



Flood Risk Assessment



2307-831 Newmarket
Road, Royston,
Hertfordshire

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DOCUMENT CONTROL SHEET

REV	ISSUE PURPOSE	AUTHOR	CHECKED	APPROVED	DATE
-	Initial submission	KK	RGW	RGW	18.03.2024

1. INTRODUCTION

Project

This Flood Risk Assessment has been undertaken for Vistry Homes Ltd to inform and support a Hybrid application for residential development of up to 325 dwellings comprising: (a) full planning application for Phase 1 comprising 102 dwellings and associated infrastructure including access from Newmarket Road, emergency and pedestrian/cycle access from Burloes Hall Drive, internal highways, public open space, landscaping and drainage and (b) outline application for up to 223 dwellings and associated infrastructure with all matters reserved apart from primary means of access and emergency and pedestrian/cycle access from Burloes Hall Drive.

The development is to comprise of a mixture of detached, semidetached houses and flats, the proposals will include the new housing, parking, private and adoptable hardstanding on a site area of approximately 14.15Ha with the development to be accessed via a new bellmouth junction off Newmarket Road.

Aims and Objectives

The purpose of this assessment is to review the proposed development and to consider the risk to it of flooding, assessing the affect it may have on any existing flood flows and flood storage within adjacent floodplains.

The risks of flooding and potential impact of alterations to the existing flood flow and storage regime and surface run-off characteristics are considered within the scope and parameters set out in the National Planning Policy Framework (NPPF). Consideration is also given to the ODPM document "Preparing for Floods".

The Environment Agency website, flood mapping was consulted during this assessment. (Please refer to the Chapter 2 for flood mapping data).

Site Location/Description

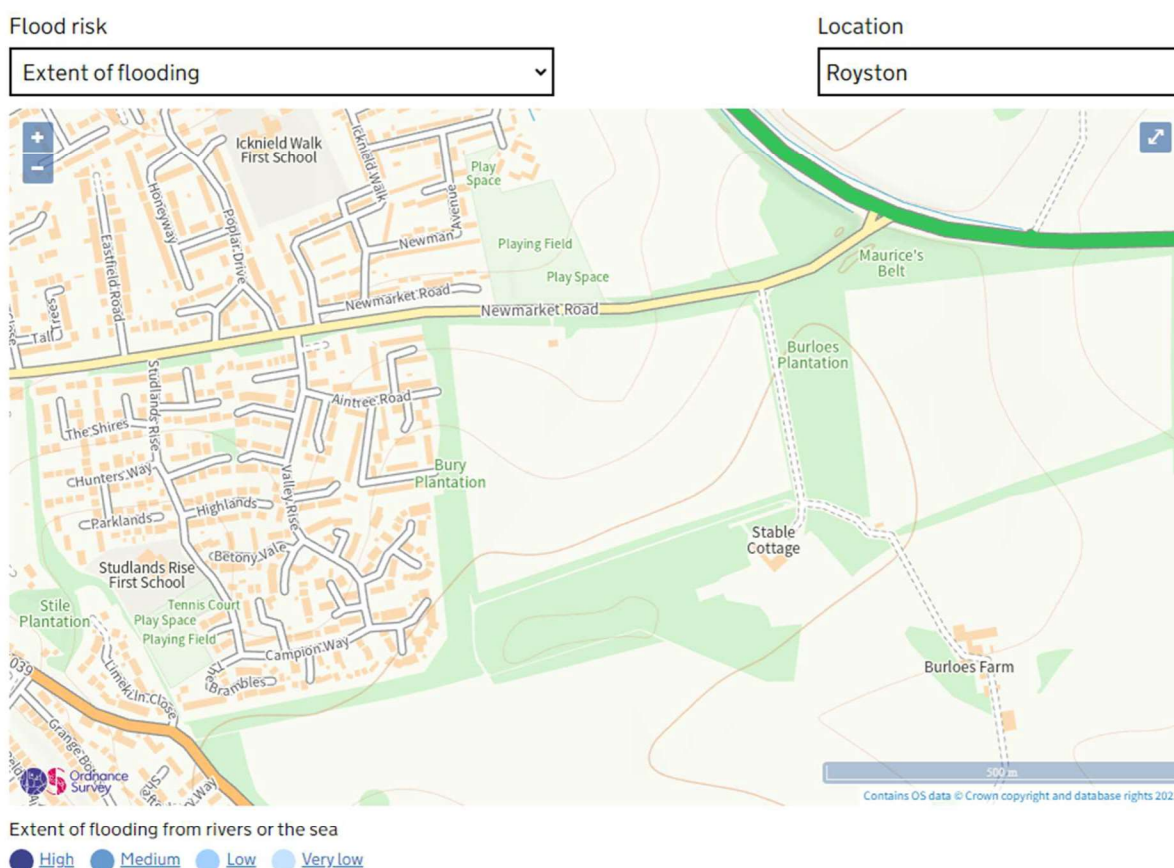
The site is located to the south of Newmarket Road, approximately 1km east of Royston, a town and civil parish in the District of North Hertfordshire and county of Hertfordshire in England. The site is approximately 14.15ha in size with a grid reference of 536909E, 240666N. The site is bound by Newmarket Road to the north and by trees on all boundaries. There are no watercourses near the site or significant vegetation at the site, except for an area of deciduous trees towards the south-eastern corner, which will be retained as part of the development.

