

Hampstead Heath Ponds Project



**LOG OF QUERIES AND ANSWERS ON
HAMPSTEAD HEATH PONDS PROJECT**

25th October 2013

Contents

Log of Queries and Answers on Hampstead Heath Ponds Project	
Schedule of External consultation on Hampstead Heath Ponds Project	3
Hampstead Heath Ponds Project – Schedule of Question and Answers	4
Position Statement on Discharge of Water from Hampstead Heath	52
Drainage Location Plan	56



Log of Queries and Answers on Hampstead Heath Ponds Project

The Log of Questions and Answers on the Hampstead Heath Ponds Project includes a schedule of all external consultation on the Ponds Project from January 2011 and all queries from engagement with the Ponds Project Stakeholder Group (PPSG) and the wider public since October. The log is a 'live' document that is regularly updated and includes responses to queries by the design team.

Schedule of External consultation on Hampstead Heath Ponds Project

Date	Event
17 Jan 2011	Meeting between officers, Hampstead Heath Consultative Committee (HHCC), Nick Haycock, Andy Hughes and Heath & Hampstead Society, to discuss the project and the issues arising
19 Jan 2011	Meeting between officers, Nick Haycock and swimming groups to discuss the project and the issues arising
20 Jan 2011	E-bulletin update on the project published on the website
30 Jan 2011	Dams and Ponds page created on City of London website
8 Mar 2011	Swimmers Forum. Project discussed.
12 Mar 2011	HHCC walk including talk at Education Centre on hydrology by Nick Haycock
2 Apr 2011	Workshop for residents, members of interest and user groups of the Heath and staff. Gave detailed information on the areas that could be affected by a flood and initial concept designs
20 Apr 2011	Briefing delivered to Camden Council
21 Apr 2011	Heath & Hampstead Society regular quarterly walk- project discussed
26 Apr 2011	Water quality seminar attended by swimming groups, staff, Nick Haycock, HHCC, Management Committee, residents associations and anglers
1 May 2011	E-bulletin update on the project published on the website
9 May 2011	Report presented to Hampstead Heath Consultative Committee
23 May 2011	Evaluation report presented to Hampstead Heath, Highgate Wood and Queens Park Management Committee
7 Jun 2011	Swimmers Forum. Update on project given.
11 Jul 2011	HHCC – update in Matters Arising
5 Jul 2011	Site visit to ponds by Court of Common Council
14 Jul 2011	Evaluation report considered by the Court of Common Council
25 Jul 2011	Short update in Matters arising at Management Committee
1 Aug 2011	Meeting between officers, HHCC, Nick Haycock, Andy Hughes, Heath & Hampstead Society and swimmers to discuss further option following further assessment by Haycock and Hughes
26 Sep 2011	Update report presented to Hampstead Heath, Highgate Wood and Queen's Park Management Committee
19 Oct 2011	Swimming Forum. Project discussed
5 Nov 2011	HHCC walk – verbal update given
7 Nov 2011	Update report presented to HHCC
11 Nov 2011	Visit to a similar dam at Tilgate Park in Crawley by staff and members of Heath & Hampstead Society
28 Nov 2011	Hampstead Heath, Highgate Wood and Queens Park Management Committee. Mentioned in minutes approval.
18 Jan 2012	Heath & Hampstead Society regular quarterly walk. Members given a brief update on project and introduced to Communications Officer
18 Jan 2012	Swimming Forum. Members given an update on project

Date	Event
23 Jan 2012	Update report presented to Hampstead Heath, Highgate Wood and Queen's Park Management Committee
26 Jan 2012	Heath & Hampstead Society (Tony Hillier and Jeremy Wright) briefed on procurement process by officers and involvement in it
2 Feb 2012	Camden New Journal print story with update on project
2 Feb 2012	Ham & High print story about project
6 Mar 2012	Ladies bathing pond improvement meeting. Wider project discussed as part of the context for the improvement works
10 Mar 2012	HHCC walk. Brief update given on the project
12 Mar 2012	Update report presented to HHCC
14 Mar 2012	Jeremy Wright of Heath & Hampstead Society looks at documents at Heathfield House
15 Mar 2012	Meeting with Sally Gimson, ward councillor, and Paul Maskell to discuss project
4 Apr 2012	Jeremy Wright from Heath & Hampstead Society looks at documents at Heathfield House
18 Apr 2012	Swimmers' Forum – Ponds Project Stakeholder Group (PPSG) discussed and Communications Strategy shared with group
23 Apr 2012	Leaflet explaining why the work is necessary is distributed to 60,000 residents around the Heath and to visitors on the Heath
8 May 2012	Mixed bathing pond improvement meeting
21 May 2012	Report on Communications Strategy presented to the Hampstead Heath, Highgate Wood and Queens Park Management Committee.
22 May 2012	Presentation and site visit given to members of Camden Council Environment Scrutiny Panel
7 July 2012	HHCC walk – presentation on project
9 July 2012	Hampstead Heath Consultative Committee. Communications strategy and Terms of Reference of Stakeholders discussed as well as tender report
16 July 2012	Inaugural meeting of PPSG
18 July 2012	Swimmers forum. Members given an update on the project.
23 July 2012	Hampstead Heath Management Committee. An update report on the progress and procurement structure given to members.
9 Aug 2012	Ham & High –Chairman's column focuses on project
30 Aug 2012	PPSG attend presentations by two prospective candidates for the role of Strategic Landscape Architect.
14 Sep 2012	First pop-up consultation. These consist of two members of staff going out on Heath for a two hour session, providing information as well as canvassing opinion on the project.
1 Oct 2012	PPSG
6 Oct 2012	Walk with PPSG – Highgate Chain. Members of the PPSG taken on a walk down the chain, stopping to discuss the key issues.
8 Oct 2012	Swimming forum. Members given an update on the project.
10 Oct 2012	Pop-up consultation
18 Oct 2012	Camden New Journal briefed on project and prints update
27 Oct 2012	Pop-up consultation

Date	Event
29 Oct 2012	PPSG
30 Oct 2012	Pop-up consultation
6 Nov 2012	Pop-up consultation
6 Nov 2012	News release announcing appointment of Strategic Landscape Architect and providing information on PPSG as well as appointment of Atkins
8 Nov 2012	Ham & High – Chairman's column focusses on project
20 Nov 2012	Dr Andy Hughes briefs PPSG's Chairman, Deputy Chairman and Heath & Hampstead Society's representative on scope of fundamental review and indicative timescales of project
24 Nov 2012	Walk with PPSG – Hampstead Chain. Members of the PPSG taken on a walk down the chain, stopping to discuss the key issues.
26 Nov 2012	Update report presented to Hampstead Heath, Highgate Wood and Queens Park Management Committee.
28 Nov 2012	Design Review Method Statement, drafted by Atkins is released to PPSG for their comments
30 Nov 2012	Pop-up consultation
3 Dec 2012	PPSG – discussion on Design Review Method Statement
17 Dec 2012	Journalist briefing with Ham and High and News release with update on consultation opportunities throughout the project
19 Dec 2012	Pop-up consultation
20 Dec 2012	Ham & High piece profiling Strategic Landscape Architect
10 Jan 2013	PPSG workshop -Peter Wilder takes PPSG on virtual tour of the ponds looking at each site and noting threats and opportunities.
14 Jan 2013	Walk of Highgate Chain with residents from Brookfield Mansions and others who could not attend original walk.
14 Jan 2013	PPSG – follow up on 10 Jan workshop
14 Jan 2013	News release inviting views from public, covered in Ham & High
17 Jan 2013	Pop-up consultation
17 Jan 2013	Draft Critical Review by Peter Wilder, issued to PPSG for their comment
18 Jan 2013	Staff workshop which follows the same format as Peter Wilders.
26 Jan 2013	Posters put up on Heath inviting people to give their views
28 Jan 2013	Hampstead Heath Management Committee
28 Jan 2013	Simon Lee meets with Oak Village Residents Association to discuss issues relating to flooding.
31 Jan 2013	Adverts in Ham & High and Camden New Journal inviting people to give their views
31 Jan 2013	PPSG – special meeting to talk about programme.
7 Feb 2013	Camden New Journal print an update on project talking about 'landscape-led' approach
11 Feb 2013	PPSG – review of critical review
18 Feb 2013	Special meeting of PPSG to talk about communications
26 Feb 2013	Swimming Facilities Forum. Members given a briefing on project
7 Mar 2013	Pop-up consultation
11 Mar 2013	Adam Leys, a resident from Kentish Town given briefing on project

