Project Title

Flood Risk Assessment
& Outline Drainage Strategy

At

Former Lilley Stone School
London Road
Newark
NG24 1TW

For

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Paul Graveney Consulting Ltd

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Table 1 – Flood Risk Summary

Item	Brief Description
Tidal	The development site is not influenced by Tidal flood risk.
Fluvial (Watercourse)	The development site is located in low-risk Flood Zone 1.
Surface (Overland Flood Flow)	The development site is predominantly at 'very low risk' of surface flooding with isolated areas at 'low risk'.
Existing Sewers & New Drainage	There are existing combined water sewers located within the adopted highways to both the north and south of the site. New drainage serving the development site to be designed in line with local and national guidance. Any exceedance flooding located away from the new dwellings to the highways and soft landscaping areas.
Groundwater	No indication through SFRA that site is at risk of groundwater flooding.
Artificial Sources	No artificial sources in close proximity.
Minimum Finished Floor Level	At or above existing ground levels.

Table 2 – Drainage & SuDS Summary

Item	Brief Description
Geology	No formal site investigation has been undertaken at this time. A review of the BGS boreholes has indicated that the site is underlain by Topsoil / made ground over Sand and Gravel.
Infiltration Rate	Infiltration techniques considered viable option for the discharge of surface water from the site. At this time and in advance of formal testing, a rate of $5x10^{-5}$ m/s to be used in the outline design.
Nearest Watercourses	The nearest watercourse is the River Trent which lies circa 500m to the north west of the site.
Nearest Adopted Sewers	No adopted sewers identified from the Severn Trent Water sewer records to exist within the site boundary. There are however a number of combined water sewers are in close proximity to the site to both the north and south. No surface water sewers in close proximity.

Item	Brief Description
Existing Discharge Rates and Outfall Location	Site can be classed for drainage purposes as both brownfield and greenfield, with brownfield areas to north draining to the STW sewer network and greenfield areas to the south draining to the ground. Brownfield Site Area 0.9ha: 1yr – 75 l/s (30mm/hr) 30yr – 162.5 l/s (65mm/hr) 100yr – 237.5 l/s (95mm/hr) Greenfield Area 3.45ha: 1yr – 8.1 l/s Qbar – 9.8 l/s 30yr – 19.2 l/s 100yr – 25.2 l/s
Proposed Surface Water Outfall and SuDS Hierarchal Approach	Surface water generated from the new impermeable areas of the development will be directed to two large infiltration tanks located in the new public open spaces to the north and south of the site.
Proposed Discharge Rate	$5x10^{-5}$ m/s Infiltration rate and FoS of 5.
Allowance for Climate Change	40% - based on a >100-year design life to 'the 2100's'.
Proposed Attenuation Method and Outline Volume	Two large geocellular infiltration tanks. Circa 1,617m^3 to contain the 100-year + 40% peak event.
SuDS features	Water Butts, permeable paving, geocellular infiltration tanks.
Maintenance Responsibility	Property Owners, sewerage authority and highways authority.
Foul Drainage Outfall	Foul drainage to discharge into the existing combined water sewers in London Road to the north and Harewood Avenue to the south of the site. Due to the levels of the public sewers in relation to the site, a new onsite adopted foul pumping station is proposed.

1.0 Introduction

1.1 PG Consulting (PGC) has been appointed by Bildurn Properties Ltd to prepare this Flood Risk Assessment and Outline Drainage Strategy to support a Hybrid planning application seeking full permission for the demolition of existing buildings, conversion of 3 no. retained heritage buildings to provide 32 apartments, retention of one dwelling and erection of 35 new dwellings including access, parking and landscaping; and outline planning permission of the erection of up to 67 new dwellings (all matters reserved except access), on land south east of Newark, situated on land off London Road, Newark, NG24 1TW. The assessment has been undertaken in line with Section 10 of the 'National Planning Policy Framework' plus the accompanying Technical Guidance on Flood Risk.

1.2 This Flood Risk Assessment (FRA) has been commissioned by Bildurn Properties Ltd and is specific to their interests in the development proposals as described by the Architectural plan in Appendix A. This report may not be assigned.

1.3 The report has been commissioned to identify any flood related issues associated with the proposed developments and any likely constraints that could be imposed plus to consider the outline drainage strategy for it. The following issues have been suggested by the Environment Agency (EA), Severn Trent Water (STW) & Newark and Sherwood District Council acting as Lead Local Flood Authority (LLFA), and subsequently addressed within this report.

- Identify available data relating to flood risk at the site.
- Determine whether the site is at risk from flooding from all sources, including but not exhaustive, from breach or overtopping of any existing flood defenses, watercourse flooding, surface water flooding and/or ground water flooding.
- If at risk from any source, devise appropriate measures to prevent flood risk whilst not compromising the flood risk elsewhere.
- Determine the current surface water drainage regime and assess impacts as a result of the proposed development.
- Discuss if required Sustainable Drainage Systems (SuDS) as an option for reducing surface water flood risk.
- Determine any potential increase in surface water peak runoff and volume as a result of the proposed development.
- Devise an appropriate outline surface water drainage strategy to deal with any increase in surface water runoff and include for climate change.
- Consider the recommendations of Newark and Sherwood District Council Strategic Flood Risk Assessment (SFRA) and the Newark and Sherwood District Council Flood Risk Management Strategy Document.
- Prepare the Flood Risk Assessment and Outline Drainage Strategy report.
- Assess mitigation measures & off-site impacts and define any residual risks.

2.0 Development Description and Location

2.1 Site Location

The site is referenced in Table 33, and a site location map is provided in Appendix A.

Table 3: Site Referencing Information

Item	Brief Description
Site name	Former Lilley Stone School
Site address and location	London Road, Newark, NG24 1TW
Council Area	Newark and Sherwood District Council
Approximate Grid Reference	OS: 479879, 353575
General Locality	The development is located on the outskirts of Newark Town centre on the south eastern periphery.

2.2 Existing site Description

2.2.1 The proposed development site is irregular in plan shape and encompasses the former Lilley and Stone School that has been left empty for a number of years. The school buildings make up the northern part of the site leading off London Road with the southern areas encompassing the school playing fields.

2.2.2 Newark Tennis Club is located to the south east of the site with vehicular access through eastern edge of the school from London Road.

2.2.3 The school site is bounded by London Road to the north and north east, residential dwellings to the east, and commercial and retail units to the west of the proposed development.

2.2.4 Figure 1 below identifying the existing site location. Further details of the existing layouts can be seen on the Red Line Plans in Appendix A.

Figure 1: Location Plan (© Google 2023)

2.3 Topography

2.3.1 A full topographical survey of the development site has been undertaken. The site is generally very flat with levels varying from 16.5m AOD in the north adjacent London Road up to circa 17.2m AOD in the south west of the site adjacent Harewood Avenue. Full details can be found on the Topographical survey in Appendix B.

2.4 Local Hydrology

2.4.1 The River Trent is located 500m north west of the site beyond the town centre and flows in a south westerly direction. No other ditches or watercourses have been identified in close proximity to the site.

3.0 Planning Policy and Consultation

3.1 National Planning Policy Framework

3.1.1 The indicative flood maps provided by the Environment Agency locate the development boundary within Flood Zone 1 i.e. land defined as having an annual probability of fluvial flooding of less than 1 in 1000 (<0.1%) in any year. As a requirement of the new NPPF (2022), Annex D, the proposed development must satisfy the requirements of the Sequential Test and where applicable the Exception Test.

3.1.2 Sequential Test:

Under the NPPF (2022), Flood Zone 1, where the development area is located is defined as low probability flood risk. The proposed development is for residential end use, which in line with Table 2 is classified as 'More Vulnerable'.

3.1.3 Placing both these criteria into Table 3 (Flood Risk Vulnerability and Flood Zone 'Compatibility'), More Vulnerable development in Flood Zone 1 determines that the 'Development is Appropriate', the sequential test is passed and that the Exception Test is not applicable to this development proposal.

3.2 Strategic Flood Risk Assessment (SFRA)

3.2.1 SFRAs assess the risk associated with all types of flooding and provide the information required to identify the amount of development permitted in an area, how drainage systems in the area should function and also how risks in vulnerable areas can be reduced and/or mitigated. The NPPF states that regional planning bodies (RPB's) or Local Planning Authorities should prepare SFRA's in consultation with the EA.

3.2.2 The development sits within the coverage of the Newark and Sherwood District Council Level 2 SFRA Final Report dated February 2020. The published SFRA identifies current and future broad scale flood related issues. The purpose of the SFRA is to assess and map all known sources of flood risk including fluvial, surface water, sewer, groundwater and all impounded water bodies, taking into account future climate change predictions.

3.2.3 A summary of the main elements from the SFRA associated with the district is detailed below. The full report can be obtained from the Newark and Sherwood District Council website.

SFRA provides a detailed understanding of flood risks across the borough from all sources.
The main source of flooding is fluvial from the River Tent to the north west of the site.
Surface water flooding is deemed a very low flood risk with isolated areas at low flood risk.
Development should seek to manage runoff rates and volumes to the receiving surface water drainage system in order to reduce the flood risk to downstream areas.
Development should be designed so that there is no flooding to the development in a 1 in 30-year event and so that there is no property flooding in a 1 in 100 year plus climate change event.
For all sites, development proposals should look at opportunities to incorporate SuDS to reduce the risk of surface water flooding.

All proposed developments must ensure that foul and surface water are kept separate.
Full sequential and exception tests to be carried out (where applicable).
Follow all local and national policy.
Flood Resilient construction to be used where applicable.
Safe dry access and egress to be assured.

3.3 Consultation

3.3.1 Severn Trent Water (STW)

At the time of writing a predevelopment enquiry has not been submitted to STW.

4.0 Definition of Flood Hazard

4.0.1 The NPPF guidelines require the developer to assess the impact of the proposed development runoff on the downstream catchment in conjunction with assessing the risk of runoff from the surrounding area on the proposed development layout.

4.0.2 In the following sections the flood risk to the site from all sources will be assessed. As the site will restrict the surface water runoff there is no increased flood risk to the downstream network.

4.1 Sources of information

4.1.1 The following section defines the flood risk receptors and anticipated flood risk. Table 4 defines the main sources of information used in the identification of flood risk.

Table 4: Sources of information used in the identification of flood risk

Source of Information	Details
Environment Agency	Flood Map from EA website
Severn Trent Water	Sewer Records
Newark and Sherwood District Council	SFRA Report & Various Maps

4.2 Flooding from Sea (Tidal) and River (Fluvial)

4.2.1 The site is not located near the sea or a tidally influenced watercourse, therefore the risk of tidal flooding is deemed to be VERY LOW.

