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PROPOSED SCHOOL DEVELOPMENT

WATER MEADOWS PRIMARY SCHOOL

SHAFTESBURY ROAD, HERSDEN, CANTERBURY

KENT, CT3 4HS

FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

FOR

WATER MEADOWS PRIMARY SCHOOL

7th October 2019

Report no: 3222 FRA

REV -

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Contents

1 Introduction and Brief

This report has been prepared for Water Meadows Primary School to assess Flood Risk and to provide guidance on the method of surface water disposal for the proposed development at Water Meadows Primary School, Shaftesbury Road, Hersden, Canterbury, Kent, CT3 4HS.

The proposal is to construct a new modular classroom block with toilet facilities, and additional parking within the existing car park area.

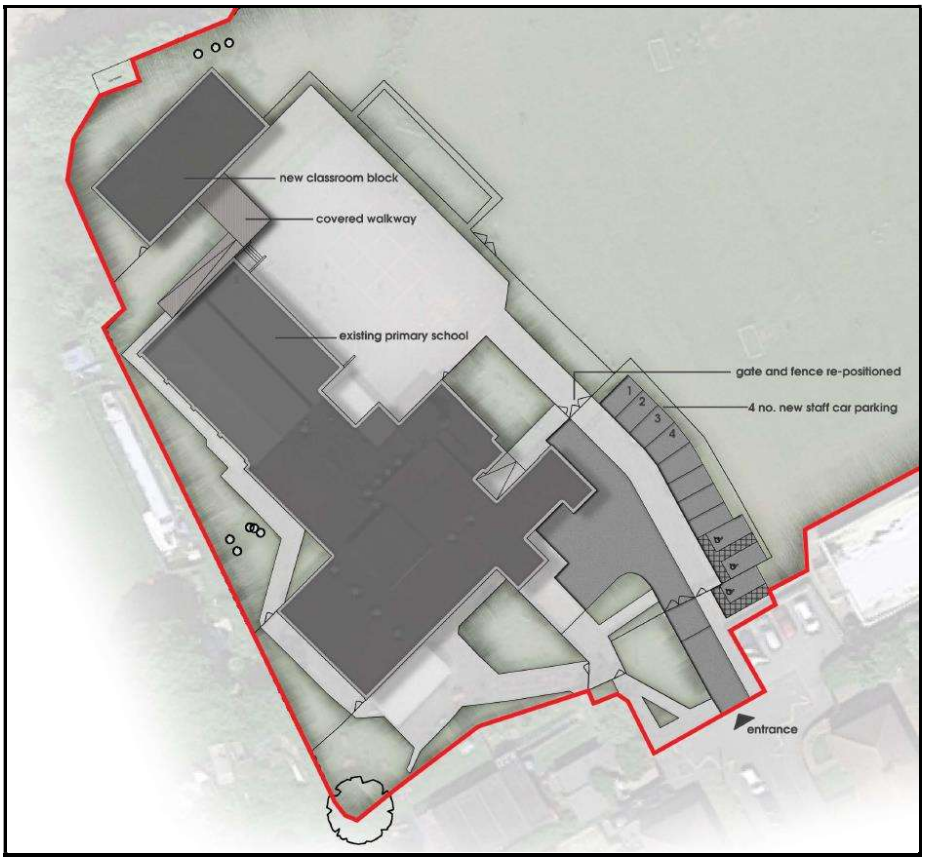

Figure 1.1 – Development Proposals – full drawing within Appendix 1

This document has been produced in accordance with current best practice and recommendations and guidance set out in the National Planning Policy Framework (NPPF).

Considine has no responsibility to any other parties to whom this report may be circulated, in part or in full, and any such parties rely on the contents of this report solely at their own risk.

2 Existing Site Conditions

2.1 Location

The development site is located at land adjacent to Water Meadows Primary School, Shaftesbury Road, Hersden, Canterbury, Kent, CT3 4HS. The British National Grid Reference is: TR 201621 (E:620191, N:162173). The figures below show the site in the wider area, more locally and then an aerial image to show the site in its current context.

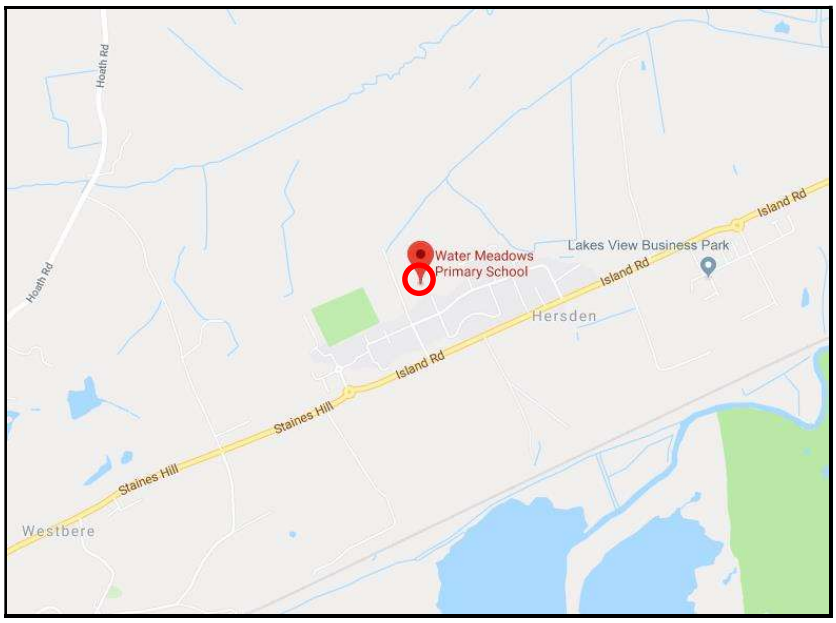

Figure 2.1 – Site location general area. Location shown by red circle. © Google Maps

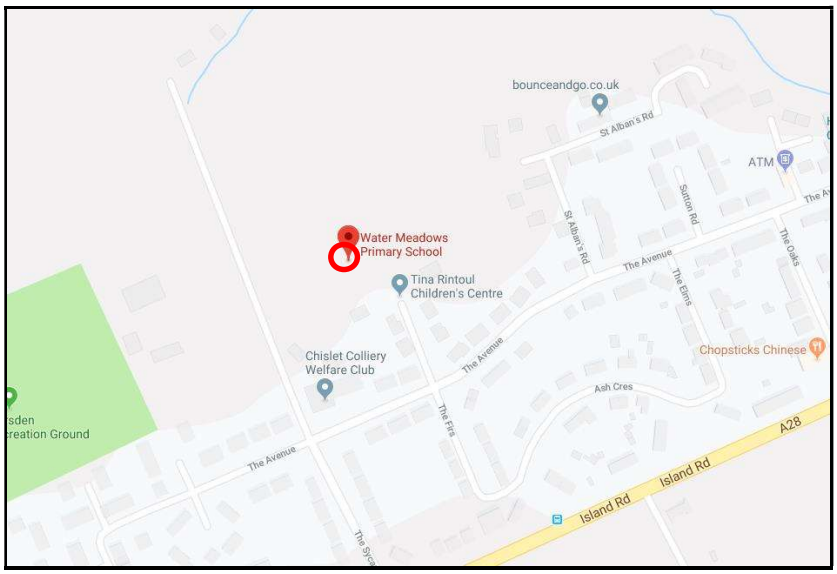

Figure 2.2 – Site Location shown by red circle. © Google Maps

The following aerial image provides additional information about the context of the site and surrounding areas.

Figure 2.3 – Aerial image of site © Google Maps. Approximate proposed footprint shown in red.

The site is a county primary school with the proposed building to be located on an undeveloped landscaped area to the North of the existing school building. The school itself, is bounded by residential to the East and South, amenity facilities to the West and agricultural land to the North.

The existing development impermeable areas are shown in the figure below and are summarised as follows:

Total Site Area:	**11,914 m^2**	(approx.)
Existing Roof Area:	1,155 m^2	
Existing Impermeable Hardstandings:	1723 m^2	
Total Impermeable Area:	**2878 m^2**	

2.2 Site Topography

A review of the topographical survey indicates that the site generally falls from the south west to the north east. Overall, there is a fall of approximately 2m resulting in an approximate average gradient of 1 in 50.

2.3 Site Geology

A review of the BGS online bedrock mapping tool has identified that the development site is likely underlain by the London Clay Formation (Clay and Silts). These sedimentary rocks are defined by the BGS as "bioturbated or poorly laminated, blue-grey or grey-brown, slightly calcareous, silty to very silty clay, clayey silt and sometimes silt, with some layers of sandy clay".

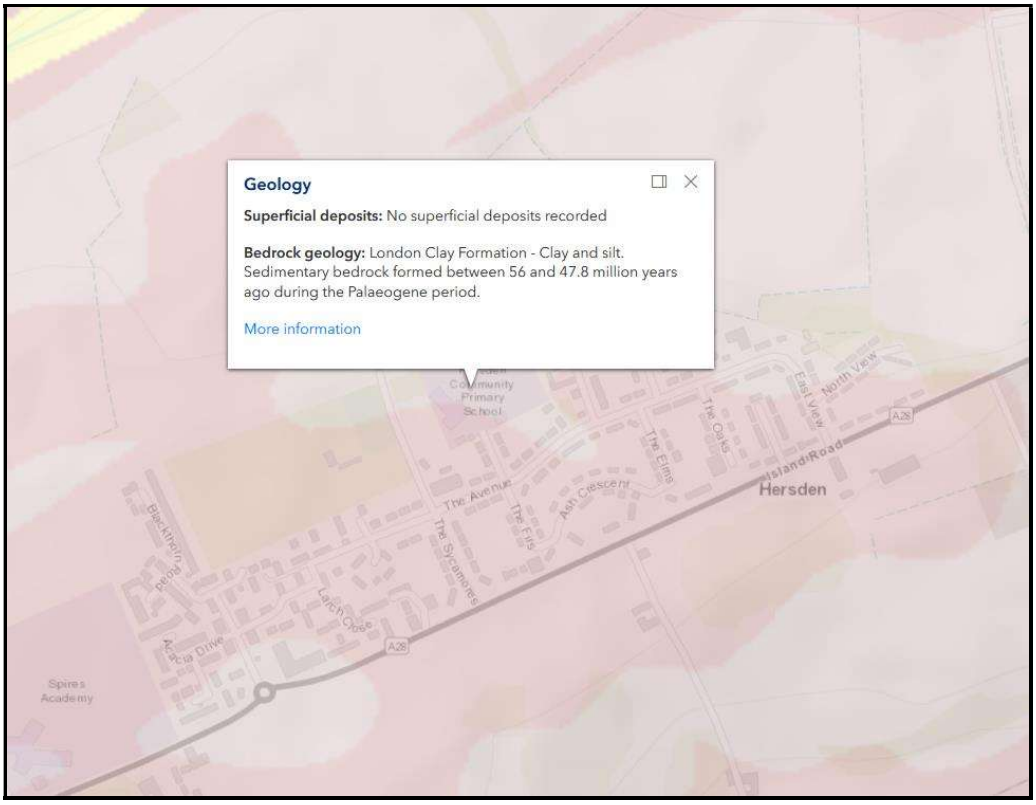

Figure 2.5 – BGS Extracts: Bedrock Geology © BGS

A review of the BGS online superficial deposits mapping tool has identified that the site is also deemed to partly overlain with superficial deposits of Head (Gravel, sands, silts and clays). Head is a poorly sorted and poorly stratified material formed from angular rock debris, hillwash and/or soil creep.

