



Civic Engineers

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Trafford Housing Trust

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Flood Risk Assessment & Drainage Strategy

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1. Introduction

1.1 Scope and Objective

Civic Engineers Ltd has been appointed by Trafford Housing Trust to prepare a site-specific Flood Risk Assessment to support a full planning application for the proposed residential development at Clitheroe Road, Whalley.

The Flood Risk Assessment presented herein will demonstrate that the proposed development at Clitheroe Road will be safe from flooding and will not pose a flood risk to sites elsewhere. The report will also describe the strategy for providing surface water and foul drainage of the site.

1.2 Development Proposals

Full Planning Permission is sought for the proposed development of 188 new residential units and associated infrastructure.

The development will extend the existing, recently constructed, residential area which is located to the west of the Site and will include a road crossing of both the Haweswater Aqueduct and an unnamed ordinary watercourse which runs from east to west across the low point of the site. At the low point of the site there are two newly constructed attenuation ponds which serve the previous and adjacent development and which have been designed to provide sufficient attenuation for the new, proposed development.

A previously consented planning application included residential development on the Site as a future phase of the recently constructed neighbouring development.

1.3 Site Description and Topography

The proposed development site is currently undeveloped greenfield and is located in Whalley, Lancashire. The Site is accessed either from Springwood Road to the west or Accrington Road to the east.

The OS Grid Coordinates of the approximate centre of the site are 373750 436535

The majority of the proposed development is located on a hillside immediately adjacent and to the east of a previous, recently constructed housing development; a further area of development is proposed to the south of the Site which will be accessed by an access road which will cross both the Haweswater Aqueduct and an ordinary watercourse.

A topographical survey has been undertaken (as included in Appendix A of this report) and shows the bed of the watercourse that passes through the site to fall from a level of approximately 57mAOD as it enters the eastern edge of the site to a low point of approximately 53mAOD as it exits the site boundary to the west. The Site rises to a high point of approximately 84mAOD to the north east edge of the site. The area to the south of the watercourse is elevated above the water level and falls from a level of approximately 59mAOD adjacent to the water course to a low point of 53mAOD to the south west corner of the site.



Figure 1: Site location plan and aerial image (Google imagery dated 2018) with indicative site extents outlined in red.

1.4 Ground Conditions

Ground investigations and a Geo-environmental Assessment have been undertaken by Deltasimons and report published in August 2018. The report summarises the ground conditions as follows:

"The ground conditions comprises topsoil (to a maximum depth of 0.6m bgl) underlain by Devensian Till. The Devensian Till typically comprises cohesive sandy and gravelly clay/silt underlain by granular clayey sand/gravel."

The Site investigation and subsequent monitoring data suggest there is a continuous groundwater table below the Site and it should be noted that the investigation and monitoring took place during a prolonged period of dry weather and therefore the groundwater table has the potential to rise once the weather conditions deteriorate. It is also understood that artesian groundwater conditions were encountered during the excavation of attenuation ponds in the central part of the Site, suggesting that the cohesive clay/silt is acting as an aquitard to the underlying granular clayey/sand/gravel"

The table below has been extracted from the Geo-environmental Assessment:

Summary of Observed Ground Conditions				
Strata	Typical Strata Description	Depth Range of Strata Base (m)	Maximum Proven Thickness (m)	Comments
Topsoil	Brown clayey fine to coarse SAND. Brown slightly silty clayey fine to medium SAND with numerous rootlets and rare gravel. Brown sandy CLAY.	0.15 – 0.6	0.6	Topsoil was present at all exploratory hole locations from ground level to a maximum depth of 0.6 m bgl. The average thickness of topsoil across the Site is c.0.3 m.
Devensian Till	Orange brown slightly sandy CLAY / SILT. Brownish grey slightly sandy gravelly CLAY with occasional to several cobbles.	The base of the Devensian Till was not proven during this Site investigation.		Devensian Till was encountered in all exploratory holes below the topsoil. Typically encountered as cohesive clay / silt underlain by granular sand and gravel.
	Very loose slightly clayey gravelly fine to coarse SAND. Loose slightly clayey sandy GRAVEL.			

Table 1: Summary of Ground Conditions Extracted from Deltasimons Geo-environmental Appraisal, August 2018.

2. Relevant Policy and Guidance

2.1 National planning Policy Framework (NPPF)

With regards to flood risk the NPPF requires that:

"Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere."