4.2.2 The National Planning Policy Framework (NPPF) categorises flood risk as follows:

Zone 1 (low probability) – Land assessed as having less than a 1 in 1,000 annual probability of river or sea flooding (<0.1%);

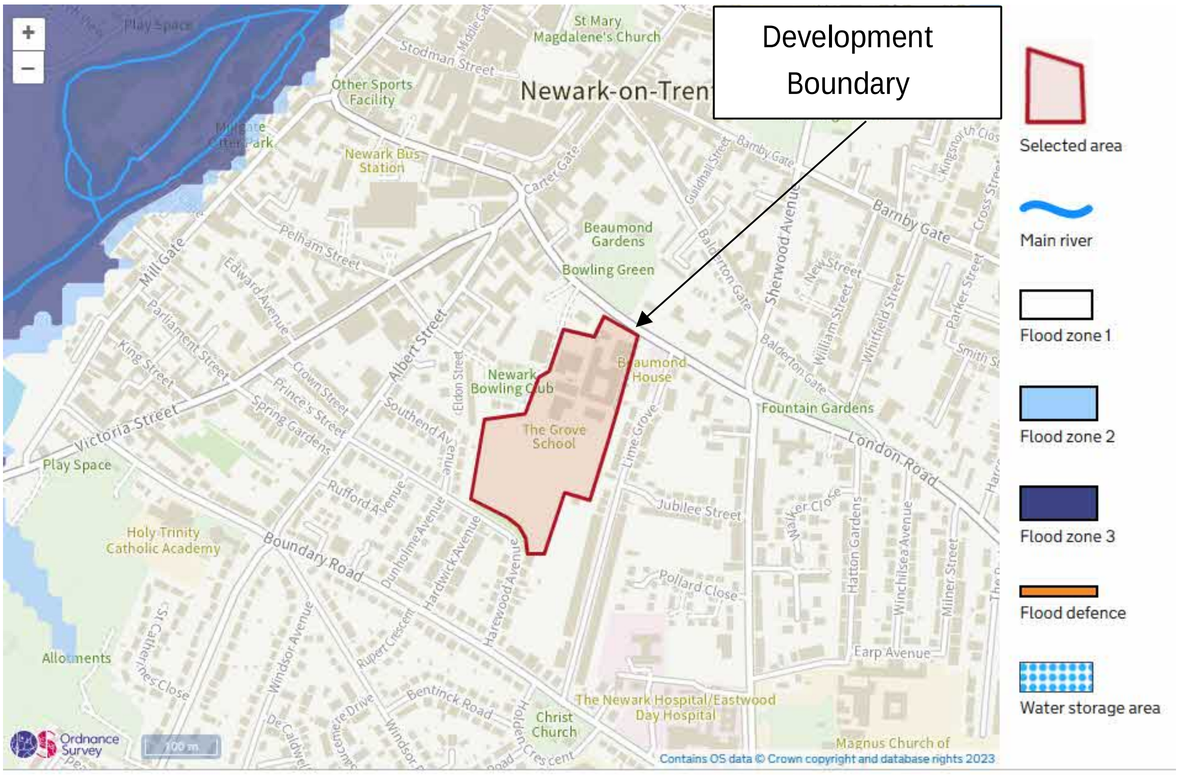
Zone 2 (medium probability) – Land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year; and

Zone 3a (high probability) - Land assessed as having a 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 The Functional Floodplain - This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the EA. (Not separately distinguished from Zone 3a on the Flood Map).

4.2.3 Figure 2 below locates the site on the Environment Agency's indicative floodplain map. It is clear from this that the red line boundary sits outside of a fluvial generator of flood water from any identified waterbody or river and thus located in LOW RISK Flood zone 1, i.e. land defined as having an annual probability of fluvial flooding of less than 1 in 1000 (<0.1%) in any year. The risk from fluvial flood water therefore reduces to acceptable levels and thus does not require further assessment.

Figure 2 – The EA's Indicative 100-year Fluvial Floodplain Map



4.3 Flooding from Land and Surface Waters (Overland Flow)

4.3.1 The EA descriptions for the High, Medium and Low risk scenarios for surface water flooding are as follows:

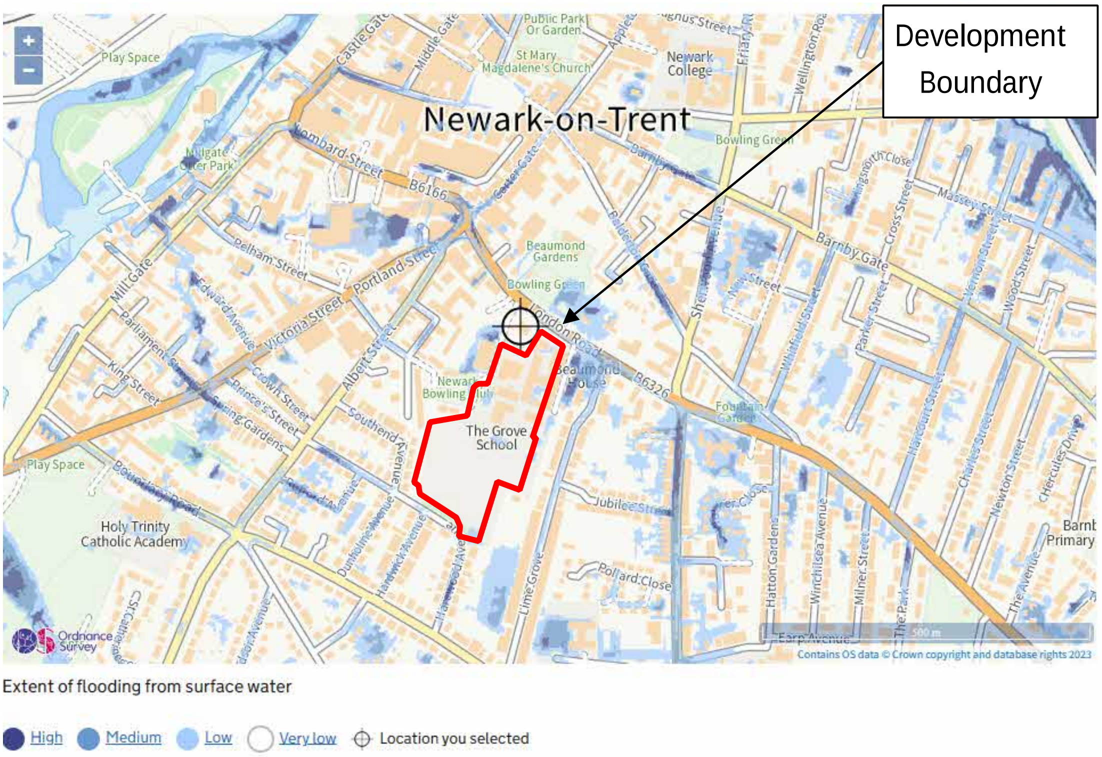
High risk means that each year this area has a chance of flooding of greater than 3.3%.
Medium risk means that each year this area has a chance of flooding of between 1% and 3.3%.
Low risk means that each year this area has a chance of flooding of between 0.1% and 1%.
Very Low risk means that each year this area has a chance of flooding of less than 0.1%.

4.3.2 The Environment Agency's surface water flood maps (refer to Figure 3) show the majority of the site area at very low risk of surface water flooding. There are isolated areas shown as low risk which are likely to be associated with topographical low points and would indicate that the site is currently subject to localised ponding as a result of the topography.

4.3.3 There are no existing surface water flow routes through the site that would need to be maintained. As part of the proposed development the levels across the development will ensure that all low points are located away from buildings, thus posing a low risk. The new surface water drainage will also be designed and installed in accordance with the latest guidance and climate change allowances to ensure no surface water ponding will occur.

4.3.4 Based on this assessment, the site can be considered at LOW RISK from surface water flooding.

Figure 3 – Extract EA Flood Risk Mapping - Flood Risk from Surface Water

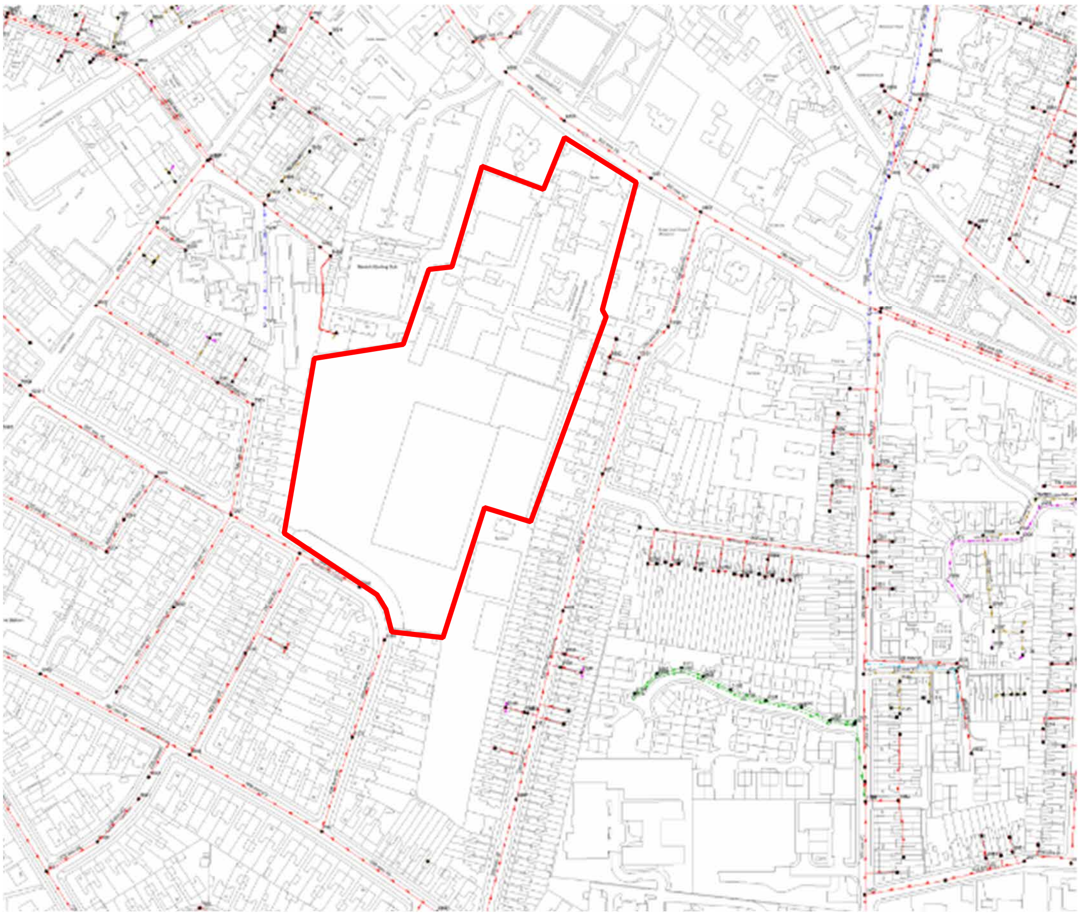


4.4 Flooding from Sewers and Private Drainage

4.4.1 The Severn Trent Water (STW) sewer records have been reviewed (see figure 4 below and Appendix E) and confirm that there are no existing sewers passing through the site. Beyond the site boundary the sewer records confirm that are a number of public sewers within the vicinity of the site. There is a 300mm combined water sewer in London Road to the north of the site, flowing in a south easterly direction. There is also a 225mm combined water sewer to the south of the site, in Harewood Avenue flowing in a north westerly direction.

