7	3.6307	0.0000	SURCHARGED
30 minute summer	15	20	68.632	1.782	229.3	2.2380	0.0000	SURCHARGED
30 minute summer	16	20	68.414	1.639	229.7	1.8781	0.0000	SURCHARGED
30 minute summer	17	20	68.318	1.568	246.6	1.9909	0.0000	SURCHARGED
30 minute summer	18	22	67.913	1.213	252.3	1.4383	0.0000	SURCHARGED
30 minute summer	19	22	67.748	1.098	250.2	1.2422	0.0000	SURCHARGED
30 minute summer	20	22	67.634	1.009	247.9	1.1408	0.0000	SURCHARGED
15 minute summer	21	10	68.042	0.042	9.5	0.0531	0.0000	OK
15 minute summer	22	12	67.677	0.377	29.0	0.5229	0.0000	SURCHARGED
15 minute summer	23	12	67.665	0.164	21.6	0.2842	0.0000	OK
15 minute summer	24	12	67.668	0.418	46.2	0.4726	0.0000	SURCHARGED
15 minute summer	25	12	67.630	0.630	55.2	0.8999	0.0000	SURCHARGED
960 minute summer	26	855	67.591	0.741	3.4	1.6589	0.0000	SURCHARGED
960 minute summer	27	825	67.590	0.790	9.4	1.1398	0.0000	SURCHARGED
960 minute summer	28	840	67.590	0.840	9.4	1.0677	0.0000	SURCHARGED

Minor flooding
to be managed
within site

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	2.000	3	-53.8	0.561	-0.218	1.8144	
15 minute summer	3	1.001	5	75.5	0.822	0.873	5.7948	
30 minute summer	4	3.000	5	48.6	0.927	0.153	1.9792	
15 minute summer	5	1.002	7	77.9	0.822	0.424	1.9610	
15 minute summer	6	4.000	7	52.5	1.132	0.151	2.9469	
15 minute summer	7	1.003	8	123.1	1.116	0.844	1.0330	
15 minute summer	8	1.004	14	185.9	1.686	3.187	6.2872	
15 minute summer	9	5.000	10	40.7	1.827	0.081	3.6962	
30 minute summer	10	5.001	13	47.7	1.291	0.082	3.6569	
15 minute summer	12	6.001	13	45.6	1.293	0.062	1.8782	
30 minute summer	13	5.002	14	80.9	0.675	0.182	1.8950	
30 minute summer	14	1.005	15	219.7	1.387	0.926	5.1309	
30 minute summer	15	1.006	16	227.8	1.438	1.492	5.2564	
30 minute summer	16	1.007	17	228.3	1.441	1.312	1.3523	
30 minute summer	17	1.008	18	245.1	1.547	2.767	10.2347	
30 minute summer	18	1.009	19	250.2	1.579	1.566	3.2033	
30 minute summer	19	1.010	20	247.9	1.565	1.613	1.7299	
30 minute summer	20	1.011	ATTENUATION BASIN	244.3	2.217	1.981	5.0366	
15 minute summer	21	7.000	22	9.5	0.491	0.042	0.6569	
15 minute summer	22	7.001	24	24.4	0.660	0.508	1.8523	
15 minute summer	23	8.000	24	24.0	1.017	0.140	0.5778	
15 minute summer	24	7.002	25	51.0	1.026	0.467	1.8231	
15 minute summer	25	7.003	27	61.6	0.875	0.846	2.0314	
960 minute summer	26	9.000	27	2.8	0.243	0.034	3.0721	
960 minute summer	27	7.004	28	8.7	0.445	0.071	1.4700	
960 minute summer	28	7.005	29	9.3	0.336	0.122	1.8695	

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 98.82%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
720 minute summer	30	675	67.591	0.941	22.1	1.0648	0.0000	FLOOD RISK
960 minute summer	31	840	67.589	0.964	18.4	1.0908	0.0000	FLOOD RISK
15 minute summer	2	12	69.363	1.363	28.5	1.9786	0.0000	SURCHARGED
30 minute summer	11	21	68.815	0.815	40.3	1.7084	0.0000	SURCHARGED
960 minute summer	29	840	67.591	0.866	18.9	3.3531	0.0000	SURCHARGED
960 minute summer	ATTENUATION BASIN	825	67.589	1.139	64.9	600.7029	0.0000	SURCHARGED
600m3 stored within detention basin								
960 minute summer	HYDROBRAKE	825	67.589	1.189	8.2	0.0000	0.0000	OK

additional 122m3 stoage within network

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
720 minute summer	30	7.007	31	21.8	0.641	0.191	0.8390	
960 minute summer	31	7.008	ATTENUATION BASIN	18.3	0.540	0.120	1.8930	
15 minute summer	2	1.000	3	26.7	0.564	0.082	2.2820	
30 minute summer	11	6.000	12	-21.2	0.980	-0.088	4.2190	
960 minute summer	29	7.006	30	18.5	0.512	0.216	4.4424	
960 minute summer	ATTENUATION BASIN	1.012	HYDROBRAKE	8.2	0.293	0.075	6.7725	
960 minute summer	HYDROBRAKE	Hydro-Brake®		7.8				489.2

Discharge restricted to 7.8 l/s

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	1	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	0.800
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
104	0.065	5.00	66.716	1200	388752.086	394583.790	1.116
105	0.050	5.00	66.415	1200	388759.387	394564.884	1.040
106	0.042	5.00	66.500	1200	388701.655	394564.233	1.100
107	0.013	5.00	66.400	1200	388707.904	394548.596	1.200
108	0.036	5.00	66.000	1200	388693.366	394545.605	1.100
109	0.007	5.00	66.000	1200	388667.157	394545.235	1.225
111	0.064	5.00	66.200	1200	388598.920	394487.267	1.000
110	0.054	5.00	66.200	1200	388641.496	394466.154	1.000
112	0.229	5.00	66.000	1200	388621.232	394476.304	0.900
113	0.008	5.00	66.737	1200	388652.487	394539.017	1.962
ATTENUATION BASIN 2			66.500	1200	388649.046	394551.893	1.750
114			66.571	1200	388656.460	394561.197	1.871
115			65.817	1200	388639.174	394576.197	1.217
116			67.877	1200	388633.657	394597.843	3.327
117			66.085	1200	388637.664	394605.649	2.560
118			65.556	1200	388632.248	394608.321	2.086
100	0.027	5.00	68.204	1200	388858.686	394621.419	1.204
101	0.038	5.00	67.695	1200	388846.170	394598.475	0.895
102	0.082	5.00	67.455	1200	388800.704	394607.643	0.805
103	0.049	5.00	67.395	1200	388809.237	394584.225	0.845
HYDROBRAKE 2			66.600	1200	388654.571	394559.009	1.875

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	100	101	26.136	0.600	67.000	66.800	0.200	130.7	300	5.32	33.1
1.001	101	103	39.587	0.600	66.800	66.550	0.250	158.3	300	5.85	31.9
2.000	102	103	24.924	0.600	66.650	66.550	0.100	249.2	300	5.42	32.8
1.002	103	105	53.471	0.600	66.550	65.450	1.100	48.6	300	6.24	31.0
3.000	104	105	20.267	0.600	65.600	65.450	0.150	135.1	300	5.25	33.2
1.003	105	107	53.998	0.600	65.375	65.200	0.175	308.6	375	7.12	29.2
4.000	106	107	16.839	0.600	65.400	65.200	0.200	84.2	375	5.14	33.5
1.004	107	108	14.842	0.600	65.200	64.900	0.300	49.5	375	7.21	29.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.374	97.1	2.5	0.904	0.595	0.027	0.0	33	0.589
1.001	1.247	88.1	5.7	0.595	0.545	0.065	0.0	51	0.708
2.000	0.991	70.1	7.3	0.505	0.545	0.082	0.0	65	0.649
1.002	2.260	159.8	16.5	0.545	0.665	0.197	0.0	65	1.476
3.000	1.351	95.5	5.9	0.816	0.665	0.065	0.0	50	0.757
1.003	1.026	113.3	24.6	0.665	0.825	0.311	0.0	118	0.826
4.000	1.975	218.2	3.8	0.725	0.825	0.042	0.0	34	0.764
1.004	2.581	285.1	28.8	0.825	0.725	0.366	0.0	79	1.674



Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.005	108	109	26.212	0.600	64.900	64.775	0.125	209.7	375	7.56	28.3
1.006	109	ATTENUATION BASIN 2	19.296	0.600	64.775	64.750	0.025	771.8	375	8.06	27.4
5.000	111	112	24.860	0.600	65.200	65.100	0.100	248.6	375	5.36	33.0
6.000	110	112	22.664	0.600	65.200	65.100	0.100	226.6	375	5.32	33.1
5.001	112	113	70.070	0.600	65.100	64.775	0.325	215.6	375	6.31	30.9
5.002	113	ATTENUATION BASIN 2	13.328	0.600	64.775	64.750	0.025	533.1	375	6.60	30.3
1.007	ATTENUATION BASIN 2	HYDROBRAKE 2	9.009	0.600	64.750	64.725	0.025	360.4	375	8.22	27.1
1.008	HYDROBRAKE 2	114	2.891	0.600	64.725	64.700	0.025	115.6	375	8.25	27.1
1.009	114	115	22.887	0.600	64.700	64.600	0.100	228.9	375	8.57	26.5
1.010	115	116	22.338	0.600	64.600	64.550	0.050	446.8	375	9.01	25.8
1.011	116	117	8.774	0.600	64.550	63.525	1.025	8.6	375	9.03	25.8
1.012	117	118	6.039	0.600	63.525	63.470	0.055	109.8	375	9.09	25.7

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.005	1.247	137.7	30.9	0.725	0.850	0.403	0.0	120	1.014
1.006	0.644	71.2	30.5	0.850	1.375	0.410	0.0	171	0.620
5.000	1.144	126.4	5.7	0.625	0.525	0.064	0.0	54	0.587
6.000	1.199	132.4	4.9	0.625	0.525	0.054	0.0	49	0.578
5.001	1.230	135.8	29.1	0.525	1.587	0.348	0.0	118	0.987
5.002	0.778	85.9	29.2	1.587	1.375	0.356	0.0	151	0.705
1.007	0.948	104.7	56.3	1.375	1.500	0.766	0.0	196	0.965
1.008	1.684	186.0	56.2	1.500	1.496	0.766	0.0	141	1.482
1.009	1.193	131.8	55.1	1.496	0.842	0.766	0.0	169	1.141
1.010	0.851	93.9	53.6	0.842	2.952	0.766	0.0	203	0.878
1.011	6.223	687.3	53.5	2.952	2.185	0.766	0.0	70	3.756
1.012	1.728	190.9	53.4	2.185	1.711	0.766	0.0	135	1.490

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	26.136	130.7	300	Circular	68.204	67.000	0.904	67.695	66.800	0.595
1.001	39.587	158.3	300	Circular	67.695	66.800	0.595	67.395	66.550	0.545
2.000	24.924	249.2	300	Circular	67.455	66.650	0.505	67.395	66.550	0.545
1.002	53.471	48.6	300	Circular	67.395	66.550	0.545	66.415	65.450	0.665
3.000	20.267	135.1	300	Circular	66.716	65.600	0.816	66.415	65.450	0.665
1.003	53.998	308.6	375	Circular	66.415	65.375	0.665	66.400	65.200	0.825
4.000	16.839	84.2	375	Circular	66.500	65.400	0.725	66.400	65.200	0.825
1.004	14.842	49.5	375	Circular	66.400	65.200	0.825	66.000	64.900	0.725
1.005	26.212	209.7	375	Circular	66.000	64.900	0.725	66.000	64.775	0.850
1.006	19.296	771.8	375	Circular	66.000	64.775	0.850	66.500	64.750	1.375
5.000	24.860	248.6	375	Circular	66.200	65.200	0.625	66.000	65.100	0.525
6.000	22.664	226.6	375	Circular	66.200	65.200	0.625	66.000	65.100	0.525

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	100	1200	Manhole	Adoptable	101	1200	Manhole	Adoptable
1.001	101	1200	Manhole	Adoptable	103	1200	Manhole	Adoptable
2.000	102	1200	Manhole	Adoptable	103	1200	Manhole	Adoptable
1.002	103	1200	Manhole	Adoptable	105	1200	Manhole	Adoptable
3.000	104	1200	Manhole	Adoptable	105	1200	Manhole	Adoptable
1.003	105	1200	Manhole	Adoptable	107	1200	Manhole	Adoptable
4.000	106	1200	Manhole	Adoptable	107	1200	Manhole	Adoptable
1.004	107	1200	Manhole	Adoptable	108	1200	Manhole	Adoptable
1.005	108	1200	Manhole	Adoptable	109	1200	Manhole	Adoptable
1.006	109	1200	Manhole	Adoptable	ATTENUATION BASIN 2	1200	Manhole	Adoptable
5.000	111	1200	Manhole	Adoptable	112	1200	Manhole	Adoptable
6.000	110	1200	Manhole	Adoptable	112	1200	Manhole	Adoptable

