Flood Risk Assessment and surface water strategy

For the proposed extensions to 37 Broadwater Road, WGC, AL7 3AX

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November 2016

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1 Executive Summary

A. The proposal is an extension to the side of the existing building so as to re-model the floor layout to provide residential dwelling units.

B The vulnerability classification of the building does not change.

C. The site lies in an equivalent of fluvial Flood Zone 1.

D. The site has a Low risk from surface water flooding.

E. Flood resilience methods will be implemented on site, safe access and egress routes are immediately available.

F. The proposed development does not impact on flood risk elsewhere.

G. The proposed development of the site is considered acceptable providing the risk is fully understood, mitigation and any warning and evacuation procedures can be maintained over the lifetime of the development.

H. The use of SuDS techniques on site will reduce run-off rates and volumes providing an, up to 46%, betterment on the existing provision.

2 Introduction

2.1 Site location

The site is at 37 Broadwater Road, Welwyn Garden City, AL7 3AX. (see Figure 1.

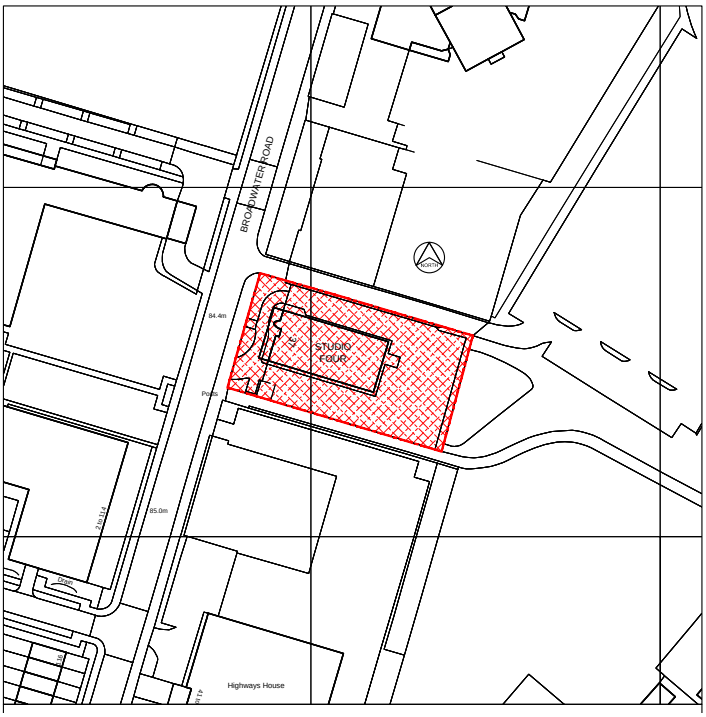

Figure 1: Site location plan, in red, North to top (source: As provided by Architect)

2.2 Proposed development description

The proposal is an extension to the side of the existing building so as to re-model the floors and incorporate additional residential dwelling units. See ground floor proposals at Appendix A. The vulnerability usage does not alter to that previously approved under Prior Approval 6/2016/1318/PN11.

2.3 Site geology

Geological mapping indicates Glacial Head (Lowestoft formation) over Chalk. Permeability is classed as poor to virtually impermeable[1]within the glacial head.

Part I

Flood Risk

3 Policies

In preparation for this Flood Risk Assessment (FRA), National Planning Policy Framework[6] and British Standards on Assessing and Managing Flood Risk[3] were reviewed, and their related policies were referred to in this report.

Furthermore, the Environment Agency was consulted in order to establish the flood zone of the proposed site.

In addition, planning policies from the Local Authority were also reviewed including its Strategic Flood Risk Assessment[9]and its earlier responses, including consultees, to the clients application for Change of Use under planning ref. 6/2016/1318/PN11.

Some of key planning policies and comments are summarised as below.

3.1 National Planning Policy Framework (NPPF) Paragraph 103

When determining planning applications, local planning authorities should ensure flood risk is not increased elsewhere and only consider development appropriate in areas at risk of flooding where, informed by a site-specific flood risk assessment following the Sequential Test, and if required the Exception Test, it can be demonstrated that:

- within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location; and
- development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed, including by emergency planning; and it gives priority to the use of sustainable drainage systems.

A site-specific flood risk assessment is required for proposals of 1 hectare or greater in Flood Zone 1; all proposals for new development (including minor development and change of use) in Flood Zones 2 and 3, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the Environment Agency); and where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.

4 Flood risk analysis

4.1 Sources of potential flooding

Flood risk from various sources at the site is analysed in this section. It is concluded that from the Flood risk from all sources is Low

4.2 Flood risk from sea and rivers

Flooding can occur from the sea due to a particularly high tide or surge, or combination of both. Flooding can also take place from flows that are not contained within the channel due to high levels of rainfall in the catchment.

With reference to the Environment Agency online Flood Map the proposed site lies in Flood Zone 1. This means that the proposed site has a Low probability from river flooding (Less than a 1 in 1000 annual probability of river flooding in any year).