4.4.2 The STW adopted sewers and private drainage networks serving the surrounding district ensures that the development footprint is protected from the impact of both upstream and downstream runoff. It is speculated that complete protection may well exist beyond a storm event equivalent to the 30-year statistical event. Beyond this projection, there may be a small degree of peripheral 'Exceedance' flooding within the areas above the sewers. However, this is expected to be localised and restricted to the location of specific manhole covers located outside the development boundary. Thus, flood risk to the site from sewers is considered LOW and diminished to acceptable levels.

Figure 4 – Severn Trent Water Sewer Records



4.5 Flooding from Groundwater

4.5.1 In general terms, groundwater flooding can occur from three main sources, raised water tables, seepage and percolation, and groundwater recovery or rebound. If groundwater levels are naturally close to the surface, then this can present a flood risk during intense rainfall.

4.5.2 At the time of writing no specific intrusive phase 2 site investigation has been carried out at the site.

4.5.3 The Newark and Sherwood District Council Level 2 Strategic Flood Risk Assessment (SFRA) indicates that no groundwater flooding has been experienced in the locality of the development site.

4.5.4 Notwithstanding this, an intrusive investigation should be undertaken in advance of detailed design stage to establish exact ground water levels and how they fluctuate seasonally. If required, measures would need to be introduced into the drainage scheme to deal with high groundwater to ensure that flooding to property does not occur.

4.5.5 It is considered that any groundwater issues can be mitigated as required, subject to further investigation, at the detailed design stage. The risk to the site from groundwater flooding is therefore considered LOW.

4.6 Flooding from Other Water Features

4.6.1 Reservoir flooding is extremely unlikely to happen and there has been no loss of life in the UK from reservoir flooding since 1925. The Environment Agency is the enforcement authority and ensures that reservoirs are inspected regularly, and essential safety work is carried out.

4.6.2 The Long-Term Flood Risk Assessment (Flood Risk from Reservoirs) map shows that the site is at VERY LOW RISK of Reservoir flooding.

5.0 Outline Drainage Strategy

5.1 External Consultation

5.1.1 At the time of writing PGC has not consulted with Severn Trent Water.

5.2 Existing Drainage

5.2.1 As per Section 4.4, the Severn Trent Water sewer records have been reviewed and confirm there are a number of sewers in close proximity to the development boundary. There is a 300mm combined water sewer in London Road to the north of the site, flowing in a south easterly direction and a 225mm combined water sewer to the south of the site, in Harewood Avenue flowing in a north westerly direction. No existing sewers have been identified passing through the site. Nor are there any surface water sewers identified in close proximity.

5.3 Existing Runoff

5.3.1 The site is currently occupied by the former Lilley Stone School, with the school buildings located to the north of the site and sports pitches located to the south. The site can therefore be considered as brownfield to the north and greenfield to the south.

5.3.2 Brownfield discharge calculations have been undertaken for the north of the site based on a peak flow rate for a variety of storm events. Table 5 below provides a summary of the existing brownfield runoff rates based on an area of 0.9ha.

Table 5: Existing Brownfield Runoff Rates

Brownfield Runoff Rates		
1 yr	30yr	100yr
75 l/s	162.5 l/s	237.5 l/s

5.3.2 Greenfield discharge calculations have been undertaken for the site in accordance with Rainfall Runoff Management for Developments (Report SC030219, October 2013, Defra/EA). In accordance with the Non-statutory Technical Standards for Sustainable Drainage Systems (March 2015, Defra) greenfield rates have been calculated for the 1 in 1 year, Q_{bar}, 1 in 30 and 1 in 100-year rainfall events. A copy of the calculations is contained in Appendix D. Table 6 below provides a summary of the existing greenfield runoff rates based on an area of 3.45ha.

Table 6: Existing Greenfield Runoff Rates

Greenfield Runoff Rates			
1 yr	Qbar	30yr	100yr
8.1 l/s	9.8 l/s	19.2 l/s	25.2 l/s

5.4 Geology

5.4.1 The British Geological Survey (BGS) map confirms that the superficial deposits of the site are described as Balderton Sand and Gravel Member overlying the bedrock geology comprised of the Edwalton Member – Mudstone.

5.4.3 A review of local boreholes indicates that the strata is generally sand and gravel overlain by made ground or topsoil.

5.4.4 The site is not located in a Groundwater Source Protection Zone.

5.4.5 Given the granular nature of the underlying geology, infiltration is likely to be a viable option for the discharge of surface water from the site. Intrusive ground investigations will be required to determine the final infiltration rates.

5.5 Hydrological Assessment

5.5.4 As discussed in previous sections, a review of the topographical survey, OS Maps and other online mapping would indicate the closest surface water feature is the River Trent located circa 500m to the northwest of the site.

5.6 Sustainable Drainage Systems (SuDS) Assessment

5.6.1 SuDS Objectives

Sustainable drainage developed in line with the ideals of sustainable development is collectively referred to as Sustainable Drainage Systems (SuDS). At a particular site, these systems are designed both to manage the environmental risks resulting from the urban runoff and to contribute wherever possible to environmental enhancement. SuDS objectives are therefore to minimise the impacts from the development on the quantity and quality of the runoff and maximise amenity and biodiversity opportunities (CIRIA C753, 2015).

5.6.2 SuDS Design Themes

The 'Management Train Approach' should be central to the surface water drainage strategy of the proposed site. The main objective is treatment and control of runoff as near to the source as possible protecting downstream habitats and further enhancing the amenity value of the site. This concept uses a hierarchy of drainage techniques to incrementally reduce pollution, flow rates and volumes of storm water discharge from the site, and is as follows:

i. Prevention – The use of good site design and housekeeping measures to prevent runoff and pollution and includes the use of rainwater reuse / harvesting.

ii. Source Controls – Control of runoff at source or as close to source as possible (e.g. soakaways, green roofs, pervious pavements).

iii. Site Control – Management of water in a local area and can include below ground storage / attenuation, detention basins, large infiltration devices.

iv. Regional Control – Management of water from a site or various sites and can include wetlands and balancing ponds.

5.6.3 SuDS Site Constraints

SuDS techniques are suitable for all sites; therefore an assessment of the existing site is required so that SuDS limitations can be determined.

Land Use Characteristics: The size and type of development enables a potential range of prevention, source control and site control SuDS devices to be considered above and below ground.

Site Characteristics: No site investigation has been carried out at the site. Findings from a review of the BGS maps indicate that the ground is granular and that infiltration techniques would potentially be suitable. Intrusive ground investigation will be required to determine infiltration rates.

Catchment Characteristics: The site is currently classed for drainage purposes as 'Brownfield' to the north and 'Greenfield' to the south and so for surface water runoff purposes off site, the runoff rates for the redeveloped area would need to demonstrate a reduction in the brownfield rate from the north and match the respective greenfield rates for the south of the site, unless local policy advises an alternative method.

Environmental and Amenity Performance: The inclusion of SuDS within the overall development is a key driver in providing both amenity and habitat creation. All types of SuDS will be considered and blended into the landscaping zone, where possible. Safety to all future users is paramount and so best practice guidance will be incorporated so that there is no requirement for significant safety precautions. Maintenance plans will be prepared for all SuDS devices that are included.

5.6.4 SuDS Methods

Table 7 & 8 on the following pages provide an assessment of various above and below ground SuDS methods that can provide water quality treatment and management of flows to reduce runoff rates & volumes and whether they can be suitably incorporated at this development site. The purpose of this assessment is to set out options to be considered at the planning stage with consideration to time constraints, viability and lifetime maintenance of the residential led development.

Table 7: Surface SuDS Methods

Method	Comment	Suitability for Development
Green Roofs	Can be used on suitable low-rise buildings to provide retention, attenuation and treatment of rainwater. Promotes evaporation and local biodiversity.	Not suitable: Architectural proposals for the development and maintenance issues deem this unsuitable.
Water Butts	Plastic tanks placed at the base of rainwater down pipes to collect rainwater runoff from the roof areas for reuse by the property owners.	Suitable: Suited to residential developments such as this and subject to client approval
Rainwater Harvesting	Rainwater harvesting reduces the total runoff volume from the developed site by reusing as 'Grey' water. Also reduces treated water consumption.	Not Suitable: Additional costs of installation would have severe effect on viability of development. Running and maintenance costs would not be acceptable to future occupiers. Not as efficient for single dwellings.
Infiltration Options	Reduces total run off volume from the development by allowing water to infiltrate to suitable sub strata.	Suitable: A review of the BGS website and local boreholes have indicated that the underlying sub strata would be suitable for infiltration-based options, subject to confirmation of infiltration rates.
Permeable Surfacing (Infiltration)	Reduces total run off volume from the development by allowing water to infiltrate to suitable sub strata. Can be used to enhance water quality.	Suitable: A review of the BGS website and local boreholes have indicated that the underlying sub strata would be suitable for infiltration-based options. Potentially used in the parking areas and driveways, subject to final architectural design and developer approval.
Permeable Surfacing (Standard)	Can be used to enhance quality of runoff water. Sub-base provides 'source' storage and reduces the volume of storage downstream with selection of stone fill or use of plastic box stems. Impermeable membrane at base of construction to prevent impact on pavement stability.	Suitable: Potentially used in the parking areas and driveways, subject to final architectural design and developer approval.
Bio-Retention	Collect and retain run-off within tree pits or above ground planers to help improve water quality, prior to discharge in piped system or infiltration.	Not Suitable: The type of the development restricts the use of above ground surface runoff storage.
Swales, basins and ponds	Provide areas for above ground surface runoff storage. Swales also improve water quality through filtration.	Not Suitable: The limited space available restricts the use of swales, basins and ponds due to their size requirements.

