LAND OFF PROVIDENCE STREET, EARLSHEATON, DEWSBURY, WF12 8HZ

FLOOD RISK AND DRAINAGE ASSESSMENT

Final Report v1.0
August 2024

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Report Title	**Land off Providence Street, Earlsheaton, Dewsbury, WF12 8HZ** Flood Risk and Drainage Assessment Final Report v1.0
Client	Precious Holdings Wakefield Ltd
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1 INTRODUCTION

1.1 Purpose of Report

Weetwood Services Ltd ('Weetwood') has been instructed by Precious Holdings Wakefield Ltd to prepare a Flood Risk and Drainage Assessment (FRDA) report to accompany an outline planning application for the proposed development of land off Providence Street, Earlsheaton, Dewsbury ("the Site") for residential use.

The assessment has been undertaken in accordance with the requirements of the revised National Planning Policy Framework (NPPF) updated on 20 December 2023 and the Planning Practice Guidance (PPG) updated on 14 February 2024.

1.2 Background

The site is allocated within the Kirklees Local Plan (adopted February 2019) and is located within site reference HS50 for residential use.

1.3 Structure of the Report

The report is structured as follows:

Section 1 Introduction and report structure
Section 2 Provides background information relating to the development site
Section 3 Presents national and local flood risk and drainage planning policy
Section 4 Assesses the potential risk of flooding to the development site
Section 5 Presents an illustrative foul water drainage scheme
Section 6 Presents an illustrative surface water drainage scheme
Section 7 Presents a summary of key findings and the recommendations

1.4 Relevant Documents

The assessment has been informed by the following documents:

- Leeds City Region Sustainable Drainage Systems Guidance, West Yorkshire Combined Authority, February 2020
- Local Plan Strategy and Policies, Kirklees Council, February 2019
- Calder Catchment Strategic Flood Risk Assessment Volume II, Kirklees Council, July 2016
- Calder Catchment Strategic Flood Risk Assessment Volume I, Kirklees Council, Calderdale Metropolitan Borough Council and Wakefield Council, April 2016

1.5 Explanatory Note on Flood Probability

This report refers to the likelihood of a flood event occurring in terms of an annual exceedance probability (AEP) expressed as a percentage. This terminology is consistent with the definition of flood zones presented in Table 1 of the PPG (refer to **Section 4.2** of this report).

The AEP is the reciprocal of the return period which describes the rarity of an event in terms of its statistical reoccurrence interval in years. For example, a '1 in 30 year flood' has a 1/30 = 0.033 (3.3%) probability of occurring or being exceeded in any one year, whilst a '1 in 100 year flood' has a 1/100 = 0.01 (1%) probability of occurring or being exceeded in any one year.

Annual Exceedance Probability	Annual Exceedance Probability expressed as a %	Return Period (years)
0.033	3.3%	30
0.010	1%	100
0.001	0.1%	1,000

2 SITE DETAILS AND PROPOSED DEVELOPMENT

2.1 Site Location

The approximately 1.98 ha site is located to the south of Providence Street and to the south-east of Town Street, Earlsheaton at Ordnance Survey National Grid Reference SE 259 211, as shown in **Figure 1**.

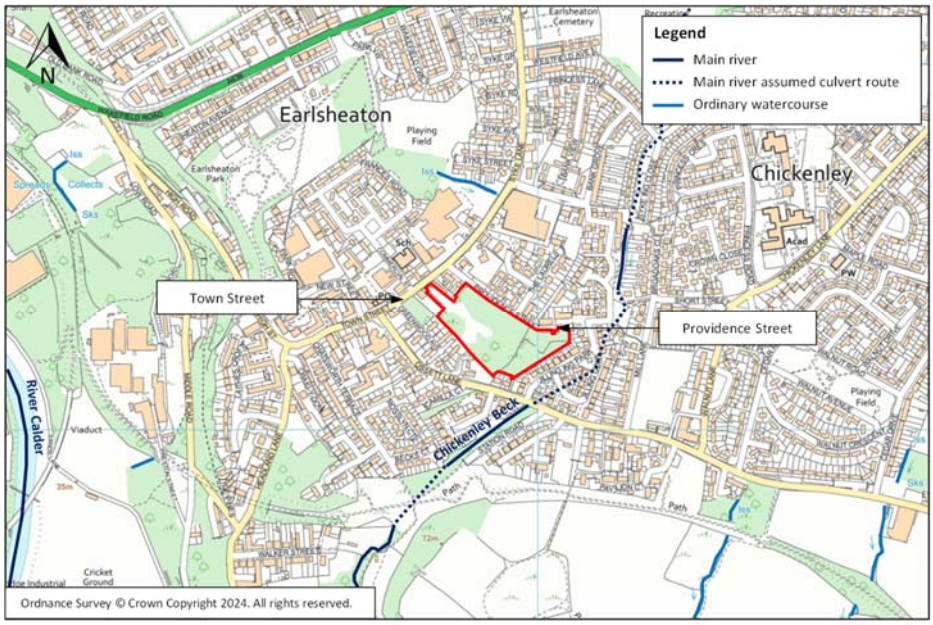

Figure 1: Site Location and Location of Surface Waterbodies

2.2 Existing and Proposed Development

The site currently comprises a building and several containers with associated hardstanding, large areas of vegetation and woodland.

The development proposals entail the construction of up to 30 residential dwellings (including conversion of the existing building) within the western half of the site. Woodland will be retained within the eastern half of the site and within the western corner of the site. Vehicular access will be provided via 2 no. new access points on Providence Street, with a pedestrian and cycle link provided via the existing access point on Town Street.

The proposed site plan is provided in **Appendix A**.

The NPPF classifies residential development as More Vulnerable to flood risk.

2.3 Surface Waterbodies in the Vicinity of the Site

Chickenley Beck flows in a southerly/south-westerly direction in open channel and culvert throughout Earlsheaton/Chickenley. With regards to the site, the beck flows in open channel approximately 105 m (at its closest point) to the north-east of the site and 50 m (at its closest) to the south-east/south of the site. In between these points, the beck flows in culvert and at its closest point is approximately 45 m to the east/south-east of the site.

The River Calder flows predominantly in a south-easterly direction approximately 700 m to the west of the site.

Chickenley Beck outfalls into the River Calder approximately 900 m to the south-west of the site. Both watercourses are classified as main river.

An unnamed ordinary watercourse flows in an easterly direction in open channel prior to in culvert approximately 165 m to the north of the site. The watercourse flows into Chickenley Beck approximately 200 m to the north-east of the site.

The above waterbodies are shown in **Figure 1**.

2.4 Topographic Levels

A topographic survey of the site has been undertaken by MT Surveys (**Appendix B**) and LiDAR data has been used to develop a digital terrain model of the site and surrounding area as illustrated in **Figure 2**.

Site levels are shown to range between approximately 63.0 to 93.5 m AOD, with levels falling in a south-easterly direction.

Ground levels at the Town Street entrance are indicated to be circa 93.9 m AOD with levels on Providence Street ranging between 70.5 to 93.0 m AOD, with levels falling in a south-easterly direction.

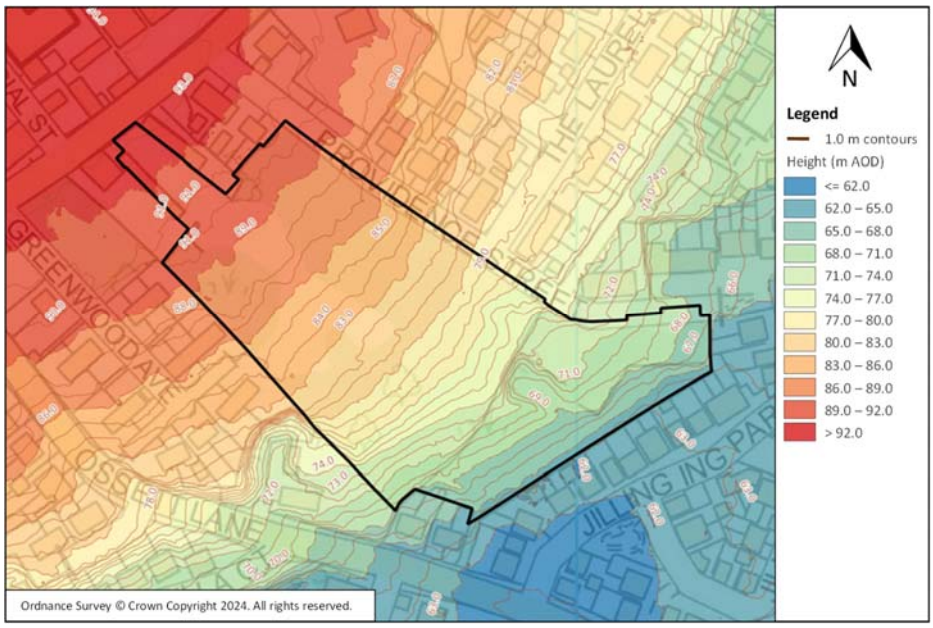

Figure 2: Digital Terrain Model from LiDAR Data

2.5 Ground Conditions

According to the Soilscapes soils dataset produced by the Cranfield Soil and AgriFood Institute[1], soil conditions at the site and within the surrounding area are described as slowly permeable loamy and clayey soils with impeded drainage.

