TOWN AND COUNTRY PLANNING ACT 1990
SECTION 78 APPEAL

APPEAL BY GREAT LAKES UK LTD
REF: APP/C3105/W/20/3259189

REBUTTAL EVIDENCE

OF

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(DRAINAGE & FLOODING)

For

Great Lakes UK Limited

motion

Document Control Sheet

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1.0 Introduction

1.1 My name is Richard Bettridge. I am a Chartered Engineer and a Chartered Environmentalist I have been a member of the Institution of Civil Engineers since 1984. I became a member of the Chartered Institution of Highways and Transportation and was a made a fellow in 1994. I became a Member of the Institution of Public Health Engineers in 1983. I am a member of the Chartered Institution of Water and Environmental Management and a Member of the Society for the Environment.

1.2 This Rebuttal Proof of Evidence is prepared in response to the Proof of Evidence of Richard Bennett, a flood risk engineer working for Oxfordshire County Council.

1.3 This document is not intended to respond to every matter addressed by Mr Bennett, but instead focuses on those points I consider will assist the Inspector by providing points of rebuttal in writing. I reserve the right to comment on those points not addressed in this rebuttal during the Inquiry. It should be read in conjunction with my main proof of evidence on which I continue to rely but do not repeat again here.

1.4 By way of a brief summary, I do not consider that any proper reason has been advanced or proper evidential basis for objecting to the drainage proposals presented by Mr Bennett, and to the contrary he appears to be pursuing an unjustifiable objection to the principle of a drainage strategy involving the use of a tank which will deliver substantial benefits from a flooding and drainage perspective.

1.5 I will deal with various points, using headings and making reference to the paragraph numbers in Mr Bennett's evidence below [-].

2.0 Rebuttal to LLFA Proof of Evidence

Existing Situation

2.1 [3.2] Richard Bennett implies that the two main drainage ditches at the golf course site are natural, when in fact they are not and represent part of the drainage of an existing golf course which were created by the golf course operator. The historic maps shown in Environmental Statement Volume 2 Appendix 11.1 (CD1-13) show that there were not any historical natural watercourses serving the development area. As was confirmed by the operators of the site, the existing drainage ditches and the land drainage provisions in place were put in as part of the golf course development. There is no reason therefore for assuming that they should necessarily inform the design of the surface water drainage scheme for the new proposals. The new proposals should be and have been designed in accordance with current planning guidance. I have shown that the scheme as proposed is fully compliant with current planning guidance.

2.2 [3.3] The maps at Figure 2 show a combination of the Flood Zones and the Surface Flooding outlined. The light blue area through Little Chesterton indicates the likelihood of surface flooding in that location, not its frequency or depth. I attach the publicly available Flood Zone map and the surface water flooding map produced by the Environment Agency. The site itself and Little Chesterton are in Flood Zone 1 (Land having a less than 1 in 1,000 annual probability of river or sea flooding). The surface water flood map shows that the risk of flooding in dark blue has an annual probability of flooding of 1 in 30, however this area clearly lies along the line of the stream and as such is not unusual. The lighter blue areas show areas of lower risk of surface flooding. These maps simply represent the pre-development situation which I have explained in detail in my evidence, will in fact be improved in the development scenario. This is because the discharge from the appeal site under events above the 1 in 2.3 return period will be lower than the existing runoff for those events.

2.3 [3.4-3.7] The aerial survey of groundwater depths has clearly demonstrated that the use of infiltration systems is not advisable and therefore the drainage strategy has rightly not pursued these. The existing ponds on the site where they are unlined tend to reflect the groundwater table as opposed to 'managing' it. The land drains on the site are purely an expedient to prevent surface water pooling on the golf course so that it is usable. Mr Bennett's statements on groundwater do not have any scientific justification and they are speculative and without evidential foundation. By contrast, the findings of the JH Groundwater report are very clear and provide an informed view of the groundwater regime at the site.

The Underground Tank

2.4 [5.7] The proposed underground tank provides 2000 cu m of storage out of 5500 cu m for the site overall. As such it provides 36% of the storage requirement. In addition, the stored water will be reused in a sustainable way to reduce the demand on potable water supply from Thames Water. The volume of water for harvesting is proposed at 13,860 cu m per year (38 cu m/day) as set out in the 'Outline water Resources Scoping Note' produced by Hoare Lea included at Appendix 12.3 of the Environmental Statement Volume 2 (CD1-13). Contrary to what appears to be suggested, the construction of the tank will be designed to address any hydrostatic uplift pressures as part of the normal design, and this is simply normal and basic engineering for structures of this kind in the ground. I attach examples of how groundwater uplift can be overcome in practice. The extract contained in Appendix A from The British Standard BS EN 1997 Part 1- Eurocode 7 – Geotechnical Design – General Rules, deals with the assessment of flotation from groundwater and indicates that it is a normal part of the design of underground structures such as tanks.

The Outfall

2.5 [7.1.1] The exact outfall position depth and size has been confirmed and information provided to the LLFA and Mr Bennett about this. The drainage proposals have been remodelled based on this even more exact information and continue to show that the scheme is still fully compliant with the planning guidance as was the case for the assumed location.

2.6 [7.1.2] The outfall depth serving the site remains unchanged for its present position and depth. The outfall manhole discharges to a pond on the golf course south of the Hotel.

2.7 [7.1.3] There is nothing misleading in the FRA or Drainage Strategy, or in the use of an assumed outfall situation of this kind in this sort of proposal; but the criticism is also simply academic given the confirmation of the exact position of the outfall and the further modelling provided.

Flood Zone Mapping

2.8 [7.1.4-7.1.5] The Flood Zone mapping at Appendix B shows that the site is situated in Flood Zone 1 which means that the annual risk of flooding from rivers or sea is less than 1 in 1000. Furthermore, the Surface Water mapping indicates that the annual risk of surface flooding at the outfall is also less than 1 in 1000. These maps clearly demonstrate that the chance that the outfall floods is very low (much less than 1 in 100 to which reference is made in the NPPG) and it is therefore reasonable to make the assumption that was made from the mapping. Furthermore, the site itself is not subject to flood risk from either rivers or surface water. This would not be the case if the outfall was subject to flooding. In addition, it has been clearly demonstrated that the proposals will actually reduce the runoff for all storms more severe than the 1 in 2.3 year event (Qbar) because the discharge is limited to Qbar (31.3 l/s), so providing significant benefits. It is simply not true to suggest that there is no reliable evidence relating to conditions at the outfall. The evidence for this is provided by the Environment Agency Flood Maps, which are reliable and are produced specifically to assist in the planning process.