The site has steep topography with falls in a northeast direction from the southwest and northwest direction from the southeast converging to the low point located at the centre of the northern boundary, levels ranging from approximately 104.000m AOD to 73.700m AOD. Gradients are consistent in the region of 1in8 (12.5%) to 1in10 (10.0%), (Please refer to the Appendix for the Topographical Survey).

2. FLOOD ANALYSIS

Flood Level

The Environment Agency flood mapping detailed below indicates that the site lies in Zone 1, outside any floodplain with <1in1000yr probability of river or sea flooding.



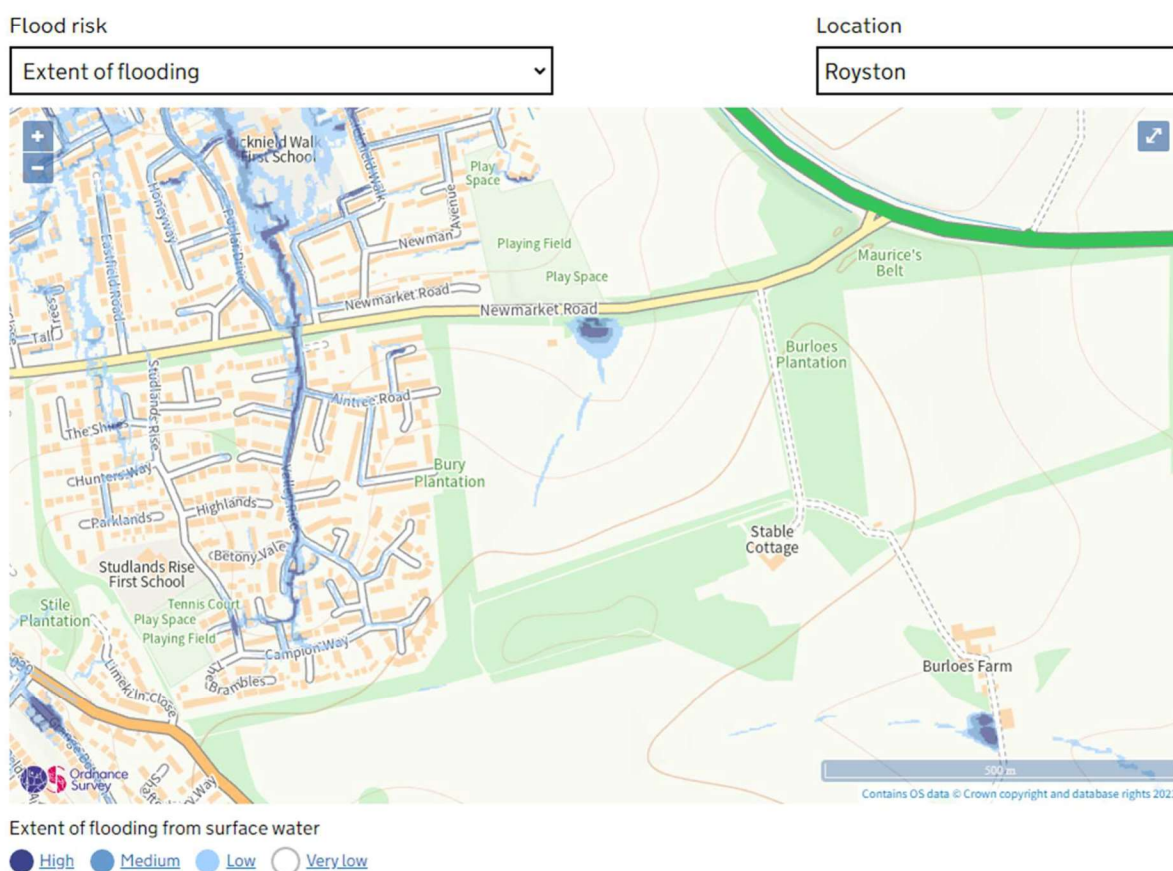
Flood Protection

Although within flood-zone 1, consideration is also required of the flood risk presented from other potential sources such as overland water, groundwater, sewers and retained water features. The site has been assessed for these threats and the proposed levels and existing topography of the site, such that in the event of large storm events, surface water flows would not threaten life or property. A detailed list of the flood risks considered is as follows:

Groundwater: Where the water table rises to such a height where flooding occurs. Most common in low-lying areas underlain by permeable ground (aquifers), usually due to extended periods of wet weather: Ground Water flooding is not considered to be significant for this development due no ground water encountered in any boreholes conducted on site to a depth of 20m supported by local BGS archives suggest groundwater to be within the underlying Chalk Aquifer at approximately 53m below ground level.

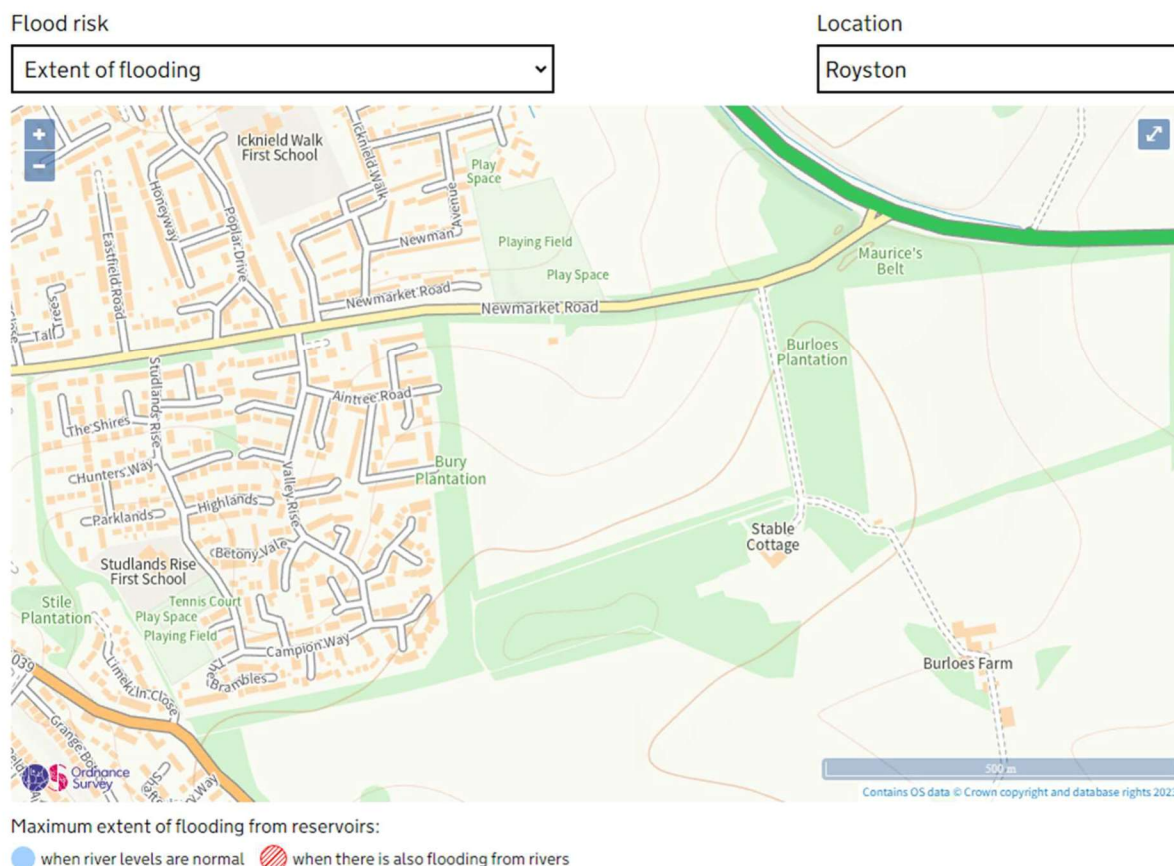
Sewers and highway drains: Combined, foul or surface water sewers and highway drains that are temporarily over-loaded due to excessive rainfall or due to blockage: Should the proposed onsite sewers become blocked the proposed road levels and garden levels surrounding the buildings will be set lower than the proposed finished floor levels therefore ensuring that no threat to adjacent property.

