

Originating Group and date	Query	Atkins Response 12/04/13	City of London Corporation Response 18/04/13
Fitzroy Park RA 20/03/13	Can we have more specific detail of exactly how much local data was integrated into the Atkins macro model for calculating the quantum? What local weighting did they integrate into to this new calculation?	<p>“Local” data was integrated as follows: For the estimation of the percentage run-off the soils map for Hampstead Heath was used to adjust the Standards Percentage Run-off which was provided by the automated routine with the FEH CD ROM.</p> <p>The HHSS rainfall record was analyzed and it was demonstrated that it was statistically inconsistent with the information from FEH. This is to be expected as it is statistically unreliable to apply data from a single rainfall gauge and with a short record length in comparison with the events being predicted (see Figures 4-4 and 4-5 in the main report).</p>	
Fitzroy Park RA 20/03/13	Prof Hughes said pathways plus a bit extra either side was assumed as hard landscaping. This is very vague. We need more detail.	See page 27 of the main report – a width of 10m was adopted.	
Fitzroy Park RA 20/03/13	With regard to rainfall, Prof Hughes talked about using weather stats from around the country yet his colleague (sitting to the side) talked about a Met	When estimating events with return periods i.e. 5, 20, 50, 100, 1, and 10,000 years, the national rainfall records are used on a statistical basis. For the estimation of the PMF, the	

	<p>Office determination methodology. Which one is it?</p>	<p>Probably Maximum Precipitation (PMP) is required. The PMP is derived in a deterministic manner and the FSR report includes maps of PMP which were prepared by the Met Office.</p>	
<p>Fitzroy Park RA 20/03/13</p>	<p>Atkins implied their computer software was far superior/sophisticated to Haycock's version? I cannot find in the report a definitive explanation of the key differences between them. Can this be provided.</p>	<p>Atkins used computer software which is widely used within industry to the extent that it can be considered to be industry "standard" software. The Atkins' hydraulic modeling incorporated 2 dimensional modeling of the land around the ponds linked to a 1 dimensional representation of the ponds and overflow arrangements. In the 1 dimensional model, the ponds are represented by mathematical expressions of the relationship between water levels and pond surface area, and the overflows by a mathematical expression for the relationship between the water and the level and discharge (flow) out of the pond. The 2 dimensional model allows better representation of the topography around the ponds by breaking the area up into a series of interlinked discrete elements. The software solves the equations for fluid flow within the elements as well as across the boundaries between elements thereby showing the spatial</p>	

		<p>variation of the flow around the ponds.</p> <p>Haycock by contrast used only 1 dimensional modeling techniques. The software they used is not widely used in industry in the UK and we have not carried out a detailed appraisal of the software.</p> <p>The Atkins modeling was more sophisticated in that it also modeled the areas around the ponds.</p>	
<p>Fitzroy Park RA 20/03/13</p>	<p>Who wrote 'Floods and Reservoir Safety – 3rd Edition'?</p>	<p>Floods and Reservoir Safety – 3rd Edition, was published by the institution of Civil Engineers in 1996.</p>	
<p>Heath & Hampstead Society 25/03/13</p>	<p>Percentage Run-off: Atkins has made two apparently reasonable simplifications. They have assumed that there is an even distribution of the path network across the Heath. However there appears to be less paths (and hence less compaction) on the higher Heath. Also, they have applied an average SPR value of 53% to all catchments, rather than use a specific lower SPR on the upper more permeable soils. Might these simplifications result in the calculated run-off into the</p>	<p>The FEH guidance on run-off estimation for the PMF states that when the SPR estimate is less than 53%, the SPR should be set at 53%. On basis of this advice, the SPR was not varied between the higher and lower Heath.</p>	

