Figure 41 Avenue Road runs down into garage areas

Figure 42 Garage areas with building on top of Terrace

For the location of potential watercourse below the ground, please refer to Figure 11 below.

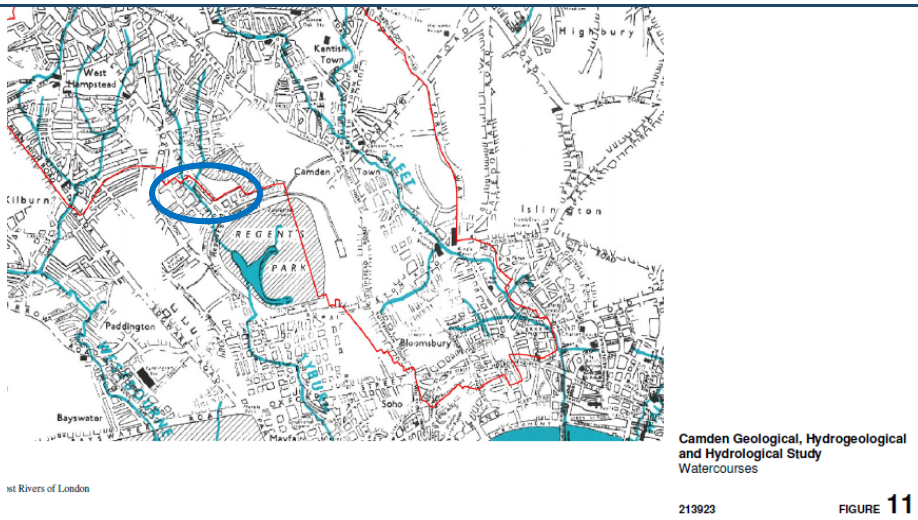


Figure 43 Arup report figure 11

The EA has not identified any flood risks associated with the nearby water courses.

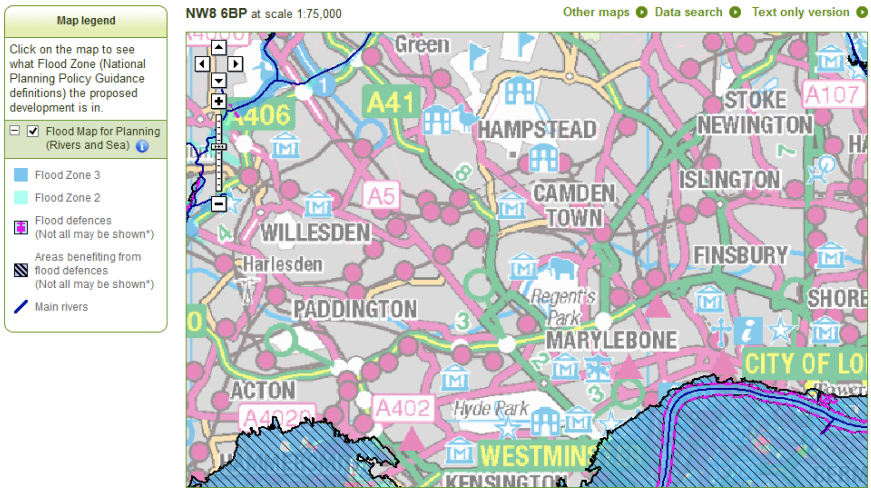


Figure 44: Flood map for planning (Environment Agency)

The site is within Zone 1, a low probability flood risk area.

8.1.2 Proposed Basement

The proposed works require the insertion of a new basement beneath the main building, extension and rear garden include one light well and glass roof light.

8.2 Screening

As explained in Section 3, 4 and 5 the street was flooded in 2002. Therefore a flood risk assessment is required

8.3 Scoping

The potential sources of flooding are summarised below:

Potential Source	Potential Flood Risk at Site?	Justification
Fluvial flooding	No	EA Flood Mapping shows Flood Zone 1. Distance from nearest surface watercourse >1km
Tidal flooding	No	Site location is 'inland' and topography > 35m AOD.
Flooding from rising / high groundwater	No	Site is located on low permeability London Clay.
Surface water (pluvial) flooding	Yes	Recorded in unspecified part of Avenue Road in 2002
Flooding from infrastructure failure	Yes	Drainage at or near the site could potentially become blocked or cracked and overflow or leak. Drainage of the basement terrace areas may rely on pumping.
Flooding from reservoirs, canals and other artificial sources	Yes	There is a Regent's Canal located 0.1mile from the site and Barrow Hill Reservoirs. It could give rise to a flood risk.