4.2.1 Historic flooding

The site lies outside any area of recorded local flood events. No other reports of historic flooding to the site have been identified.

4.2.2 Flood risk from groundwater

Groundwater flooding occurs when water levels in the ground rise above surface levels. It is most common in low-lying areas underlain by permeable rock (aquifers), usually due to extended periods of wet weather.

With reference to SFRA from the Council, the flood risk from ground water in the area is uncertain since there is currently limited understanding of this in the area. However, the mapping available within the 2016 SFRA[9]shows the site in an area with no associated risk. The site has no documented evidence of flood risk from ground water.

4.2.3 Flood risk from sewer and highway drains

Flooding occurs when combined, foul or surface water sewers and highway drains are temporarily over-loaded due to excessive rainfall or due to blockage.

There is no documented evidence of flood risk from highway drainage or sewage networks at the proposed site.

Hence, the risk of sewer and highway flooding to the site can be considered to be Low.

4.2.4 Flooding risk from surface water

Flooding occurs when combined, foul or surface water drains are temporarily over-loaded due to excessive rainfall or due to blockage.

The site has been flagged up previously by the Lead Local Flood Authority as possibly being at risk from surface water flooding - "maps of surface water flooding show that there is a risk of surface water flows coming into the YMCA from Broadwater Road, flowing alongside the building", see Figure 2.

Currently the entire site lies in, from a risk potential, what would be classified as fluvial Flood Zone 1 (i.e. at lowest risk). However, the observation of flow pathways has been raised.

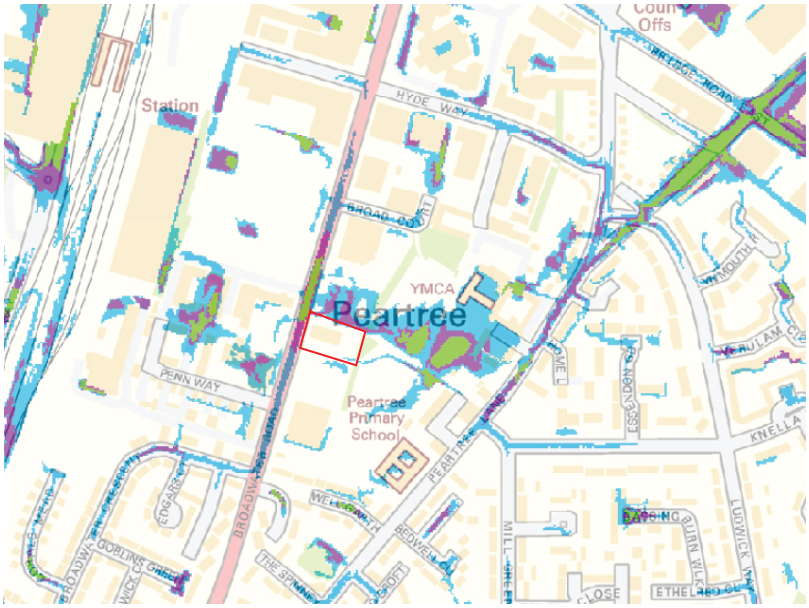

Figure 2: Risk of surface water flooding to the site as taken from the 2016 SFRA[9]. The blue shaded areas are denoted as areas with between a 1 in 100 and 1 in 1000 yr risk of SW flooding in any one year - the equivalent of EA Flood Zone 2. The purple shaded denote areas with risk between 1 in 30 and 1in 100 yr (EA Flood zone 3).

Flow directions are generally SW to NE through this area as highlighted by the LiDAR composite for the site, Figure 3

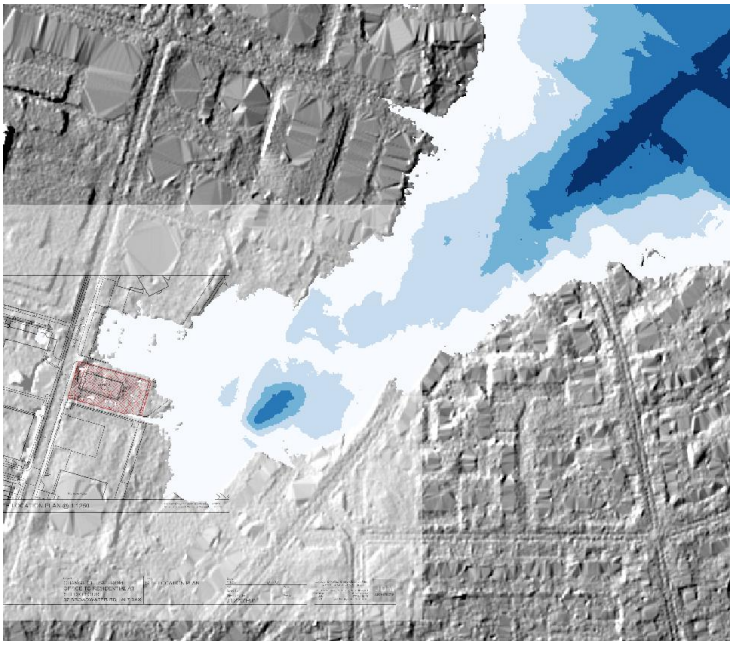

Figure 3: LiDAR composite showing lower ground generally to the NE of the site, and directly to the North of the site. The white areas represent all levels below 84.2m AOD with tones of blue at 1m lower intervals

