

CASCADES LEISURE  
CENTRE, GRAVESEND,  
DA12 4LG

7313

FLOOD RISK  
ASSESSMENT &  
DRAINAGE STRATEGY

NOVEMBER 2022

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## 1 Introduction

This document comprises a Flood Risk Assessment in accordance with the National Planning Policy Framework (NPPF), including its technical guidance, in support of a planning application for redevelopment of the existing Cascades Leisure Centre.

Furness Partnership have been commissioned by the client, Gravesham Borough Council, to identify and set out the principles of approaching and managing flood risk pertaining to the proposed redevelopment.

The objective of this FRA is to:

- 1) Collect and review available information to make a qualitative assessment of all sources of flooding to the development including drainage infrastructure; fluvial and tidal sources; groundwater sources and artificial sources.
- 2) Assess the flood risk to the application site under existing and post-development conditions; and
- 3) Outline any mitigating measures needed to meet the requirements of the NPPF.

### 1.1 Data Sources / References

Data collected during the course of this assessment is presented in Table 1 below:

| Purpose                                      | Data and Source                                 | Comment                                                               |
|----------------------------------------------|-------------------------------------------------|-----------------------------------------------------------------------|
| <b>Identification of Existing Flood Risk</b> | Thameside Stage 1 SWMP                          | Surface Water Management Plan across the Kent County Council          |
|                                              | Southern Water Sewer records                    | Identification of the local drainage system near the application site |
|                                              | Gravesham Water and Flood Risk Background Paper | Flood risk assessment across Gravesham                                |
|                                              | Environment Agency                              | Site specific flood risk data                                         |
| <b>Identification of Historical Flooding</b> | Thameside Stage 1 SWMP                          | Details of Historic flooding                                          |

Table 1 Source of Data Reviewed

## 2 Site Description and Location

### 2.1 Location

The site is situated on Thong Lane, Gravesend, Kent. It is bounded by residential properties to the west, and beyond that the wider town of Gravesend develops, while to the north there is an existing golf centre, and agricultural fields to the eastern side of the site. The site location is shown in Figure 1, with the full address and Ordnance Survey Grid Reference in Table 2.

| Site Referencing Information |                                                          |
|------------------------------|----------------------------------------------------------|
| <b>Site Address</b>          | Cascades Leisure Centre, Thong Lane, Gravesend, DA12 4LG |
| <b>Grid Reference</b>        | (TQ67100 71751) (567100E, 171751N)                       |

Table 2 Site Referencing Information



Figure 1 Site Location

## 2.2 Existing Development

The site sits within land designated as greenbelt, however, as it currently houses existing buildings for leisure use, it is considered a brownfield site. It covers a total area of 4.5 hectares and is irregular in shape. The site contains the existing Cascades leisure centre together with a car park, external tennis courts, play area and a café. See Appendix A for the existing site location plan.

## 2.3 Proposed Development

The main proposals as part of the redevelopment will comprise (full specification of the proposed work is yet to be confirmed):

- Demolition of the existing leisure centre and Regans Bar & Café;
- The main leisure centre building is to be relocated to the south-east corner of the site where the existing main car park sits;
- The car park is to be relocated to the northern part of the site, which will comprise a total of 257 parking spaces.

The proposed site plan can be found in Appendix B.

## 2.4 Topography

The site lies on a small plateau within the wider Greenbelt area, and is approximately 67 metre above sea level. This tallies up with the topographical survey, which reveals a level of 66.70m at the landscaped area to the east of the existing car park, and a low point of 62-63m to the north of the existing leisure centre building.

## 2.5 Geology

According to the British Geological Survey 'Geology' viewer tool, the site has a bedrock geology of Lewes Nodular chalk formation, Seaford chalk formation and Newhaven Chalk Formation.

A Phase 1 desk study was undertaken by Albury S.I. Ltd in November 2022, which states that Thanet Sand Formation overlies the chalk towards the southern end of the site, and made ground is predominant to the northern end of the site. A detailed site investigation is yet to be undertaken to determine the specific depths and properties of the ground.

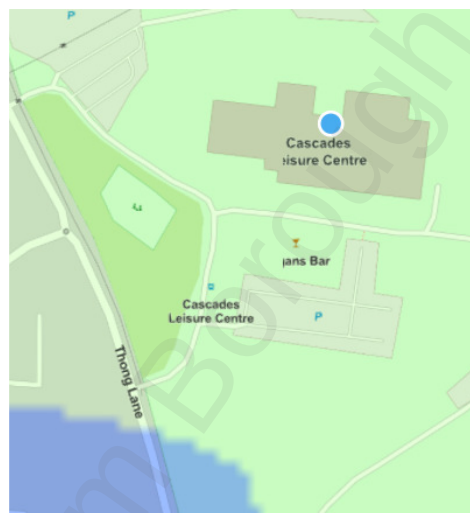


Figure 2 BGS Site Geology Map

## 2.6 Hydrology and Hydrogeology

The desk study confirms there are no watercourses within the site boundary or within 500m radius of the site. The site is, however, underlain by a Principal aquifer of high vulnerability relating to the Seaford Chalk Formation, and the Thanet Sand formation is a Secondary A aquifer. The river Thames is located approximately 2.5km away to the north.

# 3 Policy Context

## 3.1 National Policy – National Planning Policy Framework

The NPPF sets out the government's vision of sustainable development, which should be interpreted and applied locally to meet local aspirations. The National Planning Policy Framework (NPPF) technical guidance ensures flood risk is taken into account at all stages of the planning process. The aim is to avoid inappropriate development in areas at risk of flooding and direct development to low-risk areas. The NPPF retains a risk-based approach to planning and defines 3 zones (Zone 1, Zone 2, Zone 3a and Zone 3b) as the basis for applying the sequential test to developments in respect of vulnerability classification and those considered appropriate to the flood zones.

### 3.1.1 Sequential Test

The Sequential Test is undertaken to guide development to those areas at less risk of flooding. For the purpose of applying the Sequential Test and quantifying flood risk from fluvial and tidal source, flood zones are defined as per the below Figure:

| Flood Zone                        | Definition                                                                                                                                                                                                                                                                                                                                  |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Zone 1 Low Probability            | Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)                                                                                                                                                                                        |
| Zone 2 Medium Probability         | Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)                                                                                                                        |
| Zone 3a High Probability          | Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)                                                                                                                                                 |
| Zone 3b The Functional Floodplain | This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map) |

Figure 3 EA Flood Zone Classification

Figure 4 shows the classification of flood risk vulnerability and flood zone compatibility according to the Technical Guidance of NPPF. The existing site is located within flood zone 1 and is used for leisure purposes. As the proposed redevelopment is not proposing a change of use, the site is categorised as 'Less Vulnerable'. The scheme is considered appropriate within the designated flood zone for the site, and therefore, based on this classification, the Exception Test is not required.

| Flood Zones | Flood Risk Vulnerability Classification |                         |                         |                 |                  |
|-------------|-----------------------------------------|-------------------------|-------------------------|-----------------|------------------|
|             | Essential infrastructure                | Highly vulnerable       | More vulnerable         | Less vulnerable | Water compatible |
| Zone 1      | ✓                                       | ✓                       | ✓                       | ✓               | ✓                |
| Zone 2      | ✓                                       | Exception Test required | ✓                       | ✓               | ✓                |
| Zone 3a †   | Exception Test required †               | ✗                       | Exception Test required | ✓               | ✓                |
| Zone 3b *   | Exception Test required *               | ✗                       | ✗                       | ✗               | ✓*               |

Key:

✓ Development is appropriate

✗ Development should not be permitted.

Figure 4 Flood Zone Sequential Test

### 3.2 Flood and Water Management Act

The Flood and Water Management Act (FWMA) 2010 outlines roles and responsibilities for the implementation of Sustainable Drainage Systems (SuDS) in developments. Drainage systems must comply with national standards. Kent County Council is the Lead Local Flood Authority (LLFA) for the development area and in accordance with the FWMA are responsible for coordinating the management of flood risk from surface, groundwater, and ordinary watercourses. The LLFA acts a statutory consultee on surface water and SuDS proposals.