Pipeline Schedule

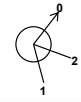
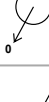
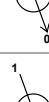
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
5.001	70.070	215.6	375	Circular	66.000	65.100	0.525	66.737	64.775	1.587
5.002	13.328	533.1	375	Circular	66.737	64.775	1.587	66.500	64.750	1.375
1.007	9.009	360.4	375	Circular	66.500	64.750	1.375	66.600	64.725	1.500
1.008	2.891	115.6	375	Circular	66.600	64.725	1.500	66.571	64.700	1.496
1.009	22.887	228.9	375	Circular	66.571	64.700	1.496	65.817	64.600	0.842
1.010	22.338	446.8	375	Circular	65.817	64.600	0.842	67.877	64.550	2.952
1.011	8.774	8.6	375	Circular	67.877	64.550	2.952	66.085	63.525	2.185
1.012	6.039	109.8	375	Circular	66.085	63.525	2.185	65.556	63.470	1.711

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
5.001	112	1200	Manhole	Adoptable	113	1200	Manhole	Adoptable
5.002	113	1200	Manhole	Adoptable	ATTENUATION BASIN 2	1200	Manhole	Adoptable
1.007	ATTENUATION BASIN 2	1200	Manhole	Adoptable	HYDROBRAKE 2	1200	Manhole	Adoptable
1.008	HYDROBRAKE 2	1200	Manhole	Adoptable	114	1200	Manhole	Adoptable
1.009	114	1200	Manhole	Adoptable	115	1200	Manhole	Adoptable
1.010	115	1200	Manhole	Adoptable	116	1200	Manhole	Adoptable
1.011	116	1200	Manhole	Adoptable	117	1200	Manhole	Adoptable
1.012	117	1200	Manhole	Adoptable	118	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
104	388752.086	394583.790	66.716	1.116	1200		0	3.000	65.600	300
105	388759.387	394564.884	66.415	1.040	1200		1 2 0	3.000 1.002 1.003	65.450 65.450 65.375	300 300 375
106	388701.655	394564.233	66.500	1.100	1200		0	4.000	65.400	375
107	388707.904	394548.596	66.400	1.200	1200		1 2 0	4.000 1.003 1.004	65.200 65.200 65.200	375 375 375
108	388693.366	394545.605	66.000	1.100	1200		1 0	1.004 1.005	64.900 64.900	375 375
109	388667.157	394545.235	66.000	1.225	1200		1 0	1.005 1.006	64.775 64.775	375 375
111	388598.920	394487.267	66.200	1.000	1200		0	5.000	65.200	375
110	388641.496	394466.154	66.200	1.000	1200		0	6.000	65.200	375
112	388621.232	394476.304	66.000	0.900	1200		1 2 0	6.000 5.000 5.001	65.100 65.100 65.100	375 375 375

**Manhole Schedule**

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
113	388652.487	394539.017	66.737	1.962	1200	 0 1	5.001	64.775	375
ATTENUATION BASIN 2	388649.046	394551.893	66.500	1.750	1200	 1 2 0	5.002	64.750	375
							1.006	64.750	375
							1.007	64.750	375
114	388656.460	394561.197	66.571	1.871	1200	 0 1	1.008	64.700	375
							1.009	64.700	375
115	388639.174	394576.197	65.817	1.217	1200	 0 1	1.009	64.600	375
							1.010	64.600	375
116	388633.657	394597.843	67.877	3.327	1200	 0 1	1.010	64.550	375
							1.011	64.550	375
117	388637.664	394605.649	66.085	2.560	1200	 0 1	1.011	63.525	375
							1.012	63.525	375
118	388632.248	394608.321	65.556	2.086	1200	 0 1	1.012	63.470	375
100	388858.686	394621.419	68.204	1.204	1200	 0 1	1.000	67.000	300
101	388846.170	394598.475	67.695	0.895	1200	 0 1 2	1.000	66.800	300
							1.001	66.800	300
102	388800.704	394607.643	67.455	0.805	1200	 0 1	2.000	66.650	300
103	388809.237	394584.225	67.395	0.845	1200	 0 1 2	2.000	66.550	300
							1.001	66.550	300
							1.002	66.550	300
HYDROBRAKE 2	388654.571	394559.009	66.600	1.875	1200	 0 1	1.007	64.725	375
							1.008	64.725	375

Simulation Settings

Rainfall Methodology	FEH-22	Skip Steady State	x	Check Discharge Rate(s)	x
Rainfall Events	Singular	Drain Down Time (mins)	240	Check Discharge Volume	x
Summer CV	0.750	Additional Storage (m³/ha)	20.0		
Analysis Speed	Normal	Starting Level (m)			

Storm Durations

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

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

Node HYDROBRAKE 2 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	64.725	Product Number	CTL-SHE-0097-4900-1500-4900
Design Depth (m)	1.500	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	4.9	Min Node Diameter (mm)	1200

Node ATTENUATION BASIN 2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	64.750
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	225.0	225.0	1.500	527.9	544.3

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 99.62%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	104	11	65.733	0.133	28.7	0.3051	0.0000	OK
15 minute summer	105	11	65.728	0.353	133.9	0.7353	0.0000	OK
720 minute summer	106	660	65.628	0.228	2.2	0.4322	0.0000	OK
720 minute summer	107	660	65.628	0.428	19.2	0.5770	0.0000	SURCHARGED
720 minute summer	108	660	65.628	0.728	20.7	1.3033	0.0000	SURCHARGED
720 minute summer	109	660	65.628	0.853	20.6	1.0684	0.0000	SURCHARGED
720 minute summer	111	660	65.628	0.428	3.4	1.0290	0.0000	SURCHARGED
720 minute summer	110	660	65.628	0.428	2.9	0.9482	0.0000	SURCHARGED
720 minute summer	112	660	65.628	0.528	17.4	3.2869	0.0000	SURCHARGED
720 minute summer	113	660	65.628	0.853	16.1	1.0351	0.0000	SURCHARGED
720 minute summer	ATTENUATION BASIN 2	660	65.628	0.878	35.9	276.2162	0.0000	SURCHARGED
15 minute summer	114	35	64.748	0.048	4.8	0.0546	0.0000	OK
15 minute summer	115	37	64.659	0.059	4.8	0.0665	0.0000	OK
15 minute summer	116	37	64.572	0.022	4.8	0.0253	0.0000	OK
15 minute summer	117	37	63.568	0.043	4.8	0.0487	0.0000	OK
15 minute summer	118	38	63.511	0.041	4.8	0.0000	0.0000	OK
15 minute summer	100	10	67.070	0.070	12.1	0.1117	0.0000	OK
15 minute summer	101	10	66.916	0.116	28.7	0.2299	0.0000	OK
15 minute summer	102	10	66.811	0.161	36.4	0.5107	0.0000	OK
15 minute summer	103	11	66.704	0.154	85.5	0.3522	0.0000	OK
720 minute summer	HYDROBRAKE 2	660	65.628	0.903	4.9	1.0208	0.0000	SURCHARGED

**No flooding in
1:30 year
storm**

**276m3
stored in
detention
basin**

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	104	3.000	105	28.5	0.808	0.298	0.9948	
15 minute summer	105	1.003	107	127.8	1.402	1.128	5.3468	
720 minute summer	106	4.000	107	2.2	0.289	0.010	1.5181	
720 minute summer	107	1.004	108	18.8	0.810	0.066	1.6370	
720 minute summer	108	1.005	109	20.2	0.363	0.147	2.8911	
720 minute summer	109	1.006	ATTENUATION BASIN 2	20.8	0.634	0.292	2.1283	
720 minute summer	111	5.000	112	3.1	0.242	0.025	2.7420	
720 minute summer	110	6.000	112	2.4	0.216	0.018	2.4998	
720 minute summer	112	5.001	113	15.7	0.373	0.116	7.7285	
720 minute summer	113	5.002	ATTENUATION BASIN 2	15.5	0.674	0.180	1.4700	
720 minute summer	ATTENUATION BASIN 2	1.007	HYDROBRAKE 2	4.9	0.116	0.047	0.9937	
15 minute summer	114	1.009	115	4.8	0.601	0.036	0.2205	
15 minute summer	115	1.010	116	4.8	0.749	0.051	0.1524	
15 minute summer	116	1.011	117	4.8	1.046	0.007	0.0422	
15 minute summer	117	1.012	118	4.8	0.716	0.025	0.0404	69.0
15 minute summer	100	1.000	101	12.0	0.641	0.123	0.4929	
15 minute summer	101	1.001	103	28.2	0.922	0.320	1.2128	
15 minute summer	102	2.000	103	35.8	0.963	0.511	0.9272	
15 minute summer	103	1.002	105	84.9	1.719	0.532	2.7921	
720 minute summer	HYDROBRAKE 2	1.008	114	4.8	0.593	0.026	0.0233	

Discharge restricted to 4.8 l/s

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.62%
No flooding in 1 in 100yr storm

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	104	12	66.226	0.626	37.9	1.4371	0.0000	SURCHARGED
15 minute summer	105	12	66.207	0.832	169.2	1.7350	0.0000	FLOOD RISK
1440 minute summer	106	1140	65.939	0.539	1.8	1.0232	0.0000	SURCHARGED
1440 minute summer	107	1140	65.939	0.739	15.8	0.9970	0.0000	SURCHARGED
1440 minute summer	108	1140	65.939	1.039	16.2	1.8610	0.0000	FLOOD RISK
1440 minute summer	109	1140	65.939	1.164	16.3	1.4585	0.0000	FLOOD RISK
1440 minute summer	111	1140	65.939	0.739	2.8	1.7782	0.0000	FLOOD RISK
1440 minute summer	110	1140	65.939	0.739	2.4	1.6385	0.0000	FLOOD RISK
1440 minute summer	112	1140	65.939	0.839	14.7	5.2266	0.0000	FLOOD RISK
1440 minute summer	113	1140	65.939	1.164	14.6	1.4131	0.0000	SURCHARGED
1440 minute summer	ATTENUATION BASIN 2	1140	65.939	1.189	29.3	411.5953	0.0000	SURCHARGED
15 minute summer	114	202	64.748	0.048	4.8	0.0546	0.0000	OK
15 minute summer	115	203	64.659	0.059	4.8	0.0665	0.0000	OK
15 minute summer	116	204	64.572	0.022	4.8	0.0253	0.0000	OK
15 minute summer	117	204	63.568	0.043	4.8	0.0487	0.0000	OK
15 minute summer	118	205	63.511	0.041	4.8	0.0000	0.0000	OK
15 minute summer	100	10	67.081	0.081	16.0	0.1286	0.0000	OK
15 minute summer	101	10	66.936	0.136	38.0	0.2702	0.0000	OK
15 minute summer	102	10	66.843	0.193	47.9	0.6136	0.0000	OK
15 minute summer	103	11	66.745	0.195	113.2	0.4460	0.0000	OK
1440 minute summer	HYDROBRAKE 2	1140	65.939	1.214	4.8	1.3729	0.0000	SURCHARGED

411m3 stored in detention basin
Additional 60m3 storage within network

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	104	3.000	105	33.4	0.794	0.350	1.4272	
15 minute summer	105	1.003	107	150.9	1.369	1.332	5.9558	
1440 minute summer	106	4.000	107	1.8	0.251	0.008	1.8573	
1440 minute summer	107	1.004	108	14.6	0.667	0.051	1.6370	
1440 minute summer	108	1.005	109	16.0	0.347	0.116	2.8911	
1440 minute summer	109	1.006	ATTENUATION BASIN 2	16.2	0.467	0.228	2.1283	
1440 minute summer	111	5.000	112	2.5	0.206	0.020	2.7420	
1440 minute summer	110	6.000	112	2.1	0.177	0.016	2.4998	
1440 minute summer	112	5.001	113	14.2	0.352	0.105	7.7285	
1440 minute summer	113	5.002	ATTENUATION BASIN 2	14.5	0.459	0.169	1.4700	
1440 minute summer	ATTENUATION BASIN 2	1.007	HYDROBRAKE 2	4.8	0.113	0.046	0.9937	
15 minute summer	114	1.009	115	4.8	0.639	0.036	0.2205	
15 minute summer	115	1.010	116	4.8	0.749	0.051	0.1524	
15 minute summer	116	1.011	117	4.8	1.330	0.007	0.0422	
15 minute summer	117	1.012	118	4.8	0.716	0.025	0.0404	69.7
15 minute summer	100	1.000	101	15.8	0.687	0.163	0.6078	
15 minute summer	101	1.001	103	37.4	0.985	0.424	1.5636	
15 minute summer	102	2.000	103	47.2	1.020	0.674	1.1927	
15 minute summer	103	1.002	105	109.6	1.713	0.686	3.1774	
1440 minute summer	HYDROBRAKE 2	1.008	114	4.8	0.593	0.026	0.0233	

Discharge restricted to 4.8 l/s

APPENDIX 6

SUDS Maintenance Plan Checklist

Maintenance Inspection Checklists

Table 1: SuDS Maintenance Inspection Checklist

GENERAL INFORMATION			
Site ID			
Site Location and co-ordinates (GIS if appropriate)			
Elements forming the SuDS scheme		Approved Drawing Reference(s)	
Inspection frequency		Approved Specification Reference	
Type of development		Specific purpose of any parts of the scheme (e.g. biodiversity, wildlife and visual aspects)	

