Linden Wates (West Hampstead)

FLOOD RISK AND DRAINAGE ASSESSMENT

Proposed Residential Development - Former Gondor Gardens Reservoir.

880113 R4 (1)

JANUARY 2012

RSK

RSK GENERAL NOTES

Project No.: 880113 R4 (1)

Title: Proposed Residential Development - Former Gondor Gardens Reservoir

Client: Linden Wates (West Hampstead)

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1 INTRODUCTION

RSK LDE Limited has been commissioned by Linden Wates (West Hampstead) to undertake a Flood Risk Assessment (FRA) and review the constraints on a site located at a former reservoir site off Gondar Gardens, West Hampstead.

This report has been produced in support of a planning application for 28 residential units along the site frontage and summarises the items and calculations that have been included in the RSK assessment. This has been produced in accordance with PPS 25 (Ref. 1) and the Interim Code of Practice for Sustainable Drainage (Ref. 2) with site-specific advice from the Environment Agency, the LPA and Linden Wates (West Hampstead). The development has been subject to environmental impact assessment (EIA) in accordance with the Town and Country Planning (Environmental Impact Assessment) Regulations 2011. This report, whilst intended to be a standalone document, also forms Technical Annex 5 of the Environmental Statement (ES) which is being submitted in support of the application.

The site lies wholly within Flood Zone 1, however due to the area of the site exceeding 1Ha, a flood risk assessment is required under the guidance of PPS 25. In addition, there is potential for the site to retain rainwater increasing the flood risk to the properties.

The comments given in this report and the opinions expressed are subject to RSK Group Service Constraints provided in **Appendix A**.

2 CONTEXT AND SCOPE OF WORKS

A key element of project development is to prepare a Flood Risk Assessment to establish the risk associated with the proposed development and to propose suitable mitigation, if required to reduce the risk to a more acceptable level.

The scope of work relating to a flood risk assessment is based on the guidance provided in PPS 25 (Ref. 1) and the accompanying guidance published by the Communities and Local Government Office (Ref. 3) and comprise of the following elements:

- To obtain information on the hydrology and hydrological regime in and around the site.
- To obtain the views of the Environment Agency including scope, location and impacts.
- To determine the extent of new flooding provision and the influence on the site.
- To review site surface water drainage based on the proposed layout. To determine the extent of infrastructure required.
- To review architect plans and planning information and other studies to determine the existing site conditions.
- To assess the impact on the site from global warming effects and anticipated increases in rainfall over a 100 year period for residential use or 60 years for commercial uses.
- Preparation of a report including calculations and summaries of the source information and elements reviewed.

3 SITE DESCRIPTION

3.1 Site Location

The site is located in West Hampstead within the London Borough of Camden at grid reference TQ 247 853, **Figure 1**. The proposed development site is located on the site of a former freshwater reservoir. Access to the site is currently off Gondar Garden road and is located within a predominantly residential area.

Figure 1: Site Location Plan

The site is bounded by:

- North – Directly bounded by the rear gardens of residential properties along Gondar Gardens
- East – Directly bounded by the rear gardens of residential properties along Agamemnon Road
- South – Directly bounded by the rear gardens of residential properties along Hillfield Road
- West – Directly bounded by Gondar Gardens and residential properties along Sarre Road beyond.

The total site area is 1.24 Ha currently consisting of a covered reservoir and associated infrastructure. The covered reservoir equates to approximately 0.5Ha, with the remaining site area consisting of infrastructure associated with the reservoir and to the east is an area of grassland.

3.2 Site Topography

An existing site topographic survey has been carried out, **Appendix B.** The topography of the site is relatively flat with a gentle fall to the east. The cover of the reservoir is approximately 80.2m AOD. The boundary of the site falls away to a level in the region of 79.7m AOD along the northern boundary, 75.5m AOD to 72.0m AOD along the eastern, 79.0m AOD to 72.0m AOD along the southern and 79.0m AOD along the western.

Access to the site is directly off Gondar Garden Road.

3.3 Development Proposals

The scheme proposes 28 residential units along the site frontage. The existing reservoir roof and internal structures would be removed and regraded / landscaped and together with remaining grassland at the rear of the site would become a enhanced wildlife /nature conservation area, as shown in **Appendix C**.

4 SOURCE OF FLOOD RISK

4.1 Types of Flood Risk

The flood risk elements that need to be considered for any site are defined in PPS 25 as the "Forms of Flooding" and are listed as:

- Flooding from Rivers (fluvial flood risk)
- Flooding from the Sea (tidal flood risk)
- Flooding from the Land (overland pluvial flood risk)
- Flooding from Groundwater
- Flooding from Sewers (sewer and drain exceedance, pumping station failure etc)
- Flooding from Reservoirs, Canals and other Artificial Structures

The following section reviews each of these in respect of the subject site.

4.2 Environment Agency Flood Zone

The Environment Agency has produced Flood Zone maps for much of England and Wales. The current displayed map is reproduced as **Figure 2**. The latest Flood Zone map shows the flood risk to the site is low with the whole site located in Flood Zone 1.

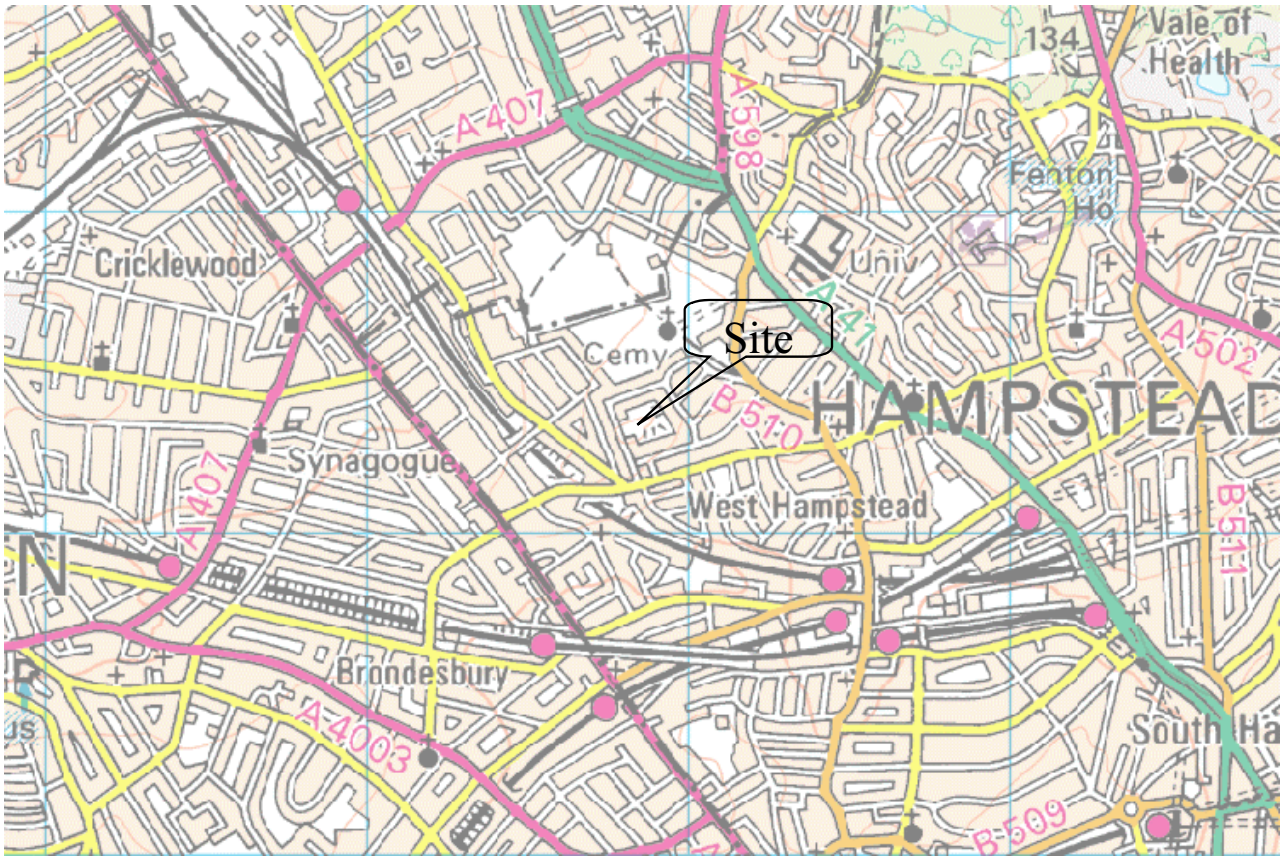


Figure 2: Environment Agency Flood Zone Map

4.3 Flooding from Rivers (Fluvial Flood Risk)

Flood risk from fluvial sources is low; this is confirmed by the location of the site in Flood Zone 1 according to the latest Environment Agency Flood Zone map

4.4 Flooding from the Sea (Tidal Flood Risk)

The site is located inland and therefore is not at risk from tidal sources

4.5 Flooding from the Land (Overland Pluvial Flood Risk)

The development site will be located within a hollow, and as such has the potential for overland flows to collect and pond. This source of flood risk has been considered in the design of the development, which will incorporate sump pumps to ensure any water entering the site will be pumped away from the properties. In addition, any water falling on the site will be utilised on site with the use of rainwater harvesting systems.

4.6 Area Geology

North London is almost entirely underlain by the London Clay formation which overlays a significant chalk aquifer. The London Clay layer varies in thickness from less than 10m near the Lee Valley to over 100m in the areas of higher ground in Camden and Barnet. The clay layer is almost entirely impermeable which has a considerable impact on lead times of fluvial flows in many of the watercourses, especially when combined with intense urban development. The upstream catchment in the River Lee comprises a predominantly chalk soil, which results in increased permeability and slower response times in the watercourse.

4.7 Flooding from Groundwater

It is estimated that groundwater flooding affects a few hundred thousand properties in the UK. Groundwater flooding most commonly occurs in low-lying areas, which are underlain by permeable rocks or aquifers. Flooding occurs when the groundwater table rises up from the permeable rocks to the ground surface, flooding low-lying areas or occurring as intermittent springs. Flooding is most likely to occur after prolonged periods of rainfall when a greater volume of rain will percolate into the ground, causing the groundwater table to rise above its usual level. Low lying areas are generally more prone to groundwater flooding because the water table is usually at a much shallower depth and groundwater flow paths tend to travel in a direction from high to low ground. Areas prone to groundwater flooding also often experience surface water flooding problems.

Localised groundwater flooding can also occur around specific geological features, such as areas of permeable soils overlying impermeable strata. Very few groundwater-flooding records are available from the Environment Agency and all of those that are recorded lie within the London Borough of Enfield. The locations of the flooding incidents are shown as **Appendix D.**

The presence of London Clays below the base of the reservoir could result in a perched groundwater level. However as the site is to be landscaped away from the properties the flood risk from groundwater flows reaching the surface will be mitigated against. According to the GI

for the site groundwater was not encountered in the boreholes, with the exception of BH1 where groundwater seepage was identified 13.0mbgl. The development will not significantly alter the hydrogeology of the area and groundwater levels are therefore not expected to vary from that at present.

4.8 Flooding from Sewers

A number of Thames Water sewers have been identified in close proximity to the site, **Appendix E**. The adopted main sewers in the area are combined accepting both foul and surface water run-off. The nearest sewer to the site is along the western boundary within Gondar Garden Road, where a 940mm x 635mm sewer flows in a southern direction. According to the sewer records supplied by Thames Water, a connection point existing to the southwest corner of the site, it is proposed to utilise this connection for the development.

Most adopted surface water drainage networks are designed to the criteria set out in Sewers for Adoption (Ref. 4). One of the design parameters is that sewer systems be designed such that no flooding of any part of the site occurs in a 1 in 30 year rainfall event. By definition a 1 in 100 year event would exceed the capacity of the surrounding sewer network as well as any proposed drainage.

When exceeded, the surcharged pipework will lead to flooding from backed up manholes and gully connections. This will lead to immediate flooding within highways surrounding the site.

There are no known issues with exceedance of the sewer system in this area.

4.9 Other Sources of Flooding

The Lost Rivers of London map (Barton, 1995) indicates that the River Westbourne used to flow in the vicinity of the site. It is known that this river is now a lost river, as it has been culverted to form one of Thames Water's main storm surface water sewers for the surrounding area.

4.10 Historic Flooding

According to the Strategic Flood Risk Assessment for this area (Ref. 5), there has been no reported incidence of flooding in close proximity of the site, **Appendix F.**

4.11 Climate Change Impacts Upon Localised Flooding

It is important to remember that the potential impacts of climate change will affect not only the risk of flooding posed to property as a result of river and/or tidal flooding, but it will also potentially increase the frequency and intensity of localised storms over the area. This may exacerbate localised drainage problems. PPS25 provides guidance as to the anticipated increase in rainfall intensity that should be considered for design purposes. Designers should assume a 10% increase in rainfall intensity over the next 20 years, a 20% increase in 50 years and a 30% increase in 100 years. For the purpose of this assessment, a 30% increase in rainfall has been assumed.

4.12 Environment Agency Consultation

A previous Flood Risk Assessment and additional information for this development site was prepared and submitted to the Environment Agency. The Environment Agency accepted that the flood risk associated with the development was considered acceptable, **Appendix G.** Since this consultation, the proposed development layout has altered, however the level of flood risk has remained low.

5 SURFACE WATER DRAINAGE ASSESSMENT

5.1 Scope

A drainage design strategy should be carried out at the outset to identify the options for the design of the surface water drainage system and how it will affect the site layout.

At this stage the applicant should produce the following information:

- Demonstrate how the principles of Sustainable Drainage Systems have been applied to the development identifying what techniques will be used.
- Set aside land specifically for SUDS.
- Estimate the discharge rate for the site. Greenfield discharge rates should be sought on Greenfield sites, and also on Brownfield sites (where possible).
- Estimate the volume of 1 in 100 year attenuation to be provided and what techniques will be used to provide the attenuation.
- Take into account PPS25's climate change requirements.

5.2 Pre-Development Situation

Prior to the proposed development of the site, the site was utilised as a covered reservoir. It has been assumed that any water falling on the surface of the covering would run-off and be collected within the reservoir itself. It is not unreasonable to assume that the covering of the reservoir would offer some initial retention of rainwater, however the majority of the rainwater falling on the covering would result in run-off. The remaining site areas could be considered as Greenfield and therefore for the purpose of this assessment, it has been assumed that the existing site use would equate to 60% Greenfield.

