

AQUAMODULTM

BLUE ROOF DESIGN CALCULATION



Project name: CROWN STREET PHASE 2

Project ID: 14360/32MS

Technical Manager: Matthew Saunders

Date: 24th November 2021



Z2-NRA-G240-Ca-Grd-001 P1

BLUE ROOFS

Traditional roof drainage design dictates that water should be removed from the roof construction as quickly as possible. However, as pressure on water management within communities due to new developments and the potential effects of climate change becomes more critical, this drainage design concept is increasingly being challenged.

Blue roofs are explicitly designed to attenuate the rate at which rainwater is drained from the roof and is allowed to enter the drainage system. When designed and implemented correctly they form an integral attenuation element within the Sustainable Drainage Systems (SuDS) design on modern developments.

The concept of blue roofs is not new with many examples recorded through history. They are now starting to become more commonplace in modern development, this is being driven, in part, by the advancement in knowledge of the subject and the development of modern, lightweight materials for use in the construction of blue roofs.

Implementing SuDS demands that water falling across a development site is not simply channelled into storm water drains and discharged into the local river. Instead, the drainage is designed to mimic that found in nature where water is attenuated, treated and infiltrated through natural process.

Blue roofs can significantly contribute to the SuDS requirements by collecting and retaining rainfall upon the roof, before discharging it at a controlled rate. This is particularly beneficial on sites where land take is tight, such as in urbanised areas, where installation of other attenuation techniques such as ponds or subterranean tanks are not feasible.

Aquamodul™ blue roof system provides attenuation capacity within the flat roof or podium deck construction of a development and can be combined with living roof and mixed amenity finishes. Utilising this space in this way means that the attenuation capacity required to meet SuDS best practice can be achieved without the requirement for land consuming ponds and retention basins, or the challenges of constructing large subterranean geocellular rainwater attenuation tanks.

Aquamodul™ blue roof system comprises a combined drainage and attenuation void within the roof make up, and an outlet system designed to release the attenuated water at a controlled discharge rate, as permitted in the planning consent of the site.

Designing a flat roof in this way allows storage capacities suitable for up to a one in a hundred



year storm event, plus an allowance (typically 30%) for the effects of climate change, to be achieved.

The Aquamodul™ blue roof System consists of two key components:

- A drainage geocomposite system with integral filter geotextiles and a series of restrictor chambers. Excess water (not absorbed by the vegetation when a living roof is installed) filters through the geotextiles and builds up in the drainage void formed by the geocomposite layers.
- This water is gradually dispersed through the system to the restrictor chamber and discharged to the roof outlet at the rate permitted for the site.

The storm water attenuation requirements are met within the roof construction, therefore the need for expensive underground rainwater storage can be eliminated. The project benefits to this design include the elimination of excavated material, reduced on site disruption, and the time and cost saving of installing an underground tank.

Placing the rainwater attenuation within the footprint of the building also has advantages in heavily urbanised developments where external space is at a premium and on site working space and material storage is limited. This reduction in material

movements also helps reduce the carbon footprint of the project whilst under construction.

PARTNERSHIP

Axter innovate, design and make high quality, robust waterproofing systems that are manufactured to last. Our mission is to protect buildings and people from the elements by designing and manufacturing the highest quality waterproofing membranes, while delivering an 'above and beyond' service that instils trust in our customers and positions us as a premium yet cost effective provider.

We work in specialist partnership with market leading designers and manufacturers of high performance geosynthetic systems for use in a wide range of civil engineering, environmental and sustainable building projects.

Together, we are able to deliver creative, sustainable solutions blue roof where the emphasis is placed upon utilising flat roof space to provide attenuation capacity, rather than immediately draining rainwater into the local environment. With our customers, colleagues and partners within the built environment, Axter are inspiring a sustainable future and developing smart solutions for smart cities.



Project Name: Crown Street Phase 2, Manchester - OPTION 2
 Date: 22/09/2022
 Axter Project ID: 646
 Notes/description: Mix of soft and hard landscaping - TBC. Potential for free-standing planters installed, on top of the 'blue roof' system. High strength due to fire tender access - TBC. Uninsulated podium.

Input Parameters - Rainfall Information (Flood Studies Report 1975)

Return period: 100 years *As supplied by Client*
 Allowance for Climate Change: 40 % *As supplied by Client*
 Location selected for FSR data: Manchester

Input Parameters – Roof Information

Total catchment area: 6965 m² *As supplied by Client*
 Attenuation area: 2350 m² *As supplied by Client*
 Maximum allowable runoff: 6 l/s *As supplied by Client*

Output – Rainfall Calculation

Duration	Time to Empty	Restricted Outflow (l/s)
15 mins	23 hours and 40 minutes	3.66
30 mins	27 hours and 40 minutes	4.16
1 hour	32 hours and 30 minutes	4.75
2 hours	36 hours and 30 minutes	5.26
4 hours	39 hours and 10 minutes	5.59
6 hours	40 hours and 50 minutes	5.78
10 hours	41 hours and 50 minutes	5.90
24 hours	39 hours and 30 minutes	5.62
48 hours	30 hours and 10 minutes	4.48

Total attenuation required: 526.00 m³

Half empty time: 9 hours and 50 minutes.