### 3.3 Regional and Local Development Documents and Policies

#### 3.3.1 Local Flood Risk Management Strategy 2017-2023 (KCC)

Kent County Council (KCC) is the Lead Local Flood Authority (LLFA) for the Borough of Kent. The aims of KCC's local flood risk management strategy are as follows:

- *To support and improve the safety and wellbeing of Kent's residents and the economy of Kent through appropriate flood risk management;*
- *To ensure that we all work together effectively to understand and deliver appropriate flood risk management in Kent*
- *To contribute to sustainable development, regeneration and land management in Kent through the promotion of sustainable flood risk management practices that utilise natural processes where appropriate.*

#### 3.3.2 Preliminary Flood Risk Assessment

A Preliminary Flood Risk Assessment (PFRA) was published in 2011 for Kent County Council. The aim of the PFRA is to provide an assessment of local flood risk across the study area; the key objectives of the document are listed below:

- *Summarise the methodology adopted from the PFRA with respect to data sources, availability and review procedures.*
- *Assess historic flood events within the study area from local sources of flooding (including flooding from surface water, groundwater and ordinary watercourses), and the consequences and impacts of these events.*
- *Establish an evidence base of historic flood risk information, which will be built up on in the future and used to support and inform the preparation of Kent's Local Flood Risk Strategy.*
- *Assess the potential harmful consequences of future flood events within the study area.*
- *Review the provisional national assessment of indicative Flood Risk Areas provided by the Environment Agency and provide explanation and justification for any amendments required to the Flood Risk Areas.*
- *Describe arrangements for partnership and collaboration for ongoing collection, assessment and storage of flood risk data and information.*

### 3.3.3 Thameside Stage 1 Surface Water Management Plan (SWMP)

Northern Kent (Gravesham Borough Council) falls within Thameside's SWMP, which aims to investigate local flooding issues arising in sewers, drains, groundwater and runoff caused by periods of heavy rainfall. According to KCC's website, the benefits of the SWMP are:

- *an increased understanding of local flooding,*
- *an increased understanding of where local flooding will occur,*
- *an action plan to identify measures to mitigate local flooding,*
- *an increased awareness of the duties and responsibilities for managing flood risk of different partners and stakeholders, and*
- *improved public engagement and understanding of local flooding.*

The plan has been produced in partnership with internal drainage boards, sewerage companies and the Environment Agency.

### 3.3.4 Gravesham Local Plan Core Strategy 2014

The Local Plan Core Strategy is the key document in the Gravesham Local Plan. It sets out the main planning policies for any new development or proposed redevelopment within Gravesham Borough Council.

The key policy relevant to this report is 'Policy CS18: Climate Change', which requires all proposed sites at risk of flooding to be accompanied by a Flood Risk Assessment, and they must pass the Sequential and Exception Tests. Section 5.14.40 also states:

*'The Council will seek to minimise the impact of drainage from new development on waste water systems. In particular, the Council will:*

- *Require that surface water run-off from all new development has, as a minimum, no greater adverse impact than the existing use; and*
- *Require the use of Sustainable Drainage Systems on all developments where technically and financially feasible.'*

## 4 Definition of Flood Hazard

### 4.1 Fluvial and Tidal Flood Risk

River (fluvial) flooding takes place when a river's capacity is exceeded and it bursts its banks, forcing the overtopping water onto surrounding land.

The application site lies within Flood Zone 1 as identified within the Environment Agency's indicative flood zone map (Figure 5). This indicates that the application site has been assessed as having between 0.01% (1 in 10000) and 0.1% (1 in 100) annual probability of river flooding i.e., low probability of flooding.

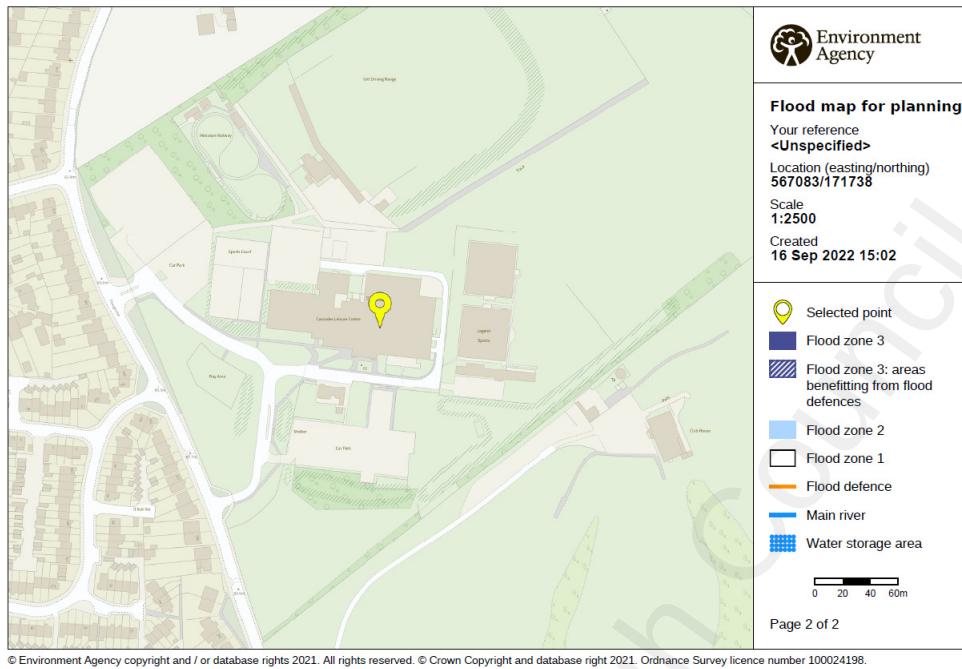


Figure 5 EA Flood Zone Map

## 4.2 Flooding from Artificial Sources

Artificial flood sources include raised channels such as canals or storage features such as ponds and reservoirs.

The Environment Agency dataset 'risk of flooding from reservoirs' shows that the proposed site is not affected by reservoir flooding.

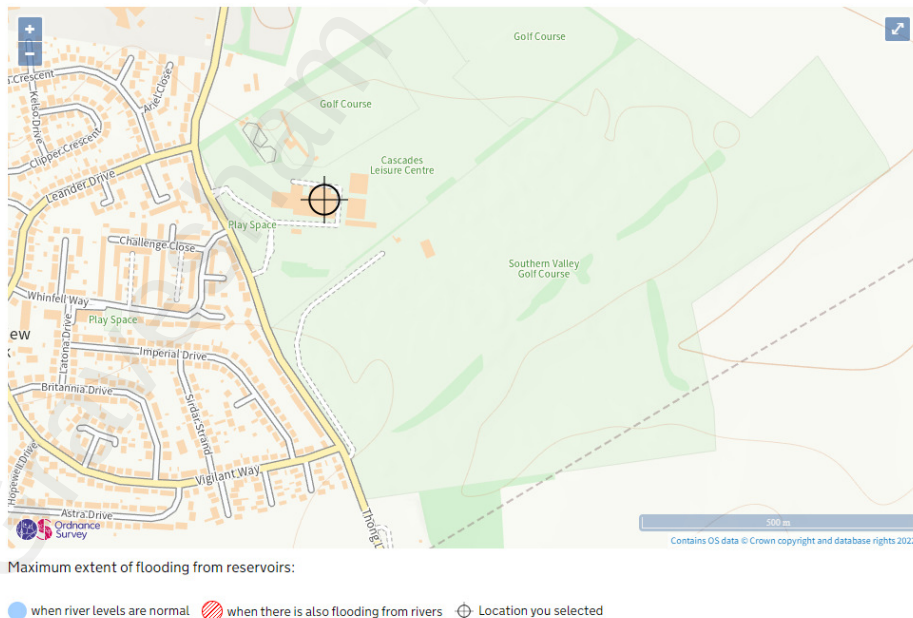


Figure 6 Flooding from reservoirs

### 4.3 Groundwater Flooding

The British Geological Survey (BGS) online mapping, indicates that the site lies within a medium-high groundwater vulnerability area, which corroborates with the Phase 1 desk study, however, there has been no recorded occurrence of groundwater flooding within or in the vicinity of the site area at the time of writing this report.

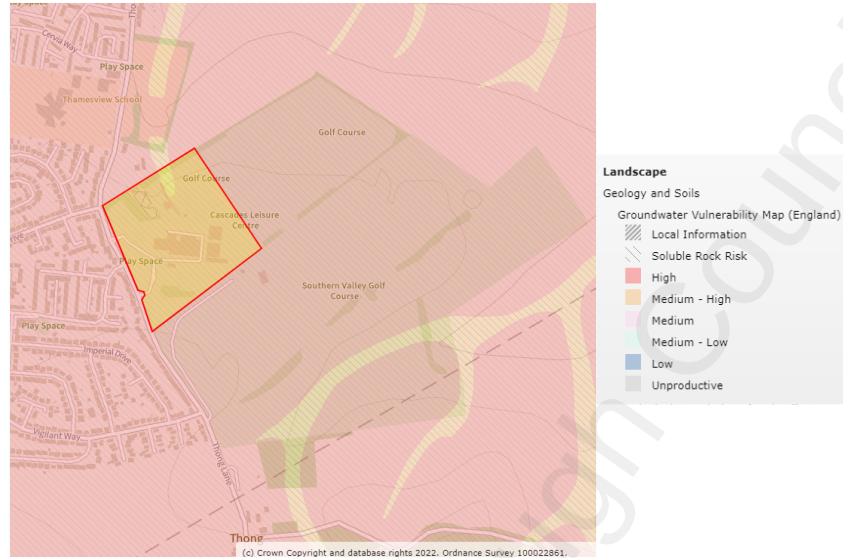


Figure 7 Groundwater vulnerability

### 4.4 Sewer Flooding

No records of sewer flooding in the vicinity of the site have been identified at the time of writing this report.