LiDAR data also shows the lowest point of Broadwater Road lies circa 30m North from the site, consistent with the SFRA SW mapping. A paved access exists from Broadwater Road to the area directly North of the site. This currently offers the line of least resistance for any SW flooding arising from Broadwater Road to the area of lower ground immediately to the North of the site (a car park). However, should this become developed land or blocked for any reason, then it is possible that this flow pathway will be removed. In this instance the project site, typically along the Northern and Eastern edges of the site, will become the flow pathway. This is however unlikely to occur, since any application to develop this adjacent site would be required to demonstrate that flood risk was not increased to this proposal site (in line with core policy).

Noting the change in levels of >2m to the East of the site and hence the resulting relatively steep gradient, it is not expected that the surface water depth will encroach ground floor levels, which are, and will remain, circa 150mm above external levels (the adjacent roadway around the building is set at this lower level and a further 150mm would be expected for Building Regulation compliance at the time of construction), Figure 4. Note also that the existing site is drained to the existing Thames Water network.

Figure 4: Image showing circa 150mm deep kerb line surrounding the building (Source: Google Earth)

Hence, while the risk of surface water flooding to the site is potentially high (in the event of blockage of existing flow pathways) the risk of surface water flooding to the building itself is Low.

4.3 Flood risk from infrastructure failure

Flooding occurs because of canals, reservoirs, industrial processes, burst water mains or failed pumping stations.

There is no documented evidence of flooding from other infrastructure failure at the proposed site therefore the flood risk from infrastructure failure at the site is classed as Low.

4.4 Off site impacts

4.4.1 Impact on flood risk elsewhere

Since the development is using viable SuDS solutions on site to reduce rainfall run-off rates and volume the development will not have an impact on flood risk elsewhere.

4.4.2 Generation of Runoff

The post-development surface water run-off volume will decrease when compared to the pre-development rates.

4.5 Flood risk vulnerability and flood zone "compatibility"

Based on 2016 model data[9] the site itself lies in an area with a Flood Risk equivalent to Fluvial Zone 1

Flood risk vulnerability classification (see table 2)		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood zone (see table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	×	Exception Test required	✓
	Zone 3b functional floodplain	Exception Test required	✓	×	×	×

Key: ✓ Development is appropriate.
× Development should not be permitted.

Figure 5: Flood risk vulnerability and flood zone compatibility[7]

With reference to Figure 5, the proposed re-development of the site retains the vulnerability classification of the building as "More Vulnerable". This is considered to be appropriate development.

5 Flood risk mitigation measures

Because the site is located in an area at (an albeit Low) risk from short term surface water flooding, flood risk mitigation measures should be considered in the proposed extension (and fit out).

In accordance with the document "Improving the Flood Performance of New Buildings - Flood Resilient Construction" [5] a series of design approaches are recommended to mitigate the flood risk.

5.1 Flood resistance and resilience measures

Table 1 provides guidance on which materials are most suitable, suitable and unsuitable, when considering construction work involved in this project. This report recommends the use of materials from the "most suitable" column were this is at all possible on site, however they are not mandatory requirements.

Component	Most suitable	Suitable	Unsuitable
Flooring	Concrete, pre-cast or in situ	Timber floor, fully sealed, use of marine plywood.	Untreated timber, Chipboard
Floor Covering	Clay tiles, Rubber sheet floors, Vinyl sheet floors	Vinyl tiles, Ceramic tiles	
External Walls - to max flood level	Engineering brick, Reinforced concrete	Low water absorption brick	Large window openings
Doors	Solid panels with waterproof adhesives, Aluminium, plastic or steel	Epoxy sealed doors	Hollow core plywood doors
Internal Partitions	Brick with waterproof mortar, Lime based plasters	Common bricks	Chipboard, Fibreboard panels, Plasterboard, Gypsum plaster
Insulation	Foam or closed cell types	Reflective insulation	Open cell fibres
Windows	Plastic, metal	Epoxy sealed timber with waterproof glues and steel or brass fittings.	Timber with PVA glues and mild steel fittings

Table 1: Summary of Material Suitability for Building Components[2]

5.2 Residual Risks

5.2.1 System failure of existing SW system

The existing Surface water drainage strategy is one area that requires ongoing maintenance and inspection. Hence the sites new occupants be required to pay a service charge to cover all on-going maintenance for the site as a whole which will include regular inspection and maintenance of the existing SW drainage infrastructure.