Table 8: Sub-Surface SuDS Methods

Method	Comment	Suitability for Development
Geocellular Storage	Suitable for sites with insufficient space for basins etc. Suitable for sites where topography prevents the use of open basins etc.	Suitable: Subject to detailed design and drainage layout to be used to attenuate the peak flows.
Large Diameter Pipes, Culverts or Tanks	Suitable for sites with insufficient space for basins etc. Provide a volume of below ground storage with a high void ratio and good man entry provision to allow for future maintenance and cleaning. Generally, be suitable for adoption by the statutory water company (e.g., United Utilities).	Suitable: The use of oversized pipes is more suited to large residential schemes.

5.6.5 SuDS Hierarchal Approach

Based on the SuDS assessment in Tables 7 & 8, plus an assessment of the local site conditions, the SuDS hierarchal approach for discharge of surface water at the development site is considered in greater detail below:

Table 9: SuDS Hierarchal Approach

Method	Suitability	Suitability for Development
Infiltration to Ground	Yes	A review of the BGS website and local boreholes have indicated that the underlying sub strata may be suitable for infiltration-based options. Further intrusive site investigation is required to determine the final infiltration rates.
Connection to Watercourse	No	There are no watercourses in close proximity to the site.
Connection to Surface Water Sewer	No	No surface water sewers identified within close proximity.
Connection to a Combined Sewer	No	There are other suitable options that would take precedent.

5.6.6 SuDS Design Philosophy

SuDS assessment and hierarchal approach discussed in Table 7, 8 and 9 above has defined the overall SuDS strategy. Thus, the SuDS philosophy for the development site is the promotion of source control and site control techniques with surface water being discharged to ground via infiltration tanks.

The following design philosophy is proposed:

Surface water treatment using the 'Management Train' approach to remove and isolate contamination at all SuDS facilities prior to conveyance to the existing drainage infrastructure.

Prevent measures in the form of water butts at the base of rear rainwater pipes for reuse by the property owners.

Source Control via the potential inclusion of permeable surfacing to the driveways and private parking areas.

Site control in the form of infiltration tanks.

Aim to limit where possible the impermeable fraction of development.

5.7 The Non-Statutory Technical Standards for SuDS

5.7.1 It is best practice to develop drainage strategies to the DEFRA document 'The Non-Statutory Technical Standards for SuDS'.

5.7.2 The DEFRA document advises the following with respect to 'Peak Flow Control' (S2) and 'Volume Control' (S4) for Greenfield sites such as this:

S2 For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100-year rainfall event should never exceed the peak greenfield runoff rate for the same event.

S3 For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100-year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.

S4 Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100-year, 6-hour rainfall event should never exceed the greenfield runoff volume for the same event.

S5 Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100-year, 6-hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.

S6 Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

5.7.3 As noted above, and in line with policy, it is intended that surface water will discharge to ground, subject to confirmation of infiltration rates by permeability testing.

5.8 Climate Change

5.8.1 In May 2022, the Environment Agency released updated climate change allowances for peak rainfall intensities which should be applied to new developments. Rather than nationwide allowances, each area will have its own peak rainfall allowances. In the case of the Newark area, this is the River Trent and Erewash Management Catchment peak rainfall allowances.

5.8.2 Based on the nature of the development, a lifespan in excess of 100 years is anticipated. Therefore, the potential climate change allowance for the 2070's ranges between 25% for the central allowance and 40% for the upper end allowance. As such, an allowance of 40% for climate change on peak 100-year rainfall intensity will be included in calculations.

5.9 Outline Surface Water Drainage Strategy

5.9.1 The general principal of the surface water drainage strategy is to collect the runoff from the roofs and other hard paved areas and direct it to two new below ground surface water drainage networks. These will flow by gravity to two infiltration tanks to be located in the Public Open Spaces in the north and south of the development site. The infiltration tanks will be in the form of geocellular tanks which will provide attenuation whilst also allowing infiltration to the underlaying sands and gravels. The private driveways and parking areas will potentially encompass permeable paving and water butts will be installed to the rear of each property, subject to Client approval and confirmation on surface finishes.

5.9.2 The proposed drainage layout for the new development site will be designed in accordance with the new Design & Construction Guidance (DCG), BS EN 752: 2008 and Building Regulations Part H guidance, i.e. up to the 30-year storm return period criterion and tested for the 1 in 100-year return period including a 40% increase to account for climate change to confirm that there is no flood risk to the properties.

5.9.3 Flooding can occur on a local scale beyond the 30yr criterion due to runoff exceeding the capacity of the minor system during extreme events and it can only be addressed on a site-specific basis. Guidance states that development should be protected against flooding from extreme events (1 in 30 year) and that flood pathways are identified when the drainage system is exceeded.

5.9.4 In the case of this development, exceedance flows will be all those over and above the 30-year design criterion set by Design & Construction Guidance. Using storage within the external areas would be achievable and would direct flood water away from the proposed properties, with flows directed back into the surface water drainage network as water levels in the drainage network receded. The exceedance flows and volumes can be calculated for the new development drainage layout. In the case of this development, consideration will be given to make sure all water is controlled so that it does not impact on any new and adjoining properties.

5.9.5 Although it is envisaged that Prevention and Source Controls measures could be included in the final scheme, this strategy will assume for outline calculations purposes that only Site Control methods are incorporated. A source control attenuation assessment has been simulated in the Microdrainage Design Software. It is noted that these rates and volumes are preliminary for this outline assessment and are likely to alter at detailed design stage when more site-specific information is made available.

5.9.6 Drawing PGC198-C-001 in Appendix C indicates the Drainage Strategy based on the Architects masterplan intent, with the outline hydraulic calculations in Appendix D.

5.9.7 Any future drainage calculations carried out as part of a site wide drainage strategy or for the development layouts themselves must include the appropriate increase in rainfall to satisfy the future Climate change allowances. In the case of this development, this would be 40%.

5.9.8 Table 10 below defines the outline attenuation volumes based on the 2 no. infiltration tanks.

Table 10: Outline Attenuation Volumes

Tank No.	Site Area (ha)	Impermeable Area (ha) @ 60%	Infiltration Rate m/s	Outline Attenuation Volumes for the 100 Year + 40% climate Change Event
1	2.31	1.37	5×10^{-5}	921m^3
2	2.04	1.03	5×10^{-5}	696m^3
Total				1,617m^3

5.10 Volume Control

5.10.1 The impermeable area of the application site will be increased as a result of the development and therefore the volume of run-off in the 100-year 6-hour storm event will be increased above the pre-development greenfield level. This increase in volume will be managed through infiltration to prevent an adverse effect on flood risk to the adjoining catchments.

5.11 Pollution Control

5.11.1 Runoff from roofs is generally considered to be clean and will be discharged directly into the new drainage network. Surface water run-off from hard paved areas at risk of contamination should receive water quality treatment. Access roads are considered as a low hazard in terms of contamination. Table 11 illustrates the pollution hazard indices for different land use classifications from The CIRIA SuDS Manual C753 (2015).

Table 11: Pollution Hazard indices for land use classification (Table 26.2 the CIRIA SuDS manual 2015)

TABLE 26.2 Pollution hazard indices for different land use classifications

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

5.11.2 Table 12 then illustrates the SuDS Component mitigation indices from The CIRIA SuDS Manual C753 (2015)

Table 12: Indicative SuDS mitigation indices (Table 26.4 the CIRIA SuDS manual 2015)

TABLE 26.4 Indicative SuDS mitigation indices for discharges to groundwater

Characteristics of the material overlying the proposed infiltration surface, through which the runoff percolates[1]	TSS	Metals	Hydrocarbons
A layer of dense vegetation underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.6[4]	0.5	0.6
A soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.4[4]	0.3	0.3
Infiltration trench (where a suitable depth of filtration material is included that provides treatment, ie graded gravel with sufficient smaller particles but not single size coarse aggregate such as 20 mm gravel) underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.4[4]	0.4	0.4
Constructed permeable pavement (where a suitable filtration layer is included that provides treatment, and including a geotextile at the base separating the foundation from the subgrade) underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.7	0.6	0.7
Bioretention underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.8[4]	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 inflow concentrations relevant to the contributing drainage area.		

Notes

1 All designs must include a minimum of 1 m unsaturated depth of aquifer material between the infiltration surface and the maximum likely groundwater level (as required in infiltration design – Chapter 25).

2 For example as recommended in Sniffer (2008a and 2008b), Scott Wilson (2010) or other appropriate guidance.

3 Alternative depths may be considered where it can be demonstrated that the combination of the proposed depth and soil characteristics will provide equivalent protection to the underlying groundwater – see note 1.

4 If significant volumes of sediment are allowed to enter an infiltration system, there will be a high risk of rapid clogging and subsequent system failure.

5 See Chapter 14 for approaches to demonstrate product performance. Note: a British Water/Environment Agency assessment code of practice is currently under development that will allow manufacturers to complete an agreed test protocol for systems intended to treat contaminated surface water runoff. Full details can be found at: **www.britishwater.co.uk/Publications/codes-of-practise.aspx**

6 SEPA only considers proprietary treatment systems as appropriate in exceptional circumstances where other types of SuDS component are not practicable. Proprietary treatment systems may also be considered appropriate for existing sites that are causing pollution, where there is a requirement to retrofit treatment. WAT-RM-08 (SEPA, 2014) also provides a flowchart with a summary of checks on suitability of a proprietary system.

5.11.3 The selection of treatment should ensure that the SuDS mitigation component index (Table 12) exceeds the pollution hazard index (Table 11).

5.11.4 Currently, permeable paving, gullies and infiltration tanks are proposed. These will provide the necessary treatment for the new roof and highway areas to reduce contamination risk to the downstream catchments.

5.12 Maintenance

5.12.1 This section is intended to give an overview of the operation and maintenance for the drainage features included with the drainage strategy and in relation to typical details. Where proprietary products are specified, the manufacturer's instructions and recommendations should be followed in priority to this document unless specifically noted otherwise due to project constraints. The recommended operations and frequencies are typical only and should be more frequent initially to ensure that there are no unforeseen issues with the operation and then adjusted to suit the site requirements.

5.12.2 Where sewers and SuDS features are offered for adoption, the adopting authority will have their own maintenance strategy in place.

5.12.3 There are three types of maintenance activities associated with surface water drainage systems. The SuDS Manual, CIRIA C753, defines these as:

Regular Maintenance – 'basic tasks undertaken on a frequent and predictable schedule' including vegetation management, litter and debris removal, and inspections.'

Occasional Maintenance – 'tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the routine tasks (sediment removal is an example.'