Date	Event
14 Mar 2013	Ham & High and CNJ run stories on results of Design Flood Assessment and the fact it will result in less intrusive work on the Heath.
15 Mar 2013	Walk of chain of ponds with members from Highgate Neighbourhood Forum
18 Mar 2013	Andy Hughes meets with residents from Oak Village and Elaine Grove
18 Mar 2013	PPSG – Andy Hughes presents the results of the Design Flood Assessment
20 Mar 2013	Simon Lee gives presentation on project to Highgate Area Action Group as part of Camden’s consultation on Flood Strategy
21 Mar 2013	Pop-up consultation
22 Mar 2013	Meeting with officers from CoL and Hampstead heath Anglers Society
22 Mar 2013	Workshop with young people at Queen’s Crescent Community Centre
27 Mar 2013	Pop-up consultation
8 April 2013	Special meeting of the HHCC – Andy Hughes presents results of Design Flood Assessment
9 April 2013	Visit to Abberton Reservoir with members of the Stakeholder Group
10 April 2013	Posters updated at Parliament Hill and Golders Hill Park
12 April 2013	Pop-up consultation. Around 40 people spoken to, approximately half were aware of project.
15 April 2013	PPSG – members of the design team give a presentation on the matrix and its function
19 April 2013	Meeting to discuss outstanding queries on Design Flood Assessment – attended by Andy Hughes, Mike Woolgar, Tony Bruggemann, Margareta Ayoung, Peter Snowdon, Ivan O’Toole, Richard Chamberlain, Charles Leonard, Karen Beare, Jeremy Wright, Jennifer Wood
24 April 2013	Pop-up consultation. Spoke to around 100 people, half of whom were aware of the project
25 April 2013	Tom Marshall, journalist at Ham & High is given a briefing on project
30 April 2013	Walk of Highgate Chain with Adam Leys and Caroline Hill, Chair of the Kentish Town Neighbourhood Forum
2 May 2013	Chairman’s Column in Ham & High with update on project
9 May 2013	Sign erected on Pond Box and on causeway between Mixed Pond and Hampstead No. 2.
9 May 2013	Report on Design Flood Assessment taken to Hampstead Heath, Highgate Wood and Queens Park Management Committee.
13 May 2013	PPSG Meeting
18 May 2013	PPSG workshop on unconstrained list
21 May 2013	MP Mark Fields is briefed on project and taken on site
29 May 2013	Pop-up consultation
3 June 2013	New Ponds Project leaflet produced
5 June 2013	Staff workshop – unconstrained list
7 June 2013	Pop-up consultation
7 June 2013	Constrained Options Report published and distributed to PPSG
10 June 2013	Briefing and press release to Ham & High
12 June 2013	Pop-up consultation
13 June 2013	First eNewsletter distributed to 900 email addresses, with details of Constrained Options Report

Date	Event
17 June 2013	PPSG walk and meeting to discuss outstanding queries on unconstrained list
27 June 2013	Pop-up consultation
30 June 2013	Pop-up consultation – City of London Festival
2 July 2013	Pop-up consultation (with Atkins)
8 July 2013	HHCC – Update report and unconstrained options presented
9 July 2013	PPSG (Jeremy Wright, Susan Rose and Marc Hutchinson)meet with Atkins in Epsom to discuss – Kenwood, QRA, hydrology
12 July 2013	Staff forum – discuss opportunities
13 July 2013	PPSG workshop – shortlist of options
16 July 2013	Pop-up consultation
22 July 2013	Hampstead Heath Management Committee – update report
22 July 2013	PPSG – meeting – continuation of discussion on shorter-list of options
25 July 2013	Staff workshop – shorter-list of options
26 July 2013	Pop-up consultation
5 Aug 2013	Shortlist Options Report published and distributed to PPSG and to wider public with newsletter.
6 Aug 2013	Pop-up consultation
9 Aug 2013	Hampstead Heath Anglers Society briefed as part of a regular meeting.
14 Aug 2013	Brookfield Mansions and EGOVRA residents meet with Atkins to discuss issues relating to Highgate No. 1 Pond.
11 Sep 2013	Evening Standard run story based on QRA
11 Sep 2013	ITV news covers Ponds Project
11 Sep 2013	Walk with West Hill Court residents (Jennifer Wood and Simon Lee)
14 Sep 2013	PPSG workshop – preferred options
18 Sep 2013	Pop-up consultation
18 Sep 2013	Email to all staff
18 Sep 2013	Legal meeting between City and H&HS
20 Sep 2013	H&HS visit to Atkins to deal with outstanding queries to Shortlist Options Report (Jeremy Wright)
27 Sep 2013	PPSG meeting with Atkins to discuss QRA
27 Sep 2013	Pop-up consultation
27 Sept 2013	Highgate Men’s Pond Association meet with Atkins to deal with outstanding queries to Shortlist Options Report
30 Sep 2013	PPSG meeting
3 Oct 2013	Pop-up consultation
9 Oct 2013	Pop-up consultation
14 Oct 2013	PPSG meeting
23 Oct 2013	Pop-up consultation
25 Oct 2013	West Hill Court Residents meeting

Hampstead Heath Ponds Project – Schedule of Question and Answers

Source	Query Number	Query	Design Team Response
Charles Leonard, EGOVRA Via email 23 October 2012	1	Please would the CoL clarify what the legal situation is regarding - its own duties and responsibilities to mitigate and/or prevent downstream flooding to us neighbours including how this impacts upon the Design process - and also whether the CoL would be liable for damage caused should this occur?	The City of London presented a Position Statement in response to the questions raised by EGOVRA this was issued on the 28th November 2012. This is appended to this Schedule.
	2	It would also be very helpful if your lawyers would clarify what the responsibilities are of the other main players in this scenario (eg Camden and Thames Water) and how and what the CoL is doing to liaise with them in protecting us against flooding from over-topping.	See Position Statement.
	3	4. Taking the lead - Involving others such as Camden and Thames Water now - and in the Fundamental Review and Design process In the meeting of 16th July 2012 I asked if the CoL were involving Camden and/or Thames Water but there was no actual answer. The minutes simply say that I asked about Camden (not Thames Water) and that 'This can be considered by the SG' but so far nothing has happened that I am aware of. I am a little concerned that there is not much follow up from issues raised at our meetings	See Position Statement.
	4	I am not a lawyer nor an engineer but it seems obvious to me that this represents a tremendous opportunity for the CoL, Camden and Thames Water (who I believe are the main players in this issue) to evolve and implement a scheme that minimises the risk of downstream flooding if they work together from the start. At present, it seems there is very little 'liaison' between the three parties - unless there is more going on that we don't know about.	See Position Statement.
	5	5. Peter Wilder's brief and scope Please would you clarify if these issues of 'over-topping' and 'downstream flooding' fall into the scope of Peter Wilder's brief? I would obviously hope they do!	The Strategic Landscape Architect shall act as a representative of both the City and the Stakeholder groups, championing the landscape and environmental aspects contributing with imagination and knowledge to the design thinking and challenging any emerging engineering solutions that fail to respect these aspects
	6	6. The post 1975 flood works I'd also be grateful for any information you have about the works that were done to mitigate/prevent a repeat of the flooding following the floods in 1975? I'm particularly interested in the large underground storage tunnel that I gather was built. I have always understood this was to protect us from future flooding somehow and would appreciate information about its purpose, size, through-put capacity and its location including entrances and exits and whether it discharges into the normal sewer system or some other tunnel.	A plan was produced by Thames Water at its presentation to Stakeholders on the 14th January 2013 showing the flood relief system. The City of London Corporation issued a diagrammatic representation of the pipe network from the ponds to EGOVRA on the 24th May 2013 (appended to this schedule).
	7	7. The water release valve to Highgate Pond No 1 I'd also be grateful for any information you can give me about the capacity of the valve system you showed us that releases water from Highgate Pond No 1? I think you said that this valve system releases water into an underground sewer pipe belonging to Thames Water (is that right?). I am interested in how much water this can take off the Heath when required including how much 'spare capacity' to Highgate Pond No 1 could be created in a given timescale, etc.	See plan appended to this schedule. The capacity of the 350mm diameter scour pipe is likely to be less than 1m ³ /s and so it will take many hours more to empty this pipe into the sewer system (if this was theoretically allowed) than the time to peak of the flood from a 1:10,000 year storm event (around 3 hours). Thames Water's sewer systems are only designed for small flood events up to around a 1:75 year return period event. Standard guidance on dam safety requires that dams can safely pass floodwater from a PMF, with spillways able to pass the floodwater from a 1:10,000 year event, so the existing sewer system cannot accommodate these kinds of floods.