5.2.2 System failure of new SuDS features

Exceedence flows, or flows from system failure will be directed back to the existing SW network. Since the original system drained 100% of the site, with no apparent issues, the

existing network has sufficient capacity to accommodate SW flows, that in the worst case, can be no greater than the current scenario.

5.2.3 Safe access and egress

The NPPF stipulates that, where required, safe access and escape routes should be available to/from new developments in flood risk areas. Access routes should be such that occupants can safely access and exit the building in design flood conditions.

The site lies at the very edge, on the "dry" side, of the SW flood zone and the LiDAR data also shows the front of the site, adjacent to the front entrance, to be at a generally elevated height when compared to the rear hence safe and dry access and egress routes are immediately available.

On the site itself, the developer will look to remove any possible submerged hazards e.g. relocating or fitting bolt down inspection covers on any m/holes, removal of any hidden drops/steps etc. on access/egress routes.

5.2.4 Flood warning scheme

Currently no flood warning schemes are available for surface water flooding in the area.

5.2.5 Flood Plans

It is widely recommended that households are "reasonably prepared" to deal with a flooding incident. Hence the developer will provide a Flood Plan (in line with the EA guidance) for this development (See Appendix B for an example). The plan will provide guidance on emergency response procedures in the event of flooding to the site. This will:

- Provide details of who to contact and how (insurers, energy suppliers, immediate family and friends etc);
- Provide details of how to turn off gas, electricity and water mains supplies;
- Provide details of designated safe egress routes out of the building and out of the local area at risk;
- Provide details of local radio stations;
- Provide a check list of essential items.

It is also suggested that such a plan could be saved securely on smartphones, webmail or in the cloud so that residents can access it anywhere they can use their phone or computer.

6 Conclusions

Given that:

- This is an extension to an existing building of less than 250m2;
- The site lies in an equivalent of fluvial Flood Zone 1 based on the current risk associated with SW flooding, with Low flood risk from other sources;
- That flood resilience measures will be implemented on site,
- Safe and dry access/egress routes exist;
- The maintenance and inspection of the existing SW network will be ongoing;
- The re-development does not impact on flood risk elsewhere;

and assuming the risk is fully understood, mitigation, any warning and evacuation procedures can be maintained over the lifetime of the development then the proposed development of the site is considered acceptable.

Part II

Surface water disposal

7 Surface water management

7.1 General considerations

- All surface water run-off that cannot be discharged to ground water via infiltration will be managed on site and discharged to the existing surface water network at agreed (and lower than existing) rates.
- The Floods and Water Management Act 2010 requires the use of SuDS.
- Sustainable Drainage Systems (SuDS) will be implemented throughout the development scheme where practicable.
- The proposed drainage arrangement will use SuDS devices to provide source control and water quality treatment
- The SuDS on site will supplement a traditional positive drainage network.
- The piped drainage elements will be designed to the standards set out in the 7th Edition, Sewers for Adoption.
- All SuDS will require maintenance and a maintenance schedule will be handed over to new owners.

The surface water disposal strategy will be required to manage the run off from:

- New roof area;
- Any areas of new hard-standing;
- Landscaped areas.

7.2 Treatment of run-off

With Reference to Table 4.3 of the SuDS Manual[4], Domestic Roofs require the removal of gross solids and sediments. With Reference to Table 26.2 of the SuDS Manual[4], pollution hazard indices for:

- Domestic Roofs are 0.2 (TSS), 0.2 Metals & 0.05 Hydrocarbons.
- Low traffic roads are 0.3 (TSS), 0.2 Metals & 0.05 Hydrocarbons.

7.3 Existing SW strategy

The site is generally 100% impermeable with all SW drained to an existing, Thames Water sewer in the adjacent highway, via a series of rainwater gulleys set into the hard standing. These pre date this application and would have been under the control of the Building Regulations in place at the time of construction. Without evidence to the contrary, this existing system appears to be functioning as designed. It is not known however, whether there is any exceedence capacity within the existing system.

7.4 SuDS Principles

In line with the SuDS management train, the following hierarchy has been considered in applying the use of SuDS into the proposed development scheme.

7.4.1 Source control

- Sedum roofs - offer interception and attenuation at source.
- Rain water harvesting / water butts. The collection and re-use of water can reduce run off volumes arising from roofs. The collected water being used for the flushing of toilets or local external irrigation.
- Infiltration devices. Typically soakaways.
- Bio-retention planting, rain gardens. Typically these systems use the natural gradients in a beneficial manner and provide surface water retention volumes.
- Permeable paving, porous asphalt. These provide both infiltration and short term storage volumes thus reducing overall un-mitigated run-off volumes.

7.4.2 Site control

- Detention basins. Areas of the site with reduced levels and allowed to flood in the short term
- Ponds.

7.4.3 Conveyance

- Filter strips. These channel and filter water arising from highways with outfalls to further SuDS solutions.

7.4.4 "End of pipe" solutions

To be considered only after implementation of the above options.