Groundwater

2.9 [7.2] In this section Mr Bennett seeks to provide evidence about groundwater in which he does not appear to have any expertise and, in any event, is not supported by analysis or proper material. He makes a number of speculative assertions which are contradicted by the expert analysis that has been provided and a number of assertions which are simply wrong from a basic engineering perspective. For example, it is common practice for a tank of this kind to be sealed from groundwater. It is also basic common practice and simply engineering to design it to remain in place because anchoring of this feature will be a basic part of the design. The groundwater will be managed during construction as is standard practice, but thereafter the groundwater regime will return to its original state. All of this is confirmed in the expert report from JH Groundwater – included at Appendix H of my proof of evidence but is commonplace. Assertions about loss of water in the pond and in relation to loss of groundwater storage are entirely speculative and simply do not accord with the findings of the JH Groundwater report or experience. The main conclusions of that report are as follows:

- The current surface water features within the development footprint are not natural. They were developed over time as water features and hazards within the golf course.
- The surface water features do not control groundwater levels, contrary to the assertion made in the OCC letter dated 15/12/20.
- The installation of the proposed retention tank will not result in an adverse impact of the local hydrogeological environment.
- Temporary dewatering may be required in order to construct the tank, resulting in temporary localised changes to groundwater levels, but this would re-equilibrate to the baseline condition following completion of works.
- The volume of groundwater storage beneath the footprint of the tank is insignificant relative to the volume of wider aquifer. No significant changes to groundwater conditions are expected as a result of the installation and groundwater levels would be anticipated to re-equilibrate rapidly after construction.
- No significant changes to local hydrogeological conditions are anticipated.

Qbar

2.10 [7.3.1/7.3.2] I take basic issue with what is stated in 7.3.1 because agreement has been reached on the use of Qbar and this agreement is consistent with the OCC Local Standards and Additional Local Guidance, which states that:

"…limit discharge rates for rainfall events up to and including the 1 in 100 year event (including climate change allowances) to the agreed QBAR rate (or 2l/s/ha whichever is greater) and 1 in 1 year event to the corresponding green field event"

2.11 Qbar is 31.3l/s. By restricting the discharge for all rainfall events to this rate there will be a reduced discharge for all events more severe than the 1 in 2.3 year return period event as a result of this development. This will necessarily improve any existing flooding situation downstream, including that experienced at Little Chesterton and Wendlebury. Furthermore, the re-use of up to 38 cu m per day of harvested runoff will yet further improve the situation downstream.

Installation and Maintenance of Underground Tank

2.12 [7.4.1] The operation of an underground tank is not complicated nor novel. It operates on a gravity system, which is a minimum operational standard. The drainage strategy has been submitted as a core document CD1-10. This sets out the proposed maintenance requirements for the drainage system. All SuDS features require enhanced maintenance by their very nature i.e. they seek to emulate natural processes. Indeed, the industry has been locked in debate for the last decade over which body should take responsibility for SuDS schemes which are intended for public areas precisely because of the maintenance requirements; public drainage bodies have been notoriously reluctant to step forward to take responsibility for SuDS features in public areas because of the high level of resources needed to maintain them properly. This does not arise for a privately maintained site. As with maintenance of any other SuDS feature, maintenance of an underground tank is normal. Moreover, underground storage of surface water is neither an unusual solution for providing discharge attenuation, nor would it be difficult to maintain as part of a site wide SuDS scheme designed to comply with para 165 of the NPPF. It is impossible to see what reasonable or logical objection is being expressed to such normal maintenance requirements that would apply to any SuDS proposal.

2.13 [7.4.3/7.4.4] The tank will sit within the groundwater table but is a common situation which affects most sub-structures. The tank will be sealed from groundwater entry to preserve storage capacity in the standard way. The design will take into account hydrostatic uplift pressures amongst other things relating to design again in a standard way. See the attached extracts in Appendix C from a web search showing different forms of dealing with groundwater uplift. The main form of anchorage for concrete tanks is the dead weight of the structure itself when empty, which has to exceed the hydrostatic uplift by a safe amount. This factor of safety (FoS) is equal to the weight of the structure divided by the weight of water displaced i.e. the uplift. The modular tank system by FP McCann is typical of pre-cast concrete tanks for surface water storage.

2.14 Furthermore, the replacement of the tank with a pond as suggested is inappropriate as it would require a much deeper excavation because it would not be acceptable for it to completely empty in the way that the tank is designed. As such, the pond option would have to be over-dug to provide a standing water depth capable of sustaining aquatic habitats. The pond would also need to exclude groundwater and, because of its increased depth, would be subject to even greater hydrostatic uplift pressures to accommodate it which would be more challenging than the simple anchoring of a tank. Furthermore, the pond option would result in the loss of significant car parking areas. This basic justification for use of a tank has been consistently ignored by the LLFA.

Biodiversity

2.15 [7.5] The submitted material with the planning application and the evidence of James Patmore demonstrates that the proposal delivers a significant net biodiversity gain. Neither CDC nor Mr Bennett present any evidence to the contrary and it is no part of CDC's case to suggest to the contrary. The OCC's own local standards state that the LLFA's primary function is 'flood prevention' and they 'will not comment on nature, landscape, visual impact and historical aspects, unless they appear to impact on the performance of the SuDS', yet despite that Mr Bennett is purporting to comment on biodiversity issues but without any evidence to contradict CDC's accepted position. Commenting on biodiversity is clearly outside of the LLFA's remit as stated within their local standards and they should instead be addressing the flood prevention aspects.

SuDS

2.16 [7.5.3] Mr Bennett once again claims that he is not happy with the use of the tank and refers once again to the level of the outfall, but the level of the outfall has been confirmed and there is simply no basis for suggesting that the use of an underground tank is contrary to any policy. There is no mention or consideration of the need for a tank here and its benefits in providing flood storage, enabling rainwater harvesting, its ability to empty without any loss of visual amenity and the ability to use the land above productively and effectively.