	<p>upper more sensitive ponds being too high, leading to too much work on these ponds? Should the total run-off be adjusted to discharge less into the upper ponds and more into the lower ponds?</p>		
<p>Heath & Hampstead Society 25/03/13</p>	<p>Upstream Spills: The original Table 1-4, Pond Storage Capacity, [Table 5-7 is identical], states in column 3 <i>excludes spills from the upstream pond</i>. A revised Table was issued on 21.3.2013 with altered % storage figures in the last column. Column 3 heading now reads <i>including spills from the upstream pond</i>. Should the data in the 3rd column [Total PMF volume...] be altered to show increased inflow?</p>	<p>The Table has been revised and the report reissued.</p>	
<p>Heath & Hampstead Society 25/03/13</p>	<p>Section 4.6 indicates that inflow hydrographs were calculated for each pond's individual catchment. It is not clear if the following sections and tables include or</p>	<p>The hydrographs presented are for the whole upstream catchment generated by the hydrological model. These hydrographs have been routed through the hydraulic model and it is this that</p>	

	<p>exclude upstream spills. Please therefore confirm from Section 4.6 onwards, whether or not upstream spills have been included, and if not, please provide amended Tables including upstream spills where appropriate.</p>	<p>provides the spills from upstream reservoirs. These spills are therefore not included in the tables showing hydrographs. The tables have not been updated to include the spill inflows as they are complex and difficult to incorporate. It has been done for the PMF and updated PMF peak inflows.</p>	
<p>Heath & Hampstead Society 25/03/13</p>	<p>Flood Estimates Table 1-1, [Table 4-7 is identical]: This table compares Atkins maximum flows for different storms at every pond with Haycock's flows, which have been extracted from his Table 7, p.43. Are these two tables directly comparable? For example, Haycock states that <i>these flows will be attenuated by the lake chain and these values thus represent the boundary conditions of the lake model.</i> Please therefore clarify this aspect, particularly for upstream inflows and whether current attenuation has been allowed in this and other relevant tables.</p> <p>Quantified Risk Assessment: Atkins has confirmed in Appendix A of their Design Review Method Statement and separately that</p>	<p>The Tables are directly comparable. As per the response above, both tables contain the peak of the hydrographs calculated from the respective hydrological models and they are therefore directly comparable.</p> <p>The Quantitative Risk Assessment will be carried out but we expect that lives will still be at risk in the urban area downstream of the Heath.</p>	

	they will carry out a QRA of the current dam situation. When will this be carried out? We urge that it be as soon as the design flood has been agreed.		
Heath & Hampstead Society 25/03/13	Precipitation / Design Rainfall Depths: Please explain how PMP and 1:10,000 rainfall depths and durations were calculated. Was 1:10,000 rainfall derived from PMP [or vice versa]?	The 10,000 year rainfall depth was determined from the FEH statistical rainfall data. The PMP was determined from the PMP maps provided in the FSR and is deterministic, not statistical.	
Heath & Hampstead Society 25/03/13	Are the PMP and 1:10,000 rainfall depths and durations proposed for design 235mm over 9.5 hours and c.141mm over 1.9 hours respectively? (If so, the PMP/1:10,000 ratio is presumably c. 1.67?). If not, please state.	There is no predetermined ratio between the PMP and 10,000 rainfall depths. As noted above, the PMP was derived using deterministic methods whereas the 10,000 year value is derived statistically.	
Heath & Hampstead Society 25/03/13	Haycock used 270mm and 135mm respectively, both over 4.4 hours. This presumably gives a much slacker PMP than Haycock, but a much more intense 1:10,000 storm, which may be the main influence on dam design. Please explain why then so much difference from Haycock in depths	Atkins expected rainfall depths from the FSR for the PMP and the 10,000 year events (all other events used the FEH rainfall). We do not know where Haycock's rainfall depths come from, but based on their assumed 4.4 hour storm, if they had used FSR rainfall (as per the guidance) the rainfall depth should have been around 164mm (see	