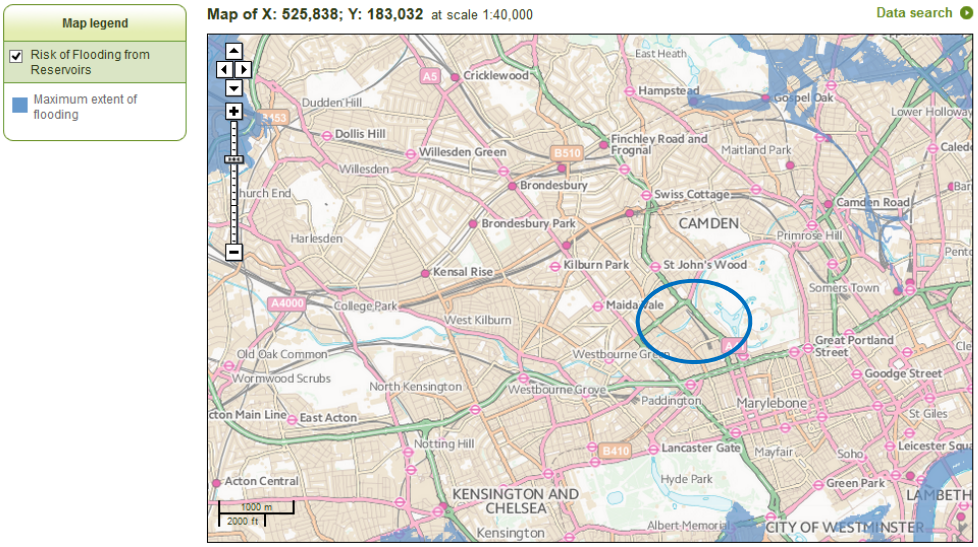


Figure 45 Extract from British Geological Survey web site

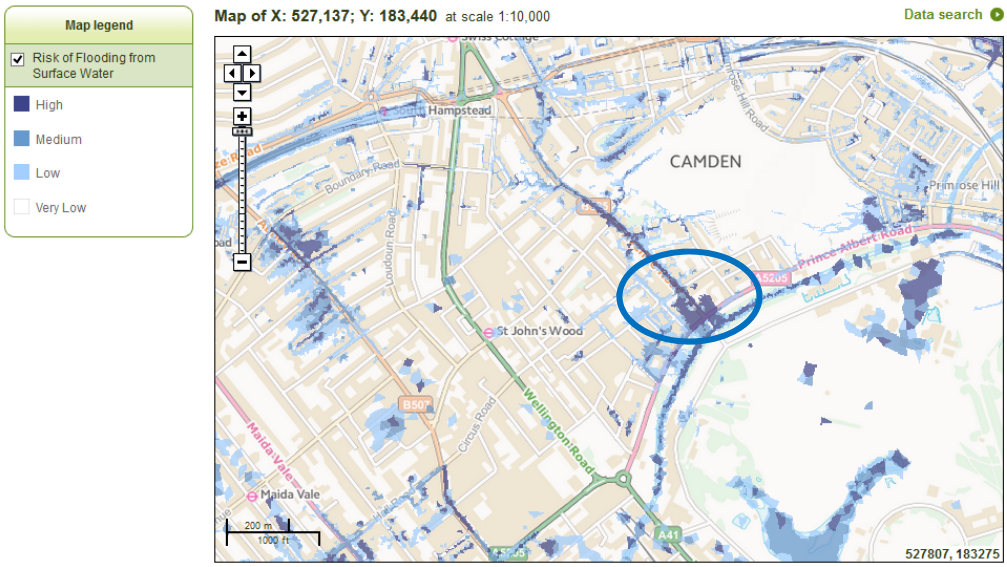


Figure 46 Extract from British Geological Survey web site

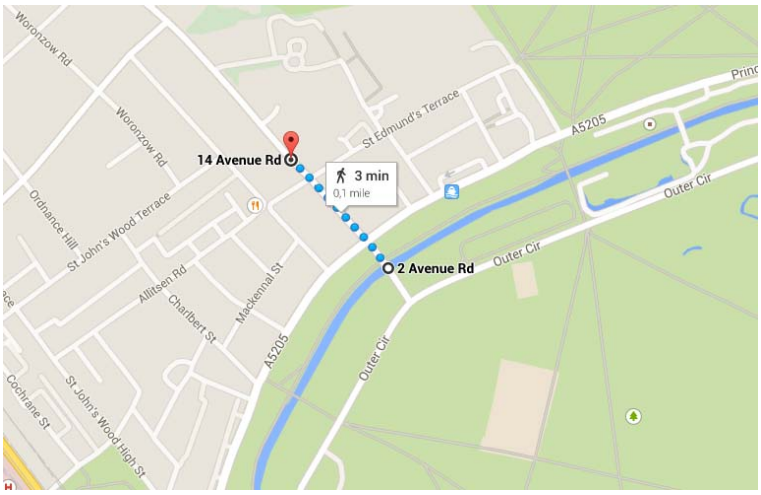


Figure 47 Regent s Canal location

It is evident from the scoping study that the only significant flood risks are due failure of existing sewers in the vicinity of the site. Croft has obtained further information to clarify the risks and propose mitigation measures.

8.4 Further Assessment

8.4.1 Potential surface water (pluvial) flooding

As described in section 8.1, the site basement is orientated in a north-east to south- west direction, set back from Avenue Road to the north - east lies on point on Avenue Road. The site is located in the north corner of a development of eight residential houses in the former location of No. 14 Avenue Road. The site is located in the Primrose Hill Area of Camden, north-west London. Any surface

water (if any) runoff would be directed to this section of the road and garage area.

It is understood that the flooding was due to the Thames Water sewer system being overloaded. It is also understood that Thames Water subsequently increased the capacity of this relief system: the likelihood of flooding of this nature is now significantly reduced.

The below actions have been undertaken to reduce flood risk in Camden area.