Source	Query Number	Query	Design Team Response
Jeremy Wright, H&HS on Design Review Method Statement 10 December 12	8	Section 1: It would be helpful if the Project Stages in the Instruction to Tender could be defined	This information will follow when the programme is circulated (separate document)
	9	Section 1: Two options only are proposed for detailed modelling. We suggest that the number of limited final options remains open until possibilities become clearer	We will involve the stakeholders throughout the options process, so the logic we use in moving from the long unconstrained list to the final shortlist will be clear. The final options themselves may have sub-options. Since limited opportunity is expected for significant works at most of the ponds, there will have to be flexibility in the two detailed options. This flexibility is likely to be provided by these suboptions at a limited number of locations.
	10	Section 2.1.3: Please explain why both cascades are to be integrated into a single model, rather than being considered separately. These cascades are largely separate except for downstream consequences in the improbable event of dam collapse simultaneously in both chains	We will be running the two cascades as separate models when assessing the effects of large flood events, identifying spillway capacity etc. During a PMF event, it is possible that both chains would be subjected to the PMF (considering the short distance between the two chains), so failure in both chains is credible. The two cascade models will therefore be joined at the last stage of dam-breach modelling, so that we can simultaneously test the scenario of dam collapses on both chains.
	11	Section 2.2.1: The Strategic Landscape Architect is likely to have a significant contribution in this options phase but is not mentioned	Agreed, text will be added to this effect.
	12	Section 2.2.1: We support avoiding works at most sensitive areas, but suggest that it is too soon to propose any specific intentions, (eg. to avoid work at the Bird Sanctuary Pond and perhaps concentrate works at the Model Boating Pond), until views are obtained from all interested organisations.	Agreed. We felt that an early reassurance on the minimisation of works to the more sensitive areas such as the Bird Sanctuary would help gain confidence from the stakeholders.
	13	Section 2.2.2: We welcome the comment from Mike Woolgar on 3 December that this does not necessarily imply that a progressive collapse of every dam in both chains will be assumed to occur near simultaneously, as taken by Nick Haycock	As stated in version 3, we are proposing to model progressive collapse scenarios. The additional reference could be that "We will use the model to estimate the overall time frame of the progressive collapse scenario in each chain". Dam breach is unlikely to occur at the same time on two dams in one chain. However, as mentioned above, it is credible that two sets of progressive collapses could occur simultaneously in a PMF event, given the proximity of the two chains.
	14	Section 4: We would appreciate a likely date for issue of the Communications Strategy and programme, as we suggest it is urgent to raise awareness with the general public, and well before the public consultation proposed in 2.2.4, 4)	Communications Strategy issued to PPSG February 2013
	15	Section 5: In the Planning Strategy, please also set out all documents required for planning application and other permissions.	Stage C – This information will be presented to stakeholder group at a later stage.
	16	Project Programme: If likely dates for all the proposed reports and milestones are shown, this will greatly help stakeholders and other to plan referral discussions within their organisations. Early issue of this programme would be helpful.	Programme Circulated end of 2012
	17	Appendix A2, 4.5: We note the Panel Engineer's comment re spillway capacities. Please clarify what return periods will be used for overflows and spillways. We submit that a simple graph showing flood precipitation x frequency (return period) would aid understanding by the stakeholders	This is mentioned earlier in line 4.2. The reservoirs will be assessed following ICE guidelines in Floods & Reservoir Safety, which require the spillway of a Category A dam to safely pass a 1:10,000 year flood (with the rest of the PMF flow safely passing over the crest). The Panel Engineer might consider a proposed spillway with 1:1000 year capacity, but the dam crest must safely pass the rest of the PMF flow. A graph of flood precipitation vs return period is not yet available but could be provided at a later date following the completion of the hydrological review.
18	Appendix A2: Page 4 of HHS proposals is missing	Fixed in the final document.	

Source	Query Number	Query	Design Team Response
Harriet King, Brookfield Mansions on Design review Method Statement 20 December 2012	19	Appendix A 7.2 We're not clear what 'safe' discharge is. Is this discharge that can be accommodated in the existing sewers? If not, clear information should be provided that will enable residents to assess their exposure to flood risk and insurers to determine the cost of the risk. This should, in turn, encourage flood risk mitigation by all parties, particularly as the insurance industry plays a vital role in funding the rebuilding, repair or replacement of damaged homes, infrastructure etc.	This was an issue raised by the Heath & Hampstead Society in relation to the Design Methodology. The City of London's responsibilities are set out in the Position Statement appended to this schedule.
	20	We have a concern as to how the works will be carried out and should like a description of possible access routes for vehicles and storage of materials together with an assessment of probable disruption to be included in evaluation of the options.	This will form part of the development of preferred options and will be an important consideration by the construction contractor. Representatives of the Stakeholder group have been involved in the selection of the preferred contractor.
Karen Beare, Fitzroy Park RA on Design Flood Assessment 20 March 2013	21	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?	"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 Standard Percentage Run-off which was provided by the automated routine with the FEH CD ROM. The HHSS rainfall record was analysed and it was demonstrated that it was statistically inconsistent with the information from the FEH. This is to be expected as it is statistically unreliable to apply data from a single rain 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).
Karen Beare, Fitzroy Park RA on Design Flood Assessment 20 March 2013	22	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 Design Flood Assessment report – a width of 10m was adopted.
Karen Beare, Fitzroy Park RA on Design Flood Assessment 20 March 2013	23	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 Office determination methodology. Which one is it?	When estimating events with return periods i.e. 5, 20, 50, 100, 1,000 and 10,000 years, the national rainfall records are used on a statistical basis. For estimation of the PMF, the Probable Maximum Precipitation (PMP) is required. The PMP is derived in a deterministic manner (based on an estimation of the maximum volume of rainfall theoretically possible, using atmospheric physics) and the FSR report includes maps of PMP which were prepared by the Met Office.
Karen Beare, Fitzroy Park RA on Design Flood Assessment 20 March 2013	24	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.	Atkins used computer software which is widely used within industry to extent that it can be considered to be industry "standard" software. The Atkins' hydraulic modelling incorporated 2 dimensional modelling 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 level and pond surface area, and the overflows by a mathematical expression for the relationship between the water 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 variation of the flow around the ponds. Haycock by contrast used only 1 dimensional modelling 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. The Atkins modelling was more sophisticated in that it also modelled the areas around the ponds.

Source	Query Number	Query	Design Team Response
Karen Beare, Fitzroy Park RA on Design Flood Assessment 20 March 2013	25	Who wrote 'Floods and Reservoir Safety – 3 rd Edition'?	Floods and Reservoir, 3 rd Edition, was published by the Institution of Civil Engineers in 1996.
Jeremy Wright H&HS, on Design Flood Assessment 25 March 2013	26	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 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?	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.
Jeremy Wright H&HS, on Design Flood Assessment 25 March 2013	27	Upstream Spills: The original Table 1-4, Pond Storage Capacity, [Table 5-7 is identical], states in column 3 excludes spills from the upstream pond. A revised Table was issued on 21.3.2013 with altered % storage figures in the last column. Column 3 heading now reads including spills from the upstream pond. Should the data in the 3rd column [Total PMF volume...] be altered to show increased inflow?	The Table has been revised the report reissued.
Jeremy Wright H&HS, on Design Flood Assessment 25 March 2013	28	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 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.	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 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 are provided.
Jeremy Wright H&HS, on Design Flood Assessment 25 March 2013	29	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 these flows will be attenuated by the lake chain and these values thus represent the boundary conditions of the lake model. Please therefore clarify this aspect, particularly for upstream inflows and whether current attenuation has been allowed in this and other relevant tables.	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.
	30	Quantified Risk Assessment: Atkins has confirmed in Appendix A of their Design Review Method Statement and separately that 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.	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.
Jeremy Wright H&HS, on Design Flood Assessment 25 March 2013	31	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.
Jeremy Wright H&HS, on Design Flood Assessment 25 March 2013	32	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.
Jeremy Wright H&HS, on Design Flood Assessment 25 March 2013	33	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 and durations, and why the Atkins durations of 9.5 hours and 1.9 hours are so different	Atkins extracted rainfall depths from the FSR for the PMF 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 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 choose a fixed 4.4 hour duration, which is not a correct approach.