### 4.5 Overland Flooding

Overland flooding is caused when water does not penetrate into the ground due to the surface being impermeable (not porous). It also occurs when the ground is already saturated or because drains are not functional or overwhelmed. This leaves the water with nowhere to go to and as a result, it will remain or flow on the surface.

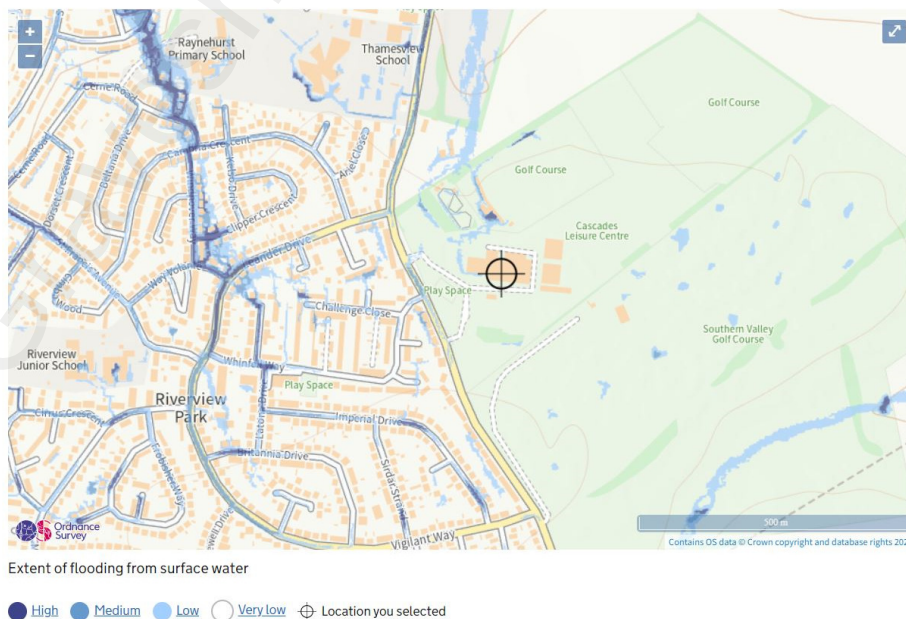


Figure 8 Flooding from surface water

The EA has provided the Flood map for surface water for the application site and surrounding area, as shown in Figure 8 above, which indicates that the site lies in a low-risk area of surface water flooding, and hence, overland flooding.

## 5 Surface Water Management and SuDS

### 5.1 Existing Surface Water Drainage

The site lies within Southern Water's wastewater responsibilities, and according to the existing asset plans, there are no surface water sewers in the vicinity of the site. The existing ground composition of the site is chalk formation, which is a good infiltration medium, and the Phase 1 desk study states that the expected groundwater profile for the site is not thought to be within 20m of the existing ground level. Therefore, for the purposes of this assessment and design, we have assumed that rainwater and subsequent surface water from the existing building and surrounding hardstanding infiltrates into the ground via soakaways.

### 5.2 Evaluation of Sustainable Drainage Systems

In accordance with best practice and requirements set out in the NPPF, and guidance from the Environment Agency, SuDS should be utilised where possible, within the planned development. It is proposed to utilise SuDS as is deemed feasible, following the hierarchy for disposal and treatment as outlined below in Table 3. A summary of comments has been provided for each method with regards to this specific development:

| SuDS Hierarchy (most to least preferred)    |                                                                                                                                                      |
|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| METHOD                                      | COMMENTS                                                                                                                                             |
| <i>Discharge into the ground</i>            | Although made ground and cohesive soils seem to be present, infiltration/percolation is feasible into the deeper layers of sand and chalk formation. |
| <i>Discharge into a surface water body</i>  | Not feasible. There does not exist any known surface water body within or near the site boundary.                                                    |
| <i>Discharge into a surface water sewer</i> | Not feasible due to lack of public surface water sewers in the vicinity of the site.                                                                 |
| <i>Discharge into a combined sewer</i>      | Not feasible. There are no combined sewers in the vicinity of the site.                                                                              |

Table 3 SuDS Hierarchy Summary

### 5.3 Proposed Surface Water Drainage / SuDS Strategy

The greenfield runoff rate for the whole site, 2.01L/s, has been calculated using the UK SuDS online tool, and can be found in Appendix E. However, as the site is brownfield in nature, it is proposed to maintain the existing rate of runoff from the site as it is considered impractical to restrict the site to its greenfield rate. For this reason, due to the existing parking area to the north-west region of the site, external tennis courts, play area and a large portion of the access roads remaining unchanged, these areas have not been included within the drainage strategy and will drain as existing. Hence, only the main areas of redevelopment will be considered for this drainage strategy.

The proposed drainage strategy is based on infiltrating/percolating the rain water directly into the ground, maintaining the assumed existing drainage strategy.

### 5.3.1 Drainage / SuDS Strategy Design Philosophy

The proposed surface water drainage strategy is split in two. The relocated leisure centre and surrounding access road/hardstanding will drain rainwater via a series of downpipes and traditional road gullies and channel drains. The relocated car park, which now sits to the northern extent of the site, will be fully surfaced with permeable paving. Perforated pipes will sit within the sub-base of the permeable paving, which itself will be lined. The network of perforated pipes will convey stormwater to the large, below ground soakaway located under the car park. The soakaway will then allow the percolation of stormwater into the surrounding Thanet sand/Lewes chalk formations.

The approximate size required for the proposed soakaway was calculated using the values listed below:

- Total site area: 4.5ha
- Proposed positively drained area: approx. 1.584ha
- SAAR: 600mm
- Rainfall ratio R: 0.409
- M5 60min: 20mm
- Climate change allowance: 20%, using Medway Management 'central allowance', due to development being classified as less vulnerable
- Soakaway type: Cellular, rectangular
- Assumed infiltration rate:  $1 \times 10^{-5}$  m/s (soakage testing has not been carried out at the site so the infiltration rate is assumed based on the BGS/Phase 1 desk study ground conditions).

This has been modelled in InfoDrainage using the positively drained area of 1.584ha. The model considers all storm durations up to the 1 in 100-year plus 20% climate change design storm.

The resulting dimensions of the cellular soakaway which produces no flooding for all storm durations is 20m x 8m x 1m depth, and 6no are proposed, one for each 'block' of parking spaces, which have a half drain down time of 1292 minutes i.e., less than the 24 hours required by BRE 365 soakage standards. The final size and location of the soakaway will depend on the detailed site investigation.

Percolation testing will need to be carried out to get a clear idea of the actual rates possible on site, in accordance with BRE 365. The proposed soakaway locations should be moved to areas where infiltration SuDS will work within the car park, hence, a matrix of percolation tests should be undertaken to determine the ideal locations.

The proposed drainage strategy has been included in Appendix F, and the InfoDrainage soakaway sizing estimate can be found in Appendix H. It should be noted that the drainage proposals in this report are outline only and further survey and assessment will be necessary as part of the detailed design stage.

### 5.3.2 Proposed Development Impact on Flood Risk / Exceedance Flows

Through the use of SuDS compliant design philosophies, with regards to runoff and stormwater treatment for adequate water quality, the proposed development adequately maintains and slightly reduces the flood risk to the receiving ground and also to the surrounding areas. The permeable

pavement mimics greenfield processes by slowing down the runoff infiltrating in to the ground while also providing a filtration and sedimentation process to better the water discharging into the groundwater. Therefore, it is expected that the proposed drainage strategy will not negatively affect the flood risk to the site.

In case of exceedance flows, it is expected that any surface flooding that occurs for heavier rainfall than the 1 in 100 year plus 20% critical storm, will simply follow the natural topography of the site and fall in a north/north-easterly direction towards the car park. Any exceedance flooding would then be bounded by the upstand kerbs proposed around the perimeter of parking, and slowly infiltrate into the ground once space becomes available within the soakaways.

### 5.3.3 Stormwater Treatment Management Train and Runoff Quality

The Surface Water treatment provided by the SuDS features will ensure that the runoff is of sufficient quality so as not to impact the receiving system.

In keeping with the CIRIA SuDS Manual philosophy, the drainage strategy proposed aims to reduce any potential pollution risk to the receiving surface water sewers and water bodies. In terms of designing for amenity and biodiversity, due to the nature of the site, there is little opportunity or value in proposing any methods to enhance either criterion, and hence, they will not be considered further.

