haymarket

Haymarket Media

Teddington Riverside (14/0914/FUL)

Flood Risk Assessment (Addendum)

Report K0358/2

July, 2014

Prepared and submitted by

Hydro-Logic Services LLP
18-20 West End Road,
Mortimer, Reading,
Berkshire RG7 3TF

T: 01189 331 325
F: 01189 331 486

enquiries@hydro-logic.co.uk

www.hydro-logic.co.uk/HL

EXECUTIVE SUMMARY OF REPORT

Hydro-Logic Services has undertaken a Flood Risk Assessment for Haymarket Media between during 2013 and 2014 for the redevelopment of the Teddington Studios for residential use. This Report is an Addendum to the FRA, following the receipt of comments on a revised FRA, submitted in June 2014.

The purpose of the work was to clarify and respond to the specific comments of the Environment Agency, made in July 2014. The Addendum is by way of clarification of the contents of the FRA but does not result in any design changes.

This Addendum should be read in conjunction with the FRA.

Contributors for Hydro-Logic Services:

Dr Paul Webster	Director, Hydrological specialist
Iain Hissett	GIS Analyst

Contributors for the following from the Project Team are gratefully acknowledged:

Bill Soper	TP Bennett Architects
Jeff Wall	TP Bennett Architects

The contribution of staff from the Environment Agency and LBRT that have engaged with this review process is acknowledged.

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Version	Date	Author(s)	Authorisation	Status/Comment
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0. Introduction

0.1 Background

The Haymarket Group is seeking the redevelopment of the Teddington Studios to residential accommodation. A Flood Risk Assessment (FRA) is required in support of the Planning Application to the London Borough of Richmond on Thames (LBRT), reference 14/914/FUL.

Hydro-Logic Services (HLS) has been appointed to undertake the FRA on behalf of The Haymarket Group. This follows from preliminary investigations undertaken by HLS in 2011. HLS staff have worked closely with the design team throughout the project, to ensure that flood risk issues have been incorporated at all relevant stages in the design process.

This Report is an Addendum to the FRA and follows from the sequence of events shown in Table 1. The main findings and actions arising from the meeting on 2nd July are shown in Appendix A and have informed this Addendum.

It is important to note that this Addendum is by way of clarifying and illustrating the concepts and proposals that have been stated in the FRA. The meeting with the LBRT/Environment Agency and this Addendum are thus by way of elaboration; they did not prompt any need for revision of the FRA itself. By implication, this Addendum needs to read alongside the FRA, issued on 13th June 2014.

Table 1 Sequence of events relevant to FRA submission

Date	Action
Feb 2014	Submission of Planning Application, including FRA (Rev 2)
7th May 2014	Environment Agency respond on FRA to LBRT
6th June 2014	Revised FRA (Rev 3) submitted to LBRT/Environment Agency (revisions in red)
13th June 2014	Resubmission to GLA including Rev 3 of FRA (red text changed to black)
1st July 2014	Environment Agency respond on FRA to LBRT
2nd July 2014	Meeting between LBRT, Environment Agency, Architect and HLS

0.2 Structure of Report

This Report has been structured to respond to each of the main points made by the Environment Agency. These are as follows:

1. Loss of floodplain storage
2. Finished floor levels
3. Flood flow route around the end of the tidal defences
4. Flood risk of parking areas
5. Changes to tidal defence wall alignment and height
6. Loss of flows path onto the site
7. Address the opportunities presented by this development for reducing flood risk
8. Surface water flooding
9. Safe access

The original Environment Agency comments are presented in full in italics in this Addendum, with the response in standard text. References to Figures, Tables and pages and to the FRA in general are to the FRA (Rev 3), submitted in June 2014.

1. Loss of floodplain storage

The values in table 4.3 of existing flood storage have changed we would appreciate clarification as to why this is the case?

This arose following a review of the contribution made by the multi-storey car park to flood storage.

The proposed development involves an increase in built footprint within the design flood extent. Built development within the floodplain can sometimes be compensated for on a volume-for-volume and level-for-level basis; however, this process requires an available area of land on the edge of the floodplain to be viable. The submitted FRA has failed to demonstrate that adequate flood storage compensation can be provided on site.

The FRA proposes that compensation up to 6.1m is provided on a volume for volume basis; as these areas would only flood if the 6.1m defence wall is overtopped. Compensation for areas over 6.1m is to be provided on a level for level and volume for volume basis. We are satisfied with this broad approach but require further information to support the detail of the proposed compensation.

For the large compensation band up to the 6.1m AOD and the subsequent 0.1m AOD compensation bands above 6.1m, any loss of flood storage must be compensated for by the reduction in level of nearby ground, such that the same volume is available at every flood level before and after the works, and that it can freely fill and drain. It is not adequate compensation to:
a) Excavate holes in the floodplain
b) Create landlocked areas of lower ground, even if connected to the main floodplain by channels or culverts
c) Provide low level volumes to replace high level floodplain and vice-versa.

As indicated on Figure 4-18 (page 47 of the FRA), which has been reproduced below, compensatory flood plain storage is provided in two floodable voids between Buildings A and C. These are in addition to extensive landscaping within which the general level of the gardens between Buildings A, B and C is at a level of 5.6 mAOD. The void below Building A is required to be a "minimum" of 0.4 m in height. Such a restricted space is impractical for maintenance, so the height is likely to exceed 0.4 m. This would lead to a further increase in floodplain storage following the development.

The storage below 6.1 mAOD must drain, of necessity, via a flapped outlet, as shown in the Figure. The suggested gradient is 1 in 100. The storage above 6.1 mAOD is able to drain freely to the river, since it is above the level of the embankment.

Further demonstration is requires to show that at every flood level after the works floodwater can freely fill and drain, as set out above.

Figure 4-19 (page 48 of the FRA) and reproduced below demonstrates that the landscaped areas are able to drain freely, either towards the Thames or towards Broom Road. Additional drawings have been provided below to show how the floodable void under Building A is able to drain to the garden and thence to the river. That under cross-section beneath Building C is able to drain via a flapped culvert to the Thames.