British Geological Survey mapping of surface geology[2] indicates the underlying bedrock formation comprises sandstone (Thornhill Rock). No superficial deposits are recorded.

According to the MAGIC website[3] the bedrock geology at the site is classified as a Secondary A aquifer. The site is not shown to be located within a designated groundwater source protection zone.

1 www.landis.org.uk/soilscapes/
2 https://www.bgs.ac.uk/map-viewers/geoindex-onshore/
3 https://magic.defra.gov.uk/MagicMap.aspx

3 PLANNING POLICY AND GUIDANCE

3.1 National Planning Policy and Policy Guidance

The thrust of national planning policy, as articulated in the NPPF is that inappropriate development in areas at risk of flooding should be avoided where possible, as summarised below:

- Inappropriate development in areas at risk of flooding should be avoided and that development should be directed away from areas at highest risk (whether existing or future), but where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere (NPPF para. 165).
- The policy of seeking to steer development to areas with the lowest risk of flooding, from any source, is implemented through the application of the flood risk Sequential Test. Development should not be allocated or permitted if there are reasonably available sites, appropriate for the proposed development in areas with a lower risk of flooding. The sequential approach should be used in areas known to be at risk now or in the future from any form of flooding (NPPF para. 168).
- If it is not possible for development to be located in zones with a lower risk of flooding (taking into account wider sustainable development objectives) the Exception Test may have to be applied. The need for the test will depend on the potential vulnerability of the site and of the development proposed (as set out in Annex 3 of NPPF; also PPG Table 2) (NPPF para. 169). For example, the Exception Test need not be applied for less vulnerable development in any flood zone, or for more vulnerable development in flood zones 1 or 2.
- Where the Exception Test must be applied, application of the test for development proposals at the application stage should be informed by a site-specific flood risk assessment. For the test to be passed it should be demonstrated that: (a) the development would provide wider sustainability benefits to the community that outweigh the flood risk; (b) and the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall (NPPF para. 170). Both elements of the test should be satisfied for the development to be permitted (NPPF para. 171).
- A site-specific flood risk assessment should be provided for all development in flood zones 2 and 3 [whilst] in flood zone 1, an assessment should accompany all proposals involving: sites of 1 ha or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use (NPPF para. 173).
- Development should not increase flood risk elsewhere (NPPF para. 173).
- Development should only be allowed in areas at risk of flooding where the flood risk assessment (and the sequential and exception tests, as applicable), demonstrate that: a) within the site, the most vulnerable development is located in areas of lowest flood risk (unless there are overriding reasons to prefer a different location); b) the development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment; c) the development incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate; d) any residual (flood) risk can be safely managed; and e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan (NPPF para.173).
- Applications for some minor development and changes of use should not be subject to the sequential or exception tests (NPPF para. 174). The exceptions are stated in Footnote 60.
- Major development should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems should: a) take account of advice from the lead local flood authority; b) have appropriate proposed minimum operational standards; c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and d) where possible, provide multifunctional benefits (NPPF para. 175).

Guidance on application of the sequential and exception test is provided in the PPG - Flood Risk and Coastal Change. For example:

- The approach is designed to ensure that areas at little or no risk of flooding from any source are developed in preference to areas at higher risk. This means avoiding, so far as possible, development in current and future (i.e. taking climate change into account) medium and high flood risk areas considering all sources of flooding including areas at risk of surface water flooding (PPG para. 023).
- Where it is not possible to locate development in low risk areas, the Sequential Test should go on to compare reasonably available sites within medium risk areas and then, only where there are no reasonably available sites in low and medium risk areas, within high risk areas (PPG para. 024).
- Initially, the presence of existing flood risk management infrastructure should be ignored, as the long-term funding, maintenance and renewal of this infrastructure is uncertain. Climate change will also impact upon the level of protection infrastructure will offer throughout the lifetime of development (PPG para. 024).
- The Sequential Test should be applied to 'Major' and 'Non-major development' proposed in areas at risk of flooding, but it will not be required where; the site has been allocated for development and subject to the test at the plan making stage (provided the proposed development is consistent with the use for which the site was allocated and provided there have been no significant changes to the known level of flood risk to the site, now or in the future which would have affected the outcome of the test); the site is in an area at low risk from all sources of flooding, unless the Strategic Flood Risk Assessment, or other information, indicates there may be a risk of flooding in the future; the application is for a development type that is exempt from the test, as specified in footnote 60 of the NPPF (PPG para. 027).
- For individual planning applications subject to the Sequential Test, the area to apply the test will be defined by local circumstances relating to the catchment area for the type of development proposed. For some developments this may be clear, for example, the catchment area for a school. In other cases, it may be identified from other Plan policies. For example, where there are large areas in Flood Zones 2 and 3 (medium to high probability of flooding) and development is needed in those areas to sustain the existing community, sites outside them are unlikely to provide reasonable alternatives. Equally, a pragmatic approach needs to be taken where proposals involve comparatively small extensions to existing premises (relative to their existing size), where it may be impractical to accommodate the additional space in an alternative location. For nationally or regionally important infrastructure the area of search to which the Sequential Test could be applied will be wider than the local planning authority boundary (PPG para. 027).
- 'Reasonably available sites' are those in a suitable location for the type of development with a reasonable prospect that the site is available to be developed at the point in time envisaged for the development. These could include a series of smaller sites and/or part of a larger site if these would be capable of accommodating the proposed development. Such lower-risk sites do not need to be owned by the applicant to be considered 'reasonably available' (PPG para. 028).
- The Exception Test should only be applied as set out in Table 2 [of the PPG ("Flood Risk Vulnerability and Flood Zone Incompatibility")] and only if the Sequential Test has shown that there are no reasonably available, lower risk sites, suitable for the proposed development, to which the development could be steered (PPG para. 032).

3.2 Local Planning Policy

The Kirklees Local Plan Strategy and Policies was adopted by Kirklees Council in February 2019. The following policies are relevant in respect of flood risk and drainage:

Policy LP27: Flood Risk

Proposals for development which require a Sequential Test in accordance with national planning guidance will need to demonstrate that development has been directed to areas at the lowest probability of flooding, following a sequential risk based approach. The whole Kirklees district should be the starting point for the sequential test with applicants required to provide justification where a smaller area of search is proposed. If following application of the sequential test, there are no reasonably available sites which could accommodate the development in zones with a lower probability of flooding, it should also be demonstrated that a sequential approach has been applied within sites. This is to ensure that highly vulnerable and more vulnerable uses are

directed towards the areas of lowest flood risk within the site. Proposals will also need to demonstrate that the exception test is passed, where applicable, as set out in national planning policy.

Proposals within flood zone 3ai will be assessed in accordance with national policies relating to flood zone 3a but with all of the following additional restrictions:

- *a. no new highly vulnerable or more vulnerable uses will be permitted;*
- *b. less vulnerable uses may only be permitted provided that the sequential test has been passed and;*
  - *i. where extensions are linked operationally to an existing business or,*
  - *ii. where redevelopment of a site provides buildings with the same or a smaller footprint;*
- *c. all proposals will be expected to include flood mitigation measures such as compensatory storage which should be identified and considered through a site specific Flood Risk Assessment;*
- *d. development will not be permitted on any part of the site identified through a site specific Flood Risk Assessment as performing a functional floodplain role.*

Proposals must be supported by an appropriate site specific Flood Risk Assessment in line with national planning policy. This must take account of all sources of flooding set out in the Strategic Flood Risk Assessment and demonstrate that the proposal will be safe throughout the lifetime of the development (taking account of climate change). The proposal must also not increase flood risk elsewhere and where possible should reduce flood risk. Mitigation measures, where necessary, should be proposed.

Proposals involving building over existing culverts or the culverting or canalisation of watercourses will not be permitted unless it can be demonstrated to be in the interests of public safety or to provide essential infrastructure and that there will be no detrimental effect on flood risk and biodiversity. Where feasible, development proposals should incorporate re-opening of culverts, modification of canalised watercourses and consideration of mitigation measures to achieve a more natural and maintainable state.

Proposals for natural management such as targeted vegetation planting in upper catchments and along river banks will be supported in appropriate locations where consistent with national and local plan policies and relevant water catchment management plans to reduce flood risk and improve water quality.