The NPPF refers to the Flood zones which are shown on the Environment Agency Flood Map and establishes the range of uses which are appropriate, or compatible, land uses for each Flood Zone.

The Flood Zones can be summarised as follows:

Zone 1: Low Probability. This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any one year. (<0.1%)

Zone 2: Medium Probability. This zone comprises land assessed as having between 1 in 100 and 1 in 1000 annual probability of river flooding (1%-0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1%) in any year.

Zone 3a: High Probability. This zone comprises land assessed as having 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

Zone 3b: Functional Flood Plain. This zone comprises land where water has to flow or be stored in times of flood. Strategic Flood Risk Assessments should identify this zone.

As part of this process it is necessary to consider the type and nature of the development. The Planning Practice Guidance Flood Risk and Coastal Change defines the type and nature of different development classifications in the context of their flood risk vulnerability. This has been summarised in Table 1 below:

Table 1: Flood Risk Vulnerability and flood zone compatibility from NPPF Technical Guide.

Flood Risk Vulnerability Classification	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Zone 1	√	√	√	√	√
Zone 2	√	Exception Test Required	√	√	√
Zone 3a	Exception Test Required	x	Exception Test Required	√	√
Zone 3b (functional floodplain)	Exception Test Required	x	x	x	√
√ Development is appropriate x Development should not be permitted.					

2.2 Local Planning Policy

The following documents have been reviewed in preparation of this FRA

Ribble Valley Strategic Flood Risk Assessment (Level1), 2017 (SFRA)

The site falls within the area which is covered by the SFRA; the documents reflects the requirements of National Planning Policy.

Core Strategy 2008-2028 A Local Plan for Ribble Valley (Adopted Version) (Core Strategy)

The Core Strategy reflects the requirements of National Planning Policy.

3. Potential Sources of Flooding

The potential sources of flooding to the development have been assessed and are discussed below:

3.1 Fluvial and Tidal Flooding

Current Environment Agency flood maps show the development falls within Flood Zone 1, as illustrated in Figure 1 below. Flood Zone 1 covers areas that have low probability of flooding (less than 1 in 1000 annual probability of flooding).