Rainwater Harvesting

2.17 [7.6.1] It is welcome that Mr Bennett now concedes that the LLFA promotes the use of rainwater harvesting (which is exactly what the drainage strategy with the undergound tank provides), but there is no evidence of Mr Bennett applying that principle in his objection to what is proposed. The principle of rainwater harvesting has been carefully considered in the design through the use of the tank.

2.18 [7.6.2] There is a basic misunderstanding by Mr Bennett evident in his approach to the use of the tank in this scheme and his concept of "rainwater harvesting volumes". It is has been repeatedly explained to the LLFA, and information and examples have been provided, as to the well-established and beneficial use of an intelligent systems for the tank. The proposals include an 'Active' rainwater harvesting system. Although a relatively recent innovation, the technology is well known and well used and delivers sustainable and highly desirable benefits. In short, the system uses telemetry to monitor the storage tank and to interrogate weather forecasting services to provide warning of impending rainfall, the amount of rain expected and when it is expected. The system enables the volume of storage required to be calculated and the tank evacuated to create that storage. The system has failsafe's and emergency procedures in the event of failure all of which are incorporated into the detailed design. This means that one can design the tank efficiently and effectively for the required storage volume but use that storage volume intelligently and sustainable for rainwater harvesting in the meantime. Mr Bennett's comments in this paragraph do not to relate to 'Active' rainwater harvesting/flood storage systems, which guarantee that the necessary storage will always be available. The system proposed will do just that and evidence has been provided of the system to be used as well as examples of where the system has already proved successful. The alternative is, of course, simply to provide a tank with even greater volume for both flood storage and rainwater harvesting (which is controlled by the proposed condition), but this is obviously less sustainable in terms of creating additional unused space underground than using an intelligent system of the type proposed. Mr Bennett does not address this.

2.19 [7.6.3] The statement that it has not been demonstrated how the proposed SDS rainwater harvesting system will be implemented appropriately in the design is simply not true. The SDS system has been explained to the LLFA and details have been provided, along with examples of where the system has been used and this is well-established and proven technology.

2.20 [7.6.4] This again betrays a basic misunderstanding of the proposal. The tank is going to be used for rainwater harvesting when water is available in the tank. Even if the tank fills completely it only takes around 18 hours to fully empty. The intelligent system does not empty a tank "immediately" before a storm event in the way described. Moreover, Mr Bennett's hypothesis is completely unrealistic. The daily reuse volume for rainwater harvesting is approximately 38 cu m. Given these sorts of level, the tank would never require emptying from full in the way described in anticipation of a storm event of the type that has to be planned for. The claim that the volume of water being discharged would double downstream a) by emptying the tank and then b) discharging at Qbar during the subsequent storm simply ignores the impact of rainwater harvesting. In addition, Mr Bennett's approach is illogical. The likelihood of the tank already being completely full at the commencement of a major event would necessarily be very rare indeed and far rarer than the 1 in 100 year event plus climate change event which planning policy requires one to address. This is because for such an event to happen i) a storm of a 1 in 100 year return period would have to occur first, so filling the tank ii) one then has to assume that there is no rainwater harvesting occurring from that tank at that time so the tank remains entirely full (despite the fact that this is part of the proposal); and then iii) one would have to expect another 100 year storm to occur again immediately. This obviously changes the characterisation of what Mr Bennett is requiring the scheme to address to a far more extreme event and improbable event beyond which any policy requires one to address. Needless to say, if one were to impose this sort of requirement on drainage systems, you would need to apply them consistently to all developments (including, for example, the design of a pond) and it is illogical that Mr Bennett is applying this approach to the tank but not to SuDS generally in the LLFA's area.

2.21 [7.6.5] Qbar is the selected (and simple method) adopted by agreement with the LLFA and it has been agreed and it is entirely consistent with their local guidance. This new reference to a 1 in 100 year 6 hour rainfall volume is not relevant to the methodology that has been agreed with the LLFA and it is a reference to a different option for assessment (the complex method) for the attenuation of runoff which the LLFA has already agreed is not to be used for this proposal.

Existing Drainage Features

2.22 [7.7] It is difficult to understand what point Mr Bennett is seeking to make. The way in which the existing drainage features was created on this site by the golf course operators is a known fact confirmed by the operators themselves. The proposal delivers a net gain in relation to biodiversity and the SuDS drainage proposals proposed are integrated with this. The existing drainage of the golf course through the layout of ponds and ditches and land drains was designed for the purpose of maintaining the golf course, so that the golf holes could be used effectively. The new proposals are completely different, and the drainage proposals are subject to appropriate planning guidance and the new proposals are compliant with the planning guidance and help to reduce flood risk downstream.

The Hotel Development

2.23 [7.8.1/7.8.2] Mr Bennett refers to a recent approval of a 62 bedroom extension to the existing hotel and the drainage strategy that was approved for that scheme. Again, it is difficult to understand what point is being made as the drainage strategy for that scheme was designed for that scheme. That proposal has not been built. It is a different development which used an ornamental pond at a lower elevation to act as an outfall for surface water runoff of that particular scheme. The proposals consisted of a modification of the existing pond to convert part of it to a small storage facility. The current proposals for the application site have been designed to address the drainage requirements of that scheme. They do not require the use of features outside of the site and there is no reason to use them.

2.24 [7.8.3] Once again, the outfall level has been confirmed and there is no basis for the claim that the drainage strategy will not work.

2.25 [8.1] Mr Bennett simply ignores that the assumptions regarding the outfall were correct and they have now been confirmed through identification of the exact location.

2.26 [8.2] The groundwater position has been appropriately accounted for in the proposed scheme from the outset and the strategy is entirely appropriate. The position in relation to the groundwater and the ability to provide the tank is confirmed by the technical report (JH Groundwater Ltd) which refutes these unfounded assertions.

2.27 [8.3] The positioning of the tank within the groundwater table is a perfectly common and normal affecting most drainage sub-structures and a simple engineering process. The tank will be sealed from groundwater entry to preserve storage capacity. The design will necessarily take into account and address hydrostatic uplift pressures (amongst other things) relating to design, just as a pond would also need to do. The Environment Agency maps for planning clearly demonstrate that the outfall is neither at risk of flooding from rivers or sea nor from surface water in the 100 year event so assertions about the outfall conditions are completely unfounded.

