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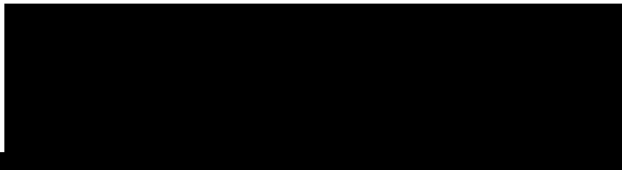
Mill Lane, Rustington

Drainage Strategy Report

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1.0 Introduction

This report has been produced to demonstrate compliance with current guidance on the choice of sustainable drainage components serving the proposed development at land adjacent to Mill Lane, Rustington, Littlehampton, West Sussex.

This document has been produced in accordance with current best practise and the recommendations and guidance set out in CIRIA C697 'The SuDs Manual'.

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2.0 The management of Surface Water

A SUDS approach to drainage can be implemented for all development sites, although individual site constraints may limit the potential for a solution to achieve maximum benefits for all functions.

Appropriately designed, constructed and maintained SUDS systems are considered more sustainable than conventional drainage methods as they mitigate many adverse effects on the environment caused by surface water run-off. They achieve this by reducing run-off rates and volumes and reducing pollutant concentrations in run-off, further protecting the receiving water course.

2.1 The Hierarchal Approach

"The SUDS Manual" makes the recommendation that a hierarchical approach should be followed when selecting suitable components for the management of surface water drainage.

The hierarchy is to provide where practical:

- Source Control - the control run-off at or very close to its source through the use of infiltration, green roofs, permeable pavements or rainwater harvesting.
- Intermediate Control – the control of run-off through intermediate structures such as swales, soakaways or porous pavements.
- Final Control - localised management of surface water by routing run-off from roofs or car parks to larger soakaways or detention structures.

The hierarchy forms a management train that aims to replicate the natural catchment process as closely as possible. This process is fundamental to designing a successful SUDS scheme as it uses a series of drainage techniques to incrementally reduce pollution, flow rates and volumes.

2.2 Selection of Individual Components

The selection of a suitable component is governed by a number of considerations such as soil type, soil soakage potential, slope of the site, topography, ecology and the sites natural drainage. The selection of components will seek to replicate the existing drainage conditions of the site.

Soil conditions

Site investigations have confirmed that the site is underlain by soils with soakage potential but a high water table has also been identified due to the existing topography of the site and its natural slope towards an existing watercourse.

Further details of the site investigation are given in the following chapter of this report.

Component selection

Suitable components have been selected according their location on site and the relative height above the groundwater level.

1. Northern west part of the site (Store Properties Investments Ltd development)

High ground level with sufficient clearance to the groundwater level determines that permeable pavements with infiltration sub-base would be suitable. This provides both source control and pollution control.

2. Northern east part of the site (Group 1 Automotive development)

Groundwater levels result in insufficient clearance to the groundwater level determines that permeable pavements with storage sub-base would be suitable. Final discharge would be via a controlled outfall to the existing watercourse, with the balance in volumes attenuated. This provides both source control and pollution control.

3. Southern Part of the Site (general)

Lower ground levels alongside the existing watercourse combined with higher groundwater levels, means that infiltration becomes impractical as the required clearance between the groundwater levels and the underside of a soakage structure cannot be achieved. It is therefore proposed that a runoff from this portion of the development is discharged to the existing watercourse via a controlled outfall with the balance in volumes attenuated in underground storage tanks. This provides a final control before discharging to the watercourse.

4. Rainwater Harvesting (Group 1 Automotive development)

Rainwater harvesting has been proposed for the eastern part of the development site as it was considered a sustainable solution to this developments water demand. A 60,000 litre tank will collect 'clean' run-off from roof areas. Excess flows will be directed into the adjacent surface water drainage system and discharged to the existing watercourse via a controlled outfall. This provides a source control and water recycling facility for the proposed development.

3.0 Site Investigations

Geo-Environmental Services Ltd were commissioned to carry out intrusive testing and investigations at the proposed development site, which included groundwater monitoring and infiltration tests. The results of which have been discussed below.

3.1 Ground Water Monitoring

Geo-Environmental Services Ltd installed twelve monitoring wells in various locations across the development site. These wells monitored groundwater depths and flows over a period of 6 months. The following table provides depths of groundwater recorded between November 2013 and April 2014.