	<p>and durations, and why the Atkins durations of 9.5 hours and 1.9 hours are so different</p>	<p>our table 4.4). Furthermore, it would appear that Haycock based their PMP value on double the 10,000 year value (wherever that came from) which is wrong. Atkins' storm durations were optimised to determine the critical storm duration for each event, whereas Haycock chose a fixed 4.4 hour duration, which is not a correct approach.</p>	
<p>Heath & Hampstead Society 25/0313</p>	<p>Maximum Flood Estimates: Haycock used the approximate rapid assessment PMP/1:10,000 rainfall ratio of 2.0. From this he derived flood estimates at both Highgate No 1 and Hampstead No 1 which both had a PMF/1:10,000 ratio also of 2.0. These are shown in Tables 1-1 / 4-7, i.e. both his input rainfall and his outflow flood ratios on the bottom ponds are the same.</p> <p>In contrast, Atkins' more detailed calculations of rainfall inputs result in flows at both bottom dams with a PMF/1:10,000 ratio of 2.12 and 2.22 respectively, which are greater than Haycock's 2.0. Why are Atkins outflow ratios not both of the order of 1.67?</p>	<p>The ratio of 2 from the rapid assessment was intended to be applied to the Peak Flows derived from the rapid method, not rainfall depths. The ratio is used only with the rapid assessment and the rapid assessment is not appropriate for design.</p> <p>The ratio of 10,000 year rainfall and PMP depths should not be expected to be the same and ratio of the peak flows.</p> <p>This is because the relationship between rainfall depth and flow is not linear and we should not expect the ratios between 10,000 and PMP rainfall to be the same as the ratio between the 10,000 flow and the PMF.</p>	

<p>Heath & Hampstead Society 25/03/13</p>	<p>Overtopping, and Dam Stability and Spillway Protection: Table 5-13 gives shows maximum depth of overtopping. Atkins Conclusions and Recommendations, p.45, state that <i>Reservoir routing resulted in generally lower overtopping depths than those predicted by Haycock</i>. Haycock's PMF overtopping depths are shown in his Tables 16 and 33. These show that Atkins statement is correct for all the Hampstead chain and for the Ladies Bathing dam. However, for the other 5 dams on the Highgate chain, Atkins overtopping PMF depths are all higher than Haycock's. How, therefore, is it that Atkins has these higher overtopping depths, bearing in mind that Atkins PMP (if this is 235mm) is only 87% of Haycock's, and is spread over a duration of over twice as long?</p>	<p>Tables 16 and 33 from the Haycock Report refer to the 10,000 year flood. Tables 17 and 34 from the Haycock report are for the PMF and these show that the Atkins statement is correct.</p>	
<p>Strategic Landscape Architect</p>	<p>The calculations for Stock Pond seemed to attribute the entire catchment north of Stock Pond to</p>	<p>The temporary storage capacity of the Kenwood Ponds was judged to be negligible.</p>	

<p>22/03/13</p>	<p>that pond alone and do not take into account any attenuation or holding back that the two Kenwood Ponds offer. Therefore, although we do not expect to carry out works on these ponds we still need Atkins to provide the attenuation capacity and take into account the effect of these ponds when assessing Stock Pond, otherwise the measures required at Stock Pond look disproportionate to the scale of the problem. This is fundamental to Atkins Problem Definition document.</p>		
<p>Brookfield Mansions 27/03/13</p>	<p>Although the primary objective of the work to be undertaken by City of London is to prevent dam failure whilst preserving the character and quality of Hampstead Heath, the secondary objective must be to lessen the quantity of surface water arising from overtopping, spillways and drains onto the Heath and subsequently into surrounding residential areas. While we welcome your assurance that the situation will not be made</p>	<p>City of London to respond.</p>	<p>Camden Council are the Lead Local Flood Authority and have statutory responsibilities in terms of surface water flooding. The City of London Corporation has a duty to ensure the safety of the dams, and works are necessary to ensure that the Probable Maximum Flood is safely passed through the catchment. Dr Hughes (the Panel Engineer) has</p>