Remedial Maintenance – 'intermittent tasks that may be required to rectify faults associated with the system, although the likelihood of faults can be minimised by good design. Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, and as such timings are difficult to predict.'

5.12.4 Specific maintenance needs should be monitored, and maintenance schedules adjusted to suit the location and condition of the drainage feature in question.

Table 13: Extract from The SuDS Manual Table 32.1: Typical key SuDS components operation and maintenance activities

Operation and Maintenance Activity	SuDS Component		
	Piped Network / Inspection Chambers	Geocellular Attenuation / Infiltration Tank	Permeable Paving
Inspection	■	■	■
Litter and debris removal	■	□	■
Grass cutting		□	□
Weed and invasive plant control			□
Shrub management (including pruning)			□
Sediment management[1]	■	■	■
Vegetation replacement		□	
Vacuum sweeping and brushing			■
Structure rehabilitation / repair	□	□	
Infiltration surface reconditioning			□

5.12.5 Piped Networks, Inspection, Manhole and Catchpit Chambers

The appropriate health and safety equipment must be used when accessing manholes. Confined space certificates must be held by any personnel entering a manhole and the appropriate permits should be obtained from the Maintenance Manager prior to any access.

Pipes are proprietary products, and the materials can vary across the site and as such where used the manufacture's recommendations should be followed.

Pipes are intended to be the main conveyance across the development and where oversized they form the attenuation volume required by the limitation of the discharge rate. They are intended to be dry except for during rainfall events. These have been designed to be self-cleaning where possible for smaller diameter pipes, and for larger diameters the risk is reduced due to the overall pipe size.

Access for maintenance is provided through access chambers and manholes.

Regular inspection and maintenance are important to identify areas which may have been obstructed / clogged and may not be drainage correctly thus exposing the development to a greater level of flood risk.

Table 14: Operation and Maintenance Requirements of Piped Networks and Inspection Chambers

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Inspect and identify any features that are not operating correctly. If required, take remedial action	Monthly for three months, then six monthly
	Debris removal from catchment surface / gratings (where may cause risks to performance)	Monthly (and after large storms)
	Remove sediment from trapped sumps, manholes and catchpits.	Annually or as required
Remedial Maintenance	Repair / rehabilitation of gratings, inlets and outlets	As required
Monitoring	Inspect / check all gratings, trapped sumps, manholes and catchpits to ensure that they are in good condition and operating as designed	Annually and after large storm events
Structure Rehabilitation / Repair	Regular Maintenance and Monitoring to identify if repair and / or replacement of features or pipework is required.	As required

5.12.6 Geocellular Attenuation / Infiltration Tanks

Geocellular tanks are proprietary products, and the materials can vary across the site and as such where used the manufacture's recommendations should be followed.

Geocellular tanks form the temporary attenuation volume required prior to surface water discharging to ground. They are intended to be dry except for during rainfall events.

Access for maintenance has been provided by locating downstream manhole chambers.

Table 15: Operation and Maintenance Requirements for Attenuation / Infiltration Tanks

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for three months, then annually
	Debris removal from catchment surface (where may cause risks to performance)	Monthly (and after large storms)
	Remove sediment from trapped sumps, manholes and catchpits.	Annually or as required
Remedial Maintenance	Repair / rehabilitation of gratings, inlets, outlets and vents	As required
Monitoring	Inspect / check all inlets, outlets, and vents to ensure that they are in good condition and operating as designed	Annually and after large storm events
	Survey inside of tank for sediment build up and remove if necessary	Every 5 years or as required

5.12.7 Permeable paving

Permeable pavements are proprietary products, and the materials can vary across the site and as such where used the manufacture's recommendations should be followed.

Permeable paving allows rainwater to infiltrate through the surface to underlying structural layers. The run-off is temporarily stored below the surface before use, infiltration to ground or controlled discharge downstream. The underlying layers can also provide a treatment medium to reduce pollutants prior to discharge.

Table 16: Operation and Maintenance Requirements for Permeable Paving

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 surface 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 glyphospate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Maintenance	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 any 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)
	Initial inspection	Monthly for three months after installation

Monitoring	Inspect for evidence of poor operation and / or weed growth – if required, take remedial action	Three-monthly, 48h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

5.13 Foul Water Drainage

5.13.1 Foul water generated by the development will be collected by new below ground piped drainage networks. These will discharge into the existing STW combined water sewers in London Road to the north and Harewood Avenue to the south of the site. Based on the existing invert levels of the STW sewers, a new adopted foul water pumping station will be incorporated into the scheme.

5.13.2 At the time of writing STW have not been consulted regarding foul water discharge into their network.

5.13.5 The proposed foul drainage for the new development site will be designed in accordance with Design & Construction Guidance (DCG), BS EN 752: 2008 and Building Regulations Part H guidance.

6.0 Management Measures, Off Site Impacts and Residual Risk

6.1 Flood Risk Management Measures

6.1.1 The assessment has determined that the development site is at low risk of flooding from all sources.

6.1.2 The surface water drainage strategy for the new development site will be discharge runoff to ground via two infiltration tanks in line with local and national policy. The infiltration tanks will also provide attenuation prior to the runoff being discharged to ground. The new surface water networks will be designed in line with current British Standard guidance up to the 100-year storm return period including an allowance for climate change.

6.1.3 The use of SuDS in the form of Prevention, Source Control and Site Control measures will help to minimise the flood risk impact to the surrounding networks.

6.1.4 There will be a site management health and safety document prepared in respect of the final development. This will include the required maintenance regime for the on-site drains & sewers, and drainage facilities such as the channels, gullies, pipes, manholes, swales and all SuDS facilities.

6.1.5 A management company and property owners will be responsible for the operation and maintenance to ensure that the surface water drainage system will always operate at its maximum efficiency.

6.2 Off Site Impacts

6.2.1 The redevelopment of the site does not impair the hydraulic continuity of any watercourse and the current ''local hydraulics'' of distributing watercourses / outfalls.

6.2.2 Surface water runoff will reduce for the higher order event from the pre-development regime and utilises SuDS solutions to satisfy the site constraints. This will reduce surface water flooding impact onto the downstream catchment.

6.2.3 As there is no flood displacement or increased rate of runoff as part of this proposal into the adjacent watercourse, the proposed development will therefore not increase flood risk onto its locality.

6.3 Residual Risk

6.3.1 Flood risk to people and property can be managed but it can never be completely removed; a residual risk remains after flood management or mitigation measures have been put in place. This relates to a rainfall event beyond what can be fully quantified.

Appendix A – Architects Drawings

Key

Existing Trees

Proposed Trees

Key

General Notes:

1. Do not scale off this drawing unless a scale bar is provided.
2. Any ambiguities, omissions and errors on this drawing should be notified immediately to the Architect before the commencement of works on site.
3. Dimensions are in millimetres unless otherwise stated.
4. Dimensions, unless otherwise indicated, are to the face of unfinished block walls or to the finished plaster face of stud partitions.
5. Dimensions are to be checked on site. Discrepancies are to be notified immediately to the Architect before the commencement of works on site.
6. All levels are in meters unless otherwise stated.
7. This drawing is to be read in conjunction with all other relevant drawings and specifications for this project.

Revision Notes:

Rev.	Date	Notes	Issuer	Checker
P7	2023-07-28	Revised Layout	TOY	SHB
P8	2023-08-01	Updated red line to include junction	TOY	SHB
P9	2023-08-01	Amended Tennis Club parking	TOY	SHB
P10	2023-08-17	Increased Tennis Club parking, revising footpath. Pump station access adjusted.	MJ	JC
P11	2023-09-08	G12 trees removed. New tree planting shown. Plots 11-22 nudged east. Substation moved to suit additional car parking bays allocated for tennis club.	MJ	SHB
P12	2023-09-21	Added cycle lane. Updated tree survey.	TOY	SHB
P13	2023-10-18	Planning Issue	MJ	SHB
P14	2023-10-26	Retained trees revised to suit Arboricultural survey.	MJ	JC
P15	2023-12-14	Updated layout post pre-application.	MJ	SHB
P16	2023-12-18	Further layout updates added.	MJ	JC

0 25m

1:500

LONDON ROAD

NEW ARK

Job Number: 23-0030

Project Address: London Rd, Newark NG24 1TW

Client Name: Bildurn Properties

Director / Associate: Matthew Branton

Project Lead: Sarah Boxford

Status: A3 Planning

Functional Breakdown: B1

Sheet Size: A0P

Scale: 1 : 500

Drawing Name:

Illustrative Masterplan

Full Document Reference:

BLR-FEA-B1-XX-DP-A-1200

Document Number: 1200

Current Revision: P16

Revision Date: 2023-12-18

FRANKLIN ELLIS ARCHITECTS

Appendix B – Topographical Survey

Castle Keep Surveys Ltd Drawing Legend

Topographical Linetypes:

- Road
- Drop Kerb
- Steps
- Building Line
- Barrier
- Channel
- Concrete
- Chain Fence
- Metal Fence
- Post & Wire Fence
- Wooden Fence
- Top of Bank
- Bottom of Bank
- Tree Canopy Line
- Verge Line
- Wall
- Footpath

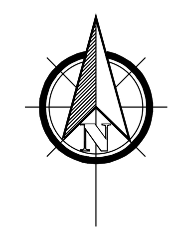
Zero Dig Linetypes

E	Electric
GAS	Gas
W	Water
CATV	Cable TV
CCTV	Closed Circuit TV
BT	British Telecom
EMPTY	Empty Ducting
UNK	Unknown Metallic Utility
GPR	GPR Anomaly Possible Utility
COM	Communications
	Foul Water Drainage Route
	Surface Water Drainage Route
	Combined Service Drainage Route
	Unknown Drainage Route
Field Drain	Field Drain
Aco Drain	Aco Drain
E-TFR	Electric - Taken from Records
E AR	Assumed Electric
O/H E	Electric Overhead
O/H BT	BT Overhead
MSR	Multi Service Route
MULTI SERVICE TRENCH	Multi Service Trench
W-TFR	Water - Taken from Records
W AR	Assumed Water
GAS AR	Assumed Gas
GAS-TFR	Gas - Taken from Records
	Survey Extents