Surface water: The net rainfall falling on a surface (on or off the site) which acts as runoff which has not infiltrated into the ground or entered a drainage system: The below surface water mapping shows ponding at the low point of the site, where overland flows are naturally conveyed due to the steep topography and accumulate due to the road embankment on Newmarket Road whilst the water infiltrates the ground.



It is considered that the proposed development will manage and intercept the overland flows by attenuating up to 1in100year + 40% climate change and infiltrating at source via create soakaways, basins, swales, rain gardens and permeable paving sub-base, in addition a basin will be located at the low point and freeboard within the basin will provide an extra measure in capturing exceedance flows of over land flows therefore no risk from surface water flooding.

Infrastructure failure: canals, reservoirs, industrial processes, burst water mains or failed pumping stations': No infrastructure present to pose a threat as indicated on the mapping below.



Flood Storage

As above the 1% flood level, the proposed redevelopment is not considered to have any impact on existing floodplain storage.

Extreme Flood Events

Consideration is given to flood events over and above the 1in100yr event and exceedance flow routes detailed on exceedance flow route drawing (see Appendix) all flows will be directed away from properties with finished floor levels set to a minimum of 150mm above ground level, low spots will be design in the hard standing directed away from buildings, ponding will give prior warning if failure of the drainage system occurred.

The drainage strategy will detail all surface water run-off up to 1in100year storm plus 40% climate change will be contained in infiltration devices whilst it infiltrates the ground and although not used in design calculations there will be additional storage volume in the piped network, granular backfill of soakaways, freeboard in the basins and permeable paving, which can accommodate further run-off above the 1in100year storm plus 40% climate change.

3. SURFACE AND FOUL WATER STRATEGY

Drainage and Site Analysis

From the trial pit and bore hole testing supplied by Geotechnical and Environmental Associates (see Appendix) the ground consists of made ground underlain with New Pit Chalk Formation to maximum depth of 20m where the boreholes terminated. Infiltration testing has been conducted with soakage rates achieved ranging from 3.34×10^{-6} m/s to 5.15×10^{-4} m/s and shows the ground conditions exhibit good drainage characteristics with no ground water encountered, up to depths of 20m where the borehole terminated.

Following the hierarchy set out in NPPF the drainage strategy will be able to drain all surface water via infiltration mimicking the existing drainage regime for the site.

The NPPF states the hierarchy for discharge of surface water to be: -

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

As a current greenfield site there is presently 0m² of impermeable area, which post development will increase to approximately 56780m² with the existing drainage regime at present that surface water run-off infiltrates the ground, in line with the NPPF it is proposed to mimic this regime via the introduction of multiple SuDS infiltration devices.

There is an existing foul sewer on site taking flows from Burloes Hall draining to a septic tank in the southeast area of the site. As part of the development the septic tank will be removed and flows from Burloes Hall will be accepted by the new onsite foul gravity sewers.

Surface Water Strategy

The greenfield site is understood to presently drain entirely by infiltration. There is no evidence of any other form of surface water drainage near the site and the British Geological Society mapping and the ground investigation report indicates that the site is underlain by Chalk Formation.

In accordance with BRE 365, infiltration testing has been undertaken on site by Geotechnical and Environmental Associates. Results of the testing (see appendix) indicate that infiltration is reasonable to depths of 3.0m with results achieved between 3.34×10^{-6} m/s to 5.15×10^{-4} m/s (see appendix for trial pit locations). The report also confirms that a 10m offset is required for concentrated infiltration devices.

Therefore, infiltration devices such as infiltration basins, swales, filter strips, rain gardens and permeable pavement and crate soakaways are likely to form a solution to surface water drainage. The type of SuDS able to be used and their number may be limited due to the steep topography and requirement for 10m offsets. An evaluation of the types of SuDS features to used is detailed in the following table.