In terms of estimating the potential runoff from the site, the pro-rated IOH method (Ref. 6) has been used to estimate the existing runoff from the site as in it's current use and in a Greenfield condition. Additional information is contained in **Appendix H.**

Return Period	Peak flow
QBAR	4.6 l/sec
1 in 1 year peak flow	3.9 l/sec
1 in 30 year peak flow	10.4 l/sec
1 in 100 year peak flow	14.7 l/sec

TABLE 5.1: IoH Surface Water runoff calculations (Whole Site Greenfield)

Return Period	Peak flow
QBAR	8.7 l/sec
1 in 1 year peak flow	7.4 l/sec
1 in 30 year peak flow	16.9 l/sec
1 in 100 year peak flow	20.9 l/sec

TABLE 5.2: IoH Surface Water runoff calculations (Whole site existing hard standing)

The existing site includes an element of impermeable land. It should be noted that PPS25 (paragraph 5) makes it clear that off-site impacts should not increase flood risk elsewhere. The Practice Guide (Ref. 3) States:

For the range of annual flow rate probabilities up to and including the one per cent annual exceedance probability (1 in 100 years) event, including an appropriate allowance for climate change, the developed rate of run-off into a watercourse, or other receiving water body, should be no greater than the existing rate of run-off for the same event. Run-off from previously developed sites should be compared with existing rates, not greenfield rates for the site before it was developed. Developers are, however, strongly encouraged to reduce run-off rates from previously developed sites as much as is reasonably practicable. Volumes of run-off should also be reduced wherever possible using infiltration and attenuation techniques. Interim guidance on calculation of site run-off rates can be found at

http://www.ciria.org/suds/pdf/preliminary_rainfall_runoff_mgt_for_development.pdf

Therefore, it is essential that the volume of runoff generated as a result of redevelopment should either remain the same as the existing discharge rate or be reduced. Preferably the discharge rate should be restricted to near the greenfield runoff rate if possible, by combining the use of SuDS onsite where feasible. The proposed developable area constitutes 1747m^2 comprising roofed, paved and parking areas. It is proposed to limit the off site discharge off the site to the Greenfield QBAR run off rate of 4.6l/s, thus reducing downstream flood risk and complying with the latest best practice guidance.

The development of the site is designed as to meet the requirement of the Code For Sustainable Homes (Code Level 4), therefore the post development run-off rate and volume will be managed to meet the requirements of the code.

5.3 Sustainable Drainage Techniques

It is proposed that the re-development of the site will utilise sustainable drainage techniques where feasible. It has been assumed that the reservoir would have been lined to prevent water leaching and therefore infiltration techniques may not be possible. This does not exclude the use of other SuDs techniques. It is proposed to utilise green roof techniques to reduce the impermeable area post development, the level of green roof coverage will be dependant on the specification of the PV cells.

The use of permeable paving should be considered where paving is proposed. Although infiltration may not be possible, on site water passing through the paving system will offer filtration of solids and can be collected below a sub-base within a piped system. However, the main attenuation will be provided within a cellular storage structure, the volume of which has been based on an off site discharge rate of the QBAR Greenfield rate, which offers a reduction in the

off-site discharge from the pre-development rate. Run-off from the site will be limited to a maximum rate as permitted by Thames Water, and may therefore be subject to change once further negotiations have taken place.

The area to the east of the site will be landscaped to provide an amenity area, this area can be assumed to be greenfield and will not increase the run off rates or volumes from the pre-development situation. Given the fact that London Clay underlies the site, infiltration will be very limited and therefore ponded water can be expected to occur during times of prolonged precipitation. The area of the base of the reservoir should be graded with a slope away from the proposed properties. This will ensure that the flood risk to the basement level will remain low.

We understand that Linden Wates propose to use a combination of SuDS methods with the proposed development consisting of both Green roof and a sub-terrain cellular storage structure. Based on the proposals we have used the Design Guide within the Source Control suite in Microdrainage to investigate the attenuation volumes that would be needed to accommodate a restricted discharge of 4.6l/s. The rainfall data is also taken from the software using Ordnance Survey grid co-ordinates to target the site. This software models storm events from 15 – 10080 minutes for both summer and winter events and highlights the highest volume of rainfall for each event. The calculations are based on a 1 in 100 year event with a 30% allowance for climate change and have determined that a storage structure offering approximately 75.0m^3 of attenuation. **Appendix I** shows the results of the Microdrainage model for the 1 in 100-year (+30%) rainfall event, with **Appendix J** showing a schematic of the proposed design.

Green Roofs

Green Roofs provide both attenuation and storage of rainwater. At this stage we do not have final design details for the construction make up of these, and have not taken this into account for the drainage calculations, should green roofs be used, it is anticipated that the attenuation volume of the cellular storage structure will be reduced.

5.4 Impact of the Development

The development of any site has potential to impact on the existing flood risk of the area. For the proposed re-development of the reservoir site this would not be the case as the site is located below the existing ground levels. Therefore, even without the proposed inclusion of several sustainable drainage techniques any run-off generated as result of the development will be retained on site and not increase flood risk to existing properties in the area.

According to the GI for the site groundwater was not encountered in the boreholes, with the exception of BH1 where groundwater seepage was identified 13.0mbgl. Therefore groundwater inundation on the site is not expected and should not affect the efficiency of any surface water drainage system.

5.5 Landscaped Area (Base of Reservoir)

The reservoir is to be uncovered with the base of the reservoir (outside of the residential development area) to be landscaped in accordance with the requirements of the Planners. The base of the reservoir is considered to be an impermeable surface and this is to be broken out, thus exposing the naturals soils below. To ensure that the basement level of the residential

development remains flood free, the landscaped area will be contoured with ground levels falling away from the development section.

MicroDrainage WINDES Software has been utilised to estimate the volumes of run-off generated from the site base of the reservoir. It has been assumed that any attenuation feature will not be lined, and will therefore benefit from natural infiltration. Although no formal infiltration testing has been carried out, it has been assumed that the base of the attenuation feature is clay with an infiltration rate of 0.0001m/hr. For this reason a number of rainfall events have been modelled calculating the maximum volume of run-off for these events. Given the low level of natural infiltration any feature should be designed to retain the volume from a number of events.

Return Period	Volume of Runoff
QBAR	215.1m^3
5 Year	253.7 m^3
10 Year	285.3 m^3
25 Year	333.2 m^3
50 Year	374.8 m^3
100 Year	421.5 m^3

A full copy of the calculations area included as **Appendix K.**

Once the cap of the reservoir has been removed and access to the base can be achieved, it is recommended that infiltration testing should be carried out to allow a more detailed design to develop.

6 SEQUENTIAL TEST

6.1 Land Use Vulnerability

Within PPS 25 Annex D (Ref. 1) each Flood Zone has a list of appropriate land uses dependent on vulnerability to flooding. The Flood Zones are described in Table D.1: Flood Zones reproduced as Table 3 below.

(Note: These Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences).

Zone 1 Low Probability **Definition** This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%). **Appropriate uses** All uses of land are appropriate in this zone. **FRA requirements** For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a FRA. This need only be brief unless the factors above or other local considerations require particular attention. See Annex E for minimum requirements. *Policy aims* In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage techniques.
Zone 2 Medium Probability **Definition** This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1%) in any year. *Appropriate uses* The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure in Table D.2 are appropriate in this zone. Subject to the Sequential Test being applied, the highly vulnerable uses in Table D.2 are only appropriate in this zone if the Exception Test (see para. D.9.) is passed. **FRA requirements** A FRA should accompany all development proposals in this zone. See Annex E for minimum requirements. **Policy aims** In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage techniques.
Zone 3a High Probability **Definition** This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year. **Appropriate uses** The water-compatible and less vulnerable uses of land in Table D.2 are appropriate in this zone. The highly vulnerable uses in Table D.2 should not be permitted in this zone. The more vulnerable and essential infrastructure uses in Table D.2 should only be permitted in this zone if the Exception Test (see para. D.9) is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood. **FRA requirements** A FRA should accompany all development proposals in this zone. See Annex E for minimum requirements. **Policy aims** In this zone, developers and local authorities should seek opportunities to: i. reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage techniques; ii. relocate existing development to land in zones with a lower probability of flooding; and iii. create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.

Zone 3b The Functional Floodplain **Definition** **This zone comprises land where water has to flow or be stored in times of flood**. Local Planning Authorities in their SFRAs should identify areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But land which would flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood in an extreme (0.1%) flood, should provide a starting point for consideration and discussions to identify the functional floodplain. **Appropriate uses** Only the water-compatible uses and the essential infrastructure listed in Table D.2 that has to be there should be permitted in this zone. It should be designed and constructed to: – remain operational and safe for users in times of flood; – result in no net loss of floodplain storage; – not impede water flows; and – not increase flood risk elsewhere. Essential infrastructure in this zone should pass the Exception Test. **FRA requirements** All development proposals in this zone should be accompanied by a FRA. See Annex E for minimum requirements. **Policy aims** In this zone, developers and local authorities should seek opportunities to: i. reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage techniques; and ii. relocate existing development to land with a lower probability of flooding.

TABLE 6.1: PPS 25 Flood Zones

The vulnerability classes are related to the sensitivity of the development to flooding and considers risk to people, property and services. The vulnerability classification Table D2 from PPS25 is reproduced below as Table 4.

Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk, • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. • Wind turbines
Highly Vulnerable	• Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations required being operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent. (where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as “Essential Infrastructure”)
More Vulnerable	• Hospitals. • Residential institutions such as residential care homes, children’s homes, social services homes, prisons and hostels. • Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels. • Non–residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, **subject to a specific warning and evacuation plan**.
Less Vulnerable	• Police, ambulance and fire stations which are **not** required to be operational during flooding • Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non–

	residential institutions not included in 'more vulnerable'; and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment works which do **not** need to remain operational during times of flood • Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).
Water-compatible Development	• Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel workings. • Docks, marinas and wharves. • Navigation facilities. • MOD defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, **subject to a specific warning and evacuation plan.**

TABLE 6.2: Flood Risk Vulnerability Classification

The site is currently a covered reservoir and the redevelopment will change its planning designation to residential. The current use falls under a "water compatible" use class with the proposed re-development changing the development class to a "more vulnerable" use, with the basement dwellings are "highly vulnerable".

As discussed above all development on this site is to be located within Flood Zone 1, therefore development will be possible. The Sequential and Exception Tests are not required for this development.

7 CONCLUSIONS AND RECOMMENDATIONS

This flood risk assessment has been prepared in support of the proposed residential development at the former reservoir off Gondar Garden Road, West Hampstead.

The site is located within Flood Zone 1 according to the latest Environment Agency Flood Zone maps, indicating that the site is not at risk from fluvial or tidal sources. Suitable mitigation can be incorporated to ensure that flood risk to the proposed properties remains low and meets the requirements of PPS 25.

A previous Flood Risk Assessment and additional information for this development site was prepared and submitted to the Environment Agency. The Environment Agency accepted that the flood risk associated with the development was considered acceptable. Since this consultation, the proposed development layout has altered, however the level of flood risk has remained low.

Data obtained from the SFRA also places the site at low risk of flooding from other sources. In accordance with PPS 25 and local policy, this FRA has considered the impact on the surface water regime in the area should development occur. Redevelopment of the site should be possible with careful consideration of the surface water and foul drainage, as well as other possible flooding issues. The proposals should balance the flood storage volumes and should not impede flood flows. Run off from the site should be limited to the Greenfield QBAR run off rate 0f 4.6l/s with all flows in excess retained on site in a cellular storage structure (75.0m^3). Off site discharge will issue into the Thames Water sewer located within Gondar Garden Road, subject to approvals from Thames Water.

Runoff generated from the base of the reservoir, which is to be landscaped with a fall away from the properties. This area should also include an attenuation/ecological feature which should be sized to accommodate a series of rainfall events. Further details should be provided following infiltration testing on the soils under the base of the reservoir.

Based on the information available the flood risk to the proposed development is **low** and **development should not be precluded** on flood risk grounds.

8 REFERENCES

1. Communities and Local Government “Planning Policy Statement – Development and Flood Risk” PPS 25, Mar 2010.

2. DEFRA “Interim Code of Practice for Sustainable Drainage Systems” National SUDS Working Group, July 2004.

3. Communities and Local Government “Planning Policy Statement 25: Development and Flood Risk Practice Guide”, Dec 2009.

4. Institute of Hydrology (IoH) “Flood Estimation for small catchments” Report 124, 1994

5. North London Strategic Flood Risk Assessment, August 2008

APPENDIX

APPENDIX A

Service Constraints

RSK GROUP
SERVICE CONSTRAINTS

1. This report and the Drainage design carried out in connection with the report (together the "Services") were compiled and carried out by RSK LDE Ltd (RSK) for Linden Wates (West Hampstead) (the "client") in accordance with the terms of a contract between RSK and the "client" dated 17 September 2010. The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable Civil Engineer at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.

2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.

3. Unless otherwise agreed the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.

4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date hereof, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.

5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.

6. The observations and conclusions described in this report are based solely upon the Services, which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.

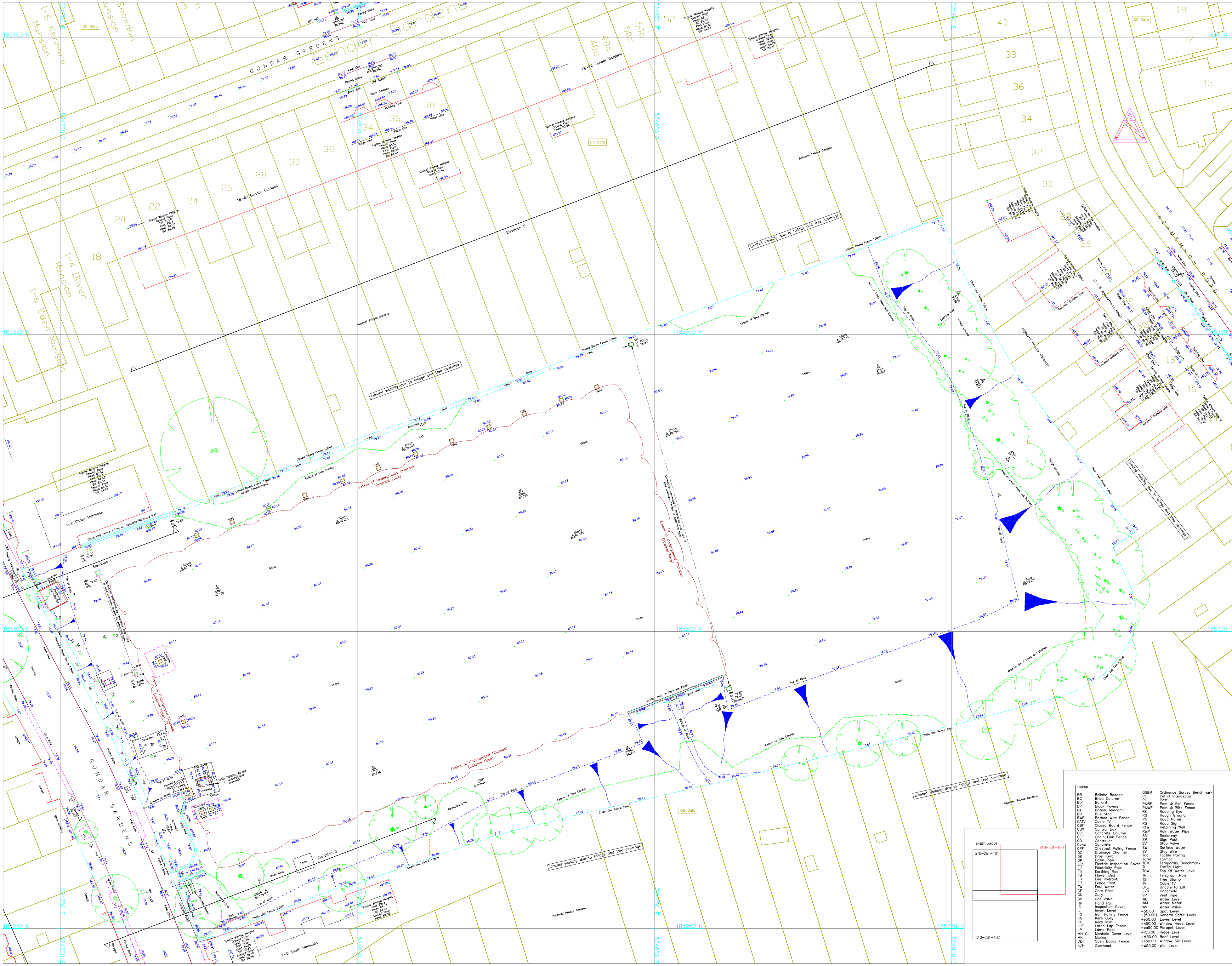
7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.