Source	Query Number	Query	Design Team Response
Jeremy Wright H&HS, on Design Flood Assessment 25 March 2013	34	<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 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 the 10,000 and PMP rainfall to be the same as the ratio between the 10,000 flow and the PMF.</p>
Jeremy Wright H&HS, on Design Flood Assessment 25 March 2013	35	<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 Reservoir routing resulted in generally lower overtopping depths than those predicted by Haycock. 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>
Peter Wilder, Strategic Landscape Architect on Design Flood Assessment 22 March 2013	36	<p>The calculations for Stock Pond seemed to attribute the entire catchment north of Stock Pond to that pond alone and do not take into account any attenuation or holding back that the two Kenwood Ponds offer.</p> <p>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>The temporary storage capacity of the Kenwood Ponds was judged to be negligible.</p> <p>The Kenwood Ponds have been modelled to assess how much water they would store during the PMF event and it was found that they would provide negligible storage so the effect of them would be insignificant. When storage in the Kenwood Ponds is taken into account, the depth of overtopping at stock Pond changed by 10mm to 20mm, thus showing that the influence of the Kenwood Ponds is negligible.</p>

Source	Query Number	Query	Design Team Response
Harriet King, Brookfield Mansions on Design Flood Assessment 27 March 2013	37	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 worse we would wish assurances that all flood waters are managed and controlled into the drainage and storm water systems in such a manner that it minimized any risk to life and property. The results from the investigation as shown in your report should be considered in conjunction with the capacity of the drains and sewers to cope with any water arising. All parties should be able to easily understand and to compare what the effect of future proposals may be with the existing situation, particularly where the residential areas affected by surface water from the Heath are likely to be affected.	<p>Camden Council are the Lead Local Flood Authority and have statutory responsibilities in terms of surface water flooding.</p> <p>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.</p> <p>Dr Hughes (the Panel Engineer) has advised that the proposed works on the Heath will not increase surface water flooding.</p>
	38	We understand that Dr. Hughes and CoL will liaise with Camden (as lead authority), TWA, EA and DEFRA and provide them with up to date information. We should like to know how and with whom this information will be shared.	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.
	39	Clear information should be made available that will enable residents to assess their exposure to flood risk and insurers to determine the cost of the risk.	Flood maps are available on the City of London Corporation and Environment Agency websites. We are unable to comment on insurers' requirements.
	40	Camden have said that they may have access to government funding if flooding is likely to occur in an event of 1:75 or less. TWA have a statutory obligation (I believe) to drain surface water arising from a 1:30 event. We should like confirmation in the light of the new calculations that anticipated volumes, speed and location of surface water arising from all events, including 1:30 and 1:75 events, be made available to statutory authorities.	The City of London Corporation will continue to liaise with the responsible statutory authorities
	41	We should like consistent and reliable information made available on the size, location and connections of drains and sewers, both for surface, foul (combined sewers) and storm water.	Thames Water Authority holds information on the surface water sewer system. The City of London Corporation has provided all of the information that has been made available to it.
	42	The figures given for the Hampstead chain indicate that the capacity of the Hampstead chain to cope with major events is better than that of the Highgate chain. A dry reservoir which will further 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.	The issue of attenuating water is a key component in both chains of ponds. All options will be considered.
Harriet King, Brookfield Mansions on Design Flood Assessment 27 March 2013	43	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?	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 QMean (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.
Charles Leonard, ECOVRA on Design Flood Assessment 28 March 2013	44	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 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>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 of any of these studies.</p> <p>Also please see Position Statement issued on 28/11/12, appended to this Schedule.</p>
Charles Leonard, ECOVRA on Design Flood Assessment 28 March 2013	45	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>See Table 5 – 12 in main report.</p> <p>All Atkins can say at this stage is that the works will not make the situation worse than they are now.</p>

Source	Query Number	Query	Design Team Response
Charles Leonard, ECOVRA on Design Flood Assessment 28 March 2013	46	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 assess this' would be most helpful.	In the existing scenario, a flood of return period greater than 1:1,000 years would cause overtopping of the dam at Hampstead No.1 Pond. In the current preferred options, this standard of protection is either matched (Option M) or exceeded (Option P).
Charles Leonard, ECOVRA on Design Flood Assessment 28 March 2013	47	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?	Work produced by Atkins is the property of the City of London. 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.
Charles Leonard, ECOVRA on Design Flood Assessment 28 March 2013	48	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...	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 for the heath, the composition of soil does allow for infiltration on some parts of the Heath.
Charles Leonard, ECOVRA on Design Flood Assessment 28 March 2013	49	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 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.	Atkins output is the property of the City of London. 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. 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.
Charles Leonard, ECOVRA on Design Flood Assessment 28 March 2013	50	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?	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.
Charles Leonard, EGOVRA on Design Flood Assessment 28 March 2013	51	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 overspill for different rainfall storm events?	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. Please also see answer to query 79.
Charles Leonard, EGOVRA on Design Flood Assessment 28 March 2013	52	May we have any information Atkins has about the pipeworks underneath and around the Heath (in our area), including 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.	The attached plan shows the location of outflow and drawdown valves associated with Heath ponds and the Thames Water Authority 'Flood Alleviation Tunnels'.

Source	Query Number	Query	Design Team Response
Colin Gregory, Garden Suburb Residents Association on Design Flood Assessment 4 April 2013	53	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 that correct?	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 provides the dam categories and the design flood inflow.
	54	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 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.	The approach is consequence based and so the categorisation is based 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.
	55	<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).</p> <p>I think we need more information about what the current risk of breach is (as 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.</p>	<p>Where a breach could endanger lives in a community, the dam is Category A and the design flood is the Probable Maximum Flood.</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 localised effects of trees, fence posts, small changes in slopes all of which contribute significant concentrations of high velocity flow. These concentrations will exacerbate erosion damage which could lead to a breach.</p>
David Lewis, Protect Our Ponds on Design Flood Assessment 8 April 2013	56	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 the their current state.
David Lewis, Protect Our Ponds on Design Flood Assessment 8 April 2013	57	<p>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):</p> <p>It should be noted that where a particular option has been flagged as red, i.e. the option has been 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. 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>It would not be precluded from the scheme provided that appropriate environmental mitigation and/or enhancement measures can be implemented on the advice of the 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>
Susan Rose, Highgate Society on Design Flood Assessment 9 April 2013	58	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? In the events of a Kenwood pond dam overtopping or collapsing would English Heritage be liable under Rylands and Fletcher?	<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>If the dams collapsed, then English Heritage would be liable under Rylands and Fletcher but not if there was no collapse.</p>
Susan Rose, Highgate Society on Design Flood Assessment 9 April 2013	59	In the events of a Kenwood pond dam overtopping or collapsing would EH be liable under Rylands and Fletcher?	<p>English Heritage would be liable under Rylands and Fletcher if the dams collapsed, but not if the dams overtopped without collapsing.</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>

Source	Query Number	Query	Design Team Response
Jeremy Wright, H&HS on Design Flood Assessment 10 April 2013	60	<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.</p> <p>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 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>We cannot change the percentage that FEH assumes in its equation for urban area adjustment.</p> <p>Please also see answer to query 78.</p>
Jeremy Wright, H&HS on Design Flood Assessment 10 April 2013	61	<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 print outs 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 10,000year and the PMF respectively.</p> <p>The reference to the 27% is from a table in the Haycock's report, which is given for Highgate 1 pond for the 10,000 year event. The 27% seems to be referring to the percentage of the 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 (in terms of what is meant by it) with our 76% and BBV's 69.64% and is the % 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 1 compared to the total gross rainfall volume for the pond and is not comparable to the SPR and 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 compaction, and these values resulted in PR of 76% for Atkins and 69.64% for Binnie for the PMF respectively.</p>
Jeremy Wright, H&HS on Design Flood Assessment 10 April 2013	62	<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>Not in Atkins scope of work.</p> <p>If water is deliberately released and it causes damage downstream, then there would be liability under Rylands and Fletcher.</p>
	63	<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 deliberately released from raised dams at upper ponds which then overtops the bottom ponds, what liability, if any, then applies?</p>	<p>This would need to be determined on a case by case basis.</p>
	64	<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>Please see Position Statement.</p>

Source	Query Number	Query	Design Team Response
Jeremy Wright, H&HS on Design Flood Assessment 10 April 2013	65	<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 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>While the natural spillway concept might appear feasible, flow through scrub, trees and fencing causes increased erosion on the downstream side of the 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>
Jeremy Wright, H&HS on Design Flood Assessment 10 April 2013	66	<p><u>Overtopping Data:</u> detailed queries:-</p> <ul style="list-style-type: none"> - 1:5 year overtopping depth for Model Boating Pond seems odd. Please confirm. - 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? <p>will Atkins provide graphs of overtopping velocity x time for all overtopping heights shown?</p>	<p>Table 5-8 shows a negative overtopping depth which means that the pond does not overtop.</p> <p>Because between the 1,000 year and 10,000 year floods we change from 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 be not be accounted for.</p>
Jeremy Wright, H&HS on Design Flood Assessment 10 April 2013	67	<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 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>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>
Jeremy Wright, H&HS on Design Flood Assessment 10 April 2013	68	<p><u>Legal Issues:</u> Atkins Design Review Method Statement November 2012 states that 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. 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 copies of all correspondence by Dr Hughes with the Government and its agencies on this issue?</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>
Jeremy Wright at Design Flood Assessment meeting on 19 April 2013	69	<p>Is calculated percentage run-off into the upper and more sensitive ponds too high?</p>	<p>Margaretta Ayoung described percentage run-off and how it had been calculated. AH said Atkins must follow best practice methodology and think of the next Inspecting Engineer – they must be happy with his estimates and must be able to reproduce them in the future. They would follow best practice and take into account local conditions.</p>
Karen Beare at Design Flood Assessment meeting on 19 April 2013	70	<p>How have Atkins taken into account local conditions?</p>	<p>Margaretta Ayoung showed on the slides the different catchment areas and how they are cumulative as you go down the chain. She said the Flood Estimation Handbook (FEH) has a high level of detail. The FEH provides depth/frequency curve and it includes rain gauges over a wide area. The point of using a large data set, as included in the FEH information, is it is much more statistically reliable.</p>