Symbols

TP	Telegraph Pole		Gate
LP	Lamp Post	MH1 CL 100.000 IL 98.000	Manhole
EP	Electric Post		
TL	Traffic Light	IC CL 100.000	Inspection Chamber
FL	Floodlight	CATV CL 100.000	Cable TV Chamber
CTV	Cable TV IC		
SC	Stop Cock	BT CL 100.000	BT Chamber
GV	Gas Valve	RG 100.000	Road Gully
BOL	Bollard	SV CL 100.000	Stop Valve
		WM CL 100.000	Water Meter
2.345	Spot Level	AV CL 100.000	Air Valve
Post	Post	WO CL 100.000	Wash Out
GUL	Gully	FH CL 100.000	Fire Hydrant
ER	Earth Rod	GV CL 100.000	Gas Valve
GR	Gas Riser	Cabinet 100.000	Cabinet
RWP	Rain Water Pipe	LB CL 100.000	Electric Link Box
RS	Road Sign		
SVP	Soil Vent Pipe	MH2 CL 100.000 IL 97.500	Circular Manhole
CKS1 E=436676.617 N=546728.511 Level=25.558	Station Control Details	MH3 CL 100.000 IL 97.500	Triangular Manhole
RE	Rodding Eye		Tree
LOR	Loss of Reflection	EOS	End of Signal

Survey Notes:



Approximate National Grid North

Newark School

JOB TITLE

GVA

CLIENT

TOPOGRAPHICAL SURVEY

DRAWING TITLE

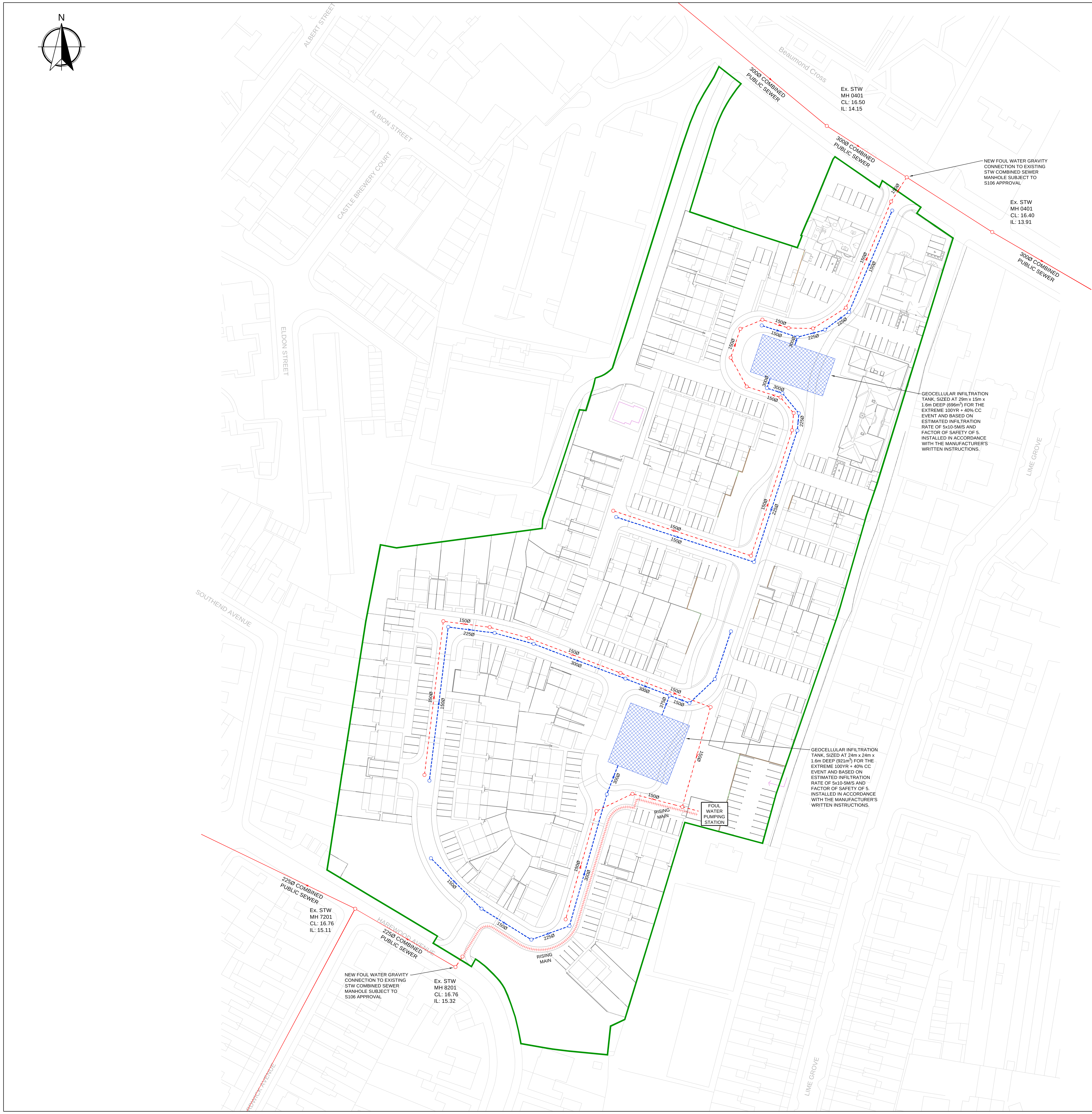
1:500 @ A0 (SCALE)	MD (DRAWN)
22/09/2017 (DATE)	MD (APPROVED)

Castle Keep Surveys Ltd
The Keep
The Village
Castle Eden
County Durham
TS24 4SL
T : 01429 835098
E: info@castlekeepsurveys.co.uk

REV	AMENDMENT	DRAWN	CHECKED

PROJECT No.	DRG No.	REV
	001	

Appendix C – PGC Drawings



SURFACE WATER DRAINAGE

CONSIDERATION HAS BEEN GIVEN TO THE HIERARCHY OF DRAINAGE OPTIONS FOR THE SITE AS FOLLOWS:

DISCHARGE INTO GROUND - UNDERLYING SANDS AND GRAVELS WILL BE SUITABLE AS A MEANS OF DRAINING THE DITE VIA INFILTRATION MEASURES.

DISCHARGE TO SURFACE WATER BODY - NO WATERCOURSE IN CLOSE PROXIMITY.

DISCHARGE TO SURFACE WATER SEWER, HIGHWAY DRAIN OR OTHER DRAINAGE SYSTEM - NO SURFACE WATER SEWER IN CLOSE PROXIMITY.

SUMMARY

TWO LARGE SOAKAWAY TO BE PLACED BENEATH THE POS AREAS TO ENABLE INFILTRATION TO THE UNDERLYING SANDS AND GRAVELS. DESIGN AT THIS TIME BASED ON ESTIMATED INFILTRATION RATE OF 5x10-5 M/S AND FACTOR OF SAFETY OF 5, THOUGH SUBJECT TO FORMAL BRE 365 TESTING.

SUDS TO ENCOMPASS:

- WATER BUTTS
- PERMEABLE SURFACING TO DRIVEWAYS
- GEOCELLULAR INFILTRATION CRATES.

FOUL WATER DRAINAGE

FOUL WATER GENERATED BY THE NEW RESIDENTIAL DEVELOPMENT WILL DISCHARGE INTO THE EXISTING STW COMBINED SEWERS TO THE NORTH AND SOUTH OF THE SITE VIA NEW CONNECTIONS. DUE TO THE SHALLOW LEVELS OF THE RECEIVING SEWER, A NEW ADOPTED FOUL WATER PUMPING STATION IS TO BE CONSTRUCTED.

GENERAL NOTES

1. DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ALL RELEVANT SPECIFICATIONS, ENGINEERS, ARCHITECTS & SERVICES DRAWINGS, INCLUDING APPROVED BUILDERS WORK DRAWINGS. CONTRACTOR TO NOTIFY ENGINEER OF DISCREPANCIES BETWEEN STRUCTURAL DRAWINGS AND SPECIFICATIONS OR OTHER DRAWINGS.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. DETAILS OF EXISTING SEWERS SHALL BE CONFIRMED BY THE CONTRACTOR ON SITE PRIOR TO THE COMMENCEMENT OF WORKS. ANY DISCREPANCIES ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY. THE CONTRACTOR SHOULD CHECK THE LEVELS OF ALL NEW OUT FALLS IN RELATION TO EXISTING SEWERS PRIOR TO ANY CONSTRUCTION TO ENSURE THE PROPOSED DESIGN CAN BE ACHIEVED.
4. DO NOT SCALE FROM THIS DRAWN, WORK TO DIMENSIONS OR COORDINATES PROVIDED. ALL LEVELS ARE IN MILLIMETRES, UNLESS OTHERWISE NOTED. ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER IMMEDIATELY.
5. THIS DRAWING IS FOR STRATEGY PURPOSES ONLY AND SUBJECT TO CHANGE AT DETAILED DESIGN STAGE

KEY

- EXISTING COMBINED SEWER
- OUTLINE SURFACE WATER GRAVITY DRAINAGE
- OUTLINE FOUL WATER GRAVITY DRAINAGE
- SITE BOUNDARY

REV	DATE	DRAWN	REV'D ENG.	NOTES
P2	08.01.24	PG	PG	SITE PLAN UPDATED
P1	18.09.23	PG	PG	PRELIMINARY ISSUE

CLIENT
BILDURN PROPERTIES LTD

PROJECT
FORMER LILLEY & STONE SCHOOL, LONDON ROAD, NEWARK

DRAWING TITLE
DRAINAGE STRATEGY PLAN

DRAWING STATUS
PRELIMINARY

SCALE	DRAWN BY	ENGINEER	SHEET
1:750	PG	PG	A1

DRAWING No	REVISION
PGC198-C-100	P2

PG Consulting
Civil & Infrastructure Engineers
108 Ack Lane West,
Cheadle Hulme,
Cheshire,
SK8 7ES
[redacted]

Appendix D – Outline Hydraulic Calculations

Greenfield Flow Rates

100 year + 40% CC Outline Attenuation Calculations

ICP SUDS Mean Annual Flood

Input

Return Period (years)	1	Soil	0.400
Area (ha)	3.450	Urban	0.000
SAAR (mm)	600	Region Number	Region 4

Results	l/s
QBAR Rural	9.8
QBAR Urban	9.8
Q1 year	8.1
Q1 year	8.1
Q30 years	19.2
Q100 years	25.2