8. The phase II or intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.

9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site.

APPENDIX B

Existing Site Survey



LEGEND

BB	Belisha Beacon	OSBM	Ordnance Survey Benchmark
BC	Brick Column	PI	Petrol Interceptor
Bol	Bollard	PO	Post
BP	Block Paving	P&RF	Post & Rail Fence
BT	British Telecom	P&WF	Post & Wire Fence
BU	Bus Stop	RE	Rodding Eye
BWF	Barbed Wire Fence	RG	Rough Ground
CATV	Cable TV	RN	Road Name
CBF	Closed Board Fence	RS	Road Sign
CBX	Control Box	RTW	Retaining Wall
CC	Concrete Column	RWP	Rain Water Pipe
CLF	Chain Link Fence	SA	Soakaway
CO	Controller	SP	Sign Post
Conc	Concrete	SV	Stop Valve
CPF	Chestnut Paling Fence	SW	Surface Water
DC	Drainage Channel	SY	Stay Wire
DK	Drop Kerb	Tac	Tactile Paving
DP	Down Pipe	Tarm	Tarmac
EIC	Electric Inspection Cover	TBM	Temporary Benchmark
EP	Electricity Pole	TL	Traffic Light
ER	Earthing Rod	TOW	Top Of Water Level
FB	Flower Bed	TP	Telegraph Pole
FH	Fire Hydrant	TS	Tree Stump
FP	Fence Post	TV	Cable TV
FW	Foul Water	UTL	Unable to Lift
GP	Gate Post	u/s	Underside
GU	Gully	VP	Vent Pipe
GV	Gas Valve	WL	Water Level
HR	Hand Rail	WM	Water Meter
IC	Inspection Cover	WV	Water Valve
IL	Invert Level	+50.00	Spot Level
IRF	Iron Railing Fence	+(50.00)	General Soffit Level
KG	Kerb Gully	+e50.00	Eaves Level
KI	Kerb Inlet	+h50.00	Window Head Level
LLF	Larch Lap Fence	+pa50.00	Parapet Level
LP	Lamp Post	+r50.00	Ridge Level
MH CL	Manhole Cover Level	+rf50.00	Roof Level
MK	Marker	+s50.00	Window Sill Level
OBF	Open Board Fence	+w50.00	Wall Level
o/h	Overhead		

STATION SCHEDULE

NO	EASTING	NORTHING	LEVEL	TYPE
1	524776.455	185307.394	80.186	PEG & NAIL
2	524827.553	185323.651	80.255	PEG & NAIL
3	524887.735	185344.577	79.644	PEG & NAIL
4	524909.563	185328.990	77.111	PEG & NAIL
5	524912.376	185308.078	78.237	PEG & NAIL
6	524861.827	185287.310	79.531	PEG & NAIL
7	524802.737	185276.991	80.236	PEG & NAIL
8	524767.494	185266.434	78.841	SURVEY NAIL
10	524770.523	185310.419	80.187	PEG & NAIL
11	524796.728	185318.353	80.251	PEG & NAIL
12	524807.810	185330.607	80.044	PEG & NAIL
13	524836.330	185315.920	80.272	PEG & NAIL
14	524852.247	185333.073	80.059	PEG & NAIL
15	524880.979	185348.805	79.711	PEG & NAIL
16	524784.680	185256.203	80.169	PEG & NAIL
30	524901.216	185356.967	75.827	PEG & NAIL
31	524905.304	185342.209	76.454	PEG & NAIL
50	524725.006	185322.599	77.029	SURVEY NAIL
51	524764.944	185238.986	78.176	SURVEY NAIL
52	524781.501	185196.647	74.661	SURVEY NAIL
53	524793.909	185159.621	70.593	SURVEY NAIL
54	524805.215	185130.320	67.335	SURVEY NAIL
60	524845.576	185280.372	79.911	PEG & NAIL
100	524720.226	185373.026	75.797	SURVEY NAIL
101	524717.257	185338.131	76.386	SURVEY NAIL
102	524742.637	185308.454	77.786	SURVEY NAIL
103	524753.330	185268.566	78.797	SURVEY NAIL
104	524779.008	185228.064	77.510	SURVEY NAIL
105	524794.629	185186.038	73.305	SURVEY NAIL
106	524809.653	185145.438	68.681	SURVEY NAIL
107	524812.792	185113.833	65.955	SURVEY NAIL
1001	524796.562	185403.151	76.742	SURVEY NAIL
1002	524802.001	185394.327	76.790	SURVEY NAIL
1003	524920.393	185437.407	75.769	SURVEY NAIL
1004	524938.855	185360.061	73.522	SURVEY NAIL
1005	524948.440	185363.896	73.350	SURVEY NAIL
1050	524804.857	185183.461	72.066	PEG & NAIL
1051	524878.539	185211.548	68.755	SURVEY NAIL
1052	524879.478	185199.270	68.858	SURVEY NAIL

TREE SCHEDULE

NO	TYPE	GIRTH	SPREAD	HEIGHT	REMARKS
1	ASH	3.5	18	19	APPROX. SIZE & POSITION
2	SYCAMORE	1.0	10	14	
3	ASH	0.8	12	10	
4	HAWTHORN	1.3	10	10	MULTI-BOLED
5	HAWTHORN	1.3	10	10	MULTI-BOLED
6	HAWTHORN	1.9	8	09	MULTI-BOLED
7	UNIDENTIFIED	0.7	6	09	
8	HAWTHORN	1.4	6	08	MULTI-BOLED
9	HAWTHORN	1.2	8	07	MULTI-BOLED
10	SYCAMORE	1.0	10	12	
11	HAWTHORN	1.9	8	08	MULTI-BOLED
12	SYCAMORE	1.4	10	12	
13	HAWTHORN	2.0	10	08	MULTI-BOLED
14	HAWTHORN	1.2	6	08	
15	SYCAMORE	0.5	6	07	MULTI-BOLED
16	SYCAMORE	0.5	6	07	MULTI-BOLED
17	SYCAMORE	0.6	4	06	
18	SYCAMORE	1.9	8	10	MULTI-BOLED
19	HAWTHORN	1.2	10	08	MULTI BOLED
20	ELDER	1.3	6	06	MULTI-BOLED
21	DEAD TREE	1.1	4	08	
22	SYCAMORE	1.6	6	12	TWIN BOLED
23	SYCAMORE	0.6	8	06	
24	SYCAMORE	1.2	6	11	
25	SYCAMORE	2.1	10	12	TWIN BOLED
26	SYCAMORE	0.7	6	10	
27	HAWTHORN	1.0	6	07	TWIN BOLED
28	SYCAMORE	1.9	8	11	MULTI-BOLED
29	SYCAMORE	1.7	6	11	
30	SYCAMORE	0.7	4	10	
31	SYCAMORE	0.7	4	10	
32	ASH	1.8	10	12	MULTI-BOLED
33	SYCAMORE	2.2	6	13	MULTI-BOLED
34	SYCAMORE	1.0	6	11	
35	SYCAMORE	1.0	6	11	
36	HAWTHORN	0.9	10	09	
37	HAWTHORN	0.9	10	09	
38	HAWTHORN	1.4	10	09	
39	HAWTHORN	1.2	10	09	MULTI-BOLED
40	ALDER	0.9	6	08	
41	SYCAMORE	0.9	6	07	
42	HAWTHORN	0.8	4	06	MULTI-BOLED
43	SYCAMORE	0.8	8	06	MULTI-BOLED
44	ASH	1.1	8	10	
45	POPLAR	3.5	10	25	APPROX. SIZE & POSITION
46	UNIDENTIFIED	0.5	6	07	
47	HAWTHORN	1.9	8	09	MULTI-BOLED
48	UNIDENTIFIED	0.9	6	08	MULTI-BOLED
49	SYCAMORE	0.5	6	07	
50	UNIDENTIFIED	0.8	8	08	
51	SYCAMORE	0.6	6	09	
52	ELDER	1.2	6	06	
53	SYCAMORE	2.5	8	10	MULTI-BOLED
54	ASH	1.4	4	07	MULTI-BOLED
55	UNIDENTIFIED	1.0	8	08	APPROX. SIZE & POSITION
56	ELDER	0.6	4	04	TWIN BOLED
57	UNIDENTIFIED	2.2	8	09	MULTI-BOLED
58	ALDER	1.1	6	06	
59	ASH	0.4	8	08	
60	ALDER	1.0	6	08	TWIN BOLED
61	UNIDENTIFIED	1.2	8	11	
62	LIME	1.7	6	08	
63	LIME	1.6	10	12	
64	LIME	1.3	2	09	
65	LIME	1.7	12	14	
66	ELDER	0.8	4	06	
67	LIME	1.7	4	10	
68	LIME	1.8	4	09	
69	SILVER BIRCH	0.9	10	11	
70	LIME	1.8	6	12	
71	LIME	1.9	8	21	
72	UNIDENTIFIED	0.8	2	06	
73	LIME	0.3	6	05	
74	CHERRY	0.6	6	04	
75	LIME	2.2	6	12	
76	LIME	2.2	6	12	
77	LONDON PLANE	2.5	12	17	

STATUS

FINAL

NOTES

The survey grid has been derived from GPS observations and related to Ordnance Survey National Grid (OSTN02). All levels relate to Ordnance Survey datum (GPS). Note that scale factor (0.999772) correction was applied to GPS derived co-ordinates(OS) based on Station 1. This eliminates the need for any further scale corrections, and dimensions measured on the drawing will relate directly to those on site.

SDP are not trained arboricultural consultants but we do try and identify tree species to the best of our ability. This can be particularly difficult during the winter months when leaves are not available to aid identification. All heights and circular spreads are estimated. In some cases it may be prudent to have tree species confirmed by a trained specialist.

Connections indicated between manholes have been confirmed by resonance only. Therefore, the sewer lines shown should not be assumed to be the physical position of the pipe unless stated. Manhole types have been identified by a visual inspection from ground level. Chambers have not been entered. In some cases, such as disused or deep manholes, assumptions may have been made. These are clearly labelled on the plan. Any drainage labelled "assumed" or "from records" should be confirmed on site before work commences, if critical.

To be read in conjunction with SDP Drawings No.s S10-261-101 & 102 (Land Survey) and S10-261-300 & 301 (Elevations C, D, E & G) and S10-261-200 (Reservoir chamber floor plan).

Revision A – Additional levels on centre lines of surrounding roads added – 18/05/10.

Revision B – Additional information in surrounding roads added – 20/05/10.

Revision C – Ordnance Survey digital data added (shown in brown) and elevation locations added – 20/05/10.

Revision D – Extent of underground reservoir chamber shown – 08/07/10.

CLIENT

LINDEN HOMES CHILTERN LIMITED

SITE

FORMER RESERVOIR
GONDAR GARDENS
NW6 1QG

Land Survey

Sheet 1 of 3

SDP SURVEYS
Suite 3, Salar House
Campfield Road
St.Albans, Hertfordshire
AL1 5HT
Tel. 01727 844606
Fax. 01727 830771
Email. surveys@sdpce.co.uk

SCALE	DRAWN	DATE
1:200 @ A0	JM	May 2010

DRAWING NO.	REV.
S10-261-100	D

APPENDIX C

Development Proposals

1 FIRST FLOOR LEVEL PLAN
SCALE: 1:200 (A1)

NOTES

1 The Contractor must check and confirm dimensions

2 All discrepancies must be reported and resolved by the Architect before works commence

3 This drawing is not to be scaled

4 All work and materials to be in accordance with current applicable Statutory Legislation and to comply with all relevant Codes of Practice and British Standards.

Rev	Date
D Planning Issue	19/01/12
C Revised Plans	16/01/12
B Drawing Number changed for Planning	11/01/12
A Issued for Information	10/01/12

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Client
LINDEN WATES (WEST HAMPSTEAD) LTD.

Project
GONDAR GARDENS

Drawing
PLAN
FIRST FLOOR LEVEL

Scale	Date	Drawn
1:200 (A1)	NOV 2011	RS

Drawing No: 4870 / T1(20) P01
Revision: D
CAD Ref No: C:\4870\T_Series\T20\2nd Application\T120P01

1 SECOND FLOOR LEVEL PLAN
SCALE: 1:200 (A1)

NOTES

1 The Contractor must check and confirm dimensions

2 All discrepancies must be reported and resolved by the Architect before works commence

3 This drawing is not to be scaled

4 All work and materials to be in accordance with current applicable Statutory Legislation and to comply with all relevant Codes of Practice and British Standards.

Rev	Date
D Planning Issue	19/01/12
C Revised Plans	16/01/12
B Drawing Number changed for Planning	11/01/12
A Issued for Information	10/01/12

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Client
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Project
GONDAR GARDENS

Drawing
PLAN
SECOND FLOOR LEVEL

Scale	Date	Drawn
1:200 (A1)	NOV 2011	RS

Drawing No	Revision
4870 / T1(20) P02	D

CAD Ref No
G:\4870\T_Series\T20\2nd Application\T120P02

1 GROUND LEVEL PLAN
SCALE: 1:200 (A1)

NOTES

1 The Contractor must check and confirm dimensions

2 All discrepancies must be reported and resolved by the Architect before works commence

3 This drawing is not to be scaled

4 All work and materials to be in accordance with current applicable Statutory Legislation and to comply with all relevant Codes of Practice and British Standards.

This scale is 100mm in length when printed at the size indicated in the title block.

Rev		Date
E	Planning Issue	19/01/12
D	Revised Plans	16/01/12
C	Drawing Number changed for Planning	11/01/12
B	Issued for Information	10/01/12
A	revised layouts	14/12/11

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Client
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Project
GONDAR GARDENS

Drawing
PLAN
GROUND LEVEL

Scale	Date	Drawn
1:200 (A1)	NOV 2011	RS

Drawing No
4870 / T1(20) P00

Revision
E

CAD Ref No
G:\4870\T_Series\T20\2nd Application\T120P00

NOTES

1 The Contractor must check and confirm dimensions

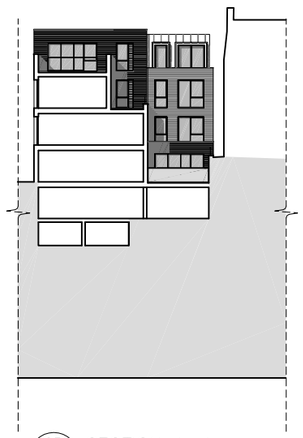
2 All discrepancies must be reported and resolved by the Architect before works commence

3 This drawing is not to be scaled

4 All work and materials to be in accordance with current applicable Statutory Legislation and to comply with all relevant Codes of Practice and British Standards.