2.28 [8.4] The proposals restrict the surface water discharge from the site under all rainfall events to 31.3 l/s. The greenfield runoff from the site under the 1 in 30 year event and the 1 in 100 year event are 70.8 l/s and 99.7 l/s respectively. As such there will be a significant reduction in the discharge from the site during events that are more severe that the 1 in 2.3 year event (Qbar), so resulting in the delivery of significant benefits. The volume of attenuation storage and the discharge rate at Qbar has been agreed. It is fully compliant with paragraph 163 of NPPF, NPPG and Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire and Policy ESD6.

2.29 [8.5] The underground tank will be subject to standard maintenance requirements, as would any SuDS feature. It will be maintained in order to enable it to provide the required flood storage at all times and to enable surface water runoff to be collected to be reused. The Drainage Strategy clearly sets out suitable maintenance regimes to be adopted. The position is no different from any SuDS feature.

2.30 The replacement of the tank with a pond is inappropriate and less sustainable in principle. It would require a much deeper excavation, because it would not be acceptable for the pond to completely empty in the way that the tank is designed. The pond option would have to be over dug to provide a standing water depth capable of providing, for example aquatic habitats. The pond itself would need to exclude groundwater. Because of its increased depth it would be subject to even greater hydrostatic uplift pressures to accommodate it as compared with a tank. Furthermore, the pond option would result in the loss of the use of the land above for, in this case car parking areas where they form part of the proposal. This justification for the tank has been consistently ignored by the LLFA. This has resulted in their failure to recognise the contribution of other SuDS measures to a net gain in biodiversity for the proposed development. It has also led them to ignore the benefits of the drainage scheme which will reduce the rate of water being discharged downstream and the rainwater harvesting scheme which will reduce the volume of runoff by reusing stored water with all the benefits that brings.

2.31 [8.6] The drainage strategy has not failed to take account of advice from the LLFA. To the contrary, it has been designed with all of the policy and guidance requirements in mind, but the LLFA through Mr Bennett has strangely refused to countenance the use of a tank despite all of its obvious benefits and compliance with policy. It is impossible to understand why. The LLFA’s role should be to address the scheme for which the planning application was made, rather than seek to impose unnecessary prescription on the design itself which is not required by either policy or guidance to achieve a satisfactory drainage strategy. The LLFA’s position is worse in this case because it is ignoring the clear benefits of the drainage strategy proposed. Throughout the process there appears to have been an obsessive interest in recreating the existing drainage regime that was imposed for the golf course (as the evidence demonstrates) and regardless of whether the proposals, or the applicant’s consultants’ explanations, comply with planning policy and guidance.

Appendix A

Extract from BS EN 1997 Part 1 – Eurocode 7

— modifications of the project in order to resist the pressures or gradients;

— seepage control;

— protective filters;

— avoidance of dispersive clays without adequate filters;

— slope revetments;

— inverted filters;

— relief wells;

— reduction of hydraulic gradient.

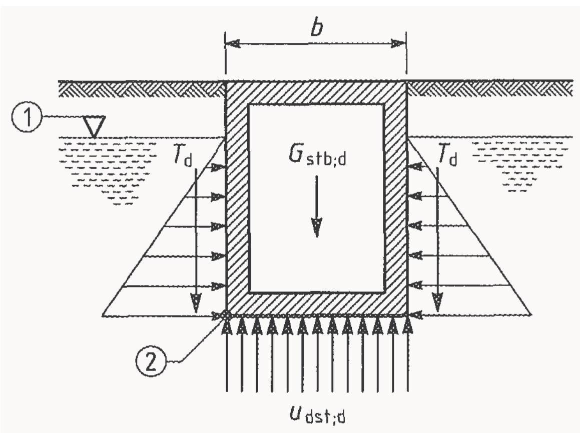
10.2 Failure by uplift

(1)P The stability of a structure or of a low permeability ground layer against uplift shall be checked by comparing the permanent stabilising actions (for example, weight and side friction) to the permanent and variable destabilising actions from water and, possibly, other sources. Examples of situations where uplift stability shall be checked are given in Figure 7.1 and Figure 10.1.

(2)P The design shall be checked against failure by uplift using inequality (2.8) of 2.4.7.4. In this inequality, the design value of the vertical component of the stabilising permanent actions ($G_{stb;d}$) is, for example, the weight of the structure and of ground layers, [AC1⟩while⟨AC1] the design resistance (R_d) is the sum of, for example, any friction forces, (T_d), and any anchor forces, (P). Resistance to uplift by friction or anchor forces may also be treated as a stabilising permanent vertical action ($G_{stb;d}$). The design value of the vertical component of the destabilising permanent and variable actions, ($V_{dst;d}$), is the sum of the water pressures applied under the structure (permanent and variable parts) and any other upwards forces.

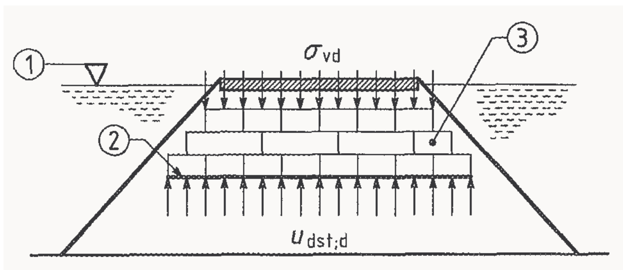
[AC1⟩(3) If allowed by the National Annex, resistance to uplift by friction or anchor forces may also be treated as a stabilising permanent vertical action ($G_{stb;d}$).