	<p>mitigate downstream flooding is being considered to improve the capacity of the Hampstead chain. We wish to be assured that similar measures be considered for the HIghgate chain.</p>		
<p>Brookfield Mansions 27/03/13</p>	<p>Table Page 8: Why are the 1:100 peak flows for the Highgate chain the only ones that Atkins have estimated to be greater than Haycock?</p>	<p>We have used the FEH rainfall-runoff model to calculate all hydrographs below the 10,000 year hydrograph. Haycock calculated the 100 year peak flow using an empirical formula to calculate Q_{MEAN} (mean annual flood), and combined this with the old FSR regional flood frequency curve. This approach used by Haycock was superseded in 1999 by the FEH and will give very different results to the FEH rainfall-runoff approach.</p>	
<p>EGOVRA 28/03/13</p>	<p>We now hope to persuade the authorities (including Camden, Thames Water, the Environment Agency, DEFRA, etc) to go the vital step further and investigate and include in their designs works that will improve our situation at least in line with the predicted increase in frequency and intensity of rainfall storm events. We understand from Dr Hughes and</p>	<p>City of London to respond.</p>	<p>Camden Council are the Lead Local Flood Authority and have statutory responsibilities in terms of surface water flooding.</p> <p>Camden Council are undertaking studies to model surface water flooding in parts of Camden where flooding has previously occurred. The City of London Corporation has not been provided with the outcome</p>

	<p>Simon Lee that should funds become available, such mitigation factors can be investigated and implemented as part of the main Works by CoL - there is still time but it is tight apparently. To do such works on the Heath would be hugely more cost-effective than trying to achieve the same result by works off the Heath. Has the CoL asked Atkins to investigate and cost 'on the Heath' mitigation measures?</p>		<p>of any of these studies.</p>
<p>EGOVRA 28/03/13</p>	<p>At what storm event do the two chains start overtopping currently? In particular, with reference to Table 5-12, are you able to give us more precise estimates of when Highgate No 1 pond starts overtopping? Will the Works change this?</p>	<p>See Tables 5 – 12 in the main report. All Atkins can say at this stage is that the works will not make the situation worse than they are now.</p>	
<p>EGOVRA 28/03/13</p>	<p>At what storm event level will surplus water passing through Hampstead No 1 pond cause flooding to our community? We appreciate that this may be beyond the scope of this report but any figures, estimations, indications or even explanations of 'how to asses this' would be most helpful.</p>	<p>No comment.</p>	

<p>EGOVRA 28/03/13</p>	<p>Will Atkins make all relevant information freely available to other authorities (such as Camden Council and Thames Water) so that they can include such information in their flood alleviation designs?</p>	<p>Work produced by Atkins is the property of the City of London. City of London to respond.</p>	<p>The City of London Corporation has shared the current Design Flood Assessment with Camden Council and Thames Water Authority and put this report on the City's website.</p>
<p>EGOVRA 28/03/13</p>	<p>We are still unsure about the run-off calculations. The gully down the side of our path (to the East of the Lido) is constantly full to overflowing with water. Often, even in light rainfall, the path itself has water flowing down it especially at the top (near the Depot) and stepping off the path means stepping into sodden, soggy mud. Instinct says that therefore any storm event rainfall would simply have to run off the surface of the Heath since the ground is already 'full'. We find it hard to understand how it is that in a 1 in 100 year storm event that 47% of the rainfall would soak into the ground...</p>	<p>While some parts of the Heath will have high runoff rates, many of the vegetated areas and areas away from compacted footpaths will, allow rainfall to infiltrate. It is also a function of the ability of the underlying soil to accept and transmit rainfall, and according to the soil maps from the Heath, the composition of soil does allow for infiltration on some parts of the Heath.</p>	
<p>EGOVRA 28/03/13</p>	<p>May we have the equivalent figures for storm events smaller than 1:100, say 1:10, 1:20, 1:30, 1:50 and 1:75 ? Mark Dickinson of</p>	<p>Atkins output is the property of the City of London.</p>	<p>The City of London Corporation has shared the current Design Flood Assessment with Camden Council and Thames Water Authority and put</p>