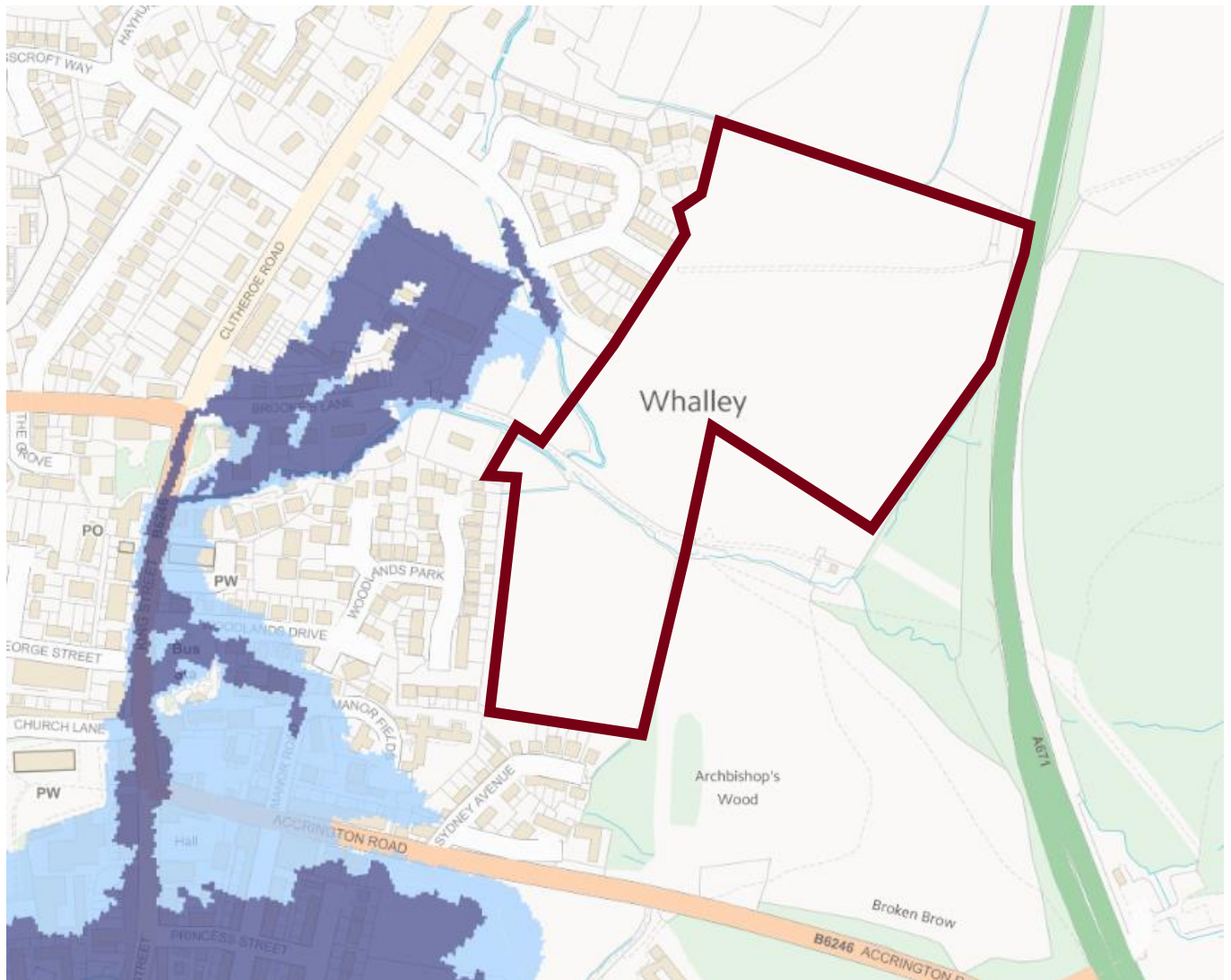


Figure 2: Extract of Gov.uk Flood Map for planning dated 10th September 2018 with indicative site extents outlined in red.

Whilst the south west edge of the site sits at a level approximately equivalent to the level of the bed of the watercourse the land mass between the watercourse and this area of the site will protect the site from overland fluvial flooding.

The Impacts of Climate Change

Peak river flow allowances for various river basins, available from EA, are suitable for both Flood Risk Assessments and Strategic Flood Risk Assessments. They consider potential increase in peak

river flow due to climate change. **Table** below, based on data provided by the EA shows anticipated flow changes for the North West district.

River Basin District	Allowance Category	Total potential change anticipated for :		
		'2020s' (2015-2039)	'2050s' (2040-2069)	'2080s' (2070-2115)
North West	Upper End	20%	35%	70%
	Higher Central	20%	30%	35%
	Central	15%	25%	30%

Table 2: Peak river flow allowances for the North West river basin district (use 1961 to 1990 baseline)

The EA presents a set of recommendations based on the level of vulnerability of a proposed structure and its Flood Zone. The higher the vulnerability and the riskier the flood zone, the higher the assumed flow increase. However, no recommendations were made for Flood Zone 1 due to its low flood risk.

Given the low risk of flooding to the site and the sites elevation above the surrounding ground levels it is not anticipated that the impacts of climate change would result in flooding to the development during a 1in100yr flood event.

3.2 Surface Water and Groundwater Flooding

Surface water flooding is dependent primarily on topography which dictates either the flow path of overland flow which is not contained within public sewers, or areas in which ponding may occur. Surface water flooding is more difficult to predict than the risk of flooding from rivers or sea as it is dependent on the amount of rain which will fall in a very localised area, the specific topography of that area and the capacity and functionality of the drainage network within that area.

EA surface water flood map shows the site to be at "very low" risk of surface water flooding which is defined as a less than 0.1% chance of flooding each year. An extract of the Surface Water Flood Map can be seen in Figure 3 below