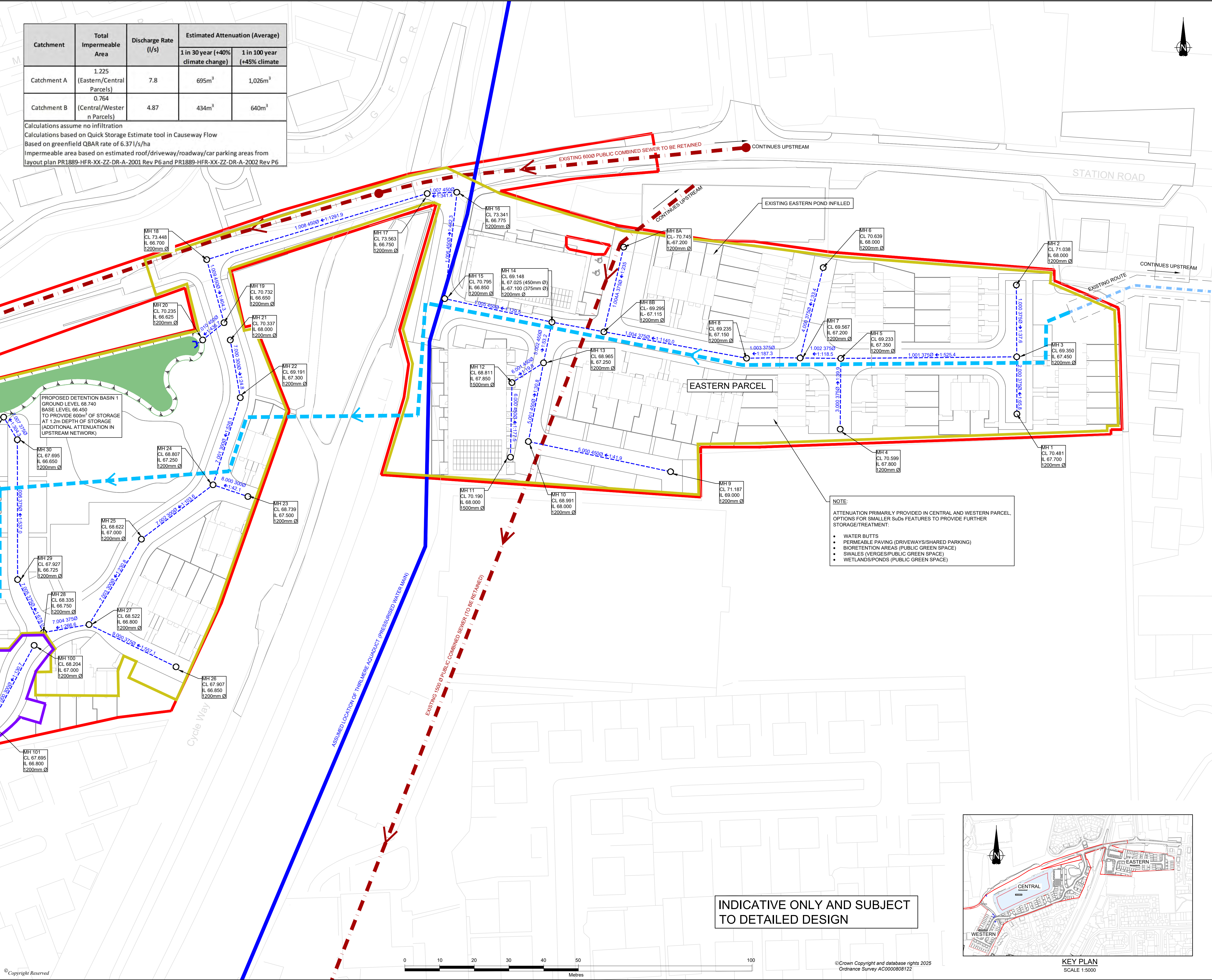
	Inspection date				Inspection date			
	Details	Y/N	Action required	Date Completed	Details	Y/N	Action required	Date Completed
GENERAL INSPECTION ITEMS								
Is there any evidence of erosion, channelling, ponding (where not desirable) or other poor hydraulic performance?								
Is there any evidence of accidental spillages, oils, poor water quality, odours, nuisance insects?								
Have any health and safety risks been identified to either the public or maintenance operatives?								

	Inspection date				Inspection date			
	Details	Y/N	Action required	Date Completed	Details	Y/N	Action required	Date Completed
Is there any deterioration in the surface of permeable surfaces (e.g. rutting or signs of ponding water)?								
SILT/SEDIMENT ACCUMULATION								
Is there any sediment accumulation at inlets (or other defined accumulation zones such as the surface of filter drains or infiltration basins and within proprietary devices)? If yes, state depth (mm) and extent Is removal required? If yes, state waste disposal requirements and confirm all waste management requirements have been complied with (consult Environment Agency).								
Is surface clogging visible (potentially problematic where water has to soak into the underlying construction or ground (e.g. under-drained swale or infiltration basin)?								
Does permeable or porous surfacing require sweeping to remove silt?								
SYSTEM BLOCKAGES / LITTER BUILD UP								
Is there evidence of litter accumulation in the system? If yes, is this a blockage risk?								
Is there any evidence of any other clogging/blockage of outlets or drainage paths?								

	Inspection date				Inspection date			
	Details	Y/N	Action required	Date Completed	Details	Y/N	Action required	Date Completed
VEGETATION								
Is the vegetation condition satisfactory (density, weed growth, coverage etc.)? (Check against approved planting regime.)								
Does any part of the system require weeding / pruning / mowing? (Check against maintenance frequency stated in approved design.)								
Is there any evidence of invasive species becoming established? If yes, state action required.								
INFRASTRUCTURE								
Are any check dams or weirs in good condition?								
Is there evidence of any accidental damage to the system (e.g. wheel ruts?)								
Is there any evidence of cross connections or other unauthorised inflows?								
Is there any evidence of tampering with the flow controls?								
Are there any other matters that could affect the performance of the system in relation to the design objectives for hydraulic, water quality, biodiversity and visual aspects? (Specify.)								
OTHER OBSERVATIONS								

	Inspection date				Inspection date			
	Details	Y/N	Action required	Date Completed	Details	Y/N	Action required	Date Completed
Information appended (e.g. photos)								
SUITABILITY OF CURRENT MAINTENANCE REGIME								
Continue as current Increase maintenance Decrease maintenance								
NEXT INSPECTION								
Proposed date for next inspection								

DRAWINGS



Catchment	Total Impermeable Area	Discharge Rate (l/s)	Estimated Attenuation (Average)	
			1 in 30 year (+40% climate change)	1 in 100 year (+45% climate)
Catchment A (Eastern/Central Parcels)	1.225	7.8	695m ³	1,026m ³
Catchment B (Central/Western Parcels)	0.764	4.87	434m ³	640m ³

Calculations assume no infiltration
Calculations based on Quick Storage Estimate tool in Causeway Flow
Based on greenfield QBAR rate of 6.37l/s/ha
Impermeable area based on estimated roof/driveway/roadway/car parking areas from layout plan PR1889-HFR-XX-ZZ-DR-A-2001 Rev P6 and PR1889-HFR-XX-ZZ-DR-A-2002 Rev P6

DO NOT SCALE FROM THIS DRAWING

NOTES

1. LAYOUT IS INDICATIVE AND SUBJECT TO DETAILED DESIGN.

2. TO BE READ IN CONJUNCTION WITH DRAWING REF: GM13736-105A, GM13736-107A, GM13736-108A, GM13726-109A, GM13736-110A AND GM13736-111A (JUNE 2025).

3. TO BE READ IN CONJUNCTION WITH FLOOD RISK ASSESSMENT (REF: GM13736-0001)

4. LAYOUT BASED ON DRAWING (REF: PR1889-HFR-XX-ZZ-DR-A-2000 'SITE LAYOUT')

5. GROUND LEVELS BASED ON TOPOGRAPHICAL SURVEY BY RJP (NOV 2018).

6. COVER LEVELS OF MANHOLE CHAMBERS BASED ON EXISTING TOPOGRAPHY AND SUBJECT TO CHANGE WHEN DETAILED DESIGN OF SITE LEVELS UNDERTAKEN.

7. SURFACE WATER NETWORK BASED ON FLOW MODEL REFS: PROPOSED SURFACE NETWORK SW EAST AND PROPOSED SURFACE WATER NETWORK SW WEST.

8. PUBLIC SEWER LOCATIONS BASED ON UNITED UTILITIES PUBLIC SEWER RECORDS (ISSUED FEBRUARY 2025).

9. PIPE DIAMETERS IN MILLIMETERS. COVER LEVELS/INVERT LEVELS IN METRES.

KEY

SITE BOUNDARY

EXISTING PRESSURISED WATER MAIN (THIRLMERE AQUADUCT)

EXISTING WATER COURSE

EXISTING PUBLIC COMBINED SEWER

EXISTING CULVERT INLET/OUTFALL

PROPOSED SURFACE WATER DRAINAGE NETWORK 'DIVERSION' (INDICATIVE)

EXISTING SURFACE WATER DRAINAGE NETWORK TO BE RETAINED (INDICATIVE)

PROPOSED SURFACE WATER DRAIN

PROPOSED SURFACE WATER MANHOLE

PROPOSED FLOW CONTROL CHAMBER

PROPOSED HEADWALL STRUCTURE

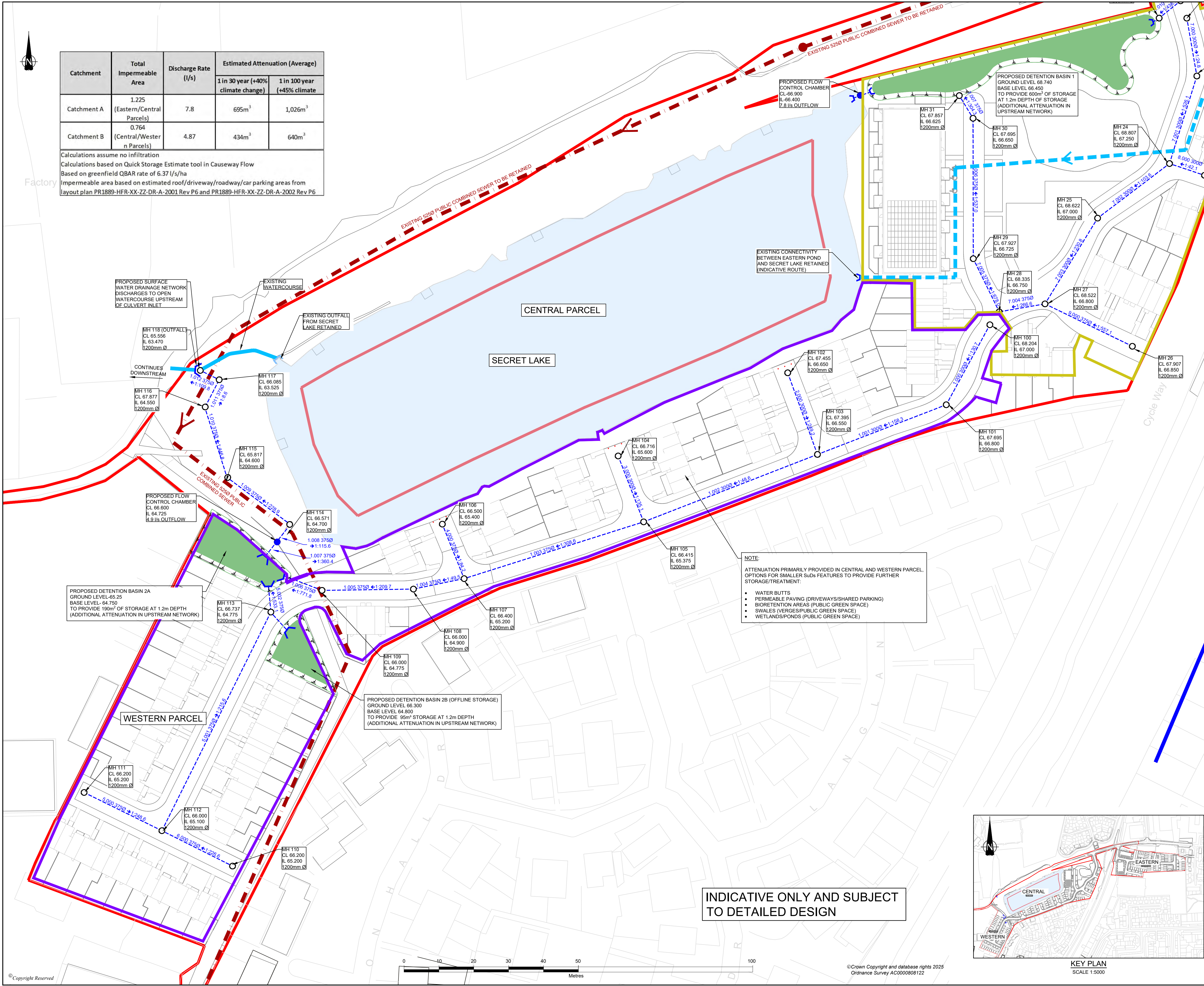
PROPOSED DETENTION BASIN

CATCHMENT A

CATCHMENT B

B	NEW LAYOUT ADDED	30-07-25	DR	BGG	EK
A	FIRST ISSUE	05-06-25	DR	BGG	EK

REVISION	DETAILS	DATE	DESIGN	CHECK	APPROV
CLIENT	NORTHERN GROUP				
PROJECT	LAND AT STATION ROAD				
DRAWING TITLE	INDICATIVE SURFACE WATER MANAGEMENT PLAN (EASTERN PARCEL)				
DRG No.	GM13736-106	REV	B	SUIT. CODE	
DRG SIZE	A1	SCALE	1:500	DATE	07/05/25
DRAWN BY	DR	CHECKED BY	BGG	APPROVED BY	EK