Policy LP28: Drainage

The presumption is that Sustainable Drainage Systems (SuDS) will be used to assist in achieving the following on each site:

- *a. for proposals on greenfield sites, typical greenfield run-off rates should not be exceeded;*
- *b. for proposals on brownfield sites there should be a minimum 30% reduction in surface water run-off where previous positive surface water connections from the site can be proven. New connections will be subject to at least greenfield restrictions;*
- *c. No negative impact on local water quality and improvements in water quality where practicable;*
- *d. Consider whether proposed open spaces and green infrastructure within sites can contribute to the sustainable drainage of the site.*

Local conditions including the existence of critical drainage areas may require a lower run-off rate to be agreed to reflect volume control, local surface water risks, watercourse capacity and flood risk further downstream.

There will be a general presumption against pumping surface water. It must also be demonstrated that the surface water management solution is designed to meet requirements over the lifetime of the development including evidence that management and maintenance arrangements have been secured to cover that period. This includes ensuring proposals to store water meet national standards and latest best practice.

Flow paths accommodating water from outside the site or due to an exceedance event should be designed to avoid buildings and curtilages.

Development will only be permitted if it can be demonstrated that the water supply and wastewater infrastructure required is available or can be co-ordinated to meet the demand generated by the new development.

Policy LP34: Conserving and Enhancing the Water Environment

Proposals must:

1. *Ensure no deterioration of watercourses or waterbodies (including groundwater) by conserving and, where practicable, enhancing:*
    a. *the natural geomorphology of watercourses, including reinstating watercourses to their natural state through removal of modifications resulting from past industrial uses;*
    b. *water quality; and*
    c. *the ecological value of the water environment, including the functionality of habitat networks.*
2. *Ensure Source Protection Zones are protected from contamination as a result of the proposal in line with national guidance*
3. *Dispose of surface water appropriately (in accordance with the Local Plan drainage policy) adhering to the following networks in order of preference:*
    a. *to an infiltration based system wherever possible (such as soakaways);*
    b. *discharge into a watercourse with the prior approval of the landowner, navigation authority or Environment Agency, where applicable. To comply with part 1 of this policy this must be following treatment where necessary or where no treatment is required to prevent pollution of the receiving watercourse;*
    c. *discharge to a public sewer.*

Proposals are encouraged to:

4. *Make positive progress towards achieving 'good status or potential' under the Water Framework Directive in surface and groundwater bodies.*
5. *Manage water demand and improve water efficiency through appropriate water conservation techniques including rainwater harvesting and grey-water recycling as well as considering water availability from surface water and groundwater sources.*
6. *Improve water quality through the incorporation of appropriately constructed and maintained SuDS and surface water management techniques taking into account the sensitivity of groundwater.*

3.3 Drainage Technical Guidance

Non-statutory technical standards for sustainable drainage published by DEFRA in March 2015 set out how surface water runoff generated during the present day 1 in 30 and 1 in 100 AEP rainfall events and for events exceeding the present day 1 in 100 AEP event should be managed, how peak runoff rates should be restricted and how runoff volumes should be controlled.

3.4 Water Framework Directive

The Water Framework Directive (WFD) provides a legal framework for the protection, improvement and sustainable use of inland surface waters, groundwater, transitional waters, and coastal waters across England, and seeks to:

- Prevent deterioration in the status of aquatic ecosystems, protect them and improve the ecological condition of waters
- Achieve at least 'good' status for all waterbodies by 2015
- Promote the sustainable use of water as a natural resource
- Conserve habitats and species that depend directly on water
- Progressively reduce or phase out the release of individual pollutants or groups of pollutants that present a significant threat to the aquatic environment
- Progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants; and
- Contribute to mitigating the effects of floods and droughts.

The WFD applies to any proposed development which has the potential to impact on a waterbody. Where this is the case, the Environment Agency may require evidence demonstrating that the proposed development does not compromise the aims of the WFD.

4 REVIEW OF FLOOD RISK

4.1 Historical Records of Flooding

The Environment Agency Historic Flood Map[4] and Set A – Strategic Flood Risk Assessment Flood Risk Map GG and Flood Risk Map II of the 2016 Strategic Flood Risk Assessment ("Kirklees Flood Risk Map GG" and "Kirklees Flood Risk Map II") indicate that there are no records of flooding at or within the immediate vicinity of the site.

4.2 Flood Risk from Rivers (Fluvial)

The Environment Agency Flood Map for Planning (Rivers and Sea)[5] (**Figure 3**) indicates the site to be located in flood zone 1. This is reiterated on Set A – Strategic Flood Risk Assessment Flood Risk Map GG and Flood Risk Map II of the 2016 Strategic Flood Risk Assessment ("Kirklees Flood Risk Map GG" and "Kirklees Flood Risk Map II").

Table 1 of the PPG defines flood zones within the vicinity of the site as follows:

- Flood zone 1: Low Probability. Land having a less than 0.1% annual probability of river flooding
- Flood zone 2: Medium Probability. Land having between a 1% and 0.1% annual probability of river flooding
- Flood zone 3a: High Probability. Land having a 1% or greater annual probability of river flooding
- Flood zone 3b: Functional Floodplain. Land where water from rivers has to flow or be stored in times of flood. Land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively or land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as a 0.1% annual probability of flooding).

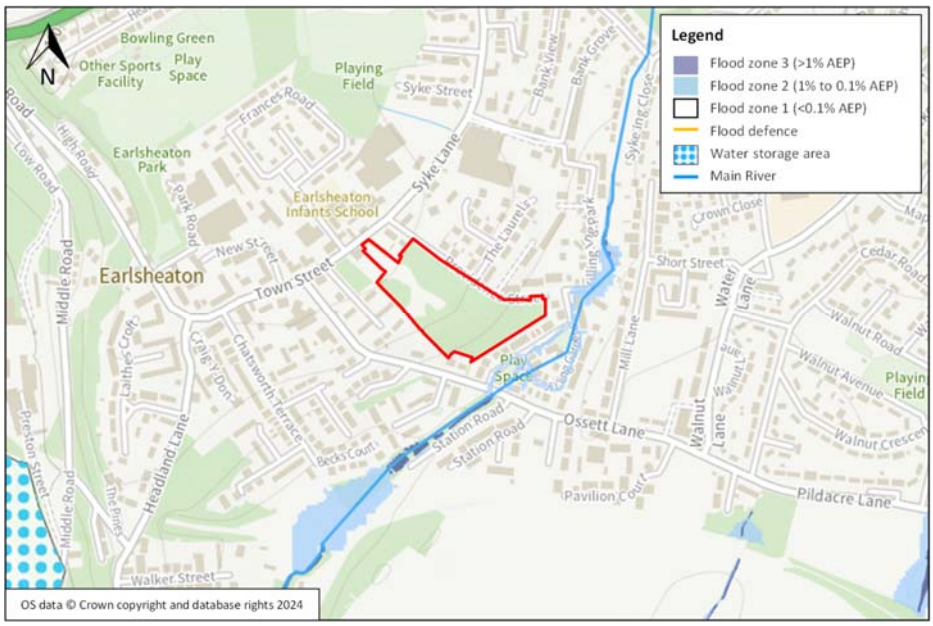

Figure 3: Flood Map for Planning
Source: gov.uk website; Accessed: August 2024

The flood zones do not take account of the possible impacts of climate change and consequent changes in the future probability of flooding. However, the development platform is a minimum of 15 m above ground

[4] https://data.gov.uk/dataset/76292bec-7d8b-43e8-9c98-02734fd89c81/historic-flood-map
[5] https://flood-map-for-planning.service.gov.uk/

levels at the extremity of the flood zone extents for Chickenley Beck. Given this, the effects of climate change are not considered to pose a risk of flooding at the site.

4.3 Flood Risk from Small Watercourses and Surface Water (Pluvial)

As detailed in **Section 2.3**, an unnamed watercourse is located approximately 165 m to the north of the site. No modelled information is available for this watercourse. The Flood Risk from Surface Water map (**Figure 4**) has therefore been utilised to assess the risk of flooding from this source as well as the risk of pluvial flooding from surface water.

The mapping indicates that the site is not at risk of flooding from small watercourses and is at a Very Low risk of flooding from pluvial surface water.