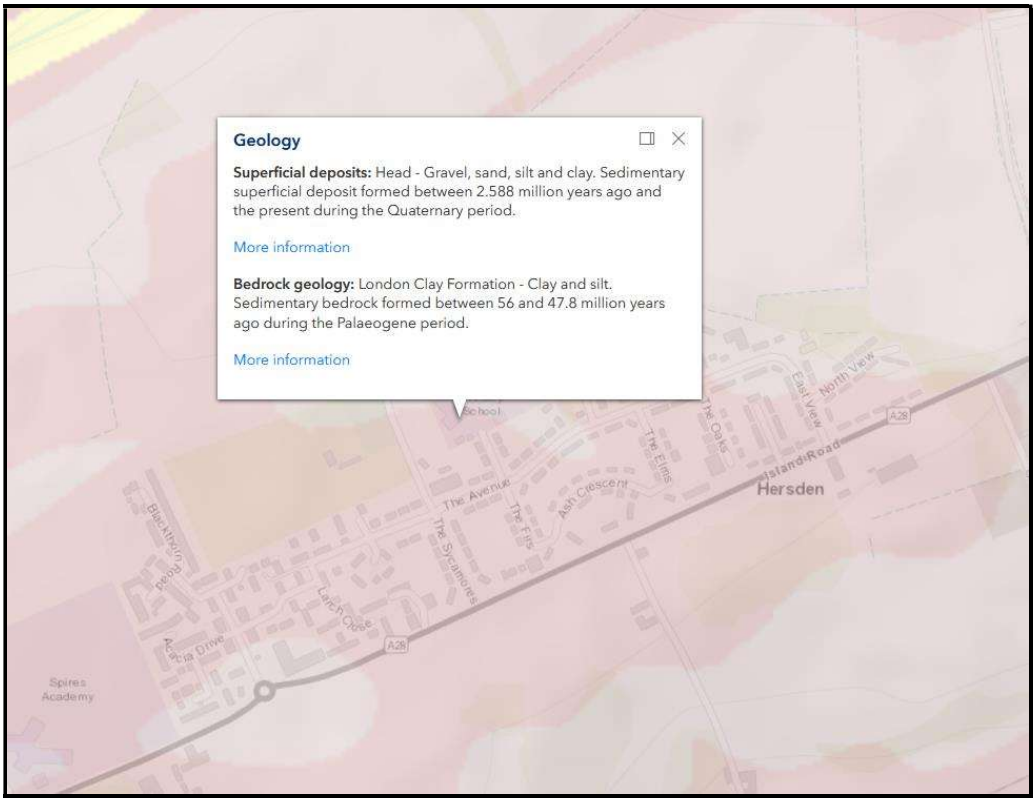

Figure 2.6 – BGS Extracts: Superficial Geology © BGS

A full site investigation is yet to be carried out on the site to prove on-site conditions and given that the available records indicate bedrock geology with typically poor soakage potential this must be undertaken prior to detailed design.

2.4 Hydrogeology and Hydrology

The Environment Agency provide information about the groundwater and aquifers. Review of that information confirms that the site is close to, but not within a Ground Water Source Protection Zone. It is, however, located over a Secondary A Aquifer in terms of the Superficial Drift and is also located in proximity to but not deemed to be within a Groundwater Vulnerability Zone. The following EA Extracts identify the zoning for the site.

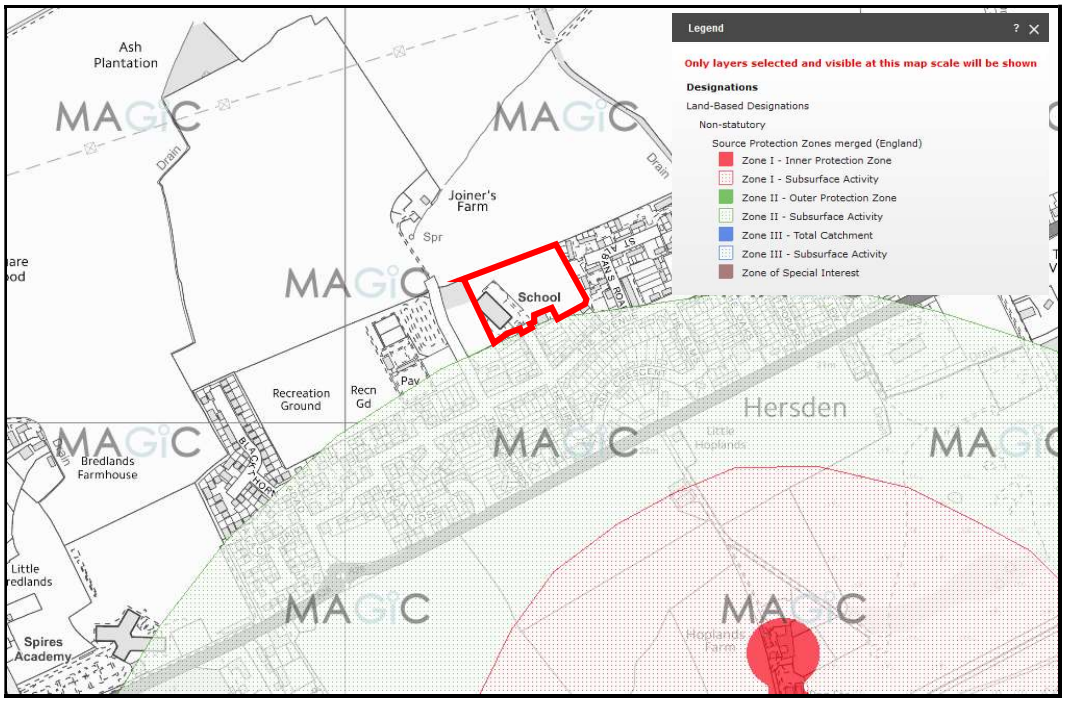

Figure 2.7 – Groundwater Source Protection Zone © Environment Agency

As defined within the figure above, the site is outside of the Groundwater Source Protection Zones.

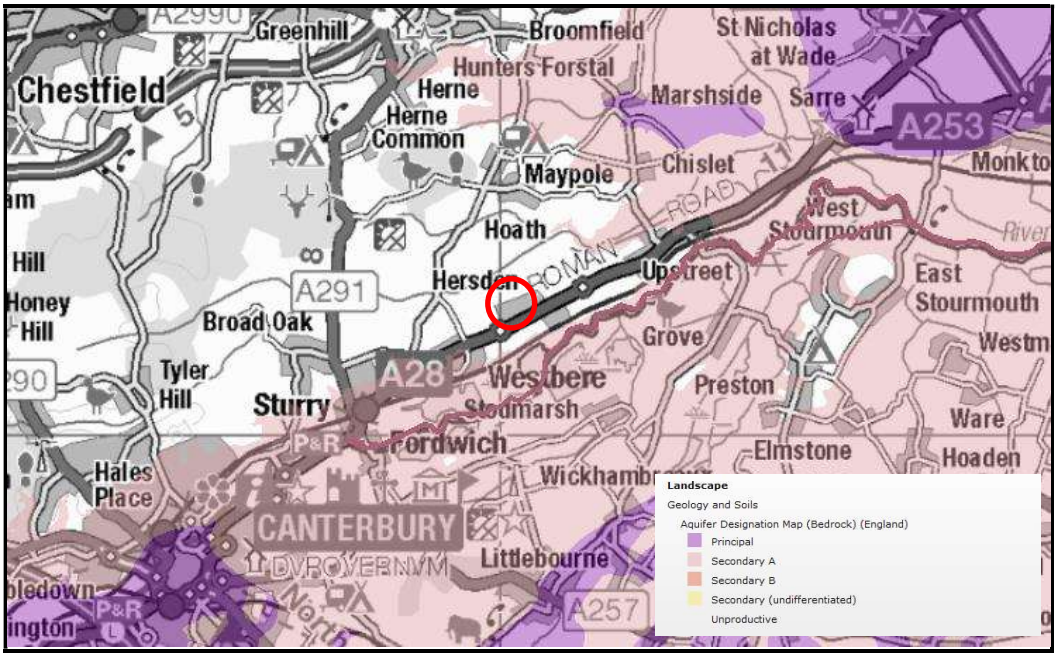

Figure 2.8 – Aquifer Designations Map (Bedrock) © Environment Agency

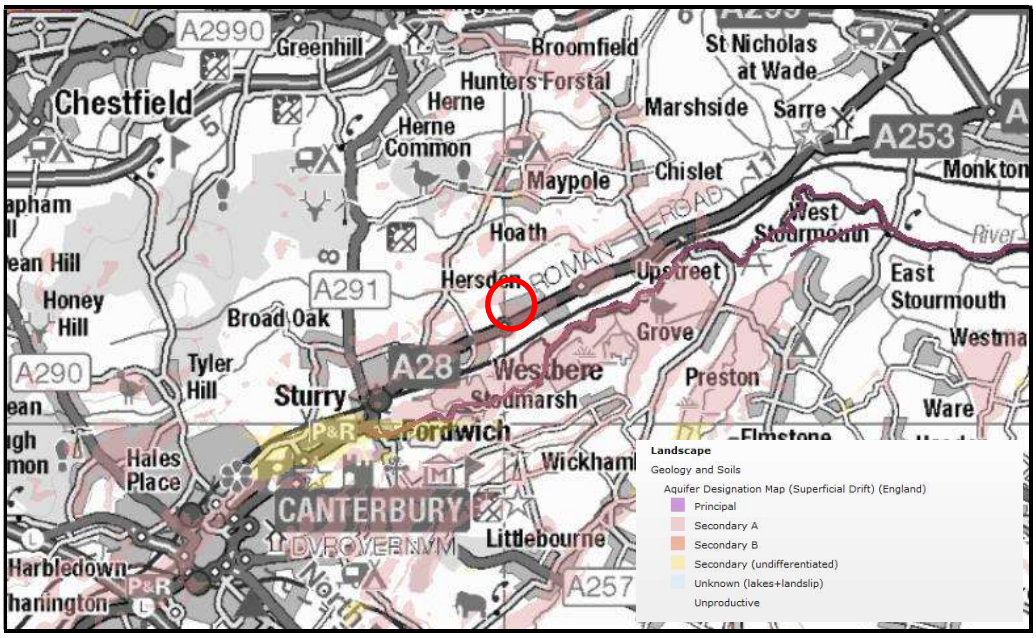

Figure 2.9 – Aquifer Designations Map (Superficial Drift) © Environment Agency

As noted within the figures above, the site is above a Secondary A aquifer (within the superficial drift). These are layers of deposits that have high intergranular and/or fracture permeability – meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a local scale. In most cases, principal aquifers are aquifers previously designated as a minor aquifer.