Figure 4-18 Proposed levels for flood storage calculation

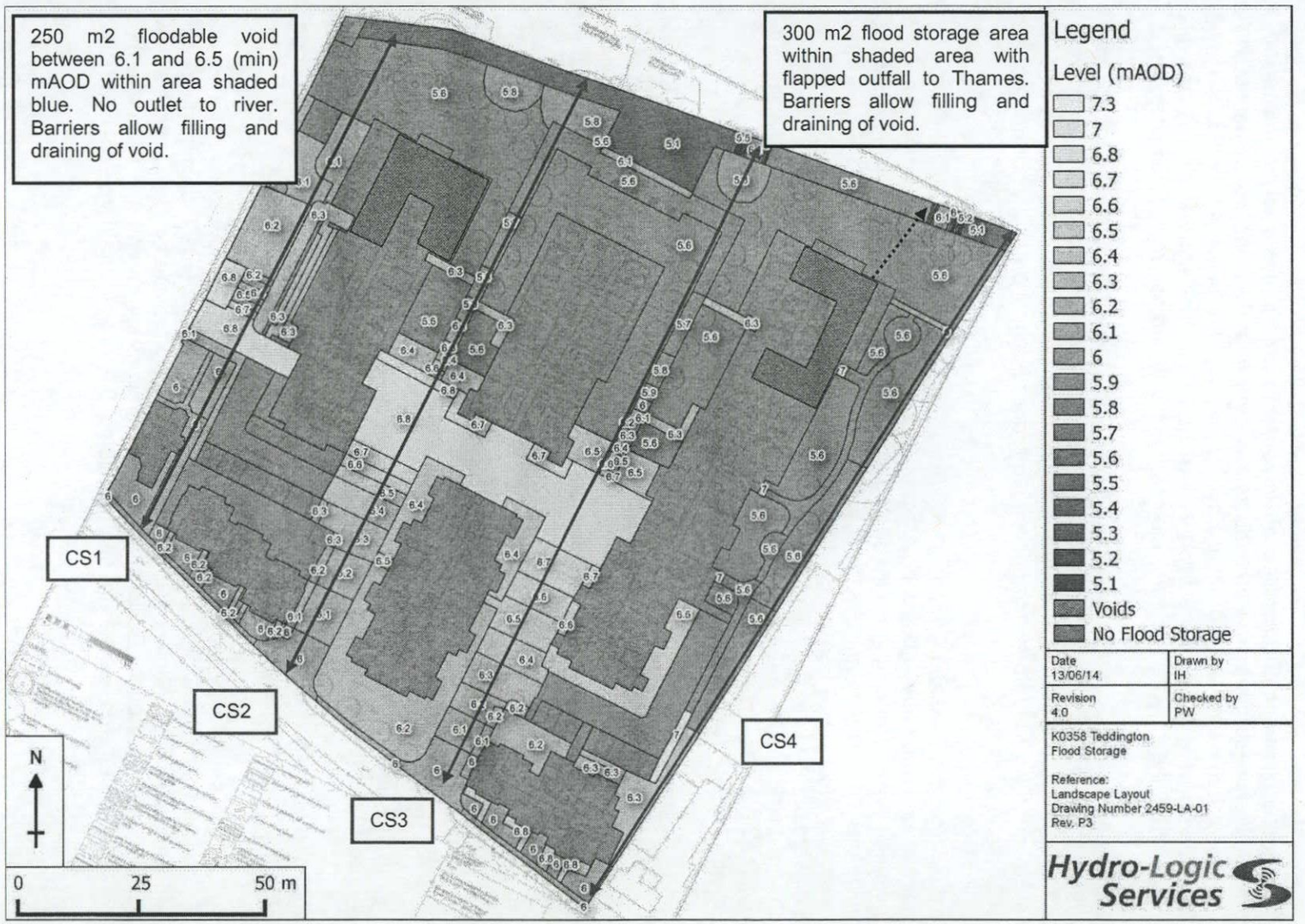
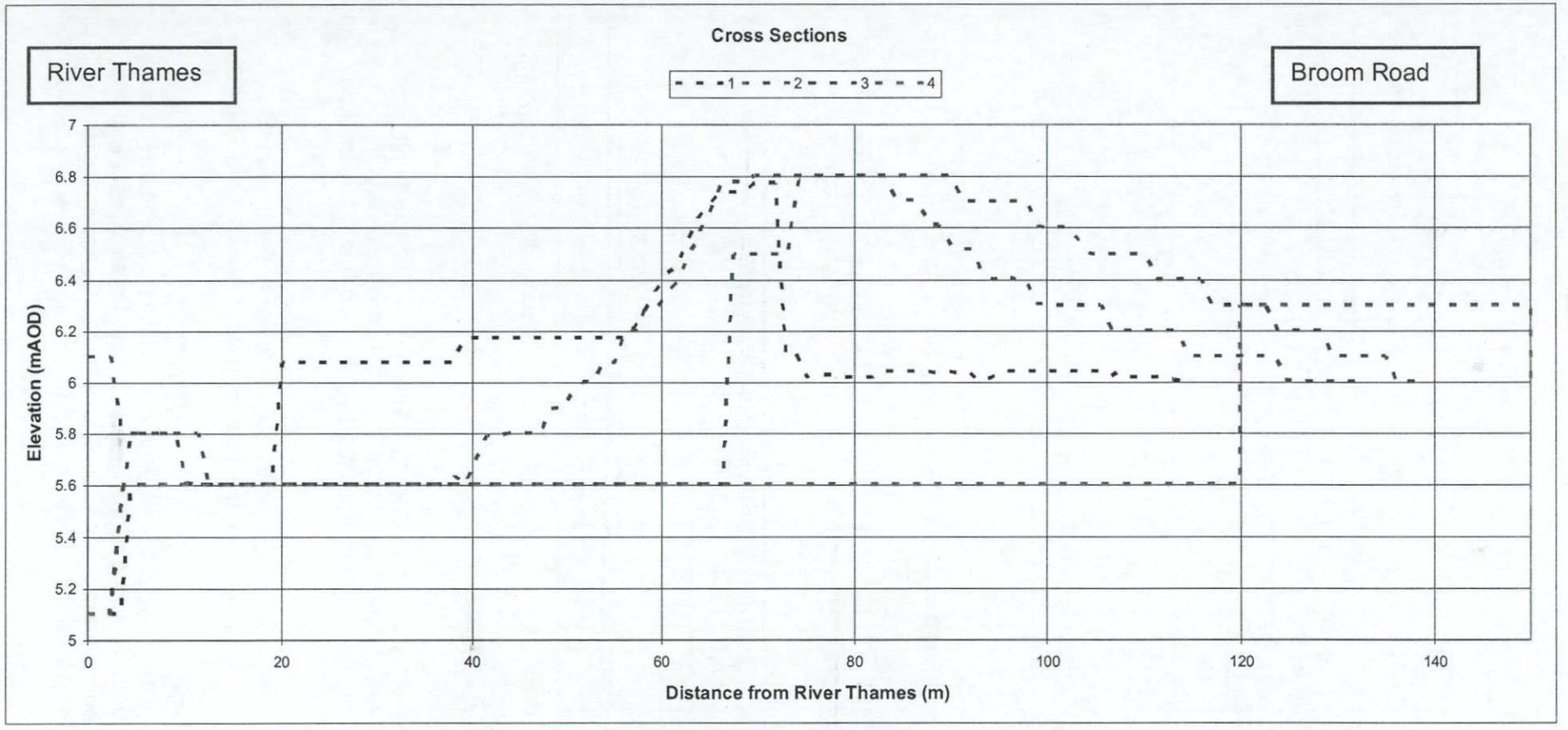
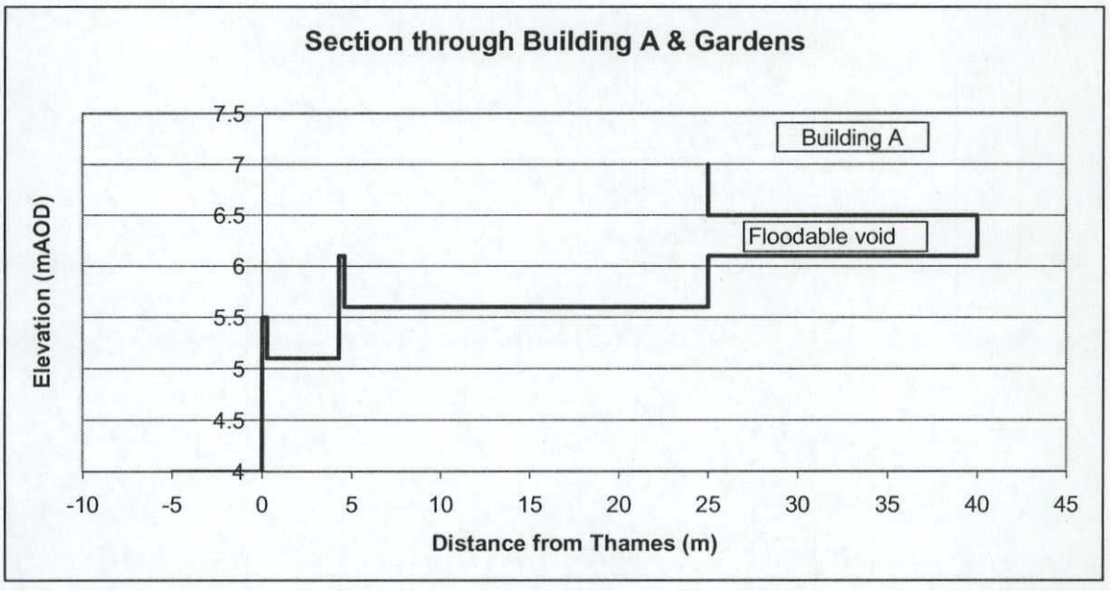
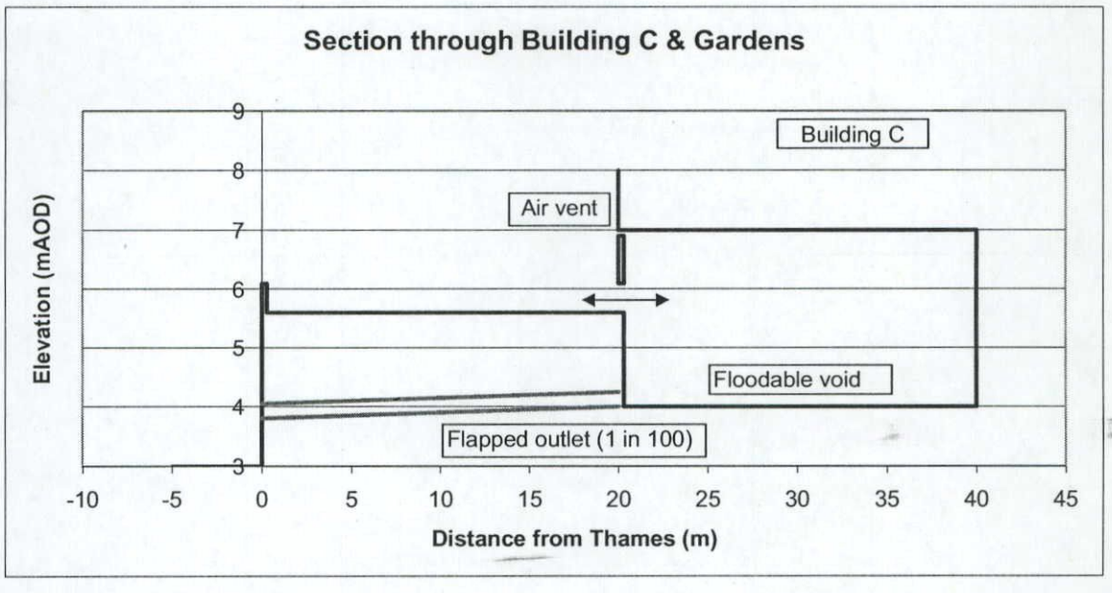


Figure 4-19 Cross sections through the site



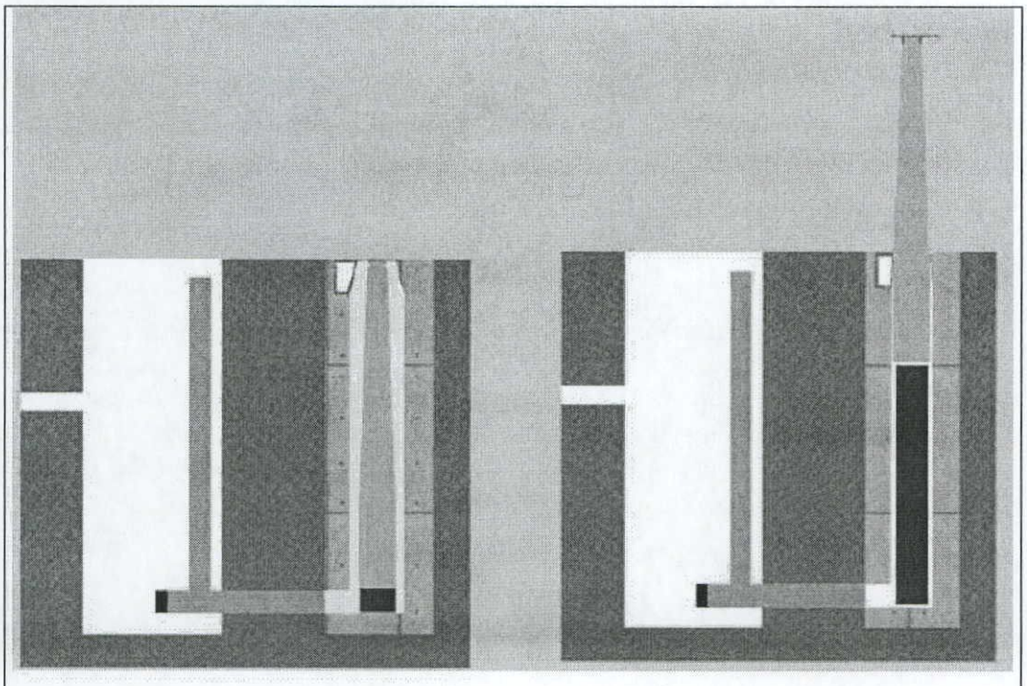




Flood water will enter the voids under Buildings A and C via openings in each void. The openings would have a width of 1 m and height of 0.5 m. Under normal conditions, the opening will be protected by a barrier; this will restrict any entry into the void.

Under flood conditions with floodwater likely to overtop the tidal defence wall at 6.1 mAOD and flow into the garden, the barriers will be lowered allowing water to flow into the voids.

The mechanism by which this is achieved is illustrated below, although in this example, the barrier is raised to provide protection. In the case of Buildings A and C, the barrier will normally be in the "raised" position, supported by an air-bag fed from a compressor. Under flood conditions, the barrier would be lowered by allowing the air bag to deflate.



Following installation and in non-flood conditions, all operational parts of the barrier are invisibly concealed in the ground inside its basin.