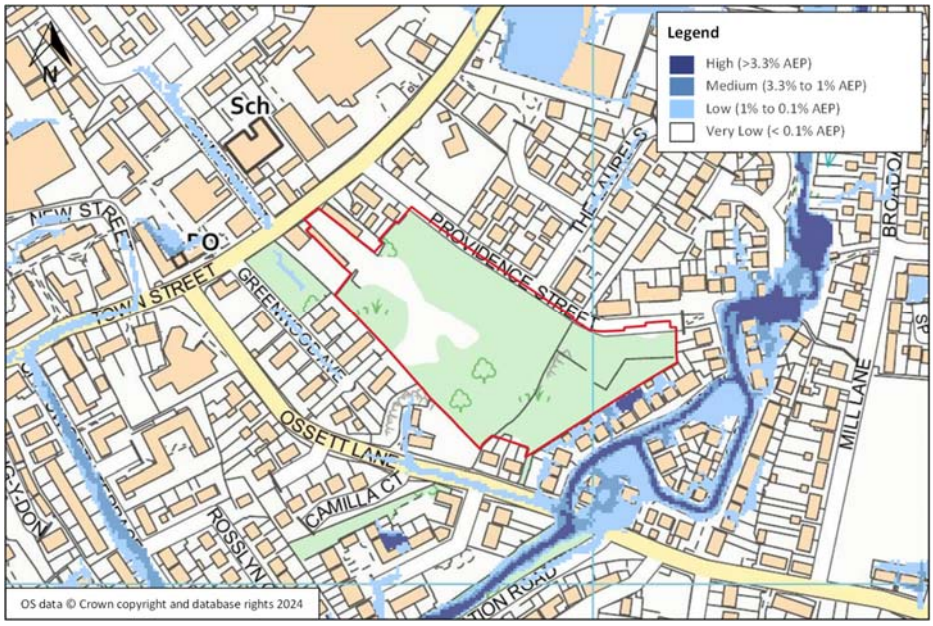

Figure 4: Flood Risk from Surface Water
Source: gov.uk website; Accessed: August 2024

4.4 Flood Risk from Reservoirs, Canals and Other Water Impounding Structures

There are no canals or other impounded waterbodies located within the immediate vicinity of the site. The Flood Risk from Reservoirs map (not shown) indicates that the site is not at risk of flooding from such sources.

4.5 Flood Risk from Groundwater

The JBA Groundwater Flood Risk Indicator map (**Figure 5**) indicates that groundwater levels at the site may be > 5.0 m bgl (defined as Very Low risk) during a 1% AEP groundwater flood event.

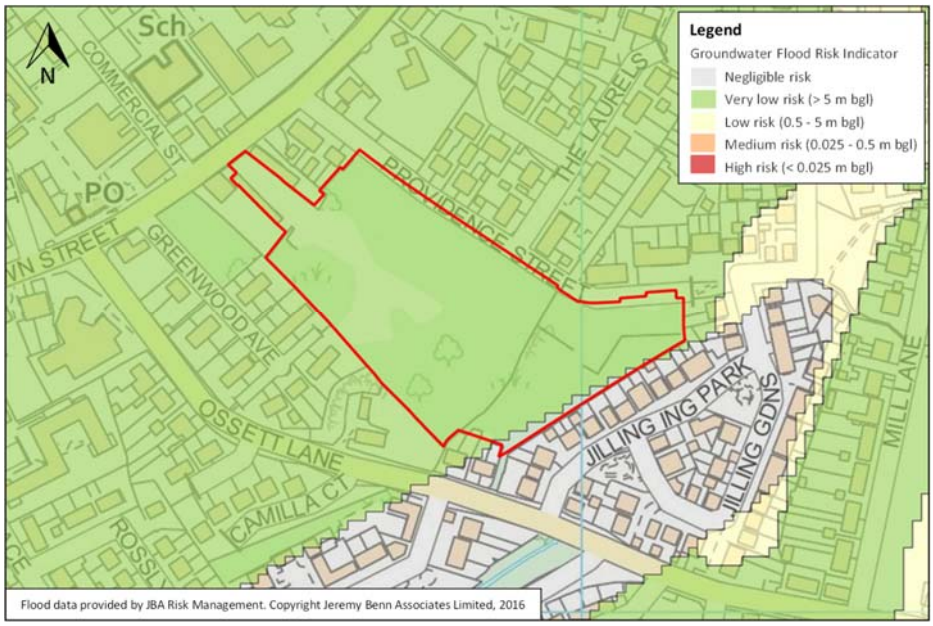

Figure 5: JBA Groundwater Flood Risk Indicator Map
Source: Blue Sky Maps; Accessed: March 2024

4.6 Flood Risk Mitigation

The risk of flooding to the proposed development from all identified sources is assessed to be low/negligible. As such, no specific flood risk mitigation measures are proposed. Notwithstanding this, finished floor levels should be at least 0.15 m above adjacent ground levels following any reprofiling of the site, with ground levels sloping down from the dwellings.

This measure will, subject to the implementation of an appropriately designed surface water drainage scheme (**Section 6**), enable any potential overland flows to be conveyed safely across the site without affecting property.

4.7 Flood Risk Elsewhere

The site is not at risk of flooding in up to a 1% AEP fluvial event including an allowance for climate change. As such the proposals would not be expected to impact flood risk elsewhere and no compensatory flood storage would need be provided on site.

4.8 Flood Risk Sequential and Exception Test

In accordance with PPG - Flood Risk and Coastal Change para. 027 application of the Sequential Test is not required where a site has been allocated for development and the proposed use is consistent with the use for which the site was allocated.

As outlined in **Section 1.2**, the site is allocated within the Kirklees Local Plan (adopted February 2019) and is located within site reference HS50 for residential development.

The Exception Test need not be applied for 'More Vulnerable' development within flood zone 1.

5 FOUL WATER MANAGEMENT

5.1 Existing Assets

An extract of the public sewer records obtained from Yorkshire Water is provided in **Appendix C**. This indicates a network of public combined sewers serving Earlsheaton including the presence of the following wastewater assets adjacent to the site:

- A 225 mm diameter public combined sewer flows in a south-westerly direction from a point adjacent to the existing access point on Town Street
- A 225 mm diameter public combined sewer flows in a north-easterly direction from a point adjacent to the existing access point on Town Street
- A 225 mm diameter public combined sewer flows in a south-easterly direction on Providence Street.

5.2 New Connections

The anticipated domestic foul loading from the site has been calculated in accordance with Design and Construction Guidance[6]. The expected total peak flow rate from the development would be 1.4 l/s.

Under the Water Industry Act (1991), developers have a right to connect foul water flows from new developments to public sewer. The Act places a general duty on sewerage undertakers to provide the additional capacity that may be required to accommodate additional flows and loads arising from new domestic development.

Yorkshire Water has advised, by way of a pre-planning sewerage enquiry response (**Appendix D**), that there is existing capacity in the local foul sewerage network to receive and treat domestic foul water from the proposed development and that foul water can discharge without restriction into the 225 mm diameter combined sewer in Providence Street.

An illustrative foul water drainage layout is provided in **Appendix E**.

[6] Sewerage Sector Guidance Appendix C, Water UK, Approved Version 2.0, March 2020

6 SURFACE WATER MANAGEMENT

6.1 Existing Assets

An extract of the public sewer records obtained from Yorkshire Water is provided in **Appendix C**. This indicates that the following assets are present adjacent to the site:

- A 150 to 300 mm diameter public surface water sewer flows in a south-easterly direction on Providence Street and discharges into Chickenley Beck
- A 225 mm diameter public surface water sewer flows in a south-westerly direction from a point adjacent to the existing access point on Town Street
- A 225 mm diameter public surface water sewer flows in a south-easterly direction on Ossett Lane and discharges into Chickenley Beck.

6.2 Surface Water Drainage at the Existing Site

The majority of the site is undeveloped greenfield. Given site topography and ground conditions, surface water runoff would be expected to infiltrate where conditions allow and flow overland in a south-easterly direction.

The far western portion of the site comprises a building, a brick setts access road and areas of gravel. Surface water runoff from the existing building and brick setts access road is indicated to be positively drained by rainwater down pipes and drainage gullies.

The site has a total developable area of 0.73 ha. For the purposes of this assessment, it is assumed that the existing building and brick setts access road will continue to drain as per the existing arrangement. The remainder of the developable area is therefore taken to be 0.69 ha. This excludes the eastern half of the site and the western corner of the site where existing woodland is to remain and will continue to drain as existing.

The greenfield surface water runoff rates for the site, calculated using the UK SuDS greenfield runoff tool are presented in **Table 1**. Details of the input parameters and the output results are provided in **Appendix F**.

Table 1: Greenfield Runoff Rate

AEP of Rainfall Event	Greenfield Runoff Rate (l/s/ha)	Greenfield Runoff Rate for 0.69 ha Site (l/s)
1 in 1	4.1	2.8
QBAR	4.7	3.2
1 in 30	8.3	5.7
1 in 100	9.9	6.8

6.3 Surface Water Drainage at the Developed Site

6.3.1 Disposal of Surface Water

In accordance with PPG - Flood Risk and Coastal Change para. 056, surface water runoff should be disposed of according to the following hierarchy: Into the ground (infiltration); To a surface water body; To a surface water sewer, highway drain, or another drainage system; To a combined sewer.

As detailed in **Section 2.5**, the site is underlain by soils with impeded drainage and as such, the disposal of surface water via infiltration is unlikely to be feasible. It is subsequently proposed to direct all runoff from the developed site to Chickenley Beck via a connection to the 225 mm diameter public surface water sewer on Providence Street.

6.3.2 Post Development Impermeable Area

Based on the site layout plan (refer to **Appendix A**), the area of impermeable surfaces within the proposed development has been estimated to be 0.41 ha i.e. 60% of the developable area.