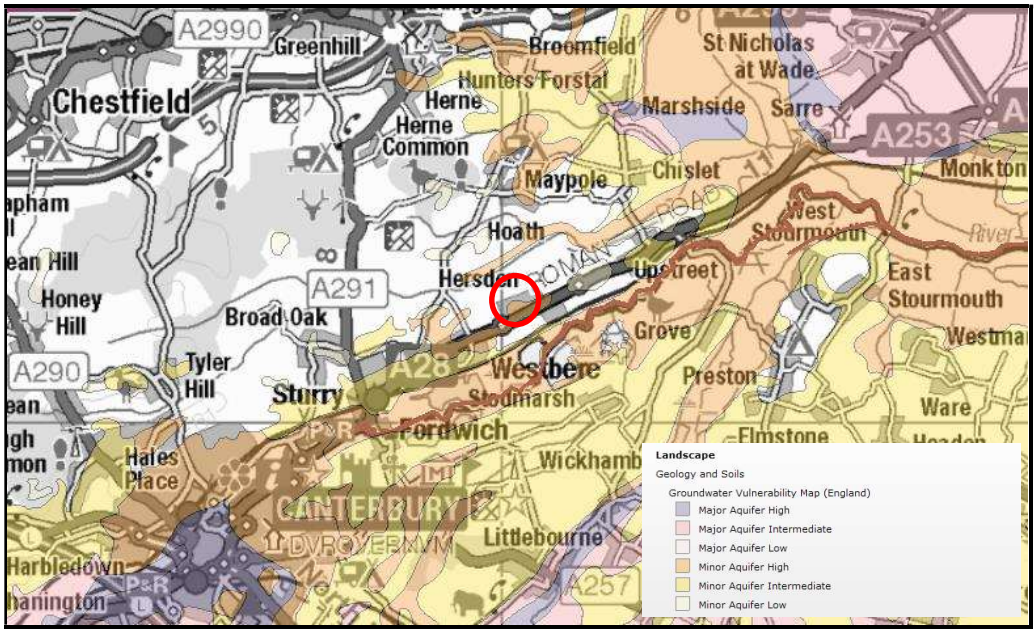

Figure 2.10 – Groundwater Vulnerability Zone Map © Environment Agency

As noted within the above figure, the site is located adjacent to but not deemed to be within the Minor Aquifer High Groundwater Vulnerability Zone. The site is deemed to be within the Minor Aquifer Low Groundwater Vulnerability Zone.

It is important to understand that pollution risks are an issue for the underlying geology. As such the risk of Pollution can be assessed using the Source, Pathway, Receptor model as follows.

Source – there are two sources of potential contamination on the site. Firstly, contamination as a result of current and previous site activities and secondly from the proposed site activities. The existing site is developed with low contamination risk. The proposed development is for educational purposes. Therefore, although there shall be an increase risk of contamination, it is still considered low.

Pathway – the pathway is the vertical movement of water through the subsoils and the bedrock. This can be by direct surface down soakage or from drainage features such as soakaways or other infiltration systems. The infiltration potential is low at the site, and therefore the opportunities for ingress of contaminants is also low.

Receptor – the receptor is the groundwater within the underlying geology. The site groundwater level has not yet been determined, however due to proposed site location being outside of any sensitive receptors (as above) there is low risk to any receptors.

Water Quality and Surface Water runoff is addressed later in this report.

3 Proposed Development

The proposal is to construct a new modular classroom block with toilet facilities, and additional parking within the existing car park area.

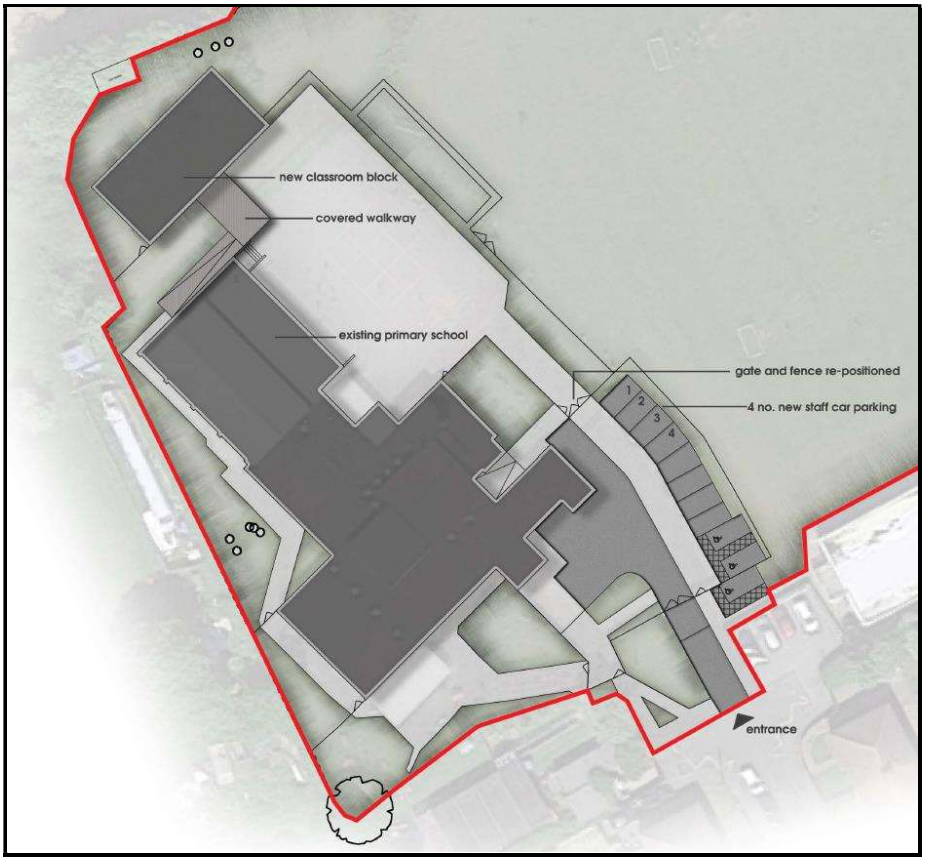

Figure 3.1 – Proposed Site Plan – full drawing within Appendix 1.

The proposed development impermeable areas are shown in the figure below and are summarised as follows:

Total Site Area:	**11,914 m²**	(approx.)
Retained Existing Roof & Canopy Area:	1,155 m²	
Proposed Roof & Canopy Area:	264 m²	
Retained Existing Impermeable Hardstandings:	1671 m²	
Proposed Impermeable Hardstandings:	124 m²	(approx.)
Total Development Impermeable Area:	**3214 m²**	

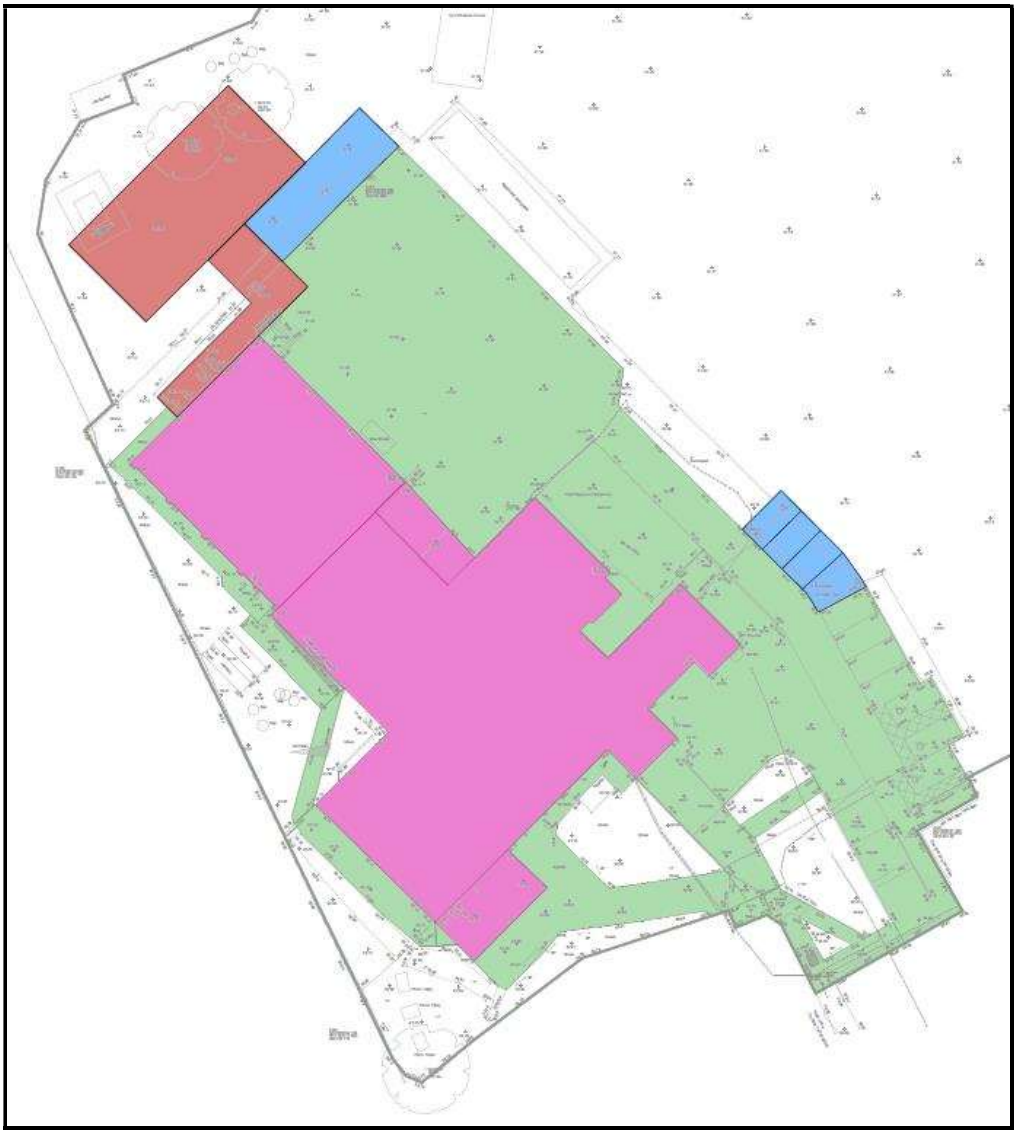

Figure 3.2 – Drained Areas Analysis Extract (Post-Development)

The proposed design increases the total impermeable area by 72m^2.