As per Section 26 of the SuDS Manual:

*'The risk posed by surface water runoff to the receiving environment is a function of:*

- *The pollution hazard at a particular site (i.e., the pollutant source)*
- *The effectiveness of SuDS treatment components in reducing levels of pollutants to environmentally acceptable levels, and/or the effectiveness of underlying soil layers in protecting the receiving groundwater (i.e., the pollutant pathway)*
- *The sensitivity of the receiving environment (i.e., the environmental receptor).'*

To ensure the design complies with the required pollution mitigation, adequate treatment of the contributing areas will need to be provided.

The following equation needs to be complied with, for each SuDS type used:

$$\text{Total SuDS mitigation index} \geq \text{Pollution hazard index}$$

To ensure the stormwater quality is as high as possible prior to infiltrating the soil, we propose to utilise gullies and channel drains with appropriate sump units that will collect/manage any debris or silt falling into the system. Following this, the stormwater will be collected in the proposed soakaway, which will then allow the stormwater to discharge into the ground.

The Simple Index Approach has been used to assess the pollution risk for this site's SuDS strategy. According to Table 26.2 'Pollution hazard indices for different land use classifications' of the SuDS Manual, the site can be classified within the following categories:

| Land use            | Pollution hazard level | Total suspended solids (TSS) | Metals | Hydrocarbons |
|---------------------|------------------------|------------------------------|--------|--------------|
| 1 Residential roofs | Very low               | 0.2                          | 0.2    | 0.05         |

|   |                                                                                                                                                                     |        |     |                                                                        |      |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----|------------------------------------------------------------------------|------|
| 2 | Other roofs                                                                                                                                                         | Low    | 0.3 | 0.2 (up to 0.8 where there is potential for metals to leach from roof) | 0.05 |
| 3 | Individual property driveways, residential car parks, low traffic roads, and non-residential car parking with infrequent change i.e., < 300 traffic movements/day   | Low    | 0.5 | 0.4                                                                    | 0.4  |
| 4 | Commercial yard and delivery areas, non-residential car parking with frequent change, all roads except low traffic roads and trunk roads/motorways                  | Medium | 0.7 | 0.6                                                                    | 0.7  |
| 5 | Sites with heavy pollution, sites where chemicals and fuels are to be delivered, handled, stored, used or manufactured, industrial sites; trunk roads and motorways | High   | 0.8 | 0.8                                                                    | 0.9  |

Table 4 Pollution Hazard Indices

The roofs of the site would fall under category 2 - 'other roofs', and the site parking and access roads would fall under category 4. Category 4 figures will be used for this check as it encompasses a higher level of pollution risk.

The following data will be used for surface water discharge to the ground:

| Type of SuDS component                   | Mitigation indices |        |              |
|------------------------------------------|--------------------|--------|--------------|
|                                          | TSS                | Metals | Hydrocarbons |
| Proprietary treatment – SPEL Stormceptor | 0.8                | 0.6    | 0.9          |
| Permeable pavement                       | 0.7                | 0.6    | 0.7          |

Table 5 Pollution Mitigation indices

Therefore, for the proposed drainage strategy for the leisure centre and surrounding hardstanding only, the following mitigation indices will apply:

SPEL Stormceptor > Soakaway > Ground

|                     | <b>Pollution hazard indices</b> | <b>Total SuDS Mitigation indices</b> | <b>Mitigation <math>\geq</math> Pollution hazard?</b> |
|---------------------|---------------------------------|--------------------------------------|-------------------------------------------------------|
| <b>TSS</b>          | 0.7                             | 0.8                                  | Yes                                                   |
| <b>Metals</b>       | 0.6                             | 0.6                                  | Yes                                                   |
| <b>Hydrocarbons</b> | 0.7                             | 0.9                                  | Yes                                                   |

Table 6 SPEL Stormceptor Treatment Train

For the proposed drainage strategy for the main car park area only, the following mitigation indices will apply:

Permeable paving > Soakaway > Ground

|                     | <b>Pollution hazard indices</b> | <b>Total SuDS Mitigation indices</b> | <b>Mitigation <math>\geq</math> Pollution hazard?</b> |
|---------------------|---------------------------------|--------------------------------------|-------------------------------------------------------|
| <b>TSS</b>          | 0.7                             | 0.7                                  | Yes                                                   |
| <b>Metals</b>       | 0.6                             | 0.6                                  | Yes                                                   |
| <b>Hydrocarbons</b> | 0.7                             | 0.7                                  | Yes                                                   |

Table 7 Permeable Pavement Treatment Train

Therefore, the proposed treatment train for both catchment areas is considered acceptable.

#### 5.3.4 Drainage / SuDS Maintenance and Management Schedule

The maintenance and management schedule required for the proposed SuDS on site should follow the below guidelines, to ensure the risk of flooding i.e., failure of the system, is reduced and even eliminated for the lifetime of the system.

Maintenance will be in accordance with Sewerage Sector Guidance Appendix C document (May 2021), the guidance of CIRIA SuDS Manual C753 and other established best practices.

The SuDS and drainage infrastructure on site will be maintained by the developer for the maintenance period after completion and handover. Long term, the owner or a site management company will be responsible for the ongoing maintenance of the SuDS infrastructure. Table 8 outlines the maintenance schedule required for the site; however, it should be noted that for the first 3 months post practical completion and handover, maintenance should be carried out every month at a minimum. Regular maintenance schedule reviewing may be required to keep up with best practice and ensure the SuDS are remaining effective.

The developer is responsible for providing the SuDS Maintenance Plan and O&M Manual to the site Management team. The O&M manual shall be handed over to each subsequent owner of the site, and within that pack should be included any relevant engineering drawings for ease.

| <b>Drainage Infrastructure Item</b>                         | <b>General maintenance</b>                                                                                     | <b>Responsibility</b>         |
|-------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-------------------------------|
| <b>Drainage pipework</b>                                    | Jet and clean as necessary                                                                                     | Site owner/Management Company |
| <b>Manholes/silt traps/catchpits/gullies/channel drains</b> | Remove cover annually to check for any sign of blockage and (jet) clean as necessary. Empty sumps as required. | Site owner/Management Company |

|                                               |                                                                                                                                                        |                               |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| <b>SPEL Stormceptor Class 1 Oil Separator</b> | Bi-annual visual inspection, remove any significant debris/litter. Servicing as per manufacturers requirements.                                        | Site owner/Management Company |
| <b>Permeable Pavement</b>                     | Monthly brushing and vacuuming (standard cosmetic sweep over whole surface).                                                                           | Site owner/Management Company |
| <b>Cellular Soakaway</b>                      | Bi-annual inspection for sediment and debris in pre-treatment components and floor of inspection chamber. Servicing as per manufacturers requirements. | Site owner/Management Company |

Table 8 Maintenance Schedule

## 6 Foul Water Strategy

There is not much known about the existing site foul drainage at the time of writing this report, but it is expected that all existing foul drains serving the existing leisure centre will need to be removed.

The foul water flows from the new building will be collected through a new gravity system which will pick up the numerous WC's, showers, washbasins and any kitchen waste, and then discharged the flow into an assumed existing foul manhole located at the south-west corner of the site. It is assumed this then connects to a public sewer within Thong Lane. Further investigation will be needed to determine whether this proposed point of connection is in fact an existing foul manhole, and hence, the actual point of discharge to be used.

The swimming pool within the leisure centre will require a backwash tank, which has been proposed to the west of the building, although this could be located within the new plant room dependent on room available. This tank will need to be sized during detailed design, and the tank pump flow rate will either need to be maintained at the same rate as the existing tank, which is assumed to be in the basement plant room of the existing centre, or may need to be agreed with Southern Water if the total proposed pool water volume is different than existing.

All foul drainage will be designed to Building Regulations Part H, and BS 752 standards.

## 7 Conclusions

The redevelopment proposes to demolish the existing leisure centre building and construct a new one at the location of the existing parking area; the car park will be moved to the location of the existing leisure centre.

Environment Agency mapping shows that the site lies in Flood Zone 1, which indicates a low risk of flooding. The site is at a low risk from flooding when considering all sources, including surface, groundwater, overland, and fluvial. As the redevelopment does not propose a change of use, the site is considered less vulnerable, and hence, the exception test was not required to be undertaken.

For the drainage strategy design, the site has been split into two main catchment areas, the proposed leisure centre building and the new main car park to the north of the site. A total positively drained area of 1.584 hectares was used. Traditional below ground drainage will intercept rainwater falling on the leisure centre building, and a permeable pavement will cover the new car park. Both areas will connect to two cellular soakaways proposed under the car park which will enable the rainwater to discharge into the ground.