6.3.3 Peak Flow Control

It is proposed to restrict surface water runoff to the existing greenfield QBAR rate of 1.9 l/s (i.e. 4.7 l/s/ha) post development, as outlined in **Table 1**.

Note, if the drainage system is to be adopted by Yorkshire Water (refer to **Section 6.3.9**), the minimum discharge rate will need to be increased to approximately 3.5 l/s to suit a 75 mm diameter flow control device in accordance with Yorkshire Water guidance.

6.3.4 Volume Control

As outlined within the CIRIA SuDS Manual 2015 extra runoff volumes in extreme events may be managed by releasing all runoff (above the 1 in 1 AEP event) from the site at a maximum rate of 2 l/s/ha or QBAR, whichever is the higher value.

It is therefore proposed to restrict peak discharge rates to the greenfield QBAR rate in up to the 1 in 100 AEP event, including an allowance for climate change.

6.3.5 Attenuation Storage

Attenuation storage will be provided to store surface water runoff generated across roofs and hardstanding.

The attenuation storage facility has been modelled using the Source Control module of MicroDrainage (**Appendix G**). The required storage volume has been sized to store the 1 in 100 AEP rainfall event including a 45% increase in rainfall intensity to allow for climate change in accordance with Environment Agency guidance[7].

Assuming a peak discharge rate of 1.9 l/s, a total storage volume of 297.8 m^3 would be required.

The storage volume could be accommodated within 80 m of 2.7 x 1.5 m diameter box culverts located beneath the access roads.

An illustrative surface water drainage layout is provided in **Appendix E**.

6.3.6 Urban Creep

Given that the proposed layout is illustrative, no allowance for urban creep has been applied. This would be incorporated into the design calculations when the layout is fixed.

6.3.7 Exceedance Routes

Flows resulting from rainfall in excess of the 1 in 100 AEP rainfall event including an allowance for climate change will be managed in exceedance routes. It is assumed that as the development proposals progress, the design of the site would ensure flood flows are directed towards carriageways, with the site being profiled to ensure that flood flows are directed away from built development.

6.3.8 Pollution Control

The potential for SuDS features to be utilised at the site would be investigated further at the detailed design stage. SuDS features may include for example, permeable paving, rain gardens/bioretention areas, filter drains and swales. The final level design of the site may influence the selection of SuDS, and additionally, any adoption requirements by Yorkshire Water or the local highway authority as appropriate.

It is recommended that the proposed trees adjacent to the access roads are utilised as tree pits, with runoff from the roads directed to tree pits either via dropped kerbs or gullies as appropriate. A proprietary system such as GreenBlue Urban's 'ArborFlow' system, or similar, may be utilised.

[7] Flood Risk Assessments: climate change allowances (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances)

6.3.9 Adoption and Maintenance of SuDS

The pipe network, designed in accordance with the Design and Construction Guidance[8], may be adopted by Yorkshire Water. Alternatively, the pipe network may remain private and would be maintained by a management company. SuDS elements within the curtilage of residential dwellings would be the responsibility of the owner of the property, whilst SuDS in open spaces may be maintained by a management company or Yorkshire Water if adopted.

An indicative maintenance schedule is presented in **Table 2**.

Table 2: Maintenance Requirements

Schedule	Required action	Frequency
Tree Pits		
Regular maintenance	Remove sediments, litter, surface debris and weeds	Quarterly
	Replace any plants, to maintain planting density.	As required
Occasional maintenance	Infill any holes or scour in the filter, improve erosion protection if required	
Remedial actions	Remove and replace filter and vegetation above	As required but likely to be > 20 years
Flow Control Unit		
Routine maintenance	Remove litter and debris and inspect for sediment accumulation	Six Monthly
	Remove sediment from sump	As necessary – Indicated by system inspections
Remedial actions	Replace malfunctioning parts or structures	As required
Monitoring	Inspect for evidence of poor operation	Six Monthly
	Inspect flow control unit and establish appropriate replacement frequencies	Six Monthly
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first year of operation, then every six months

[8] Design and Construction Guidance for foul and surface water sewers offered for adoption under the Code for adoption agreements for water and sewerage companies operating wholly or mainly in England ("the Code"), Approved Version 2.0, 10 March 2020

7 SUMMARY AND RECOMMENDATIONS

This report has been prepared on behalf of Precious Holdings Wakefield Ltd and relates to the proposed development of land off Providence Street, Earlsheaton for residential use.

The Environment Agency Flood Map for Planning indicates the site to be located in flood zone 1.

An assessment of flood risk from all identified potential sources of flooding has been undertaken using best available information. On the basis of the assessment, it is concluded that the site is at a negligible/low risk of flooding from all identified sources.

The site is allocated within the Kirklees Local Plan (adopted February 2019) and is located within site reference HS50 for residential development. The proposed development accords with this and as such, is considered to comply with the requirements of the Sequential Test in accordance with PPG - Flood Risk and Coastal Change para. 027.

The Exception Test need not be applied for 'More Vulnerable' development within flood zone 1. Based on the assessment of flood risk, it is concluded that no specific measures need be implemented to mitigate flood risk, although finished floor levels should be at least 0.15 m above adjacent ground levels with ground levels sloping down from the dwellings, in accordance with best practice.

The proposed development would not have an adverse impact on flood risk elsewhere.

The assessment presents a preliminary scheme for the management of surface water from the proposed development. A summary of the principal findings and proposals is provided below:

- Surface water runoff will discharge from roofs and hardstanding surfaces to Chickenley Beck via the 225 mm diameter public surface water sewer on Providence Street.
- Attenuation storage could be accommodated within 80 m of 2.7 x 1.5 m diameter box culverts located under the access roads. SuDS features such as permeable paving, rain gardens/bioretention areas/tree pits, filter drains or swales would be investigated further at the detailed design stage to provide water quality treatment.
- The pipe network within the surface water drainage system may be adopted by Yorkshire Water or maintained by a management company. SuDS elements within the curtilage of residential dwellings would be the responsibility of the owner of the property, whilst SuDS in open spaces may be maintained by a management company or Yorkshire Water if adopted.

Yorkshire Water has advised, by way of a pre-planning sewerage enquiry response that there is existing capacity in the local foul sewerage network to receive and treat domestic foul water from the proposed development and that foul water can discharge without restriction into the 225 mm diameter combined sewer in Providence Street.

In conclusion, this report demonstrates that the proposed development may be completed in accordance with the requirements of national and local planning policy.

APPENDIX A

Proposed Site Plan

NORTH

1:1000 SCALE

10m 100m

Do not scale off this drawing - Only figured dimensions to be taken from this drawing. Drawings based on Ordnance Survey and/or existing record drawings - Design and Drawing content subject to Site Survey, Structural Survey, Site Investigations, Planning and Statutory Requirements and Approvals.
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02 / ILLUSTRATIVE MASTERPLAN