In accordance with KCC's Drainage and Planning Policy Statement, non-residential developments do not need to provide an allowance for urban creep.

Therefore, an impermeable area increase of 72m^2 needs to be considered for surface water design.

4 Flood Risk

4.1 Scoping Study

This Flood Risk Assessment (FRA) is based on the guidance provided within section 10 of the NPPF and accompanying Planning Practice Guidance (PPG). As according to the PPG, a site typically requires a specific detailed FRA where the total site area is greater than 1ha or the site is found to be at risk of flooding.

As per the Environment Agency's Flood Map for Planning, the site is noted to be within Flood Zone 1. Flood Zone 1 is defined as having a low probability of flooding (less than 1:1000 annual probability).

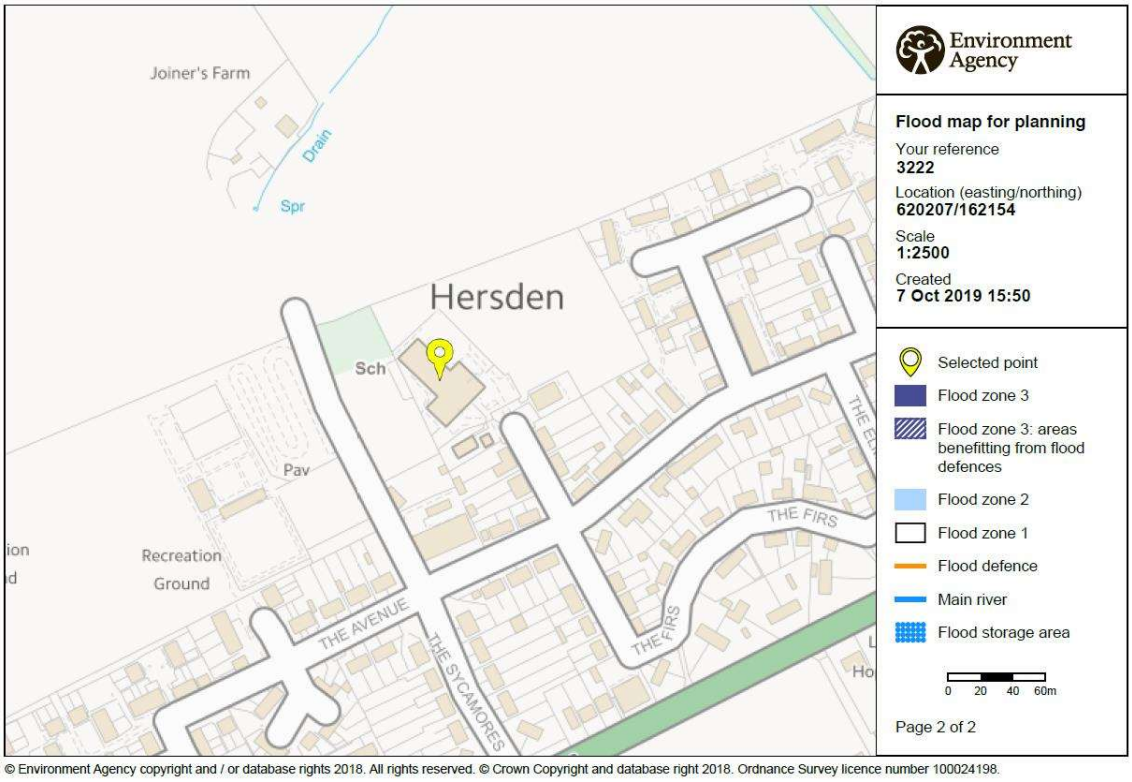

Figure 4.1 – Extract of Environment Agency's Flood Map for Planning – full report is shown at Appendix 2 of this report.

For the avoidance of doubt, the Environment Agency's Long Term Flood Risk Map has been interrogated. The site is noted to be at very low risk of flooding (less than 1:1000 annual probability).

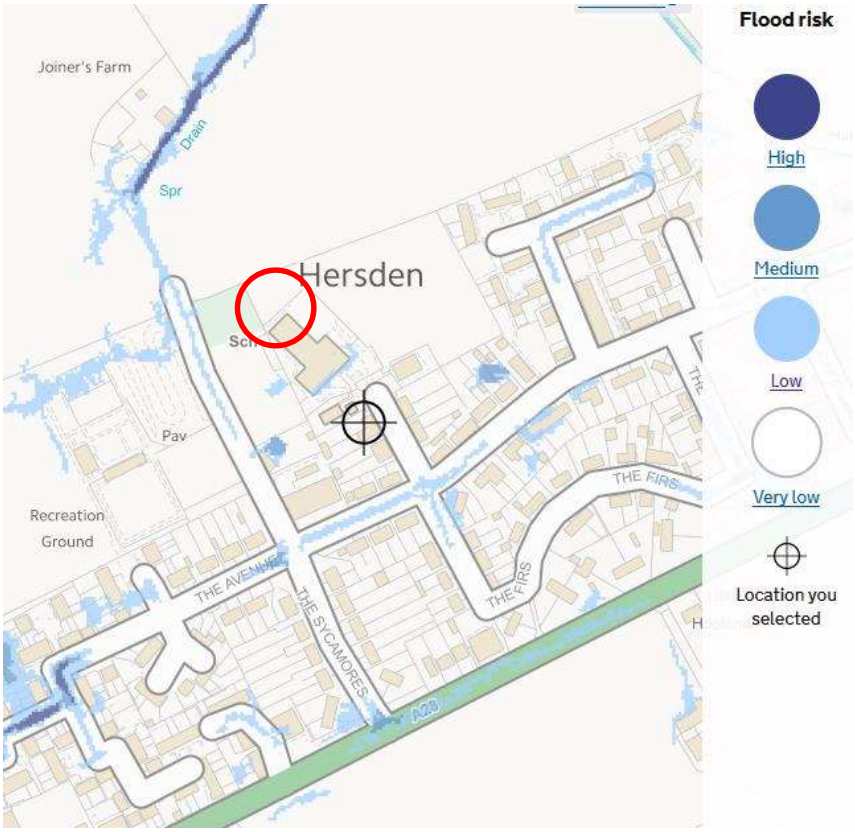

Figure 4.2 – Extract of Environment Agency's Surface Water Flood Map.

The site comprises an existing school, with the proposed development equating to a total works area of approximately 440m^2. Whilst the entire school site asset is 11,914m^2, the site is within Flood Zone 1 and with the proposed development area being less than 1 ha it is deemed that there is no requirement for an FRA.

4.2 Flood Risk Summary

As the proposed development area is less than 1ha and there is no noted risk of flooding to the development, it is deemed, in accordance with PPG, that an FRA is not required.

5 Proposed Foul Water Strategy

5.1 Existing Development FW System

The existing site discharges via combined sewer network to the West of the existing access.

This is assumed to discharge to a public sewer network, however sewer records have not been obtained to-date.

The existing structure appears to have had a previous extension to the north west which accommodates a hall and shower facilities. This extension foul water drains to the East and discharges to a pumping station which appears to lift flows circa 200mm and gravity discharge under the older part of the structure to the combined network to the South before discharging off-site.

The existing pump system appears to be failing and the proposed network looks to provide a new pump to convey foul water from the new development as well as the section of existing structure.

5.2 Capacity Check

Since the OFWAT Regulation changes of April 2018 it is no longer a requisite to check available capacity. The new requirement is for the sewer authority to accept all discharge from new development sites into their nearest available sewer. In exchange they receive an enhanced connection payment per dwelling in order to fund network improvements. If the local network does not have available capacity and the improvement programme is not going to be completed until sometime after the development is complete, then the sewer authority (Southern Water Services) can work with the developers to agree temporary solutions to the capacity issue – these measures can include on site storage or timed pumping.

The proposal is to construct a new classroom block with 7 new wash basins and 7 new toilets..

Existing Occupancy

The existing site comprises an existing primary school and accompanying facilities. Therefore the site already discharges foul water to the main sewer network.

Proposed Occupancy

The FW expected to be generated by the new classroom block has a peak flow of approximately 0.618 litres per second with an average flow of 0.103 litres per second. This is calculated as follows:-

Residential Load

4 no. additional classrooms located within the vicinity of the new toilets, assumed 30 students per class with one teacher. Classrooms assumed as maximum occupancy throughout the day.
Total population (P) = 124.

Adjusted population (P) = 124 x 0.8 = 99.

Total occupancy of 99 persons at 90 litres per day (Flows and Loads – non-residential school with on-site catering facilities) = 8,910 l/day.

8,910 / (24x60x60) = 5,400 / 86,400 = 0.103 l/s average which is 0.618 l/s peak flow.

This is an increase in peak flow by approximately 0.618 l/s. It is a requirement that the local drainage authority is consulted to approve the additional incoming connections (new connected facilities) connecting from the new development to the public sewer network. This would typically be completed under a formal Section 106 connection agreement.

5.3 Foul Water Strategy

On the basis of the above, it is proposed that the foul network is connected to the existing sewer network (on-site) to discharge off-site via the existing drainage network.

The existing structure appears to have had a previous extension to the north west which accommodates a hall and shower facilities. This extension foul water drains to the East and discharges to a pumping station which appears to lift flows circa 200mm and gravity discharge under the older part of the structure to the combined network to the South before discharging off-site.

The existing pump system appears to be failing and the proposed network looks to provide a new pump to convey foul water from the new development as well as the section of existing structure.

The proposals attached show the location of the new pump which will include appropriate emergency wet well storage and will accommodate flows from the existing and proposed. The pump will lift flows into the existing network at a similar location to the existing and re-use the existing downstream network to discharge.