	Lilley Stone School Northern Area 100yr + 40% CC Attenuation	
Date 13/09/2023 File Lilley Stone Northern A...	Designed by paulg Checked by	
Innovyze	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 1012 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	14.547	0.547	4.8	223.3	O K
30 min Summer	14.702	0.702	4.9	286.8	O K
60 min Summer	14.908	0.908	5.1	370.8	O K
120 min Summer	15.128	1.128	5.2	460.7	O K
180 min Summer	15.218	1.218	5.3	497.5	O K
240 min Summer	15.289	1.289	5.4	526.5	O K
360 min Summer	15.334	1.334	5.4	544.8	O K
480 min Summer	15.350	1.350	5.4	551.7	O K
600 min Summer	15.348	1.348	5.4	550.5	O K
720 min Summer	15.333	1.333	5.4	544.6	O K
960 min Summer	15.291	1.291	5.4	527.6	O K
1440 min Summer	15.212	1.212	5.3	495.2	O K
2160 min Summer	15.113	1.113	5.2	454.8	O K
2880 min Summer	15.025	1.025	5.2	418.9	O K
4320 min Summer	14.866	0.866	5.0	353.8	O K
5760 min Summer	14.723	0.723	4.9	295.5	O K
7200 min Summer	14.597	0.597	4.8	243.7	O K
8640 min Summer	14.485	0.485	4.7	198.0	O K
10080 min Summer	14.388	0.388	4.6	158.4	O K
15 min Winter	14.657	0.657	4.8	268.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	134.356	0.0	42
30 min Summer	87.792	0.0	52
60 min Summer	54.663	0.0	82
120 min Summer	32.917	0.0	136
180 min Summer	24.162	0.0	196
240 min Summer	19.298	0.0	254
360 min Summer	13.967	0.0	372
480 min Summer	11.112	0.0	488
600 min Summer	9.299	0.0	606
720 min Summer	8.037	0.0	722
960 min Summer	6.379	0.0	840
1440 min Summer	4.600	0.0	1088
2160 min Summer	3.312	0.0	1488
2880 min Summer	2.621	0.0	1896
4320 min Summer	1.882	0.0	2704
5760 min Summer	1.487	0.0	3480
7200 min Summer	1.238	0.0	4256
8640 min Summer	1.065	0.0	5016
10080 min Summer	0.938	0.0	5672
15 min Winter	134.356	0.0	39

	Lilley Stone School Northern Area 100yr + 40% CC Attenuation
Date 13/09/2023 File Lilley Stone Northern A...	Designed by paulg Checked by
Innovyze	Source Control 2017.1.2

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	14.836	0.836	5.0	341.6	O K
60 min Winter	15.036	1.036	5.2	423.3	O K
120 min Winter	15.255	1.255	5.3	512.7	O K
180 min Winter	15.376	1.376	5.4	562.1	O K
240 min Winter	15.458	1.458	5.5	595.6	O K
360 min Winter	15.527	1.527	5.6	623.9	O K
480 min Winter	15.555	1.555	5.6	635.2	O K
600 min Winter	15.562	1.562	5.6	638.1	O K
720 min Winter	15.556	1.556	5.6	635.6	O K
960 min Winter	15.520	1.520	5.6	621.0	O K
1440 min Winter	15.419	1.419	5.5	579.8	O K
2160 min Winter	15.287	1.287	5.4	525.7	O K
2880 min Winter	15.161	1.161	5.3	474.2	O K
4320 min Winter	14.924	0.924	5.1	377.5	O K
5760 min Winter	14.714	0.714	4.9	291.6	O K
7200 min Winter	14.531	0.531	4.7	216.9	O K
8640 min Winter	14.375	0.375	4.6	153.3	O K
10080 min Winter	14.246	0.246	4.5	100.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	87.792	0.0	52
60 min Winter	54.663	0.0	82
120 min Winter	32.917	0.0	138
180 min Winter	24.162	0.0	194
240 min Winter	19.298	0.0	250
360 min Winter	13.967	0.0	366
480 min Winter	11.112	0.0	480
600 min Winter	9.299	0.0	594
720 min Winter	8.037	0.0	704
960 min Winter	6.379	0.0	918
1440 min Winter	4.600	0.0	1152
2160 min Winter	3.312	0.0	1612
2880 min Winter	2.621	0.0	2060
4320 min Winter	1.882	0.0	2916
5760 min Winter	1.487	0.0	3752
7200 min Winter	1.238	0.0	4488
8640 min Winter	1.065	0.0	5200
10080 min Winter	0.938	0.0	5872

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.300	Shortest Storm (mins)	15
Ratio R	0.413	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Pipe Network

Volume in Pipe Network (m^3)	10	Dia of Outfall Pipe (m)	0.3
Slope of Outfall Pipe (1:X)	200	Roughness of Outfall Pipe (mm)	0.600

Time Area Diagram

Total Area (ha) 1.030

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.200	8	12	0.300	16	20	0.100	24	28	0.030
4	8	0.200	12	16	0.100	20	24	0.100			

Model Details

Storage is Online Cover Level (m) 16.500

Cellular Storage Structure

Invert Level (m) 14.000 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.18000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.18000

Depth (m)	Area (m²)	Inf.Area (m²)	Depth (m)	Area (m²)	Inf.Area (m²)
0.000	430.0	430.0	5.200	0.0	563.1
0.400	430.0	463.2	5.600	0.0	563.1
0.800	430.0	496.4	6.000	0.0	563.1
1.200	430.0	529.5	6.400	0.0	563.1
1.600	430.0	562.7	6.800	0.0	563.1
1.610	0.0	563.1	7.200	0.0	563.1
2.400	0.0	563.1	7.600	0.0	563.1
2.800	0.0	563.1	8.000	0.0	563.1
3.200	0.0	563.1	8.400	0.0	563.1
3.600	0.0	563.1	8.800	0.0	563.1
4.000	0.0	563.1	9.200	0.0	563.1
4.400	0.0	563.1	9.600	0.0	563.1
4.800	0.0	563.1	10.000	0.0	563.1

	Lilley Stone School Southern Area 100yr + 40% CC Attenuation	
Date 13/09/2023 File Lilley Stone Southern A...	Designed by paulg Checked by	
Innovyze	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 1045 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	14.553	0.553	6.3	301.8	O K
30 min Summer	14.689	0.689	6.4	376.1	O K
60 min Summer	14.959	0.959	6.7	523.7	O K
120 min Summer	15.067	1.067	6.8	582.9	O K
180 min Summer	15.219	1.219	6.9	666.1	O K
240 min Summer	15.246	1.246	6.9	680.6	O K
360 min Summer	15.290	1.290	7.0	704.8	O K
480 min Summer	15.319	1.319	7.0	720.6	O K
600 min Summer	15.337	1.337	7.0	730.2	O K
720 min Summer	15.331	1.331	7.0	727.2	O K
960 min Summer	15.290	1.290	7.0	704.7	O K
1440 min Summer	15.211	1.211	6.9	661.4	O K
2160 min Summer	15.112	1.112	6.8	607.7	O K
2880 min Summer	15.025	1.025	6.7	559.9	O K
4320 min Summer	14.866	0.866	6.6	473.1	O K
5760 min Summer	14.723	0.723	6.4	395.0	O K
7200 min Summer	14.596	0.596	6.3	325.6	O K
8640 min Summer	14.484	0.484	6.2	264.2	O K
10080 min Summer	14.386	0.386	6.1	210.9	O K
15 min Winter	14.621	0.621	6.3	339.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	134.356	0.0	44
30 min Summer	87.792	0.0	57
60 min Summer	54.663	0.0	84
120 min Summer	32.917	0.0	142
180 min Summer	24.162	0.0	198
240 min Summer	19.298	0.0	258
360 min Summer	13.967	0.0	372
480 min Summer	11.112	0.0	488
600 min Summer	9.299	0.0	608
720 min Summer	8.037	0.0	724
960 min Summer	6.379	0.0	856
1440 min Summer	4.600	0.0	1098
2160 min Summer	3.312	0.0	1496
2880 min Summer	2.621	0.0	1908
4320 min Summer	1.882	0.0	2720
5760 min Summer	1.487	0.0	3488
7200 min Summer	1.238	0.0	4264
8640 min Summer	1.065	0.0	5016
10080 min Summer	0.938	0.0	5680
15 min Winter	134.356	0.0	44

	Lilley Stone School Southern Area 100yr + 40% CC Attenuation	
Date 13/09/2023 File Lilley Stone Southern A...	Designed by paulg Checked by	
Innovyze	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	14.773	0.773	6.5	422.5	O K
60 min Winter	14.979	0.979	6.7	535.0	O K
120 min Winter	15.251	1.251	7.0	683.5	O K
180 min Winter	15.325	1.325	7.0	723.7	O K
240 min Winter	15.404	1.404	7.1	766.8	O K
360 min Winter	15.500	1.500	7.2	819.4	O K
480 min Winter	15.533	1.533	7.2	837.5	O K
600 min Winter	15.559	1.559	7.2	851.5	O K
720 min Winter	15.554	1.554	7.2	848.8	O K
960 min Winter	15.520	1.520	7.2	830.5	O K
1440 min Winter	15.419	1.419	7.1	775.2	O K
2160 min Winter	15.288	1.288	7.0	703.6	O K
2880 min Winter	15.163	1.163	6.9	635.2	O K
4320 min Winter	14.926	0.926	6.6	506.1	O K
5760 min Winter	14.715	0.715	6.4	390.7	O K
7200 min Winter	14.531	0.531	6.3	290.0	O K
8640 min Winter	14.374	0.374	6.1	204.2	O K
10080 min Winter	14.244	0.244	6.0	133.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	87.792	0.0	60
60 min Winter	54.663	0.0	86
120 min Winter	32.917	0.0	142
180 min Winter	24.162	0.0	198
240 min Winter	19.298	0.0	252
360 min Winter	13.967	0.0	368
480 min Winter	11.112	0.0	480
600 min Winter	9.299	0.0	596
720 min Winter	8.037	0.0	708
960 min Winter	6.379	0.0	924
1440 min Winter	4.600	0.0	1166
2160 min Winter	3.312	0.0	1620
2880 min Winter	2.621	0.0	2076
4320 min Winter	1.882	0.0	2944
5760 min Winter	1.487	0.0	3752
7200 min Winter	1.238	0.0	4528
8640 min Winter	1.065	0.0	5208
10080 min Winter	0.938	0.0	5872

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.300	Shortest Storm (mins)	15
Ratio R	0.413	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Pipe Network

Volume in Pipe Network (m³)	10	Dia of Outfall Pipe (m)	0.3
Slope of Outfall Pipe (1:X)	200	Roughness of Outfall Pipe (mm)	0.600

Time Area Diagram

Total Area (ha) 1.370

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.200	8	12	0.300	16	20	0.200	24	28	0.100
4	8	0.200	12	16	0.200	20	24	0.100	28	32	0.070