Catchment	Total Impermeable Area	Discharge Rate (l/s)	Estimated Attenuation (Average)	
			1 in 30 year (+40% climate change)	1 in 100 year (+45% climate)
Catchment A (Eastern/Central Parcels)	1.225	7.8	695m ³	1,026m ³
Catchment B (Central/Western Parcels)	0.764	4.87	434m ³	640m ³

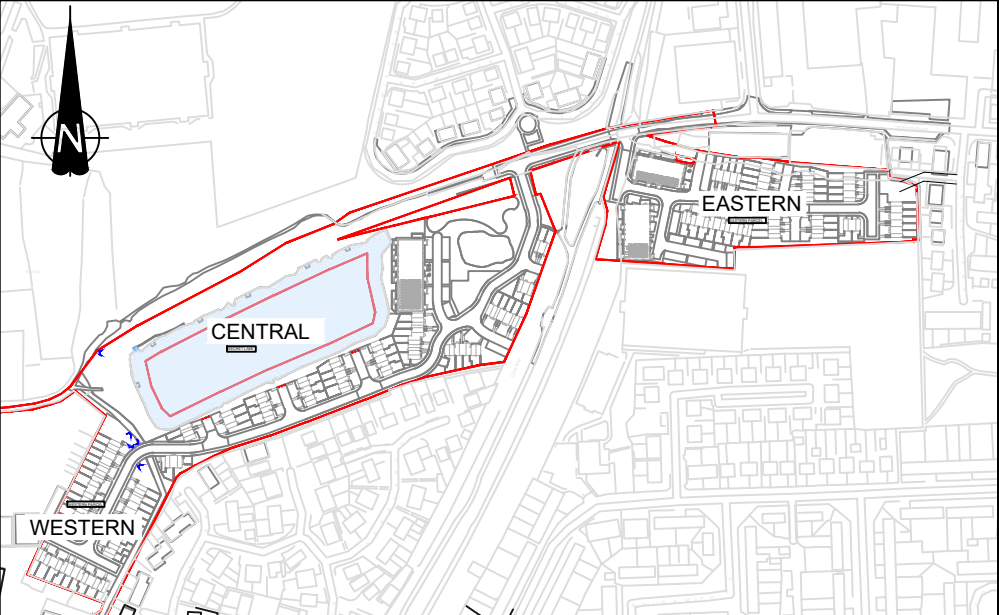
Calculations assume no infiltration
Calculations based on Quick Storage Estimate tool in Causeway Flow
Based on greenfield QBAR rate of 6.37 l/s/ha
Impermeable area based on estimated roof/driveway/roadway/car parking areas from layout plan PR1889-HFR-XX-ZZ-DR-A-2001 Rev P6 and PR1889-HFR-XX-ZZ-DR-A-2002 Rev P6

DO NOT SCALE FROM THIS DRAWING

- NOTES
- LAYOUT IS INDICATIVE AND SUBJECT TO DETAILED DESIGN.
 - TO BE READ IN CONJUNCTION WITH DRAWING REF: GM13736-106A, GM13736-107A, GM13736-108A, GM13726-109A, GM13736-110A AND GM13736-111A (JUNE 2025).
 - TO BE READ IN CONJUNCTION WITH FLOOD RISK ASSESSMENT (REF: GM13736-0001)
 - LAYOUT BASED ON DRAWING (REF: PR1889-HFR-XX-ZZ-DR-A-2000 'SITE LAYOUT')
 - GROUND LEVELS BASED ON TOPOGRAPHICAL SURVEY BY RJP (NOV 2018).
 - COVER LEVELS OF MANHOLE CHAMBERS BASED ON EXISTING TOPOGRAPHY AND SUBJECT TO CHANGE WHEN DETAILED DESIGN OF SITE LEVELS UNDERTAKEN.
 - SURFACE WATER NETWORK BASED ON FLOW MODEL REFS: PROPOSED SURFACE NETWORK SW EAST AND PROPOSED SURFACE WATER NETWORK SW WEST.
 - PUBLIC SEWER LOCATIONS BASED ON UNITED UTILITIES PUBLIC SEWER RECORDS (ISSUED FEBRUARY 2025).
 - PIPE DIAMETERS IN MILLIMETERS. COVER LEVELS/INVERT LEVELS IN METRES.

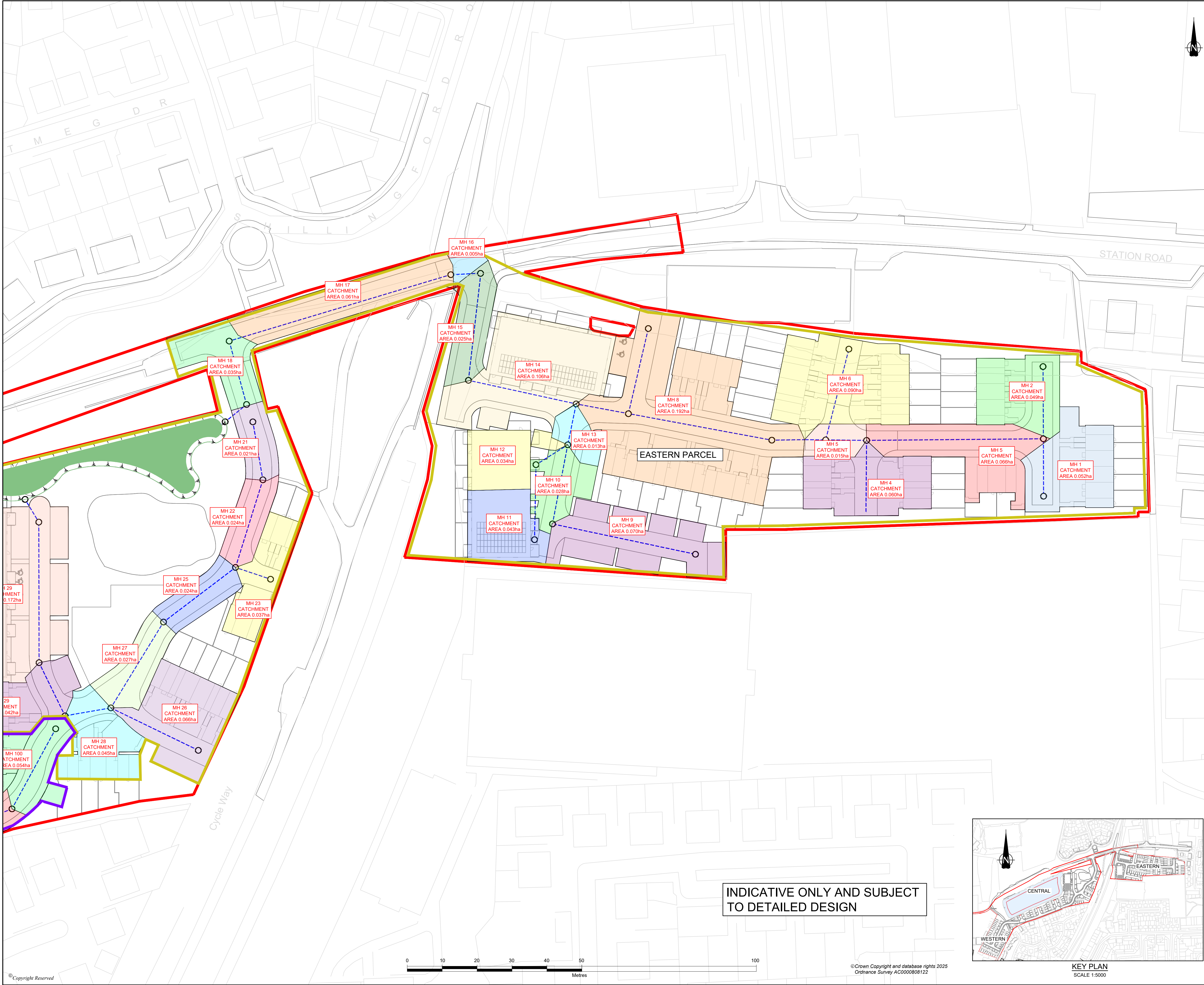
- KEY
- SITE BOUNDARY
 - EXISTING PRESSURISED WATER MAIN (THIRLMERE AQUADUCT)
 - EXISTING WATER COURSE
 - EXISTING PUBLIC COMBINED SEWER
 - EXISTING CULVERT INLET/OUTFALL
 - PROPOSED SURFACE WATER DRAINAGE NETWORK 'DIVERSION' (INDICATIVE)
 - EXISTING SURFACE WATER DRAINAGE NETWORK TO BE RETAINED (INDICATIVE)
 - PROPOSED SURFACE WATER DRAIN
 - PROPOSED SURFACE WATER MANHOLE
 - PROPOSED FLOW CONTROL CHAMBER
 - PROPOSED HEADWALL STRUCTURE
 - PROPOSED DETENTION BASIN
 - CATCHMENT A
 - CATCHMENT B

B	NEW LAYOUT ADDED	30-07-25	DR	BGG	EK
A	FIRST ISSUE	04-06-25	BS	BGG	EK
REVISION	DETAILS	DATE	ISSUED	CHECKED	APPROVED
CLIENT	NORTHERN GROUP				
PROJECT	LAND AT STATION ROAD				
DRAWING TITLE	INDICATIVE SURFACE WATER MANAGEMENT PLAN (CENTRAL AND WESTERN PARCELS)				
DRG No.	GM13736-105	REV	B	SUIT. CODE	
DRG SIZE	A1	SCALE	1:500	DATE	07/05/24
DRAWN BY	DR	CHECKED BY	BGG	APPROVED BY	EK
 PART OF SLR					



KEY PLAN
SCALE 1:5000

INDICATIVE ONLY AND SUBJECT TO DETAILED DESIGN



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TO DETAILED DESIGN

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NOTES

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2. TO BE READ IN CONJUNCTION WITH DRAWING REF: GM13736-105A, GM13736-106A, GM13726-108A, GM13736-110A AND GM13736-111A (JUNE 2025).

3. TO BE READ IN CONJUNCTION WITH FLOOD RISK ASSESSMENT (REF: GM13736-0001)

4. LAYOUT BASED ON DRAWING (REF: PR1889-HFR-XX-ZZ-DR-A-2000 'SITE LAYOUT')

5. GROUND LEVELS BASED ON TOPOGRAPHICAL SURVEY BY RJP (NOV 2018).

6. COVER LEVELS OF MANHOLE CHAMBERS BASED ON EXISTING TOPOGRAPHY AND SUBJECT TO CHANGE WHEN DETAILED DESIGN OF SITE LEVELS UNDERTAKEN.

7. SURFACE WATER NETWORK BASED ON FLOW MODEL REFS: PROPOSED SURFACE NETWORK SW EAST AND PROPOSED SURFACE WATER NETWORK SW WEST.