Source	Query Number	Query	Design Team Response
Jeremy Wright at Design Flood Assessment meeting on 19 April 2013	71	How detailed is the FEH and are slopes taken into account?	<p>Data is provided for half km squares and yes slopes are taken into account.</p> <p>Margaretta Ayoung went on to explain the difference between the Standard Percentage Runoff (SPR) and the Percentage Runoff (PR). The SPR is the runoff associated with the 29 soil types included in the FEH data base. The PR is the estimate of the runoff that would be expected to occur in the field and is calculated by adjusting the SPR by two dynamic factors (copies of pages 26-27 of the Assessment of Design Flood Report were handed out). MA explained that the FEH provides for 29 different soil types (using the UK Hydrology of Soil Type (HOST) values) representing all of the different soil types found in the UK.</p> <p>MA said 30.97% is the default SPR for Hampstead which is based on the two main soil types that occur in the Heath. The FEH default SPR was adjusted to the local conditions on the Heath by taking account of the area (plus 10m buffer) of footpaths that Haycock assessed as being heavily compacted. This adjusted SPR was carried through to the PR calculation.</p>
Karen Beare at Design Flood Assessment meeting on 19 April 2013	72	Does it included the overlay of geology?	<p>The FEH soil type data base takes into account the geology of the area.</p> <p>MA said a width of 10 m was added on either side of the footpaths to allow for additional soil compaction on either side of the footpaths. – this was then used to adjust the 30.97% to get 46%. This derived value, 46%, was then increased to a value of 53% as is recommended by the FEH for catchments prone to drying and compaction.</p>
Jeremy Wright at Design Flood Assessment meeting on 19 April 2013	73	Should an adjustment for compaction be made to upper catchment, which potentially have fewer footpaths?	<p>Margaretta Ayoung showed the results of sensitivity analyses, which showed that any resulting difference in overtopping depth is not significant.</p>
Jeremy Wright at Design Flood Assessment meeting on 19 April 2013	74	Can stakeholders have a detailed explanation of the method of calculating 1:10,000 and PMP flows and the peak storm durations?	<p>Answer: MA said the Probable Maximum Precipitation (PMP) was estimated by the Meteorological Office and is based on the physics of the atmosphere – it is an estimate of the maximum amount of water the atmosphere can hold. This exercise was carried out by the Met Office over the whole country and a series of maps for the whole country is included in the Flood Studies Report. The 10,000 year rainfall is based on a statistical examination of rain gauge data for the whole country. For any catchment that you choose you can obtain the 10,000 year rainfall information from the Flood Studies Report. KB asked what weighting was given to local data and if climate change was taken into account.</p> <p>MA said climate change was not taken into account as these are already extreme events.</p>

Source	Query Number	Query	Design Team Response
Charles Leonard at Design Flood Assessment meeting on 19 April 2013	75	What about the EU directive?	<p>MA said EU flood directive is for floods of a smaller return period and the PMF is a flood so extreme that it does not have an adjustment for climate change as is required by the EU directive for smaller floods.</p> <p>MA said that there was only 100 years of local rainfall data which is too short a record length to use in deriving the extreme floods required for this project. She stated that a common rule of thumb is that the return period which can be reliably derived from a dataset of N years in length, is N/2. Hence for Hampstead Heath the HHSS rainfall data could also be used to reliably derive rainfall depths of up to the 1 in 50 year rainfall. When asked why the HHSS data was not used to provide the rainfall depth up to the 1 in 50 year rainfall, she said the local HHSS 1 in 50 year rainfall depth agrees with the FEH 1 in 50 year rainfall depth for the 24 hours duration storm, so the local data would not make a meaningful difference for these short return period floods. In addition, the HHSS rainfall data is daily total rainfall and the flood estimation for Hampstead Heath requires sub-daily data (because the critical storm durations are of a few hours rather than days), so the HHSS data set could not be used in any case on its own.</p>
Jeremy Wright at Design Flood Assessment meeting on 19 April 2013	76	Surprised that the PMF/1:10,000 ratio at the bottom dams results in ratios of 2.12 and 2.22, bearing in mind that ratios on some dams in other parts of the country can be much lower, e.g. Tilgate Dam PMF is only 1.14x10,000 year flood. Why does the Heath have what appears to be an unusually high ratio?	<p>MA and AH explained that there is no fixed ratio between the 10,000 year PMF peak flow. The ratio is a function of the physical characteristics of a given catchment. Floods and Reservoir Safety provides approximate guidance and suggests a ratio of 2 which is close to ratio Atkins obtained on the Heath.</p> <p>AH added that the floods at Tilgate would be influenced by the presence of the M23 and the reservoir chain is much smaller than on the Heath. AH confirmed that he is happy with the ratio for Hampstead Heath.</p>
Jeremy Wright at Design Flood Assessment meeting on 19 April 2013	77	What detailed work has been carried out by Atkins to demonstrate that flows into the Stock Pond are not over-estimated? Please give details of the modelling done on the Kenwood Ponds	<p>Answer: AH said the Kenwood ponds had been modelled to assess how much water they would store during the PMF event and it was found they would provide negligible storage so the effect of them would be insignificant.</p> <p>AH said output from the modelling of these ponds could be shown to the stakeholder group.</p> <p>MA showed a table of results which showed that when the storage of the Kenwood Ponds is taken into account, the depth of overtopping at Stock Pond changed by 10mm to 20mm, thus showing that the influence of the Kenwood Ponds is negligible.</p>
Jeremy Wright at Design Flood Assessment meeting on 19 April 2013	78	H&HS believe the run-off taken for the Highgate slopes is far too high and account needs to be taken of the fact that much of the area described as urban is in fact of rural character (large gardens) that would absorb much of the water. Also asked why the urban catchment percentage for the Bird Sanctuary is higher than Hampstead No. 1 pond.	<p>MA responded that the catchment areas used to derive the floods are cumulative so that urban extent values were for the cumulative catchments and not the intermediate catchments which JW was describing. This is why the urban extent value generally increases as you go down chain. Gardens have been taken into account as FEH urban extent value is comprised of values for urban as well as suburban grid cells based on a half a kilometre square resolution. FEH therefore preserves the green areas within each 0.5 kilometre square cell if the cell is not 100% covered by urban landuse and treats urban and suburban differently. In addition, the urban extent has been updated using OS mapping and there is a facility to update urban extent to take account for urbanisation since urban extent was derived.</p>

Source	Query Number	Query	Design Team Response
Jeremy Wright at Design Flood Assessment meeting on 19 April 2013	79	Stakeholders would like further details on the rate of release from the scour pipe of Highgate No. 1 Pond.	<p>Answer: AH said the estimated rate of release from this pipe is 10 litres per second and it would take 15 hours to get the water level down 0.4m. The PMF flood peaks at 32000 litres per second.</p> <p>CL asked if the scour pipe would be removed as Simon Lee had indicated it might not form part of the final design.</p> <p>AH said he had no intention of getting rid of the scour valves, as there was no reason to do so and they are useful for normal circumstances CL asked how often the valves had been used to release water downstream. AH said he was not sure – anecdotally he had heard they had been used a couple of times in the past.</p> <p>PS said the City would probably not have that information but he had also heard anecdotally they had been used a few times.</p> <p>AH said he opens the valves every six months when he inspects the dams.</p>
Jeremy Wright at Design Flood Assessment meeting on 19 April 2013	80	H&HS said Atkins have rejected spillways which would follow small natural "valleys" on the sides of some of the ponds, and asks why?	AH said nothing had been rejected as the project was not in the design stage. The decision on what sort of spillways has still to be made.
Charles Leonard at Design Flood Assessment meeting on 19 April 2013	81	Do Thames Water/ Camden Council / Atkins /City of London all mean the same when they talk about different event sizes e.g. 1 in 20, 1 in 50 etc.	Yes they should all mean the same thing
Charles Leonard at Design Flood Assessment meeting on 19 April 2013	82	Can the runoff data for other rainfall event sizes be given to stakeholders?	Yes, Atkins provided the runoff data (in a hydrograph) for a 1 in 5, 1 in 20, 1 in 50 and 1 in 100 year events for each pond on 23 May 2013
Harriet King 19 April 2013	83	Is the overflow pipe at Highgate No. 1 significant?	AH said Highgate No. 1 has an overflow and a drain pipe at a lower level (which release water at 10 litres per second. AH said the overflow is at high level and is running all the time.
Karen Beare at Design Flood Assessment meeting on 19 April 2013	84	There is confusion about other large rainfall events that had happened on Hampstead, i.e. 1975 event, 2002 event, 2010 event. Could Atkins work out how much rain had fallen during these large events so it can be communicated to stakeholders and the wider public what has been happening on the Heath.	Atkins to estimated the return period of these storms and shared the data on 23 May.
Charles Leonard at Design Flood Assessment meeting on 19 April 2013	85	What is the capacity of the emergency valve system on Highgate No. 1 pond?	The capacity of this pipe requires calculation but as it is only 350mm in diameter it is unlikely to be more than 1m ³ /s.