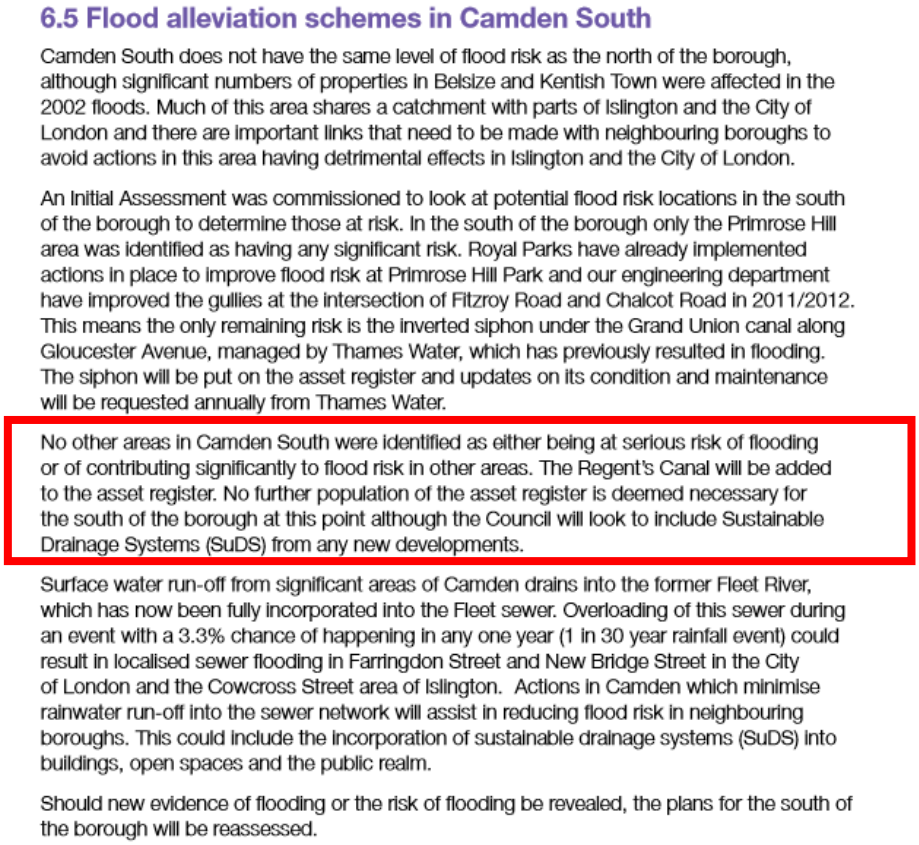
Table 2.1 Actions for reducing flood risk in Camden North, South and West

Area	Action	Deadline
Camden North	Completion of review of risk from Hampstead Heath Ponds	March 2013 (Completed)
Camden North	Delivery of Project Appraisal Reports for Gospel Oak and Hampstead	April 2013 (Completed)
Camden North	Begin investigation of Royal Free Hospital flood risk	June 2013
Camden North/ South	Complete modelling of Thames Water sewer system in Highgate and South Camden	July 2013
Camden West	Complete Project Appraisal Report for West Camden	September 2013
Camden North	Complete consultation on preferred option of Hampstead Ponds	September 2013
Camden North	Submission of Detailed Planning Application for Hampstead Heath Ponds by City of London	February 2014
Camden North	Finish assessment of Royal Free Hospital flood risk	March 2014
Camden South	Maintenance of Primrose Hill siphon	On-going

Figure 48 Managing flood risk in Camden, The London Borough of Camden, flood risk management strategy

8.4.2 Potential flooding from infrastructure failure and from canals/reservoirs

Section 6.5 (reproduced below) identifies Gloster Road, Fitzory Road, Chalcot Road ...etc. as being at risk of flooding on the scale experienced in 2002. From a study of the contours on OS maps, these roads are unlikely to have an effect on the flow of surface water along Avenue Road. Furthermore, Section 6.5 states that no other areas of Camden South are at risk of flooding.



6.5 Flood alleviation schemes in Camden South

Camden South does not have the same level of flood risk as the north of the borough, although significant numbers of properties in Belsize and Kentish Town were affected in the 2002 floods. Much of this area shares a catchment with parts of Islington and the City of London and there are important links that need to be made with neighbouring boroughs to avoid actions in this area having detrimental effects in Islington and the City of London.

An Initial Assessment was commissioned to look at potential flood risk locations in the south of the borough to determine those at risk. In the south of the borough only the Primrose Hill area was identified as having any significant risk. Royal Parks have already implemented actions in place to improve flood risk at Primrose Hill Park and our engineering department have improved the gullies at the intersection of Fitzroy Road and Chalcot Road in 2011/2012. This means the only remaining risk is the inverted siphon under the Grand Union canal along Gloucester Avenue, managed by Thames Water, which has previously resulted in flooding. The siphon will be put on the asset register and updates on its condition and maintenance will be requested annually from Thames Water.

No other areas in Camden South were identified as either being at serious risk of flooding or of contributing significantly to flood risk in other areas. The Regent's Canal will be added to the asset register. No further population of the asset register is deemed necessary for the south of the borough at this point although the Council will look to include Sustainable Drainage Systems (SuDS) from any new developments.

Surface water run-off from significant areas of Camden drains into the former Fleet River, which has now been fully incorporated into the Fleet sewer. Overloading of this sewer during an event with a 3.3% chance of happening in any one year (1 in 30 year rainfall event) could result in localised sewer flooding in Farringdon Street and New Bridge Street in the City of London and the Cowcross Street area of Islington. Actions in Camden which minimise rainwater run-off into the sewer network will assist in reducing flood risk in neighbouring boroughs. This could include the incorporation of sustainable drainage systems (SuDS) into buildings, open spaces and the public realm.

Should new evidence of flooding or the risk of flooding be revealed, the plans for the south of the borough will be reassessed.

Figure 49 Managing flood risk in Camden, The London Borough of Camden, flood risk management strategy

In the unlikely event of surface water flooding in the vicinity, the likelihood of the water entering and accumulating in or the basement is low. This is because the site is on a slope and water will continue to flow downhill, away from the property.