When there is a need for the barrier to be deployed before the water enters the vicinity, the Duty Assist Mode is activated and the barrier is deployed.

This principle has been used previously and an example, with Environment Agency and planning approval, is described in the following link:
http://www.ukfloodbarriers.co.uk/selfactivatingfloodbarriersmart.aspx

Although Figure 4-18 shows a single void under Building A and C, the detailed Basement Plans show that these voids are further sub-divided, with each sub-void having a nominal area of about 250 to 300 m^2. It is proposed that there is one "opening" for each of the floodable sub-voids. Assuming a plan area of around 250 m^2, this would provide around 400 m^3 of storage between the base of the void at 4.0 mAOD and the level of the garden at 5.6 mAOD. There is clearly additional storage above this level. The time taken for the sub-void to fill would require a detailed calculation involving the rate of overtopping and the rate of filling of the sub-void. However, a rough indication of the time taken to fill a sub-void is given in the following table. This shows the time taken for the nominal 400 m^3 storage to be filled for different constant depths of water in the garden – delivering different rates of flow into the sub-void. This shows that the time taken to fill the void (assuming a constant rate of flow) would range from 114 minutes (for 0.1 m depth) to 10 minutes (for 0.5 m depth).

For water levels above 6.1 mAOD, the rate of change of fluvial/tidal water level will be sufficiently small that the width of the opening will not be a limiting factor.

It is recognised that these openings do not conform to the target 20% of linear length sought by the Environment Agency. However, the calculations have shown that the

provision of openings of 1 m width are sufficient to allow the voids to fill in reasonable time.

Depth (m)	Flow rate (m3/s)	Time (secs)	Time (mins)
0.1	0.06	6845	114
0.2	0.17	2420	40
0.3	0.30	1317	22
0.4	0.47	856	14
0.5	0.65	612	10

Based on filling of a 400 m^3 void via a rectangular thin plate weir.

Discussion point: The proposed culvert has been moved from the west to east piazza. We would like to discuss how this culvert connects the floodplain in the north and south of site compared with the existing flow route at the gatehouse. As well as understand the potential flow route indicted in figure 4.12b.

See Section 6.

Section 4.3.2 indicates that soil embankments are proposed on the site, the revised FRA has now clarified that these are for not for flood protection.

We previously highlighted a discrepancy in the proposed use of voids:

- *section 4.3.2 stated that voids could be incorporated under block B*
- *section 4.4.3 refers to a flow route and storage under both blocks B and D*

The revised FRA no longer refers to any flood storage under either blocks B or D as contingency for further changes to the landscaping and resulting loss of flood storage.

However section 4.4.3 now refers to necessity for flood voids under blocks C and A as a result of revisions to the alignment of the defences. We require further information of the revised alignment of the flood defence and the impact this has on the need for further compensation. We would also like to discuss the use of voids and their proposed design. The use of voids, stilts or undercroft parking as mitigation for a loss in floodplain storage should be avoided as they can become blocked over time by debris or domestic effects.

As indicated in Section 4.3.2c (page 44 of FRA) and in Figure 4-18, voids are proposed under Buildings A and C; there is no compensatory flood storage or flow route under Buildings B and D. As indicated above, the additional flood storage is due to the multi-storey car park; not the realignment of the defences, details of which are provided in Section 5.

2. Finished Floor Levels (FFL)

During a flood event some of the development could flood internally causing a danger to people and property. The London Borough of Richmond's Emergency planners should consider if more vulnerable development with finished floor levels below the design flood event is acceptable.

Section 4.2.1 considers finished floor levels of the proposed development. It is proposed that blocks A, B, C, D and E7 (affordable housing) have a finished floor level above the design event. However it is proposed that dwellings elsewhere on the site are set below this level, and therefore at risk of flooding.

The proposed town houses along broom road are to be set at only 6.2m AOD, below the design flood event level. It is proposed that these dwelling include flood resistant measure however if any of these measures fail internal flooding of around 80cm would be experienced up to the design event. Finished floor levels should be set at design event; we would recommend that a further 300mm freeboard is allowed for.

In response to this comment, the architects have provided the following response within quotation marks.

"Illustrative material is provided below to show why the design proposal for town houses E1 to E6 is best served by the proposed internal ground floor level of these townhouses to be at 6.2 mAOD, rather than the 7.3 mAOD adopted for apartment buildings. There is a balance to be struck in all design and especially in this part of the design, where several competing considerations come into play. Flood considerations would be satisfactorily addressed using a level of 7.3 mAOD but this is neither practical nor balanced, nor is it the only way to provide a defence that is entirely robust. "

"In this particular location, streetscape continuity and setting, both of the local building of historic merit (Weir Cottage) and the Teddington Lock Conservation Area are also very important considerations, as too are Lifetime Homes criteria and Social Inclusion policies. Along with the aspiration to increase the width of the existing pavement by giving application site land over for adoption, these factors combine to make a particular challenge. The narrow existing street pavement frontage is at circa 6.0 mAOD and setting the houses at 7.3 would require incongruous lengths of unsightly quite bizarre ramped approaches along with 8 steps. "

"At the steepest gradients permitted under Part M 1:12, we can only rise in 2 m long ramp increments before we need to have a landing and this will only rise up 166 mm in each increment (B.Regs M Table 1) so 1300mm divided by 166mm equates to 8 such short ramps and 7 landings, before we arrive at the front door landing alongside the individual steps up to each townhouse. There is simply not the space available to achieve this even if it were visually acceptable, which it could never be. It would also lead to a loss of flood plain storage. Taking a more gentle ramp at say 1.15 this would require 20m of ramp in 4no. 5m lengths with 3 number landings before reaching the final front door landing shared with the steps; again an incongruous proposition. Once again, there is simply not the space to provide this. On the drawing below which is based on the 1:15 option we would only ever be able to provide approximately 50% of the required ramping at most and we would lose the three proposed trees intended to green the landscape and street continuity context where intermittent trees are a feature of the road."

"In terms of the issue of streetscape and setting, the bizarre extent of ramping would not only be visually inappropriate and detrimental to setting and streetscape, but in addition a 7.3 mAOD ffl would entail a circa 15% increase in bulk of the elevation as a result of the increase from 6.2 AOD to 7.3AOD. This would be at the expense of streetscape and setting criteria. "

"Set against all this, it is possible to provide waterproof walls, specify a flood proof door to BS/EU widely accepted standards and the entrances themselves could be further protected by the detail design incorporating flip up automatic barriers or demountable barriers."

Furthermore, drawings have been provided by the architect on page 13 in support of this.

The building 'Weir cottage' is currently used for commercial use; it is proposed that as part of the planning application that 'a change of use' is undertaken to residential. This would result in an increase in vulnerability in flood risk terms from Less Vulnerable to more Vulnerable as set out in table 2: Flood Risk Vulnerability Classification, Planning Practice Guidance: Flood Risk and Coastal Change.

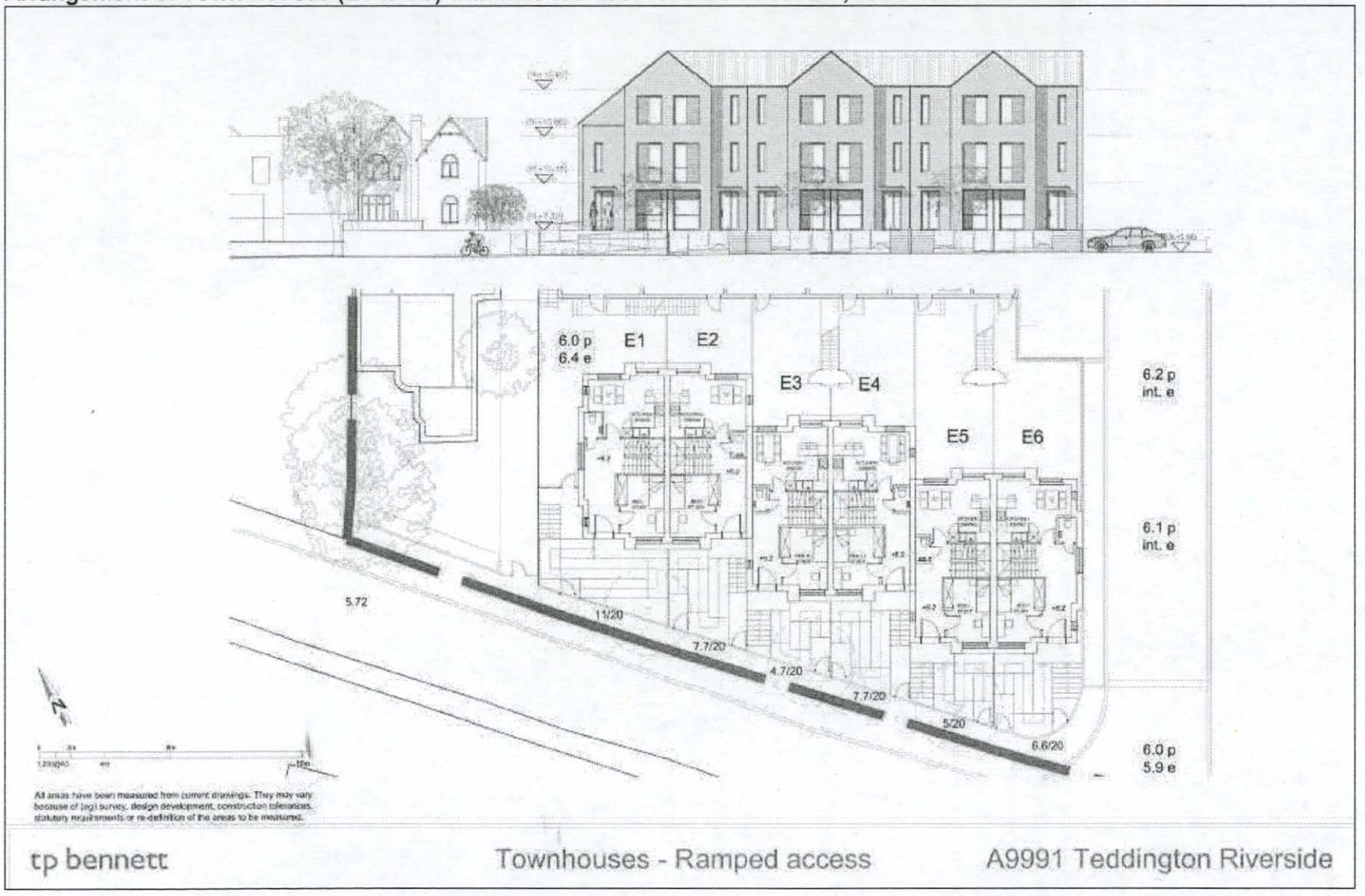
The existing floor level of the weir cottage is around 6.92, which is below the design flood event level. It is proposed that the dwelling include flood resistant measures, however if these fail the building could suffer from internal flooding and the FRA notes that due to the age of the building masonry walls may not even be watertight. The revised FRA notes that inspection is required by a suitability qualified flood surveyor, to identify possible routes of water entry and appropriate mitigation measures. If the use of resistance and resilience measures for Weir Cottage is acceptable in principle to London Borough Emergency planners, the applicant should carry out the proposed survey to inform the full planning application.

Given that the maximum predicted flood depth is only 5 cm for the 1%CC event, it is considered that the recommendations made in the FRA (Section 4.2.1, page 28) for flood resistance and resilience measures to be used in any renovation is appropriate.

In absence of approval from the London Borough Richmond emergency planners we maintain that finished floor levels should be raised in weir cottage above the design event; we would recommend a freeboard of 300mm above the design event. Alternatively the proposal for the cottage should be altered to maintain a less vulnerable use; together with flood resistant measures to reduce flood risk.

Weir Cottage has recently been in residential use, so the change of use does not apply.

Arrangement of Town Houses (E1 to E6) with finished floor level at 7.3 mAOD, rather than 6.2 mAOD



3. Flood flow route around the end of the tidal defences

The FRA indicates that the area is protected by the tidal river wall along the Thames built to a statutory level of 6.1m AOD. However a flood flow route may exist around the tidal defences before the defences are over topped.

This may have an impact on

- *the section 4.2.2 (b) 'Access for moderate floods' and support for the statement that 'it is expected that any change in depth and velocity [of flooding] along broom road would occur fairly slowly'*
- *the need for level for level or volume for volume flood compensation up to 6.1m AOD.*

The extent of the topographic survey and FRA fails to sufficiently consider the risk of a flow route around the end of tidal defence at The Lensbury (TQ1698971155) and along Broom Road. Section 4.2.2b of the revised FRA indicates that this risk is consider low because the flooding is likely to be of short duration and tidal. However flooding by this route is likely to be fluvial originating upriver of Teddington lock.

It was noted in the FRA (Section 4.2.2b, page 30) that this source of flooding was likely to be tidal flooding and thus of short duration. It is further noted that the 5% **fluvial** level is only 5.55 mAOD, based on Halcrow modelling and would not lead to outflanking.

Furthermore, Figure B-2 of the FRA (page 76) shows road levels (from LiDAR) along Broom Road which have a minimum level of around 5.8 mAOD meaning that flood depths from any outflanking would indeed by shallow.

Accordingly, there is not considered to be any risk to the site or the access route from this source of flooding.

4. Flood risk of parking areas

Flood risk of cars parked on surface car park

Section 4.2.3 of the FRA indicates that surface parking is proposed at 6.1 and that the cars would therefore be a risk of experiencing flooding of up to around 0.9m. The document 'Flooding information sheet – your questions answered' Dec 13 by the Association of British Insurers and the Environment Agency indicates that cars can float in 2ft (60cm) of floodwater. The revised FRA proposes that following flood warnings all cars on the surface car park will be relocated to the underground car park using valet parking by site staff. By repositioning the cars already located in the underground park it is suggested that from all the spaces on site (258 spaces) can be accommodated underground.

The councils emergency planners should assess how sensible and achievable this proposal is.

The Section 4.2.3 of the revised FRA (page 32) states that there is provision for all cars parked in surface car parks to be relocated in the subterranean car park. This is considered to be reasonable, in view of the fact that surface parking is for visitors, who are unlikely to be visiting at times of flooding.

Flood risk associated with subterranean car park

The entrance of the subterranean car park is to be set at 6.3m AOD, approximetly 0.7m below the design event. It is proposed that the car park is protected by a flip up 1m high barrier. These would be reliant on site management staff to erect and could fail; the subterranean car park is liable to fill rapidly and submerge cars in flood water; potentially putting people at risk. In the revised FRA the raising of the barrier is likely to be delayed as site staff will not be able to raise the barrier until all the cars on the surface have been relocated in the underground car park.

The proposal should be amended to provide passive protection to the car park, such as a bund, that is not reliant on human action.The councils emergency planners should assess how sensible and achievable the proposal to use a flip up defence is.

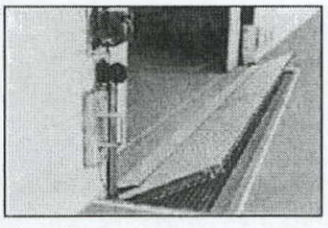
Further information on the proposed barrier made on page 32 of the FRA (Figure 4-3) is shown in the extract below, taken from the web site of Flood Control International (http://www.floodcontrolinternational.com/index.php). As indicated in the accompanying text, the gate closure can be triggered automatically, or with manual override.

The management arrangements for deployment of the barriers are presented in Section 9.

FLIP-UP BARRIERS

To provide unrestricted access to pedestrian and vehicle entrances, this self-rising flood barrier is fully recessed in to the ground when not in use.

Activated by a push button, automatically triggered by sensors, or manually, this flood barrier rises up to flood defence heights of 2m as standard and up to lengths of 12m.

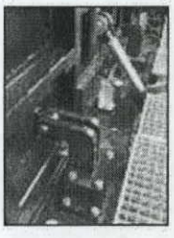


Self-rising flood barrier being deployed.

Designed to provide totally unrestricted access to pedestrian and vehicle entrances.

A range of surface finishes is available; from skid resistant epoxy coatings to timber cladding or paving to fit in with the external hard landscaping.

These flood barriers can rise automatically with the rising flood waters or by push button in advance keeping you in control for complete peace of mind. Uninterrupted Power Supply (UPS) and manual backups mean these flood barriers will not let you down.



Flip-up flood barrier steel detail.

A single flip-up flood barrier system can protect openings up to 12m wide and multiple systems can be linked with intermediate posts to create a flood defence run of almost any length. Depending on span, flood defence heights of up to 2m are available.

Movement and weight sensors prevent the barriers opening if the entrance is obstructed whilst optional audio/visual alarms sound prior to and during operation.

http://www.floodcontrolinternational.com/PRODUCTS/FLOOD-BARRIERS/flip-up.html

5. Changes to tidal defence wall alignment and height

Section 4.2.4 considers the realignment of the existing tidal defences along the river frontage. The text and figure 4.4 appear to indicate that it is proposed that the east end of the wall would be set forward of its current position – closer to the river, although we note in the revised FRA the length of wall moved forward has been reduced. This could result in a loss of flood storage and may also limit the Richmond on Thames' aspiration to provide public access across the river frontage. Further information should be provided to demonstrate the total realignment proposed will not result in a loss of flood storage.

The proposed alignment is shown in Figure 4-5 of the FRA (page 34). A further drawing has been provided below showing the existing and proposed alignments. This shows that for approximately half of its length, the alignment has not changed.

It is shown in Table 4-4 on Page 42 and Table 4-6 on Page 45 that there is no loss of floodplain storage. This is supported by the comparison of the relative areas of the riverside paths (before and after realignment) in Figure 4-5.

The provision of public access requires balancing with other constraints, including flooding. The proposed alignment does make provision for wheelchair access to the water's edge adjacent to Building C and which is considered to be a valuable attribute.

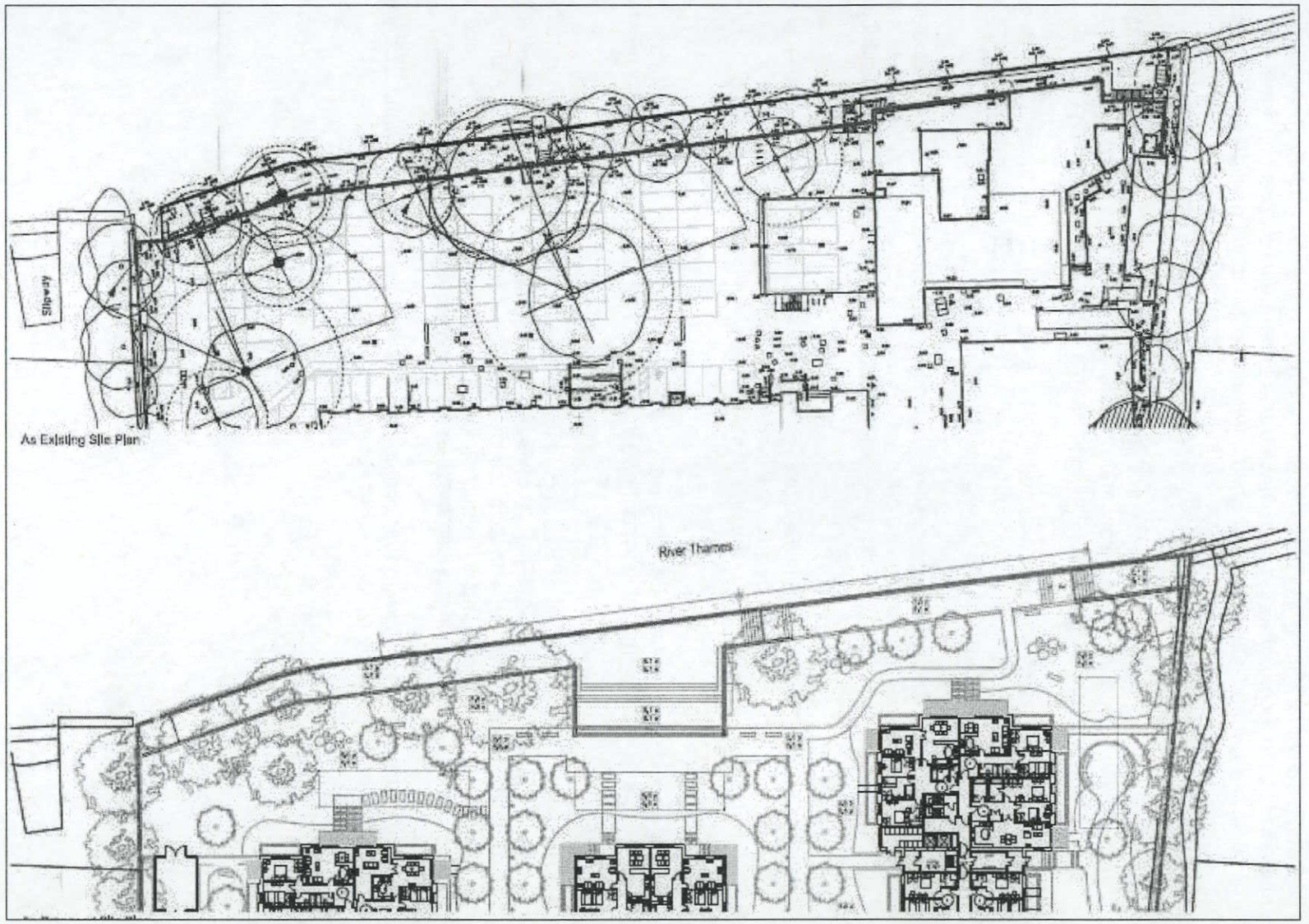
The sketch in figure 4.8 indicates how the walls could be raised by 80cm to 6.9m AOD in line with TE2100 requirement near block B. However the proposal includes the use of flood gates, we would not be supportive of the use of these gates that would be reliant on human action.

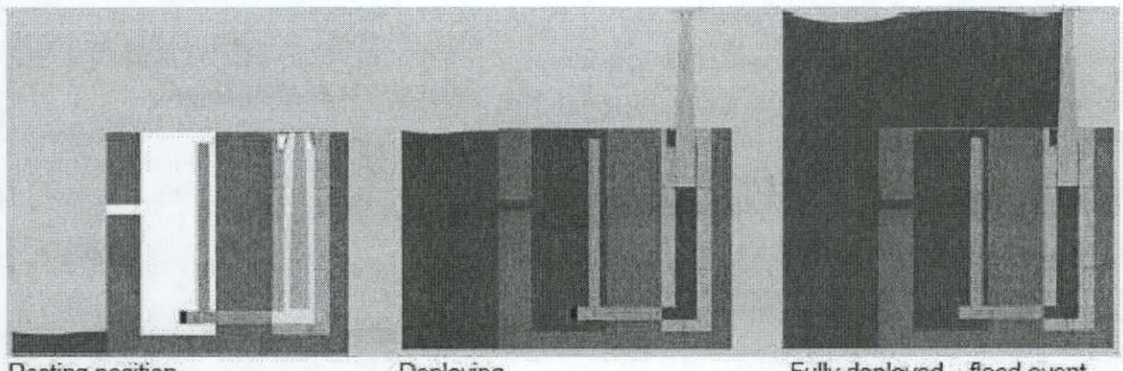
In addition, consideration should be given on impact of raised wall at the two locations it crosses the riverside path– this may impact on wheelchair and pushchair access along the proposed riverside path.

There are three sets of steps where gates are proposed in the raised defences. All feature voids beneath the steps. The voids would be suitable for installation of self activating flood barriers, as shown in the image below. Such barriers are provided by UK Flood Barriers and have been installed at Cockermouth following the recent flooding there. It is recommended that these are configured as "automatic gates".

Discussion point: *We would like to understand the revised alignment of the flood defence and the impact this has on the need for further compensation.*

See above


Sidney
As Existing Site Plan
River Thames



Resting position	Deploying	Fully deployed – flood event
Following installation and in non-flood conditions, all operational parts of the barrier are invisibly concealed in the underground basin.	When floodwater rises to within 10cm (or another predetermined level) below the pre-flood level, the basin, housing the floating wall, starts to fill up through an inlet pipe from the adjacent service pit.	The flood wall floats and rises. When the basin is totally filled, the angled support block will 'lock' the barrier into position making it watertight. The floodwater can now continue to rise without flooding the protected area.

Courtesy of UK Flood Barriers Ltd.

6. Loss of flows path onto the site

Section 4.2.4 identifies a flow route between the site and broom road at the gatehouse around 7m wide. The ground levels at this point are stated to be 6.41m AOD, indicating flood depths of up of over 0.5m for the design event. It is proposed that this flow path is maintained through a culvert. This is unlikely to sufficiently mimic to existing open flow path situation:

- *the proposed culvert and grills are liable to blockages compared to the existing situation*
- *the proposed culvert has a far smaller cross sectional area compared with the existing open flood route*

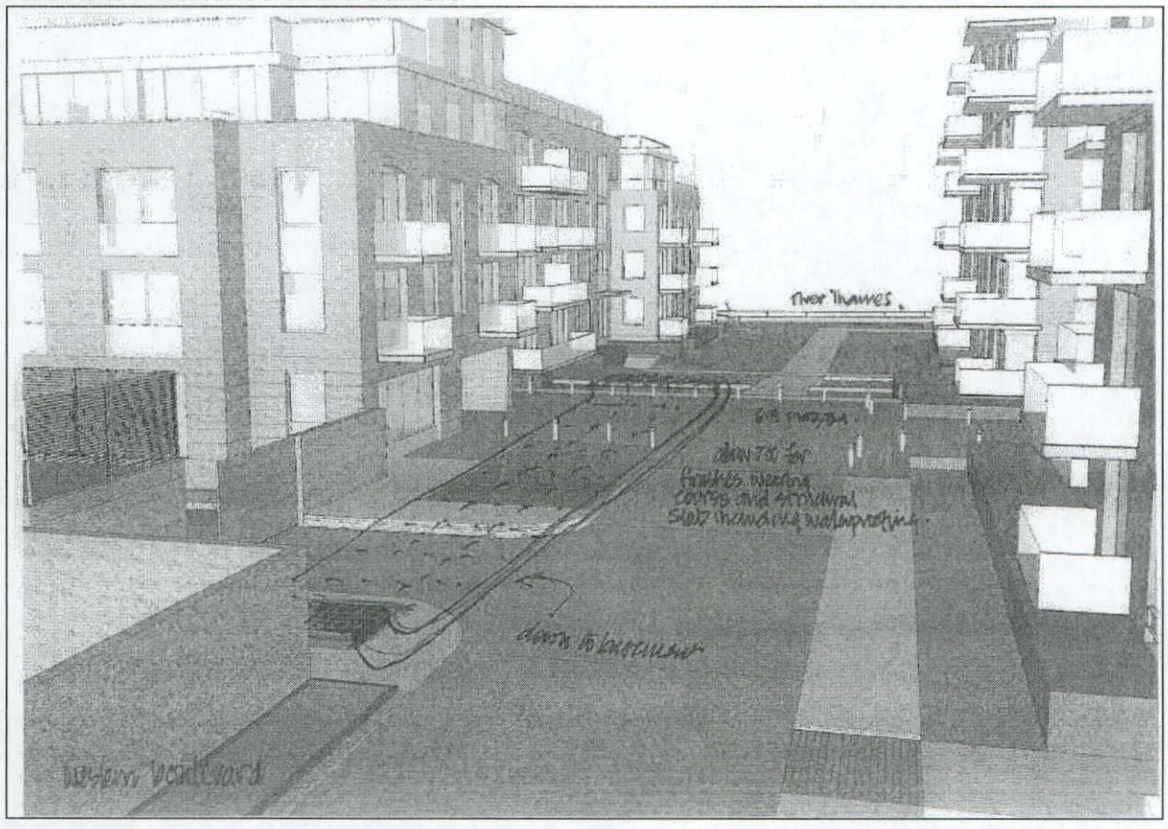
The proposed flow route should be amended to remove the culvert and maintain an open channel, so the flow route is not restricted potentially increasing flood risk.

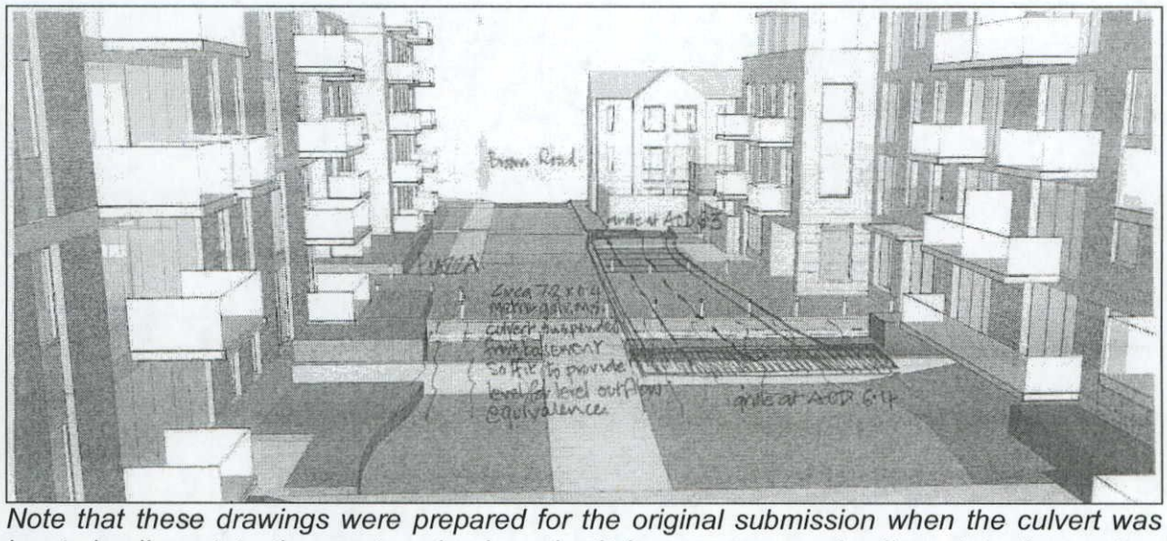
The proposed culvert has been moved from the west to east piazza. We would like to discuss how this culvert connects the floodplain in the north and south of site compared with the existing flow route at the gatehouse.

In Section 4.3.1 (page 36 of the FRA), we outline the case for the proposed culvert, which is illustrated below. Note that the hand annotated sketches were prepared for the original planning submission and show the culvert on the western boulevard. It has been relocated to the eastern boulevard and is illustrated more formally in the landscape drawing, in which the culvert is shaded in orange. It should be noted that the existing flow path at the Gatehouse does not behave like an open channel as the gate mechanisms will restrict flow to some extent.

The more important point, as stated in the FRA, is that the flow through the existing flow route and through the proposed culvert will be dictated by relatively small differences in relative level. The hydraulics of the respective flow paths are unlikely to be limiting factors for the flow through on either path.

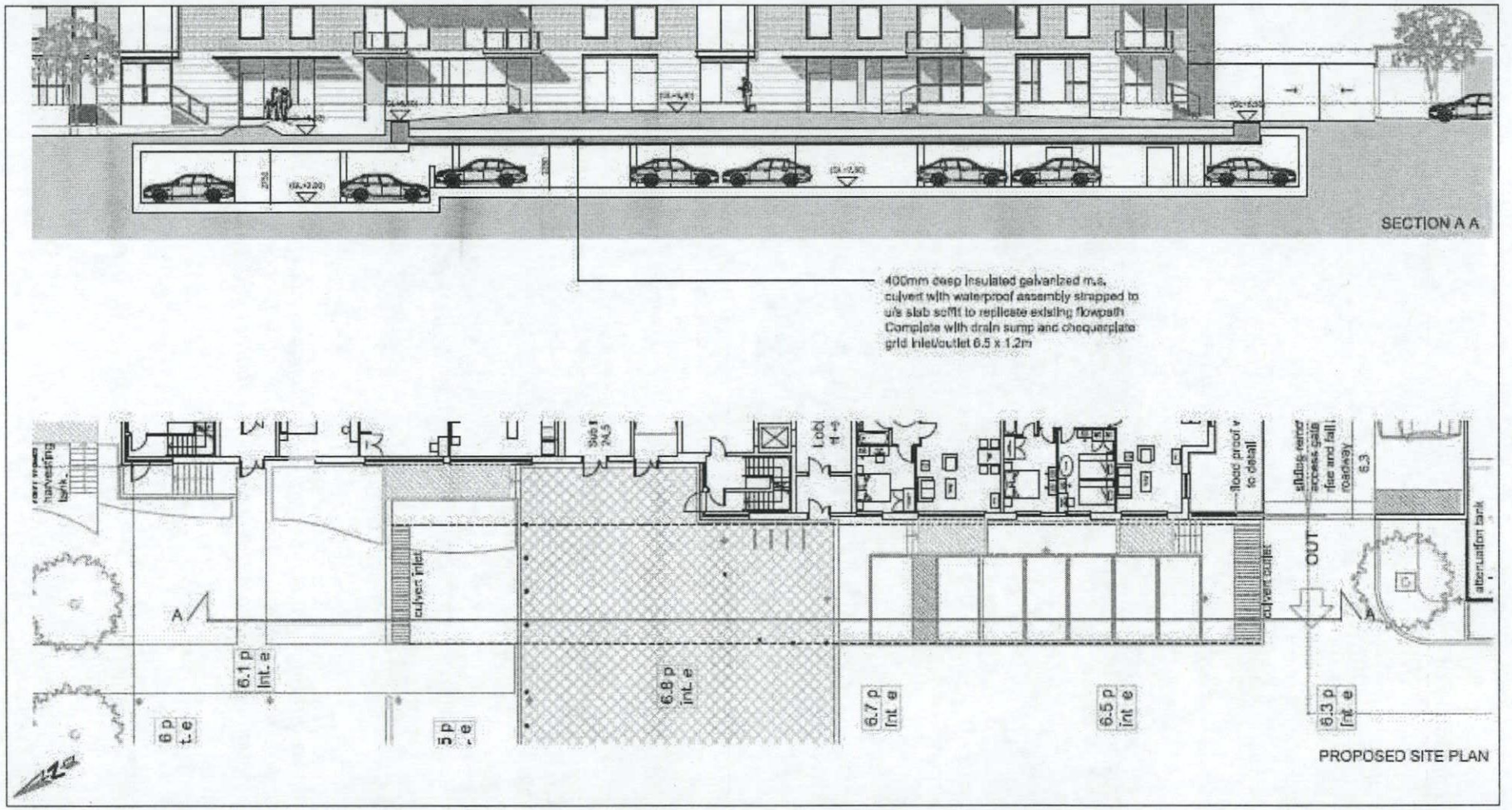
Annotated sketches of the culvert





Note that these drawings were prepared for the original submission when the culvert was located adjacent to the western boulevard. It is now proposed adjacent to the eastern boulevard, though the broad principles remain as shown in the drawings.

Section through culvert



7. Surface Water Flooding

The applicant must demonstrate through their surface water strategy that the proposed development will not create an increased risk of flooding from surface water.

The proposed drainage strategy is shown in Figure 4-22 of the FRA, which has been reproduced below for convenience.

Soakage tests
We are supportive of infiltration but a soakage tests should be carried out in support of the soakaways design shown in figure 4.15, for an application seeking full permission such as this one. Infiltration rates should be worked out in accordance with BRE 365. The revised FRA indicates that the tests cannot be carried out currently. Once the tests have been carried out we would be supportive, as outlined in the FRA, of the drainage design being amended to maximise the use of soakaways.

As indicated in Section 4.3.3e (Page 58 of FRA), it is not possible to undertake soakage tests given the current site usage. We have therefore used a conservative value for infiltration coefficient (0.05 m/hr or 1.39 x 10^{-5} m/s). Furthermore, we have shown that in the even that soakaways are not viable, the attenuation tank under Building B can be increased in size to attenuate all of the runoff that is proposed to drain to the three soakaways. This is regarded as a flexible and robust strategy, that can be refined following the relevant Site Investigations.

Surface water discharge hierarchy
The surface water strategy should be carried out in accordance with the National Planning Policy Framework and Planning Practice Guidance, giving preference to infiltration over discharge to a watercourse, which in turn is preferable to discharge to surface water sewer. Section 4.3.3c indicates runoff from the affordable housing will discharge to the Thames water sewer system; the least sustainable option in this location in the London Drainage hierarchy. It is unclear why discharge to the Thames water sewer system is proposed.

The existing arrangements for surface water disposal are described in Section 3; namely the sewer map obtained from Thames Water on Figure 3-6 on page 16 of the FRA and photographs in Figure 3-12 on page 22 showing the line of surface drainage into that sewer. Accordingly, a significant part of the site (possibly 1/3 to ½ already discharges, without attenuation, to the Thames Water sewer.

The drainage strategy presented in Section 4.3.3 of the FRA makes provision for the outfall from a small attenuation tank to discharge to the Thames Water sewer. Not only does this represent a substantial **reduction in area** draining to the Thames Water sewer, it is also **attenuated** in the proposed stormwater tank adjacent to the Affordable Housing.

Surface water attenuation
Surface water for up to the 1 in 100 chance in any year storm event, including an allowance for climate change, must be safely contained on site. It is acceptable to partially flood the site during this event, ensuring that buildings are not affected by flooding and the site can be safely navigated by users. Where this flooding will be within roads or pathways, the applicants must ensure that safe access and egress is still available.

The stormwater design for soakaways and stormwater tanks presented in Appendix G, has used the 1% (1 in 100 year) storm with a 30% allowance for climate change. No

additional flooding is thus expected up to this level. The residual risks are in any case considered to be small given that the site has considerable flood storage within the gardens, which may be partially flooded in the event of design exceedance. The design is thus considered to be robust.

We are supportive of the use of rainwater harvesting, and are therefore disappointed that this element has been removed. The applicant should provide to the planning authority detailed calculations of the full surface water network together with a drawing indicating attenuation volumes and pipe numbers; to show the surface water system has been designed to ensure:

- *No flooding for the 100 year climate event in the entire surfacewater system or*
- *No flooding for the 30 year event in the entire surfacewater system and that all surfacewater flooding can be safely contained on site for the 100 year plus climate change event.*

Rainwater harvesting and green roofs still form part of the proposed strategy. However, it has been assumed, for reasons of conservatism, that they do not make any contribution to the drainage calculations.

As discussed during the 3rd July meeting, we believe that further design of the drainage network is best done following Site Investigations that can inform both the soakaways and the contribution of the existing attenuation tank in the north-west corner of the site. We would recommend that such work would be amenable to a Planning Condition. The calculations presented in the FRA confirm that there will be no flooding for the 1 in 100 year event with climate change.

Surface water run-off should be controlled as near to its source as possible through a sustainable drainage approach to surface water management (SuDS). SuDS are an approach to managing surface water run-off which seeks to mimic natural drainage systems and retain water on or near the site as opposed to traditional drainage approaches which involve piping water off site as quickly as possible. SuDS involve a range of techniques including soakaways, infiltration trenches, permeable pavements, grassed swales, ponds and wetlands. SuDS offer significant advantages over conventional piped drainage systems in reducing flood risk by attenuating the rate and quantity of surface water run-off from a site, promoting groundwater recharge, and improving water quality and amenity.

The variety of SuDS techniques available means that virtually any development should be able to include a scheme based around these principles.
Further information on SuDS can be found in:

- *Planning Practice Guidance*
- *CIRIA C522 document Sustainable Drainage Systems – design manual for England and Wales*
- *CIRIA C697 document SuDS manual.*

These have informed the drainage design process.

Consider the impact of tidal locking on surface water discharge
During high tides / flood events in the water level in the Thames may be above the level of the outfall from the surface water system. This may prevent surface water being discharged from the site and attenuation features from being emptied potentially causing flooding on site.

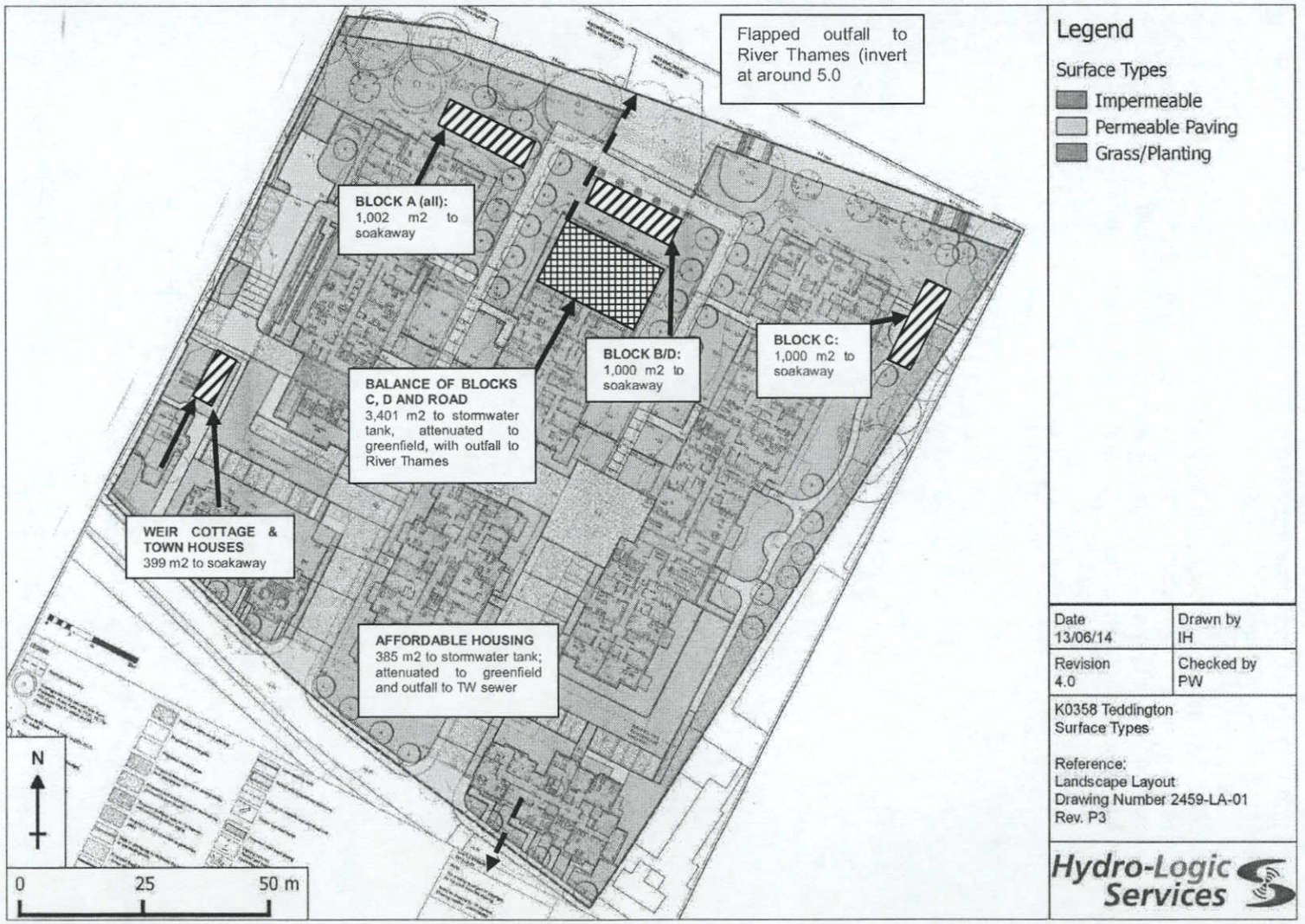
The revised FRA indicates that tidal locking may be a problem and that a larger tank may be required. Investigation should be undertaken to understand the impact of tidal locking.

Although the outfall from the stormwater tank may be below the Thames level, the base of the stormwater tank is at the local ground level - a minimum of 5.6 mAOD. It could possibly be higher as the proposed depth for the tank is 1 m, meaning that there is some contingency between the top of the tank and the slab base. However, with a minimum level of 5.6 mAOD, the driving head for the flapped outlet from the stormwater tank will be in excess of 5.6 mAOD.

The greatest potential problem for tidelocking is from high fluvial levels, since they will generally be of long duration. The 5% AEP level from the Product 4 data is 5.5 mAOD (Node 2.01) which is **below** the base of the stormwater tank. It is thus not considered that high fluvial levels pose any problem for tidelocking.

Tidelocking may also occur with high tidal levels. However, the duration of high levels is relatively short on account of the tidal cycle. The critical storm duration for the main stormwater tank is 4 hours which will lead to sustained outflows for a duration of 6 to 8 hours. It is thus not considered that high tidal levels pose any problems for tidelocking.

Figure 4-22 Drainage Strategy



8. Address the opportunities presented by this development for reducing flood risk

We are pleased the revised FRA highlights wider opportunities for reducing flood risk to the wider community. Specifically, these include:

- *Provision of emergency car parking;*
- *Allowing neighbours to use the proposed emergency access*
- *Allowing use of any emergency transport along Broom Road;*
- *Use of the site as a refuge*
- *Provision of access/egress route for the Lensbury Hotel*

We would also point out that the proposed development will lead to a reduction in surface water runoff from the site and will increase the provision of flood storage.

9. Safe Access

The proposed development involves more vulnerable development and requires a safe means of access and/or egress in the event of flooding. At the moment the applicant has not demonstrated that safe access and egress is available.

If you consider the FRA to contain sufficient information for a flood emergency plan or if an emergency flood plan is submitted, you and your emergency planners should be satisfied with it and find it adequate for the purposes of the local authority flood plan (for example, possible rescue of inhabitants during a flood, temporary accommodation whilst flood waters subside and properties are inhabitable).

Blocks A, B and C
Finished floor levels in blocks A, B and C are to be set at 7.3m AOD. Each block has a number of lobby entrances, set at around 6m AOD, incorporating stairwells and lifts to be used on an daily basis. During a flood these lobby areas are liable to flood to around 1m for the design event. It is proposed that the stairwells are protected by demountable flood barriers. These would be reliant on site management staff to erect and could fail. If residents evacuated through these lobby areas they would exit at ground level in the garden at around 5.6m AOD; indicating flooding of around 1.4m AOD for the design event in crossing the garden area. This means that the access route is dangerous for most people, according to Defra/EA Technical Report FD2320: Flood Risk Assessment Guidance for New Development. The revised FRA makes it clear that during a flood event these lobby entrances do not form part of the emergency access/egress route.

During a flood event each block has a single exit route achieving 7.3m AOD throughout onto the piazza (internal path); above the design event.

> The flush entrance levels at 6.0 mAOD are provided for compliance with Lifetime Homes criteria as explained in the architectural DAS. They will not be subject to flooding as they will be protected by either demountable barriers, or by automated flip-up barriers, similar to those proposed for the subterranean car park. These entrances would therefore be decommissioned during any flood event with the "safe" access route being via the "piazza" at 6.8 mAOD. This is confirmed very clearly on p 33 of DAS that states that in the event of a flood alert, all apartments are accessible in an emergency off the "piazza". Whilst the "flush" entrances are sealed off, daily life can continue with access/egress off piazza.

Internal paths
Section 4.2.2 indicates that internal paths at the site will be at a minimum of 6.8m AOD; therefore sections of the path may be below the design event and flood up to a depth of around 17cm. This means for velocity over 1m/s that the access route would be considered dangerous for some people, according to Defra/EA Technical Report FD2320: Flood Risk Assessment Guidance for New Development.

> As stated on Page 29 of the Revised FRA (Section 4.2.2), such velocities are most unlikely on the access route, in view of the shallow depth of flooding, the protected nature of the piazza and the very gradual changes in water level over time at these elevations. Drainage design would minimise any inspection covers in the elevated section of the piazza.

Deployment of the temporary bridge from site to Teddington lock.
These would be reliant on "on-call contractors" to erect and could fail; further clarification should be provided

- *how it will be ensured that "on-call contractors" can get to site at any time.*
- *how Flood Access Vehicle (FAV) will be moved into place*
- *how the Flood Access Vehicle (FAV) will be maintained for the design life of the development – section 106 agreement*
- *how access across the Anglers Public House garden between the site and Teddington lock will be maintained in perpetuity and kept clear of trees etc.*

An outline Management Plan is being issued simultaneously with this Addendum to the FRA, outlining the comprehensive range of undertakings that the management company would provide. This covers both the routine activities and those during emergency situations (such as when a flood alert is in place) when the management suite would be staffed 24/7.

The "on-call contracting" support, which may be an integral part of the management company, will have ample time to arrive at site in the lead up to any emergency due to the long lead times for flooding at this location.

The FAV would be developed with specialists and would not be reliant on being hauled into position. It would have its own diesel/petrol driven engine with a cabin integral to the FAV, at an elevated level above any flood water.

The perpetuity of the arrangement would be provided through legally binding agreement – we believe that such detail can be satisfactorily discharged by a suitable condition attached to any consent that members may be minded to grant.

The FAV would be periodically serviced and maintained in a high state of readiness – which can be guaranteed by legal undertaking, and fully detailed in agreement with officers under discharge of planning condition as referred to above.

Blocks E
The finished floor level of this block is 6.2m AOD indicating flooding of around 0.8m. Section 4.2.2 has been revised to indicate that access from this block will be a 'short walk' of up to 10m through gardens and 'shallow flooding' to an internal paths set at 6.8m AOD, which as previously stated could be flooded. It is proposed that the flooding will be mitigated by the installation of two sump-pump systems in this part of the site. The pumps will be actuated on an automated basis when water levels in the sumps exceed a threshold level. However the FRA fails to specify further details of the pumps or the expected depth with or without pumps operating.

The rear gardens are totally enclosed and so the expectation is that there will be no floodwater in the gardens. The sump pumps are proposed as a precautionary measure in the event that flood water is able to enter this protected area by subsurface flow routes. The specification of the sump pumps will be informed by the Site Investigation that will provide an indication of the sub-surface soil properties. It is suggested that this level of detail can be conditioned.

Block F: Cottage
Section 4.2.2 states that access from the cottage will be via a dedicated walkway leading to the internal paths set at 6.8m AOD, which as previously stated could be flooded. However the FRA fails to indicate the level and expected flooding of the dedicated cottage walkway.

The walkway descends from the floor level of Cottage at 6.92 mAOD to the default level of the access route of 6.8 mAOD.

Council planning department / emergency planning

We wish to draw to the council emergency planners the following comments on appendix B: Flood Emergency Plan.

- *The FRA provides no detail of when the 'site staff' will based on site. Chapter 4 of the environmental statement indicates that staff will not be on site 24 hour, except during an emergency.*

  Under normal conditions, the management suite would be staffed during normal office hours. However, during a flood emergency, the Management suite shown in Drawing D0003 at the southern end of Building A, would be staffed on a 24/7 basis. The Management suite has an area of c50 m^2, and would, in such emergency have access to adjacent health club. Sleeping and welfare facilities would be arranged in the event that 24/7 occupation was required.

- *The FRA provides no detail of how it will be ensured that "on-call contractors" can get to site at any time to deploy the telescopic bridge.*

  It is indicated above that "on-call contractors" may be an integral part of the management company and would have sufficient lead time to arrive on site and make the necessary deployments in advance of any major flooding – this due to the predictability of flooding at this location.

- *Suitability of Flood Access Vehicle (FAV) or a "Burg Buggy", inspired by the Burg Island courtesy vehicle that crosses the underwater causeway at high tide to connect the island with the mainland. The design and access statement appears to indicate that both these technologies are unproven for flood evacuation.*

  The technology is not unproven. The "Burg Buggy" is essentially a heavy duty vehicle with sufficient weight and freeboard to allow it to traverse deep water. For the telescopic bridge, the Architect advises that it has been used previously and refers to the example cited in the DAS of moving the Rolling Stones to a stage at a major outdoor venue.

- *It is proposed that following flood warnings the cars on the surface car park need to be relocated to the underground car park using valet parking by site staff. Cars remaining in the car park are likely to float. The councils emergency planners should assess how sensible and achievable this proposal is.*

  It has already been indicated in Section 4 that there will be no cars in the surface car parks during flood events.