Source	Query Number	Query	Design Team Response
Charles Leonard at Design Flood Assessment meeting on 19 April 2013	86	Stakeholders would like verification that situation downstream will not be made worse following the work.	AH described that any work they do will help the situation downstream as they will be creating more storage area for water further up the chain so it will be released downstream in a controlled manner less than the natural peak rate. This is true for all sizes of storms, including the smaller storm events and not just the ones that threaten dam failure and that this could be verified through the hydraulic model. Additional Note October 2013: This verification has since been done, and it has been shown that the frequency of flooding downstream will be reduced as a consequence of these works.
Jeremy Wright at Design Flood Assessment meeting on 19 April 2013	87	In the area above Stock Pond the terrain appeared to be favourable to the temporary storage of runoff. Has been taken into account?	Localised micro-topography does not have a significant influence on flood estimates, particularly for the longer return periods and PMF.
Ian Harrison 19 April 2013	88	Questioned whether the catchment boundaries shown in Figures 4-2 and 4-3 have been drawn correctly as visual observations on the ground suggested more water would flow to Vale of Health Pond and less to Catch Pit than suggested by the boundary shown on Figure 4-3?	MA replied that because the flood estimates have been based on cumulative catchment area above each pond, these variations in the catchment boundaries would have an insignificant effect on the flood estimates. Moreover, that in the context of the size of the catchment area as a whole, the suggested boundary variations would have negligible effect on the estimated flood flow.
Jeremy Wright H&HS on Constrained Options report 25 June 2013	89	We agree with the principle of attenuation if this will reduce or avoid the need for work on sensitive ponds. However, for comparison purposes we would like to see visual images of the option of spillways on both chains without any increased attenuation.	To pass the PMF and achieve the Design Principles raising of dams is necessary.
Jeremy Wright H&HS on Constrained Options report 25 June 2013	90	We agree that the Catchpit seems to be the least visible location on the Hampstead chain for raising/creating a dam, and appreciated the indication on site of the possible extent of 4m, 5.2m and 7m earth mounds. In order to assess which might be the most appropriate, we ask that computer generated images of the 'trade-off' comparisons be prepared of the different works that might be needed on the downstream dams with each of the suggested Catchpit mound heights, and with some spreading of attenuation throughout the chain. We also particularly request information on how the mature trees in the Catchpit valley will be preserved.	This issue was considered as part of the Shortlist report and July workshop of PPSG where trade-offs between dam raising and spillways were modelled. The actual location of the Catchpit dam requires detailed topographic and tree surveys that are currently being commissioned.
Jeremy Wright H&HS on Constrained Options report 25 June 2013	91	We are concerned that the large quantity of earth to form the Catchpit mound may require a large and intrusive borrow pit, if obtained on site. We request that this be investigated urgently, and different options for obtaining this earth be provided.	Depending upon the silt surveys it might be possible to dewater the silt and reuse to fill potential borrow pits. Analysis of the silt is being undertaken.
Jeremy Wright H&HS on Constrained Options report 25 June 2013	92	We agree that the Boat Pond seems to be the most appropriate site for attenuation on the Highgate chain as it is the least natural looking pond. However, we have mixed views, and some of us have concerns that the dam raised by as much as 3m would be much too high, as shown to us on site. In order to help us to judge, we ask that computer generated images of the 'trade-off' comparisons be prepared of the different works that might be needed on the downstream dams and the Boat pond, with the Boat pond dam raised by say 1m, 2m and 3m, and with some spreading of attenuation throughout the chain. We need this to establish exactly what relevant reduction of work would result on the rest of the chain in relation to those options.	This issue was considered as part of the Shortlist report and July workshop of PPSG where trade-offs between dam raising and spillways were modelled.
Jeremy Wright, H&HS on Constrained Options report 25 June 2013	93	We would appreciate receiving indicative (quantified) hydrographs for the 'trade-off' comparisons for both chains	Hydrographs for the two Highgate chain options (4 and 6) for the Highgate No.1 and Model Boating Ponds are appended to the Preferred Options Report. Hydrographs for the Hampstead chain options will follow.

Source	Query Number	Query	Design Team Response
Jeremy Wright, H&HS on Constrained Options report 25 June 2013	94	In order to be able to consider the impacts of various proposals, we urge that construction management planning be urgently addressed	Early contractor involvement is seen as an integral part of the design solution, particularly the development of the CMP. Stakeholders have formed part of the team selecting the preferred construction contractor.
Rachel Douglas, Mixed Pond Association on Constrained Options Report 25 June 2013	95	The Catchpit embankment/barrier, whether sited as proposed on 17.6.13, or, as also suggested, even closer to the pond, will substantially change the appearance of the North end of the Pond, since a structure of that size in that position will be visible even if and when dense vegetation is re-established. This will undoubtedly be disliked by many Pond users. Details of exact positioning, replanting and so on will be crucial to mitigate the expected antagonism the proposition of so large a barrier is bound to produce.	It is recognized that location of this new embankment will need to be carefully modelled to minimize its visual intrusion. Both topographic and tree surveys are currently being undertaken to enable analysis of where this new embankment might best be located.
Rachel Douglas, Mixed Pond Association on Constrained Options Report 25 June 2013	96	The wilderness in the valley upstream from the Mixed Pond adds to the charm of the Pond environment and is also very much valued by general Heath users as well as swimmers. We are therefore concerned that when the work is over there should be a viable plan to enable similar dense vegetation to be re-established. This may require fencing off the damaged areas until such time as the vegetation is dense enough to deter mass access and to ensure people keep to paths. Such plans must be made clear before the proposal goes out for public consultation.	The City Corporation is proposing to have a Term Maintenance Plan to ensure that the scheme is adequately maintained, ensuring the Heath's natural aspect is retained.
Marc Hutchinson, Highgate Men's Bathing Pond on Constrained Options Report 27 June 2013	97	We need to see a precise correlation between the size of the raised BP dam and the consequent increased spillway engineering works for the MP, including regarding the loss of trees, change in or loss of vegetation, and change in the appearance of the vegetation. And the engineering works need to be explicitly linked to the waterflow statistics.	Options modelling so far has been intended to show the size of raising works at ponds downstream of Model Boating Pond and to allow like-for-like comparison (of the effects of varying the raising of Model Boating Pond) the spillway size at Men's Bathing Pond was kept the same. However, refinements on the size of the spillway can be carried out in the outline design stage and will use new topographical survey information to do this.
Marc Hutchinson, Highgate Men's Bathing Pond on Constrained Options Report 27 June 2013	98	What is the proposed size of the "new pipe to pass through raised part of dam" on BP?	This has not yet been modelled. It is likely to be a refinement to one of the preferred options.
Marc Hutchinson, Highgate Men's Bathing Pond on Constrained Options Report 27 June 2013	99	Have Atkins seriously considered the scale and impact of constructing the BP dam raised by 3m? If it is 3m x 15m triangular section x 120m long (say), it would require 2700 m3 of soil brought in. If a dumper truck carries 10m3, it would need 270 loads through Camden, up or down West Hill and along Millfield Lane. Is this environmentally acceptable? Could the existing BP dam withstand this punishment? Is the intention to avoid this large-scale bringing in of soil by excavating and extending the west side of the BP? In other words, does the 3m dam necessarily entail this extension (regardless of the latter's visual impact)?	In the Preferred Option scheme the 3m height option of raising Boating pond dam has been discounted. CoL are working with Atkins to identify borrow pit locations to provide material for the dam, this would reduce movements of materials for dam construction. In addition, depending on silt surveys it may be possible to dewater the silt and re-use it to fill potential borrow pits. Analysis of silt is being undertaken.
	100	We understand "a reinforced spillway" (as distinct from "a spillway") cannot have trees on it, but it can have grass and vegetation. Is this correct? We need to see exactly, if the BP dam was raised 1.5 to 2m only, which trees would have to be removed from the "chosen area" of the MP dam.	This is correct. A tree loss plan will be provided soon after the new topographical information is combined with the tree survey info and the outline design. Currently it is estimated that one less tree will be affected in a 2.0m raising option than in the 2.5m or 3.0m raising options.
Marc Hutchinson, Highgate Men's Bathing Pond on Constrained Options Report 27 June 2013	101	We need to see more details about the size and number of the pipes and spillways proposed. The Report does not make this clear.	More information about provisional spillway depths and locations is given in the Preferred Options Report.