- Retention tanks with outfall controlled by hydraulic means as required to agreed rates and volumes to discharge to existing flow pathways.

7.5 Health and Safety

The proposed SuDS solutions will be designed in line with best practice National SuDS standards to ensure they meet both hydraulic and safety criteria.

8 SuDS appraisal

8.1 Infiltration devices

Due to the expected poor infiltration rates associated with the local geology, Section 2.3, infiltration devices are not ideally suited for this site.

8.2 Permeable hard standing

8.2.1 Permeable paving

A 30% void ratio is assumed through a 350mm sub-base. This is appropriate for a DOT Type 3 Sub-base hence the storage capacity equates to circa 105mm per $1m^2$ therefore based on a M6 100hr + cc storm of 87mm rainfall the paving offers, without any allowance for infiltration, a circa 1:1.2 drained volume:storage volume capacity. Hence there is no anticipated exceedence flow from the areas of permeable paving.

Note: where attenuation cells or soakaways are located under areas of permeable paving the perimeter of each attenuation tank or soakaway will be bunded within the sub-base with an appropriate up-stand or kerbing so as to prevent the sub-base draining directly into the attenuation tanks or soakaways.

TSS 0.7, Metals 0.6, Hydrocarbons 0.7 = suitable for trafficked areas

All permeable paving offers sufficient storage volume to accommodate the 5mm event.

8.3 Bio-retention

Bio-retention is ideally suited for this site for direct mitigation and attenuation storage. All areas of undeveloped impermeable surface can be replaced with topsoil (and typical garden planting) to further reduce unattenuated runoff.

TSS 0.8, Metals 0.8, Hydrocarbons 0.8 = suitable for driveways

8.4 Rainwater harvesting

8.4.1 For external use

Water butts are suitable in providing both volume and run-off control. Water butts should be located, where possible, away from any external foul water gulleys so as to prevent surface water entering the foul drainage system. These are designed to collect water via readily available rainwater diverters which allow exceedence flows back into the SW network.

8.5 Sedum/green roofs.

The use of Sedum roofs can significantly reduce run-off volumes from roofs [8].

8.6 Site control

8.6.1 Attenuation ponds

These features can be used to provide easily maintained retention volumes and are suitable in reducing run-off rates when coupled with end of site solutions. Due to site constraints, they are found un-suitable for this site.

8.7 "End of pipe" solutions

To be considered only after implementation of the above options.

- Retention tanks with outfall controlled by hydraulic means (e.g. hydrobrakes, land drainage network) to existing rates and volumes to discharge to existing flow pathways.

9 Proposed Surface water drainage strategy

For this site the proposed strategy for SuDS and SW drainage design are (see also drainage strategy plan at Appendix C):

- Provision of a Sedum roof to a significant part of the combined existing and new roof area.
- Provision of permeable paving or permeable tarmac to any new areas of hard standing[1].
- Provision of areas of bio-retention planting along site boundaries and conversion of un-developed areas of hard standing areas to domestic gardens.
- Exceedence flow will be directed to the existing SW drainage infrastructure.

9.1 Domestic roofs

All surface water arising from roofed areas is primarily controlled by a Sedum roof, with exceedence flows taken to the existing system (without requiring alteration to, or any increase in capacity of, the existing infrastructure).

9.1.1 Design parameters

"In summer green roofs can retain 70–80% of rainfall and in winter they retain 10–35%" [8] hence, it follows, will reduce runoff by these amounts.

The green roof will be designed to prevent runoff from all rainfall events up to the 5mm event - generally the standard target reduction for sedum roofs.

Roof area of sedum is 340m^2(main roof) + 30m^2 (on terrace) = 370m^2

Maximum intensity storm for the site for a 1 in 100 yr return period is an 8 minute summer profile storm giving a total of 18.1mm rainfall.

9.1.2 Existing peak out fall rate

Existing roof area = 483m^2

[1] A contamination report prepared for the site finds that there is a possibility of contamination being present, albeit a medium to low one. Hence subject to further investigative works, the use of infiltration may be restricted on some areas of the site. The strategy does not however rely on infiltration as "the" SuDS solution, however where possible its use will be a positive addition to the other SuDS solutions adopted.

Area of hard-standing to be covered by extension = 317m^2

Runoff rate from existing roof + area of impermeable landscaping to be covered =

18.1 x 600/(60 x 8) = 22.6 ls^{-1}

9.1.3 Proposed peak outfall rate

Proposed total roof area = circa 800m^2

Sedum roof area = 370m^2

Assuming a conservative 50% retention of a summer storm (refer to 9.1.1 above) by the sedum roof, max 1:100 out fall rate from the sedum roof area, in ls^{-1}, is therefore circa:

0.5 x 18.1 x 370/(60 x 8) = 7.0 ls^{-1}(reducing to circa 3.4ls^{-1} when established).