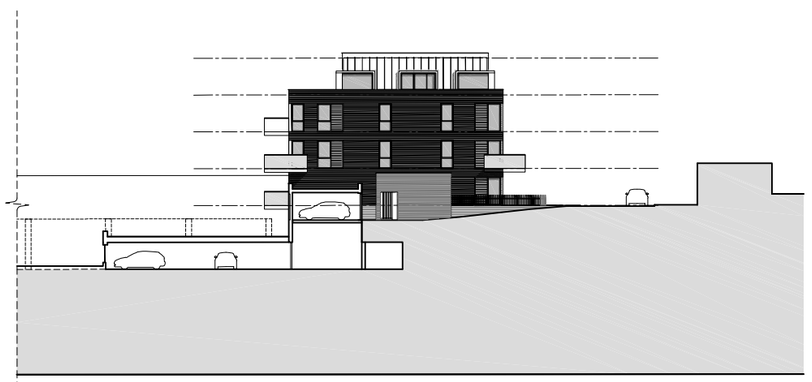
1 – ELEVATION 3–3
SCALE: 1:100 (A1)

2A – SECTION A–A
SCALE: 1:250 (A1)

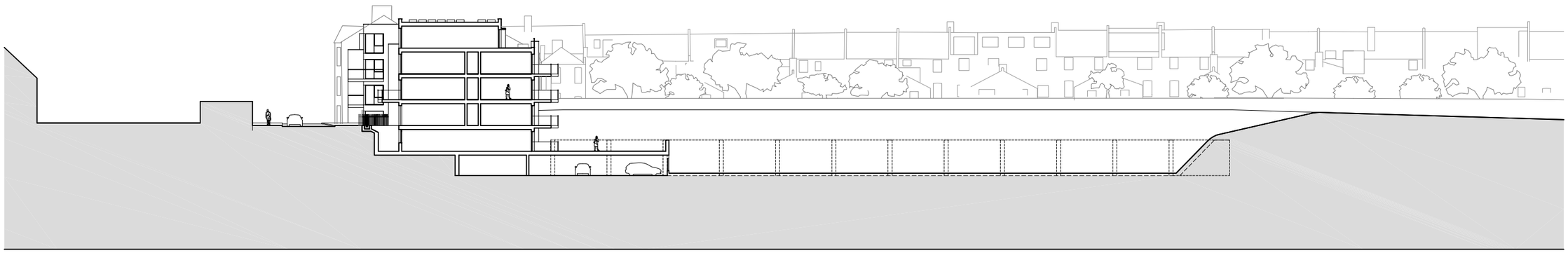


2B – SECTION A–A
SCALE: 1:250 (A1)

SECTION D–D – 4
1:250 (A1) : SCALE:



5 – SECTION E–E
SCALE: 1:250 (A1)



3 – SECTION B–B
SCALE: 1:250 (A1)

This scale is 100mm in length when printed at the size indicated in the title block.

Rev	Date
D Planning Issue	19/01/12
C Revised Elevations	16/01/12
B Drawing Number changed for Planning	11/01/12
A Issued for Information	10/01/12

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Client
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Project
GONDAR GARDENS

Drawing
ELEVATION AND SECTIONS
GONDAR GARDENS

Scale	Date	Drawn
Varies (A1)	JAN 2011	RS

Drawing No
4870 / T1(20) E03

Revision
D

CAD Ref No
G:\4870\T_Series\120\2nd Application\T120E03

NOTES

1 The Contractor must check and confirm dimensions

2 All discrepancies must be reported and resolved by the Architect before works commence

3 This drawing is not to be scaled

4 All work and materials to be in accordance with current applicable Statutory Legislation and to comply with all relevant Codes of Practice and British Standards.

1 – GONDAR GARDENS REAR ELEVATION
SCALE: 1:100 (A1)

Rev		Date
D	Planning Issue	19/01/12
C	Revised Elevations	16/01/12
B	Drawing Number changed for Planning	11/01/12
A	Issued for information	10/01/12

2 – GONDAR GARDENS REAR ELEVATION
SCALE: 1:250 (A1)

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Client
LINDEN WATES (WEST HAMPSTEAD) LTD.

Project
GONDAR GARDENS

Drawing
ELEVATION
GONDAR GARDENS

Scale	Date	Drawn
Varies (A1)	JAN 2011	RS

Drawing No	Revision
4870 / T1(20) E02	D

CAD Ref No
G:\4870\T_Series\T20\2nd Application\T120E02

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1 THIRD FLOOR LEVEL PLAN
SCALE: 1:200 (A1)

NOTES

1 The Contractor must check and confirm dimensions

2 All discrepancies must be reported and resolved by the Architect before works commence

3 This drawing is not to be scaled

4 All work and materials to be in accordance with current applicable Statutory Legislation and to comply with all relevant Codes of Practice and British Standards.

This scale is 100mm in length when printed at the size indicated in the title block.

Rev		Date
D	Planning Issue	19/01/12
C	Revised Plans	16/01/12
B	Drawing Number changed for Planning	11/01/12
A	Issued for Information	10/01/12

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Client
LINDEN WATES (WEST HAMPSTEAD) LTD.

Project
GONDAR GARDENS

Drawing
PLAN
THIRD FLOOR LEVEL

Scale	Date	Drawn
1:200 (A1)	NOV 2011	RS

Drawing No	Revision
4870 / T1(20) P03	D

CAD Ref No
G:\4870\T_Series\T20\2nd Application\T120P03

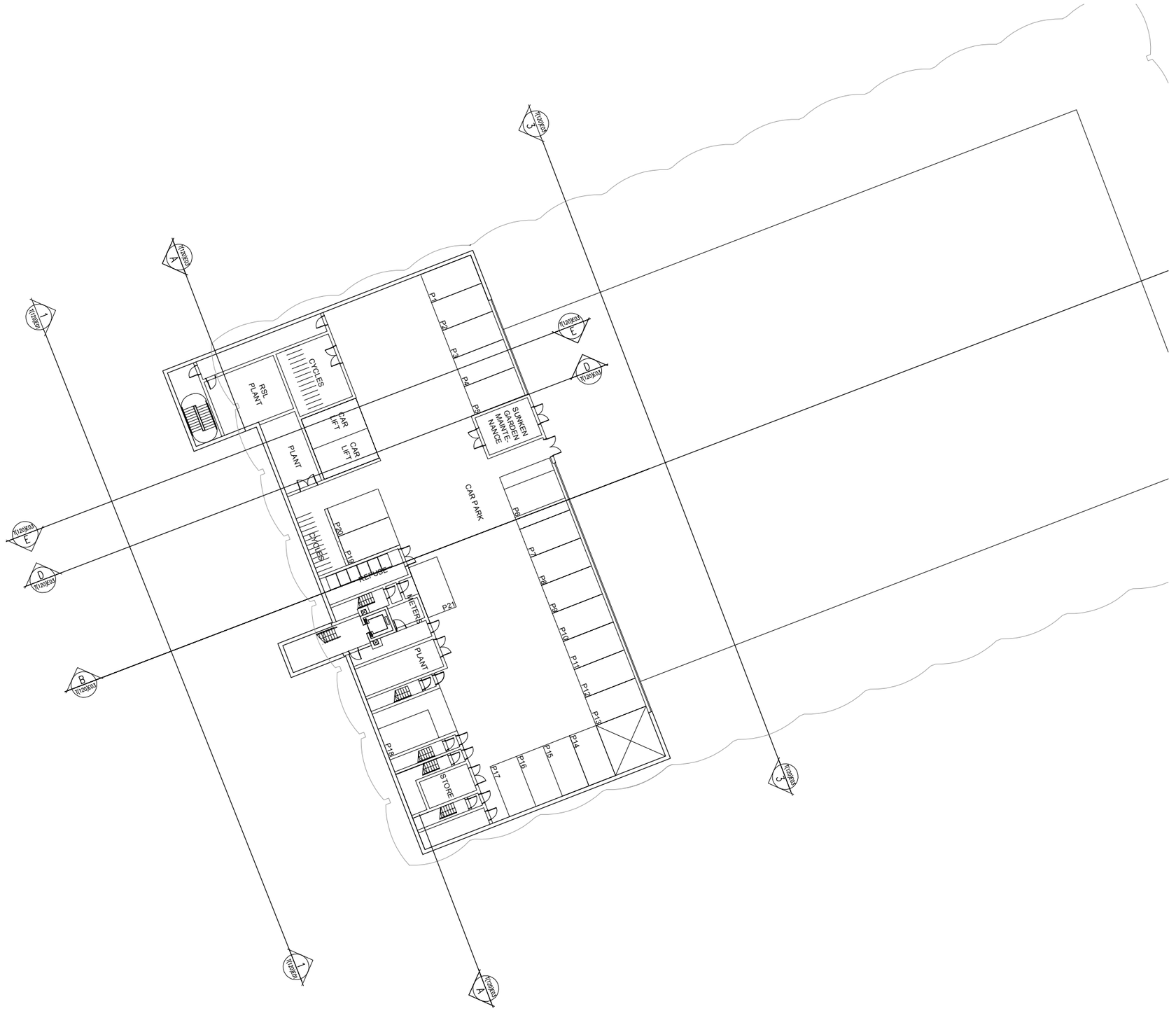
NOTES

1 The Contractor must check and confirm dimensions

2 All discrepancies must be reported and resolved by the Architect before works commence

3 This drawing is not to be scaled

4 All work and materials to be in accordance with current applicable Statutory Legislation and to comply with all relevant Codes of Practice and British Standards.



1 BASEMENT LEVEL PLAN
SCALE: 1: 200 (A1)

Rev	Date
E Planning Issue	19/01/12
D Revised Plans	16/01/12
C Drawing Number changed for Planning	11/01/12
B Issued for Information	10/01/12
A Drawings developed	14/12/11

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Client
LINDEN WATES (WEST HAMPSTEAD) LTD.

Project
GONDAR GARDENS

Drawing
PLAN
BASEMENT LEVEL

Scale	Date	Drawn
1: 200 (A1)	NOV 2011	RS

Drawing No	Revision
4870 / T1(20) P-2	E

CAD Ref No
G:\4870\T_Series\T20\2nd Application\T120P-2

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1 ROOF LEVEL PLAN
SCALE: 1:200 (A1)

NOTES

1 The Contractor must check and confirm dimensions

2 All discrepancies must be reported and resolved by the Architect before works commence

3 This drawing is not to be scaled

4 All work and materials to be in accordance with current applicable Statutory Legislation and to comply with all relevant Codes of Practice and British Standards.

Rev		Date
D	Planning Issue	19/01/12
C	Revised Plans	16/01/12
B	Drawing Number changed for Planning	11/01/12
A	Issued for Information	10/01/12

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Client
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Project
GONDAR GARDENS

Drawing
PLAN
ROOF LEVEL

Scale	Date	Drawn
1:200 (A1)	NOV 2011	RS

Drawing No	Revision
4870 / T1(27) P04	D

CAD Ref No
G:\4870\T_Series\T20\2nd Application\T127P04

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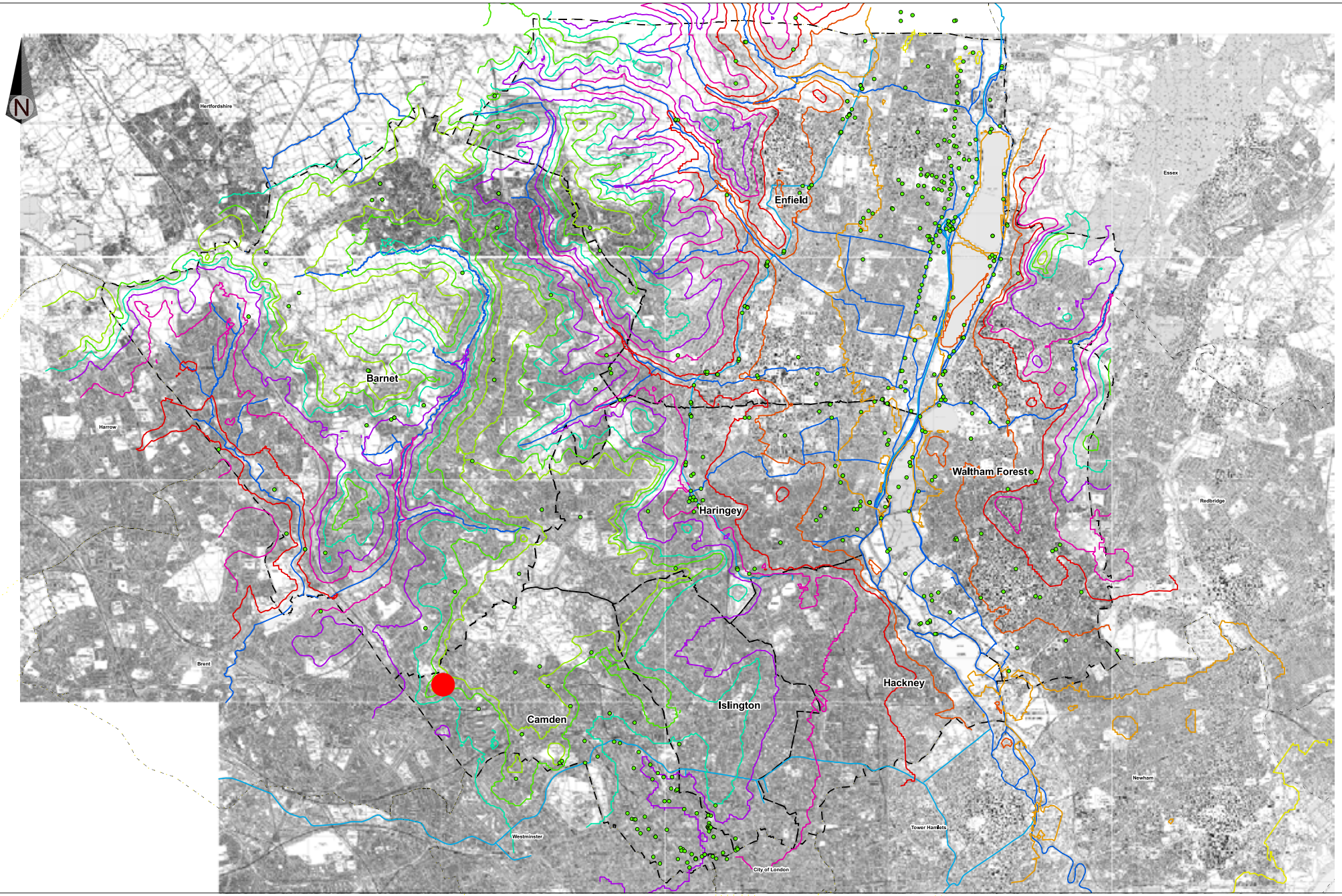
APPENDIX D

Groundwater Flooding Vulnerability



Legend

- Borough Boundaries
- Watercourses
- Canals
- Borehole

Groundwater Contours

Depth below Ground Level (m)

- 10
- 20
- 30
- 40
- 50
- 60
- 70
- 80
- 90

SITE LOCATION

Data Origin
EA provided Groundwater contours (depth below depth), all borehole locations, canals and watercourses. No filtering of borehole data obtained has been undertaken.

mouchel

Client: North London Waste Plan

Project: North London Strategic Flood Risk Assessment

Purpose: Information

Drawing Title: Map 12: Groundwater Contours

Drawn	KR	Checked	IB	Approved	FP
Date	01/08/06	Date	01/08/06	Date	04/08/06

Draft

Issue ●

Scale (at A1 size): 1:40,000

Issuing Office: Sutton Coldfield

Telephone: 0121 355 8949

Drawing Number: 722586/012

Rev: B

APPENDIX E

Thames Water Sewer Records

Asset Location Search

Colin Whittingham
RSK Land And Development Engineering Ltd
Spring Lodge
172 Chester Road
HELSBY
WA6 0AR

earch a ress su lie NW6 1QF

our re erence N/A

ur re erence ALS/ALS Standard/2010_1880381

earch ate 8 October 2010

ou are no a le to or er our Asset ocation earch re uests online isiting
t ro ert insight co u

Thames Water Utilities Ltd

Property Insight
PO Box 3189
Slough SL1 4WW

DX 151280 Slough 13

T 0118 925 1504
F 0118 923 6655/57
E searches@thameswater.co.uk
I www.twpropertyinsight.co.uk

Registered in England and Wales
No. 2366661, Registered office
Clearwater Court, Vastern Road
Reading RG1 8DB

Asset Location Search

earch a ress su lie NW6 1QF

Dear Sir / Madam

An Asset ocation earch is reco en e hen un erta ing a site e elo ent It is essential to obtain information on the size and location of clean water and sewerage assets to safeguard against expensive damage and allow cost-effective service design.