NOTE The values of the partial factors may be set by the National Annex. ⟨AC1]



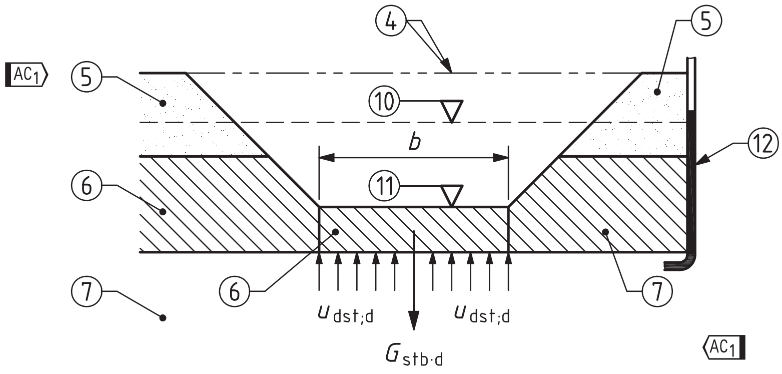
a) Uplift of a buried hollow structure

1 [AC1⟩groundwater table⟨AC1]
2 water tight surface



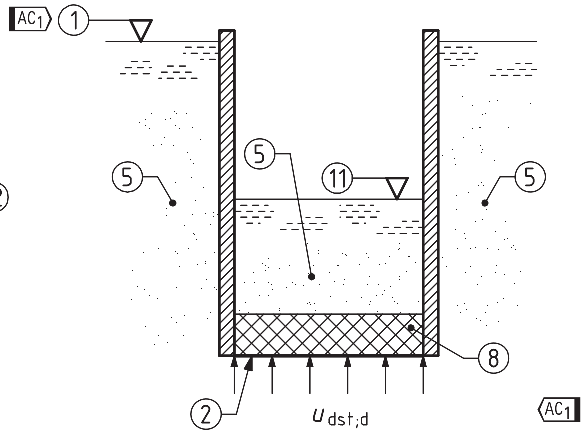
b) Uplift of a lightweight embankment during flood

1 [AC1⟩groundwater table⟨AC1]
2 water tight surface
3 light weight embankment material



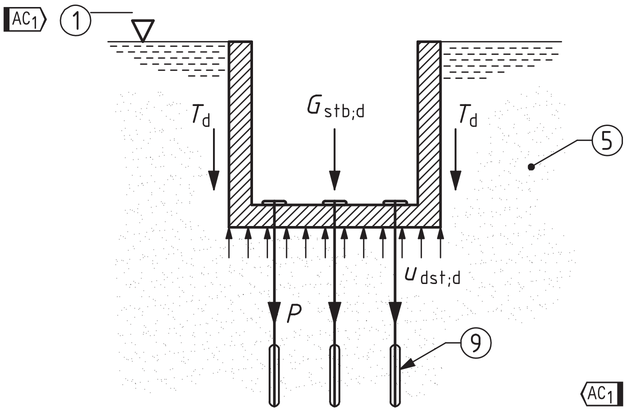
c) Uplift of the bottom of an excavation

4 former ground surface
5 sand
6 clay
7 gravel
[AC1⟩ 10 groundwater level before the excavation
11 groundwater level in the excavation
12 piezometric level at the base of the clay layer ⟨AC1]



d) Execution of a slab below water level

1 [AC1⟩ groundwater table ⟨AC1]
2 water tight surface
5 sand
[AC1⟩ *Text deleted* ⟨AC1]
8 injected sand
[AC1⟩ 11 groundwater level in the excavation ⟨AC1]



e) Structure anchored to resist uplift

1 [AC1⟩ groundwater table ⟨AC1]
5 sand
9 [A1⟩ anchor ⟨A1]

Figure 10.1 — Examples of situations where uplift might be critical

(4) The measures most commonly adopted to resist failure by uplift are:

— increasing the weight of the structure;

— decreasing the water pressure below the structure by drainage;

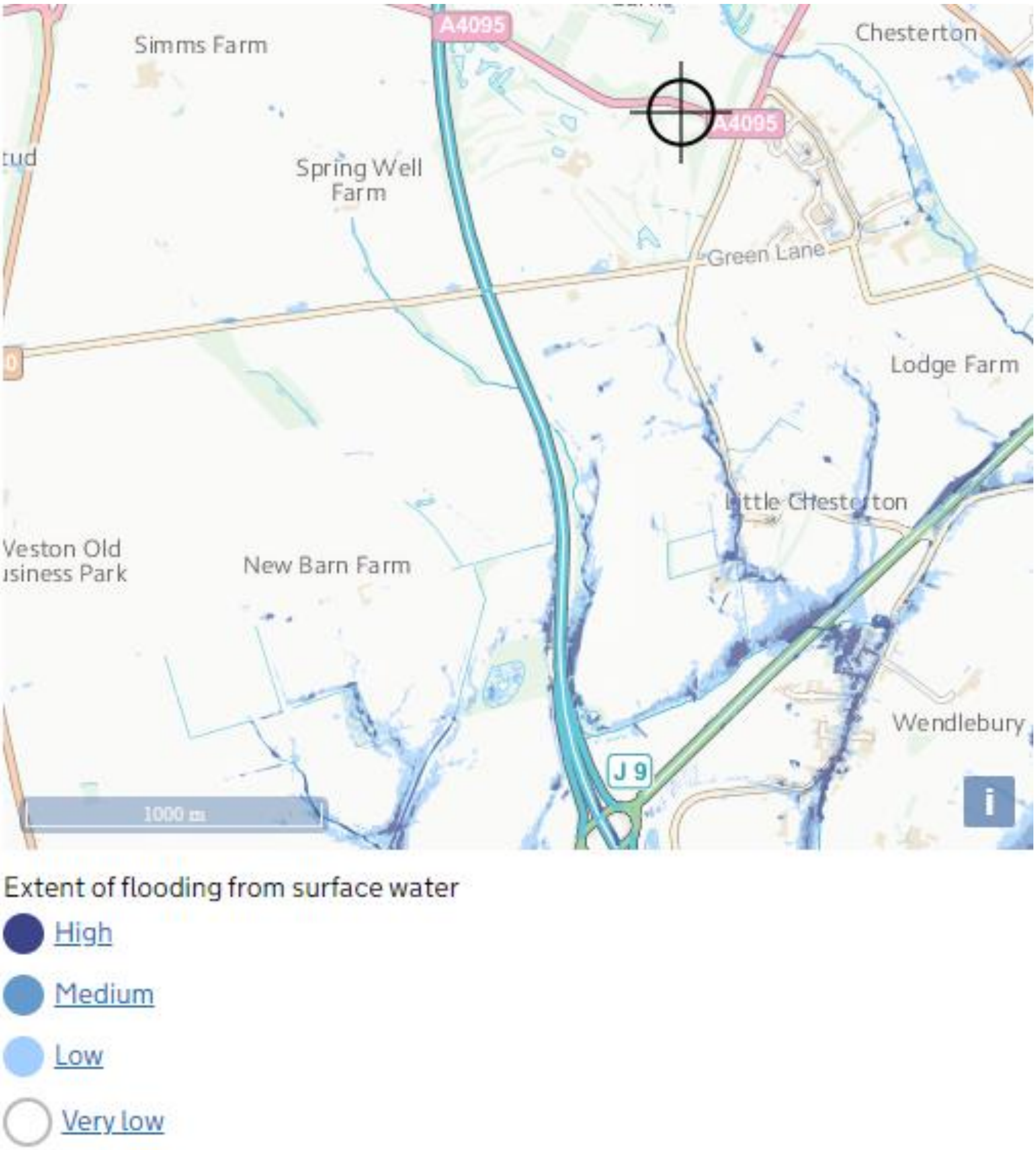
— anchoring the structure in the underlying strata.