	Thames Water told us that Ofwat will only allow them to upgrade areas who are at risk from a 1:10 storm event and can only upgrade them to a 1:30 level. Thus, as per our point 7 above, such information would be very useful.		<p>this report on the City's website.</p> <p>The City of London Corporation can be required to carry out works to ensure that the risk of failure of the dams on its statutory reservoirs due to overtopping is "virtually eliminated". The Design Standards therefore require modelling of extreme rainfall events rather than more frequent rainfall events.</p>
EGOVRA 28/03/13	Are there any discussions being had with Camden Council and/or Thames Water about where the rainfall water that 'passes through' Highgate No 1 pond and Hampstead No 1 pond will enter their drainage systems?	City of London to respond.	The City of London Corporation has a duty to ensure the safety of the dams, and works are necessary to ensure that the Probable Maximum Flood is safely passed through the catchments.
EGOVRA 28/03/13	What is the capacity of the Emergency Valve system on Highgate No 1? Is this system being retained for operational use? Do any of the figures in the report reflect how much this reduces eg overflow for different rainfall storm events?	City of London to respond.	This has not been evaluated; the valve is a draw down mechanism enabling maintenance works and currently emergency drawdown of water. It is too early to say whether this will be retained.
EGOVRA 28/03/13	May we have any information Atkins has about the pipeworks underneath and around the Heath (in our area), including	City of London to respond.	The attached plan shows the location of outflow and drawdown valves associated with Heath ponds and the Thames Water Authority

	<p>information about the Flood Alleviation Tunnels? We (and others) have asked CoL and Thames Water for such information without success. We have various 'maps' that conflicting and very limited information.</p>		<p>'Flood Alleviation Tunnels'.</p>
<p>Hampstead Garden Suburb Residents Association 04/04/2013</p>	<p>My understanding is that the risk to be addressed is that of a dam failing and causing damage to property (other than the City's), injury or loss of life. Although Rylands v Fletcher liability is strict, the risk cannot realistically be reduced to zero. What has to be decided is what works are necessary to reduce the risk of a dam failing in the event of a specified level of rainfall to an acceptably low level. Is this correct?</p> <p>Although there is a lot in the paper about overtopping and volumes and speeds of flood water, not much detail is provided on the risk of dam failure. On page 53 (page 43 of the paper) it's stated that "standard guidance</p>	<p>The current guidance for reservoir safety standards in Floods and Reservoir Safety, 3rd Edition, published by the Institution of Civil Engineers in 1996. Table 1 in this document provided the dam categories and the design flood inflow.</p> <p>The approach is consequence based and so the categorisation is based on the potential effect of a dam breach i.e. it considers the consequences of a dam breach, and does not assess the probability of failure of the dam.</p> <p>Where a breach could endanger lives in a community, the dam Category A and the design flood is the Probable Maximum Flood.</p>	

	<p>suggests that the dam slopes would need reinforcement to prevent erosion which could lead to a breach of the dam". My understanding is that the City is not liable if water passes over the dams without a breach, even if flooding occurs lower down (indeed this is what the works are designed to achieve) but most of the risks addressed are about overtopping. I think we need more information about the "standard guidance" referred to and evidence about the likelihood of breach.</p>		
<p>Hampstead Garden Suburb Residents Association 04/04/2013</p>	<p>The conclusion says that "to reduce the risk of breaching, improvements will need to be made to some of the dams". This doesn't say anything about what an acceptable reduced level of risk would be. It appears that the risk to be guarded against is the risk of breach in the event of a "probable maximum flood" (occurring less than once in 10,000 years). I think we need more information about what the current risk of breach is (as</p>	<p>Risk is the product of the probability of failure and the consequence of failure. We will be carrying out a Quantitative Risk Assessment (QRA) as part of this project and this should provide an understanding of the overall risk of failure of the embankments.</p> <p>It should also be noted that the velocities given in the report are based on a smooth uniform slope and do not take into account the localized effects of trees, fence post, small changes in slopes all of which contribute</p>	

	opposed to overtopping) and what the aim is in terms of the reduced level of risk, including the reason for selecting "probable maximum flood" as the event to be guarded against.	significant concentrations of high velocity flow. These concentrations will exacerbate erosion damage which could lead to a breach.	
		Atkins Response 12/04/12	
Protect Our Ponds 8/4/2013	But work is still required as all of the ponds can overtop even in smaller rainfall events. With earth dams (such as those on the Heath) overtopping can cause erosion and potentially lead to dam failure. "Can" is the operative word. We are back with the original disaster movie scenario.	Overtopping can cause failure and has caused failure on the Heath and in other places. The predicted return period for overtopping, the depth and velocities are such that most ponds will suffer significant damage and could fail in their current state.	
Protect Our Ponds 8/4/2013	Even more sinister is the statement (from the recent memo by Atkins to the City of London referring to the spread sheet matrix of opinions on the plans): It should be noted that where a particular option has been flagged as red, i.e. the option has been	It would not be precluded from our scheme provided that appropriate environmental mitigation and/or enhancement measures can be implemented on the advice of the	