SuDS Evaluation

Type of SuDS	Description	Assessment
Rainwater Harvesting	Rain gardens and water butts are considered a suitable type of harvesting system	Appropriate in this instance.
Green Roofs	Due to the roof pitches and greater loading, it is not considered a viable option for residential dwellings on this development. There is also a high maintenance requirement that would fall to the individual homeowners and therefore not sustainable.	Not appropriate in this instance.
Blue Roofs	Due to the higher structural loading and roof pitches, it is not considered a viable option for residential dwellings on this development. There is also a high maintenance requirement that would fall to the individual homeowners and therefore not sustainable.	Not appropriate in this instance.
Infiltration Basins	Due to the high permeability of the geology and that basins are an above ground SuDS feature these are a preferred method of discharge of surface water and will be incorporated into the development however the number may be limited due to the steep topography of the site resulting in a high land take and the geotechnical requirement of 10m offsets from buildings/structures.	Appropriate in this instance but limited in number.
Swales & Filter Strips	Swales and filter striped are both considered viable, however due to the topography incorporation site wide may be limited, in addition they will likely be required to be under-drained to ensure no exceedance.	Appropriate in this instance but limited in number.
Permeable paving	Permeable paving is considered one of the most appropriate methods for the development enabling source control, especially due to the 10m offset required for other methods of infiltration.	Appropriate in this instance across the site except for adoptable roads.
Infiltration Tanks	Whilst below ground SuDS are not a preferred option, the steep topography and requirement of 10m offsets is likely to limit the sites storage capacity and therefore these will be required.	Appropriate in this instance, however these are to be kept to a minimum as much as reasonably possible.
Proprietary Treatment Systems	Not expected to be required for the development.	

The surface water strategy will be a combination of multiple infiltration methods, where roof areas will drain to basins, swales and filter strips and crate soakaways. Adoptable roads will drain to swales in the first instance, discharging to a piped network, subsequently conveying to a detention basin and infiltration crates below the basins. Private roads will mostly drain via permeable paving, but filter strips/swales will be used where the site topography allows.

The appended preliminary drainage strategy drawings (see appendix) illustrate how the required attenuation may be located within the development, which will be designed for a 1 in 100-year event plus a 40% allowance for climate change and an additional 10% for consideration of urban creep.

The strategy is therefore considered to provide a robust solution to surface water drainage for the proposed development with all water contained in such a way as to pose no threat to life or property. The proposed system can accommodate surface water from events up to and including the 1 in 100-year event plus a 40%, as per appended example calculations.

Phase 1 Surface Water Strategy

Phase 1 is approximately 5.9 ha in size of which 2.15ha will be impermeable and consist of adoptable roads, houses and private roads and parking. The remaining roads and parking will be permeable paving to drain via infiltration, roof areas will be conveyed to infiltration devices, namely a crate infiltration system in the northwest corner of the site, a basin located centrally with a crate system beneath, two further basins are located in the south of the phase and in addition a further basin will be located in the northeast corner of phase 1 with a crate system beneath.

The crate infiltration systems will be encased in a hydrocarbon wrap to provide additional treatment to the surface run-off prior to gradually release to the ground.

Access to the development will be from Newmarket Road via a new adoptable road to include a bus turning loop. The main road will drain to infiltration swales that will include rain gardens (subject to highway approval).

Drainage strategy drawings are appended in this report detailing how all surface water run-off is managed and construction details of all SuDS features and hydraulic calculations detailing for a 1 in 100-year event plus a 40% allowance for climate change and an additional 10% for consideration of urban creep.

Foul Water Strategy

An Anglian Water pre-development report has been prepared for the site reference 00005820 dated March 2015. The report confirms that the foul drainage from the proposed development is in the catchment of Royston Water Recycling Centre. At the time of the report the recycling centre had capacity to accept flows from the development but due to the time that has elapsed an updated predevelopment report will be required to confirm this is still the case.

The foul water will drain via a new adoptable gravity sewer network with final connection to an existing Anglia Water manhole 5801 off Newmarket Road at National grid reference (NGR) TL36564082.

4. CONCLUSIONS AND RECOMMENDATIONS

The proposed new residential development has been assessed for the risk to the site from fluvial flooding in accordance with the guidelines of the NPPF. Assessment has also been made of the impact of the proposed development on the existing floodplain storage at this location, and of the risk of pluvial flooding from storm water contribution from the development exacerbating downstream flooding, as directed by the guidance.

The site has been found to lie within Flood Zone 1 and is therefore not considered to be at risk from fluvial flooding. Other sources of flooding have similarly been assessed and found to pose no threat to development on the site.

The proposals do not affect flood storage within the floodplain and the peak surface water runoff rate leaving the site will be captured via crate infiltration and attenuation system and therefore surface water drainage from the site will mimic the existing drainage regime.

The discharge of future surface water runoff from the site will not be increased as a result of the development but will provide a betterment in peak flows discharging from site, by attenuating and slowing the rate at which it infiltrates the ground by the use of infiltration devices.

It is considered from this assessment that the level of risk of flooding to and from the proposed development is of an acceptable level and in keeping with current policy.

5. SUDS DESIGN AND MANAGEMENT

Water Quality, Amenity and Biodiversity

The approach to Sustainable Drainage Systems (SuDS) is to control water quantity, water quality, amenity, and biodiversity by incorporating multiple SuDS features into a drainage design and producing a management train it is possible to achieve enhancements in all areas.