6 Proposed Surface Water Strategy

6.1 Existing Surface Water Strategy

The majority of the existing site discharges surface water to the two existing soakaways located to the North and East of the existing building.

It is noted that an element of the existing surface water discharges to the existing combined drainage network.

It is important to note that the British Geological Survey indicates that the site is underlain by London Clay Formation and partially covered with superficial deposits of gravels, sands, silts and clays. As such we would typically expect the site to offer relatively poor soakage potential, however the presence of the two existing soakaways indicate that discharge via infiltration is being utilised for the current building.

It is also noted that the school has not reported any incidents of surface water flooding and the Environment Agency surface water flood mapping (Figure 4.2) shows minimal surface water flooding (Low) giving confidence that there is soakage available on the site and this should be confirmed by a BRE 365 soakage test prior to commencement of the detailed design.

One of these soakaways is located under the proposed building location and therefore will need to be decommissioned and appropriately backfilled. The proposed strategy places a new geocellular soakaway within the field area which will be designed to accommodate the new structure as well as the areas previously draining to the old soakaway.

6.2 Existing Run Off Rates

The existing site comprises an existing school with paved and grassed areas.

The underlying geology from review of BGS data indicates that the site is likely impermeable in terms of infiltration. Accordingly, the existing runoff rates have been calculated using HR Wallingford's Greenfield runoff rate estimation tool for sites.

Table 6.1 - Summary of Existing Greenfield Runoff Rates obtained from HR Wallingford for a minimum area of 0.1 ha.

QBAR (l/s):	0.22
1 in 1 year (l/s):	0.18
1 in 30 years (l/s):	0.50
1 in 100 year (l/s):	0.69

Methods for managing surface water are discussed in the following sections.

6.3 Managing Surface Water

The management of surface water has been assessed in accordance with the guidance set out in Ciria report C753 'The SuDS Manual 2015'.

To mimic the natural catchment processes as closely as possible, a "management train" is required. This concept is fundamental to successful management of surface water and employs drainage techniques in series to incrementally reduce pollution, flow rates and volumes.

The hierarchy of techniques and processes that should be considered in developing the management train are as follows:

- **Prevention.** The use of good site design and housekeeping measures to prevent run off transporting pollutants to the drainage system.
- **Source Control.** Control of run off at or very near to its source. This includes disposal methods that comprise soakaways and other infiltration techniques, green roofs and permeable pavements.
- **Site Control.** Management of surface water locally within a development site. This includes disposal techniques that comprise infiltration structures and detention basins.
- **Regional Control.** Management of run off from a site, or series of sites, typically in a balancing pond or wetland. However, for this development regional controls do not apply.

6.4 Managing Surface Water – Scheme Proposals

Wherever possible, surface water should be managed in small cost effective landscaped features located within small sub catchments rather than being conveyed to and managed in large systems at the bottom of the drained area. The techniques that are higher in the hierarchy are preferred to those further down so that prevention and control of water at source should always be considered before site or regional controls. However, where upstream opportunities are restricted, a number of lower hierarchy options should be used in series and water should only be conveyed elsewhere if it cannot be dealt with on site.

Prevention

Due to the minimal parking and access road area, it is reasonable to provide pollution prevention measures such as deep trapped gullys and catchpit chambers.

Source Control

As already noted, source control features include permeable pavements and other infiltration structures which are explored further as follows.

Permeable Pavements - provide a pavement suitable for pedestrian or vehicle traffic, while allowing rainwater to infiltrate through the surface and into the underlying layers. The water is temporarily stored before either infiltrating into the ground below or discharging to piped outfall. They are traditionally 'shallow' structures with a depth to formation of around 350mm, depending on the traffic conditions and recorded soakage rate/discharge rate.

Permeable pavements also offer an extra stage of pollution control as a direct result of their construction. The permeable sub bases and block work laying course can remove between 60% and 95% of total suspended solids and 70% to 90% of hydrocarbons. When subjected to low level oil drips, such as in car parks, the pavements can continue to biodegrade the hydrocarbons indefinitely. 'Pollution Prevention Guideline' PPG 3 (Environment Agency, 2006) identified the beneficial performance of permeable pavements in removing pollution from runoff.

It stated that: "*Techniques that control pollution close to the source, such as permeable surfaces or infiltration trenches, can offer a suitable means of treatment for runoff from low risk areas such as roofs, car parks, and non-operational areas*". Permeable pavements are more effective at removing a wider range of pollutants from runoff than oil separators (Ciria, 2004).

It is anticipated that infiltration is limited, but possible at the site. Although permeable pavements can be lined and act as attenuation, it is deemed that the external works merely look to extend the existing surfaces to maintain uniform construction and aesthetic within these areas. Additionally, the area of hardstanding increase is low and it is believed contaminants can be adequately controlled via deep gully traps and catchpits. Therefore, permeable pavements have not been recommended for this site.

Swales – The development site layout does not naturally lend itself to the widespread use of swales. There are some areas that could include an element of swale if the detailed design of the other elements allows sufficient space, but this has been discounted in the assessment thus far.

Ponds – The development site layout does not naturally lend itself to the use of ponds for infiltration or attenuation purposes.

Green Roofs - comprise a multi-layered system that covers the roof of a building or podium structure with vegetation/landscaping over a drainage layer. They are designed to intercept and retain rainfall and reduce the volume of run off and attenuate peak flows. Green roofs should be designed to attenuate all storms up to and including the peak 2 year event, they will also contribute to attenuation of peak flows during larger storm events. This should be taken in to account when sizing downstream drainage systems.

Ciria Report C753 gives advice on the installation of green roofs and states that they operate at their optimum at angles between 0 and 18 degrees. Ciria Report C644 states that a green roof comprising a strata thickness between a 100mm and 150mm offers between a 50% and 60% reduction in run off when compared to an impermeable surface of equivalent area, depending on pitch. Ciria C753 states that on roofs steeper than 18 degrees, design input should be sought from the specific manufacturer to prevent rapid run off.

It should also be noted that extensive green roofs can increase the self-weight of a roof by up to 5.0kN/m^2, depending on the specific manufacturer and planting mix. Specialist structural design input is required to ensure the roof can support the increased loading imposed by the green roof.

The proposed construction does not naturally lend itself to utilising green roofs. Green roofs have therefore been discounted for this development.

Site Control

The use of a geocellular soakaway provides a means to retain and infiltrate all the surface water that falls on the proposed classroom block provides 100% site control. The proposed car parking extension will tie into the existing drainage network which will also discharge to the existing soakaway (subject to assessment of the existing asset). An element of site control must include provision for Climate Change. The Technical Guidance to the National Planning Policy Framework States that:

"*In making an assessment of the impacts of climate change on flooding from land, rivers and the sea as part of a flood risk assessment, the sensitivity ranges in table 5 may provide an appropriate precautionary response to the uncertainty about climate change impacts on rainfall intensities, river flow, wave height and wind speed*"

Table 5: Recommended national precautionary sensitivity ranges for peak rainfall intensities, peak river flows, offshore wind speeds and wave heights

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	*+5%*	*+10%*	*+20%*	*+30%*
Peak river flow	*+10%*	*+20%*		
Offshore wind speed	*+5%*		*+10%*	
Extreme wave height	*+5%*		*+10%*	

Figure 6.1 – NPPF Technical Guidance, Table 5

It is assumed that the lifetime of the development will be in excess of 100 years. Over this period climate change is predicted to cause an increase in rainfall of 5% rising to 30% in the period 2085 – 2115.

However, KCC have adopted recently emerging government policy which calls for an increase in allowance for climate change to 40%. This policy determines that the drainage design accommodates the 1 in 100 year storm with a 20% allowance for climate change, with

an additional analysis undertaken to understand the flooding implication for a greater climate change allowance of 40%.

Therefore, the surface water drainage strategy will include a 20% within the drainage network, but will also assess the flooding implications of a 40% allowance from increased rainfall intensities as a direct result of climate change.

The proposal is to utilise a geocellular soakaway. Accordingly, all storm events up to and including the critical 100-year event with a 40% allowance for climate change will be assessed when considering the volume for the infiltration structures.

Flow Control & Attenuation

The existing site is green space, this is to be mimicked where possible. As noted previously, the anticipated runoff is less than 2.0l/s for the 1:100 year event.

It is considered that devices used to restrict runoff to less than 2.0l/s are often subject to maintenance issues and therefore cause a greater flood risk.

When a flow control is used, surface water from a proposed development and associated hard standings should be positively drained and flow via gravity to a geocellular attenuation tank with 95% voids. A vortex flow control, downstream of the attenuation tank, would restrict discharge to the public sewer to the required rate.

Although no infiltration test has been undertaken at the time of writing, it has been assumed that infiltration is viable due to the presence of existing soakaways and no reported surface water flooding on the site. It is important to note that the existing geology would typically indicate poor soakage potential, and therefore a full BRE365 infiltration test should be undertaken to confirm assumptions prior to detailed design.

No flow control and connected attenuation is required for this site as the proposals look to infiltrate all surface water into the ground

Soakaway Proposals

The surface water from the proposed roof, canopy and associated hardstandings shall be positively drained and flow via gravity to a geocellular infiltration system with 95% voids.

Although no infiltration test has been undertaken at the time of writing, it has been assumed that infiltration is viable due to the presence of existing soakaways and no reported surface water flooding on the site. It is important to note that the existing geology would typically indicate poor soakage potential, and therefore a full BRE365 infiltration test should be undertaken to confirm assumptions prior to detailed design.

The preliminary design calculations, appended to this report, indicate that one (approx.) 280m^3 geocellular soakaway structure shall fully accommodate the 1:100 year storm event with a 20% climate change allowance. In the event of a 1:100 year storm + 40% climate change (or an exceedance event), surface water is anticipated to discharge over the existing

grassed playing field (school asset) to the East following existing levels. The volume of this exceedance is estimated as 27m^3 (1:100 year event + 40% climate change).

The preliminary design notes that for the assumed soakage rate (5x10^{-6} m/s) the 24 hour half drain time requirement can not be met. Therefore the preliminary design is sized to incorporate a storm on storm event (ie a 1 in 10 Year + 40% climate change storm occurring directly after a 1:100 + 40% climate change storm event).

A drainage strategy layout has been appended to this report, which identifies the strategic network and associative infiltration features.

6.5 Exceedance and Surface Water Conveyance

Exceedance routes closely follow those that currently exist and shall be provided by appropriate existing external levels design during the detailed design stage. The exceedance routes shall need to accommodate system failure and events greater than the 1:100 year event inclusive of a 20% climate change allowance. Exceedance routes have been shown on the appended drainage strategy layout.