Remainder of roof = 230m^2

Run-off rate from remainder of roof =

18.1 x 230/(60 x 8) = 8.7ls^{-1}

Total proposed run off rate = 15.7ls^{-1}

9.1.4 Betterment over existing

The proposed run-off rate of 15.7 ls^{-1} represents a circa 30% betterment over the existing scenario (and up to a 46% betterment when established).

9.2 Driveways and hard standing

Any new areas of hard standing on the site will be constructed using a permeable medium on a DOT/MOT 3 subbase of 350mm depth (refer to Section 8.2).

The perimeter of these areas will be considered for Bio retention planting to accommodate any exceedence flows.

9.3 Landscaped areas

All areas of landscaping on the site will be adapted to include bio retention planting hence there is no anticipated surface water flow from these areas of garden planting.

9.4 Maintenance of SuDS

Ultimate responsibility for the long term maintenance with SuDS in this environment lay with the land owner/management company.

All SuDS on site to be installed with full consideration to long term maintenance. The following guidance applies:

9.4.1 Sedum roofs

Full details can be found in Appendix D.

9.4.2 Permeable pavements

A maintenance plan for rainwater harvesting devices should include:

- Monthly litter removal;
- Bi-Annual suction sweeping.
- Annual inspection and repairs as/if required.

9.5 Summary

The use of SuDS techniques on site, as detailed in this report, will reduce run-off rates and volumes providing a betterment on the existing provision.

Signed: 

Dr. R. D. Saunders C. Build E, MCABE, BEng(Hons), PhD

Date: 22nd November, 2016

References

[1] Anon. Code of practice for Foundations. Technical Report BS8004:1986, BSi, 1986.

[2] J Wingfield; M Bell; P Bowker. Improving the flood resilience of buildings through improved material, methods and details. Technical Report WP2c, CIRA, 2005.

[3] BSI. BS 8533:2011. Technical report, 2011.

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[6] Department for Communities and Local Government. National planning policy framework. 2012.

[7] Department for Communities and Local Government. Technical guidance to the national planning policy framework. 2012.

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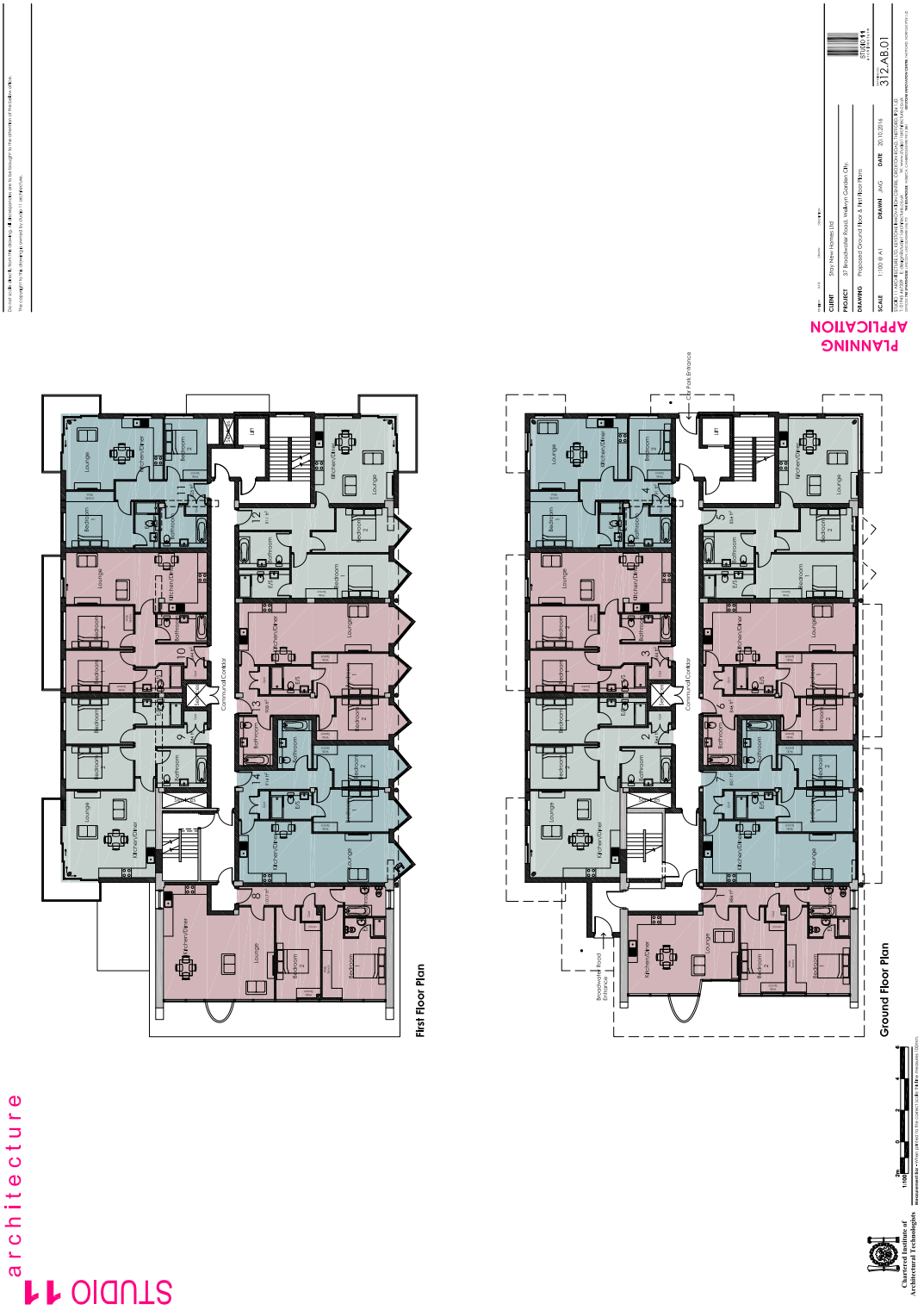
A Proposal plans