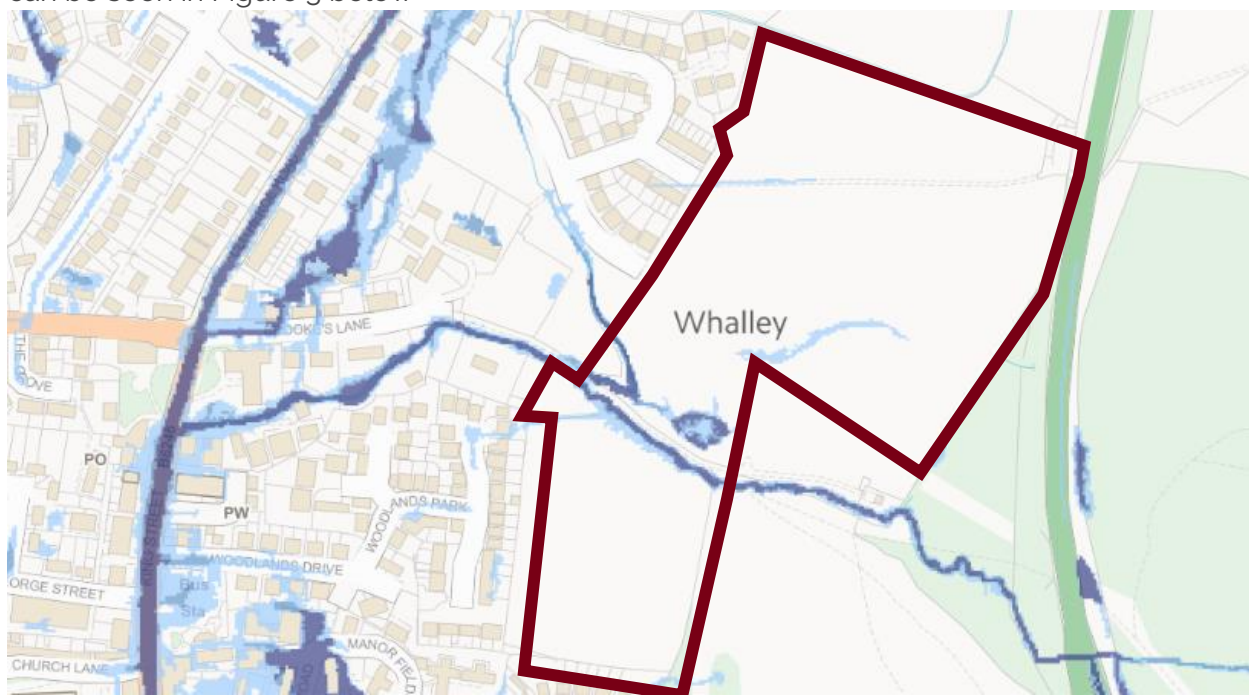


Figure 3: Extract of Gov.uk Surface Water Flood map for planning dated 10th September 2018 with indicative site extents outlined in red.

Ground Investigations suggest there is a "continuous (and fluctuating due to weather conditions) groundwater table below the Site, and an elevation of approximately 77mAOD in the far north east and 50mAOD in the far south-west (approximately 2.5m-3.0m below existing ground level)".

Whilst it is noted that the investigations were undertaken during a prolonged period of dry weather and that ground water levels could rise during a period or prolonged rainfall the lowest proposed building floor level is 54mAOD in the south west of the site which is 4m higher than the recorded groundwater level in this area and which is higher than the adjacent gforu

3.3 Flood Risk from Sewers

There are no known cases of the site flooding as a result of surcharged public sewers or overland flow.

4. Flood Risk and Proposed Mitigation

The proposed development falls into fluvial Flood Zone 1 and has a low probability of flooding from fluvial sources.

The surface water flood risk is shown to be very low however flows will need to be managed along flow paths through the site with overland flow directed away from homes. Creating these flow paths will also mitigate any residual flood risk associated with flooding from sewers and the drainage network.

Whilst the flood risk from all sources is considered to be low the following flood mitigation measures will be provided:

- Streets and external works will be designed to direct overland flows away from property. The levels will be set such that overland flow (should it occur) will be directed to the corridor of open space at the centre of the site adjacent to the recently constructed attenuation basins.
- Site levels in the south western corner of the southern section of the site will beset at a minimum of 54mAOD which is 4m higher than the recorded ground water level in this area.

5. Surface Water Management Strategy

5.1 Existing Site Drainage

The site is currently a greenfield site and there is no evidence of positive drainage.

As part of the previous phase of works two attenuation basins have been constructed at the low point of the site and the eastern basin has been designed to provide a sufficient volume of attenuation of surface water from the northern area of the proposed development prior to discharge to the watercourse at a previously agreed rate.