6.6 SuDS Hierarchy

The SuDS Hierarchy has been considered and the results are found within Appendix 5.

6.7 Surface Water Strategy Summary

As the proposed works sits on current undeveloped parts of the site and there are existing soakaways on the existing site, it is assumed that the site presents soakage potential and the proposed works can utilise a new proposed soakaway.

Although no infiltration test has been undertaken at the time of writing, it has been assumed that infiltration is viable due to the presence of existing soakaways and no reported surface water flooding on the site. It is important to note that the existing geology would typically indicate poor soakage potential, and therefore a full BRE365 infiltration test should be undertaken to confirm assumptions prior to detailed design.

The surface water from the proposed roof, canopy and associated hard standings shall be positively drained and flow via gravity to a geocellular infiltration system with 95% voids.

The geo-cellular infiltration system will be sized to accommodate a 1 in 100 year storm event with a 20% allowance for future climate change. This is in accordance with KCC's Drainage and Planning Policy Statement (June 2017). Exceedance over and above this design storm is deemed to discharge onto the existing grassed playing field (school asset) to the east and follow existing contours.

It is anticipated that a condition will be imposed on a planning permission requiring further details of the surface water drainage system to be submitted for approval.

It is evident from the aforementioned that a suitable surface water network can be provided that accords with National and Local Planning Policy Guidance in addition to KCC's Drainage and Planning Policy Statement (June 2017).

7 Conclusions

This document has been produced in accordance with current best practice and recommendations and guidance set out in the National Planning Policy Framework (NPPF) and as required by Kent County Council's Drainage and Planning Policy Statement (2017).

The report concludes:

- The site is a county primary school with the proposed building to be located on an undeveloped landscaped area to the North of the existing school building. The school itself, is bounded by residential to the East and South, amenity facilities to the West and agricultural land to the North.

- A review of the BGS online bedrock mapping tool has identified that the development site is underlain by the London Clay Formation and partly overlain with superficial deposits of Head (Gravel, sands, silts and clays).

- No infiltration test has been undertaken at the time of writing, it has been assumed that infiltration is viable due to the presence of existing soakaways and no reported surface water flooding on the site. It is important to note that the existing geology would typically indicate poor soakage potential, and therefore a full BRE365 infiltration test should be undertaken to confirm assumptions prior to detailed design.

- A review of the Environment Agency's online mapping tool has identified that the site is within Flood Zone 1, and at low risk of flooding from Rivers and Sea.

- A review of the Environment Agency's Long Term Flood Risk Map has identified the site is at very low risk of flooding (less than 1:1000 annual probability).

- The proposal is to construct a new modular classroom block with toilet facilities, and additional parking within the existing car park area.

- An assessment of peak foul water flow has been carried out in accordance with 'Sewers for Adoption 7th Edition'. It is anticipated that there shall be an increase in peak flow by approximately 0.618 l/s.

- It is proposed that the foul network is to discharge to the existing sewer via the existing combined drainage network on school site. A connection is subject to a formal Section 106 connection agreement with Southern Water.

- The surface water from the proposed buildings and hardstandings shall flow through a gravity network with the final discharge point at the proposed infiltration system.

- A 280m^3 geocellular soakaway with minimum 95% voids is required, based on an assumed infiltration rate of 5x10^{-6} m/s.

- The surface water drainage strategy will include a 20% allowance from increased rainfall intensities as a direct result of climate change, and will be assessed to understand the flooding implication for a greater climate change allowance of 40% and above.

- It is evident that the site can be drained satisfactorily in accordance with Local and National Planning Policy Guidance. The details of the drainage systems should be the subject of suitably worded Planning Conditions which would require the schemes to be submitted to the local authority for approval prior to construction work commencing.

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Appendix 1

Proposed Site Plan

general notes:
do not scale from the drawing. all dimensions shall be checked on site prior to commencing works.
all works shall conform to the current edition of the building regulations and other relevant statutory requirements.
all materials and workmanship shall conform with the relevant british standard specifications and codes of practice.
this drawing is the copyright of gdm architects and shall not be copied or reproduced without permission.
this drawing shall be read in conjunction with gdm architect's health and safety risk assessments and all works shall be carried out in a safe manner, by competent persons.
drawing produced by gdm architects ltd trading as gdm architects.

Rev	Description	Dr	Date

gdm architects
the master's house, college road, maidstone, kent. ME15 6YF
t: 01622 760670 e: info@gdmarchitects.co.uk w: gdmarchitects.co.uk

client: Kier / Gen2

project: Watermeadows Primary School

drawing: Site Plan

date: 10/03/19 drawn by: lh

scale: 1 : 500 @A3 checked: ge

project number	drawing number	revision
4110	P001	

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Appendix 2

Environment Agency Flood Map for Planning Purposes

Flood map for planning

Your reference	Location (easting/northing)	Created
3222	**620207/162154**	**7 Oct 2019 15:50**

Your selected location is in flood zone 1, an area with a low probability of flooding.

This means:

- you don't need to do a flood risk assessment if your development is smaller than 1 hectare and not affected by other sources of flooding
- you may need to do a flood risk assessment if your development is larger than 1 hectare or affected by other sources of flooding or in an area with critical drainage problems

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

Environment Agency

Flood map for planning

Your reference
3222

Location (easting/northing)
620207/162154

Scale
1:2500

Created
7 Oct 2019 15:50

- Selected point
- Flood zone 3
- Flood zone 3: areas benefitting from flood defences
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Flood storage area

0 20 40 60m

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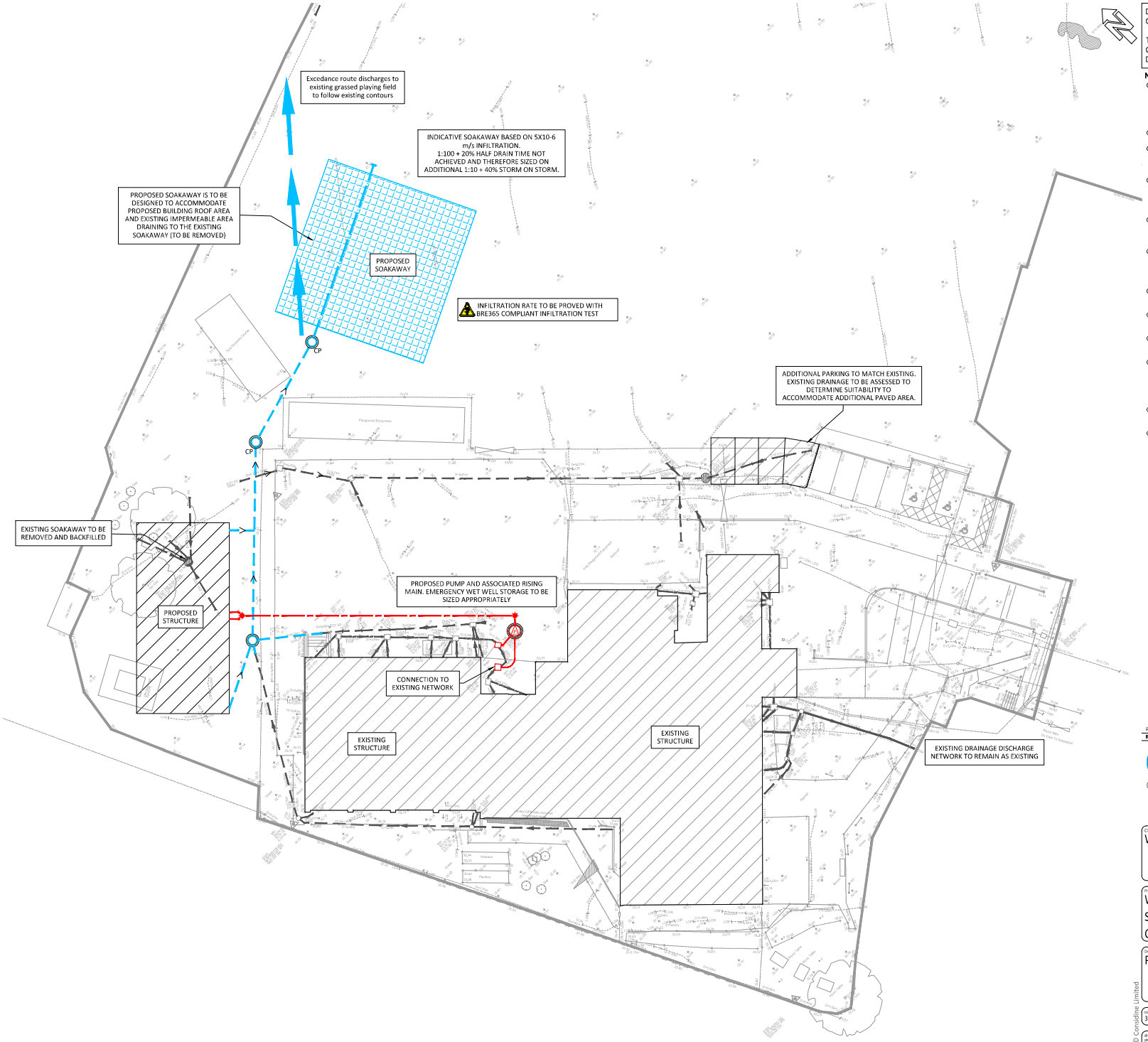
Appendix 3

FW and SW Drainage Strategy

CDM 2015 RESIDUAL RISKS

1. Contractor is to identify, protect and minimise work on, to and/or adjacent to protected structures, grounds, etc. in line with Historic England Guidelines.
2. The Contractor is to locate, protect and divert as necessary all existing services on site prior to commencing work.
3. All areas of excavation are to be scanned and marked for existing services prior to any excavation.
4. Be aware of possible live drainage flows and foul effluent during construction. The Contractor shall assess and implement a safe working system and equipment (PPE) as necessary.
5. When working with live drainage there is an increased risk from waterborne diseases such as leptospirosis and weils disease.
6. Unauthorised access to the site must be prevented at all times.
7. Support or batter back as necessary excavations in unstable ground.

The above residual risks are for non-standard hazards. It is assumed that a competent contractor familiar with the construction of this type of work will be appointed who will be aware ofthe standard hazards.