All private hard standing is to be permeable paving to collect and clean surface run-off, with the addition of Catch pit manholes and trapped gullies to provide a pre-treatment stage for surface water run-off.

These combined measures produce a management train, which facilitates the capture, conveyance, and storage of surface water run-off, while delivering interception and pollution risk management.

The use of SUDS is proposed within the surface water drainage strategy for the proposed development of 325 new residential dwellings by Vistry Homes, in order to serve several functions:

- Control of runoff water rates and volumes, thereby reducing downstream flood risk
- Reducing pollutant concentrations and act as a buffer for accidental spills to improve runoff water quality.

The range of SUDs is described in this document and the recommended maintenance regimes to be applied to each feature and who it is envisaged will be responsible for implementing the maintenance.

SuDS Features and Maintenance Responsibilities

The proposed SuDS are as follows:

- **Permeable Paving** will be provided to the majority of private hardstanding where swales and filter strips are not viable, maintenance will be carried out by the onsite management company.
- **Detention/Infiltration Basins** – will be located in openspace areas where the required 10m offset is achievable and maintenance will be by the adopting water authority.
- **Soakaways** – will be located where the required 10m offset is achievable, maintenance will be carried out by the onsite management company or water authority if adoption is possible.
- **Rain Gardens** – Will be provide across the site, maintenance will be carried out by the onsite management company.
- **Swales** – will be located alongside adoptable roads to be maintained by the highway authority and private drives where possible, with maintenance falling to the onsite management company.
- **Under drained Filter Strip** – will be located by private drives where possible, with maintenance falling to the onsite management company.

Maintenance of SuDS

Infiltration/Detention Basins

Infiltration Basins are flat bottomed, shallow landscaped depressions that store runoff allowing pollutants to settle and filter out before infiltration into the subsurface soils

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter, debris and trash	Monthly
	Cut grass – for landscaped areas and access routes	Monthly (during growing season) or as required
	Cut grass – meadow grass in and around basin	Half yearly: spring (before nesting season) and autumn
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
Occasional maintenance	Reseed areas of poor vegetation growth	Annually, or as required
	Prune and trim trees and remove cuttings	As required
	Remove sediment from pre-treatment system when 50% full	As required
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realign the rip-rap	As required
	Repair or rehabilitate inlets, outlets and overflows	As required
	Rehabilitate infiltration surface using scarifying and spiking techniques if performance deteriorates	As required
	Relevel uneven surfaces and reinstate design levels	As required
Monitoring	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and pre-treatment systems for silt accumulation; establish appropriate silt removal frequencies	Half yearly
	Inspect infiltration surfaces for compaction and ponding	Monthly

Pervious Pavements

Pervious pavements including permeable block paving, porous asphalt or gravel and allow rain to percolate through the surface into underlying drainage layers. They should be protected from silt, sand, compost, mulch etc. Permeable block paving and porous asphalt can be cleaned by suction brushing

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 glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm 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)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Soakaways

Soakaways are excavations that are filled with a void-forming material that allows the temporary storage of water before it soaks into the ground. They promote infiltration as an effective means of controlling and reducing run-off whilst supporting ground water recharge

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect for sediment and debris in pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	Annually
	Cleaning of gutters and any filters on downpipes	Annually (or as required based on inspections)
	Trimming any roots that may be causing blockages	Annually (or as required)
Occasional maintenance	Remove sediment and debris from pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	As required, based on inspections
Remedial actions	Reconstruct soakaway and/or replace or clean void fill, if performance deteriorates or failure occurs	As required
	Replacement of clogged geotextile (will require reconstruction of soakaway)	As required
Monitoring	Inspect silt traps and note rate of sediment accumulation	Monthly in the first year and then annually
	Check soakaway to ensure emptying is occurring	Annually

Swales

Swales are shallow, flat bottomed, vegetated and open channels designed to convey, treat and often attenuate surface water runoff. When incorporated into site design, they can enhance the natural landscape and provide aesthetic and biodiversity benefits.

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if bare soil is exposed over 10% or more of the swale treatment area
Remedial actions	Repair erosion or other damage by re-turfing or reseeded	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

Filter Strips

Filter strips are uniformly graded and gently sloping strips of grass or other dense vegetation that are designed to treat runoff from adjacent impermeable areas by promoting sedimentation, filtration and infiltration (where acceptable).