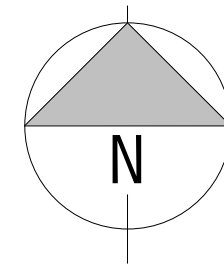
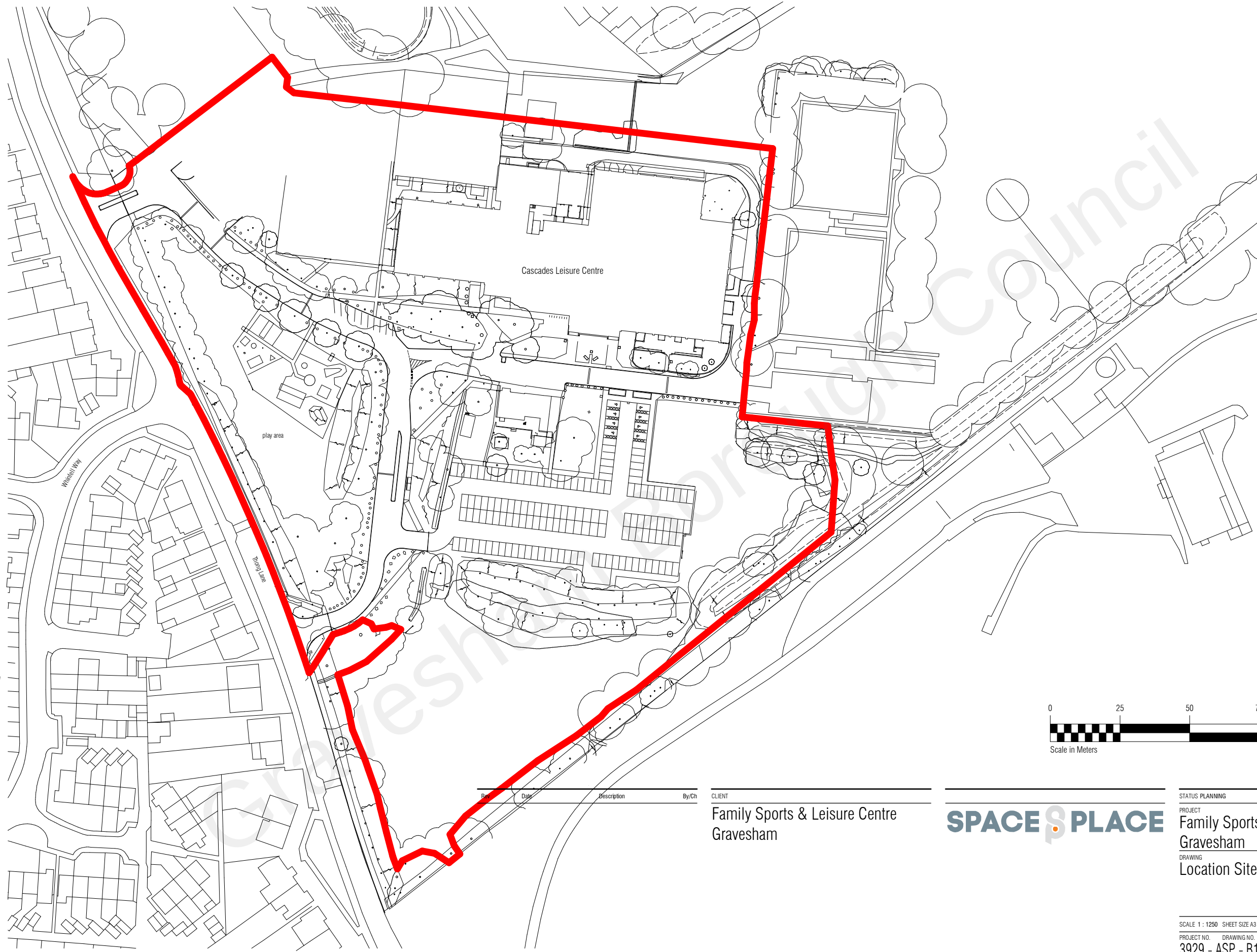
The proposed drainage strategy is considered to slightly improve the flood risk of the site, through the use of the permeable pavement and soakaway, which will ensure stormwater is slowly discharged into the ground, mimicking natural processes.

New foul drainage is proposed for the leisure centre building, which includes a pool water backwash tank, which will need to be pumped at the same rate as existing, or a rate to be agreed. The final point of connection from the site needs to be determined during later design stages.

The drainage strategy is subject to the findings of a detailed CCTV survey and a site investigation.

**APPENDIX A – Existing Site Plan**

Gravesham Borough Council



NOTES

| Rev | Date | Description | By/Ch |
|-----|------|-------------|-------|
|-----|------|-------------|-------|

CLIENT  
Family Sports & Leisure Centre  
Gravesham



STATUS PLANNING  
PROJECT  
Family Sports & Leisure Centre  
Gravesham  
DRAWING  
Location Site Plan

SCALE 1 : 1250 SHEET SIZE A3 DRAWN BY AS CHECKED BY JB DATE 10/21/22  
PROJECT NO. 3929 - ASP - B1 - XX - DR - A - 0801  
DRAWING NO. REVISION

+44 800 909 8008 answers@space-place.com www.space-place.com

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**APPENDIX B – Proposed Site Plan**

Gravesham Borough Council



NOTE

KEY LEGEND

- Property Line
- Site Area Total - 45028.93 m²
- Parking spaces
- Green/Vegetation spaces
- Car access road
- Pavement
- Retaining Wall

- A Gravesend Airfield Memorial
- B Sub-Station
- C Bin Store
- D Gas
- E Car access only for Legend Sports users and Leisure Centre Service Road

- Proposed Tree
- Existing Tree
- Tree to be replanted/demolished

Car Park numbers

203 car spaces  
15 disabled car spaces  
14 car spaces (services)  
Total: 232 spaces

25 existing car spaces  
13 motorcycle spaces  
35 bike stands ( 15 covered ones )

| Revision | Date | Description | By/Ch |
|----------|------|-------------|-------|
|----------|------|-------------|-------|

STATUS  
Gravesham Borough Council

SPACE & PLACE

+44 800 900 8000  
arrows@space-place.com  
www.space-place.com

STATUS PLANNING

PROJECT

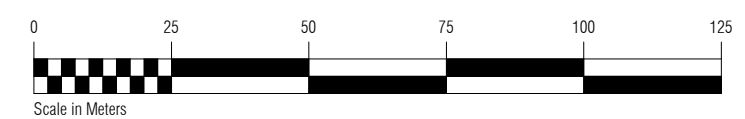
Family Sports & Leisure Centre  
Gravesham

DRAWING

Site Plan

SCALE 1:500 SHEET SIZE A1 DRAWN BY AS CHECKED BY JR DATE 10/21/22  
PROJECT NO. 3929 - ASP - B1 - XX - DR - A - 0803 -  
DRAWING NO. REVISION

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**APPENDIX C – EA Flood Map**

Gravesham Borough Council

# Flood map for planning

Your reference  
<Unspecified>

Location (easting/northing)  
567083/171738

Created  
16 Sep 2022 15:02

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

You will need to do a flood risk assessment if your site is **any of the following:**

- bigger than 1 hectare (ha)
- In an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