Model Details

Storage is Online Cover Level (m) 16.500

Cellular Storage Structure

Invert Level (m) 14.000 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.18000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.18000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	575.0	575.0	5.200	0.0	728.9
0.400	575.0	613.4	5.600	0.0	728.9
0.800	575.0	651.7	6.000	0.0	728.9
1.200	575.0	690.1	6.400	0.0	728.9
1.600	575.0	728.5	6.800	0.0	728.9
1.610	0.0	728.9	7.200	0.0	728.9
2.400	0.0	728.9	7.600	0.0	728.9
2.800	0.0	728.9	8.000	0.0	728.9
3.200	0.0	728.9	8.400	0.0	728.9
3.600	0.0	728.9	8.800	0.0	728.9
4.000	0.0	728.9	9.200	0.0	728.9
4.400	0.0	728.9	9.600	0.0	728.9
4.800	0.0	728.9	10.000	0.0	728.9

Appendix E – Severn Trent Water Sewer Records

Date: 04/11/22 | Scale: 1:1250 | Map Centre: 479911,353294 | Data updated: 14/10/22 | Our Ref: 995008 - 1 | Wastewater Plan A1

Public Foul Gravity/Lateral Drain
Public Combined Gravity/Lateral Drain
Public Surface Water Gravity/Lateral Drain
Pressure Foul
Pressure Combined
Pressure Surface Water
Highway Drain
Overflow Pipe
Disposal Pipe
Culverted Water Course
Pumping Station
Fitting
Manhole Foul
Manhole Surface
Abandoned Pipe
Chamber
Section 104 sewers are shown in green
Private sewers are shown in magenta

[redacted]

Lilley Stone

SEVERN
TRENT

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
	C		0	0
	C		0	0
	C		0	0
	C	16.44	13.93	2.51
	C	16.68	14.65	2.03
	C		15.09	0
	C		0	0
	C		0	0
	C		0	0
	C	16.46	13.59	2.87
	C	16.4	13.46	2.94
	C	16.52	13.27	3.24
	C	16.53	13.26	3.27
	C		0	0
	C		0	0
	C		0	0
	C		0	0
	C	15.97	0	0
	C	16.12	0	0
0252	C		0	0
0253	C		0	0
0256	C		0	0
0259	C		0	0
0262	C		0	0
0264	C		0	0
0268	C		0	0
0301	C	16.46	14.36	2.1
0302	C	16.48	14.23	2.25
0401	C	16.4	13.91	2.49
0402	C		0	0
0603	C	17.11	15.58	1.53
1001	C	16.16	14.58	1.58
1002	C	16.15	0	0
1052	C		0	0
1101	C	16.14	13.69	2.45
1105	C		0	0
1106	C		14.37	0
1201	C		13.52	0
1251	C		0	0
1253	C		0	0
1257	C		0	0
1259	C		0	0
1261	C		0	0
1352	C		0	0
1356	C		0	0
1400	C		13.16	0
1401	C	16.99	15.09	1.9
1500	C		0	0
1501	C	16.46	14.58	1.88
1503	C	16.16	14.05	2.11
1504	C		0	0
1552	C		0	0
1556	C		0	0
2001	C	16.47	15.41	1.06
2002	C	16.59	14.81	1.78
2051	C		0	0
2054	C		0	0
2101	C	16.28	14.36	1.92
2102	C	16.35	14.87	1.48
2108	C	16.24	14.29	1.95
2151	C		0	0
2153	C		0	0
2155	C		0	0
2252	C		0	0
2401	C	16.49	14.59	1.9
2453	C		0	0
2455	C		0	0
2456	C		0	0
2501	C	16.51	13.87	2.64
2502	C	15.96	14.35	1.61
2503	C	16.14	13.99	2.15
2510	C		0	0
2552	C		0	0
2555	C		0	0
2557	C		0	0
2601	C	15.89	13.72	2.17
2602	C	15.9	14.37	1.53
3001	C	16.75	15.9	0.85
3002	C	16.86	15.43	1.43
3102	C	16.54	14.22	2.32
3103	C	16.77	14.64	2.13
3151	C		0	0
3156	C		0	0
3201	C		12.97	0
3202	C	16.36	13.18	3.18
3203	C	16.37	13.59	2.78
3204	C	16.33	13.35	2.98
3301	C	16.51	12.55	3.96
3302	C	16.21	14.39	1.82
3303	C	16.44	12.77	3.67
3401	C	16.22	13.92	2.3
3451	C		0	0
3455	C		0	0
3466	C		0	0
3501	C	16.23	13.42	2.81
3503	C	16.38	13.61	2.77
3510	C		0	0
3557	C		0	0
3558	C		0	0
3560	C		0	0
3563	C		0	0
3602	C	16.55	13.94	2.61
4001	C	16.52	11.85	4.67
4002	C		0	0

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
4100	C	16.52	11.69	4.83
4101	C		0	0
4102	C	16.69	12.11	4.58
4103	C		0	0
4161	C		0	0
4200	C		0	0
4201	C		0	0
4202	C	16.23	11.31	4.92
4203	C	16.23	14.99	1.24
4205	C		0	0
4207	C	16.43	0	0
4208	C		0	0
4209	C		0	0
4210	C		0	0
4211	C	15.7	13.04	2.66
4301	C	15.18	12.96	2.22
4302	C		0	0
4401	C	15.17	13.13	2.04
4402	C	15.64	13.35	2.29
4403	C	14.83	12.63	2.2
4451	C		0	0
4455	C		0	0
4503	C	15.19	14.61	0.58
4510	C	15.6	14.14	1.46
5001	C	17.06	14.47	2.59
5101	C	16.7	11.83	4.87
5102	C	16.98	12.71	4.27
5103	C	16.79	12.53	4.26
5201	C	16.44	13.81	2.63
5300	C		0	0
5301	C	16.74	14.3	2.44
5302	C	16.56	13.51	3.05
5304	C	16.43	14.28	2.15
5401	C	15.6	13.62	1.98
5403	C		0	0
5551	C		0	0
5601	C	15.73	13.37	2.36
5602	C	15.69	12.92	2.77
5652	C		0	0
6001	C	16.56	15.26	1.3
6002	C	16.62	14.72	1.9
6003	C	16.7	14.86	1.84
6101	C	16.88	15.82	1.06
6102	C	16.97	13.09	3.88
6201	C	16.35	15.14	1.21
6202	C	16.72	15.46	1.26
6203	C	16.44	14.74	1.7
6204	C	16.29	14.8	1.49
6401	C	17.2	14.94	2.26
6402	C	17.02	15.8	1.22
6403	C	17.38	15.64	1.74
6501	C	16.63	14.97	1.66
6502	C	16.74	14.25	2.49
6504	C	16.85	13.3	3.55
6551	C		0	0
6553	C		0	0
6556	C		0	0
7001	C	16.95	13.51	3.44
7101	C	16.74	15.44	1.3
7201	C	16.76	15.11	1.65
7202	C	16.79	0	0
7301	C	17.26	16.25	1.01
7303	C	17.35	15.97	1.38
7401	C	17.18	15.28	1.9
7402	C	17.35	15.65	1.7
7403	C	17.39	16.14	1.25
7500	C		0	0
7501	C	16.56	14.8	1.76
7502	C	17.01	14.62	2.39
7503	C	16.94	14.62	2.32
7504	C	16.33	14.29	2.04
7506	C	17.03	13.52	3.51
7551	C		0	0
7554	C		0	0
7601	C	16.17	14.07	2.1
7901	C	16.64	15.78	0.86
7902	C	16.51	15.29	1.22
8101	C	16.84	15.07	1.77
8102	C	16.62	14.43	2.19
8201	C	16.76	15.32	1.44
8501	C	17.32	0	0
8502	C	16.4	14.43	1.97
8903	C	16.84	13.95	2.89
8904	C		0	0
8905	C	16.89	15.82	1.07
8906	C	16.72	0	0
9001	C	16.78	15.47	1.31
9100	C		0	0
9101	C	16.72	15.17	1.55
9104	C		0	0
9105	C		0	0
9106	C		0	0
9107	C		0	0
9108	C		0	0
9201	C		0	0
9202	C	16.64	14.89	1.75
9300	C	0	0	0
9501	C	16.62	14.72	1.9
9502	C	16.47	14.64	1.83
9503	C		0	0
	F		0	0
	F		0	0
	F		0	0
	F		0	0

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
	F		0	0
	F		0	0
	F		0	0
	F		0	0
	F		0	0
	F		0	0
	F		0	0
	F		0	0
	F		0	0
	F		0	0
	F		0	0
	F		0	0
	F		0	0
	F		0	0
	F		0	0
	F		0	0
0100	F		0	0
0101	F		0	0
0102	F		0	0
0103	F		0	0
0104	F		0	0
1100	F		0	0
1104	F		0	0
1151	F		0	0
1153	F		0	0
1155	F		0	0
2105	F	16.39	14.71	1.68
2106	F	16.03	15.35	0.68
2107	F	16.05	15.21	0.84
2109	F		0	0
2204	F	16.17	14.61	1.56
2206	F	16.3	14.35	1.95
2207	F	16.27	13.91	2.36
2210	F	16.03	15.01	1.02
3352	F	0	0	0
3353	F	0	0	0
4501	F	15.31	13.55	1.76
4502	F	15.07	13.55	1.52
4504	F	14.44	12.79	1.65
4505	F	14.1	12.3	1.8
4525	F	16.7	14.95	1.75
4526	F	16.84	14.23	2.61
4603	F	13.7	11.88	1.82
6503	F	16.74	14.67	2.07
6600	F		0	0
6601	F	17.09	14.93	2.16
6602	F		0	0
6603	F		0	0
6604	F		0	0
6605	F		0	0
7304	F		0	0
7404	F	17.03	15.23	1.79
7405	F	16.89	15.32	1.57
7505	F	16.88	15.5	1.38
9109	F		0	0
	S	16.43	14.49	1.94
	S	16.39	14.46	1.93
0105	S		0	0
0106	S		0	0
0107	S		0	0
0108	S		0	0
1107	S		0	0
1108	S		0	0
1109	S		0	0
1301	S	15.8	0	0
1402	S	16.55	14.41	2.14
1502	S	16.47	14.22	2.25
2201	S	15.97	14.71	1.26
2202	S	15.98	14.56	1.42
2203	S	16.03	14.47	1.56
2205	S	16.25	14.12	2.13
2208	S	16.27	14.01	2.26
2209	S	16.39	13.79	2.6
3502	S	16.18	12.48	3.7
4206	S	16.38	11.25	5.13
4506	S	15.31	13.9	1.41
4507	S	15.07	13.7	1.37
4508	S	14.44	13.16	1.28
4509	S	14.1	12.59	1.51
4513	S	16.65	14.65	2
4605	S	13.7	12.19	1.51
5903	S	17.05	15.29	1.76
6902	S	17.15	15.36	1.79
7302	S		0	0
7406	S		0	0
9110	S		0	0

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert