Counters Creek Flood Alleviation Scheme: Supplementary Information

1. Introduction

Thames Water issued letters and additional information in February 2018 following separate requests from both the Lead Local Flooding Authority (LLFA), The Royal Borough of Kensington and Chelsea (RBKC) and the Greater London Authority (GLA). A meeting was requested to discuss the contents of the letters and Additional Information Report, out of which further information was requested. This document sets out this supplementary information and should be read with the Additional Information Report which accompanied Thames Water's letters to both Authorities. The headings used in this document reflect the headings used in an email from P Cuervo on 2 March 2018 ahead of the meeting, which was held on 6 March. Blue italic font is used to indicate the wording from that email.

2. Points raised in the letter

FLIPS: *information around their maintenance as we have heard concerns of residents about how often they are maintained (or not)*

A presentation has been prepared summarising the maintenance regime, providing statistics on number of units visited over the past year. Thames Water believes that the maintenance, both preventative and reactive, is robust.

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Twenty for twenty programme*: we presented the consultants few ready-to-go SuDS schemes which seemed to comply with the requirements of the programme. We were told that the schemes were very likely to be accepted and that we would have a response before last Christmas. Yet, to this date and despite several emails from us and the GLA, no response has been given. Could you please clarify this so we can get a final answer and move on with the projects?*

It was agreed at the meeting that a separate meeting would be set up to discuss and follow up on the twenty for twenty programme and plans for AMP7.

Modelling*: your models for climate change assume that the rainfall falling in the area enters the sewer system. Shouldn't your models allow for scenarios where the sewers are surcharging and water cannot enter the sewer as they are full? Surface water drainage in RBKC is part of the sewer* *system as it is combined so it is not clear why both systems seemed separated in your models (paragraph before last in your letter). Further details of the modelling used will be required to fully understand how the model works.*

The hydraulic models used by Thames Water represent the sewer network only. They are conservative in that they make no allowance for the ability of surface water to get into the sewer network eg extent or availability of road gullies is not modelled (for all scenarios, not just climate change), so the water levels in the sewerage system will be predicted to be higher than perhaps would be observed under severe rainfall scenarios, where the surface drainage system capacity could restrict the amount of water entering the sewer network. Even under these extreme conditions, the surcharge water levels within the sewer network are not predicted to reach ground level and therefore there should not be any restriction to surface water entering the sewer system because of surcharged sewers. It is worth remembering that hydraulic sewer flooding problem is predominately observed in basement properties in this area caused by sewer surcharge and backing up of laterals as opposed to overland sewage escape. Thames Water believes it is likely that the effectiveness of the surface water collection system will be the challenge for climate change scenarios, where rainfall is more likely to be intensive, thus overwhelming the surface drainage system and as a result of not being able to get into the sewerage system and potentially cause flooding to properties through overland flooding.

As discussed at the meeting, the Environment Agency uses data provided by the LLFA to create two-dimensional models of the area to estimate the overland flooding risk (see figure 1 below, which is a screen-shot from the EA website showing part of the Counters Creek area). This model makes assumptions about how much surface water can drain into the sewer network, and from the topography of the area shows where surface water will accumulate. Coupling this model to the sewerage network model, in order to increase the accuracy of predictions, would be a lengthy and costly undertaking.

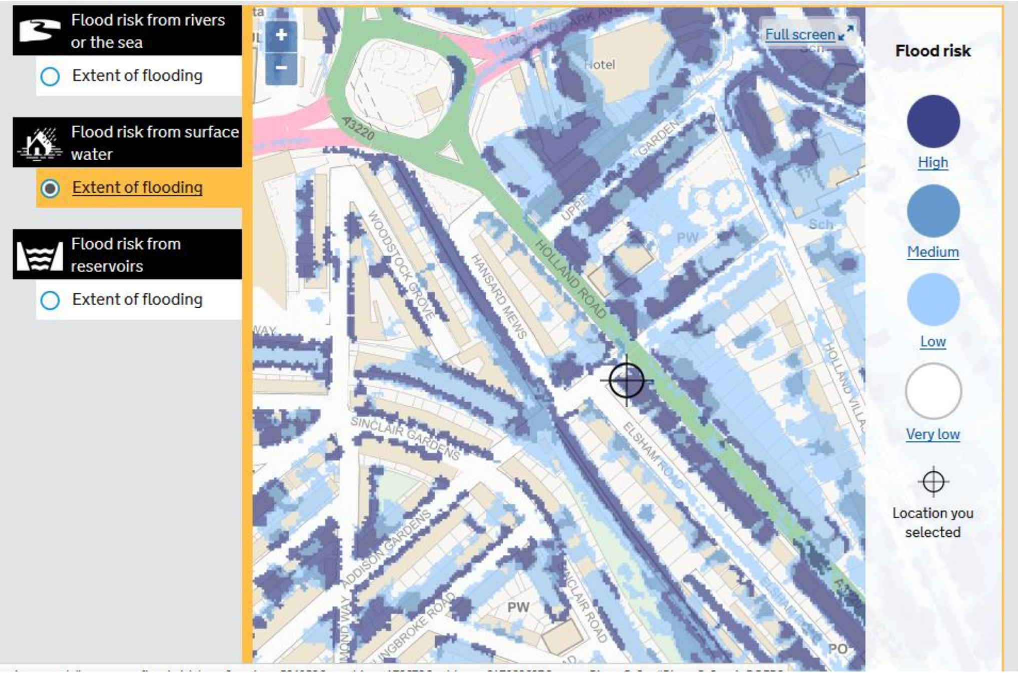

Figure 1: Screen shot of surface flooding risk map from EA website.

3. Points raised in the Additional information for LLFA paper

The detailed review of the requirement for the strategic sewer

- *How and why will the integration of the Thames Tideway Tunnel and the Counters Creek scheme reduce the effectiveness of the Counters Creek tunnel?*

The original design for the new Counters Creek storm relief sewer included a new pumping station at Lots Road to discharge the contents of the tunnel directly to the river. Following the initial stage of consultation in 2014 the design was changed to connect the Counters Creek storm relief sewer to the Thames Tideway Tunnel (TTT), therefore removing the direct discharge to river. This change restricts the hydraulic performance of the Counters Creek storm relief sewer as it interacts with the filling and emptying of the TTT: effectively, this moves the design from a conveyance system to a store and release solution. As a result, the new storm relief sewer protects fewer properties than if the flow entering it could be discharged directly to the river.

- *Could you please expand the information contained in point 1 of page 2 regarding the model predictions being sensitive to the connectivity data?*

Individual properties are not represented in the hydraulic model, given the number and complexity this would involve. Instead, information on basement properties (ie the properties that are potentially at risk of hydraulic sewer flooding) is held in a database, known as 'the basement layer.' The top water levels predicted for given rainfall events from the hydraulic model are compared with the information on the depth of the c30,000 basements held in the basement layer to predict whether a property is at risk of flooding. The recent study referred to in the report looked at the information in the basement layer and the sensitivity of the predictions resulting from changes to this information. For example, the depth of basements on the most part is interpolated data: around 2,000 out of the 30,000 basements have been surveyed, but it is impractical to survey all basements, hence the levels on non-surveyed properties are estimated from the basement surveys and ground level. Small changes to the basement depth has been shown to result in large changes to the number of properties predicted to flood. Further, not all basements are connected to the sewer system. From the survey work, c30% were found not to be. Again, it is not possible to know exactly which properties are/are not connected to the sewer network without surveying every basement property, which is not practical. Additionally, the hydraulic model does not model the connection itself (ie the pipe connecting the property to the sewer). This pipework will provide a headloss (ie a resistance) to water from the sewer flowing back up the pipe and into the property. The effect of this has also been studied, and again the number of properties predicted to flood by the model has been shown to be sensitive to small changes in this parameter. As a result of this work, Thames Water has concluded that the flood risk in the area is much lower than the initial modelling suggested, and that the current levels of reported flooding is a good representation of the risk in the area.

- *Have you got information of where all the cast iron flap valves (mentioned in points 2 and 3 of page 3) and their status of operation and has that information being included in the model?*

Thames Water has used historic CCTV records to review the number and status of flap valves in the area. The table below summarises the results of the review, which was discussed at the 6 March meeting:

	RBKC	LBHF
No. of Flap Valves Identified	6,149	1,320
Percentage of Flap Valves Functioning	83%	94%
No. of Flap Valves in Roads with basements	5,503	1,310

Note that the hydraulic model does not contain the flap valves – this would require perfect knowledge on which flap valves protect which property, which cannot be obtained from the CCTV survey records.

As can be seen, there are a large number of flap valves across the region, the majority of which are operational. Most of the flap valves are in roads with basements and are therefore providing protection to those basements from hydraulic flooding. As discussed at the meeting, most of these valves were installed as part of the original sewer installation meaning that the sewers were designed to fill and surcharge without causing flooding. It was noted at the meeting that the FLIP is a modern version of the flap valve, however more effective as the pump ensures flows continue to be discharged to the sewer even when the sewer is surcharged.

- *Point 4 of page 3 explains that overland run-off associated with the 2007 event would not have been remediated by the strategic tunnel. Is this because the 2007 event was higher than 30 yr-event. How does this reflect the fact that you have taken climate change into consideration in your model?*

The overland flow would not have been remediated by the strategic tunnel because the tunnel was designed to address hydraulic sewer flooding caused by sewer surcharge, not surface water drainage. It achieved this by reducing water levels (surcharge) in the sewer network. If the water could not get into the sewerage system, perhaps because the surface water collection system was blocked or undersized, then this would result in surface flooding /overland flows: reduced water levels in the sewer would not help. Likewise, the current approach of local schemes, such as FLIPs, would also not address or exacerbate the surface water drainage system.

- *We have done a study on SuDS in North Kensington and it showed that they are unlikely to protect properties against climate change. What type of SuDS are you taking about in page 3? Do you refer to strategic SuDS? And if so, where will they be located?*

Thames Water requested details of this study at the 6 March meeting.

The modelling that has been carried out by Thames Water has taken the major proposed developments in the area and adjusted the run off from those areas in the model by 50%, in line with anecdotal evidence from the GLA Action Plan. This modelling shows that SuDS have a beneficial effect in terms of reducing the number of properties the model predicts to be at risk of flooding, which counters the adverse impacts of climate change.

The meeting on 6 March appeared to uncover a confusion around the wording on page 3, and reflected in the question above. The proposed approach to alleviating hydraulic sewer flooding is to implement local solutions, such as FLIPs. It does not specifically include constructing further SuDS (noting that three pilot schemes have been completed as part of the project already). Thames Water believes that the implementation of the Borough's and GLA's policies on SuDS for new developments will help offset the impacts of climate change, making the current approach robust in the medium to long term. However, it was noted that Thames Water is seeking funding as part of its Price Review process to invest in further SuDS schemes across its region (not specifically in the Counters Creek area) in the period 2020-2025. It was agreed that a separate meeting on this would be helpful.

- *Only the outputs of the 2007 and 2016 scenarios were included in the information. What are the outputs of the other scenarios?*

The outputs from the other scenarios are referred to within the text, for example in the discussion about the known developments in the area, the commissioning of the Thames Tideway Tunnel and climate change (see section 7). The results from these scenarios show the adverse effects of climate change on the sewerage network are offset by the positive effects of the uptake of SuDS and the commissioning of the TTT.

Modelling of the network and the scenarios considered

- *When was the model used finalised? Was this model used to support the pre-application discussions for the strategic sewer?*

The model is being continually updated as things change within the catchment. However, most of the current model was built by 2012. It was independently audited between 2011 and 2012, as noted in section 3. The model was used to examine the impact of the proposed strategic sewer on the catchment, to predict the potential benefits of the solution, as well as understand the interface with the TTT project, in particular the frequency of discharges from combined sewer overflows into the river which is a key performance measure for that project.

- *Is there any logger data which could be used to validate the outputs of the model for the Counters Creek? (you refer to the Low level No1 and the Fleet storm sewer)*

Logger data referred to in section 3 has been used to verify the Counters Creek model. The two figures included in the report (figures 2 and 3) show the modelled and measured water levels at the Low Level 1 and Fleet Sewer depth monitors for two events in June 2016, showing the model is capable of accurately representing the flow and level dynamics within the network.

- *What return events were used to model the 2007 and 2016 events?*

The actual rainfall data[1] (in 1 km x 1 km squares) was used in the model simulations rather than events generated from synthetic return periods. As discussed at the meeting, comparing rainfall

[1] Thames Water obtains rainfall data from the Met Office for all its region at a 1km resolution. This data comes from the Met Offices weather radar system.

events is complex as no two are the same. Table 1 below presents comparative statistics for the two events. As can be seen from the summary, the two events had similar characteristics.

Measure	Unit	2007	2016
Maximum return period	1:x years	19	37
Average return period	1:x years	5	6
Maximum Intensity	mm/hr	74	103
Average Intensity	mm/hr	47	40
Maximum Rainfall Depth	mm	31	44
Average Rainfall Depth	mm	20	27

Table 1: rainfall characteristics for 20 July 2007 and 23 June 2016 events

- *How does the Commissioning of the Tideway Tunnel affect the model as the idea of the Tideway is not to discharge foul water into the Thames rather than to create capacity into the sewer system? Why was this used as a catchment scenario?*

The aim of the Thames Tideway Tunnel (TTT) project is to reduce the discharges of untreated sewage into the Thames. As part of the design of the TTT the arrangement at Hammersmith Pumping Station is being changed. Currently, excess flows arriving at the pumping station are discharged to the river via the existing combined sewer overflow. When TTT is commissioned, these excess flows will discharge to the tunnel rather than the river. To achieve this, weirs are to be installed, which will reduce the top water level in the system local to Hammersmith Pumping Station. This reduction in water level provides protection to properties at risk of flooding, hence it was included as one of the future scenarios.

- *What are the details used for the development in the area scenarios (peak rates of foul and surface water flows). Where was this information taken from?*

The model calculates run off rates for a given area, considering the extent of impermeable area and the permeability of the ground in the area. For the large developments cited in table 2 of the Additional Information Report, the model is used initially to calculate the run off for the baseline situation (ie undeveloped). When the potential future development is considered, the existing connected area is adjusted in the model such that the run off flow is reduced from the baseline. The target area reduction used was 50% as this was the figure quoted as being currently achieved. The foul water flows are amended based on the published number of properties the development is seeking to create, using a per capita flow allowance. The approach is therefore not a detailed assessment, which would be done once the design for the developments are at a more advanced stage, but provides an indicative change from the baseline scenario.

- *What are the details used for the scenarios: 'following the implementation of the strategic sewer tunnel' and 'climate change to 2040'?*

Regarding the TTT, please see the answer above. In terms of climate change, as noted in section 7 of the Additional Information Report, an uplift of 10%[2] is applied to the intensity of rainfall for

[2] This is the central estimate in the EA methodology. This was chosen over the upper estimate as the 1:20 yr FEH simulation is viewed as already being conservative.

the synthetic 1:20yr FEH rainfall event[3] within the model to determine the impact by 2040. This is in line with the Environment Agency's methodology (The Environment Agency's Flood risk assessments climate change allowances guidance - https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances).

- *Have the potential local sewer improvements been taken into consideration in the modelling? Has the modelling identify any hotspots for potential local sewer improvements?*

The potential local sewer improvements have not been included in the model. The model will be used as part of the methodology to develop these solutions. Likewise, FLIPs are also not included in the model. As noted at the meeting, there are currently around 900 properties on Thames Water's database which currently have not been protected by a local scheme/FLIP. A desk top review of the information on the data base suggests that around 300 properties will require a solution. However, it was also noted that all customers on this data base have been contacted to establish evidence of hydraulic sewer flooding, and request access for a property survey to assist in developing the solution should one be necessary.

Thames Water's default solution will be a FLIP, this providing the best value for customers in most circumstances. However, other local solutions, such as sewer upgrades or in-street storage, may be required if:

- There are a cluster of properties in the same street, and where it would be more economic to provide a street rather than property level solution
- Where the installation of a FLIP could result in flooding to neighbouring properties that currently don't flood.

Once the confirmed list of properties where evidence of hydraulic sewer flooding has been established, those properties that will require a FLIP and those that will form part of a local scheme can be established. Thames Water is not currently able to confirm this given the low response rate to the letters and customer contacts to date. At the time of the meeting it was noted that out of the 1000 properties that had been contacted there were around 700 where no response had been obtained. As discussed at the meeting, a programme of 'door knocking' has begun to reach as many of the properties owners as possible. This is being carried out across both Boroughs during the evenings to maximise the chances of contact.

Review of the 2016 Storms

- *Point i refers to poor connectivity and its effects on the model outputs. Wasn't the connectivity addressed in the model? You referred to" information from additional monitors fitted to the network since the July 2007 storm which led you to conclude that the flooding caused by the 2007 storm should have led to widespread flooding in June 2016". What were those and how do they relate to the Counters Creek sewer?*

As noted in the answer in section 3 above (second bullet point, page 3), the 'model' is in fact a combination of the hydraulic model, which predicts water levels and flow rates within the sewer network for a given rainfall, and the basement layer, which contains information on

[3] FEH = Flood Estimating Handbook. This applies a 1:20yr event across the Counters Creek catchment and a 1:15 yr rainfall across the rest of the Beckton catchment.

whether a property has a basement, and its depth. The study reviewed the information in the basement layer and found small changes led to significant changes to the number or properties predicted to flood. Figures 4 and 5 in the Additional Information Report show that the combined model predicts many more (between six and twenty times) properties are at risk of flooding than have reported flooding. Because most of the information in the basement layer is interpolated, it is not possible to amend the model to address the connectivity and re-run the predictions. This would require almost perfect knowledge of every connection, which is not practical to achieve. Thames Water's view is that the levels of reported flooding better represent the flooding risk in the area, which the project is focussing on addressing. The reference to the additional monitors is in relation to developing confidence in the hydraulic element of the model, which from figures 2 and 3 of the Additional Information Report show a good match between the observed and predicted levels within the sewers.

- *Point ii: wouldn't overland flooding have a direct link with the sewer capacity? the model assumes that the rainfall gets into the sewer. Shouldn't the model be redefined to include a trigger point for surface water run-off to stop getting into the sewer to ensure the output reflect reality better?*

Please refer to the earlier answer (Section 2, page 2)

- *What were the variables used to model the 2007 and 2016 events? And what were the assumptions? How can the outputs predict less flooding in LBHF and more in RBKC in 2016 than in 2007? Were the FLIPS locations included in the model? If not included in the model, how do the FLIP locations correlate with the outputs?*

As noted in the earlier answer (Section 3, last bullet on page 5 and table 1), the actual rainfall data for both the 20 July 2007 and the 23 June 2016 events was used with the model, rather than synthetic rainfall events based on return periods. Although the events were similar in characteristics (see table 1) it was noted in the meeting that the main difference was where the most intense rainfall fell in the area: in 2007 the more intense rainfall was to the west of the region, ie west of LBHF, whereas in 2016 it was to the south of the region, equally across both Boroughs. These differences, and how the water flows into and out of the region (ie all flows generally travel from west to east towards Beckton Sewage Treatment Works) lead to differences in the locations of the model predictions of property flooding. As also noted above, FLIPs installed since 2007 are not represented in the model. There is a good correlation between properties predicted to flood and those now installed with a FLIP.

Flood Protection Provided by FLIP Devices Installed

- *Of the 900 remaining properties without a solution, how many are in RBKC?*

RBKC	343
LBHF	564
Total	907

Table 2: Split of remaining properties on the Sewer Flooding History Database without a solution by Borough

- *Thank you for the FLIP information. We requested information about their location and surveys undertaken. Could we please have information about their maintenance and maintenance programme (surveys)?*

Please see the attached presentation to the earlier answer (Section 2, page 1), which sets out the maintenance regimes for FLIP installations.

Assessment of Development in the Area

- *Why was 10% figure for Climate Change used? We need to know the assumptions made to understand this figure and the outputs.*

Please refer to the earlier answer, Section 3, last bullet page 6).

- *Could you please explain what do you mean with the first sentence of the 2nd paragraph in page 12? Are you taking about strategic SuDS or SuDS in each development? (see earlier comment).*

The sentence refers to the SuDS that are part of each proposed development. However, the context of the paragraph is in relation to larger developments, such as that proposed for Earls Court or Old Oak Common/Park Royal. Section 7 of the Additional Information Report focusses on the potential opportunity that SuDS uptake across the region provide in offsetting the adverse impacts of climate change. However, the success clearly requires the various planning policies that are referenced in Section 7 to be implemented and enforced for new developments.

- *We asked for information regarding the assessment of the potential impacts of further development in the catchment with any scenarios examined. The information you submitted regarding the OPDC figures assumes a post-development scenario of greenfield run-off which is an aspiration and probably unlikely to be achieved throughout. Have you looked at other scenarios? Also, aren't the peak sewer discharges the key figures for the sewer capacity? And if so, the figures in the IWMS show over a 4 times increase. Would this not be an issue? What is the current capacity of the sewer at peak times?*

The information on the OPDC development was included in Section 7 of the Additional Information Report (table 3) to illustrate that the domestic element of development is insignificant to the surface water element of the flow. As can be seen from the table, despite the peak domestic flow to the sewer increasing from 57 l/sec to 277 l/s (an increase in flow of nearly 400%) the increased flow is dwarfed by the surface water flow reported for the pre-developed (ie baseline) position: 53,988 l/s. This conclusion is not specific to the OPDC development area. In a combined sewer system it is the surface (rain water) element of the flow that is significantly greater and more dominant over the dry weather (domestic) flow. It is for this reason that development in the area should not be seen as a threat (because of the increase in population developments bring with them) but as an opportunity to significantly reduce the overall flow into the sewers through the adoption of SuDS/source separation schemes. For example, even if the post-development figures for the OPDC example are optimistic, and they only achieve half of the aspiration set out in table 3 of the Additional Information Report, the reduction achieved would still be around 25,000 l/s, ie 1000 times more than the increase in flow as a result of population growth.

As discussed earlier in this report, rather than using the published figures for proposed flow reduction post-development from the various developers' literature, the model has calculated the baseline surface run off for the area of the development and reduced this by 50% in the model to examine the impact on the system. Thames Water believes this is an appropriate methodology for a high level assessment, as the reductions are in line with observed reductions from recent developments (as referred to in the GLA's Sustainable Drainage Action Plan). Any new development would of course need to be examined in detail to understand how the specifics of the design might impact on the local network.

- *We do agree that flood management needs to start with addressing surface water run-off at source in new development but we also need to manage current flood risk.*

Thames Water's responsibility under the Counters Creek Flood Alleviation Scheme is to understand the risk to basement properties from hydraulic sewer flooding and provide solutions to those properties where there is evidence of hydraulic flooding. Thames Water recognises that as the Lead Local Flooding Authority, RBKC has a wider remit to manage flood risk in the area, which includes fluvial and pluvial flooding. It is also recognised that managing the sources of flow into the drainage system requires cooperation and coordination with the Boroughs, the GLA and developers. Success in managing the overall flood risk in the area is highly dependent on the enforcement of current policies to ensure that continued source separation is achieved. Thames Water remains committed to resolving hydraulic sewer flooding in the area, and continuing to work with all stakeholders to assist in managing this risk in the future.

4. Additional points raised at the 6 March Meeting

<u>Properties that have recorded a flooding incident but are not predicted to flood by the model</u>

Figure 4 in the Additional Information Report shows that there are many properties (c700) where Thames Water has a record of flooding on the 20 July 2007 event but were not predicted to flood by the model. A request was made at the meeting for location information on these properties. Please see attached spreadsheet, which breaks this down by Borough. It is important to note that, as discussed above and in the Additional Information Report, a record of flooding does not necessarily mean that the property has suffered from hydraulic sewer flooding. Therefore, this list should not be interpreted as a confirmed list of properties that have flooded. As also noted above, Thames Water is investigating all incidents of reported flooding, whether predicted to flood by the model or not, to verify if hydraulic sewer flooding has occurred and hence whether a solution is required.

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<u>Locations of depth monitors</u>

A request was made at the meeting for the location of the depth monitors that have been installed throughout the Counters Creek network. Please see attached spreadsheet.

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