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect filter strip surface to identify evidence of erosion, poor vegetation growth, compaction, ponding, sedimentation and contamination (eg oils)	Monthly (at start, then half yearly)
	Check flow spreader and filter strip surface for even gradients	Monthly (at start, then half yearly)
	Inspect gravel flow spreader upstream of filter strip for clogging	Monthly (at start, then half yearly)
	Inspect silt accumulation rates and establish appropriate removal frequencies	Monthly (at start, then half yearly)
Occasional maintenance	Reseed areas of poor vegetation growth; alter plant types to better suit conditions, if required	As required or if bare soil is exposed over > 10% of the filter strip area.
Remedial actions	Repair erosion or other damage by re-turfing or reseeded	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

Filter Drains

Filter drains are shallow trenches filled with stone/gravel that create temporary subsurface storage for the attenuation, conveyance and filtration of surface water runoff.

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly (or as required)
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (eg NJUG, 2007 or BS 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

Rainwater Harvesting

Rainwater harvesting (RWH) is the collection of rainwater runoff for use. Runoff can be collected from roofs and other impermeable areas, stored, treated (where required) and then used as a supply of water for domestic, commercial, industrial and/or institutional properties.

- They can meet some of the building's water demand, delivering sustainability and climate resilience benefits.
- They can help reduce the volume of runoff from a site.
- They can help reduce the volume of attenuation storage required on the site.

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspection of the tank for debris and sediment build-up, inlets/outlets/withdrawal devices, overflow areas, pumps, filters	Annually (and following poor performance)
	Cleaning of tank, inlets, outlets, gutters, withdrawal devices and roof drain filters of silts and other debris	Annually (and following poor performance)
Occasional maintenance	Cleaning and/or replacement of any filters	Three monthly (or as required)
Remedial actions	Repair of overflow erosion damage or damage to tank	As required
	Pump repairs	As required

Bioretention Systems

Bioretention systems (including rain gardens) are shallow landscaped depressions that can reduce runoff rates and volumes, and treat pollution through the use of engineered soils and vegetation. They are particularly effective in delivering Interception and can also provide:

- attractive landscape features that are self-irrigating and fertilising
- habitat and biodiversity
- cooling of the local microclimate due to evapotranspiration.

Maintenance schedule	Required action	Typical frequency
Regular inspections	Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary	Quarterly
	Check operation of underdrains by inspection of flows after rain	Annually
	Assess plants for disease infection, poor growth, invasive species etc and replace as necessary	Quarterly
	Inspect inlets and outlets for blockage	Quarterly
Regular maintenance	Remove litter and surface debris and weeds	Quarterly (or more frequently for tidiness or aesthetic reasons)
	Replace any plants, to maintain planting density	As required
	Remove sediment, litter and debris build-up from around inlets or from forebays	Quarterly to biannually
Occasional maintenance	Infill any holes or scour in the filter medium, improve erosion protection if required	As required
	Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch	As required
Remedial actions	Remove and replace filter medium and vegetation above	As required but likely to be > 20 years

Trees

Trees and their planting structures provide benefits to surface water management in the following ways:

- **Transpiration** – This is the process by which water, taken in from the soil by tree roots, is evaporated through the pores or stomata on the surface of leaves (Nisbet, 2005). Trees draw large quantities of water from the soil, which can contribute to reducing runoff volumes (**Box 19.1**).
- **Interception** – Leaves, branches and trunk surfaces intercept (store and allow the water to evaporate) and absorb rainfall, reducing the amount of water that reaches the ground, delaying the onset and reducing the volume of runoff (**Box 19.1**).
- **Increased infiltration** – Root growth and decomposition increase soil infiltration capacity and rate, reducing runoff volumes.
- **Phytoremediation** – In the process of drawing water from the soil, trees also take up trace amounts of harmful chemicals, including metals, organic compounds, fuels and solvents that are present in the soil. Inside the tree, these chemicals can be transformed into less harmful substances, used as nutrients and/or stored in roots, stems and leaves.

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets and outlets	Inspect monthly
Occasional maintenance	Check tree health and manage tree appropriately	Annually
	Remove silt build-up from inlets and surface and replace mulch as necessary	Annually, or as required
	Water	As required (in periods of drought)
Monitoring	Inspect silt accumulation rates and establish appropriate removal frequencies	Half yearly

SuDS Mitigation

To deliver adequate treatment, SuDS components should have a total pollution mitigation index for each contamination type that is greater than or equal to the pollution hazard index as detailed in the following tables from CIRIA SuDS Manual (C753) 2016

As the proposed development is for residential properties with associated roads and infrastructure the pollution hazard indices are taken from the below table from with the areas relevant highlighted.