Source	Query Number	Query	Design Team Response
Marc Hutchinson, Highgate Men's Bathing Pond on Constrained Options Report 27 June 2013	102	We need specificity on which trees have to be felled and what vegetation can remain or be planted in relation to each option.	See above response (to query 100) about the tree loss plan to be produced at outline design stage.
Marc Hutchinson, Highgate Men's Bathing Pond on Constrained Options Report 27 June 2013	103	What is the current position with the reported leaks on the MP dam? Have they been plugged, and what is/was their significance for the Project?	The leaks will be investigated further and remedial works to stop the leaks will be designed as part of the project. These works will be quantified after ground investigation into the dam material and analysis of the dam's stability.
Marc Hutchinson, Highgate Men's Bathing Pond on Constrained Options Report 27 June 2013	104	We are unclear (i) how the percentage estimates of water attenuation for the various options have been calculated, and (ii) how these are linked to the estimated volumes of run-off based on revised (i.e. post-Haylock) absorption calculations.	<p>Assuming the query relates to Constrained options report p39 "BJ said by raising 3m, it could create 106,000m³ storage- almost 50% of the designed flood."</p> <p>This statement was made before the detailed modelling of the options was finalised and was therefore intended to be indicative only.</p> <p>Inflow volumes to any given pond can be calculated as the sum of the inflow volume from: Direct rainfall falling on the pond; Runoff from the surrounding land; Inflow from the upstream pond pipe; and Inflow over the upstream pond dam crest; These inflow volumes can be calculated for the existing situation and for the modeled options.</p> <p>Storage capacities of each pond are calculated as the volume of water which can be stored between the Top Water Level (defined as the pipe invert level) and the dam crest level. This is therefore the volume of water than can be stored in the pond without the dam crest overtopping.</p> <p>The percentage of water that can be attenuated is therefore the storage capacity above TWL as a percentage of the total pond inflow.</p>
Harriet King, Brookfield Mansions on Constrained Options Report 28 June 2013	105	The 'constrained options' comprise a limited version of the unconstrained options. Nearly all 'opportunities' for Highgate No 1 summarised in the Critical Review have disappeared. Why have these been set aside?	Enlarging the pond area would result in tree and shrub loss and an impact on visual amenity and character of pond and setting of Heath.
Harriet King, Brookfield Mansions on Constrained Options Report 28 June 2013	106	The potential for raising the Stock Pond dam to provide additional storage was considered and supported as an option at the workshop. The impact on trees can be mitigated by using a wall construction on the downstream face. Why has this option been set aside?	Further modelling revealed that the benefit of providing additional attenuation at Stock Pond was very small (of the order of 20 -30mm drop in peak water levels for an extra 0.5m raising at Stock Pond on top of the 0.5m being considered.)

Source	Query Number	Query	Design Team Response
Harriet King, Brookfield Mansions on Constrained Options Report 28 June 2013	107	At what event will the spillway proposed to the west of Highgate No1 dam come into use?	In both the Preferred Options for Highgate chain of ponds the Highgate No. 1 spillway will not operate until a 1:1000 event. Currently the ponds overtop in an uncontrolled manner in a 1:100 year event.
Harriet King, Brookfield Mansions on Constrained Options Report 28 June 2013	108	What is the planned total PMF volume and available storage for Highgate No1 pond, subsequent to the Hampstead Heath Pond Project?	In Option 4, Highgate No1 pond has a storage capacity of 43,356m ³ between the pipe invert level and the dam crest level. The PMF inflow volume to Highgate No1 pond in Option 4 is 215,687m ³ .
Harriet King, Brookfield Mansions on Constrained Options Report 28 June 2013	109	What is the current maximum flow discharge capacity of the pipes that drain Highgate No1 pond?	The capacity of the existing 0.46m diameter overflow pipe at Highgate No.1 Pond has been calculated at between 0.5 and 0.9m ³ /s. The outflow in the existing scenario peaks at over 17m ³ /s (in a 1:10,000 year event) and 38m ³ /s in a PMF event, which means that the overflow pipe would be insufficient and floodwater would be back up and flow over the dam. The capacity of the 350mm diameter scour pipe is likely to be less than 1m ³ /s.
Harriet King, Brookfield Mansions on Constrained Options Report 28 June 2013	110	Are CoL proposing continuing use of the scour pipe as an overflow?	No, the scour pipe is only for maintenance purposes. The City of London require consent from Thames Water to release water using the scour pipe.
Harriet King, Brookfield Mansions on Constrained Options Report 28 June 2013	111	What is the volume of additional storage capacity that is being planned for in the Highgate Chain?	A total of 133,317m ³ of additional storage capacity is planned for the ponds in the Highgate chain under Option 4. This has been calculated as the sum total of the additional storage capacity provided at each of the six ponds between pipe invert level and dam crest level.
Harriet King, Brookfield Mansions on Constrained Options Report 28 June 2013	112	Does 'Improve discharge capacity' mean 'increase the quantity of water that will/can be discharged in m ³ / sec?	Yes, since the current discharge capacity of both the overflow pipes and the scour pipes are inadequate for dealing with flows in 1:10,000 year events on all the dams.
Harriet King, Brookfield Mansions on Constrained Options Report 28 June 2013	113	How is the discharge of water from Highgate No1 pond to be managed? eg a) bigger drains b) catchpit/ dry reservoir or c) spillway	Water will pass through the chain of ponds and then pass downstream.
Harriet King, Brookfield Mansions on Constrained Options Report 28 June 2013	114	The following options have been discounted. Why? a Dam raising: this should not be discounted at this pond. It has the lowest crest level above the outflow of any of the ponds on the health. b Piling the face, clearing downstream face and other options have also been discounted or reasons which are unclear. c Enlarging the pond has also been ruled out. Assuming this means increased potential to contain flood water in extreme events this is worth considering in conjunction with landscaping to the perimeter.	a. Would need to know which pond is being referred to here. b. Adding more sheet piling to the ponds would be unpopular in terms of its visual impact. "Clearing the downstream face" means removal of trees on all dams, which we are trying to avoid. c. Enlarging the pond is only being considered at Model Boating Pond in order to provide material to build a raising embankment. Enlarging does not significantly alter flood storage capacity by itself.

Source	Query Number	Query	Design Team Response
Harriet King, Brookfield Mansions on Constrained Options Report 28 June 2013	115	Engineering options need to consider the management of flood waters beyond this dam and into the municipal drainage system. What works are being considered to protect residential properties by the creation of a dry reservoir area?	The dry reservoir would need to store approximately 107,000m ³ in a 1:10,000 year event. This is twice the capacity of Highgate No.1 Pond and this would not be achievable given the topography downstream of Highgate No.1.
Charles Leonard, EGOVRA on Constrained Options Report 28 June 2013	116	Would the CoL confirm that computer modelling of various alternatives will be provided and that this will be in a form that enables us to realistically understand the impact of raising one or more of the other dams in each chain - such as that of the Stock Pond in the Highgate chain? This is in reference to the parameters of the outflow of water from the ponds at the bottom of each chain and its management.	The options flowcharts in the Shortlist Options Report (and updated in the Preferred Options Report) were intended to illustrate the consequences and trade-offs of raising the last 3 dams in the Highgate chain. See also the hydrographs which are being appended to in the Preferred Options Report.
Charles Leonard, EGOVRA at Stakeholder meeting 22 July 2013	117	Can raising Stock Pond by 1 m be considered?	Further modelling revealed that the benefit of providing additional attenuation at Stock Pond was very small (of the order of 20 -30mm drop in peak water levels for an extra 0.5m raising at Stock Pond on top of the 0.5m being considered.)
Rob Mitchell, Brookfield Mansions 6 Aug 2013	118	What is the existing standard of protection for Highgate No1 Pond (HGNo1)? The Assessment of Flood Design specifies this falls between 50 and 100 years. Please provide this with greater accuracy.	The minimum crest level of Highgate No.1 pond has been amended in the model, and since it has slightly increased to 63.77mAOD, the 1 in 100 year return period event does not now cause overtopping. The peak water level in Highgate No.1 Pond during the 1 in 100 year event is 63.764m, so the Standard of Protection (SoP) is almost exactly 1 in 100 years.
Rob Mitchell, Brookfield Mansions 6 Aug 2013	119	Does the determination of the standard of protection include the utilization of all pipes (Overflow Pipe and the Scour Pipe) leaving HGNo1?	<p>Overflow pipes are included in the model and were considered to be open and flowing during the model runs to determine Standard of Protection (SoP).</p> <p>The scour pipes were not included in the model as the valves on these are normally closed, so we have not modelled scour pipes (nor did Haycocks). Since scour pipes have to be opened by someone to be effective, we have to assume that they are not open or not available during an event.</p>
Rob Mitchell, Brookfield Mansions 6 Aug 2013	120	What are the flood management procedures that have been used to manage the floodwaters of HGNo1 including both through existing drainage systems and any other means e.g. surface water?	This system is primarily associated with undertaking maintenance works, allowing with Thames Water consent water levels to be lowered. The lack of adequate spillway provision is a matter that the Ponds Project seeks to address allowing water to pass through the chain of ponds but "virtually eliminating" the risk of dam failure.
Rob Mitchell, Brookfield Mansions 6 Aug 2013	121	Who owns or is responsible for each pipe leaving HGNo1 including their maintenance?	The City of London Corporation owns to the first point of communication with another drain.
Rob Mitchell, Brookfield Mansions 6 Aug 2013	122	What is the existing height of the dam above the normal water level?	The minimum dam crest level at Highgate No 1 is 63.77mAD. The typical water level [note 18th Oct – this should say Top Water Level] is at the overflow invert level which is at 62.45mAD. The minimum height of the dam above overflow invert level is therefore 1.32m.