8. PUBLIC SEWER LOCATIONS BASED ON UNITED UTILITIES PUBLIC SEWER RECORDS (ISSUED FEBRUARY 2025).

9. PIPE DIAMETERS IN MILLIMETERS. COVER LEVELS/INVERT LEVELS IN METRES.

KEY

SITE BOUNDARY

PROPOSED SURFACE WATER DRAIN

PROPOSED SURFACE WATER MANHOLE

PROPOSED FLOW CONTROL CHAMBER

CATCHMENT A

CATCHMENT B

MANHOLE REFERENCE AND CONTRIBUTING IMPERMEABLE AREA

PROPOSED DETENTION BASIN

B	NEW LAYOUT ADDED	30-07-25	DR	BGG	EK
A	FIRST ISSUE	05-06-25	DR	BGG	EK

REVISION

DETAILS

DATE

ISSUED

CHNGD

APPROV

CLIENT

NORTHERN GROUP

PROJECT

LAND AT STATION ROAD

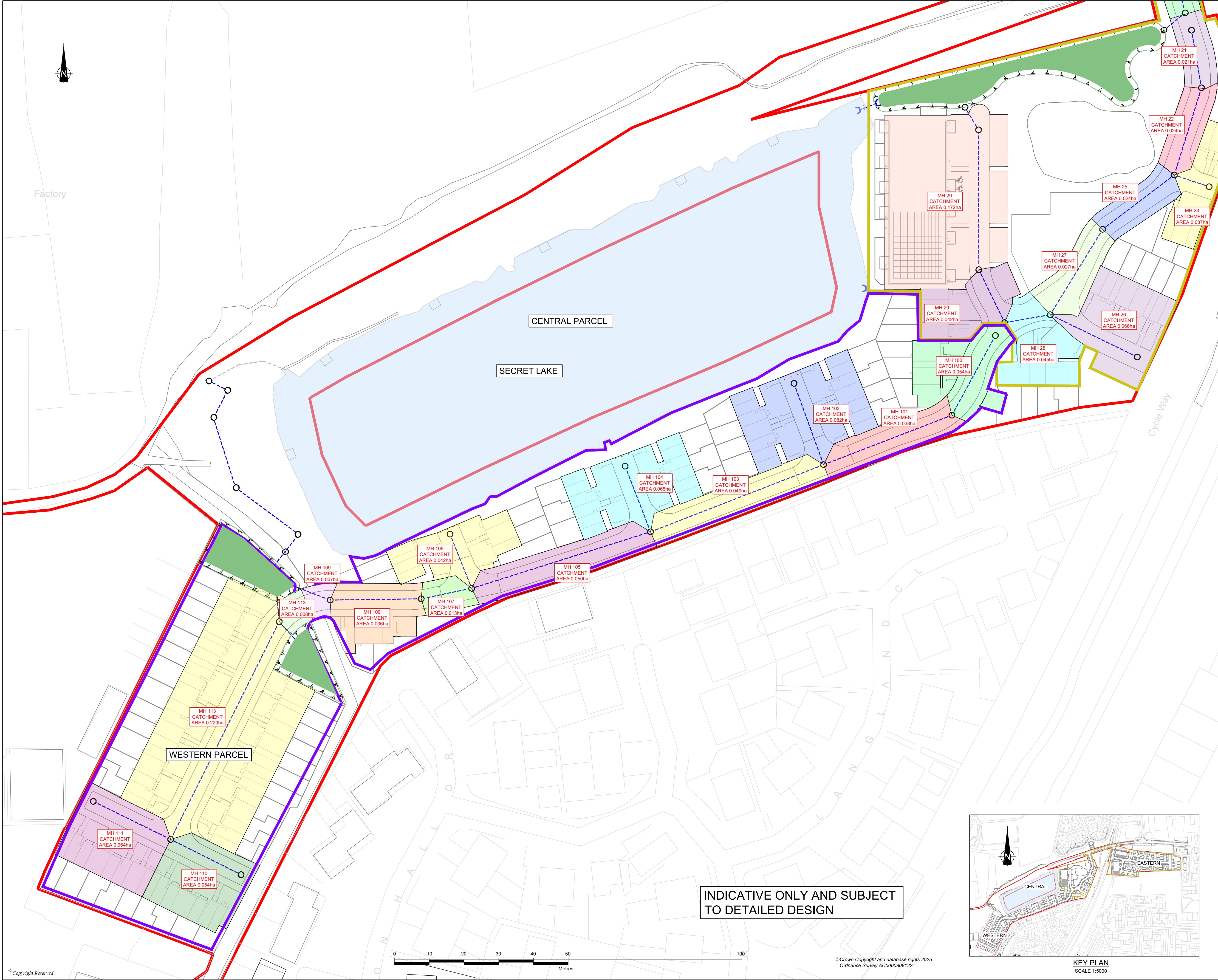
DRAWING TITLE

DRAINAGE CATCHMENT PLAN
(CENTRAL AND WESTERN PARCEL)

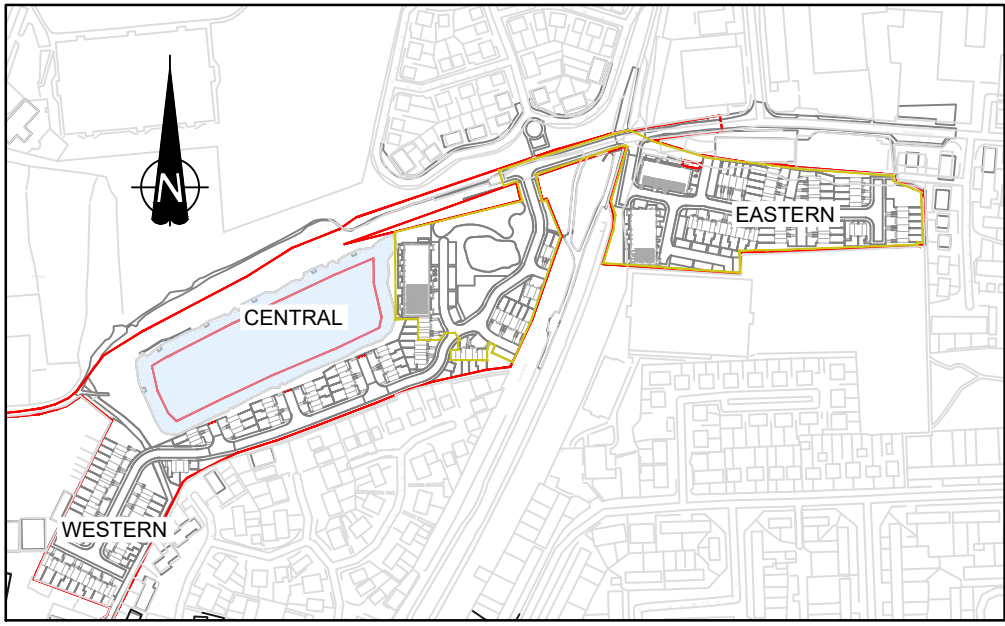
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DRG SIZE	A1	SCALE	1:500	DATE
DRAWN BY	BS	CHECKED BY	BGG	APPROVED BY
				EK

wardell
armstrong

PART OF SLR



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TO DETAILED DESIGN



KEY PLAN
SCALE 1:5000

DO NOT SCALE FROM THIS DRAWING

- NOTES
- LAYOUT IS INDICATIVE AND SUBJECT TO DETAILED DESIGN.
 - TO BE READ IN CONJUNCTION WITH DRAWING REF: GM13736-105A, GM13736-106A, GM13736-107A, GM13726-109A, GM13736-110A AND GM13736-111A (JUNE 2025).
 - TO BE READ IN CONJUNCTION WITH FLOOD RISK ASSESSMENT (REF: GM13736-0001)
 - LAYOUT BASED ON DRAWING (REF: PR1889-HFR-XX-ZZ-DR-A-2000 'SITE LAYOUT')
 - GROUND LEVELS BASED ON TOPOGRAPHICAL SURVEY BY RJP (NOV 2018).
 - COVER LEVELS OF MANHOLE CHAMBERS BASED ON EXISTING TOPOGRAPHY AND SUBJECT TO CHANGE WHEN DETAILED DESIGN OF SITE LEVELS UNDERTAKEN.
 - SURFACE WATER NETWORK BASED ON FLOW MODEL REF: PROPOSED SURFACE NETWORK SW EAST AND PROPOSED SURFACE WATER NETWORK SW WEST.
 - PUBLIC SEWER LOCATIONS BASED ON UNITED UTILITIES PUBLIC SEWER RECORDS (ISSUED FEBRUARY 2025).
 - PIPE DIAMETERS IN MILLIMETERS, COVER LEVELS/INVERT LEVELS IN METRES.

KEY

- SITE BOUNDARY
- 5 000 PROPOSED SURFACE WATER DRAIN
- PROPOSED SURFACE WATER MANHOLE
- PROPOSED FLOW CONTROL CHAMBER
- CATCHMENT A
- CATCHMENT B
- MH 2 CATCHMENT AREA 0.049ha
- MANHOLE REFERENCE AND CONTRIBUTING IMPERMEABLE AREA
- PROPOSED DETENTION BASIN

B	NEW LAYOUT ADDED	30-07-25	DR	BGG	EK
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A	FIRST ISSUE	05-06-25	DR	BGG	EK
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REVISION	DETAILS	DATE	ISSUED	CHNGD	APPROV
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CLIENT

NORTHERN GROUP

PROJECT

LAND AT STATION ROAD

DRAWING TITLE

DRAINAGE CATCHMENT PLAN
(EASTERN PARCEL)

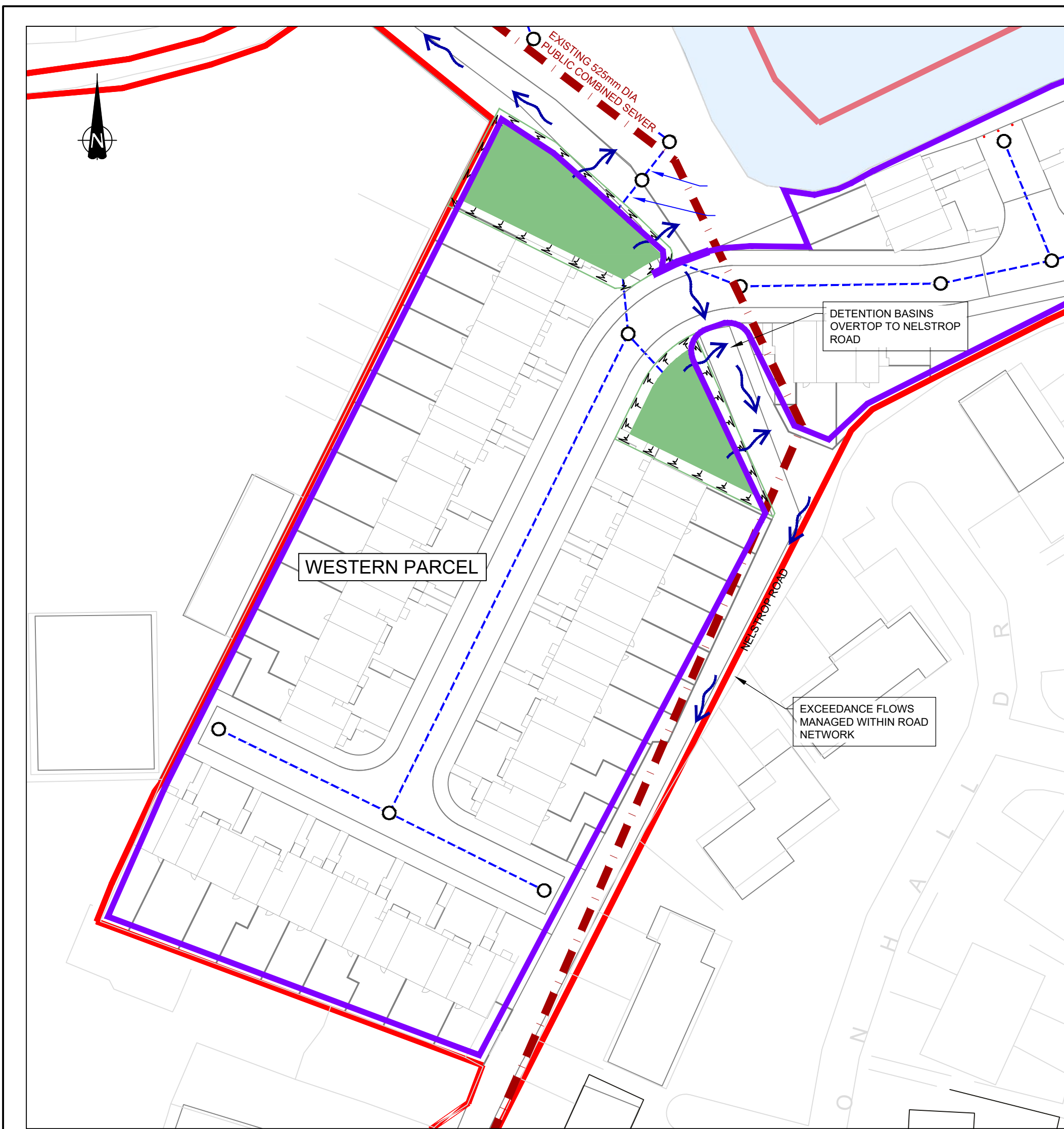
DRG No.	GM13736-108	REV	B	SUIT. CODE
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DRG SIZE	A1	SCALE	1:500	DATE	07/05/25
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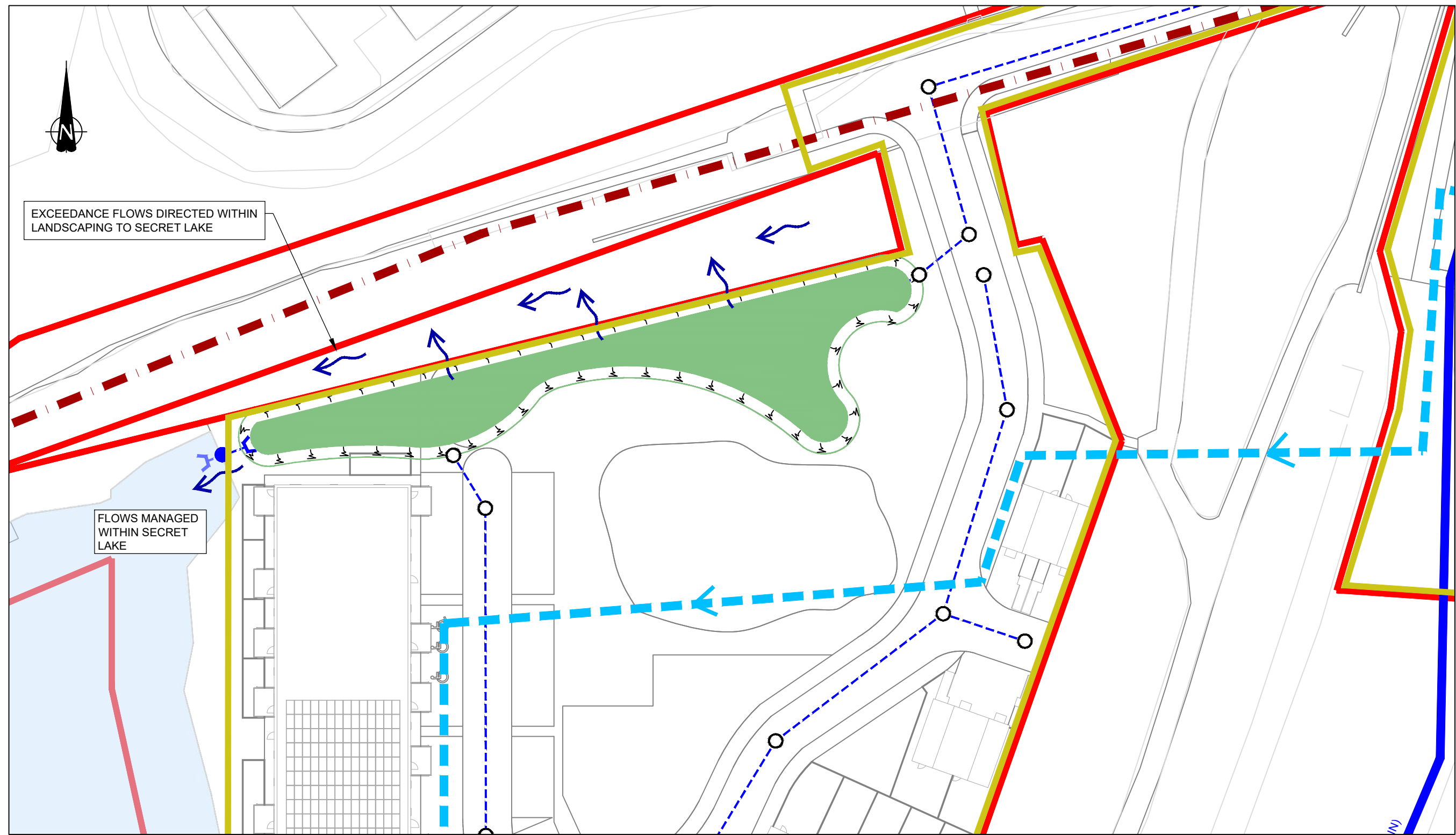
DRAWN BY	BS	CHECKED BY	BGG	APPROVED BY	EK
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**wardell
armstrong**
PART OF **SLR**