5.2 Proposed Point of Discharge

NPPF Planning Practice Guidance Paragraph 080 Reference ID:7-080-20150323 states that:

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

- 1. Into the ground (infiltration);*
- 2. To a surface water body;*
- 3. To a surface water sewer, highway drain, or another drainage system;*
- 4. To a combined sewer."*

Whilst potentially permeable strata have been identified through ground investigation, site topography does not lend itself to disposal of surface water by infiltration.

An unnamed ordinary watercourse runs from east to west through the central section of the site and it is proposed to discharge surface water to this watercourse.

5.3 Sustainable Drainage Systems (SuDS)

Section 1.1 of the SuDS Manual (Ciria C753) states the following:

"Sustainable drainage systems (SuDS) can deliver multiple benefits.

Surface water is a valuable resource and this should be reflected in the way it is managed and used in the built environment. It can add to and enhance biodiversity, beauty, tranquillity and the natural aesthetic of buildings, places and landscapes and it can help make them more resilient to the changing climate.

The philosophy of sustainable drainage systems is about maximising the benefits and minimising the negative impacts of surface water run-off from developed areas.

The SuDS approach involves slowing down and reducing the quantity of surface water runoff from a developed area to manage downstream flood risk, and reducing the risk of that runoff causing pollution. This is achieved by harvesting, infiltrating, slowing, storing, conveying and treating runoff on site and, where possible, on the surface rather than underground. Water then becomes a much more visible and tangible part of the built environment, which can be enjoyed by everyone."

The SuDS Manual describes the four pillars of SuDS design as Water Quality, Water Quantity, Amenity and Biodiversity as illustrated in **Figure 2** below.

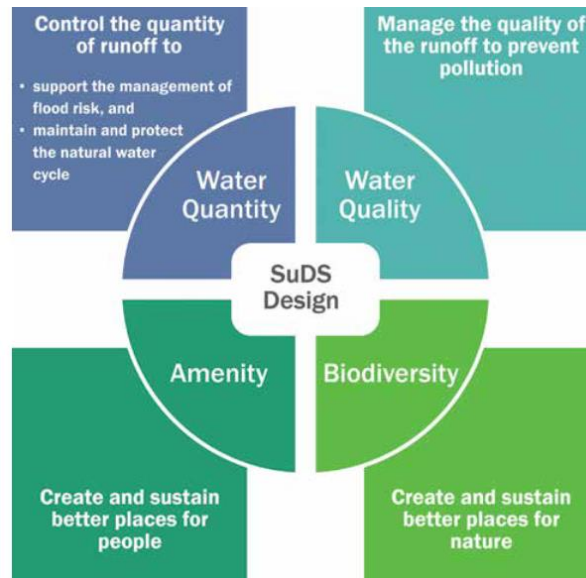


Figure 2: Sustainable Development Objectives (Representation of Figure 2.1 of The SuDS Manual)

Minimising the Impact of the Development on the QUANTITY of Surface Water Run-Off

In order to minimise the impact of the development on existing infrastructure and to reduce the risk of downstream flooding it is important to manage the rate and volume of surface water discharge such that it does not exceed the pre-developed condition and where practicable achieves a betterment.

The surface water drainage network for the northern section of the site will be designed to discharge into the existing attenuation basin which will then discharge to the watercourse at a previously agreed discharge rate.

The surface water drainage serving the southern section of the site will be designed such that discharge is restricted to the equivalent of greenfield run-off rates.

Surface water drainage calculations are contained in Appendix C of this report.

Minimising the Impact of the Development on the QUALITY of Surface Water Run-Off

To protect the water quality of receiving surface waters and groundwaters effectively, run off discharged from the site should be of an acceptable water quality.

The surface water run-off from the site will be from roofs, hardstanding (including driveways) and estate roads and would be classified as having a low "pollution hazard level" in Table 4.3 of the SuDS Manual and as such a "simple index approach" to treatment should be adopted. Table 26.2 of the SuDS Manual describes the "pollution hazard indices for different land use classes and figure 5 below is an excerpt from that table that relates to the proposed development.

TABLE 26.2 Pollution hazard indices for different land use classifications				
Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydrocarbons
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4

Figure 5 Excerpt of SuDS Manual Table 26.2 Pollution hazard indices for different use classes.

Table 26.3 (which is represented in Figure 6 below) illustrates the "indicative SuDS mitigation indices for discharge to surface waters" and can be used to inform the SuDS strategy at the site.