Output – Recommended Blue Roof System:

System Name: Axter bluroof VF HD+ 308mm
 Description: The blue roof depth of 308mm. No. of control positions TBC by design team, and also with the structural engineer's deflection analysis. Additional 'tell-tale' parapet overflow outlets, may also be added by the architect.

Total attenuation capacity: 674.4 m³

Number of Blue Roof outlets: 6

Notes:

1. This document contains an estimate which has been prepared by Axter Ltd and its partners and is illustrative only and not a detailed design.
2. Further details on the theories used in this estimate are available upon request from Axter Ltd. The values given for the performance of the system relate to testing, modelling and analysis of our systems obtained from laboratories and testing institutes. In line with our policy of continuous improvement the right is reserved to make changes to our systems without notice at any time.
3. The estimate given in this report is based on the stated parameters as per the brief. If these parameters are not correct or have changed, Axter Ltd should be contacted to provide a revised estimate.
4. This estimate is specific to the characteristics of Axter Ltd products/systems and is not applicable to other competitor products. The substitution of the whole or any component of this design for a material supplied from another source renders this estimate invalid.
5. Final determination of the suitability of any information is the sole responsibility of the user. Axter Ltd will be pleased to discuss the use of this or any other product but responsibility for selection of a material and its application in any specific project remains with the user.

DESIGN SERVICE TERMS AND CONDITIONS

This document is to be read in conjunction with Axter Terms and Conditions of Sale and Axter Delivery Conditions.

1. DEFINITIONS

'Consultant' means Axter Ltd Partner and its legal successors. 'Client' means the person, firm, company or organisation for whom the Consultant is performing the Services. 'Agreement' means the contract referred to in Clause 2. 'Services' means the services to be performed by the Consultant in accordance with the proposal from the Consultant. 'Project' means the project or works for which the Client has commissioned the Services.

2. GENERAL

Unless and until a formal agreement is entered into, the Client's acceptance of the proposal for Services from the Consultant or a request for some or all the Services to be performed by the Consultant, shall constitute a binding contract between the Client and the Consultant which contract will be subject to any terms and conditions contained or referred to in the aforementioned proposal and these terms and conditions. In the event of any conflict, the terms and conditions in the proposal shall prevail over these terms and conditions. The Agreement so formed shall supersede all previous understandings, commitments or agreements whether written or oral between the Client and the Consultant relating to the subject matter hereof. No person or entity shall have any rights in relation to this Agreement, whether as third parties or otherwise, save the parties to this Agreement. Should any term or condition of this Agreement be held to be unenforceable or invalid by the courts of any jurisdiction to which it is subject then such term or condition shall be disregarded and the remaining terms and conditions shall remain in full force and effect.

3. PERFORMANCE OF SERVICES AND SCOPE

The Consultant shall perform the Services using the degree of skill care and diligence to be expected from a consultant experienced in the provision of services of similar scope size and complexity. The Consultant shall use reasonable endeavours to complete the Services within the time or programme agreed but shall not be responsible for any delay beyond the reasonable control of the Consultant. The fee contained in the proposal is for the scope of services as defined therein. If not already contained in the proposal the Consultant and the Client shall agree as an initial activity an integrated project services programme to include the activities of all the parties to the Project relevant to the Services to be supplied by the Consultant. The aforesaid programme shall show the key dates for final information and the delivery of such to the Consultant so as to enable the Consultant to carry out the services in an efficient once through manner to achieve the programme delivery dates for the Services.

The Consultant provides various services including Design and Product use advice which is distinct from a Design Service. The Design Service may or may not attract a fee. Where the Consultant's services are of an advisory nature and dependent upon the degree of information and release thereof by the Client then the Client agrees that any reliance placed on the services by the Client shall take due account of such constraints.

4. CONFIDENTIALITY AND INTELLECTUAL PROPERTY RIGHTS

(i) The Consultant and the Client shall keep confidential all information pertaining to the Services.

(ii) Copyright for all reports, documents and the like produced by the Consultant in the performance of the Services shall remain vested with the Consultant, but the Consultant shall grant an irrevocable royalty free license to the Client to use such reports, documents and the like for any purpose in connection with the Project.

5. LIABILITY

(i) The Consultant shall be liable to pay compensation to the Client arising out of or in connection with this Agreement only if a breach of the duty of care in Clause 3 is established against the Consultant.