B Emergency flood plan (example)

Personal Flood Plan

Checklist ***Things to do before a flood***

Find out if you are at risk of flooding	☐
Find out if you can receive flood warnings	☑
Prepare and keep a list of all your important contacts to hand or save them on your mobile phone	☑
Think about what items you can move now and what you would want to move to safety during a flood such as pets, cars, furniture, and electrical equipment	☑
Know how to turn off gas, electricity and water supplies	☑
Prepare a flood kit of essential items and keep it handy. It can include copies of important documents, a torch, a battery-powered or wind-up radio, blankets and warm clothing, waterproofs, rubber gloves and a first aid kit including all essential medication.	☑
Consider buying flood protection products such as flood boards and airbrick covers to help reduce flood water getting into your property	☐

Checklist ***Things to do during a flood***

Tune into your local radio station on a battery or wind-up radio	☑
Fill jugs and saucepans with water	☑
Grab your flood kit - if you have prepared one	☑
Collect blankets, torch, first aid kit, medication and food	☑
Move important documents, personal items, valuables, and lightweight belongings upstairs or to high shelves	☑
Raise large items of furniture, or put them in large bags if you have them	☑
Move people, outdoor belongings, cars and pets to higher ground	☐
Switch off water, gas and electricity at mains when water is about to enter your home. Do not touch sources of electricity when standing in water	☑
Fit flood protection products, if you have them, for example flood boards, airbrick covers, sandbags	☐
Put plugs in sinks and baths. Weigh them down with a pillowcase or plastic bag filled with soil	☐

If you do not have non-return valves fitted, plug water inlet pipes with towels or cloths	☐
Move your family and pets upstairs or to a high place with a means of escape	☐
Listen to the advice of the emergency service and evacuate if told to do so	☑
Avoid walking or driving through flood water. Six inches of fast-flowing water can knock over an adult and two feet of water can move a car	☑

Checklist ***Things to do after a flood***

If you have flooded, contact your insurance company as soon as possible	☑
Take photographs and videos of your damaged property as a record for your insurance company	☐
If you don't have insurance, contact your local authority for information on grants and charities that may help you	☐
Flood water can contain sewage, chemicals and animal waste. Always wear waterproof outerwear, including gloves, wellington boots and a face mask	☐
Have your electrics, central heating and water checked by qualified engineers before switching them back on	☐