Figure 50: Rear and front of the property

A pumping mechanism will be installed for the proposed basement. There is a likelihood that this may fail and allow excess water to accumulate. If this were to occur, the build-up of water would be gradual and noticeable before it becomes a significant life-threatening hazard.

8.5 Mitigation measures

We would recommend the following measures to reduce the risks mentioned above:

- Construct an up stand around the roof light to form a barrier against excess flow.
- Landscaping and soil above the basement – ceiling slab to allow water to drain into the soil.
- Install a dual pumping system to maintain operation in the event of a failure. This should include a battery backup and a suitable alarm system for warning purposes,
- The development is for extension of an existing residential property and there will be no additional sleeping accommodation in the basement,
- in terms of flood vulnerability, significant „betterment" can be achieved through the implementation of warning procedures and formalisation of a safe egress route to the upper floors of the building,
- During basement construction, it is recommended that rainwater entering the excavation from above be pumped out to the existing site surface water drainage system, with a settlement tank as necessary to remove excessive suspended fines,
- All electrical and communications services to be routed from ceiling down rather than floor up,

- Tiles are recommended rather than carpets for flooring in the basement rooms.

8.6 Summary

The risk of flooding from excess surface water is not considered significant. There is a risk of flooding due to the failure of the pumping system but this can be reduced to acceptable levels with appropriate design and installation measures. It is considered that the development would not increase the risk of flooding elsewhere.

9. Stage 3 - Site Investigation

Monitoring and Reporting	The Soil investigation was completed by (Soil investigation Company). From the Scoping stage we considered that their brief should cover: • Three trial pits have been done to confirm the existing building foundations. The purpose is to consider the effect of the works on the neighbouring properties and the find the ground conditions below the site. • One borehole has been completed on the site. With the size of site, and our knowledge of the area it is not expect for there to be a large variation across the small site, therefore one borehole 6m deep is sufficient. • Stand pipe to a minimum depth 5.0m bgl to be inserted to monitor ground water; record initial strike and the water level after 1 month. • Site testing to determine in-situ soil parameter. SPT testing to be undertaken. • Laboratory testing to confirm soil make up and properties. • The Historic maps and walk over survey did not highlight any significant contamination sources, therefore no site test of the ground has been requested. • Factual Report on soil conditions. • Calculation of bearing pressures from SPT. • Indication of Ø (angle of friction) from SPT. • Indication of soil type. **See Appendix E for Soil Investigation report**

10. OS Map extract showing location of Railway

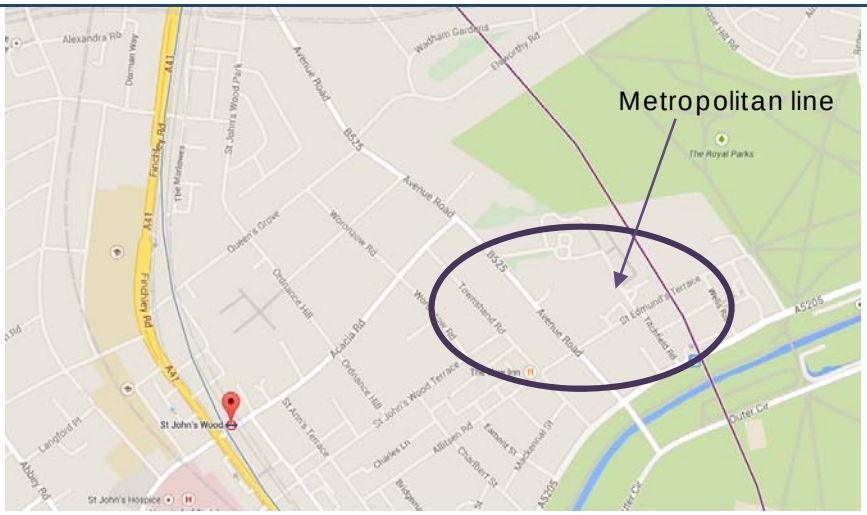


Figure 51 Extract from google map

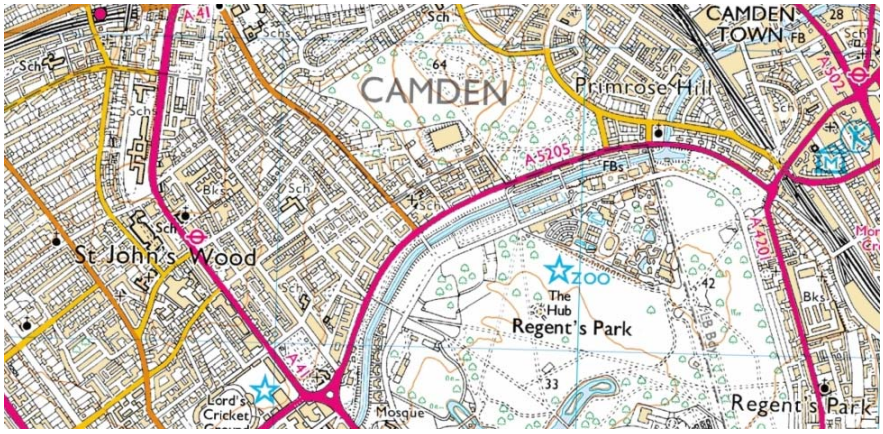


Figure 52 14 F Avenue Road; Extract from OS map showing proximity to nearest

11. Stage 4 - Impact Assessment

Subterranean flow	Refer To Hydrogeologist report : Conclusions re stated in the Executive Summary The site is not within the catchment of the Hampstead Heath Ponds. It is a considerable distance from the ponds and standing water courses in the area. The development will not have an impact on the Hampstead heath ponds nor their catchement. The proposed development depth is expected to be at 3.1-3.6m below external ground floor level. The ground below the proposed basement is London Clay. This is not very permeable and is unlikely to allow ground water to pass through it. **The bore hole is to have a stand pipe inserted (at min depth of 5.0m bgl) to confirm the water level after a 1 month period.** Groundwater was not encountered during drilling and a return visit in October 2014 by Ground & Water to site found the standpipe to be dry. However a return visit in December 2014 dipped the water level at 0.67m bgl. It is below new basement level. The local affect of the basement will be to divert any flowing ground water away from the foot print of the building. To the front side and rear of the property large areas over 10m wide are present. With a large dispersal area for the flow to be diverted around the affects on the surrounding area will be minimal.