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

These index figures are compared to the SuDS mitigation for discharge to surface water, as detailed earlier in this report the surface water strategy is to have an infiltration basin, swale, filter strips and permeable paving, therefore the SuDS mitigation is as highlighted below. A factor of 0.5 is used for subsequent features for the reduced performance of secondary components.

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters

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

As the Total SuDS mitigation index is greater the pollution hazard index for each component the SuDS mitigation is met inline with CIRIA SuDS Manual (C753) 2016

Management of surface water during construction

The requirement for management of surface water during construction will be highlighted to contractors at all stages of construction. Specific issues to be addressed and the methods that might be used are all detailed in the following chapter **Construction Surface Water Management Plan**.

The following chapter should be used as guidance for contractors at tender stage and they will be expected to produce method statements responding to their Plan and include allowance within their pricing to implement the agreed method statements.

6. CONSTRUCTION SURFACE WATER MANAGEMENT PLAN

The construction of SuDS usually only requires the use of standard civil engineering and landscaping operations such as excavation, filling, grading, pipe-laying, chamber construction, topsoiling, seeding and planting. There are some specific process and programming considerations required for their application to SuDS construction, and these will be considered when programming the residential development.

The intention is to issue this Construction Surface Water Management Plan to the appointed builder with the requirement for method statements (MS) addressing the issues raised to be submitted for review by the Engineer. Only once the Engineer is satisfied that all related items have been satisfied by the MS will works commence.

The construction surface water will therefore be managed in this way by this plan.

General construction issues relating to SuDS.

Programming

The programming of SuDS construction needs to be considered at all stages of the site construction process. Subsurface piped drainage networks are usually one of the first facilities to be constructed on a site. For SuDS, although the form of the drainage will be constructed during the earthworks phase, the final construction should not take place until the end of the development programme, unless adequate provision is made to remove any silt that is deposited during construction operations and to refurbish any areas that have been subject to over-compaction.

Method statements and pre-construction site planning operations will form an essential part of pre-construction activities to ensure successful completion of the SuDS.

The construction of swales, basins and ponds at an early stage in the construction can assist in managing runoff and help settle out the high volumes of sediments created during construction. However, complete reinstatement of these components will be required once construction is finished. The contract is likely to stipulate establishment of vegetation and sediment removal sometime after site works have been completed and before the start of the maintenance period.

Pollution and sediment control

Runoff from a construction site should not be allowed to enter SuDS or flow off site unless it has been allowed for in the design and specification. Construction runoff is heavily laden with sediment, which can build up in storage systems and pollute receiving waters.

Skills

The contractor and all relevant operatives should have a general understanding of how SuDS work, and the purpose of the specific SuDS components being used on a site, to ensure that appropriate construction practice and component protection is used. "Toolbox Talks" for workers are a particularly effective way of increasing awareness of appropriate construction of SuDS.

Landscaping

Good landscape construction practices are fundamental to SuDS construction. As SuDS are normally surface systems, attention to detail and aesthetics should be given a high priority. The seasonal and physical requirements of planting and the requirements for establishing vegetation and preventing soil erosion should be given careful consideration. Appropriately skilled and experienced operatives are required with an understanding of all aspects of vegetation establishment. Adjacent ground levels to components should be designed to prevent any overland sediment wash-off during high intensity rainfall events, or groundwater seepage during particularly wet periods. Settlement of soils should be taken into consideration.

At Newmarket Road, Royston, the earthworks will be carried out with awareness of the final planned landscaping and be sensitive to it.

Erosion control

Before runoff is allowed to flow through vegetated SuDs, they should be fully stabilised by planting or temporary erosion protection. This will prevent erosion of the sides and base or the clogging of downstream components.

Construction programming for SuDS

Effective construction programming for SuDS is very important to:

Protect the receiving environment from runoff during construction.

Protect each SuDS component from damage during construction.

Protect the natural infiltration characteristics of the site soils and subsoils.

Deliver a surface water management system where runoff is conveyed and stored, as designed, without causing unacceptable erosion, channelling or sedimentation.

Promote the healthy establishment of required vegetation and habitats.

The following issues will be considered in developing the construction programme:

Sediment basins and traps should be installed before any major site earthworks/groundworks take place. Further sediment traps and silt fences should be installed as earthworks/groundworks progress, to keep sediment contained on site at appropriate locations.

Runoff control measures should be used in conjunction with sediment traps to divert water around planned earthworks areas and to remove silt. Surface water runoff from upstream should be diverted around areas to be disturbed before any earthworks/groundwork's operations. Any perimeter drains