This search provides maps showing the position, size of Thames Water assets close to the proposed development and also manhole cover and invert levels, where available.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information. The replies contained in this letter are given following inspection of the public service records available to this company. No responsibility can be accepted for any error or omission in the replies.

You should be aware that the information contained on these plans is current only on the day that the plans are issued. The plans should only be used for the duration of the work that is being carried out at the present time. Under no circumstances should this data be copied or transmitted to parties other than those for whom the current work is being carried out.

Thames Water do update these service plans on a regular basis and failure to observe the above conditions could lead to damage arising to new or diverted services at a later date.

ontact s

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0118 925 1504, or use the address below:

Thames Water Utilities Ltd
Property Insight
PO Box 3189
Slough
SL1 4WW

Tel: 0118 925 1504
Fax: 0118 923 6657

Email: searches@thameswater.co.uk
Web: www.twpropertyinsight.co.uk

Thames Water Utilities Ltd

Property Insight
PO Box 3189
Slough SL1 4WW

DX 151280 Slough 13

T 0118 925 1504
F 0118 923 6655/57
E searches@thameswater.co.uk
I www.twpropertyinsight.co.uk

Asset Location Search

aste ater er ices

Please ro i e a co e tract ro the u lic se er a

Enclosed is a map showing the approximate lines of our sewers. Our plans do not show sewer connections from individual properties or any sewers not owned by Thames Water unless specifically annotated otherwise. Records such as "private" pipework are in some cases available from the Building Control Department of the relevant Local Authority.

Where the Local Authority does not hold such plans it might be advisable to consult the property deeds for the site or contact neighbouring landowners.

This report relates only to sewerage apparatus of Thames Water Utilities Ltd, it does not disclose details of cables and or communications equipment that may be running through or around such apparatus.

The sewer level information contained in this response represents all of the level data available in our existing records. Should you require any further Information, please refer to the relevant section within the 'Further Contacts' page found later in this document.

For your guidance:

- The Company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Sewers indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an ‘as constructed’ record. It is recommended that these details are checked with the developer.

lean ater er ices

Please ro i e a co e tract ro the u lic ater ain a

Enclosed is a map showing the approximate positions of our water mains and associated apparatus. Please note that records are not kept of the positions of individual domestic supplies.

For your information, there will be a pressure of at least 10m head at the outside stop valve. If you would like to know the static pressure, please contact our Customer Centre on 0845 920 0800. The Customer Centre can

Thames Water Utilities Ltd

Property Insight
PO Box 3189
Slough SL1 4WW

DX 151280 Slough 13

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F 0118 923 6655/57
E searches@thameswater.co.uk
I www.twpropertyinsight.co.uk

Registered in England and Wales
No. 2366661, Registered office
Clearwater Court, Vastern Road
Reading RG1 8DB

Asset Location Search

also arrange for a full flow and pressure test to be carried out for a fee.

For your guidance:

- Assets other than vested water mains may be shown on the plan, for information only.
- If an extract of the public water main record is enclosed, this will show known public water mains in the vicinity of the property. It should be possible to estimate the likely length and route of any private water supply pipe connecting the property to the public water network.

Pa ent or this earch

An invoice is enclosed. Please send remittance to Thames Water Utilities Ltd., PO Box 223, Swindon, SN38 2TW.

Thames Water Utilities Ltd

Property Insight
PO Box 3189
Slough SL1 4WW

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Reading RG1 8DB

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urther contacts

aste ater ueries

Should you require verification of the invert levels of public sewers, by site measurement, you will need to approach the relevant Thames Water Area Network Office for permission to lift the appropriate covers. This permission will usually involve you completing a TWOSA form. For further information please contact our Customer Centre on Tel: 0845 920 0800. Alternatively, a survey can be arranged, for a fee, through our Customer Centre on the above number.

If you have any questions regarding sewer connections, building over issues or any other questions regarding operational issues please direct them to our service desk. Which can be contacted by writing to:

Developer Services (Waste Water)
Thames Water
Clear Water Court
Vastern Road
Reading
RG1 8DB

Tel: 0845 850 2777
Fax: 0118 923 6613
Email: developer.services@thameswater.co.uk

Should you require any further information regarding budget estimates, diversions or stopping up notices then please contact:

DevCon Team
Asset Investment
Thames Water
Maple Lodge STW
Denham Way
Rickmansworth
Hertfordshire
WD3 9SQ

Tel: 01923 898 072
Fax: 01923 898 106
Email: devcon.team@thameswater.co.uk

Thames Water Utilities Ltd

Property Insight
PO Box 3189
Slough SL1 4WW

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E searches@thameswater.co.uk
I www.twpropertyinsight.co.uk

Registered in England and Wales
No. 2366661, Registered office
Clearwater Court, Vastern Road
Reading RG1 8DB

Asset Location Search

lean ater ueries

Should you require any advice concerning clean water operational issues or clean water connections, please contact our Kew Service Desk by writing to:

Clean Water Design
Thames Water Utilities
1 Kew Bridge Road
Brentford
Middlesex
TW8 0EF

Tel: 0845 850 2777
Fax: 0208 213 8833
Email: developer.services@thameswater.co.uk

Thames Water Utilities Ltd

Property Insight
PO Box 3189
Slough SL1 4WW

DX 151280 Slough 13

T 0118 925 1504
F 0118 923 6655/57
E searches@thameswater.co.uk
I www.twpropertyinsight.co.uk

Registered in England and Wales
No. 2366661, Registered office
Clearwater Court, Vastern Road
Reading RG1 8DB

Asset ocation earch e er a A A tan ar | **T**

The width of the displayed area is 258m and the centre of the map is located at OS coordinates 524835,185309

The osition o the a aratus sho n on this lan is gi en ithout o ligation an arrant an the accurac cannot e guarantee er ice i es are not sho n ut their resence shoul e antici ate o lia ilit o an in hatsoe er is acce te Tha es ater or an error or o ission The actual osition o ains an ser ices ust e eri ie an esta lishe on site e ore an or s are un erta en

ase on the r nance ur e a ith the anction o the controller o tationer ice icense no ro n o right eser e

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

anhole e erence	anhole o er e el	anhole ln ert e el
	n a	n a
A	n a	n a
	n a	
The osition o the a aratus sho n on this lan is gi en ithout o ligation an arrant an the accurac cannot e guarantee er ice i es are not sho n ut their resence shoul e antici ate o lia ilit o an in hatsoe er is acce te Tha es ater or an error or o ission The actual osition o ains an ser ices ust e eri ie an esta lishe on site e ore an or s are un erta en		

ALS Sewer Map Key

Pu lic e er T es (Operated & Maintained by Thames Water)

oul A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

ur ace ater A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

o ine A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

e er ittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

Air Valve

Dam Chase

Fitting

Meter

Vent Column

erational ontrols

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

Control Valve

Drop Pipe

Ancillary

Weir

n lte s

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

Outfall

Undefined End

Inlet

ther ols

Symbols used on maps which do not fall under other general categories

Public/Private Pumping Station

Change of characteristic indicator (C.O.C.I.)

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

ther e er T es (Not Operated or Maintained by Thames Water)

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

Proposed

Abandoned Sewer

otes

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plans are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
5) 'na' or '0' on a manhole level indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0118 925 1504.

Asset ocation earch ater a A A tan ar | **T**

The width of the displayed area is 258m and the centre of the map is located at OS coordinates 524835,185309

The osition o the a aratus sho n on this lan is gi en ithout o ligation an arrant an the accurac cannot e guarantee er ice i es are not sho n ut their resence shoul e antici ate o lia ilit o an in hatsoe er is acce te Tha es ater or an error or o ission The actual osition o ains an ser ices ust e eri ie an esta lishe on site e ore an or s are un erta en

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ALS Water Map Key

ater Pi es (Operated & Maintained by Thames Water)

4"

istri ution ain The most common pipe shown on water maps. With few exceptions, domestic connections are only made to distribution mains.

16"

Trun ain A main carrying water from a source of supply to a treatment plant or reservoir, or from one treatment plant or reservoir to another. Also a main transferring water in bulk to smaller water mains used for supplying individual customers.

3" SUPPLY

u l ain A supply main indicates that the water main is used as a supply for a single property or group of properties.

3" FIRE

ire ain Where a pipe is used as a fire supply, the word FIRE will be displayed along the pipe.

3" METERED

etere Pi e A metered main indicates that the pipe in question supplies water for a single property or group of properties and that quantity of water passing through the pipe is metered even though there may be no meter symbol shown.

Trans ission Tunnel A very large diameter water pipe. Most tunnels are buried very deep underground. These pipes are not expected to affect the structural integrity of buildings shown on the map provided.

Pro ose ain A main that is still in the planning stages or in the process of being laid. More details of the proposed main and its reference number are generally included near the main.

PIP IA T	PT
Up to 300mm (12")	900mm (3')
300mm - 600mm (12" - 24")	1100mm (3' 8")
600mm and bigger (24" plus)	1200mm (4')

al es

- General PurposeValve
- Air Valve
- Pressure ControlValve
- CustomerValve

rants

- Single Hydrant

eters

- Meter

n lte s

Symbol indicating what happens at the end of a water main.

- Blank Flange
- Capped End
- Emptying Pit
- Undefined End
- Manifold
- Customer Supply
- Fire Supply

erational ites

- Booster Station
- Other
- Other (Proposed)
- Pumping Station
- Service Reservoir
- Shaft Inspection
- Treatment Works
- Unknown
- Water Tower

ther ols

- Data Logger

ther ater Pi es (Not Operated or Maintained by Thames Water)

ther ater o an ain Occasionally other water company water pipes may overlap the border of our clean water coverage area. These mains are denoted in purple and in most cases have the owner of the pipe displayed along them.

Pri ate ain Indiates that the water main in question is not owned by Thames Water. These mains normally have text associated with them indicating the diameter and owner of the pipe.

Ter s an on itions

All sales are made in accordance with Thames Water Utilities Limited (TWUL) standard terms and conditions unless previously agreed in writing.

1. All goods remain in the property of Thames Water Utilities Ltd until full payment is received.
2. Provision of service will be in accordance with all legal requirements and published TWUL policies.
3. All invoices are strictly due for payment 14 days from due date of the invoice. Any other terms must be accepted/agreed in writing prior to provision of goods or service, or will be held to be invalid.
4. Thames Water does not accept post-dated cheques-any cheques received will be processed for payment on date of receipt.
5. In case of dispute TWUL`s terms and conditions shall apply.
6. Penalty interest may be invoked by TWUL in the event of unjustifiable payment delay. Interest charges will be in line with UK Statute Law 'The Late Payment of Commercial Debts (Interest) Act 1998'.
7. Interest will be charged in line with current Court Interest Charges, if legal action is taken.
8. A charge may be made at the discretion of the company for increased administration costs.

A copy of Thames Water's standard terms and conditions are available from the Commercial Billing Team (TW.cashoperations@npower.com).

We publish several Codes of Practice including a guaranteed standards scheme. You can obtain copies of these leaflets by calling us on 0845 9200 800.

If you are unhappy with our service you can speak to your original goods or customer service provider. If you are not satisfied with the response, your complaint will be reviewed by the Customer Services Director. You can write to him at: Thames Water Utilities Ltd. PO Box 492, Swindon, SN38 8TU.

If the Goods or Services covered by this invoice falls under the regulation of the 1991 Water Industry Act, and you remain dissatisfied you can refer your complaint to WaterVoice Thames on 0845 758 1658 (it will cost you the same as a local call) or write to them at 4th Floor (South), High Holborn House, 52-54 High Holborn, London WC1V 6RL.

a s to a our ill

Post Cheque only, made payable to 'Thames Water Utilities Ltd' writing your Thames Water account number on the back. Please fill in the payment slip below and send it with your cheque to Thames Water Utilities Ltd., PO Box 223, Swindon SN38 2TW	**A Pa ent** direct to our bank on account number 90478703, sort code 60-00-01 may be made. A remittance advice must be sent to Thames Water Utilities Ltd., PO Box 223, Swindon SN38 2TW. Or fax to 01793 424599 or email: cashoperations@thameswater.co.uk	**Tele hone an ing** By calling your bank and quoting your invoice number and the Thames Water's bank account number 90478703 and sort code 60-00-01	**i t Trans er** You may make your payment via SWIFT by quoting together with our bank account number 90478703, sort code 60-00-01 and invoice number

In oice

olin hittingha

RSK Land And Development Engineering Ltd
172 Spring Lodge
Chester Road
Helsby
WA6 0AR

Thames Water Utilities Ltd.
PO Box 223
Swindon
SN38 2TW

usto er e erence	N/A	**In oice o ur e**	ADS10289819 ALS/ALS Standard/2010_1880381
usto er u er	ADS103255	**Posting ate**	08-10-2010
Purchase r er o		**ue ate**	22-10-2010

earch A ress u lie NW6 1QF

escri tion o harges	**t**	**nit Price**	**AT**	**A ount Inc AT**
Asset Location Search	1	£46.00	£8.05	£54.05

Mr Ian Clark agreed to be invoiced on 08/10/2010 for Â£54.05

T TA I A T Inc AT £54.05

Please sen an outstan ing a ount to Tha es ater P o in on T

Your payment terms are within 14 days. Please see previous page for ways to pay.

For queries please contact the Property Insight Customer Support Team on Tel: 0118 925 1504.