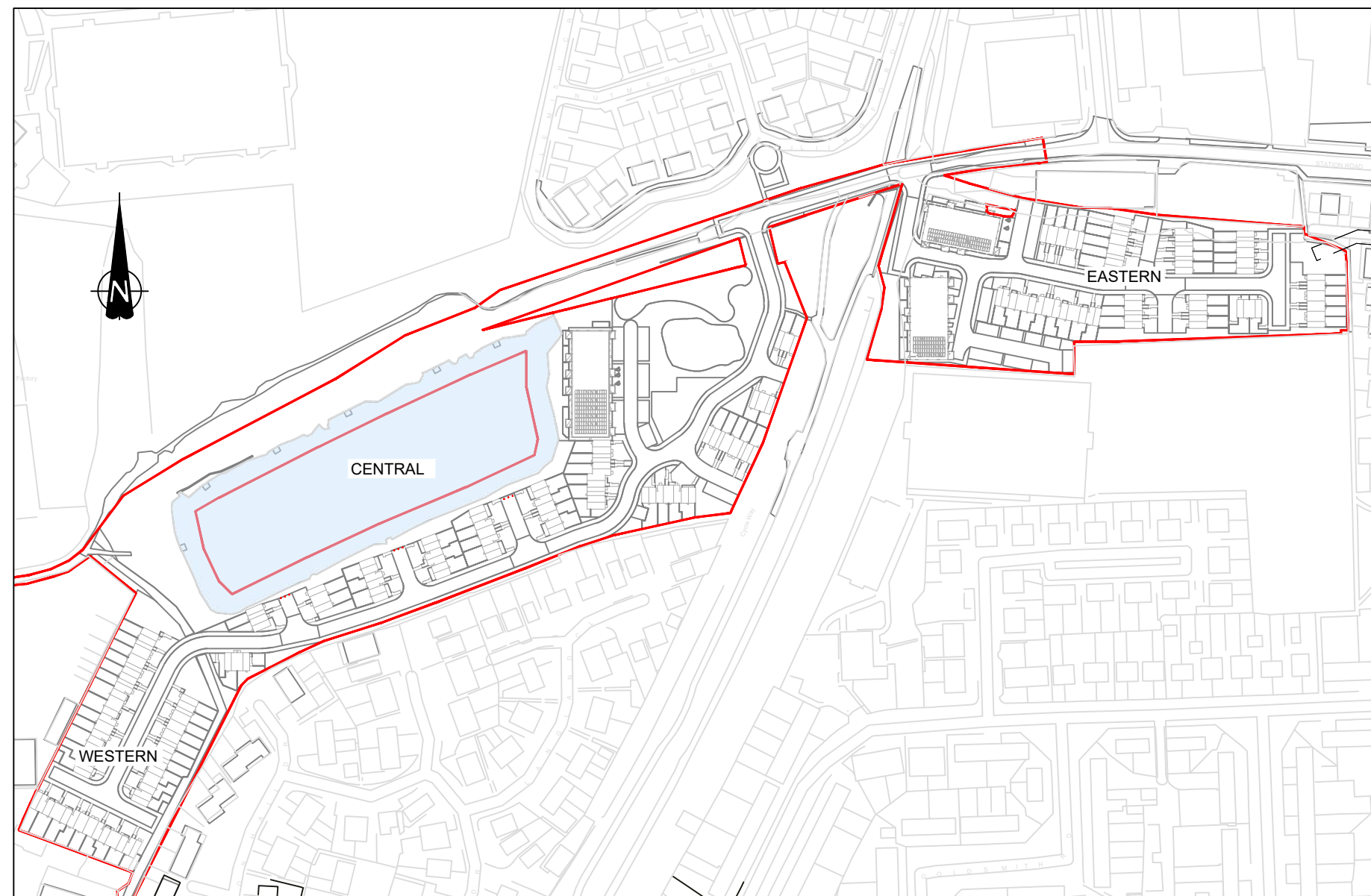




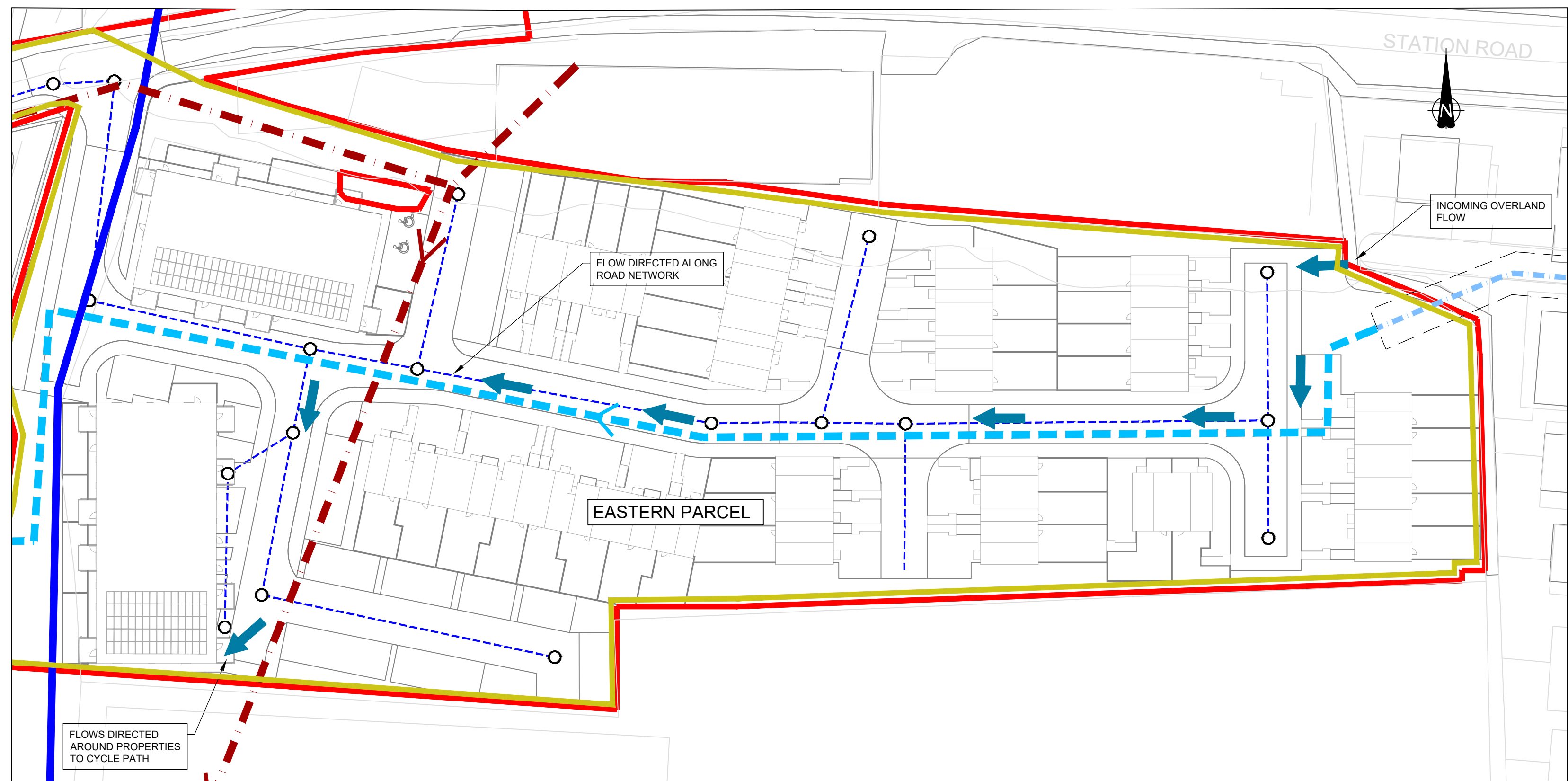
INDICATIVE EXCEEDANCE ROUTES
(CATCHMENT B)



INDICATIVE EXCEEDANCE ROUTES
(CATCHMENT A)



KEY PLAN
SCALE 1:2500



EXISTING OVERLAND FLOW ROUTE
(1:1000 YEAR SCENARIO)

DO NOT SCALE FROM THIS DRAWING

NOTES

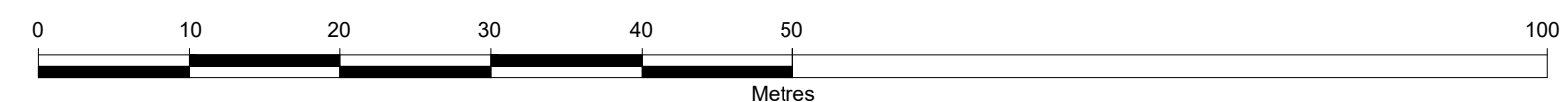
- LAYOUT IS INDICATIVE AND SUBJECT TO DETAILED DESIGN.
- TO BE READ IN CONJUNCTION WITH DRAWING REF: GM13736-105A, GM13736-106A, GM13736-107A, GM13736-108A, GM13736-110A AND GM13736-111A (JUNE 2025).
- TO BE READ IN CONJUNCTION WITH FLOOD RISK ASSESSMENT (REF: GM13736-0001)
- LAYOUT BASED ON DRAWING (REF: PR1889-HFR-XX-ZZ-DR-A-2000 'SITE LAYOUT')
- GROUND LEVELS BASED ON TOPOGRAPHICAL SURVEY BY RJP (NOV 2018).
- COVER LEVELS OF MANHOLE CHAMBERS BASED ON EXISTING TOPOGRAPHY AND SUBJECT TO CHANGE WHEN DETAILED DESIGN OF SITE LEVELS UNDERTAKEN.
- SURFACE WATER NETWORK BASED ON FLOW MODEL REFS: PROPOSED SURFACE NETWORK SW EAST AND PROPOSED SURFACE WATER NETWORK SW WEST.
- PUBLIC SEWER LOCATIONS BASED ON UNITED UTILITIES PUBLIC SEWER RECORDS (ISSUED FEBRUARY 2025).
- PIPE DIAMETERS IN MILLIMETERS. COVER LEVELS/INVERT LEVELS IN METRES.