	<p>identified as likely to result in significant negative effects on any particular discipline, or will not be supported by a particular stakeholder group, this does not necessarily preclude that particular engineering option for inclusion in the scheme.</p> <p>It seems pointless having this elaborate consultation if the designer reserves the right to ignore significant comments made by stakeholders and others. If this actually happens, the whole process will have been a sham. Remember that the (now much criticised) designs in the Haycock Report were made by Atkins (not Haycock), a fact that has somehow escaped comment recently.</p>	<p>relevant technical specialist.</p> <p>Stakeholder comments will be taken into account.</p> <p>The designs in the Haycock Report were by Haycock and NOT Atkins.</p>	
<p>Highgate Society 09/04/13</p>	<p>Have the same calculations re. flow rates, velocity etc. been done for the Kenwood ponds as for the Heath ponds? What are the figures? How does this information impact on the measures needed to protect the Heath dams?</p>	<p>Explicit calculations for the Kenwood ponds have not been carried out as these ponds are not the responsibility of the city of London. Their catchments have been taken into account in estimating the flows into the other ponds on the Highgate Chain.</p>	

<p>Highgate Society 09/04/13</p>	<p>In the events of a Kenwood pond dam overtopping or collapsing would EH be liable under Rylands and Fletcher?</p>		<p>It is not appropriate for the City of London Corporation to comment on the potential liability of other organisations. Any concerns regarding the Kenwood ponds should be addressed to English Heritage.</p>
<p>Heath & Hampstead Society 10/04/13</p>	<p><u>Rainfall Run-off from the Urban Fraction of the Highgate Catchment</u>: Section 4.3 states that the urban areas adjacent to the pond chain will be included for flow estimation. Section 4.4 states that 61.5% of 'urban' areas is assumed to be impervious. This may be appropriate for high density housing in much of London, but we suggest that it is not appropriate for the catchments of the Highgate slopes. Figure 4-2 shows that Highgate Ponds 1 to 5 all have catchments that lie outside the Heath. The Bird Sanctuary Pond has a very large area and the</p>	<p>We cannot change the percentage that FEH assumes in its equation for urban area adjustment.</p>	

	<p>Ladies Bathing Pond and Model Boating Pond also have sizeable areas, external to the Heath. These areas, such as Fitzroy Park and Highfields Grove are not typically urban and heavily built up, but generally are isolated dwellings in very large gardens. We suggest that a much lower percentage be assumed as impervious.</p>		
<p>Heath & Hampstead Society 10/04/13</p>	<p><u>Overall Rainfall Run-off Percentages:</u> Haycock used 80% to 90%. Atkins has reduced this to 76% for PMF. Both Binnie in 1987 and Black & Veatch in 2007, both highly respected dam engineers, used 27%. There is judgement in selecting an appropriate run-off. Should not Atkins percentage be significantly lower than 76%? Please clarify in detail.</p>	<p>There appears to be a difference in the terminology used by previous consultants who have undertaken flood estimation for the Heath. We have reviewed the Binnie and Partner's 1987 hand calculations and computer printouts of their FSR model. Their 1987 model print outs show that they used an SPR value of 47% which resulted in PR values of 53.5% and 69.64% for the 10,000 year and PMF respectively.</p> <p>The reference to the 27% is from a table in the Haycock report, which is given for Highgate No. 1 pond for the 10,000 year event. The 27% seems to be referring to the percentage of the</p>	