	Without field testing in the neighbouring properties or along the road there is a low residual risk that the ground wall flow may affect the external ground. ***The basement design must allow for variants in ground water. The retaining walls must be designed to provide lateral resistance to water up to 1m from the top of the wall. The design must follow the recommendations as noted in BS8102.*** The bore hole is to have a stand pipe inserted (at min depth of 5.0m bgl) to confirm the water level after a 1 month period. Groundwater was not encountered during drilling and a return visit in October 2014 by Ground & Water to site found the standpipe to be dry. However a return visit in December 2014 dipped the water level at 0.67m bgl. A full hydrology report will be provided for 14f Avenue Road seperately.
Slope Stability	Refer to Geologist Report: Conclusions re stated in the Executive Summary From the walk over survey, the OS map and the Arups report the slopes around the site are less than 7º. Land slip is not a problem due to any circular failure patterns. The retaining walls must be designed to accommodate the lateral pressures from the soils.
Foundation type	Reinforced concrete cantilevered retaining walls The designs for the retaining walls have been calculated using software TEDDS. The software is specifically designed for retaining walls and ensures the design is kept to a limit to prevent damage to the adjacent property. **Attached printout of TEDDS calculations and Deflections of walls in Appendix C** The overall stability of the walls are design using K_a & K_p values, while the design of the wall uses K_o values. This approach minimise the level of movement from the concrete affecting the adjacent properties. The Investigations have highlight that water is not present. The walls are designed to cope with the hydrostatic pressure. The design of the walls however considers the long term items. It is possible that a water main

may break causing local high water table. The basement will be designed with the water table to full height as specified in the Eurocode.

The Design also considers floatation as a risk. The design of has considered the weight of the building and the uplift forces from the water. The weight of the building is greater than the uplift resulting in a stable structure.

Below are the design pressures and loadings.