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters			
Type of SuDS component	Mitigation indices ¹		
	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4 ²	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond ⁴	0.7 ³	0.7	0.5
Wetland	0.8 ³	0.8	0.8
Proprietary treatment systems ^{5,6}	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Figure 6 Representation of SuDS Manual Table 26.3 SuDS mitigation indices (for notes refer to source material)

Maximise AMENITY & BIODIVERSITY Opportunities

Landscaping to the areas of open space and attenuation basins will provide significant opportunities for improved amenity.

5.4 Development Surface Water Drainage Strategy

The surface water management strategy at the site is split into two catchments; the northern catchment will discharge via a pipe network to the existing, eastern, attenuation basin which has been constructed to serve the development, before discharging to the watercourse at a controlled discharge rate.

The southern catchment will discharge via a piped network to a new attenuation basin before discharging to the watercourse at a rate equivalent to the greenfield run-off rate. Due to the site levels part of this network will be pumped.

Table 4 below summarises the SuDS components which will be incorporated into the development and highlights where they contribute to the objectives as set out in The SuDS Manual.

Components	Comments	Benefits		
		Quantity*	Quality	Amenity & Biodiversity
Trapped gullies.	Trapped gullies will reduce the quantity of suspended detritus and coarse sediment that will make its way into the drainage network.		√	
Attenuation Basins	Attenuation Basins will provide a degree of settlement and filtration to initial rainfall and will contributing positively in terms of biodiversity and amenity.	√	√	√

* reduction in quantity is based on flow rate rather than volume. Significant reductions in the volume of run-off can only realistically be achieved through rainwater harvesting and/or infiltration to the ground.

Table 4: Proposed SuDS Scheme Components

It is understood that the details of the existing attenuation basin have been agreed prior to construction. The proposed attenuation basin will be designed in accordance with the design guidance with respect to hydraulics and treatment as set out in the SuDS Manual and other relevant documents.

Applying the "simple Index approach" to assess the level of treatment provided (as described in Section 5.3 above) the Pond in isolation would provide sufficient mitigation indices when assessed against the relevant hazard indices. This is as summarised in Table 5 below:

	Total Suspended Solids	Metals	Hydrocarbons
Relevant hazard indices (refer to Figure 5)	0.5	0.4	0.4
SuDS Mitigation Indices	0.7	0.7	0.5

Table 5: Site Specific Hazard v's SuDS Mitigation Indices

The proposed trapped gullies will remove coarse sediment before it enters the drainage network; this will have a positive impact on the maintenance regime for both the buried drainage and the ponds.

Landscaping of the ponds will contribute positively to the development both in terms of biodiversity and amenity.

The proposed surface water drainage scheme is as shown on Civic Engineers' drawings contained in Appendix B of this report and drainage calculations are contained in Appendix C.

The surface water drainage will be designed to adoptable standards and will be proposed for adoption by United Utilities.

6. Foul Drainage

The foul drainage from both catchments is proposed to be discharged in to the existing drainage network which was constructed as part of the neighbouring development. Due to the site topography this will require drainage from the southern catchment to be pumped and a pumping station and rising main are shown on the relevant drawings in Appendix B.

The foul drainage will be designed to adoptable standards and will be proposed for adoption by United Utilities.

7. Conclusion

The proposed development is located within Flood Zone 1, which is characterised by low probability of a flood occurring. Residential developments, such as this one, are classified as "*more vulnerable*" by the NPPF and Table 1 above states that this type of development is compatible with Flood Zone 1.

Flood risk from all sources has been considered and it has been demonstrated that the flood risk to the site is low. The following mitigation measures are proposed to mitigate the residual flood risk:

- Streets and external works will be designed to direct overland flows away from property. The levels will be set such that overland flow (should it occur) will be directed to the corridor of open space at the centre of the site adjacent to the recently constructed attenuation basins.
- Site levels in the south western corner of the southern section of the site will be raised such that the minimum ground floor level of any unit is 54mAOD.

Surface water will be managed by adequately designed drainage systems, so that the site will not flood due to surface water flow, nor result in an increased flood risk elsewhere.

With incorporation of the proposed mitigation measures as described above the risk of flooding to the site will be low and the development will comply with National and Local Planning Policy.

Appendix A Topographical Survey

Appendix B Civic Engineers Proposed Drainage Drawings

Appendix C Civic Engineers' Initial Surface Water Drainage Calculations



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