		<p>10,000 year volume that outflows from the pond (after it has been routed through the pond, presumably through a hydraulic model) compared to the rainfall volume in (this appears to be the gross rainfall depth and not the net rainfall after the percentage runoff (PR as we understand it for the FEH/FSRR-R model is applied). So we are not comparing like for like with respect to the 27%.</p> <p>We believe that the 80-90% that Haycock have been talking about is comparable (interms of what is mean by it) with our 76% and BBV's 69.64% and is the percentage of rainfall that is converted to runoff into the reservoir (i.e. only in the hydrological model). However the 27% value attributed to BBV is the percentage of outflow from Highgate No. 1 compared to the total gross rainfall volume for the pond and is not comparable to the SPR and the PR we have been discussing. The Binnie SPR value of 47% is very similar to the adjusted value of 46% we got for our SPR before increasing it to 53% to account for summer drying and sompaction, and these values resulted</p>	
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		in PR of 76% for Atkins and 69.64% for Binnie for the PMF respectively.	
Heath & Hampstead Society 10/04/13	<p><u>Release of Water from the Ponds:</u> We understand from the City's Position Statement on Discharge of Water, November 2012, that the City is not liable for downstream consequences for additional flood water that safely overtops a dam. However, if there is an escape or a deliberate release of stored water, then liability under Rylands and Fletcher may apply.</p> <p>It may be necessary to open the valve on the outlet pipe of a pond for two reasons: in an emergency to lower rapidly the water level to prevent a dam breach; and also more routinely to release attenuated (stored) water after it has been held back behind higher dams during an extreme storm, to provide storage capacity for a future storm.</p> <p>What is the maximum rate of release from both Highgate and Hampstead No 1 ponds that will not incur liability under Rylands and Fletcher? If stored water is</p>	<p>Not in Atkins scope of work.</p> <p>City of London to respond.</p>	<p>This would need to be determined on a case by case basis.</p>

	<p>deliberately released from raised dams at upper ponds which then overtops the bottom ponds, what liability, if any, then applies?</p> <p>Has the City sought or received technical or legal advice on how it should exercise a choice between releasing water to prevent dam breach and not doing so?</p>		
<p>Heath & Hampstead Society 10/04/13</p>	<p><u>Natural Spillways:</u> Dr Hughes has stated that it is essential for the dams to be designed with spillways to take flood flow safely without significant erosion to the dam slopes, and that these may have to be in reinforced construction to minimise damage. He has indicated that 3 phase spillways may be considered (hard, soft with reinforced grass, and some crest overtopping), all sited on the dam and discharging down the downstream slope. We have suggested that an alternative concept of 'natural spillways' could be far preferable. These could be designed for extreme floods to discharge as overbank flows out of the sides of some reservoirs, and</p>	<p>While the natural spillway concept might appear feasible, flow through scrub, trees and fencing causes increased erosion on the downstream side of these features. These would tend cause further flow concentrations with enhanced erosion which could channel water back towards the dam mitres and cause damage in this location. Moreover, there could be backward erosion until the contents of the pond and cause increased damage downstream. It is more reliable to provide a soft engineered spillway to control the flow in a more reliable manner.</p>	

	<p>then flow through scrub, trees and fences, all left untouched, on a natural route to the lower pond which leaves the dam slopes, toe and mitres untouched. This would be similar to the way the spillway on the Model Boating pond discharges at present. Because natural ground slopes are shallow and the route avoids the dam structure, no surface reinforcement would be necessary, the existing landscape could remain untouched, and reinforced spillways may not be needed on the dam itself.</p> <p>Figure 5-2 clearly shows this side overbank possibility on the Highgate chain. Highgate Nos 2, 3 and 5 ponds appear easily suitable, and the other ponds may be able to use this principle with some ground re-shaping. Will Atkins investigate this in preference to reinforced spillways sited on the dams?</p>		
<p>Heath & Hampstead Society 10/04/13</p>	<p><u>Overtopping Data:</u> detailed queries:- - 1:5 year overtopping depth for Model Boating Pond seems odd.</p>	<p>Table 5-8 shows a negative overtopping depth which means that the pond does not overtop.</p>	