AT eg o

Girobank Transcash

Girobank plc Bootle Merseyside GIR 0AA

Payment slip

bank giro credit

138
208
70

Reference (customer account number): ADS103255 / ADS10289819

Credit account number: 257 1706

Amount due (40p fee payable at PO counter): £ 54.05

Cheque NOT acceptable at Post Office

By transfer from Alliance and Leicester Giro account number

Cashiers stamp and initials

Signature

Date

RSK Land And Development Engineering Ltd
172 Spring Lodge
Chester Road
Helsby
WA6 0AR

57-17-06

NatWest
Collection Account
Thames Water Utilities Ltd

Cash

Cheques

£

Items Fee

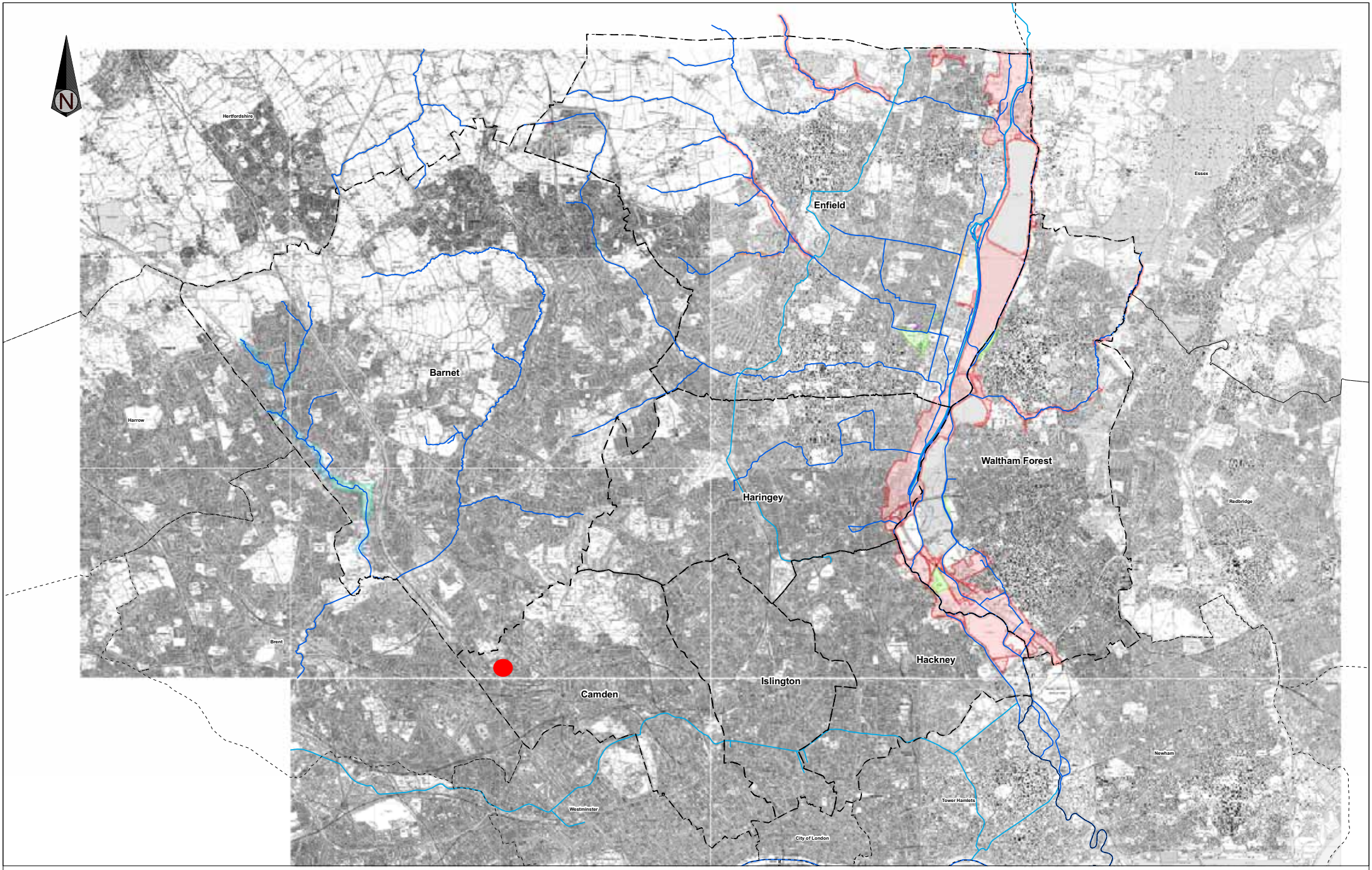
Please do not write or mark below this line and do not fold this counterfoil

Paragon 9530 01/2004

010010002898196 V7702571706 000054054 74 X

APPENDIX F

Historic Flooding Incidence



Legend

- Borough Boundaries
- Canals
- Watercourses

Historic Flood

- 1947
- 1964
- 1977
- 1980
- 1981
- 1987
- 1992
- 1999
- 2000

SITE LOCATION

Data Origin
Historic flood extents, Canals and Watercourses data provided by the EA.

mouchel

Client: North London Waste Plan

Project: North London Strategic Flood Risk Assessment

Purpose: Information

Drawing Title: Map 10: Historic EA Flood Maps

Drawn	SL	Chckd	KR	Apprvd	FP
Date	(initials)	Date	(initials)	Date	(initials)

Draft

Issue

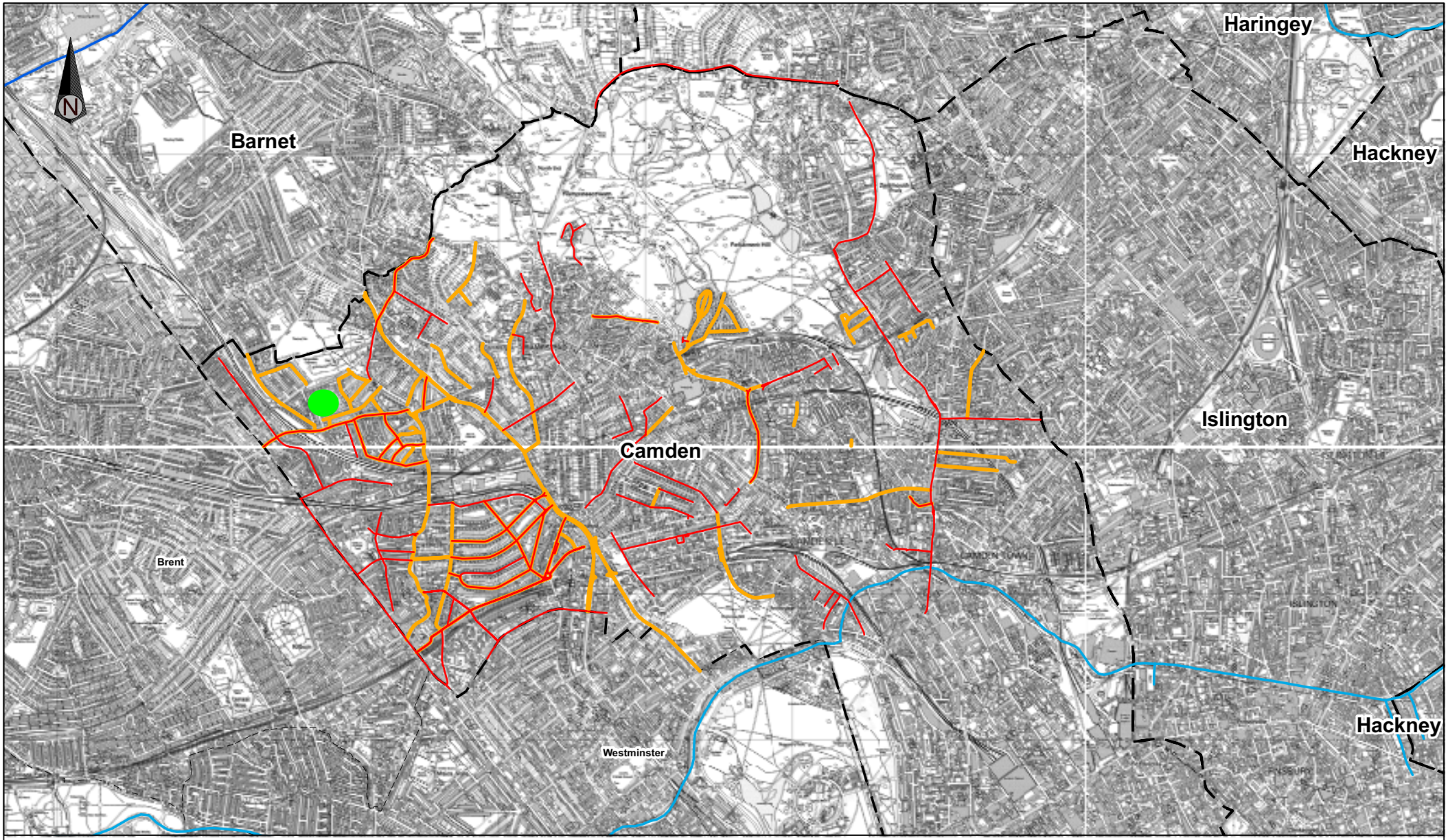
Scale (at A3 size) 1:40,000

Issuing Office: Sutton Coldfield

Telephone: 0121 355 8949

Drawing Number: 722586/010

Rev: C



Legend

- Flood Streets 1975
- Flood Streets 2002
- Canals
- Watercourses
- Borough Boundaries
- SITE LOCATION

Data Origin
Flood data provided by LB Camden. Canal data was provided by the EA.

mouchel

Client: **North London Waste Plan**

Project: **North London Strategic Flood Risk Assessment**

Purpose: **Information**

Drawing Title: **Map 22: Camden Flooding Map**

Drawn	SL	Chckd	KR	Apprvd	FP
Date	07/08/08	Date	07/08/08	Date	08/08/08

Draft		Scale (at A3 size)	Issuing Office	Sutton Coldfield	Drawing Number	Rev
Issue	●	1:25,000	Telephone	0121 355 8949	722586/002	B

APPENDIX G

Environment Agency Correspondence

creating a better place

Environment Agency

Gavin Sexton
London Borough of Camden
Development Control
Town Hall Extension Argyle Street
London
WC1H 8EQ

Our ref: NE/2011/111419/02-L01
Your ref: 2011/0395/P

Date: 8 July 2011

By email:
gavin.sexton@camden.gov.uk

Dear Gavin

Gondar Gardens Reservoir, Gondar Gardens, London.

Redevelopment of the covered reservoir structure to provide 16x 4-bed residential units (Use class C3) with associated parking, refuse storage and landscaping. This application is accompanied by an Environmental Impact Assessment (EIA).

Further to the receipt of further surface water drainage proposals from Ian Clark of RSK which you confirmed you had also received we are able to **remove our objection** to the above planning application.

The proposed development will however only be acceptable if a planning condition is imposed requiring the following drainage details.

Condition
Development shall not begin until a surface water drainage scheme for the site, based on sustainable drainage principles and an assessment of the hydrological and hydrogeological context of the development, has been submitted to and approved in writing by the local planning authority. The scheme shall subsequently be implemented in accordance with the approved details before the development is completed.

The scheme shall also include details of how the scheme shall be maintained and managed after completion.

Reason
To prevent the increased risk of flooding

Please contact me if you require anything further.

Yours sincerely

Miss Eleri Randall
Planning Liaison Officer
Direct dial 020 7091 4044
Direct e-mail northlondonplanning@environment-agency.gov.uk

APPENDIX H

Pre-Development Run Off Rates

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (Ha)	1.240	Urban	0.000
SAAR (mm)	607.000	Region Number	6

Results **l/s**

QBAR Rural	4.6
QBAR Urban	4.6
Q 100 years	14.7
Q 1 year	3.9
Q 30 years	10.4
Q 100 years	14.7

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (Ha)	1.240	Urban	0.400
SAAR (mm)	607.000	Region Number	6

Results **l/s**

QBAR Rural	4.6
QBAR Urban	8.7
Q 100 years	20.9
Q 1 year	7.4
Q 30 years	16.9
Q 100 years	20.9

APPENDIX I

MicroDrainage Attenuation Calculations

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 145 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Σ Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	78.552	0.552	0.0	4.6	4.6	42.0	O K
30 min Summer	78.696	0.696	0.0	4.6	4.6	52.9	O K
60 min Summer	78.811	0.811	0.0	4.6	4.6	61.6	O K
120 min Summer	78.859	0.859	0.0	4.6	4.6	65.3	O K
180 min Summer	78.856	0.856	0.0	4.6	4.6	65.1	O K
240 min Summer	78.839	0.839	0.0	4.6	4.6	63.8	O K
360 min Summer	78.795	0.795	0.0	4.6	4.6	60.4	O K
480 min Summer	78.746	0.746	0.0	4.6	4.6	56.7	O K
600 min Summer	78.696	0.696	0.0	4.6	4.6	52.9	O K
720 min Summer	78.648	0.648	0.0	4.6	4.6	49.3	O K
960 min Summer	78.564	0.564	0.0	4.6	4.6	42.9	O K
1440 min Summer	78.461	0.461	0.0	4.2	4.2	35.0	O K
2160 min Summer	78.373	0.373	0.0	3.4	3.4	28.4	O K
2880 min Summer	78.316	0.316	0.0	2.9	2.9	24.0	O K
4320 min Summer	78.244	0.244	0.0	2.2	2.2	18.5	O K
5760 min Summer	78.200	0.200	0.0	1.8	1.8	15.2	O K
7200 min Summer	78.170	0.170	0.0	1.6	1.6	12.9	O K
8640 min Summer	78.149	0.149	0.0	1.4	1.4	11.3	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	139.002	24
30 min Summer	89.961	37
60 min Summer	55.351	64
120 min Summer	32.877	112
180 min Summer	23.920	142
240 min Summer	18.978	174
360 min Summer	13.703	242
480 min Summer	10.865	308
600 min Summer	9.069	374
720 min Summer	7.821	438
960 min Summer	6.188	560
1440 min Summer	4.442	798
2160 min Summer	3.184	1168
2880 min Summer	2.512	1532
4320 min Summer	1.796	2252
5760 min Summer	1.414	2992
7200 min Summer	1.175	3680
8640 min Summer	1.009	4416

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	78.133	0.133	0.0	1.2	1.2	10.1	O K
15 min Winter	78.622	0.622	0.0	4.6	4.6	47.3	O K
30 min Winter	78.787	0.787	0.0	4.6	4.6	59.8	O K
60 min Winter	78.921	0.921	0.0	4.6	4.6	70.0	O K
120 min Winter	78.986	0.986	0.0	4.6	4.6	75.0	O K
180 min Winter	78.972	0.972	0.0	4.6	4.6	73.9	O K
240 min Winter	78.945	0.945	0.0	4.6	4.6	71.8	O K
360 min Winter	78.876	0.876	0.0	4.6	4.6	66.6	O K
480 min Winter	78.799	0.799	0.0	4.6	4.6	60.7	O K
600 min Winter	78.723	0.723	0.0	4.6	4.6	54.9	O K
720 min Winter	78.651	0.651	0.0	4.6	4.6	49.5	O K
960 min Winter	78.534	0.534	0.0	4.6	4.6	40.6	O K
1440 min Winter	78.419	0.419	0.0	3.9	3.9	31.9	O K
2160 min Winter	78.323	0.323	0.0	3.0	3.0	24.5	O K
2880 min Winter	78.263	0.263	0.0	2.4	2.4	20.0	O K
4320 min Winter	78.194	0.194	0.0	1.8	1.8	14.8	O K
5760 min Winter	78.155	0.155	0.0	1.4	1.4	11.8	O K
7200 min Winter	78.130	0.130	0.0	1.2	1.2	9.9	O K
8640 min Winter	78.112	0.112	0.0	1.0	1.0	8.5	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
10080 min Summer	0.887	5144
15 min Winter	139.002	24
30 min Winter	89.961	38
60 min Winter	55.351	64
120 min Winter	32.877	118
180 min Winter	23.920	152
240 min Winter	18.978	188
360 min Winter	13.703	264
480 min Winter	10.865	334
600 min Winter	9.069	402
720 min Winter	7.821	466
960 min Winter	6.188	584
1440 min Winter	4.442	826
2160 min Winter	3.184	1192
2880 min Winter	2.512	1560
4320 min Winter	1.796	2292
5760 min Winter	1.414	3000
7200 min Winter	1.175	3744
8640 min Winter	1.009	4424