(5)P Where piles or [A1⟩ anchors ⟨A1] are used to provide resistance against failure by uplift, the design shall be checked according to 7.6.3 or 8.5, respectively, using the partial factors given in 2.4.7.4.

Appendix B

Flood Zone Mapping

Surface Water Flood Map



Fluvial Flood Map

Appendix C

Anchoring of Tanks Examples

Photo of tank held down with concrete beam and anchoring straps

Image of GRP tank held down with concrete beam and anchoring tanks

Example of Geocellular tank held down with balast

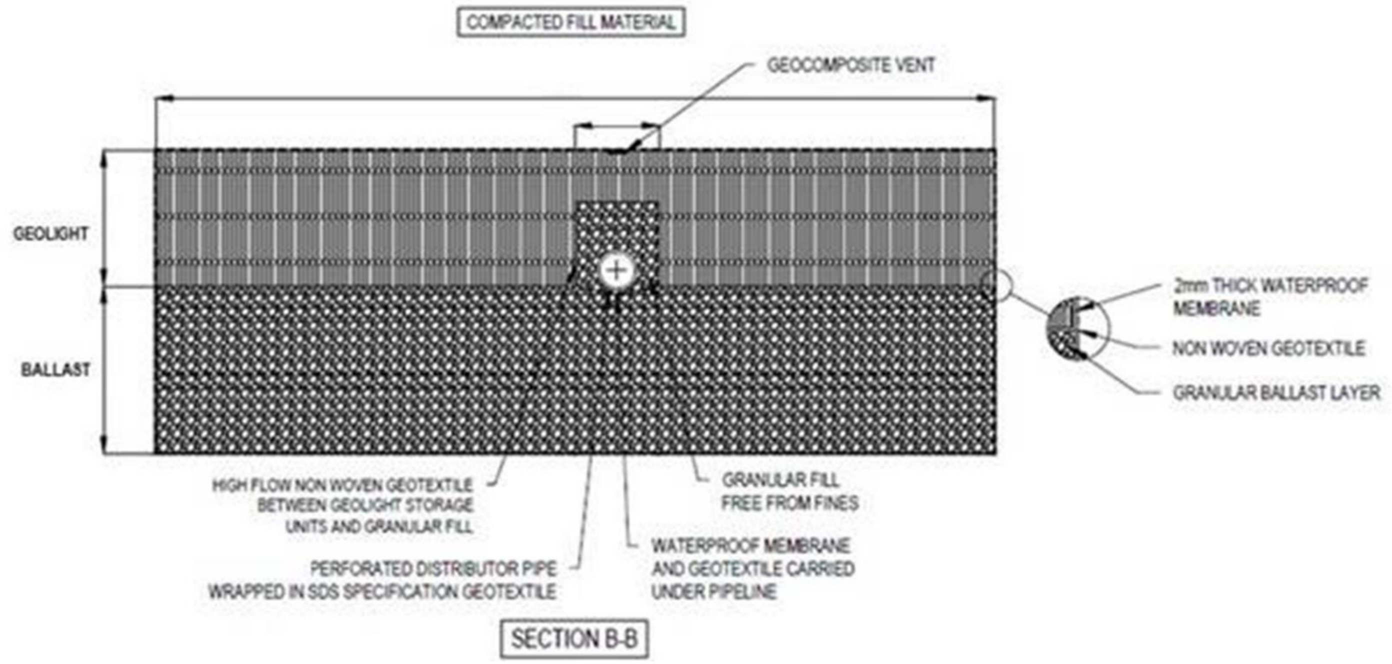
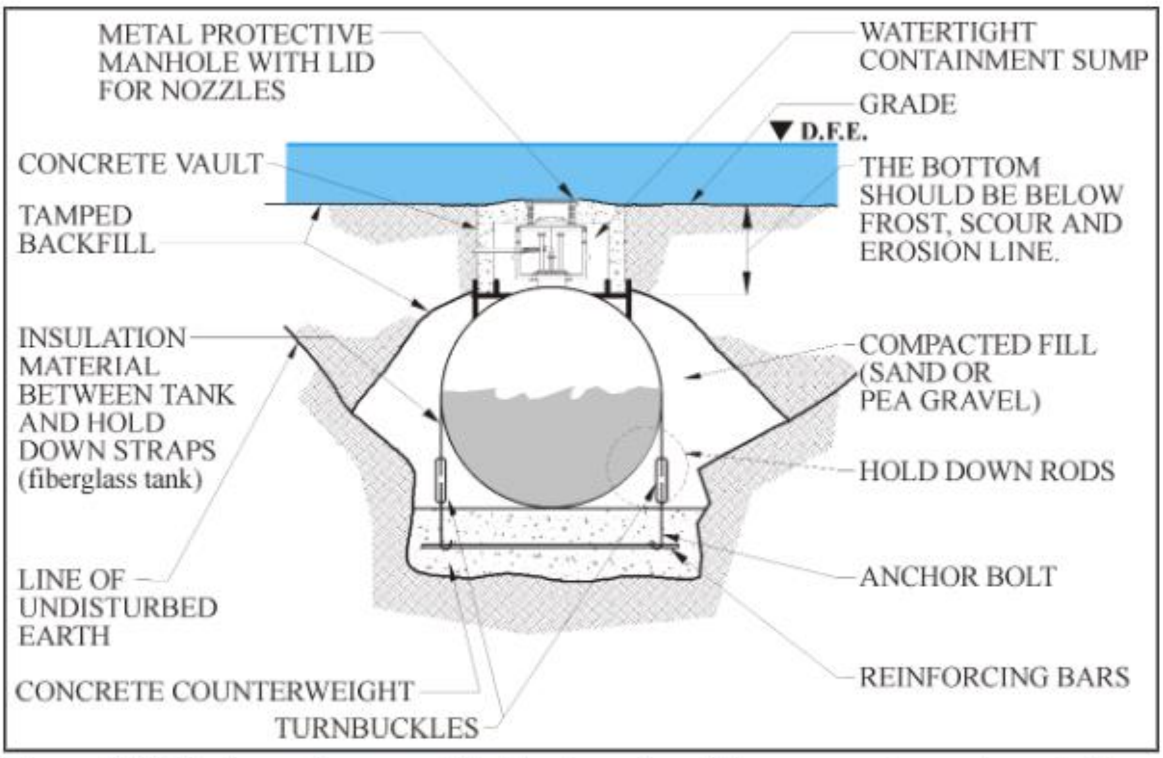