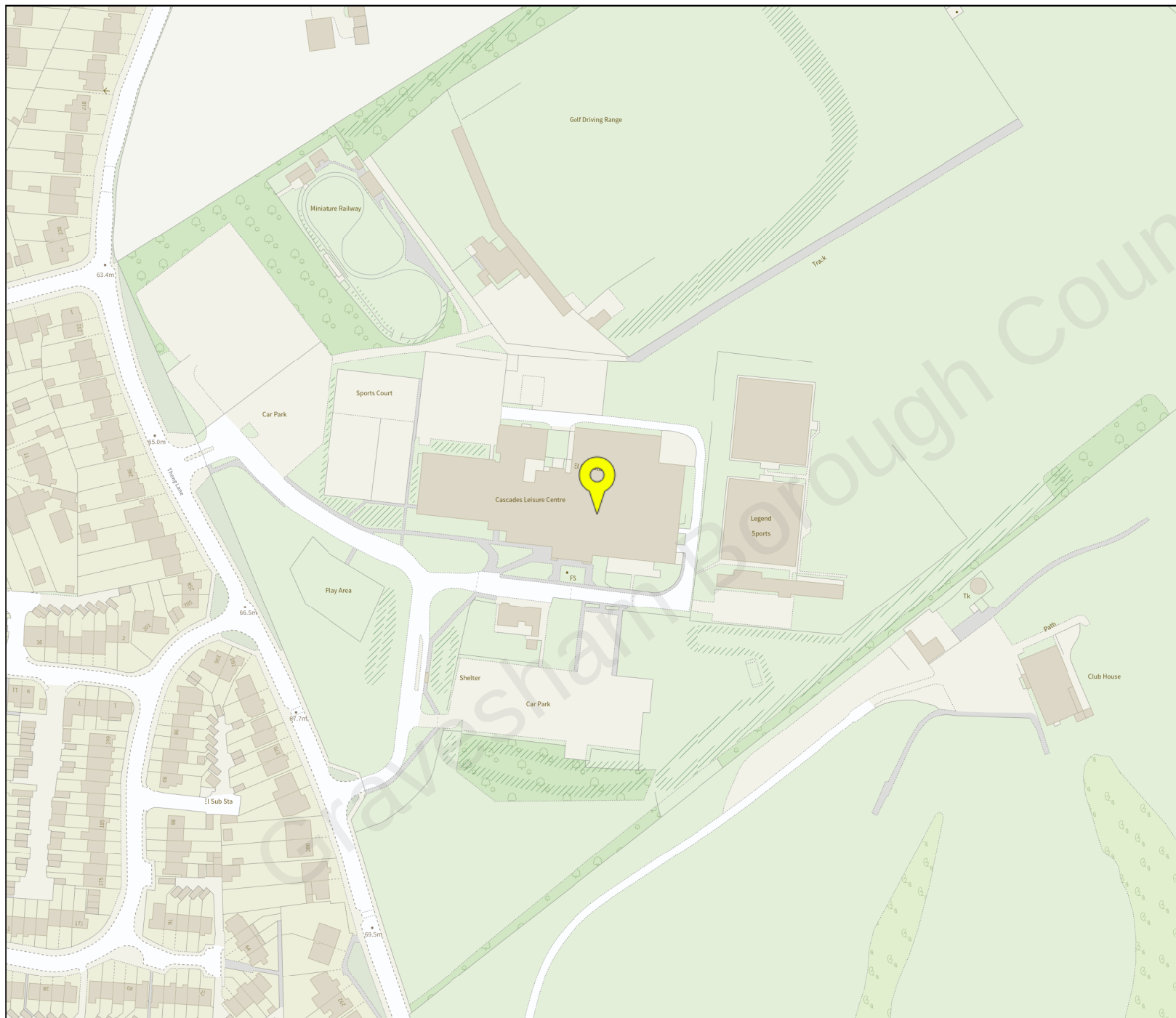
## Notes

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.

Flood risk data is covered by the Open Government Licence **which** sets out the terms and conditions for using government data. <https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/>

Use of the address and mapping data is subject to Ordnance Survey public viewing terms under Crown copyright and database rights 2021 OS 100024198. <https://flood-map-for-planning.service.gov.uk/os-terms>



## Flood map for planning

Your reference  
<Unspecified>

Location (easting/northing)  
**567083/171738**

Scale  
**1:2500**

Created  
**16 Sep 2022 15:02**

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

0 20 40 60m

**APPENDIX D – Southern Water Asset Plan**

Gravesham Borough Council



Wastewater Plan A2  
Powered by digdat



from  
**Southern  
Water.**

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.



**APPENDIX E – Greenfield Runoff Rate Calculation**

Gravesham Borough Council

Calculated by:

Site name:

Site location:

## Site Details

Latitude:

Longitude:

Reference:

Date:

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.

Runoff estimation approach

## Site characteristics

Total site area (ha):

## Methodology

$Q_{BAR}$  estimation method:

SPR estimation method:

## Soil characteristics

|              | Default                          | Edited                           |
|--------------|----------------------------------|----------------------------------|
| SOIL type:   | <input type="text" value="1"/>   | <input type="text" value="1"/>   |
| HOST class:  | <input type="text" value="N/A"/> | <input type="text" value="N/A"/> |
| SPR/SPRHOST: | <input type="text" value="0.1"/> | <input type="text" value="0.1"/> |

## Hydrological characteristics

|                                | Default                           | Edited                            |
|--------------------------------|-----------------------------------|-----------------------------------|
| SAAR (mm):                     | <input type="text" value="600"/>  | <input type="text" value="600"/>  |
| Hydrological region:           | <input type="text" value="7"/>    | <input type="text" value="7"/>    |
| Growth curve factor 1 year:    | <input type="text" value="0.85"/> | <input type="text" value="0.85"/> |
| Growth curve factor 30 years:  | <input type="text" value="2.3"/>  | <input type="text" value="2.3"/>  |
| Growth curve factor 100 years: | <input type="text" value="3.19"/> | <input type="text" value="3.19"/> |
| Growth curve factor 200 years: | <input type="text" value="3.74"/> | <input type="text" value="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 $SPR/SPRHOST \leq 0.3$ ?

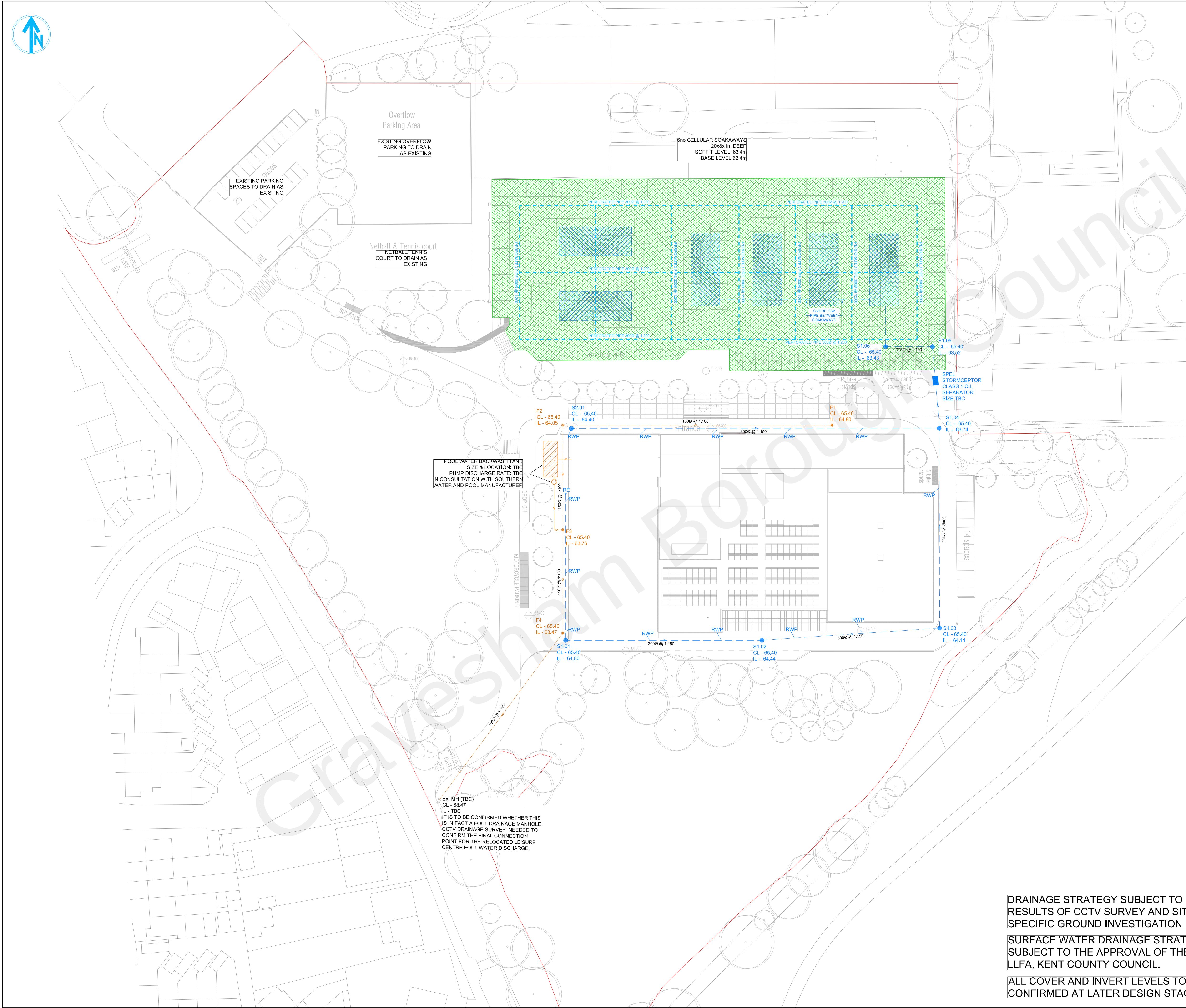
Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

| Greenfield runoff rates | Default                           | Edited                            |
|-------------------------|-----------------------------------|-----------------------------------|
| $Q_{BAR}$ (l/s):        | <input type="text" value="0.63"/> | <input type="text" value="0.63"/> |
| 1 in 1 year (l/s):      | <input type="text" value="0.54"/> | <input type="text" value="0.54"/> |
| 1 in 30 years (l/s):    | <input type="text" value="1.45"/> | <input type="text" value="1.45"/> |
| 1 in 100 year (l/s):    | <input type="text" value="2.01"/> | <input type="text" value="2.01"/> |
| 1 in 200 years (l/s):   | <input type="text" value="2.36"/> | <input type="text" value="2.36"/> |