KEY

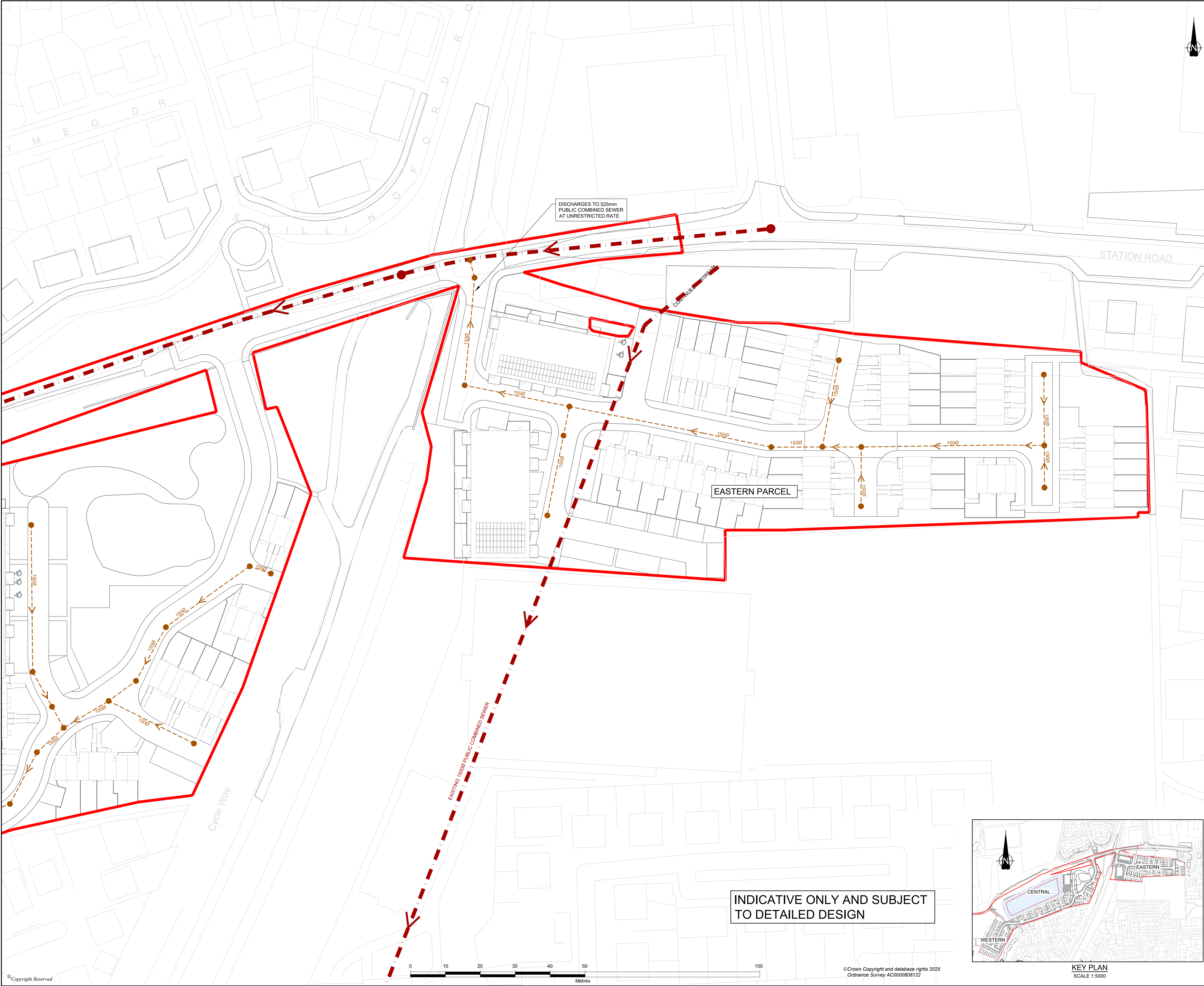
- SITE BOUNDARY
- EXISTING PRESSURISED WATER MAIN (THIRLMERE AQUADUCT)
- EXISTING WATER COURSE
- EXISTING PUBLIC COMBINED SEWER
- EXISTING CULVERT INLET
- PROPOSED EXISTING SURFACE DRAINAGE NETWORK DIVERSION (INDICATIVE ROUTE)
- PROPOSED SURFACE WATER DRAIN
- PROPOSED SURFACE WATER MANHOLE
- PROPOSED FLOW CONTROL CHAMBER
- PROPOSED HEADWALL STRUCTURE
- PROPOSED DETENTION BASIN
- INDICATIVE EXCEEDANCE FLOW ROUTE
- INDICATIVE OVERLAND FLOW ROUTE
- CATCHMENT A
- CATCHMENT B

B	NEW LAYOUT ADDED	30-07-25	DR	BGG	EK
A	FIRST ISSUE	05-06-25	DR	BGG	EK
REVISION	DETAILS	DATE	DRAWN	CHECK	APPROVED
CLIENT	NORTHERN GROUP				
PROJECT	LAND AT STATION ROAD				
DRAWING TITLE	INDICATIVE EXCEEDANCE ROUTES				
DRG No.	GM13736-109	REV	B	SUIT. CODE	
DRG SIZE	A1	SCALE	1:500	DATE	13-05-25
DRAWN BY	DR	CHECKED BY	BGG	APPROVED BY	EK
 wardell armstrong PART OF SLR 					

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NOTES

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3. TO BE READ IN CONJUNCTION WITH FLOOD RISK ASSESSMENT (REF: GM13736-0001)

4. LAYOUT BASED ON DRAWING (REF: PR1889-HFR-XX-ZZ-DR-A-2000 'SITE LAYOUT')

5. GROUND LEVELS BASED ON TOPOGRAPHICAL SURVEY BY RJP (NOV 2018).

6. COVER LEVELS OF MANHOLE CHAMBERS BASED ON EXISTING TOPOGRAPHY AND SUBJECT TO CHANGE WHEN DETAILED DESIGN OF SITE LEVELS UNDERTAKEN.

7. PUBLIC SEWER LOCATIONS BASED ON UNITED UTILITIES PUBLIC SEWER RECORDS (ISSUED FEBRUARY 2025).

8. PIPE DIAMETERS IN MILLIMETERS.

KEY

SITE BOUNDARY

EXISTING PUBLIC COMBINED SEWER

PROPOSED FOUL DRAIN

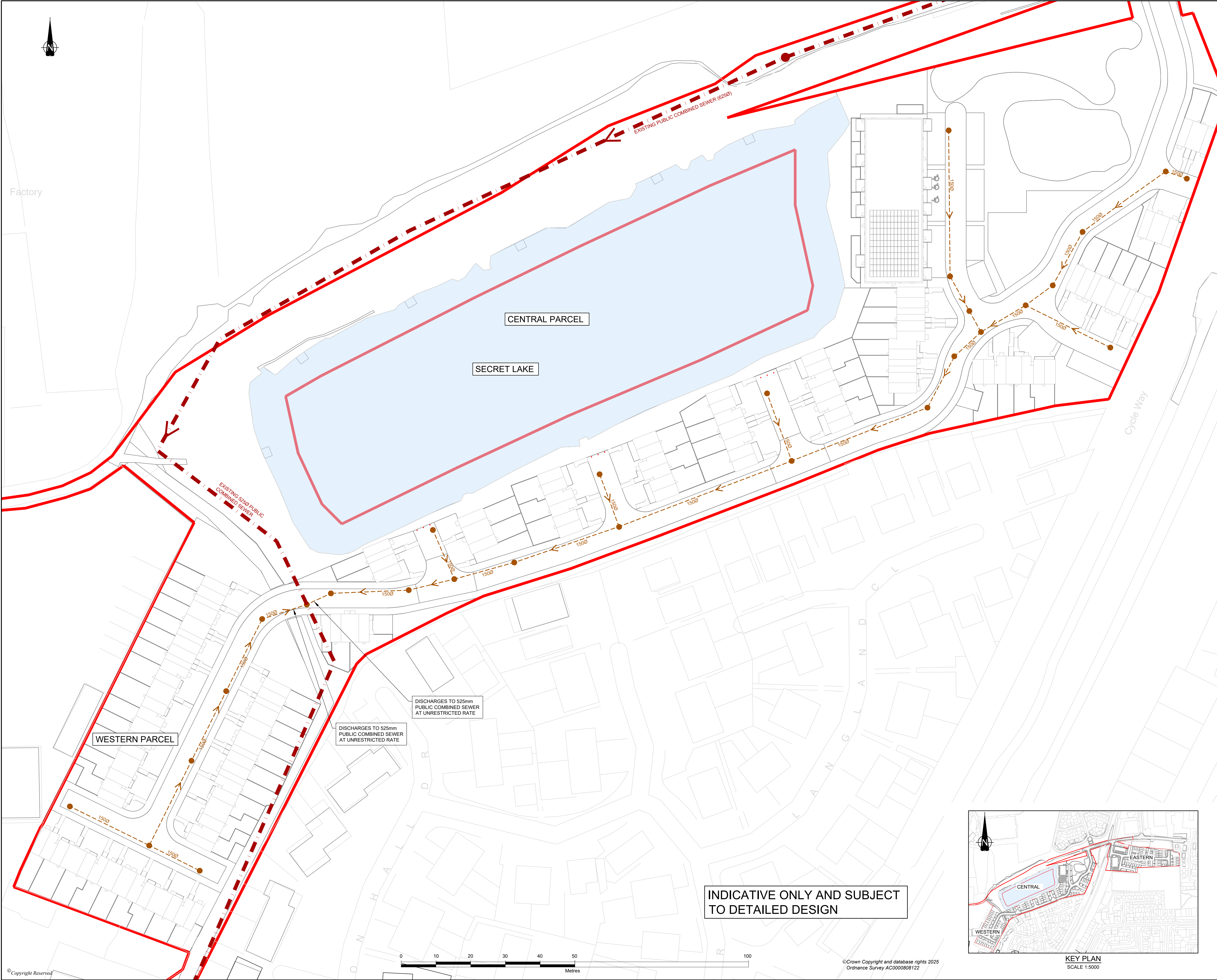
1200Ø FOUL WATER MANHOLE

B	NEW LAYOUT ADDED	30-07-25	DR	BGG	EK
A	FIRST ISSUE	05-06-25	BS	BGG	EK
REVISION	DETAILS	DATE	DRAWN	CHECK	APPROVED
CLIENT NORTHERN GROUP					
PROJECT LAND AT STATION ROAD					
DRAWING TITLE INDICATIVE FOUL WATER DRAINAGE STRATEGY EASTERN SITE					
DRG No. GM13736-111		REV A	SUIT. CODE		
DRG SIZE A1	SCALE 1:500	DATE 13-05-25			
DRAWN BY DR	CHECKED BY BGG	APPROVED BY EK			
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N:\GAG\GM13736-STATION ROAD-REDOES\H03-DESIGN\AUTOCAD\GM13736-110A & 111-B INDICATIVE FOUL WATER DRAINAGE STRATEGY.DWG

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3. TO BE READ IN CONJUNCTION WITH FLOOD RISK ASSESSMENT (REF: GM13736-0001)

4. LAYOUT BASED ON DRAWING (REF: PR1889-HFR-XX-ZZ-DR-A-2000 'SITE LAYOUT')

5. GROUND LEVELS BASED ON TOPOGRAPHICAL SURVEY BY RJP (NOV 2018).

6. COVER LEVELS OF MANHOLE CHAMBERS BASED ON EXISTING TOPOGRAPHY AND SUBJECT TO CHANGE WHEN DETAILED DESIGN OF SITE LEVELS UNDERTAKEN.

7. PUBLIC SEWER LOCATIONS BASED ON UNITED UTILITIES PUBLIC SEWER RECORDS (ISSUED FEBRUARY 2025).

8. PIPE DIAMETERS IN MILLIMETERS.

KEY

SITE BOUNDARY

EXISTING PUBLIC COMBINED SEWER

PROPOSED FOUL DRAIN

1200Ø FOUL WATER MANHOLE

B	NEW LAYOUT ADDED	30-07-25	DR	BGS	EK
A	FIRST ISSUE	05-06-25	BS	BGS	EK
REVISION	DETAILS	DATE	ISSUED	CHNG	APPR
CLIENT NORTHERN GROUP					
PROJECT LAND AT STATION ROAD					
DRAWING TITLE INDICATIVE FOUL WATER DRAINAGE STRATEGY (CENTRAL AND WESTERN PARCELS)					
DRG No. GM13736-110		REV A	SUIT. CODE		
DRG SIZE A1	SCALE 1:500	DATE 13-05-25			
DRAWN BY DR	CHECKED BY BGG	APPROVED BY EK			
wardell armstrong PART OF SLR					

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KEY PLAN
SCALE 1:5000



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Units Key

Apartments

1 Bed
2 Bed

Houses

2 Bed
3 Bed

Total Scheme

Name	Count
Apartments	
1B2P	52
1B2P (AM)	6
2B4P	30
2B4P (AM)	3
Townhouse	
2B4P/3P2B/TH	62
2B4P/3P2B/TH	47
Grand total:	200

Rev	Revision Details	Drawn	Date	Chk'd
1	Project No: PR1889 Subsidiary: SO WORK IN PROGRESS Status: PLANNING			
2	Client: Northern Group			
3	Project: Station Road Reddish			
4	Street Name: Planning - Proposed Site Plan - Western & Central Parcel			
5	Drawing No: PR1889-HFR-XX-ZZ-DR-A-9003	Rev.		
6	Drawn by: ED	Scale:	As indicated @ A0	
7	Created: JULY 2025			

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90-XX_Proposed Site Plan - Eastern Parcel
1:200

Units Key

- Apartments**
1 Bed
2 Bed
- Houses**
2 Bed
3 Bed

Total Scheme	
Name	Count
Apartment	
1B2P	52
1B2P (M4)	6
2B4P	30
2B4P (M4)	3
Townhouse	
2BedSP/3BedTH	62
3BedSP/3BedTH	47
Grand total:	200

Rev	Revision Details	Drawn	Date	Chk'd
1	Project No. PR1889 Subsidiary: SO WORK IN PROGRESS Status: PLANNING			

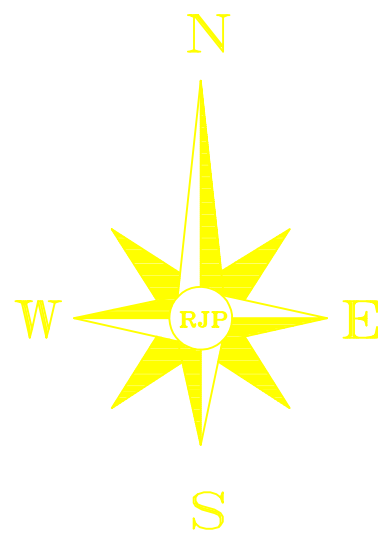
Client: Northern Group

Project: Station Road Reddish

Street Name: Planning - Proposed Site Plan - Eastern Parcel	Rev.
Drawing No. PR1889-HFR-XX-ZZ-DR-A-9005	
Drawn by: ED	Scale: As indicated @ A0
Created: JULY 2025	

HORIZON
fletcher | rae

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T +44 (0) 161 242 1140
W www.fletcher-rae.com
E info@fletcher-rae.com



COORDINATED STATIONS

STATION	EASTING	NORTHING	LEVEL (m)
A	388976.102	394748.691	73.522
B	389017.092	394763.544	71.746
C	388971.183	394716.593	71.508
D	388947.501	394746.126	73.428
F	388976.102	394768.654	71.571