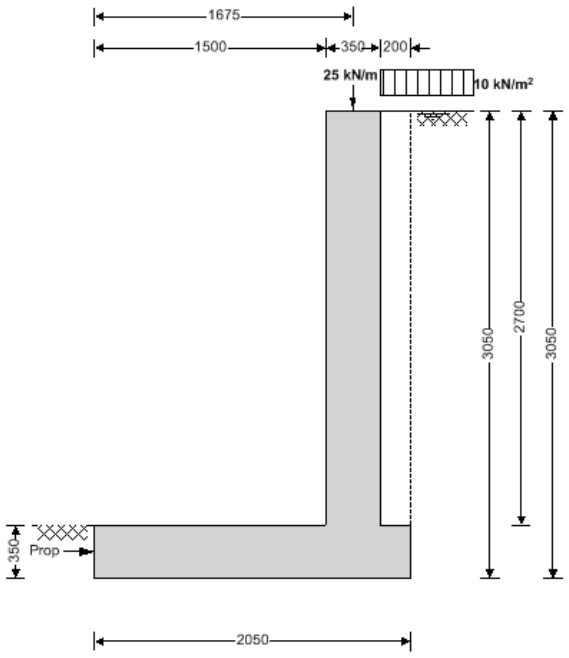


Figure 53 RC retaining wall structure – permanent conditions

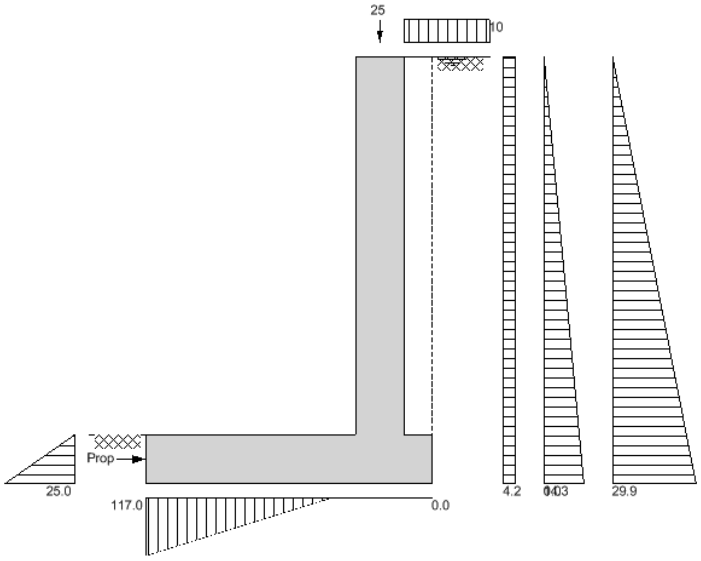


Figure 54 RC Retaining wall 1 stresses – permanent conditions

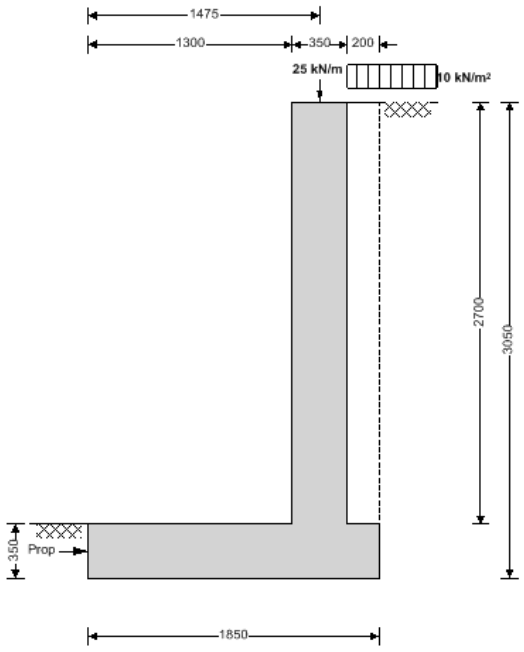


Figure 55 RC retaining wall structure – TW conditions

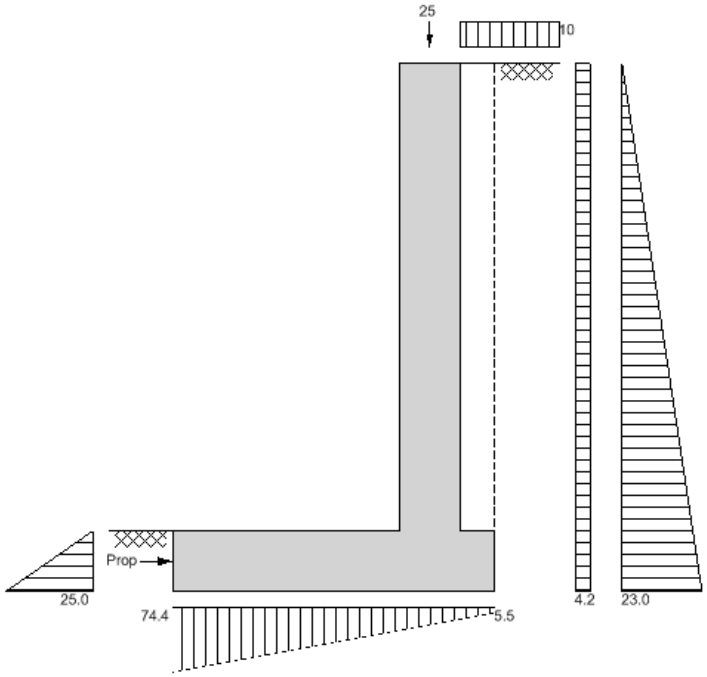


Figure 56 RC Retaining wall 1 stresses – TW conditions

Vicinity of Trees	Two existing trunks are going to be removed for the new garden layout only.
Special precautions due to trees	Design using NHBC guidance Basement depth will allow for footings to be placed outside the effects of the trees. The current trees roots will be limited by the existing foundations. The new basements excavations will not significantly/ adversely affect the root protection zones of the neighbouring trees.
Drainage effects on Structure	No build over agreements known of. Flooding. The site is in an area of low - medium risk flooding.
Roads	The building does not undermine the highway, but car parking is present to the front of the property. It is possible for heavier goods vehicles to reverse on to the property to allow for this risk loadings are to be taken from the Highways loading code. <u>Highways loading allow:</u> 10kN/m² if within 45° of road 100kN point loads if under road or with in 1.5m 5kN/m² if within 45° of Pavement Garden Surcharge 2.5kN/m² Surcharge for adjacent property 1.5kN/m² + 4kN/m² for concrete ground bearing slab
Intended use of structure and user requirements	Family/domestic use
Loading Requirements (EC1-1)	**Domestic Single Dwellings** — UDL 1.5 kN/m², Concentrated Loads 2.0 kN The basement does not line within a 45º angle of the highway. Therefore Highways HA loading is not required to be applied.
Number of Storeys	3 storey becoming 4 Is Live Load Reduction included in design No / %

Progressive Collapse	Design for consequences of localized failure in building from an unspecified cause
Is the Building Multi Occupancy?	No
Part A3 Progressive collapse	EN 1991-1-7:1996 Table A1

Class 1	Single occupancy houses not exceeding 4 storeys Agricultural buildings Buildings into which people rarely go, provided no part of the building is closer to another building, or area where people do go, than a distance of 1.5 times the building height

Progressive collapse Change of use	To NHBC guidance compliance is only required to other floors if a material change of use occurs to the property.

Proposed Building Class	1
If class has changed material change has occurred	Yes / No

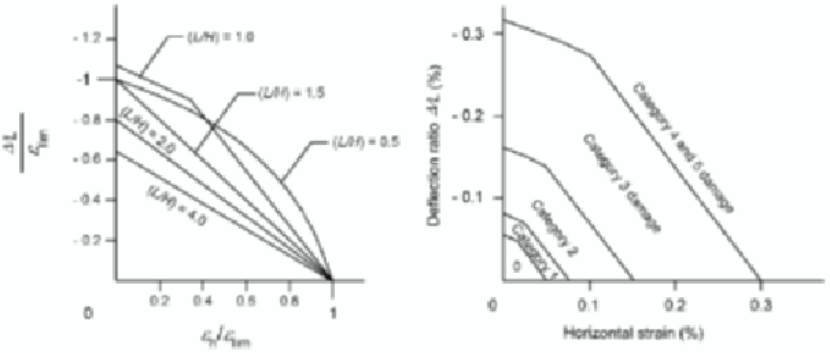
Additional Design Requirements to Comply with Progressive Collapse	**Class1 – Design to satisfy EN 1990 to EN 1999 stability requirements**