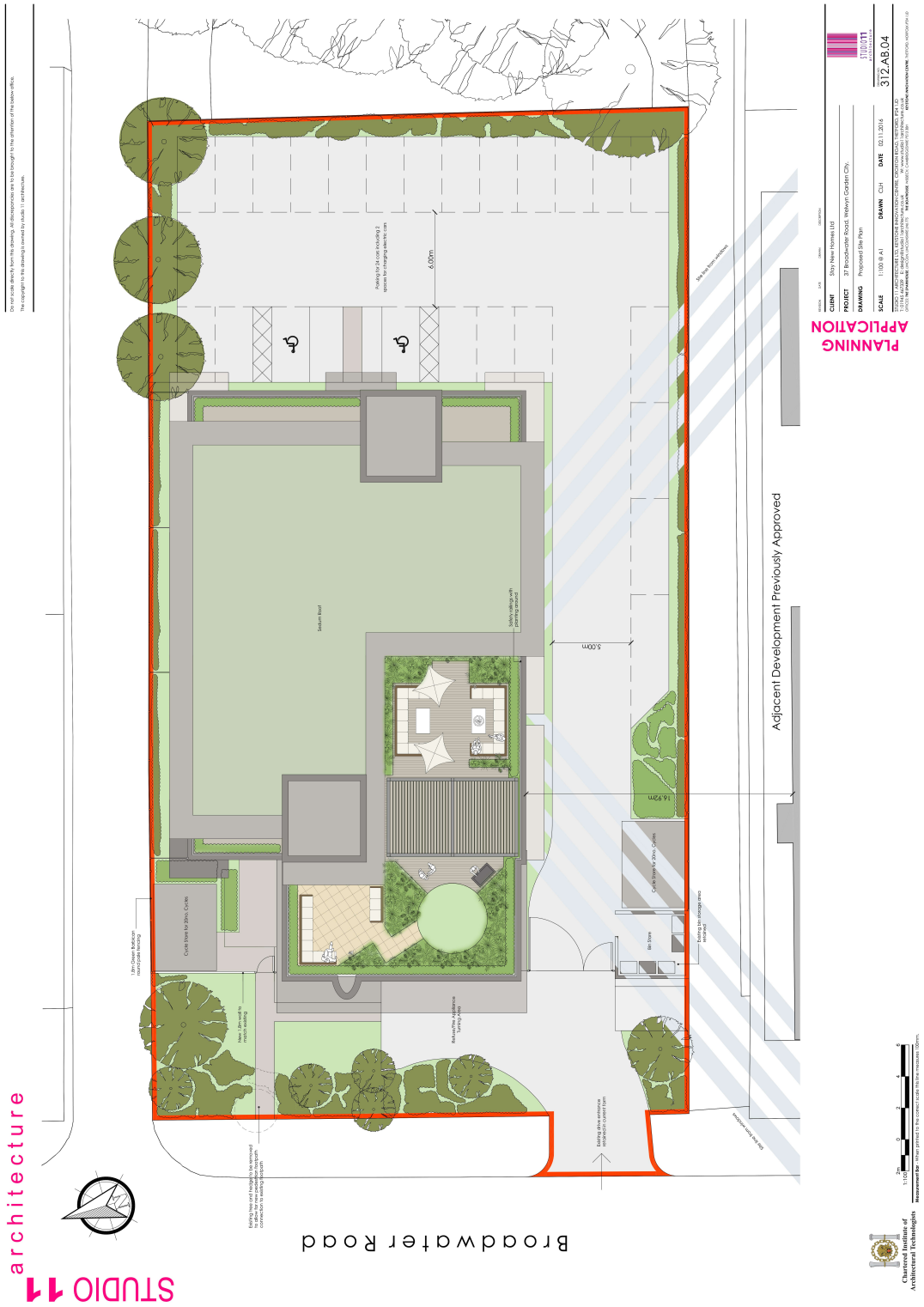
Utilities ***Utility contacts***

Contact	Company	Number	Cut-off	Notes
Electricity provider	A B C Electrical	01234 56789	In hallway	
Gas provider				
Water company				
Telephone provider				
Insurance company				
Local council				

Contact list

Name	Contact	Description

C SuDS strategy



D Maintenance guide for sedum roofs

Extensive roof maintenance - < 100mm low nutrition substrate

- Irrigation: Post-establishment, irrigation should not be required for most extensive green roofs, although the water storage capacity of the system and the plants' water demands should be appropriately assessed.
- Fertilization: Extensive green roofs typically have low nutrient requirements and are therefore often fertilized on an annual basis, each spring, using a slow-release fertilizer.
- Plant management: Removal of undesirable plant species and fallen leaves should take place twice each year
- General: Drainage outlets (including inspection chambers) and shingle/gravel perimeters to be cleared of vegetation, twice yearly

Biodiverse – very low to low nutrition substrate

- Irrigation: Typically not required
- Fertilization: Generally not required, particularly where indigenous species are being encouraged to replicate native habitats. Whilst a low vegetative density is common, zero vegetation is generally undesirable
- Plant Management: A maintenance programme should be drawn up to follow the biodiversity hypothesis, ensuring that no materials are removed from the roof that may adversely affect the biodiversity potential of the roof
- General: Drainage outlets (with inspection chambers) and gravel/shingle perimeters should be inspected twice yearly and cleared of any living or dead vegetation

Semi intensive – 100mm to 200mm low to medium nutrition substrate

- Irrigation: Periodic irrigation is expected, depending upon the plant specification and the climatic and microclimatic conditions prevailing at roof level.
- Fertilization: With a wider range of planting, using a more fertile growing medium, more regular fertilization is required.

- Plant management: Removal of undesirable vegetation on the greened area twice yearly.
- General: Drainage outlets (including inspection chambers) and shingle/gravel perimeters to be cleared of vegetation, twice yearly

Intensive – 200mm + medium nutrition substrates and top soils

- Irrigation: Regular irrigation is often required, subject to the plant specification and the climatic and microclimatic conditions prevailing at roof level.
- Fertilization: With a wider range of planting, using a more fertile growing medium, more regular fertilization is required.
- Plant management: The intensive maintenance of lawns, hedges, borders etc. is required on a regular basis, so as to maintain the roof aesthetics. Undesirable vegetation should be removed from the green areas at least twice yearly. Failed plants in excess of 5% of the plants installed should be replaced.
- General: Drainage outlets (including inspection chambers) and shingle/gravel perimeters to be cleared of vegetation, twice yearly. Where excessive substrate settlement has occurred, this should be replenished.