KEY

- Proposed Surface Water Pipe Ø and gradient TBC
- Proposed Permeable Surface Water Pipe Ø and gradient TBC
- Proposed Foul Water Pipe Ø and gradient TBC
- Proposed Foul Water Rising Main
- Existing Surface Water Pipe Ø and gradient TBC
- Existing Foul Water Pipe Ø and gradient TBC
- Existing Combined Water Pipe Ø and gradient TBC
- Proposed Surface Water PPIC size TBC
- Proposed Foul Water PPIC size TBC
- Proposed Surface Water Manhole Pre Cast Concrete - Circular Size TBC
- Proposed Foul Water Manhole Precast concrete - Circular Size TBC
- CP Proposed Catchpit

1m 2m 3m 4m 5m 10m 15m 20m
SCALE 1-200

DO NOT SCALE THIS DRAWING. ALL SETTING OUT TO ARCHITECTS DETAILS AND DRAWINGS

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWING ISSUES AND THE SPECIFICATION.

Notes:

G1. All building materials, components and workmanship to comply with the appropriate public health acts, building regulations, british standards and codes of practice and the appropriate manufacturers recommendations.

G2. For all specialist work see relevant drawings.

G3. Any discrepancies, errors or omissions to be reported to the project co-ordinator for further instructions before commencement of works.

G4. The Engineer is not responsible for dimensions, except where shown on his drawings. All setting out information, dimensions, etc, shall be calculated from the Architects drawings.

G5. All private drainage shall comply with the requirements of the Building Regulations approved Document H.

G6. All drainage forming part of, &/or final connection to a public sewer shall comply with the requirements of Sewers for Adoption 7th Edition.

G7. Cover levels are shown indicative only and are subject to final adjustment on site.

G8. All FW pipes to be 100mm diameter unless noted otherwise,

G9. All SW pipes to be 100mm diameter unless noted otherwise.

G10. Minimum depth to invert of foul branch pipes to SVP/SS below finished floor level to be:

450mm 0 - 3 storey's
750mm 4 - 5 storey's

G11. Gradient of under floor branch pipes to be 1:40 and no flatter than 1:80 (minimum of 1 WC connected).

G12. All RWP, SVP and SS positions are subject to confirmation from the architect.

Rev	Amendment	Drn	Chk	Date
P01	PRELIMINARY ISSUE	MJF	RSC	03.10.19

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Client:
WATER MEADOWS PRIMARY SCHOOL

Project:
WATER MEADOWS PRIMARY SCHOOL
SHAFTESBURY ROAD, HERSDEN
CANTERBURY, CT3 4HS

Drawing Title:
PROPOSED DRAINAGE STRATEGY

considine ref	drawn by	date	drawing status	original paper size
3222	MJF	OCT'19	1:200@A1, 1:400@A3	A1

drawing reference : project - originator - volume - level - type - role - number
3222 - CON - 00 - XX - DR - C - SK100

status :	status description :
S0	SUITABLE FOR INFORMATION
revision :	revision status :
P01	PRELIMINARY

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Appendix 4

Drained Areas Analysis

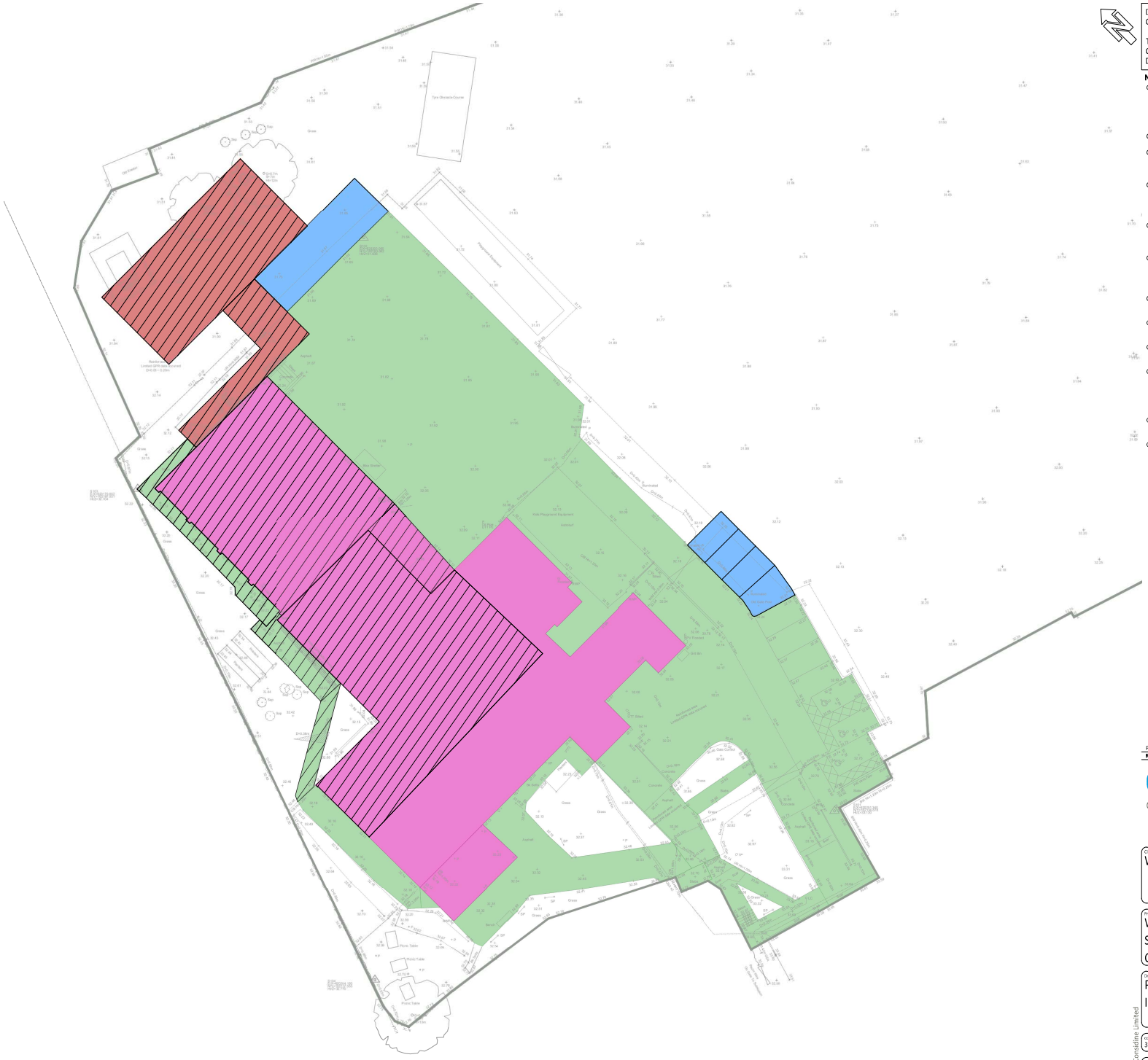
CDM 2015 RESIDUAL RISKS

1. Contractor is to identify, protect and minimise work on, to and/or adjacent to protected structures, grounds, etc. in line with Historic England Guidelines.
2. The Contractor is to locate, protect and divert as necessary all existing services on site prior to commencing work.
3. All areas of excavation are to be scanned and marked for existing services prior to any excavation.
4. Be aware of possible live drainage flows and foul effluent during construction. The Contractor shall assess and implement a safe working system and equipment (PPE) as necessary.
5. When working with live drainage there is an increased risk from waterborne diseases such as leptospirosis and weils disease.
6. Unauthorised access to the site must be prevented at all times.
7. Support or batter back as necessary excavations in unstable ground.

The above residual risks are for non-standard hazards. It is assumed that a competent contractor familiar with the construction of this type of work will be appointed who will be aware ofthe standard hazards.

KEY

	Retained Existing Roof & Canopy Area:	1155m²
	Retained Existing External Area:	1671m²
	Proposed Roof & Canopy Area:	264m²
	Proposed External Area:	124m²
	Proposed Component Area discharging to proposed soakaway	1077m²



1m 2m 3m 4m 5m 10m 15m 20m
SCALE 1-200

DO NOT SCALE THIS DRAWING. ALL SETTING OUT TO ARCHITECTS DETAILS AND DRAWINGS

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWING ISSUES AND THE SPECIFICATION.

Notes:

G1. All building materials, components and workmanship to comply with the appropriate public health acts, building regulations, british standards and codes of practice and the appropriate manufacturers recommendations.

G2. For all specialist work see relevant drawings.

G3. Any discrepancies, errors or omissions to be reported to the project co-ordinator for further instructions before commencement of works.

G4. The Engineer is not responsible for dimensions, except where shown on his drawings. All setting out information, dimensions, etc, shall be calculated from the Architects drawings.

G5. All private drainage shall comply with the requirements of the Building Regulations approved Document H.

G6. All drainage forming part of, &/or final connection to a public sewer shall comply with the requirements of Sewers for Adoption 7th Edition.

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G8. All FW pipes to be 100mm diameter unless noted otherwise.

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G10. Minimum depth to invert of foul branch pipes to SVP/SS below finished floor level to be:

450mm 0 - 3 storey's
750mm 4 - 5 storey's

G11. Gradient of under floor branch pipes to be 1:40 and no flatter than 1:80 (minimum of 1 WC connected).

G12. All RWP, SVP and SS positions are subject to confirmation from the architect.