jrp Architecture Planning Urban Design Landscape

CLIENT:
PRECIOUS HOLDINGS

PROJECT:
PROVIDENCE STREET
EARLSHEATON

DRAWING:
ILLUSTRATIVE MASTERPLAN

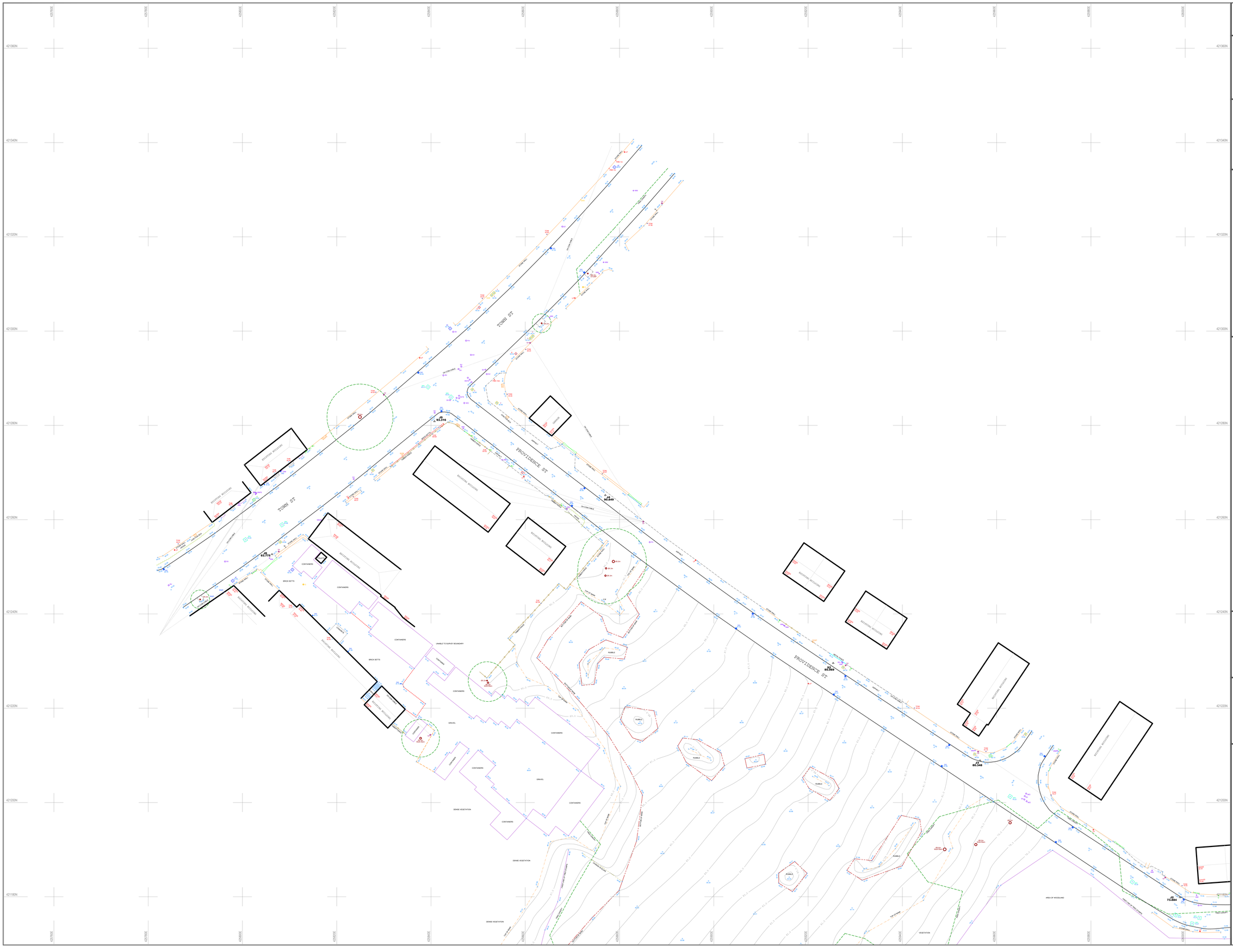
DRAWING NUMBER:
24 5721 02

SCALE @ A2:
1:1000

DRAWN:	DATE:
LB	AUG 24
CHECKED:	**DATE:**
VS	AUG 24

APPENDIX B

Topographic Survey



Notes

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Direction of North

NORTH

GRID

OS NATIONAL GRID.
Using the OS GPS Network and applying OSTN15 transformation and then removing the scale factor for true distances.

DATUM

OS LEVEL DATUM.
Using the OS GPS Network and applying OSGM15 National Geoid Model to obtain local area corrections.

STATION LISTING

Station	Easting	Northing	Level
J1	426031.115	421179.414	69.989
J2	425990.893	421179.894	73.884
J3	425956.480	421208.895	80.348
J4	425876.978	421265.196	90.849
J5	425840.731	421280.868	93.316
J6	425806.274	421252.667	93.775
B2	425925.321	421229.577	85.069

TOPOGRAPHICAL SURVEY KEY

DRAINAGE & WATER SERVICES

- DS Drain/Gully
- KO Kerb Outlet
- MH Circular Manhole
- MH Square Manhole
- MH Triangular Manhole
- RE Rodding Eye
- FH Fire Hydrant
- ST Stop Tap
- SV Stop Valve
- TAP Tap
- WO Wash Out
- WM Water Meter
- WV Water Valve
- AV Air Valve

STREET FURNITURE & GEOTEC

- MAIL Post Box
- BUS Bus Stop
- BOL Bollard
- SIGN Sign
- TL Traffic Light
- CCTV Camera
- LP Lamp Post
- LIGHT Light
- COL Column
- VENT Vent
- BM Bench Mark
- M Marker Post
- TP Trial Pit
- BH Borehole

SERVICES

- G Gas Valve
- IC Inspection Cover
- C Cable TV Cover
- C Cable TV Supply
- E Electric Cover
- EP Electricity Pole
- ER Earth Rod
- T Telecoms Cover
- TP Telegraph Pole
- GAS Gas Riser Pipe
- RWP Rainwater Pipe
- SVP Soil Vent Pipe

ABBREVIATIONS

- CL Cover Level
- IL Invert Level
- UTR Unable To Raise
- THR Threshold Level
- TOF Top Of Fence
- TOH Top Of Hedge
- TOW Top Of Wall
- UIS Underside
- WC Window Cill Level
- WH Window Head Level
- DH Door Head Level

TITLE LAYOUT

(A0-1) (A0-2)

(w) www.mtsurveys.com
(e) admin@mtsurveys.com
(t) (0)1274 408352

MT Surveys Ltd
Unit 8
Parkview Court
Shipley
BD18 3DZ

MT SURVEYS

CLIENT: ID Planning

SITE: Providence Street, Earlsheaton, Wakefield

DRAWING TITLE: 2D Topographical Survey

DRAWING REF:(LAYOUT TAB)	SCALE@A0
1120-104_2D (A0-1)	1/250
PROJECT REF: 1120-104	REV: Ø

SURVEYED	HR,JW	DRAWN	HR,JW
CHECKED	MT	DATE	14 / 05 / 2024

REV	DATE	DRAWN	DESCRIPTION	CHECKED
-	-- / -- / ----	--	--	--

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Direction of North

NORTH

GRID

OS NATIONAL GRID.
Using the OS GPS Network and applying OSTN15 transformation and then removing the scale factor for true distances.

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DRAINAGE & WATER SERVICES

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KO	Kerb Outlet
MH	Circular Manhole
MH	Square Manhole
MH	Triangular Manhole
RE	Rodding Eye
FH	Fire Hydrant
BT	Stop Tap
BV	Stop Valve
TAP	Tap
WO	Wash Out
WM	Water Meter
WV	Water Valve
AV	Air Valve

STREET FURNITURE & GEOTEC

MAIL	Post Box
BUS	Bus Stop
BOL	Bollard
SIGN	Sign
TL	Traffic Light
CCTV	Camera
LP	Lamp Post
LIGHT	Light
COL	Column
	Vent
BM	Bench Mark
M	Marker Post
	Trial Pit
BH	Borehole

SERVICES

G	Gas Valve
IC	Inspection Cover
C	Cable TV Cover
C	Cable TV Supply
E	Electric Cover
EP	Electricity Pole
ER	Earth Rod
T	Telecoms Cover
TP	Telegraph Pole
GAS	Gas Riser Pipe
RWP	Rainwater Pipe
SVP	Soil Vent Pipe

ABBREVIATIONS

CL	Cover Level
IL	Invert Level
UTR	Unable To Raise
THR	Threshold Level
TOF	Top Of Fence
TOH	Top Of Hedge
TOW	Top Of Wall
UIS	Underside
WC	Window Cill Level
WH	Window Head Level
DH	Door Head Level

TITLE LAYOUT

(A0-1) (A0-2)

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MT Surveys Ltd
Unit 8
Parkview Court
Shipley
BD18 3DZ