	<p>Please confirm.</p> <ul style="list-style-type: none"> - why is the overtopping depth increase between 1:1,000 to 1:10,000 years so small generally in comparison with the increases between all other events? - will Atkins provide graphs of overtopping velocity x time for all overtopping heights shown? 	<p>Because between the 1,000 and 10,000 year floods we change the FEH to FSR rainfall and there is little difference between the 1,000 year and the 10,000 year rainfall depths, hence similar for the overtopping depths.</p> <p>We have not produced such charts as they would be misleading because they would be based on a uniform smooth surface and the localized influences of fences, trees and slope irregularities and concentrated flows at low points on the crest would not be accounted for.</p>	
<p>Heath & Hampstead Society 10/04/13</p>	<p><u>Dam Breach Scenario and Quantified Risk Assessment:</u> Dr Hughes, Atkins Design Review Method Statement, and the City of London's report to the Consultative Committee on 8 April all state that the next steps should be to define the potential design options. We disagree and urge that a Tier 3 QRA be immediately carried out. Dr Hughes has previously advocated the use of QRA to inform the design process, and we understand that a dam breach analysis is required under</p>	<p>The breach modelling is in progress and the inundation areas are required to assess the population at risk and therefore to attempt a Tier 3 Quantitative Risk Assessment is premature. Moreover, from our experience QRA is unlikely to make a difference as to whether or not works are required because the probability of failure and the likely population at risk are too high in this case.</p>	

	<p>the Reservoir Act 1975. We urge that this should include the probability of dam failure. We therefore request that a QRA be carried out before potential design options are developed. (This qualifies our query of 25 March). When will this be available?</p>		
<p>Heath & Hampstead Society 10/04/13</p>	<p><u>Legal Issues:</u> Atkins Design Review Method Statement November 2012 states that <i>Dr Hughes has written to the Government asking for a hierarchy of Acts, i.e. Acts promoting Reservoir Safety (i.e. human life) vs 1871 Hampstead Heath Acts ensuring future of the Heath.</i> At the Consultative Committee meeting on 8 April 2013, Dr Hughes stated that he had not received a reply, even after a further request to the Minister, but he would show the response to us if received. We have previously stated that we consider it essential that the designers, and the community have a clear brief on all legal issues before design proceeds, and this issue remains outstanding. May we be given</p>	<p>The issue that is trying to be resolved is reservoir safety legislation works being delayed by other legislation. Resolution of this issue will not make any difference to need for works required on the Heath.</p> <p>Dr Hughes's communications with the Minister are personal and will not be made available.</p>	

	<p>copies of all correspondence by Dr Hughes with the Government and its agencies on this issue?</p>		
<p>Vale of Health Society 18/04/13</p>	<p>The catchment area figures in Table 4.1 (and the consequent flood estimates) are presumably based on the Boundary Maps in Figures 4.2-4.3, but I am concerned that part of the boundary VoH Pond and the Catch Pit catchment may not be drawn in quite the right place:</p> <ul style="list-style-type: none"> • Fig 4.3 shows the boundary between in the NE corner of the VoH catchment area (i.e. where it runs through the Vale) as running down the S side of the (E-W) Vale road which runs down to Spencer House and between the N & S Fairgrounds to the causeway which leads to the VoH Pond dam. • However, it is clear (from a visual check this morning) that the camber on this road runs N to S, so I don't see that the boundary can be on the <u>S</u> side of the 	<p>See Note of Meeting held on the 19th April 2013 (Appendix 6)</p>	

	<p>road.</p> <ul style="list-style-type: none"> • Perhaps more importantly, the N fairground slopes down N to S, and at least some of its run-off would therefore go across this road onto the S fairground and thence into the VoH Pond. • If this is correct, then a significant part of the run-off from the N (curved) part of the main Vale road and from the path in front of The Gables (and, a fortiori, from at least some of the NW corner of the Catch Pit catchment area: the bit shaded white on Fig 4.3) would also go into the VoH Pond. <p>If my analysis is valid, all this could shift quite a bit of flood water from Catch Pit to VoH Pond. It may be that any such move would nevertheless be insufficient to have a material effect on design recommendations but I would be grateful if the point could be checked.</p>		
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