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	78.099	0.099	0.0	0.9	0.9	7.5	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
10080 min Winter	0.887	5152

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	21.000	Shortest Storm (mins)	15
Ratio R	0.432	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time / Area Diagram

Total Area (ha) 0.175

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.058	4-8	0.058	8-12	0.058

Model Details

Storage is Online Cover Level (m) 80.000

Cellular Storage Structure

Invert Level (m) 78.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	80.0	0.0	1.001	0.0	0.0
1.000	80.0	0.0			

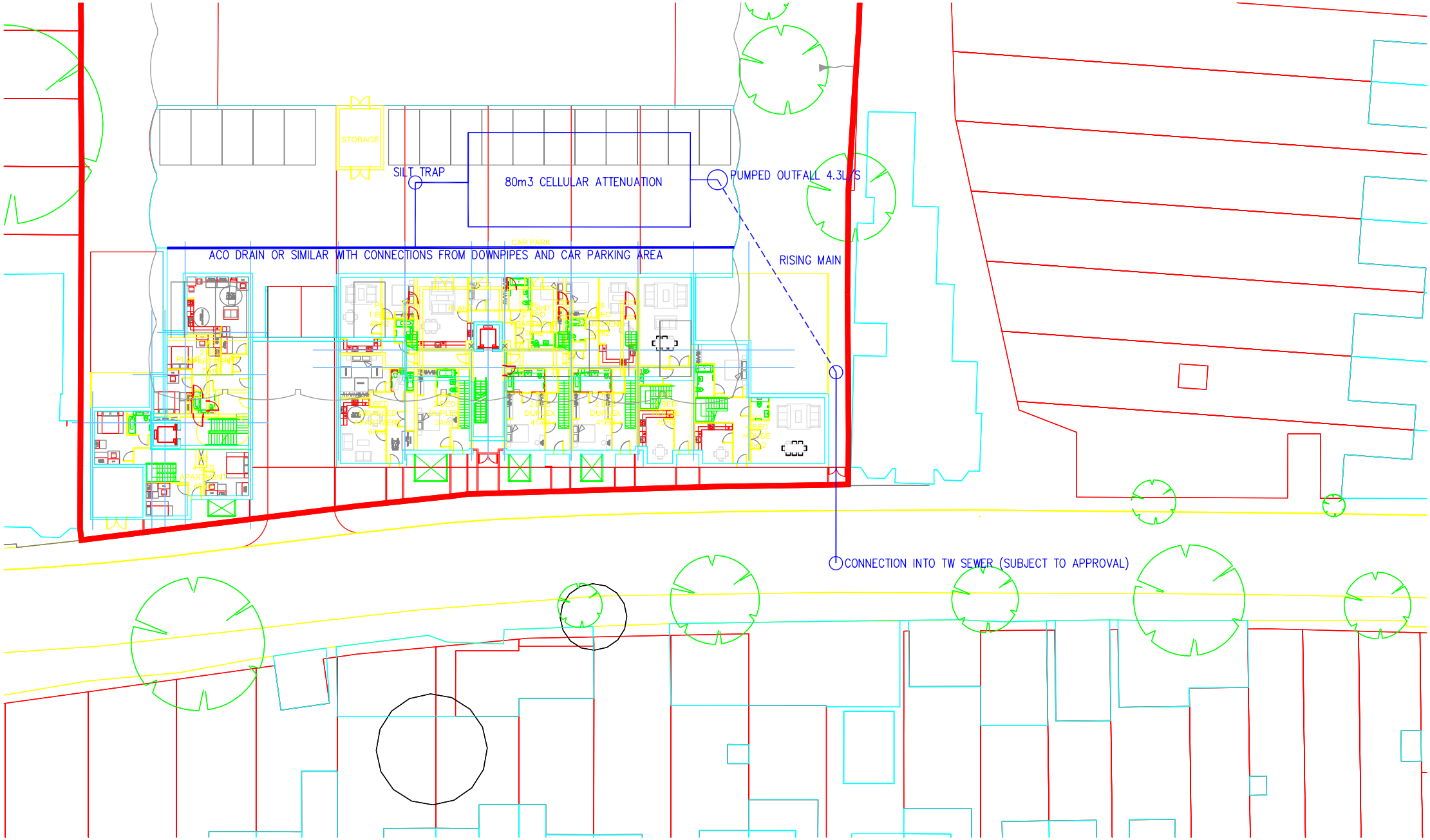
Pump Outflow Control

Invert Level (m) 78.000

Depth (m)	Flow (l/s)
0.500	4.6000

APPENDIX J

Surface Water Drainage Schematic


STORAGE
SILT TRAP
80m3 CELLULAR ATTENUATION
PUMPED OUTFALL 4.3L/S
CAR PARK
ACO DRAIN OR SIMILAR WITH CONNECTIONS FROM DOWNPIPES AND CAR PARKING AREA
RISING MAIN
CONNECTION INTO TW SEWER (SUBJECT TO APPROVAL)

APPENDIX K

Landscaped Area Drainage Calculations

Summary of Results for 2 year Return Period (+30%)

Half Drain Time exceeds 7 days.

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m^3)	Status
15 min Summer	8.453	0.453	0.0	35.7	O K
30 min Summer	8.524	0.524	0.0	45.7	O K
60 min Summer	8.592	0.592	0.0	56.4	O K
120 min Summer	8.658	0.658	0.0	67.9	O K
180 min Summer	8.698	0.698	0.0	75.3	O K
240 min Summer	8.727	0.727	0.0	80.9	O K
360 min Summer	8.768	0.768	0.0	89.2	O K
480 min Summer	8.797	0.797	0.0	95.4	O K
600 min Summer	8.821	0.821	0.0	100.5	O K
720 min Summer	8.840	0.840	0.0	104.9	O K
960 min Summer	8.872	0.872	0.0	112.1	O K
1440 min Summer	8.919	0.919	0.0	123.2	O K
2160 min Summer	8.967	0.967	0.0	135.3	O K
2880 min Summer	9.003	1.003	0.0	144.5	O K
4320 min Summer	9.055	1.055	0.0	158.5	O K
5760 min Summer	9.093	1.093	0.0	169.2	O K
7200 min Summer	9.123	1.123	0.0	177.9	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	56.173	45
30 min Summer	35.987	60
60 min Summer	22.168	90
120 min Summer	13.358	150
180 min Summer	9.877	210
240 min Summer	7.960	270
360 min Summer	5.848	390
480 min Summer	4.694	510
600 min Summer	3.957	630
720 min Summer	3.441	750
960 min Summer	2.760	990
1440 min Summer	2.022	1470
2160 min Summer	1.482	2192
2880 min Summer	1.188	2912
4320 min Summer	0.870	4352
5760 min Summer	0.697	5792
7200 min Summer	0.587	7232

Summary of Results for 2 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
8640 min Summer	9.149	1.149	0.0	185.4	O K
10080 min Summer	9.170	1.170	0.0	191.9	O K
15 min Winter	8.484	0.484	0.0	40.0	O K
30 min Winter	8.560	0.560	0.0	51.2	O K
60 min Winter	8.631	0.631	0.0	63.1	O K
120 min Winter	8.702	0.702	0.0	76.1	O K
180 min Winter	8.744	0.744	0.0	84.3	O K
240 min Winter	8.775	0.775	0.0	90.6	O K
360 min Winter	8.818	0.818	0.0	99.9	O K
480 min Winter	8.849	0.849	0.0	106.9	O K
600 min Winter	8.874	0.874	0.0	112.6	O K
720 min Winter	8.895	0.895	0.0	117.5	O K
960 min Winter	8.929	0.929	0.0	125.6	O K
1440 min Winter	8.978	0.978	0.0	138.0	O K
2160 min Winter	9.029	1.029	0.0	151.5	O K
2880 min Winter	9.067	1.067	0.0	161.9	O K
4320 min Winter	9.122	1.122	0.0	177.5	O K
5760 min Winter	9.162	1.162	0.0	189.5	O K
7200 min Winter	9.195	1.195	0.0	199.4	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
8640 min Summer	0.511	8672
10080 min Summer	0.454	10112
15 min Winter	56.173	45
30 min Winter	35.987	60
60 min Winter	22.168	90
120 min Winter	13.358	150
180 min Winter	9.877	210
240 min Winter	7.960	270
360 min Winter	5.848	390
480 min Winter	4.694	510
600 min Winter	3.957	628
720 min Winter	3.441	748
960 min Winter	2.760	988
1440 min Winter	2.022	1468
2160 min Winter	1.482	2188
2880 min Winter	1.188	2904
4320 min Winter	0.870	4344
5760 min Winter	0.697	5784
7200 min Winter	0.587	7216

Summary of Results for 2 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
8640 min Winter	9.222	1.222	0.0	207.8	O K
10080 min Winter	9.245	1.245	0.0	215.1	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
8640 min Winter	0.511	8656
10080 min Winter	0.454	10096

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	21.000	Shortest Storm (mins)	15
Ratio R	0.432	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time / Area Diagram

Total Area (ha) 0.339

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-10	0.113	10-20	0.113	20-30	0.113

Model Details

Storage is Online Cover Level (m) 10.000

Infiltration Basin Structure

Invert Level (m)	8.000	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00010	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.00010		

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	25.0	2.000	500.0

Summary of Results for 5 year Return Period (+30%)

Half Drain Time exceeds 7 days.

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m^3)	Status
15 min Summer	8.525	0.525	0.0	45.9	O K
30 min Summer	8.603	0.603	0.0	58.3	O K
60 min Summer	8.676	0.676	0.0	71.2	O K
120 min Summer	8.747	0.747	0.0	84.9	O K
180 min Summer	8.788	0.788	0.0	93.5	O K
240 min Summer	8.818	0.818	0.0	100.0	O K
360 min Summer	8.861	0.861	0.0	109.7	O K
480 min Summer	8.893	0.893	0.0	117.0	O K
600 min Summer	8.918	0.918	0.0	123.0	O K
720 min Summer	8.938	0.938	0.0	128.1	O K
960 min Summer	8.972	0.972	0.0	136.4	O K
1440 min Summer	9.020	1.020	0.0	149.1	O K
2160 min Summer	9.071	1.071	0.0	162.9	O K
2880 min Summer	9.108	1.108	0.0	173.4	O K
4320 min Summer	9.161	1.161	0.0	189.2	O K
5760 min Summer	9.200	1.200	0.0	201.2	O K
7200 min Summer	9.232	1.232	0.0	210.9	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	72.179	45
30 min Summer	45.852	60
60 min Summer	27.989	90
120 min Summer	16.696	150
180 min Summer	12.264	210
240 min Summer	9.834	270
360 min Summer	7.193	390
480 min Summer	5.756	510
600 min Summer	4.840	630
720 min Summer	4.201	750
960 min Summer	3.358	990
1440 min Summer	2.448	1470
2160 min Summer	1.784	2192
2880 min Summer	1.425	2912
4320 min Summer	1.038	4352
5760 min Summer	0.829	5792
7200 min Summer	0.696	7232

Summary of Results for 5 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
8640 min Summer	9.257	1.257	0.0	219.2	O K
10080 min Summer	9.279	1.279	0.0	226.4	O K
15 min Winter	8.561	0.561	0.0	51.4	O K
30 min Winter	8.644	0.644	0.0	65.3	O K
60 min Winter	8.721	0.721	0.0	79.7	O K
120 min Winter	8.796	0.796	0.0	95.1	O K
180 min Winter	8.840	0.840	0.0	104.7	O K
240 min Winter	8.871	0.871	0.0	112.0	O K
360 min Winter	8.917	0.917	0.0	122.8	O K
480 min Winter	8.951	0.951	0.0	131.0	O K
600 min Winter	8.977	0.977	0.0	137.7	O K
720 min Winter	8.999	0.999	0.0	143.4	O K
960 min Winter	9.034	1.034	0.0	152.8	O K
1440 min Winter	9.085	1.085	0.0	167.0	O K
2160 min Winter	9.139	1.139	0.0	182.5	O K
2880 min Winter	9.178	1.178	0.0	194.2	O K
4320 min Winter	9.235	1.235	0.0	211.9	O K
5760 min Winter	9.276	1.276	0.0	225.4	O K
7200 min Winter	9.309	1.309	0.0	236.3	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
8640 min Summer	0.603	8672
10080 min Summer	0.535	10112
15 min Winter	72.179	45
30 min Winter	45.852	60
60 min Winter	27.989	90
120 min Winter	16.696	150
180 min Winter	12.264	210
240 min Winter	9.834	270
360 min Winter	7.193	390
480 min Winter	5.756	510
600 min Winter	4.840	628
720 min Winter	4.201	748
960 min Winter	3.358	988
1440 min Winter	2.448	1468
2160 min Winter	1.784	2188
2880 min Winter	1.425	2904
4320 min Winter	1.038	4344
5760 min Winter	0.829	5784
7200 min Winter	0.696	7224

Summary of Results for 5 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
8640 min Winter	9.337	1.337	0.0	245.6	O K
10080 min Winter	9.360	1.360	0.0	253.7	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
8640 min Winter	0.603	8656
10080 min Winter	0.535	10096

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	5	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	21.000	Shortest Storm (mins)	15
Ratio R	0.432	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time / Area Diagram

Total Area (ha) 0.339

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-10	0.113	10-20	0.113	20-30	0.113

Model Details

Storage is Online Cover Level (m) 10.000

Infiltration Basin Structure

Invert Level (m)	8.000	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00010	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.00010		

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	25.0	2.000	500.0

Summary of Results for 10 year Return Period (+30%)

Half Drain Time exceeds 7 days.