Lateral Stability Exposure and wind loading conditions	Basic wind speed Vb = 21 m/s to EC1-2 Topography not considered significant.
Stability Design	The cantilevered walls are suitable to carry the lateral loading applied from above
Lateral Actions	The soil loads apply a lateral load on the retaining walls. Hydrostatic pressure will be applied to the wall Imposed loading will surcharge the wall.
Retained soil parameters	Design overall stability to K_a & K_p values. Lateral movement necessary to achieve K_a mobilisation is height/500 (from Tomlinson). This is tighter than the deflection limits of the concrete wall.
Water table	Has a soil investigation been carried out Yes <u>Known water table from boreholes</u> Design temporary condition for water table level, If deeper than basement ignore Design Permanent condition for water table level: If deeper than existing, design reinforcement for water table at full basement depth to allow for local failure of water mains, drainage and storm water. Global uplift forces <u>can</u> be ignored when water table lower than basement. BS8102 only indicates guidance
Drainage and Damp Waterproofing	Assumed that drainage and damp proofing is by others: Details are not provided within our brief. It is recommended that a water proofing specialist is employed to ensure all the water proofing requirements are met. Croft structural engineers are not the waterproofing designer nor act as the structural waterproof designer. Croft are not the structural waterproofer. The waterproofing specialist must name who is their structural waterproofer. The Structural waterproofer must inspect the structural details and confirm that are happy with the robustness. Due to the construction nature of the segmental basement it is not possible to water proof the joints. All water proofing must be made by

Localised Dewatering	the waterproofing specialist. They should make review of our details and recommend to us if water bars and stops are necessary. The waterproof design must not assume that the structure is watertight. To help reduce water floor through joints in the segmental pins all faces should be; • Cleaned of all debris and detritus • Faces between pins should be needle hammered to improve key • All pipe work and other penetrations should have puddle flanges or hydrophilic strips Localised dewater to pins may be necessary. Some engineers may raise the theoretical questions about pumping of water causing localised settlement. We believe that this argument is a red herring when applied to single storey basements and our reason for stating this is: • The water table in the area is variable, • The water level naturally rises and falls over time and does not lead to subsidence • The water table has naturally been rising and falling for over the last 20,000 years, any fines that will have been removed from the soil would have done so already. • If the water table rises and falls naturally why does this not cause subsidence due to fine removals every year? It does not because the soil has been soil is naturally consolidated by the rise and fall of the water table in the area. • The effect of local pumping for small excavations will not affect the local area. • There is only a risk of subsidence from large scale pumping of soil which lowers the water table below is natural lowest level. •
Temporary works	Walls are designed to be temporarily stable. Temporary propping details will be required for the ground and soil and this must be provided by the contractor. Their details should be forwarded to Croft Structural Engineers. Particular attention should be paid to the point loads from above. Critical areas where point loads are present from above Cross wall Chimney Stack Door openings
Geological assessment and land stability	Has the retaining wall design been assessed by a Chartered Geological Engineer? Yes inspected see supplementary report.

Adjacent Properties	***Any ground works pose an elevated risk to adjacent properties. The proposed works undermines the adjacent property along the party wall line:*** The party wall is to be underpinned. Underpinning the party wall will remove the risk of the movement to the adjacent property. The works must be carried out in accordance with the party wall act and condition surveys will be necessary at the beginning and end of the works. The method statement provided at the end of this report has been formulated with our experience of over 150 basements completed without error. The design of the retaining walls is completed to K_O lateral design stress values. This increases the design stresses on the concrete retaining walls and limits the overall deflection of the retaining wall. It is not expected that any cracking will occurring during the works. However our experience informs us that there is a risk of movement to the neighbours. To reduce the risk the development: • Employ a reputable firm for extensive knowledge of basement works, • Employ suitably qualified consultants. Croft Structural engineer has completed over 120 basements in the last 4 years, • Design the underpins to the stable without the need for elaborate temporary propping or needing the floor slab to be present, • Provide method statements for the contractors to follow, • Investigate the ground, now completed, • Record and monitor the external properties. This is completed by a condition survey on under the Party Wall Act before and after the works are completed. See end of method statement. • Allow for unforeseen ground conditions: Loose ground is always a concern. The method statement and drawings show the use of precast lintels to areas of soft ground; this follows the guidance by the underpinning association.

With the above the maximum level of cracking anticipated is Hairline cracking which can be repaired with decorative cracking and can be repaired with decorative repairs. Under the party wall Act damage is allowed (although unwanted) to occur to a neighbouring property as long as repairs are suitability undertaken to rectify this. To mitigate this risk The Party Wall Act is to be followed and a Party Wall Surveyor will be appointed.



(b) Influence of horizontal strain on $\Delta/L / \varepsilon_{lim}$ (after Burland, 2001)

(c) Relationship between damage category and deflection ratio and horizontal tensile strain for hogging for (L/H) = 1.0 (after Burland, 2001)

Extract from The Institution of Structural Engineers "Subsidence of Low-Rise Buildings"

Table 6.2 Classification of visible damage to walls with particular reference to type of repair, and rectification consideration

Category of Damage	Approximate crack width	Limiting Tensile strain	Definitions of cracks and repair types/considerations
0	**Up to 0.1**	0.0-0.05	**HAIRLINE – Internally cracks can be filled or covered by wall covering, and redecorated. Externally, cracks rarely visible and remedial works rarely justified.**
1	0.2 to 2	0.05-0.075	FINE – Internally cracks can be filled or covered by wall covering, and redecorated. Externally, cracks may be visible, sometimes repairs required for weather tightness or aesthetics. NOTE: Plaster cracks may, in time, become visible again if not covered by a wall covering.
2	2 to 5	0.075-0.015	MODERATE – Internal cracks are likely to need raking out and repairing to a recognised specification. May need to be chopped back, and repaired with expanded metal/plaster, then redecorated. The crack will inevitably become visible again in time if these measures are not carried out. External cracks will require raking out and repointing, cracked bricks may require replacement.