Groundwater Depths (mbgl)							
Location	Elevation mAOD	Nov	Dec	Jan	Feb	Mar	Apr
BH1	3.77	1.85	5.88	1.28	1.45	1.47	1.77
BH2	3.02	0.90	3.00	0.31	1.43	0.55	0.86
BH3	1.82	0.00	0.00	0.00	0.00	0.00	0.54
BH4	5.13	3.05	5.90	2.54	2.72	2.73	2.99
BH5	4.80	2.53	4.85	2.05	0.00	2.82	2.46
BH6	4.30	2.23	4.06	1.88	2.01	2.00	2.15
BH7	5.08	3.55	4.02	0.00	0.00	3.13	3.50
BH8	4.73	3.12	4.02	2.64	0.00	2.80	3.07
BH9	3.27	1.83	3.05	1.55	1.63	1.66	1.84
BH10	4.33	2.48	4.93	1.85	2.07	2.06	2.45
BH11	3.68	1.74	4.82	1.13	1.30	1.32	1.69
BH12	2.46	0.55	3.30	0.00	0.00	0.00	0.48

Table 3.1 – Groundwater Depths

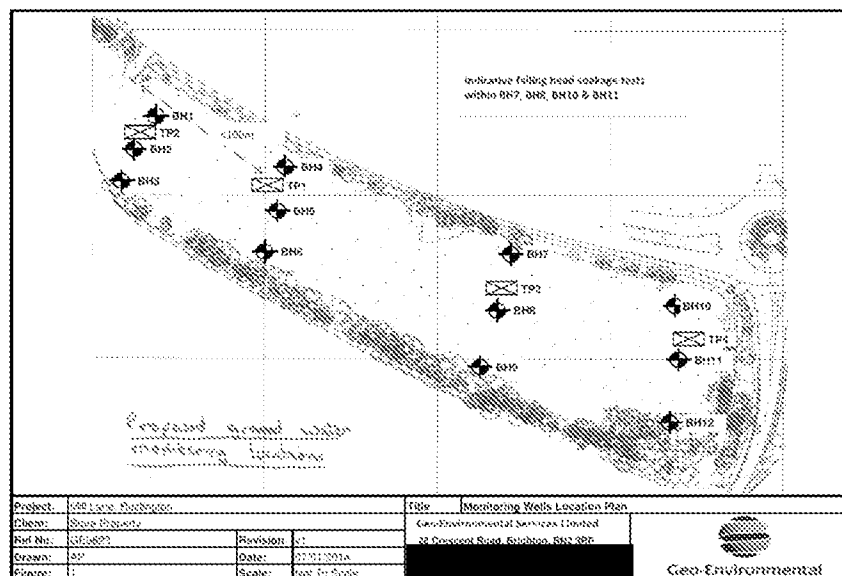


Figure 3.1 – Groundwater Monitoring Locations

It is clear to see from the above that 5 of the 12 monitoring wells recorded groundwater levels at 0.00m below ground level and would therefore have caused surface flooding. A level of 0.00m was recorded in BH3, BH5, BH7, BH8 and BH12 during the month of February.

Groundwater in the remaining seven wells remained below ground level with the greatest depths being recorded in BH4, BH10, BH6 and BH1, with depths ranging between 3.3 and 2.3m below ground level.

Full details of details of the geotechnical engineers report can be found in Appendix 1.

3.2 Infiltration Testing

Geo-Environmental Services Ltd attended site on the 12th February 2014 to undertake full scale soakage testing and indicative falling head soakage testing. A full BRE365 compliant soakage test was carried out in TP1 (refer to figure 3.1 for location) and resulted in an infiltration rate of 2.2×10^{-4} m/s.

Due to access limitations full scale soakage testing could only be carried out in the western side of the site. Falling head soakage tests were undertaken in BH7, BH8, BH10 and BH11 (refer to figure 3.1 for location). However, due to the high infiltration rate it was not possible to raise head more than 0.04m above the ground water level.

Full details of details of the geotechnical engineers report can be found in Appendix 1.

3.3 Summary

The soakage testing has identified that infiltration is a viable method of surface water disposal. However, the results of the groundwater monitoring places restrictions on the location and type of soakage structure that can be used.

It has been identified that the groundwater levels in the north west and north east portions of the development site remain at a level sufficient to allow a soakage system to be constructed in these locations. Current guidance states that a minimum of 1.0m, clear, must be maintained at all times between the groundwater level and the base of any soakage structure.

It is therefore believed that traditional soakage structures (i.e soakaways) could not be of sufficient size to accommodate the development while maintaining the required separation at all times of the year. We would therefore propose the use of other forms of soakage system i.e permeable pavements, as the increased infiltration area results in a reduced depth of construction.