ABBREVIATIONS

AV	AIR VALVE/VENT	IC	INSPECT CHAMBER
BOL	BOLLARD	IL	INVERT LEVEL
BB	BELUSHA BEACON	JKW	JAPANESE KNOTT WEED
BM	BENCH MARK	LH	LAMP HOLE
BL	BED LEVEL	LP	LAMP POST
BS	BUS STOP	NP	NAME PLATE
BT	BRITISH TELECOM	MH	MANHOLE
CL	COVER LEVEL	PS	POST/SIGN POST
DII	DILAPIDATED	PB	POST BOX
Dis	DISUSED	PX	UNKNOWN SERVICE
EL	EAVES LEVEL	RE	RODDING EYE
ELE	ELEC JUNCT. BOX	RL	RIDGE LEVEL
EP	ELECTRICITY POLE	RS	ROAD SIGN
FH	FIRE HYDRANT	ST	STOP TAP
FL	FLOOR LEVEL	TH	TRIAL HOLE
FOS	FULL OF SEDIMENT	TL	TRAFFIC LIGHT
FP	FLAG POLE	TP	TELEGRAPH POLE
G	GULLY	TV	CABLE TV BOX
GM	GAS METER	UI	UNABLE TO LIFT
GV	GAS VALVE	WM	WATER METER

SYMBOLS

	SURVEY STATION		TREE
	O\H ELEC CABLE		BENCH MARK
	O\H PHONE LINE		TRIAL PIT
	CANOPY\HEDGE		BOREHOLE

NOTES

- A) ONLY MANHOLES AND SERVICES VISIBLE AT TIME OF SURVEY SHOWN
- B) O/S USED AND ORIENTATED TO TRUE NORTH
- C) LEVELS IN METRES RELATED TO G.P.S.
- D) DRAINAGE INFORMATION TAKEN FROM LOCAL AUTHORITY RECORDS. INFORMATION MUST BE CHECKED PRIOR TO WORK COMMENCING

Rev	Description	Date
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PROPOSED DEVELOPMENT AT
STATION ROAD, STOCKPORT

REDROW HOMES

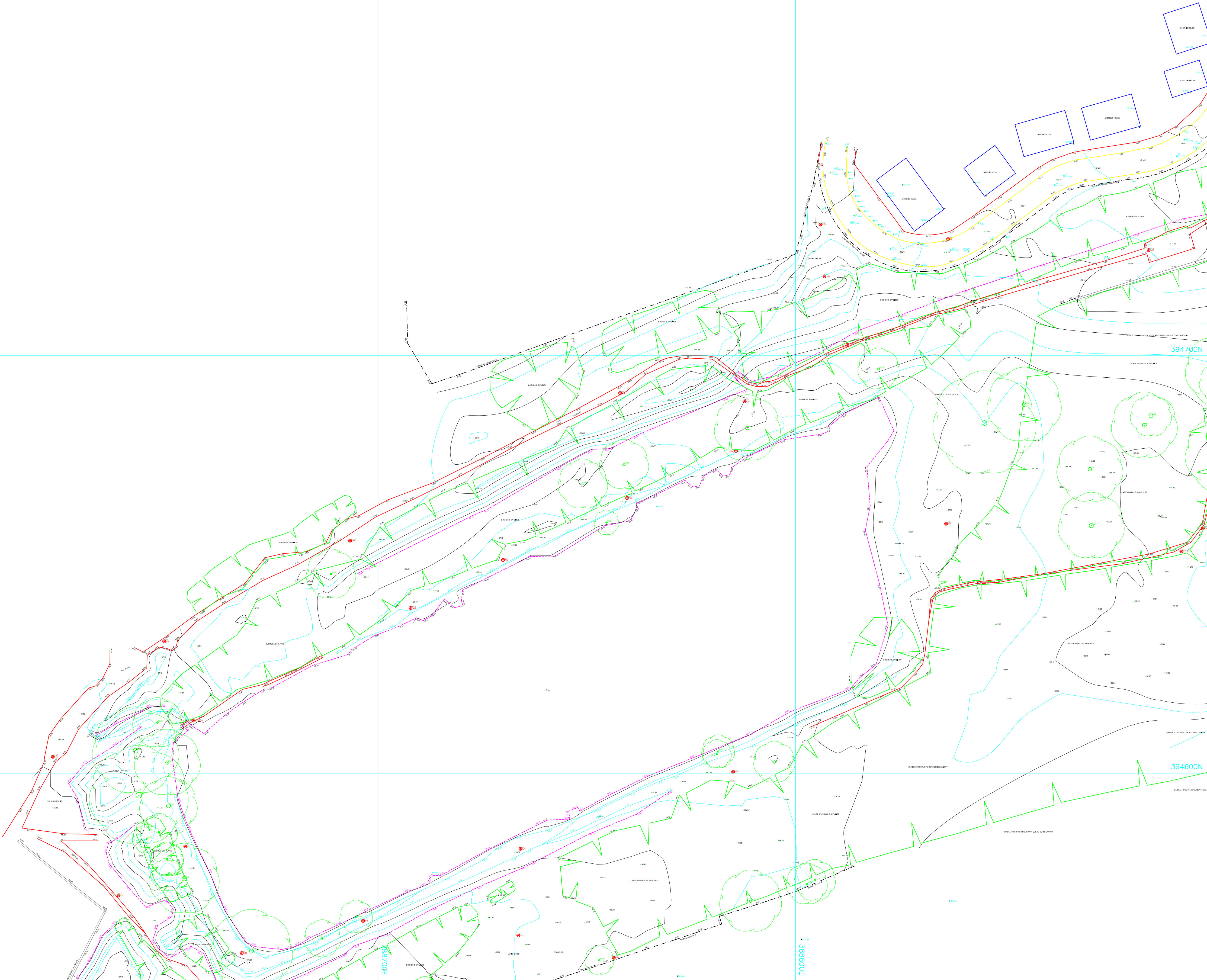
TOPOGRAPHICAL SURVEY

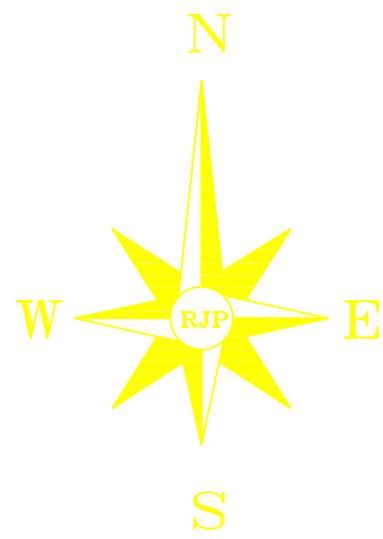
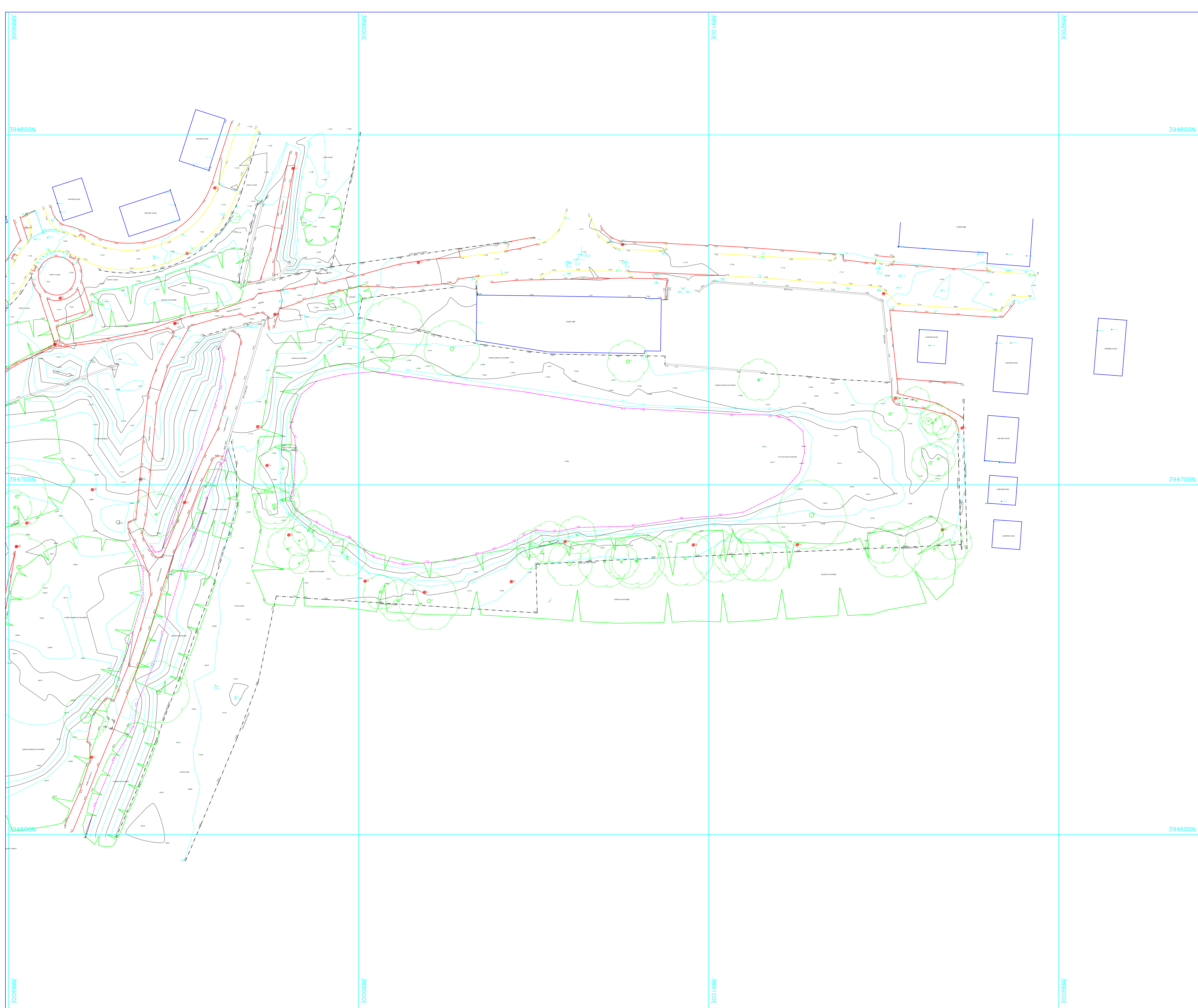
(SHEET 1 OF 3)	Drawn	S. FAIRHURST
BH062/T00	Date	NOV 2018
	Scale	1:500 @ A1

RJP Surveying Consultants Ltd
LAND SURVEYORS & SITE ENGINEERS

AYREFIELD COTTAGE
AYREFIELD ROAD
ROBY MILL
UPHOLLAND
LANCASHIRE
WN8 0QP

TEL: 01257 251554
MOBILE: 07710 308709
WEBSITE : www.rjpsurveyors.co.uk
E-MAIL: mail@rjpsurveyors.co.uk





COORDINATED STATIONS			
STATION	EASTING	NORTHING	LEVEL (m)
A	388976.102	394748.691	73.522
B	389017.092	394763.544	71.746
C	388971.183	394716.593	71.508
D	388947.501	394746.126	73.428
F	388976.102	394768.654	71.571

ABBREVIATIONS

AV	AIR VALVE/VENT	IC	INSPECT CHAMBER
BOL	BOLLARD	IL	INVERT LEVEL
BB	BELISHA BEACON	JKW	JAPANESE KNOTT WEED
BM	BENCH MARK	LH	LAMP HOLE
BL	BED LEVEL	LP	LAMP POST
BS	BUS STOP	NP	NAME PLATE
BT	BRITISH TELECOM	MH	MANHOLE
CL	COVER LEVEL	PS	POST/SIGN POST
DII	DILAPIDATED	PB	POST BOX
Dis	DISUSED	PX	UNKNOWN SERVICE
EL	EAVES LEVEL	RE	RODDING EYE
ELE	ELEC JUNCT. BOX	RL	RIDGE LEVEL
EP	ELECTRICITY POLE	RS	ROAD SIGN
FH	FIRE HYDRANT	ST	STOP TAP
FL	FLOOR LEVEL	TH	TRIAL HOLE
FOS	FULL OF SEDIMENT	TL	TRAFFIC LIGHT
FP	FLAG POLE	TP	TELEGRAPH POLE
G	GULLY	TV	CABLE TV BOX
GM	GAS METER	URI	UNABLE TO LIFT
GV	GAS VALVE	WM	WATER METER

SYMBOLS

	SURVEY STATION		TREE
	O\H ELEC CABLE		BENCH MARK
	O\H PHONE LINE		TRIAL PIT
	CANOPY\HEDGE		BOREHOLE

NOTES

- A) ONLY MANHOLES AND SERVICES VISIBLE AT TIME OF SURVEY SHOWN
- B) O/S USED AND ORIENTATED TO TRUE NORTH
- C) LEVELS IN METRES RELATED TO G.P.S.
- D) DRAINAGE INFORMATION TAKEN FROM LOCAL AUTHORITY RECORDS. INFORMATION MUST BE CHECKED PRIOR TO WORK COMMENCING

Rev	Description	Date
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PROPOSED DEVELOPMENT AT
STATION ROAD, STOCKPORT

REDROW HOMES

TOPOGRAPHICAL SURVEY

BH062/TOO	(SHEET 2 OF 3)	Drawn	S. FAIRHURST
		Date	NOV 2018
		Scale	1:500 @ A1

RJP Surveying Consultants Ltd
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STOKE-ON-TRENT

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