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m^3)	Status
15 min Summer	8.573	0.573	0.0	53.4	O K
30 min Summer	8.659	0.659	0.0	68.1	O K
60 min Summer	8.739	0.739	0.0	83.3	O K
120 min Summer	8.815	0.815	0.0	99.3	O K
180 min Summer	8.859	0.859	0.0	109.1	O K
240 min Summer	8.890	0.890	0.0	116.4	O K
360 min Summer	8.936	0.936	0.0	127.3	O K
480 min Summer	8.968	0.968	0.0	135.5	O K
600 min Summer	8.994	0.994	0.0	142.2	O K
720 min Summer	9.016	1.016	0.0	147.9	O K
960 min Summer	9.050	1.050	0.0	157.2	O K
1440 min Summer	9.100	1.100	0.0	171.2	O K
2160 min Summer	9.152	1.152	0.0	186.3	O K
2880 min Summer	9.189	1.189	0.0	197.7	O K
4320 min Summer	9.244	1.244	0.0	214.8	O K
5760 min Summer	9.283	1.283	0.0	227.7	O K
7200 min Summer	9.315	1.315	0.0	238.2	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	83.997	45
30 min Summer	53.590	60
60 min Summer	32.772	90
120 min Summer	19.530	150
180 min Summer	14.314	210
240 min Summer	11.450	270
360 min Summer	8.349	390
480 min Summer	6.667	510
600 min Summer	5.597	630
720 min Summer	4.851	750
960 min Summer	3.868	990
1440 min Summer	2.810	1470
2160 min Summer	2.040	2192
2880 min Summer	1.624	2912
4320 min Summer	1.178	4352
5760 min Summer	0.938	5792
7200 min Summer	0.786	7232

Summary of Results for 10 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
8640 min Summer	9.341	1.341	0.0	247.0	O K
10080 min Summer	9.363	1.363	0.0	254.6	O K
15 min Winter	8.612	0.612	0.0	59.8	O K
30 min Winter	8.703	0.703	0.0	76.3	O K
60 min Winter	8.787	0.787	0.0	93.3	O K
120 min Winter	8.868	0.868	0.0	111.2	O K
180 min Winter	8.915	0.915	0.0	122.2	O K
240 min Winter	8.948	0.948	0.0	130.4	O K
360 min Winter	8.996	0.996	0.0	142.6	O K
480 min Winter	9.030	1.030	0.0	151.8	O K
600 min Winter	9.058	1.058	0.0	159.3	O K
720 min Winter	9.080	1.080	0.0	165.6	O K
960 min Winter	9.117	1.117	0.0	176.1	O K
1440 min Winter	9.170	1.170	0.0	191.7	O K
2160 min Winter	9.224	1.224	0.0	208.7	O K
2880 min Winter	9.264	1.264	0.0	221.4	O K
4320 min Winter	9.322	1.322	0.0	240.6	O K
5760 min Winter	9.364	1.364	0.0	255.1	O K
7200 min Winter	9.397	1.397	0.0	266.8	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
8640 min Summer	0.680	8672
10080 min Summer	0.601	10112
15 min Winter	83.997	45
30 min Winter	53.590	60
60 min Winter	32.772	90
120 min Winter	19.530	150
180 min Winter	14.314	210
240 min Winter	11.450	270
360 min Winter	8.349	390
480 min Winter	6.667	510
600 min Winter	5.597	630
720 min Winter	4.851	748
960 min Winter	3.868	988
1440 min Winter	2.810	1468
2160 min Winter	2.040	2188
2880 min Winter	1.624	2908
4320 min Winter	1.178	4344
5760 min Winter	0.938	5784
7200 min Winter	0.786	7224

Summary of Results for 10 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
8640 min Winter	9.425	1.425	0.0	276.7	O K
10080 min Winter	9.448	1.448	0.0	285.3	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
8640 min Winter	0.680	8656
10080 min Winter	0.601	10096

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	10	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	21.000	Shortest Storm (mins)	15
Ratio R	0.432	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time / Area Diagram

Total Area (ha) 0.339

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-10	0.113	10-20	0.113	20-30	0.113

Model Details

Storage is Online Cover Level (m) 10.000

Infiltration Basin Structure

Invert Level (m)	8.000	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00010	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.00010		

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	25.0	2.000	500.0

Summary of Results for 25 year Return Period (+30%)

Half Drain Time exceeds 7 days.

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m^3)	Status
15 min Summer	8.643	0.643	0.0	65.2	O K
30 min Summer	8.741	0.741	0.0	83.7	O K
60 min Summer	8.830	0.830	0.0	102.6	O K
120 min Summer	8.914	0.914	0.0	122.2	O K
180 min Summer	8.962	0.962	0.0	133.9	O K
240 min Summer	8.995	0.995	0.0	142.3	O K
360 min Summer	9.042	1.042	0.0	155.1	O K
480 min Summer	9.077	1.077	0.0	164.6	O K
600 min Summer	9.104	1.104	0.0	172.3	O K
720 min Summer	9.126	1.126	0.0	178.8	O K
960 min Summer	9.162	1.162	0.0	189.5	O K
1440 min Summer	9.214	1.214	0.0	205.4	O K
2160 min Summer	9.267	1.267	0.0	222.4	O K
2880 min Summer	9.306	1.306	0.0	235.2	O K
4320 min Summer	9.361	1.361	0.0	254.1	O K
5760 min Summer	9.401	1.401	0.0	268.3	O K
7200 min Summer	9.433	1.433	0.0	279.6	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	102.640	45
30 min Summer	65.858	60
60 min Summer	40.372	90
120 min Summer	24.028	150
180 min Summer	17.559	210
240 min Summer	14.000	270
360 min Summer	10.169	390
480 min Summer	8.097	510
600 min Summer	6.782	630
720 min Summer	5.866	750
960 min Summer	4.663	990
1440 min Summer	3.371	1470
2160 min Summer	2.435	2192
2880 min Summer	1.932	2912
4320 min Summer	1.393	4352
5760 min Summer	1.104	5792
7200 min Summer	0.922	7232

Summary of Results for 25 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
8640 min Summer	9.459	1.459	0.0	289.2	O K
10080 min Summer	9.481	1.481	0.0	297.4	O K
15 min Winter	8.686	0.686	0.0	73.1	O K
30 min Winter	8.790	0.790	0.0	93.8	O K
60 min Winter	8.884	0.884	0.0	115.0	O K
120 min Winter	8.973	0.973	0.0	136.8	O K
180 min Winter	9.023	1.023	0.0	150.0	O K
240 min Winter	9.058	1.058	0.0	159.4	O K
360 min Winter	9.109	1.109	0.0	173.7	O K
480 min Winter	9.145	1.145	0.0	184.4	O K
600 min Winter	9.174	1.174	0.0	193.0	O K
720 min Winter	9.198	1.198	0.0	200.3	O K
960 min Winter	9.236	1.236	0.0	212.3	O K
1440 min Winter	9.291	1.291	0.0	230.1	O K
2160 min Winter	9.347	1.347	0.0	249.1	O K
2880 min Winter	9.388	1.388	0.0	263.4	O K
4320 min Winter	9.447	1.447	0.0	284.7	O K
5760 min Winter	9.489	1.489	0.0	300.5	O K
7200 min Winter	9.522	1.522	0.0	313.3	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
8640 min Summer	0.795	8672
10080 min Summer	0.702	10112
15 min Winter	102.640	45
30 min Winter	65.858	60
60 min Winter	40.372	90
120 min Winter	24.028	150
180 min Winter	17.559	210
240 min Winter	14.000	270
360 min Winter	10.169	390
480 min Winter	8.097	510
600 min Winter	6.782	630
720 min Winter	5.866	748
960 min Winter	4.663	988
1440 min Winter	3.371	1468
2160 min Winter	2.435	2188
2880 min Winter	1.932	2908
4320 min Winter	1.393	4344
5760 min Winter	1.104	5784
7200 min Winter	0.922	7224

Summary of Results for 25 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
8640 min Winter	9.550	1.550	0.0	324.0	O K
10080 min Winter	9.573	1.573	0.0	333.2	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
8640 min Winter	0.795	8664
10080 min Winter	0.702	10096

Summary of Results for 50 year Return Period (+30%)

Half Drain Time exceeds 7 days.

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m^3)	Status
15 min Summer	8.701	0.701	0.0	75.9	O K
30 min Summer	8.809	0.809	0.0	97.8	O K
60 min Summer	8.906	0.906	0.0	120.2	O K
120 min Summer	8.997	0.997	0.0	142.9	O K
180 min Summer	9.047	1.047	0.0	156.3	O K
240 min Summer	9.081	1.081	0.0	165.7	O K
360 min Summer	9.130	1.130	0.0	180.0	O K
480 min Summer	9.166	1.166	0.0	190.7	O K
600 min Summer	9.194	1.194	0.0	199.3	O K
720 min Summer	9.218	1.218	0.0	206.5	O K
960 min Summer	9.255	1.255	0.0	218.3	O K
1440 min Summer	9.308	1.308	0.0	235.8	O K
2160 min Summer	9.362	1.362	0.0	254.4	O K
2880 min Summer	9.401	1.401	0.0	268.2	O K
4320 min Summer	9.457	1.457	0.0	288.6	O K
5760 min Summer	9.497	1.497	0.0	303.7	O K
7200 min Summer	9.529	1.529	0.0	315.7	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	119.446	45
30 min Summer	76.972	60
60 min Summer	47.272	90
120 min Summer	28.106	150
180 min Summer	20.494	210
240 min Summer	16.300	270
360 min Summer	11.804	390
480 min Summer	9.380	510
600 min Summer	7.843	630
720 min Summer	6.773	750
960 min Summer	5.372	990
1440 min Summer	3.870	1470
2160 min Summer	2.784	2192
2880 min Summer	2.203	2912
4320 min Summer	1.582	4352
5760 min Summer	1.250	5792
7200 min Summer	1.041	7232

Summary of Results for 50 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
8640 min Summer	9.555	1.555	0.0	325.8	O K
10080 min Summer	9.576	1.576	0.0	334.5	O K
15 min Winter	8.747	0.747	0.0	85.0	O K
30 min Winter	8.861	0.861	0.0	109.6	O K
60 min Winter	8.965	0.965	0.0	134.6	O K
120 min Winter	9.060	1.060	0.0	160.0	O K
180 min Winter	9.113	1.113	0.0	175.0	O K
240 min Winter	9.149	1.149	0.0	185.6	O K
360 min Winter	9.202	1.202	0.0	201.6	O K
480 min Winter	9.240	1.240	0.0	213.6	O K
600 min Winter	9.270	1.270	0.0	223.2	O K
720 min Winter	9.294	1.294	0.0	231.3	O K
960 min Winter	9.334	1.334	0.0	244.5	O K
1440 min Winter	9.390	1.390	0.0	264.1	O K
2160 min Winter	9.447	1.447	0.0	284.9	O K
2880 min Winter	9.489	1.489	0.0	300.4	O K
4320 min Winter	9.548	1.548	0.0	323.2	O K
5760 min Winter	9.591	1.591	0.0	340.2	O K
7200 min Winter	9.624	1.624	0.0	353.7	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
8640 min Summer	0.896	8672
10080 min Summer	0.789	10112
15 min Winter	119.446	45
30 min Winter	76.972	60
60 min Winter	47.272	90
120 min Winter	28.106	150
180 min Winter	20.494	210
240 min Winter	16.300	270
360 min Winter	11.804	390
480 min Winter	9.380	510
600 min Winter	7.843	630
720 min Winter	6.773	750
960 min Winter	5.372	988
1440 min Winter	3.870	1468
2160 min Winter	2.784	2188
2880 min Winter	2.203	2908
4320 min Winter	1.582	4344
5760 min Winter	1.250	5784
7200 min Winter	1.041	7224

Summary of Results for 50 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
8640 min Winter	9.651	1.651	0.0	365.0	O K
10080 min Winter	9.674	1.674	0.0	374.8	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
8640 min Winter	0.896	8664
10080 min Winter	0.789	10096

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	50	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	21.000	Shortest Storm (mins)	15
Ratio R	0.432	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time / Area Diagram

Total Area (ha) 0.339

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-10	0.113	10-20	0.113	20-30	0.113

Model Details

Storage is Online Cover Level (m) 10.000

Infiltration Basin Structure

Invert Level (m)	8.000	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00010	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.00010		

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	25.0	2.000	500.0

Summary of Results for 100 year Return Period (+30%)

Half Drain Time exceeds 7 days.

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m^3)	Status
15 min Summer	8.764	0.764	0.0	88.3	O K
30 min Summer	8.882	0.882	0.0	114.4	O K
60 min Summer	8.988	0.988	0.0	140.7	O K
120 min Summer	9.086	1.086	0.0	167.2	O K
180 min Summer	9.139	1.139	0.0	182.4	O K
240 min Summer	9.174	1.174	0.0	193.0	O K
360 min Summer	9.225	1.225	0.0	209.0	O K
480 min Summer	9.263	1.263	0.0	220.9	O K
600 min Summer	9.292	1.292	0.0	230.4	O K
720 min Summer	9.316	1.316	0.0	238.5	O K
960 min Summer	9.354	1.354	0.0	251.5	O K
1440 min Summer	9.408	1.408	0.0	270.7	O K
2160 min Summer	9.463	1.463	0.0	290.9	O K
2880 min Summer	9.503	1.503	0.0	305.8	O K
4320 min Summer	9.559	1.559	0.0	327.7	O K
5760 min Summer	9.599	1.599	0.0	343.7	O K
7200 min Summer	9.631	1.631	0.0	356.5	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	139.002	45
30 min Summer	89.961	60
60 min Summer	55.351	90
120 min Summer	32.877	150
180 min Summer	23.920	210
240 min Summer	18.978	270
360 min Summer	13.703	390
480 min Summer	10.865	510
600 min Summer	9.069	630
720 min Summer	7.821	750
960 min Summer	6.188	990
1440 min Summer	4.442	1470
2160 min Summer	3.184	2192
2880 min Summer	2.512	2912
4320 min Summer	1.796	4352
5760 min Summer	1.414	5792
7200 min Summer	1.175	7232

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
8640 min Summer	9.656	1.656	0.0	367.1	O K
10080 min Summer	9.678	1.678	0.0	376.2	O K
15 min Winter	8.814	0.814	0.0	98.9	O K
30 min Winter	8.939	0.939	0.0	128.1	O K
60 min Winter	9.052	1.052	0.0	157.6	O K
120 min Winter	9.155	1.155	0.0	187.2	O K
180 min Winter	9.211	1.211	0.0	204.3	O K
240 min Winter	9.248	1.248	0.0	216.1	O K
360 min Winter	9.303	1.303	0.0	234.0	O K
480 min Winter	9.342	1.342	0.0	247.4	O K
600 min Winter	9.373	1.373	0.0	258.1	O K
720 min Winter	9.398	1.398	0.0	267.1	O K
960 min Winter	9.438	1.438	0.0	281.7	O K
1440 min Winter	9.496	1.496	0.0	303.2	O K
2160 min Winter	9.554	1.554	0.0	325.8	O K
2880 min Winter	9.596	1.596	0.0	342.5	O K
4320 min Winter	9.656	1.656	0.0	367.0	O K
5760 min Winter	9.699	1.699	0.0	385.1	O K
7200 min Winter	9.732	1.732	0.0	399.4	Flood Risk

Storm Event	Rain (mm/hr)	Time-Peak (mins)
8640 min Summer	1.009	8672
10080 min Summer	0.887	10112
15 min Winter	139.002	45
30 min Winter	89.961	60
60 min Winter	55.351	90
120 min Winter	32.877	150
180 min Winter	23.920	210
240 min Winter	18.978	270
360 min Winter	13.703	390
480 min Winter	10.865	510
600 min Winter	9.069	630
720 min Winter	7.821	750
960 min Winter	6.188	988
1440 min Winter	4.442	1468
2160 min Winter	3.184	2188
2880 min Winter	2.512	2908
4320 min Winter	1.796	4344
5760 min Winter	1.414	5784
7200 min Winter	1.175	7224

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
8640 min Winter	9.759	1.759	0.0	411.3	Flood Risk
10080 min Winter	9.782	1.782	0.0	421.5	Flood Risk

Storm Event	Rain (mm/hr)	Time-Peak (mins)
8640 min Winter	1.009	8664
10080 min Winter	0.887	10096

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	21.000	Shortest Storm (mins)	15
Ratio R	0.432	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30