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at [www.uksuds.com](http://www.uksuds.com). The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at [www.uksuds.com/terms-and-conditions.htm](http://www.uksuds.com/terms-and-conditions.htm). The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

**APPENDIX F – Proposed Drainage Strategy**

Gravesham Borough Council



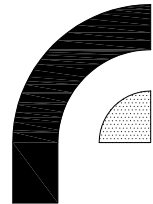
- GENERAL NOTES
- LOCATION OF ALL EXISTING DRAINAGE TO BE CONFIRMED BY CCTV SURVEY AND ON SITE PRIOR TO COMMENCEMENT OF WORKS.
  - ALL DRAINAGE AT MANHOLES/ACCESS CHAMBERS TO CONNECT WITH SOFFITS LEVEL UNLESS OTHERWISE NOTED.
  - ALL FOUL DRAINAGE TO BE MIN 100mm DIA, LAID AT FALLS NOTE LESS THAN 1:80, UNLESS OTHERWISE NOTED.
  - ALL PROPOSED SURFACE WATER DRAINAGE TO BE MIN 150mm DIA, LAID AT FALLS NOT LESS THAN 1:150, UNLESS OTHERWISE NOTED.
  - ALL RAINWATER DOWNPIPES THAT DO NOT CONNECT DIRECTLY TO AN ACCESS POINT SHALL HAVE A RODDING FACILITY FITTED.
  - ALL EXTERNAL FOUL AND SURFACE WATER INSPECTION CHAMBERS SITUATED IN AREAS WITH VEHICULAR ACCESS TO BE MIN. 450/600mm DIA WITH GEN 3 CONCRETE SURROUND UNLESS NOTED OTHERWISE.
  - ALL EXTERNAL FOUL AND SURFACE WATER INSPECTION CHAMBERS SITUATED IN AREAS WITHOUT VEHICULAR ACCESS TO BE MIN. 450/600mm DIA WITH 150mm DOT TYPE 1 SURROUND UNLESS NOTED OTHERWISE.
  - MANHOLE COVER LEVELS ARE SUBJECT TO CONFIRMATION OF FINAL FINISHED FLOOR AND GROUND LEVELS.
  - REFERENCE SHOULD BE MADE TO ARCHITECT & M&E ENGINEERS DRAWINGS FOR ABOVE GROUND DRAINAGE DETAILS & SET-OUT.

- LEGEND
- PROPOSED FOUL WATER SEWER
  - FXX PROPOSED FOUL WATER MANHOLE
  - PROPOSED SURFACE WATER SEWER
  - SXX PROPOSED SURFACE WATER MANHOLE
  - RWP PROPOSED RAINWATER PIPE
  - RE PROPOSED RODDING EYE
  - PROPOSED PERMEABLE PAVING
  - PROPOSED PERFORATED PIPE
  - PROPOSED CELLULAR SOAKAWAY

|     |          |                                       |    |       |
|-----|----------|---------------------------------------|----|-------|
| P01 | 25/11/22 | ISSUED FOR INFORMATION (PRE-PLANNING) | PS | HP    |
| Rev | Date     | Comment                               | By | Check |

|             |                |
|-------------|----------------|
| Status Code | Drawing Status |
| S2          | PRELIMINARY    |

This drawing may only be used for construction/manufacture if status is CONSTRUCTION



**Furness Partnership**  
Consulting Structural/Civil Engineers

■ London 20 Britton Street, London, EC1M 6TX  
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tel: 01274 392092  
e-mail: mail@furnesspartnership.com

Project

**CASCADES LEISURE CENTRE, GRAVESEND**

Drawing Title

**PROPOSED DRAINAGE STRATEGY**

|            |       |          |         |            |
|------------|-------|----------|---------|------------|
| FP Job No. | Drawn | Date     | Checked | Scale @ A1 |
| 7313       | PS    | NOV 2022 | HP      | 1:500      |

| PROJECT | OPERATOR | ZONE / VOLUME | LEVEL / LOCATION | FILE TYPE | ROLE | SHEET No. | Rev. |
|---------|----------|---------------|------------------|-----------|------|-----------|------|
| /       | FUR      | ZZ            | XX               | DR        | D    | 0910      | P01  |

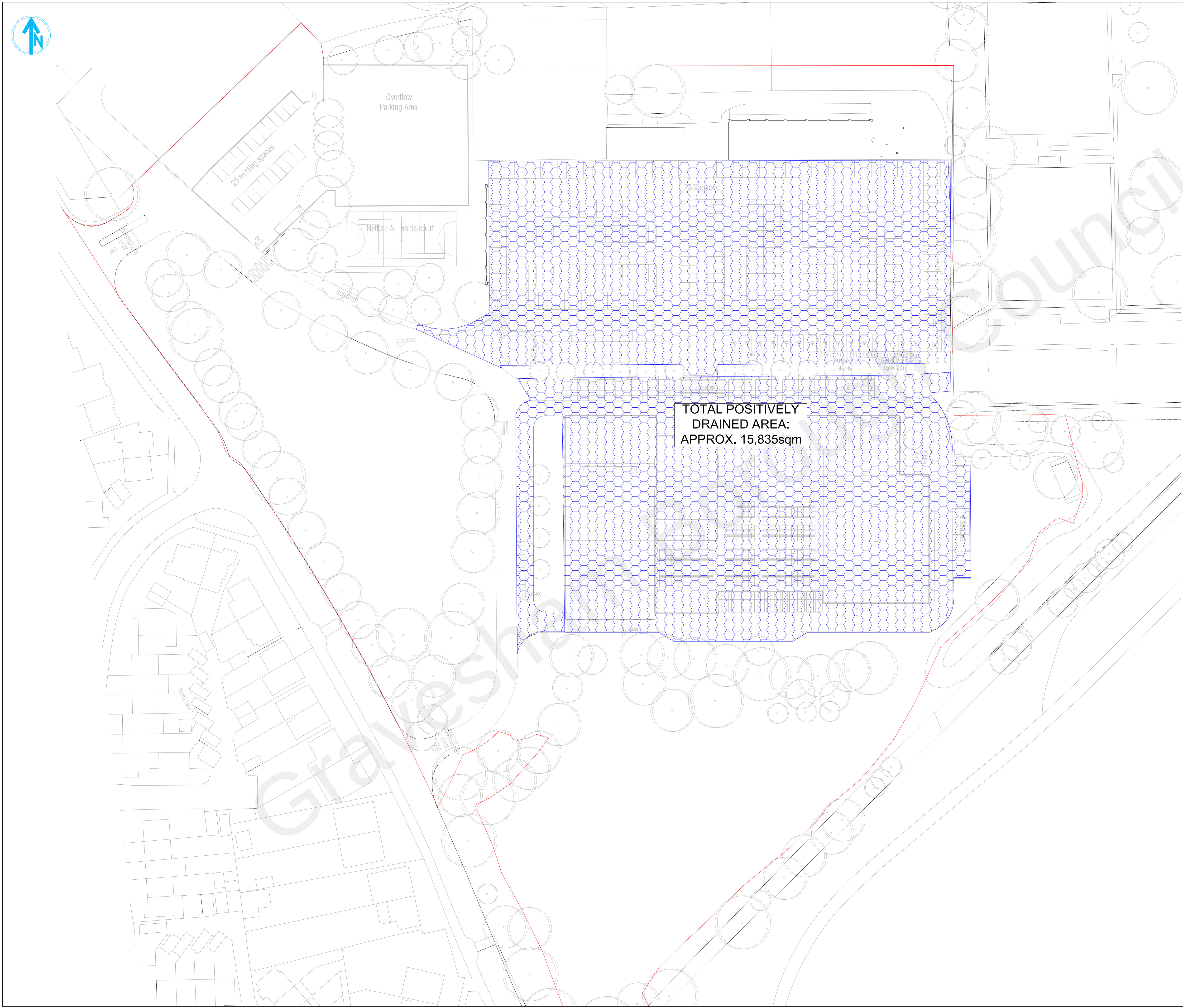
DRAINAGE STRATEGY SUBJECT TO RESULTS OF CCTV SURVEY AND SITE SPECIFIC GROUND INVESTIGATION

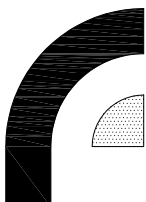
SURFACE WATER DRAINAGE STRATEGY SUBJECT TO THE APPROVAL OF THE LLFA, KENT COUNTY COUNCIL.

ALL COVER AND INVERT LEVELS TO BE CONFIRMED AT LATER DESIGN STAGES.