Rev	Amendment	Drn	Chk	Date
P01	PRELIMINARY ISSUE	MJF	RSC	04.10.19

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Client:
WATER MEADOWS PRIMARY SCHOOL

Project:
WATER MEADOWS PRIMARY SCHOOL
SHAFTESBURY ROAD, HERSDEN
CANTERBURY, CT3 4HS

Drawing Title:
PROPOSED DRAINAGE STRATEGY
IMPERMEABLE AREAS

considine ref	drawn by	date	drawing scales	original paper size
3222	MJF	OCT'19	1:200@A1, 1:400@A3	A1

drawing reference :

project	originator	volume	level	type	role	number
3222	CON	00	XX	DR	C	SK101

status :	status description :
S0	SUITABLE FOR INFORMATION
revision :	revision status :
P01	PRELIMINARY

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Appendix 5

SuDS Hierarchy Assessment

The SuDS Hierarchy

Most Suitable	SuDS Technique	Flood Reduction	Pollution Reduction	Landscape and Wildlife Benefit	Included in the Scheme?	Comments
	Living Roofs	X	X	X		The proposed roof does not lend itself to living roofs.
	Basins and Ponds + Constructed + Wetlands + Detention Ponds + Retention ponds	X	X	X		Discounted due to the inherent risks of use, for the sizes required, in locations designed for regular use by children.
	Filter strips and Swales	X	X	X		Discounted due to the inherent risks of use, for the sizes required, in locations designed for regular use by children.
	Infiltration Devices + soakaway + infiltration trench + infiltration basin	X	X	X	X	Soakaways have been proposed due to presence of existing soakaways on site.
	Permeable surfaces and filter drains + gravelled areas + porous surfaces + engineered grass + solid paving blocks + resin bound + filter trenches	X	X	X	X	Minimal proposed hard-standing areas. Hardstanding areas will drain to existing landscaped areas or existing soakaway.
	Tanked System + oversized pipes/ crated tanks / storage cells	X	X	X		Not required as infiltration is proposed.
Least Suitable						

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Appendix 6

Preliminary Surface Water Network Calculations

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 5495 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	95.422	0.422	0.1	34.9	O K
30 min Summer	95.556	0.556	0.2	45.9	O K
60 min Summer	95.695	0.695	0.2	57.4	O K
120 min Summer	95.839	0.839	0.2	69.4	O K
180 min Summer	95.945	0.945	0.2	78.1	O K
240 min Summer	96.032	1.032	0.2	85.3	O K
360 min Summer	96.179	1.179	0.2	97.5	O K
480 min Summer	96.305	1.305	0.2	107.9	O K
600 min Summer	96.411	1.411	0.2	116.6	O K
720 min Summer	96.501	1.501	0.2	124.0	O K
960 min Summer	96.638	1.638	0.3	135.4	O K
1440 min Summer	96.806	1.806	0.3	149.2	O K
2160 min Summer	96.913	1.913	0.3	158.1	O K
2880 min Summer	96.943	1.943	0.3	160.6	O K
4320 min Summer	96.908	1.908	0.3	157.7	O K
5760 min Summer	96.856	1.856	0.3	153.4	O K
7200 min Summer	96.803	1.803	0.3	149.1	O K
8640 min Summer	96.752	1.752	0.3	144.8	O K
10080 min Summer	96.702	1.702	0.3	140.7	O K
15 min Winter	95.422	0.422	0.1	34.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	118.646	0.0	19
30 min Summer	78.283	0.0	34
60 min Summer	49.102	0.0	64
120 min Summer	29.832	0.0	124
180 min Summer	22.503	0.0	184
240 min Summer	18.532	0.0	244
360 min Summer	14.252	0.0	364
480 min Summer	11.933	0.0	484
600 min Summer	10.404	0.0	604
720 min Summer	9.294	0.0	722
960 min Summer	7.727	0.0	962
1440 min Summer	5.852	0.0	1442
2160 min Summer	4.323	0.0	2160
2880 min Summer	3.445	0.0	2880
4320 min Summer	2.464	0.0	4020
5760 min Summer	1.933	0.0	4672
7200 min Summer	1.599	0.0	5408
8640 min Summer	1.369	0.0	6216
10080 min Summer	1.200	0.0	6968
15 min Winter	118.646	0.0	19

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	95.556	0.556	0.2	46.0	O K
60 min Winter	95.695	0.695	0.2	57.5	O K
120 min Winter	95.840	0.840	0.2	69.4	O K
180 min Winter	95.945	0.945	0.2	78.1	O K
240 min Winter	96.032	1.032	0.2	85.3	O K
360 min Winter	96.180	1.180	0.2	97.5	O K
480 min Winter	96.307	1.307	0.2	108.0	O K
600 min Winter	96.413	1.413	0.2	116.8	O K
720 min Winter	96.503	1.503	0.2	124.2	O K
960 min Winter	96.641	1.641	0.3	135.6	O K
1440 min Winter	96.810	1.810	0.3	149.6	O K
2160 min Winter	96.921	1.921	0.3	158.8	O K
2880 min Winter	96.956	1.956	0.3	161.7	O K
4320 min Winter	96.931	1.931	0.3	159.6	O K
5760 min Winter	96.865	1.865	0.3	154.1	O K
7200 min Winter	96.809	1.809	0.3	149.5	O K
8640 min Winter	96.751	1.751	0.3	144.7	O K
10080 min Winter	96.693	1.693	0.3	139.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	78.283	0.0	34
60 min Winter	49.102	0.0	64
120 min Winter	29.832	0.0	122
180 min Winter	22.503	0.0	182
240 min Winter	18.532	0.0	242
360 min Winter	14.252	0.0	360
480 min Winter	11.933	0.0	478
600 min Winter	10.404	0.0	596
720 min Winter	9.294	0.0	714
960 min Winter	7.727	0.0	952
1440 min Winter	5.852	0.0	1414
2160 min Winter	4.323	0.0	2116
2880 min Winter	3.445	0.0	2792
4320 min Winter	2.464	0.0	4104
5760 min Winter	1.933	0.0	4840
7200 min Winter	1.599	0.0	5616
8640 min Winter	1.369	0.0	6488
10080 min Winter	1.200	0.0	7464

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
FEH Rainfall Version	2013	Cv (Winter)	1.000
Site Location	GB 620224 162139	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.118

Time (mins) From:	To:	Area (ha)
0	4	0.118

Model Details

Storage is Online Cover Level (m) 100.000

Cellular Storage Structure

Invert Level (m) 95.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00900 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.01800

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	87.0	87.0	2.001	0.0	161.6
2.000	87.0	161.6			

Summary of Results for 10 year Return Period (+40%)

Half Drain Time : 4953 minutes.

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	95.291	0.291	0.1	24.1	O K
30 min Summer	95.376	0.376	0.1	31.1	O K
60 min Summer	95.467	0.467	0.1	38.6	O K
120 min Summer	95.588	0.588	0.1	48.6	O K
180 min Summer	95.664	0.664	0.1	54.9	O K
240 min Summer	95.719	0.719	0.1	59.4	O K
360 min Summer	95.796	0.796	0.1	65.8	O K
480 min Summer	95.851	0.851	0.2	70.3	O K
600 min Summer	95.892	0.892	0.2	73.7	O K
720 min Summer	95.925	0.925	0.2	76.5	O K
960 min Summer	95.976	0.976	0.2	80.7	O K
1440 min Summer	96.039	1.039	0.2	85.9	O K
2160 min Summer	96.087	1.087	0.2	89.9	O K
2880 min Summer	96.109	1.109	0.2	91.6	O K
4320 min Summer	96.134	1.134	0.2	93.8	O K
5760 min Summer	96.158	1.158	0.2	95.7	O K
7200 min Summer	96.181	1.181	0.2	97.6	O K
8640 min Summer	96.202	1.202	0.2	99.3	O K
10080 min Summer	96.223	1.223	0.2	100.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	81.691	0.0	19
30 min Summer	52.841	0.0	34
60 min Summer	32.861	0.0	64
120 min Summer	20.770	0.0	124
180 min Summer	15.692	0.0	184
240 min Summer	12.796	0.0	244
360 min Summer	9.527	0.0	364
480 min Summer	7.695	0.0	484
600 min Summer	6.509	0.0	604
720 min Summer	5.671	0.0	722
960 min Summer	4.558	0.0	962
1440 min Summer	3.342	0.0	1442
2160 min Summer	2.445	0.0	2160
2880 min Summer	1.961	0.0	2856
4320 min Summer	1.443	0.0	3500
5760 min Summer	1.169	0.0	4216
7200 min Summer	1.000	0.0	5040
8640 min Summer	0.884	0.0	5872
10080 min Summer	0.800	0.0	6656

Summary of Results for 10 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Winter	95.291	0.291	0.1	24.1	O K
30 min Winter	95.376	0.376	0.1	31.1	O K
60 min Winter	95.467	0.467	0.1	38.6	O K
120 min Winter	95.588	0.588	0.1	48.6	O K
180 min Winter	95.664	0.664	0.1	54.9	O K
240 min Winter	95.719	0.719	0.1	59.4	O K
360 min Winter	95.797	0.797	0.1	65.8	O K
480 min Winter	95.851	0.851	0.2	70.3	O K
600 min Winter	95.893	0.893	0.2	73.8	O K
720 min Winter	95.926	0.926	0.2	76.5	O K
960 min Winter	95.977	0.977	0.2	80.7	O K
1440 min Winter	96.042	1.042	0.2	86.1	O K
2160 min Winter	96.092	1.092	0.2	90.3	O K
2880 min Winter	96.118	1.118	0.2	92.4	O K
4320 min Winter	96.136	1.136	0.2	93.9	O K
5760 min Winter	96.156	1.156	0.2	95.5	O K
7200 min Winter	96.173	1.173	0.2	96.9	O K
8640 min Winter	96.185	1.185	0.2	98.0	O K
10080 min Winter	96.195	1.195	0.2	98.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Winter	81.691	0.0	19
30 min Winter	52.841	0.0	34
60 min Winter	32.861	0.0	64
120 min Winter	20.770	0.0	124
180 min Winter	15.692	0.0	182
240 min Winter	12.796	0.0	242
360 min Winter	9.527	0.0	360
480 min Winter	7.695	0.0	478
600 min Winter	6.509	0.0	596
720 min Winter	5.671	0.0	714
960 min Winter	4.558	0.0	950
1440 min Winter	3.342	0.0	1412
2160 min Winter	2.445	0.0	2096
2880 min Winter	1.961	0.0	2740
4320 min Winter	1.443	0.0	3588
5760 min Winter	1.169	0.0	4432
7200 min Winter	1.000	0.0	5336
8640 min Winter	0.884	0.0	6232
10080 min Winter	0.800	0.0	7160

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	10	Cv (Summer)	1.000
FEH Rainfall Version	2013	Cv (Winter)	1.000
Site Location	GB 620224 162139	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.118

Time (mins) From:	To:	Area (ha)
0	4	0.118

Model Details

Storage is Online Cover Level (m) 100.000

Cellular Storage Structure

Invert Level (m) 95.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.03600

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	87.0	87.0	1.221	0.0	132.5
1.220	87.0	132.5			

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Appendix 7

Greenfield Runoff Rates

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Mike Frazer
Site name:	Water Meadows Primary
Site location:	Hersden

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

Site Details

Latitude:	51.31608° N
Longitude:	1.15850° E
Reference:	2550077721
Date:	Oct 04 2019 17:01

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha):	.1

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Calculate from dominant HOST
HOST class:	18
BFI / BFIHOST:	0.52
Q_{MED} (l/s):	0.19
Q_{BAR} / Q_{MED} factor:	1.14

Hydrological characteristics

	Default	Edited
SAAR (mm):	615	615
Hydrological region:	7	7
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	0.22	0.22
1 in 1 year (l/s):	0.18	0.18
1 in 30 years (l/s):	0.5	0.5
1 in 100 year (l/s):	0.69	0.69
1 in 200 years (l/s):	0.81	0.81