CLIENT: ID Planning

SITE: Providence Street, Earlsheaton, Wakefield

DRAWING TITLE: 2D Topographical Survey

DRAWING REF:(LAYOUT TAB)	SCALE@A0
1120-104_2D (A0-2)	1/250

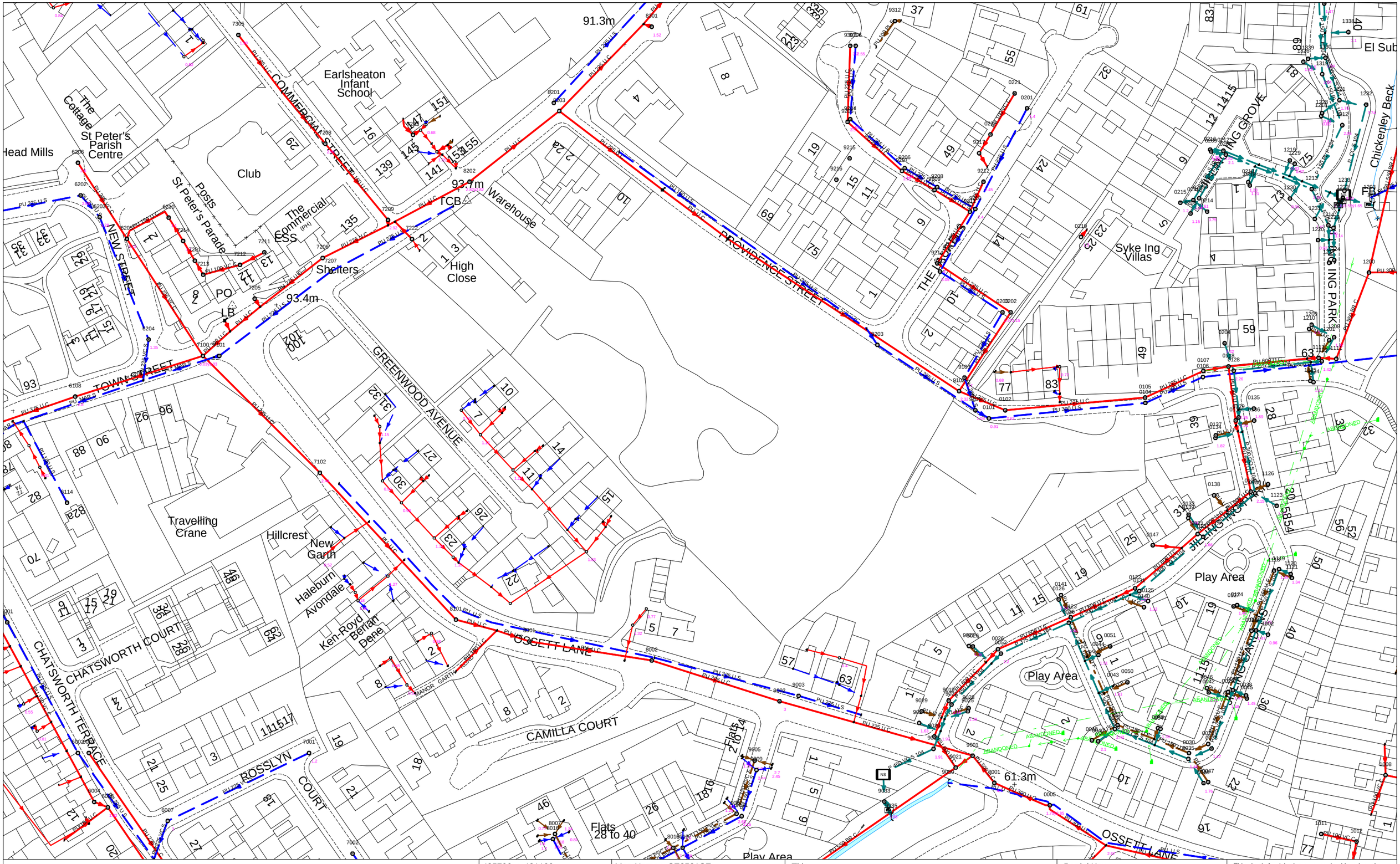
PROJECT REF	REV
1120-104	Ø

SURVEYED	HR,JW	DRAWN	HR,JW
CHECKED	MT	DATE	14 / 05 / 2024

REV	DATE	DRAWN	DESCRIPTION	CHECKED
-	-- / -- / ----	--	--	--

APPENDIX C

Yorkshire Water Public Sewer Record



425796 : 421109	Map Name : SE2521SE	Title	Partial Key
	Notes		Foul Sewer = F Combined Sewer = C Surface Water Sewer = SW Trade Sewer = TD Partially Separate = PS
YorkshireWater	Yorkshire Water, PO Box 500, Halifax Road, Bradford BD6 2LZ Contact Name : YorMap Advisor C ROBERTS Contact Tel : 87 2582	(Ody) COPYRIGHT STATEMENTS: Reproduced by permission of Ordnance Survey on behalf of HMSO © Crown copyright and database 2014. All rights reserved Ordnance Survey Licence number 100022432	Date Req : 12/08/2024, 09:36:20 Source : Sewer Network Enquiry

This plan is furnished as a general guide only and no warranty as to its correctness is given or implied. This plan must not be relied upon in the event of excavations or other works made in the vicinity of public sewers. No house or property connections are shown.

Date Gen : 12/08/2024, 09:43:41

UPN: Undefined Originator: C ROBERTS, YorMap, 87 2582

APPENDIX D

Yorkshire Water Pre-Planning Enquiry

YorkshireWater

Ms K Bonser
Weetwood Services Ltd
22C Josephs Well
Hanover Walk
Leeds
LS3 1AB

Yorkshire Water Services
Developer Services
Pre-Development Team
PO BOX 52
Bradford
BD3 7AY

Tel: 0345 120 8482

Email:
technical.sewerage@yorkshirewater.co.uk

For telephone enquiries ring:
Chris Roberts on 0345 120 8482

Your Ref:
Our Ref: A003679

12th August 2024

Dear Mr Bonser,

Land off Providence Street, Earlsheaton, Dewsbury, WF12 8HZ- Pre-Planning Sewerage Enquiry V570538

Thank you for your recent enquiry and remittance. Our official VAT receipt has been sent to you under separate cover. Please find enclosed a complimentary extract from the Statutory Sewer Map which indicates the recorded position of the public sewers. Please note that as of October 2011 and the private to public sewer transfer, there are many uncharted Yorkshire Water assets currently not shown on our records.

The following comments reflect our view, with regard to the public sewer network only, based on a 'desk top' study of the site and are valid for a maximum period of twelve months:

Development of the site should take place with separate systems for foul and surface water drainage. The separate systems should extend to the points of discharge to be agreed.

Foul Water

Foul water domestic waste can discharge to the 225 mm diameter public combined sewer recorded in Providence Street, at a point to the northwest of the site.

This permission is not an acceptance in respect to any planning conditions imposed under the Grant of Planning Permission.

Surface Water

As soakaways will not be viable curtilage surface water may discharge to the 225 mm diameter public surface water sewer recorded in Providence Street, at a point to the northwest of the site.

The surface water discharge from the site to be restricted to not greater than the proposed 1.9 (one point nine) litres/second.

This permission is not an acceptance in respect to any planning conditions imposed under the Grant of Planning Permission.

Please note further restrictions on surface water disposal from the site may be imposed by other parties. You are strongly advised to seek advice/comments from the Environment Agency/Land Drainage Authority/Internal Drainage Board, with regard to surface water disposal from the site.

Other Observations

Any new connection to an existing public sewer will require the prior approval of Yorkshire Water. You may apply on line or obtain an application form from our website - https://www.yorkshirewater.com/developers/sewerage/sewerage-connections/

Prospectively adoptable sewers and pumping stations must be designed and constructed in accordance with the Code for Adoption 2024/25, pursuant to an agreement under Section 104 of the Water Industry Act 1991. We are happy to offer pre-development technical advice on any prospective sites that you would like to put forward for adoption, prior to submission of your adoption application.

An application to enter into a Section 104 agreement must be made in writing prior to any works commencing on site. Please contact our Sewer Adoption, Diversion and Requisition (telephone 0345 120 84 82) or email technical.sewerage@yorkshirewater.co.uk or visit - https://www.yorkshirewater.com/developers/sewerage/sewer-adoptions/ for further information.

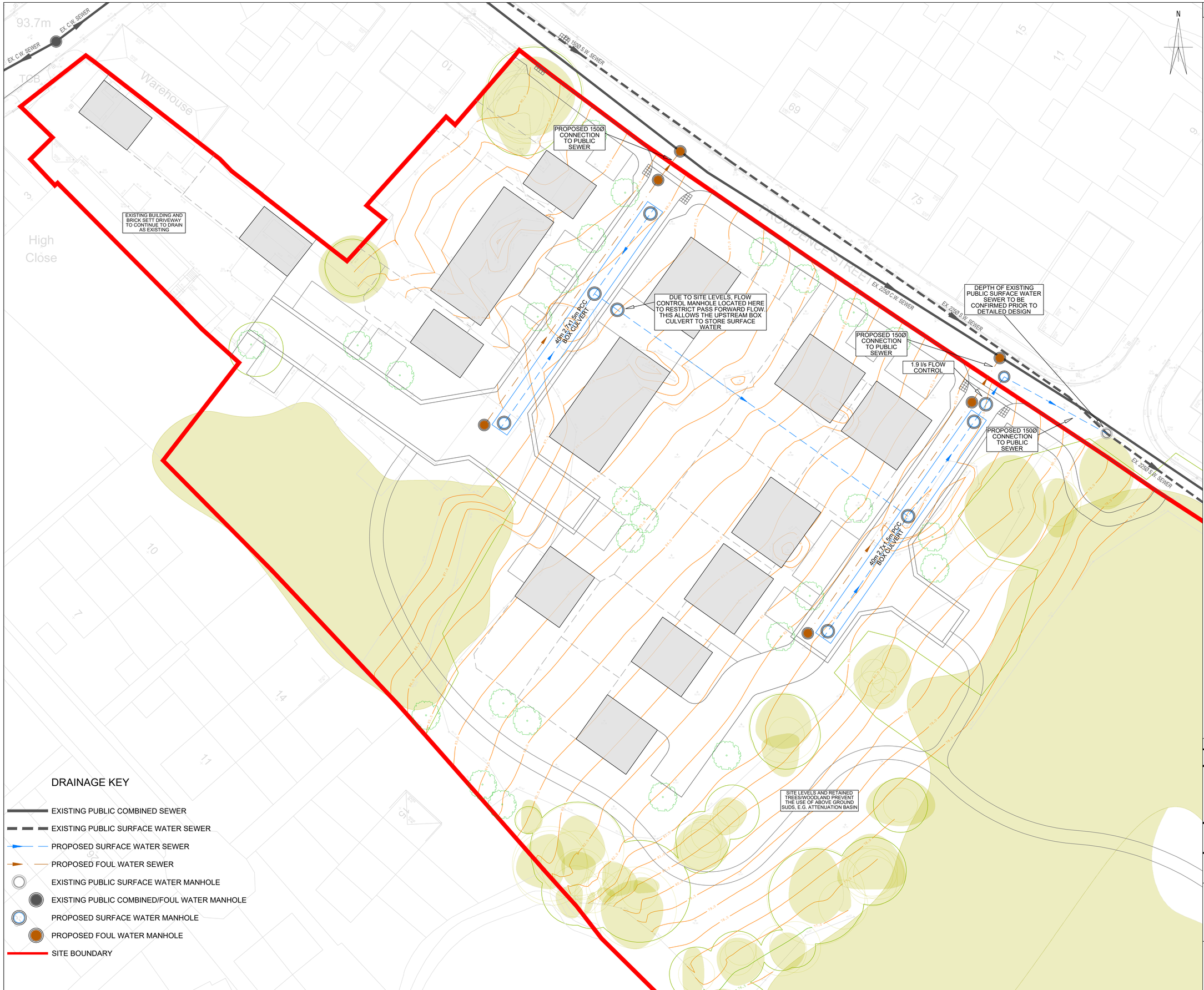
All the above comments are based upon the information and records available at the present time and is subject to formal planning approval agreement. The information contained in this letter together with that shown on any extract from the Statutory Sewer Map that may be enclosed is believed to be correct and is supplied in good faith. Please note that capacity in the public sewer network is not reserved for specific future development. It is used up on a 'first come, first served' basis. You should visit the site and establish the line and level of any public sewers affecting your proposals before the commencement of any design work.