**APPENDIX G – Proposed Drainage Strategy Catchment Area Plan**

Gravesham Borough Council



|                                                                                       |          |               |                                                                                                                                                                                                                                                                                                                                                                                                                                                             |           |            |           |      |       |
|---------------------------------------------------------------------------------------|----------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------------|-----------|------|-------|
| P01                                                                                   |          | 25/11/22      | ISSUED FOR INFORMATION [PRE-PLANNING]                                                                                                                                                                                                                                                                                                                                                                                                                       |           |            |           | PS   | HP    |
| Rev                                                                                   |          | Date          | Comment                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |            |           | By   | Check |
| Status Code                                                                           |          |               | Drawing Status                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |            |           |      |       |
| S2                                                                                    |          |               | PRELIMINARY                                                                                                                                                                                                                                                                                                                                                                                                                                                 |           |            |           |      |       |
| This drawing may only be used for construction/manufacture if status is CONSTRUCTION  |          |               |                                                                                                                                                                                                                                                                                                                                                                                                                                                             |           |            |           |      |       |
|  |          |               | <div><div>Furness Partnership</div><div>Consulting Structural/Civil Engineers</div></div> <div><div><div>■ London</div><div>20 Britton Street, London, EC1M 6TX</div><div>tel: 020 7490 4353 fax: 020 7490 4354</div><div>e-mail: info@furnesspartnership.com</div></div><div><div><div>□ Bradford</div><div>The Paper Hall, Anne Gate, Bradford, BD1 4EQ</div><div>tel: 01274 392092</div><div>e-mail: mail@furnesspartnership.com</div></div></div></div> |           |            |           |      |       |
| Project                                                                               |          |               |                                                                                                                                                                                                                                                                                                                                                                                                                                                             |           |            |           |      |       |
| CASCADES LEISURE CENTRE, GRAVESEND                                                    |          |               |                                                                                                                                                                                                                                                                                                                                                                                                                                                             |           |            |           |      |       |
| Drawing Title                                                                         |          |               | PROPOSED DRAINAGE STRATEGY CATCHMENT AREA                                                                                                                                                                                                                                                                                                                                                                                                                   |           |            |           |      |       |
| FP Job No.                                                                            |          | Drawn         | Date                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Checked   | Scale @ A1 |           |      |       |
| 7313                                                                                  |          | PS            | NOV 2022                                                                                                                                                                                                                                                                                                                                                                                                                                                    | HP        | 1:500      |           |      |       |
| PROJECT                                                                               | OPERATOR | ZONE / VOLUME | LEVEL / LOCATION                                                                                                                                                                                                                                                                                                                                                                                                                                            | FILE TYPE | ROLE       | SHEET No. | Rev. |       |
| /                                                                                     | FUR      | ZZ            | XX                                                                                                                                                                                                                                                                                                                                                                                                                                                          | DR        | D          | 0911      | P01  |       |

**APPENDIX H – InfoDrainage Model Soakaway Sizing Estimate**

Gravesham Borough Council

|                                                 |                         |             |              |                                                                                     |
|-------------------------------------------------|-------------------------|-------------|--------------|-------------------------------------------------------------------------------------|
| Project:                                        | Date:<br>25/11/2022     |             |              |  |
|                                                 | Designed by:<br>h.patel | Checked by: | Approved By: |                                                                                     |
| Report Details:                                 | Company Address:        |             |              |                                                                                     |
| Type: Stormwater Controls<br>Storm Phase: Phase |                         |             |              |                                                                                     |



## Soakaway

Type : Soakaway

### Dimensions

|                               |             |
|-------------------------------|-------------|
| Exceedence Level (m)          | 65.400      |
| Depth (m)                     | 3.000       |
| Base Level (m)                | 62.400      |
| Freeboard (mm)                | 1000        |
| Soakaway Shape                | Rectangular |
| Diameter / Width (m)          | 8.000       |
| Length (m)                    | 20.000      |
| Porosity (%)                  | 95          |
| Ineffective Storage Depth (m) | 2.000       |
| Number of Soakaways           | 6           |
| Base Infiltration Rate (m/hr) | 0.036       |
| Side Infiltration Rate (m/hr) | 0.036       |
| Safety Factor                 | 2.0         |
| Total Volume (m³)             | 912.000     |

### Inlets

#### Inlet

|                    |                |
|--------------------|----------------|
| Incoming Item(s)   | Catchment Area |
| Bypass Destination | (None)         |
| Capacity Type      | No Restriction |

|                                                               |                         |                  |              |
|---------------------------------------------------------------|-------------------------|------------------|--------------|
| Project:                                                      | Date:<br>25/11/2022     |                  |              |
|                                                               | Designed by:<br>h.patel | Checked by:      | Approved By: |
| Report Details:<br>Type: Inflow Summary<br>Storm Phase: Phase |                         | Company Address: |              |



| Inflow Label   | Connected To | Flow (L/s) | Runoff Method         | Area (ha)    | Percentage Impervious (%) | Urban Creep (%) | Adjusted Percentage Impervious (%) | Area Analysed (ha) |
|----------------|--------------|------------|-----------------------|--------------|---------------------------|-----------------|------------------------------------|--------------------|
| Catchment Area | Soakaway     |            | Time of Concentration | 1.584        | 100                       | 0               | 100                                | 1.584              |
| <b>TOTAL</b>   |              | <b>0.0</b> |                       | <b>1.584</b> |                           |                 |                                    | <b>1.584</b>       |

Gravesham Borough Council

|                                             |                         |             |              |                                                                                     |
|---------------------------------------------|-------------------------|-------------|--------------|-------------------------------------------------------------------------------------|
| Project:                                    | Date:<br>25/11/2022     |             |              |  |
|                                             | Designed by:<br>h.patel | Checked by: | Approved By: |                                                                                     |
| Report Title:<br>Rainfall Analysis Criteria | Company Address:        |             |              |                                                                                     |

|                                 |                          |
|---------------------------------|--------------------------|
| Runoff Type                     | Dynamic                  |
| Output Interval (mins)          | 5                        |
| Time Step                       | Default                  |
| Urban Creep                     | Apply Global Value       |
| Urban Creep Global Value (%)    | 0                        |
| Junction Flood Risk Margin (mm) | 300                      |
| Perform No Discharge Analysis   | <input type="checkbox"/> |

### Rainfall

|            |                                     |
|------------|-------------------------------------|
| FSR        | Type: FSR                           |
| Region     | England and Wales                   |
| M5-60 (mm) | 20.0                                |
| Ratio R    | 0.409                               |
| Summer     | <input checked="" type="checkbox"/> |
| Winter     | <input checked="" type="checkbox"/> |

### Return Period

| Return Period (years) | Increase Rainfall (%) |
|-----------------------|-----------------------|
| 1.0                   | 0                     |
| 30.0                  | 0                     |
| 100.0                 | 20                    |

### Storm Durations

| Duration (mins) | Run Time (mins) |
|-----------------|-----------------|
| 15              | 30              |
| 30              | 60              |
| 60              | 120             |
| 120             | 240             |
| 180             | 360             |
| 240             | 480             |
| 360             | 720             |
| 480             | 960             |
| 600             | 1200            |
| 720             | 1440            |
| 960             | 1920            |
| 1440            | 2880            |
| 2160            | 4320            |
| 2880            | 5760            |
| 4320            | 8640            |
| 5760            | 11520           |
| 7200            | 14400           |
| 8640            | 17280           |
| 10080           | 20160           |

|                                                                            |                         |             |              |
|----------------------------------------------------------------------------|-------------------------|-------------|--------------|
| Project:                                                                   | Date:<br>25/11/2022     |             |              |
|                                                                            | Designed by:<br>h.patel | Checked by: | Approved By: |
| Report Details:<br>Type: Stormwater Controls Summary<br>Storm Phase: Phase | Company Address:        |             |              |





### Critical Storm

| Stormwater Control | Storm Event                             | Max. US Level (m) | Max. DS Level (m) | Max. US Depth (m) | Max. DS Depth (m) | Max. Inflow (L/s) | Max. Residual Volume (m³) | Max. Flooded Volume (m³) | Total Lost Volume (m³) | Max. Outflow (L/s) | Total Discharge Volume (m³) | Half Drain Down Time (mins) | Percentage Available (%) | Status |
|--------------------|-----------------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|---------------------------|--------------------------|------------------------|--------------------|-----------------------------|-----------------------------|--------------------------|--------|
| Soakaway           | FSR: 100 years: +20 %: 720 mins: Winter | 63.389            | 63.389            | 0.989             | 0.989             | 66.7              | 901.773                   | 0.000                    | 508.674                | 0.0                | 0.000                       | 1292                        | 1                        | OK     |

Gravesham Borough Council

Gravesham Borough Council

|                               |                          |                  |
|-------------------------------|--------------------------|------------------|
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