Image of underground tank anchored to concrete slab



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The StormTank™ multipurpose panel system is an underground structure consisting of wall panels, an in-situ or precast concrete base and cover slab, which are assembled on-site by the contractor or an approved installer using a range of standard jointing types. The panels can be made with cast-in pipe connections, recesses and openings and have penstocks or flap valves pre-installed. Internal weir-walls, overflows, underpasses and baffle walls can also be incorporated into the structure.

This system can be used for a variety of uses such as CSO chambers, storage tanks, large size manholes, pumping stations, valve chambers etc. The main advantage of using this system is that there is no size limitation, except for the height, which cannot exceed six metres, with a two metre overburden. A detailed installation guide is available. Please contact FP McCann for further details.

PRODUCT APPLICATIONS

- Air-infiltration chambers
- Hydro-brake chambers
- Large CSO chambers
- Water storage tanks
- Pumping stations
- Attenuation tanks
- Large manholes
- ASP structures
- Sludge tanks
- Basements
- Headwalls

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MODULAR TANK SYSTEM

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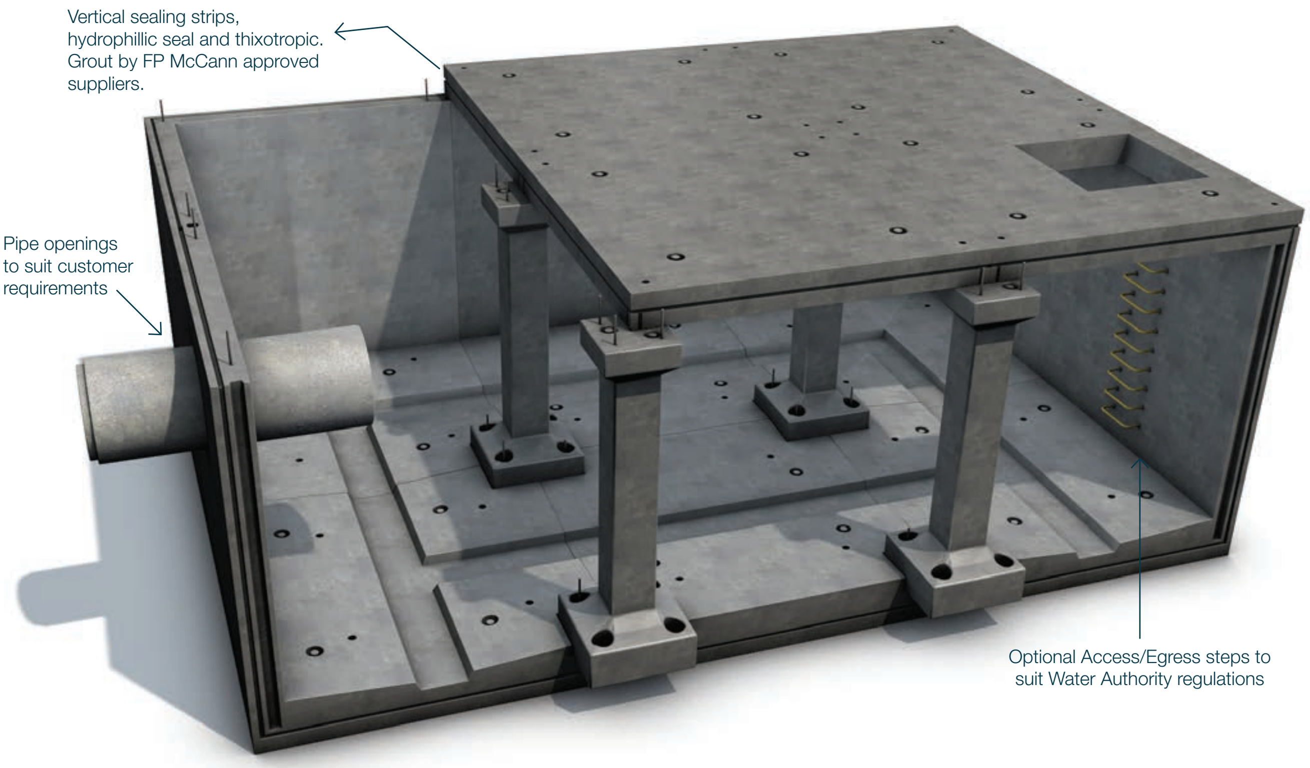
StormStore (storm and waste water management system) provides a multifunctional, durable solution for the detention, retention, infiltration, harvesting and treatment of water, comprising of a combination of standardised precast concrete elements, which are designed to solve your storm and waste water management needs.



DETENTION

StormStore™ provides a cost-effective solution for site applications where stormwater needs to be detained and allowed to discharge at a controlled rate.

RETENTION

StormStore™ retention systems are ideal for applications where the goal is to retain rainwater or stormwater for some type of harvest and reuse applications.

INFILTRATION

Eliminate the issues created with discharging stormwater off-site by using a StormStore™ to infiltrate stormwater into the soil for natural treatment and to replenish local aquifiers.

HARVESTING

Water harvesting is the collection, storage, cleaning and recycling of stormwater to replace or reduce the consumption of municipal potable water.

TREATMENT

Stormwater treatment options such as pre-treatment, post-treatment and oil water separators are available as stand-alone systems, as well as integration with StormStore.