- *Following flood warnings flip up barriers are proposed to protect the subterranean car park. In the revised FRA the raising of the barrier is likely to be delayed as site staff will not be able to raise the barrier until all the cars on the surface have been relocated in the underground car park.*

  This risk is considered small given the long lead times and the fact that the surface car parks are for visitors only who are not likely to be visiting at times of impending flooding.

- *The FRA fails to sufficiently consider the potential for a flood flow route around the end of the tidal defences*

  See response in Section 3.

- *The elevation of the telescopic bridge has been amended to 8m in the emergency plan (table B4) however the design and access statement indicates only 6.8m AOD*

  This refinement follows the setting of the safe access route at 8.0 mAOD along the western margin. This detail is to facilitate parking of cars, under normal conditions, underneath the elevated walkway.

- *The report refers to telescopic bridge and drawbridge – unclear if these are the same*

  These terms are not the same. The "drawbridge" refers to the connection between the end of the telescopic bridge and the Teddington Lock footbridge.

10. Flood level defence level and data

Table 3.3 in the FRA indicates major Thames floods; the Thames has recently expended high flows during the winter 2013 floods of peak around 505 cumec. Whilst this is lower than some of the other peaks flows in the table the duration of high flows continued over a number of months during the winter, resulting in the barrier being closed around 50 times. Further information all previous closures of the Thames Barrier can be found in 'Thames Barrier project pack' please see
https://www.gov.uk/government/publications/the-thames-barrier/how-the-thames-barrier-works

Advice to LPA/applicant
In addition to planning permission, under the terms of the Water Resources Act 1991, and the Thames Region Land Drainage Byelaws, 1981, the prior written consent from us is required for proposed works or structures, in, under, over or within 16 metres of the landward side of the tidal flood defences.
Walls and fences can have a significant impact on flood water flow and to some extent flood water storage, especially if they are constructed across a flood flow route. This can lead to higher flood water levels on the upstream side potentially increasing the flood risk to nearby areas. Therefore walls and fences should be permeable to flood water.

The least disruptive is a post and rail fence but this does not provide privacy. If privacy is required, hit and miss fencing (vertical slats fixed alternately on each side of horizontal posts), or hedging are preferred. If a solid wall is proposed there must be openings to the design flood water level to allow uninterrupted flood flow. The openings should be at least 1 metre wide by the depth of flooding, and there should be one opening in every 5-metre run of wall on all sides.

The design of fences adjacent to Buildings A and C has been informed by the need to ensure that they are permeable to flood water

Appendix A Notes of meeting between LBRT and Environment Agency held on 2nd July 2014

Attending:

For LBRT: Andrea Kitzberger (AK), Antonia Liu (AL), Kevin Hornett (KH), Bryan Staff (BSt)
For EA: Joe Martyn (JM), Chris Thilthorpe (CT)
For TPB: Bill Soper (BS); Jeff Wall, (JW)
For Hydro-Logic Services: Paul Webster (PW)

0 BACKGROUND

- This meeting was to review comments by the EA, dated 1st July in response to the revised FRA was submitted on 6th June 2014 for Teddington Riverside and in particular to elaborate and expand on any necessary matters.
- The key purpose as such was to identify what additional clarification was needed to enable the EA to fully understand and hopefully thereby remove their current objections to the proposal and to provide this initially in this round table forum
- This is not a detailed minute of the discussions however, but provides a summary of key outcomes, with actions shown in bold text.
- Satisfactory completion of these actions should enable the EA to remove their present objections
- The paragraph numbers cross reference to those in the EA response.

1 LOSS OF FLOODPLAIN STORAGE

- PW clarified proposed voids beneath buildings A and C were for supplementary flood storage
- The additional storage requirement, compared to the Feb 2014 FRA related to the way the existing multi-storey car park had been evaluated – it did not relate to any of the minor refinements to the scheme design and layout arising as a result of the applicant's meeting with the GLA..
- CT indicated that, although voids were not the preferred way to provide flood compensatory storage, they were acceptable if all other landscaping options had been considered, which was considered to be the case here.

Critical actions:

- **PW to provide additional detail on the voids and on the means by which water entered and exited the voids. Note that the proportion of voids to length of wall should be 20%.**
- **JW providing updated Basement Plan as part of the current refinements being incorporated into the proposal. Separate cross-sections would be provided for information only to illustrate the levels shown on the drawings**

2 FINISHED FLOOR LEVELS (FFL)

- The EA response was by way of alerting the LBRT to the fact that the proposed FFL was below the 1%CC design flood for the Weir Cottage and the Town Houses (E1 to E6)
- For Weir Cottage, it was noted that the maximum flood depth for the design flood was only 5 cm and that this could be mitigated by appropriate flood resistance and resilience measures, as already stated in the revised FRA.

- For the Town Houses, the proposed FFL of 6.2 mAOD reflects architectural townscape and access considerations.
- It is considered that flood risk to these properties can be mitigated by appropriate construction, including tanking of walls, flood proof doors, non-return valves etc.
- The key issue is the balancing of flood risk and townscape setting considerations along with LT Homes and wheelchair access issues

Critical actions:

- **JW to provide short written statement including informal drawings to LBRT comparing alternative FFL for the Town Houses, for setting out the case to Members why the Town Houses do not meet the normal FFL requirements This to include elevations of the relevant block (and in part, relation to the adjacent buildings) and where those issues of inclusive access, Lifetime Homes etc can be met and what the design implications of this would be, i.e. cluttered ramp access etc.**
- **PW to stress that residents of Town Houses must sign up for the EA flood warning service**

3 FLOW ROUTE AROUND THE END OF THE TIDAL DEFENCES

- CT explained the possible outflanking of the existing tidal defences which terminate at the Lensbury Hotel.
- PW reiterated that this source of flooding was likely to be tidal flooding and thus of short duration. He advised that the 5% fluvial level was only 5.55 mAOD, based on Halcrow modelling.
- Further, Figure B-2 of the FRA shows road levels (from LiDAR) along Broom Road which have a minimum level of around 5.8 mAOD meaning that flood depths would indeed by shallow.

Critical actions:

- **CT to further check on this source of flood risk and confirm if risk to site and access is indeed acceptable**

4 FLOOD RISK OF PARKING AREAS

- The EA concern related to cars parked in the surface car park and protection of the subterranean car park.
- For surface parking, BS indicated that these spaces were for visitors only and highly unlikely to be in use at times of flooding.
- For subterranean parking, PW outlined the proposed "flip-up" barriers – that could be deployed manually or automatically based on water levels. In view of the infrequent operation, it was suggested that they should be manually deployed.
- JW suggested that this could form part of a condition to any consent members might be minded to grant

Critical actions:

- **JW/PW to provide a management framework for information setting out objectives with details to be confirmed by condition.**
- **PW to provide further clarification of barriers.**

5 TIDAL DEFENCE WALL

- PW clarified the proposed alignment and the basis for the deviation from the exiting alignment. This was driven mainly by the requirement to satisfy a 16m standoff for any building (Building C) from the defences
- At the September 2013 meeting, it had been considered that the realignment of the defence was the most expedient way to accommodate the proximity of Building C to the river.
- BS advised that the current proposal provided disabled access to the riverside adjacent to Building C
- CT also raised concerns about the use of demountable gates as part of the TE2100 raised defences
- PW indicated that there was a void under the stepped piazza that would be suitable for installation of an automated gate.

Critical actions:

- **PW to prepare a drawing to show the existing and proposed alignments showing the potential raising of the flood defences in the future**
- **JM to discuss alignment options with the EA colleague to review EA position and if there was any more favourable alternative**

6 LOSS OF FLOW PATHS ONTO SITE

- CT sought clarity on the proposed culvert

Critical Actions

- **PW to provide a drawing, including cross-sections to help illustrate the proposed arrangement**

7 SURFACE WATER FLOODING

- PW outlined the flexible "hybrid" approach based on infiltration and attenuation.
- Noted that infiltration rates were not available and testing would not be viable given current usage of site. It would be possible to undertake design of the system, including pipe diameters, once the SI had been completed and accordingly, the size of soakaways and tanks could be confirmed. It was suggested that this could be conditioned.
- PW clarified that the discharge to the TW sewer was only from the Affordable Housing (Building E7), was at Greenfield rate and was much lower than the existing discharge to the TW sewer from approximately 1/3 of the site. CT commented that whilst this was not the most "sustainable" solution, it was acceptable if other options had been considered and found to be incompatible, as had clearly been the case. He also noted that the likely discharge point to the river was close to the site.

Critical Actions

- **PW to provide a drawing to illustrate the proposed surface water drainage arrangement**

8 OPPORTUNITIES PROVIDED FOR REDUCING FLOOD RISK

No further action required.

9 SAFE ACCESS

- PW outlined the access/egress arrangements, based on the principle that the site has been designed to be "safe" and "habitable" for the duration of flood events ie a safe refuge.
- The Emergency Plan provides for an escalation of response based on the long lead times for major flood events. This would enable appropriate action to be taken by residents and management staff.
- Some residents may choose to leave the site in advance of flooding. For those remaining, the access would be dictated by flood depths on Broom Road – ranging from pedestrian, through 4X4 through to dedicated vehicle eg "Burg Buggy".
- For major events, the proposed telescopic bridge would provide an alternative access to the Ham Bank – where remaining residents could access public transport or private vehicles.
- Mass evacuation of the site was thus not envisaged, though the telescopic bridge would be part of the plan should this need to be done.
- KH outlined that although the telescopic bridge deployment was technically feasible, there remained concerns about the management procedures that would lead to a successful deployment.
- KH also highlighted the need for "managing" people on the bridge
- BS clarified that such arrangements are in place for dealing with "high buildings" and would provide relevant documents to support this.
- BS also clarified that discussions were ongoing with Fullers regarding access over the Anglers and that they had no objection to the emergency deployment and a legal agreement will be incorporated to ensure this. .
- PW clarified that access from Weir Cottage would be initially 6.92 mAOD ie higher than the agreed "safe" access level of 6.8 mAOD.
- PW to provide indication of depths in rear gardens of Buildings E1 to E6

Critical Actions

- **JW/BS to clarify operational and management arrangements for telescopic bridge deployment**
- **JW/BS to clarify arrangements for any use of a "Burg Buggy"**

10 FLOOD LEVEL DATA

This was an "informative" response; no further action required.

PW
7th July 2014

Offices at

Bromyard

Reading

Sheffield

Stirling

Tiverton

Registered office

Hydro-Logic Services LLP
Old Grammar School
Church Street
Bromyard
Herefordshire
HR7 4DP

Registered in England OC381974