It is also proposed that any drainage system constructed to the southern portion of the development site be sufficiently protected against the ingress of ground water.

4.0 Design Philosophy

The development site area totals approximately 3.93Ha and is currently undeveloped. However, the total area has been sub divided into two smaller development sites. The west site (Store Properties Investments Ltd development site) area totals approximately 2.33Ha and comprises the construction of retail floor space with associated access road and parking. The East site (Group 1 Automotive development site) area totals approximately 1.60 Ha and comprises the construction of a car show room and garage with associated access roads and parking.

It is proposed to control run-off from the proposed development site and limit the discharge to the existing water course. Discharge shall be limited to a rate no greater than the sites existing run-off rate, with the balance in volumes attenuated. Final discharge will be to an existing watercourse located to the development sites southern boundary.

A new public access road will be served by a dedicated highway drainage system that will collect runoff from areas of new public highway. This will be collected in an underground storage tank and discharged to the existing watercourse at a restricted rate as noted on ABMH drawings included in Appendix 1.0.

4.1 Store Properties Investments Ltd Development Site

It is proposed to construct the area of car parking, to the north of the new buildings, using porous pavements. The levels in this part of the development site provide the greatest separation between the existing ground water level and the formation of the new car park. Therefore, the porous pavements shall be designed as full infiltration systems. Should a storm occur that exceeds the capacity of the sub base an overflow link shall be provided to the adjacent buildings drainage system.

Run-off from the new buildings and remaining impermeable areas shall be drained through a conventional drainage system and collected in a geo-cellular storage tank. As infiltration is less practical in the lower parts of the development site, these tanks will provide long term storage. The outflow from the storage tanks will be restricted using a hydro-brake (or similar) flow control device limiting discharge to the development sites greenfield rate. This rate will be calculated for this proportion of the total site area.

It is proposed that the retail units and the service road are served by their own dedicated surface water drainage system, resulting in three individual connections to the watercourse. The discharge rate of the individual connections have been adjusted to ensure the cumulative discharge from all three connections does not exceed the greenfield rate of the development site. Current drainage proposals for this development can be found in Appendix 2.

4.2 Group 1 Automotive Development Site

It is proposed to construct the area of car parking, to the north of the new buildings, using porous pavements. Unfortunately the levels in this part of the development site do not provide the requirement minimum separation between the existing ground water level and the formation of the new car park. Therefore, the porous pavements shall be designed using sub-base storage systems, with a controlled discharge to the adjacent drainage system.

Run-off from the new buildings and remaining impermeable areas shall be drained through a conventional drainage system and collected in a geo-cellular storage tank. As infiltration is less practical in this part of the development site, these tanks will provide long term storage. The outflow from the storage tanks will be restricted using a hydro-brake (or similar) flow control device limiting discharge to the development sites greenfield rate. This rate will be calculated for this proportion of the total site area. The discharge rate of the individual connections have been adjusted to ensure the cumulative discharge from both new connections does not exceed the greenfield rate of the development site.

A 60,000 litre, rainwater harvesting tank will collect 'clean' run-off from roof areas. Excess flows will be directed into the adjacent surface water drainage system and discharged to the existing watercourse via a controlled outfall. Current drainage proposals for this development can be found in Appendix 3.

4.3 Summary

Sustainable drainage components have been included in the surface water drainage systems for both parts of the development site in the form of porous paving, flow controls and Rainwater harvesting. Additional pollution controls have been introduced into the drainage systems in the form of catchpits and gulley sumps to comply with the recommendations of the SUDs Manual.

Discharge rates and storage volumes will be designed to accommodate the peak 100 year event with a 30% allowance for climate change over the life of the development in compliance with the recommendations of the SUDS Manual and the National Planning Policy Framework, Technical Guidance for Flood Risk.

The existing stream has been identified by the Environment Agency as an Ordinary Water Course and as such Arun District Council will be required to grant formal land drainage consent and will allow the construction of the new surface water outfalls. Detailed proposals have been submitted to Arun District Council (Appendix 4) and we currently await formal approval.

The existing watercourse is currently unfenced and access is completely unrestricted. The architect's current proposals (Appendix 2) shows a 3m wide casting way adjacent to the stream, with access controlled by a new fence and access gate. Discussions have been held with network rail, regarding maintenance access to the existing watercourse and the debates have been ongoing. Architects proposals have been included in Appendix 2.