BENEFITS OF MODULAR TANK SYSTEM

MANUFACTURING BENEFITS

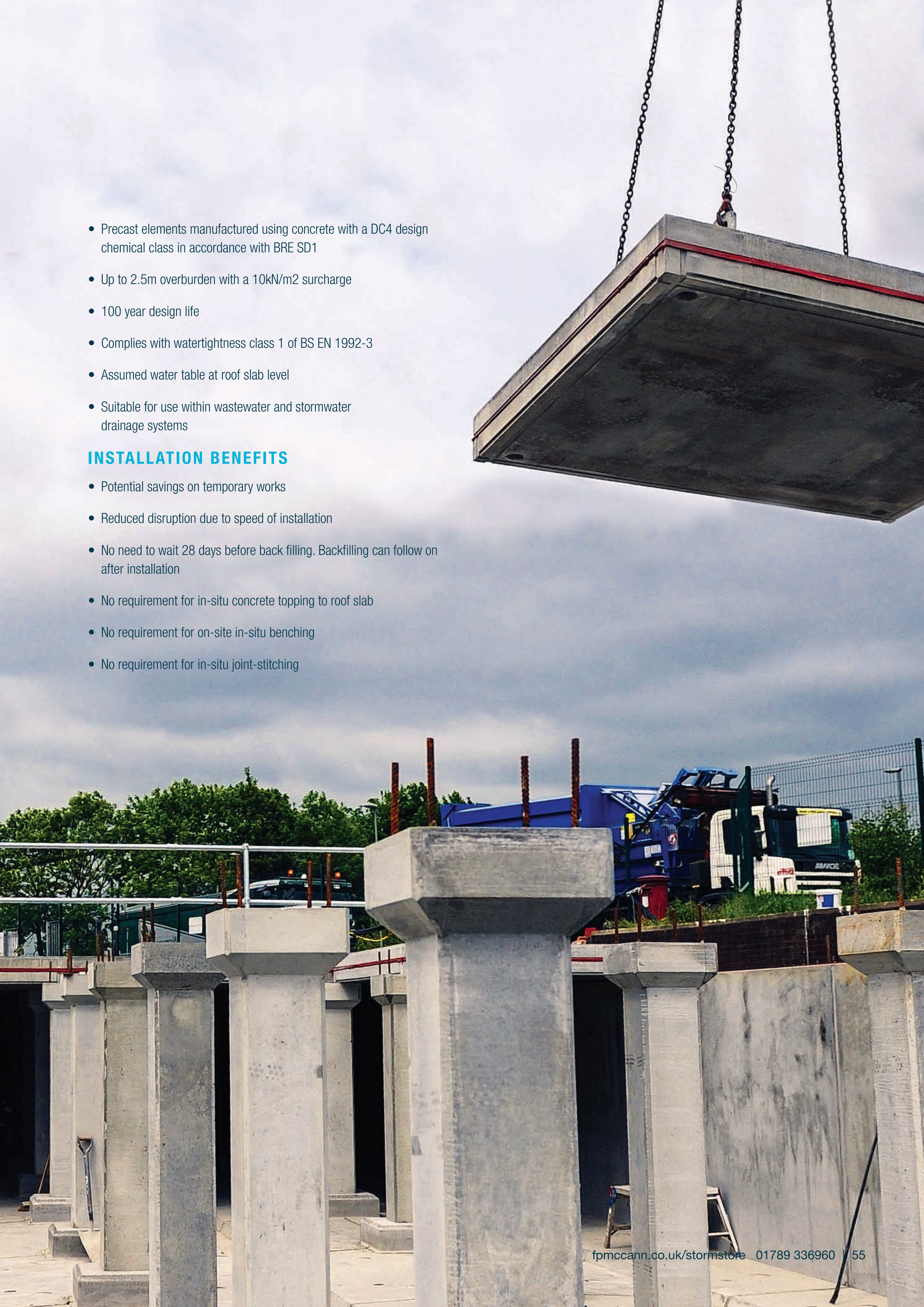
- Manufactured locally
- Bespoke inlets and outlets
- An adoptable system which can cater for the 1 in 30 and 1 in 100 year storm event
- FP McCann uses state-of-the-art tooling to manufacture products of the highest quality
- A fully modular system encompassing inherent health and safety benefits

MAINTENANCE AND CLEANING BENEFITS

- The StormStore system excels where most other systems fail, incorporating features that provide maximum system performance and life cycles. As with all stormwater systems, inspection and maintenance of the StormStore system is vital for satisfactory performance and extended life cycle of the stormwater management system
- A self-cleansing and easy maintainable system which includes silt collection areas
- Designed to create safe walking channels during the maintenance, cleaning and inspection process
- Easily inspected visually, offering reduced inspection costs
- System provides clear lines of sight to aid health and safety during maintenance and cleaning

DESIGN BENEFITS

- Complies with BS EN 1992
- Grated inlets may also be incorporated to accommodate surface stormwater flows directly into the StormStore system, reducing the requirements for conventional site drainage components. Any grated inlets may also include pre-treatment devices for pollutant removal
- Standard units reduce design cost
- No requirement for in-situ structural topping to roof slab – offering reduced fill depths and cost savings
- Fully accessible system with the option of including step rungs or ladders
- A fully modular system that brings with it inherent health and safety benefits
- The design and performance meets CESWI 7th edition
- Standard internal heights from underside of roof slab to the channel inverts of 1500, 1800, 2100 and 2400mm. All available with either 1 in 4 or 1 in 20 benching gradients
- The system fully meets CE Marking requirements
- The system and installation is approved by WRc
- Complies with Sewers for Adoption 7th edition and Sewers for Scotland 3rd Edition 2015



- Precast elements manufactured using concrete with a DC4 design chemical class in accordance with BRE SD1
- Up to 2.5m overburden with a 10kN/m2 surcharge
- 100 year design life
- Complies with watertightness class 1 of BS EN 1992-3
- Assumed water table at roof slab level
- Suitable for use within wastewater and stormwater drainage systems

INSTALLATION BENEFITS

- Potential savings on temporary works
- Reduced disruption due to speed of installation
- No need to wait 28 days before back filling. Backfilling can follow on after installation
- No requirement for in-situ concrete topping to roof slab
- No requirement for on-site in-situ benching
- No requirement for in-situ joint-stitching