(ii) Notwithstanding any other term to the contrary in this Agreement or any related document and whether the cause of action for any claim arises under or in connection with the Agreement in contract or in tort, in negligence or for breach of statutory duty or otherwise the Consultant shall have no liability to the Client in respect

of any claim for loss or damage arising from acts of war or terrorism or arising from flooding, burst water mains or failed drainage or arising from any incidence of toxic mould or asbestos but otherwise in relation to any cause of action as aforesaid the total liability of the Consultant in the aggregate for all claims shall be limited to a sum equivalent to ten (10) times the fee payable under this Agreement or £50,000, whichever is the lesser, or such other sum as may be expressly stated in the Consultant's proposal, and further but without prejudice to the aforesaid limit of liability any such liability of the Consultant shall be limited to such sum or sums as it would be just and equitable for the Consultant to pay having regard to the Consultant's responsibility for the same and on the basis that all other parties appointed or to be appointed by the Client to perform related services in connection with the Project shall be deemed to have provided undertakings on terms no less onerous than this Agreement and shall be deemed to have paid to the Client such contribution as it would be just and equitable for them to pay having regard to their responsibility for any loss or damage and providing that it shall be deemed that such other parties have not limited or excluded their liability to the Client for such loss or damage in any way which may be prejudicial to the Consultant's liability under this clause. Nothing in this clause shall operate to exclude or limit the Consultant's liability for death or personal injury.

(iii) The Client shall indemnify and keep indemnified the Consultant from and against all claims, demands, proceedings, damages, costs and expenses arising out of or in connection with this Agreement or the Project arising from acts of terrorism or arising otherwise in excess of the liability of the Consultant under this Agreement or which may be made in respect of events occurring after the expiry of the period of liability stated in this Agreement.

(iv) No action or proceedings under or in connection with this Agreement shall be commenced against the Consultant after the expiry of one year from completion of the Services.

(v) Axter Ltd Partner is not responsible for consequential, indirect or incidental losses.

6. INSURANCE

The Consultant shall arrange Professional Indemnity Insurance cover for the amount stated in Clause 5(ii). The Consultant will use all reasonable endeavours to maintain Professional Indemnity Insurance cover for the period stated in 5(iv) above, providing such insurance remains available to the Consultant at commercially reasonable rates.

7. CLIENT'S OBLIGATIONS

The Client shall supply, without charge and in such time so as not to delay or disrupt the performance of the Consultant in carrying out the Services, all necessary and relevant information, in his possession or available to him from his other agents or consultants and all necessary approvals or consents. Any deviation on any information from the proposal shall be confirmed in writing and any attendant consequential fees will be forwarded for approval by the Client before any changes are made. The Consultant shall not be liable for any consequential delays on site. Every reasonable effort will be made to mitigate against delays, however no liability for losses and costs will be accepted. The approval or consent by the Client to the Services shall not relieve the Consultant from any liability under this Agreement. All work undertaken by the Consultant must be ratified and signed off by the Client.

8. PAYMENT

The Client shall pay the Consultant for the Services in accordance with the proposal and this Agreement. If the Consultant performs any additional services or if the Services are delayed or disrupted for reasons beyond the reasonable control of the Consultant, then the Consultant shall be entitled to such additional fees as are fair and reasonable in the circumstances. The Consultant may render an invoice at monthly intervals for services properly performed. The agreed invoice, or in the event of a dispute the undisputed element, shall be paid within 28 days of receipt of the invoice by the Client. Any invoice paid after this period will attract interest at 3% above the base rate of the central bank of the country of the currency of payment along with any collection costs which may occur. (ii) The Client shall not withhold any payment of any sum or part of a sum due to the Consultant under this Agreement by reason of claims or alleged claims against the Consultant unless the amount to be withheld has been agreed between the Client and the Consultant as due to the Client or such sum arises from an award in adjudication, arbitration or litigation in favour of the Client and arises under or in connection with the Agreement. Save as aforesaid all rights of set off at common law, in equity or otherwise which the Client may otherwise be entitled to exercise are hereby expressly excluded.

9. TERMINATION

If a party is in breach of a material term of this Agreement and despite written notice from the other party fails to remedy such breach within 30 days or such other period as may be agreed between the parties, then the other party shall be entitled to terminate this Agreement forthwith. The Consultant may seek to recoup costs incurred for works completed prior to termination.

10. DISPUTE RESOLUTION

Any dispute between the parties that cannot be settled by mutual agreement shall be referred for final settlement to the arbitration of a person agreed between the parties or failing such agreement appointed upon the application of either party by the President of the Chartered Institute of Arbitrators and the said arbitration shall be carried out in accordance with the Construction Industry Model Arbitration Rules 1998 or such other version current at the time of the referral under this clause. Where the Agreement is subject to a governing law other than that of England and Wales then any dispute between the parties that cannot be settled by mutual agreement shall be finally settled by arbitration in accordance with the UNCITRAL Arbitration Rules by one arbitrator appointed in compliance with the said Rules. In either case such rules as appropriate are deemed to be incorporated into this Agreement by reference.

11. COMPLIANCE WITH LAWS This Agreement shall be governed by and construed in accordance with the law of England and Wales unless stated otherwise in the proposal for services from the Consultant.

Changes to the above terms and conditions will only be considered if agreed in writing as part of the appointment process prior to Axter Ltd commencing work.

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