3	5 to 15	0.15-0.3	SERIOUS – Internal cracks repaired as for MODERATE, plus perhaps reconstruction if seriously cracked. Rebonding will be required. External cracks may require reconstruction perhaps of panels of brickwork. Alternatively, specialist resin bonding techniques may need to be employed and/or joint reinforcement.
4	15 to 25	>0.3	SEVERE Major reconstruction works to both internal and external wall skins are likely to be required. Realignment of windows and doors may be necessary.
5	Greater than 25		VERY SEVERE –Major reconstruction works, plus possibly structural lifting or sectional demolition and rebuild may need to be considered. Replacement of windows and doors, plus other structural elements, possibly necessary. NOTE – Building & CDM Regulations will probably apply to this category of work, see sections 10.4, 10.6 and Appendix F.

Monitoring and Predicted Category of Damage

Monitoring - In order to safeguard the existing structures during underpinning and new basement construction movement monitoring is to be undertaken. Surveying studs are to be attached to the adjacent structures at ground, first, second and third floor levels at front and rear as shown on the attached sketch M-10.

The surveying points on the adjacent structures are to be set up using an EDM prior to commencement of the works and to be read daily and reported against the following control values.

Limits on ground and adjacent structures movement during underpinning and throughout the construction works.

Movement of survey points must not exceed:

Settlement:
Action values: 5mm (stop work)
Trigger values: 65% of action values (submit proposals for ensuring action values are not exceeded)

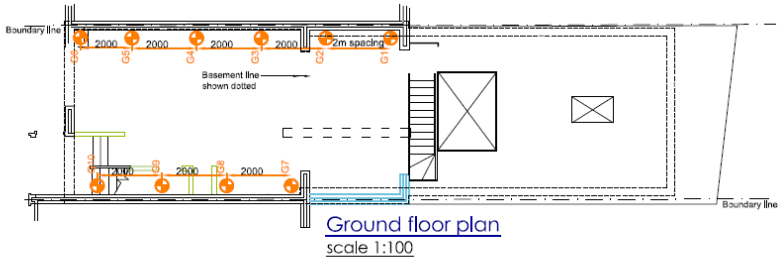
Lateral displacement:
Action values: 6mm (stop work)
Trigger values: 65% of action values (submit proposals for ensuring action values are not exceeded)

Movement approaching critical values:
Trigger: Submit proposals for ensuring action values are not exceeded
Action: Stop work

The reporting format will be in the form of a table as attached.

Predicted Category of Damage

The predicted category of damage is likely to be within BRE Category Slight, with possible localised crack widths 2mm to 5mm Classification Aesthetic.



Location:	Date:						
	Initial:						Final:
G1							
G2							
G3							
G4							
G5							
G6							
G7							
G8							
G9							
G10							

Settlement limit along length of wall	Category	Action
0-2mm	Green	Carry on Works. Record values in table below.
2-5mm	Amber	Carry out a local structural review; Contract Croft Engineer and publish results to PWS. Preparation for the implementation of remedial measures should they be required.
>5mm	Red	Implement structural support as required; Cease works within a 5m zone of the affected section; Review monitoring data and implement revised method of works. Inform Croft Structural Engineers.

Figure 57 Monitoring M-10 drawing with the tables

Basement Monitoring statement included in Appendix F

Drainage and Damp proofing	Assumed that drainage and damp proofing is by others: Details are not provided within our brief. Our recommendation is that drained cavity systems are used to habitable basements with pumped sumps. This is a specialist contractor design item. Concrete is not designed BS 8007. But where possible BS 8007 detailing is observed to help limit crack widths of concrete

Party Wall	Underpinning basement works has a risk associated to it. To mitigate these risks a Party wall surveyor must be appointed

Temporary Works	Temporary works are the contractor's responsibility. Loads can be provided on request. Foundations; All trenches deeper than 1.0m must be shored. Where works undermine existing foundations contractor must allow for additional support. The Method statement lays out the process for constructing the basement

Noise and Nuisance Control	The contractor is to follow the good working practices and guidance laid down in the "Considerate Constructors Scheme". The hours of working will be limited to those allowed; 8am to 5pm Monday to Friday and Saturday Morning 8am to 1pm. None of the practices cause undue noise that one would typically expect from a construction site. The conveyor belt typically runs at around 70dB. The site has car parking to the front to which the skip will be stored. The site will be hoarded with 8' site hoarding to prevent access.

	The hours of working will further be defined within the Party Wall Act. The site is to be hoarded to minimise the level of direct noise from the site. Ground floor slab is not being removed minimising the vibration and sound to adjacent properties. While working in the basement the work generally requires hand tools to be used. The level of noise generally will be no greater than that of digging of soil. The noise is reduced and muffled by the works being undertaken underground. A level of noise from a basement is lower than typical ground level construction due to this.
CTMP	The council may require a Construction Traffic Management plan to be produced. This is outside the brief of the Basement impact assessment and is not covered within Croft's Brief