Yours sincerely

Chris Roberts
Town Planning Technician
Land & Property
For any Pre-Planning correspondence please email -
technical.sewerage@yorkshirewater.co.uk
For any Planning correspondence please email -
planningconsultation@yorkshirewater.co.uk

APPENDIX E

Illustrative Drainage Layout



NOTES

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT WEETWOOD DRAWINGS.
2. PROPOSED SITE LAYOUT TAKEN FROM JRP 'ILLUSTRATIVE MASTERPLAN' DRAWING (REF: 24 5721 02, AUG 2024).
3. EXISTING LEVEL INFORMATION TAKEN FROM MT SURVEYS 'TOPOGRAPHIC SURVEY' DRAWING (REF: 1120-104, MAY 2024).
4. EXISTING DRAINAGE INFORMATION TAKEN FROM YORKSHIRE WATER SEWER RECORDS, AUG 2024.

DRAINAGE KEY

- EXISTING PUBLIC COMBINED SEWER
- EXISTING PUBLIC SURFACE WATER SEWER
- PROPOSED SURFACE WATER SEWER
- PROPOSED FOUL WATER SEWER
- EXISTING PUBLIC SURFACE WATER MANHOLE
- EXISTING PUBLIC COMBINED/FOUL WATER MANHOLE
- PROPOSED SURFACE WATER MANHOLE
- PROPOSED FOUL WATER MANHOLE
- SITE BOUNDARY

REV	DATE	DESCRIPTION	DRAWN	CHECK
P1	19.08.24	INITIAL ISSUE	DSH	TB

Weetwood
Development • Planning • Environment
Park House, Ffordd Bynwr Gwair, Mold CH7 1FQ
Tel 01352 700045
info@weetwood.net
www.weetwood.net

Client
PRECIOUS HOLDINGS WAKEFIELD LTD

Drawing Status: PLANNING	Date: AUG 24
	Scale (A1): 1:250
Project: LAND OFF PROVIDENCE STREET, EARLSHEATON	Drawn: DSH
	Checked: TB
	Project No: 6173
Title: ILLUSTRATIVE DRAINAGE LAYOUT	Drawing No: 104
	Revision: P1

THIS DRAWING MUST BE READ IN CONJUNCTION WITH THE SPECIFICATION AND ALL OTHER RELEVANT DRAWINGS. DO NOT SCALE FROM THIS DRAWING.

APPENDIX F

Greenfield Runoff Calculations

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Keely Bonser
Site name:	6173 Providence Street
Site location:	Earlsheaton

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:	53.68616° N
Longitude:	1.60887° W
Reference:	1210811580
Date:	Mar 27 2024 12:20

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 1

Methodology

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

Soil characteristics

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

Hydrological characteristics

	Default	Edited
SAAR (mm):	689	689
Hydrological region:	3	3
Growth curve factor 1 year:	0.86	0.86
Growth curve factor 30 years:	1.75	1.75
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	4.74	4.74
1 in 1 year (l/s):	4.08	4.08
1 in 30 years (l/s):	8.29	8.29
1 in 100 year (l/s):	9.86	9.86
1 in 200 years (l/s):	11.23	11.23

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 G

Surface Water Attenuation - Storage Volume Calculation

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	78.163	0.663	1.4	107.5	O K
30 min Summer	78.326	0.826	1.4	142.8	O K
60 min Summer	78.503	1.003	1.5	181.2	O K
120 min Summer	78.632	1.132	1.6	209.1	O K
180 min Summer	78.705	1.205	1.7	224.9	O K
240 min Summer	78.753	1.253	1.7	235.3	O K
360 min Summer	78.812	1.312	1.7	248.0	O K
480 min Summer	78.841	1.341	1.7	254.3	O K
600 min Summer	78.855	1.355	1.8	257.2	O K
720 min Summer	78.859	1.359	1.8	258.1	O K
960 min Summer	78.850	1.350	1.8	256.2	O K
1440 min Summer	78.804	1.304	1.7	246.4	O K
15 min Winter	78.224	0.724	1.4	120.5	O K
30 min Winter	78.407	0.907	1.5	160.2	O K
60 min Winter	78.606	1.106	1.6	203.6	O K
120 min Winter	78.754	1.254	1.7	235.6	O K
180 min Winter	78.839	1.339	1.7	253.9	O K
240 min Winter	78.897	1.397	1.8	266.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	141.888	0.0	109.0	23
30 min Summer	94.693	0.0	111.1	38
60 min Summer	60.687	0.0	186.6	68
120 min Summer	35.733	0.0	219.8	126
180 min Summer	26.108	0.0	239.1	186
240 min Summer	20.866	0.0	242.0	246
360 min Summer	15.185	0.0	245.2	364
480 min Summer	12.086	0.0	247.5	484
600 min Summer	10.118	0.0	249.6	602
720 min Summer	8.748	0.0	251.6	722
960 min Summer	6.957	0.0	255.6	960
1440 min Summer	5.038	0.0	258.0	1232
15 min Winter	141.888	0.0	111.7	23
30 min Winter	94.693	0.0	111.9	37
60 min Winter	60.687	0.0	209.0	66
120 min Winter	35.733	0.0	241.2	124
180 min Winter	26.108	0.0	245.2	184
240 min Winter	20.866	0.0	248.2	242

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
360 min Winter	78.971	1.471	1.8	281.8	O K
480 min Winter	79.012	1.512	1.8	290.2	O K
600 min Winter	79.037	1.537	1.9	294.9	O K
720 min Winter	79.051	1.551	1.9	297.2	O K
960 min Winter	79.054	1.554	1.9	297.8	O K
1440 min Winter	79.011	1.511	1.8	290.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
360 min Winter	15.185	0.0	253.4	358
480 min Winter	12.086	0.0	258.2	474
600 min Winter	10.118	0.0	262.5	590
720 min Winter	8.748	0.0	265.6	704
960 min Winter	6.957	0.0	269.3	928
1440 min Winter	5.038	0.0	270.6	1356

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 425903 421189 SE 25903 21189
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	1440
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.410

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.210	4	8	0.200

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Model Details

Storage is Online Cover Level (m) 80.000

Pipe Structure

Diameter (m) Conduit Section Length (m) 80.000
Slope (1:X) 500.000 Invert Level (m) 77.500

Section Number 20 Minor Dimn (mm) 1500 4 * Hyd Radius (mm) 2.006
Conduit Type [] Side Slope (Deg) 90.0 XSect Area (m²) 3.949
Major Dimn (mm) 2700 Corner Splay (mm) 225

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0058-1900-1600-1900
Design Head (m)	1.600
Design Flow (l/s)	1.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	58
Invert Level (m)	77.500
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	1.9	Kick-Flo®	0.520	1.1
Flush-Flo™	0.255	1.4	Mean Flow over Head Range	-	1.4

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.2	1.200	1.7	3.000	2.5	7.000	3.7
0.200	1.4	1.400	1.8	3.500	2.7	7.500	3.9
0.300	1.4	1.600	1.9	4.000	2.9	8.000	4.0
0.400	1.3	1.800	2.0	4.500	3.1	8.500	4.1
0.500	1.2	2.000	2.1	5.000	3.2	9.000	4.2
0.600	1.2	2.200	2.2	5.500	3.3	9.500	4.3
0.800	1.4	2.400	2.3	6.000	3.5		
1.000	1.5	2.600	2.4	6.500	3.6		

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