Source	Query Number	Query	Design Team Response																																																				
Rob Mitchell, Brookfield Mansions 6 Aug 2013	123	What are the dimensions, maximum discharge flow rate and volume of each pipe (Overflow and Scour Pipes) that leaves HGNo1?	<p>The overflow pipe diameter is 0.31m. <i>[Note 18th Oct – this should say 460mm.]</i> The calculated stage (height) vs discharge relationship for the overflow pipe is tabulated below, with the maximum flow rate reaching 0.7m³/s. <i>[note 18th Oct – this maximum was for the highest pond water level that occurred in Option 3. For Options 4 and 6 where water levels reach higher than 64.44mAOD, up to 64.92m, the flow rate will increase slightly more, up to 0.8 m³/s. The table below is separately calculated stage-discharge relationship which was used in the hydraulic model so that it could interpolate the discharge in the overflow pipe for any water level in the pond. The table was calculated for higher levels but only the part of the table that covers levels up to 64.94m is given here, since this is the nearest value to the modelled peak water level of 64.93m which occurs in Options 4 and 6 in the PMF event.]</i> (The scour pipe has not been modelled, for the reasons given above in response to query 119).</p> <table border="1"> <thead> <tr> <th>Flow m³/s</th> <th>Stage (water level) mAOD</th> </tr> </thead> <tbody> <tr><td>0</td><td>62.45</td></tr> <tr><td>0.011</td><td>62.64</td></tr> <tr><td>0.046</td><td>62.74</td></tr> <tr><td>0.102</td><td>62.84</td></tr> <tr><td>0.172</td><td>62.94</td></tr> <tr><td>0.228</td><td>63.04</td></tr> <tr><td>0.279</td><td>63.14</td></tr> <tr><td>0.332</td><td>63.24</td></tr> <tr><td>0.373</td><td>63.34</td></tr> <tr><td>0.405</td><td>63.44</td></tr> <tr><td>0.436</td><td>63.54</td></tr> <tr><td>0.466</td><td>63.64</td></tr> <tr><td>0.495</td><td>63.74</td></tr> <tr><td>0.523</td><td>63.84</td></tr> <tr><td>0.551</td><td>63.94</td></tr> <tr><td>0.578</td><td>64.04</td></tr> <tr><td>0.605</td><td>64.14</td></tr> <tr><td>0.631</td><td>64.24</td></tr> <tr><td>0.657</td><td>64.34</td></tr> <tr><td>0.682</td><td>64.44</td></tr> <tr><td>0.707</td><td>64.54</td></tr> <tr><td>0.732</td><td>64.64</td></tr> <tr><td>0.756</td><td>64.74</td></tr> <tr><td>0.780</td><td>64.84</td></tr> <tr><td>0.803</td><td>64.94</td></tr> </tbody> </table> <p style="text-align: right;"><i>Added 18th Oct</i></p>	Flow m ³ /s	Stage (water level) mAOD	0	62.45	0.011	62.64	0.046	62.74	0.102	62.84	0.172	62.94	0.228	63.04	0.279	63.14	0.332	63.24	0.373	63.34	0.405	63.44	0.436	63.54	0.466	63.64	0.495	63.74	0.523	63.84	0.551	63.94	0.578	64.04	0.605	64.14	0.631	64.24	0.657	64.34	0.682	64.44	0.707	64.54	0.732	64.64	0.756	64.74	0.780	64.84	0.803	64.94
Flow m ³ /s	Stage (water level) mAOD																																																						
0	62.45																																																						
0.011	62.64																																																						
0.046	62.74																																																						
0.102	62.84																																																						
0.172	62.94																																																						
0.228	63.04																																																						
0.279	63.14																																																						
0.332	63.24																																																						
0.373	63.34																																																						
0.405	63.44																																																						
0.436	63.54																																																						
0.466	63.64																																																						
0.495	63.74																																																						
0.523	63.84																																																						
0.551	63.94																																																						
0.578	64.04																																																						
0.605	64.14																																																						
0.631	64.24																																																						
0.657	64.34																																																						
0.682	64.44																																																						
0.707	64.54																																																						
0.732	64.64																																																						
0.756	64.74																																																						
0.780	64.84																																																						
0.803	64.94																																																						

Source	Query Number	Query	Design Team Response															
Rob Mitchell, Brookfield Mansions 6 Aug 2013	124	Please provide figures for the existing volume and discharge flow rates of water passing through the overflow pipe during 1) normal conditions (i.e. when there isn't any rain) and 2) storm events of 1 in 10, 20, 30 and 50 and at the point when overtopping begins? This is to establish the current conditions for comparison with the expected conditions after the proposed works have been completed.	<p>In dry conditions, there is no flow through the overflow pipe, these dry conditions are reported to happen approximately 5 months in a year. The hydrology for the 1 in 10 year and 1 in 30 year flood events was not calculated, so the flows during the 1 in 20, 1 in 50, 1 in 100 and 1 in 1,000 year events have been given, to allow comparisons.</p> <table border="1"> <thead> <tr> <th>Return period (1 in T years)</th> <th>Total volume discharged through overflow pipe (m3)</th> <th>Peak discharge in pipe (m3/s)</th> </tr> </thead> <tbody> <tr> <td>1 in 20</td> <td>6,047</td> <td>0.01</td> </tr> <tr> <td>1 in 50</td> <td>10,534</td> <td>0.40</td> </tr> <tr> <td>1 in 100</td> <td>17,728</td> <td>0.50</td> </tr> <tr> <td>1 in 1000</td> <td>19,256</td> <td>0.53</td> </tr> </tbody> </table>	Return period (1 in T years)	Total volume discharged through overflow pipe (m3)	Peak discharge in pipe (m3/s)	1 in 20	6,047	0.01	1 in 50	10,534	0.40	1 in 100	17,728	0.50	1 in 1000	19,256	0.53
Return period (1 in T years)	Total volume discharged through overflow pipe (m3)	Peak discharge in pipe (m3/s)																
1 in 20	6,047	0.01																
1 in 50	10,534	0.40																
1 in 100	17,728	0.50																
1 in 1000	19,256	0.53																
Rob Mitchell, Brookfield Mansions 6 Aug 2013	125	Provide details of the existing total volume, peak discharge flow rate, depth of overtopping and overtopping duration in 50, 75 and 100 year storm events.	<p>The dam is not overtopped in the 1 in 50 and 1 in 100 year return period events in the existing scenario.</p> <p>Therefore, to allow a meaningful comparison of existing and proposed scenarios, we ran the model for the 1 in 1000 year event, with results as follows:</p> <p>Total volume overtopping = 5,327m³ Peak discharge flow rate = 2.1m³/s. Max depth of overtopping = 0.11m Duration of overtopping = 1 hr 45 minutes.</p>															
Rob Mitchell, Brookfield Mansions 6 Aug 2013	126	Provide a topographical map of HGNo1 identifying the location dimensions and design of the proposed spillway, the pond area that would be inundated by a flood prior to water coming down the spillway, where the spillway will discharge water and the expected direction of water flow off the City of London (CoL) property	<p>We are aiming to provide a flood map based on LIDAR data in the near future. Please also see answer to query 229.</p>															
Rob Mitchell, Brookfield Mansions 6 Aug 2013	127	Is it proposed that there will be any earthworks (bund or otherwise) to manage the direction and speed of water flow once it has come down the spillway?	<p>Such earthworks are not currently part of the scheme, since there is no high ground downstream to tie into, so the discharged water would still circulate back to the low ground downstream of the dam. However, both the speed and the volume of the discharged water will be reduced by increasing storage in the pond chain system</p>															
Rob Mitchell, Brookfield Mansions 6 Aug 2013	128	Is it proposed to change the flood management procedures in future and if so why are these changes being introduced and what are the proposed new flood management procedures including through existing drainage and surface water systems? Is any consideration being given to a system that pre-empts periods of expected high rainfall by increasing the water discharged from the pond in advance of the storm?	<p>The City of London Corporation has implemented an on-site emergency action plan. Camden Council has responsibility for the off-site emergency action plan.</p> <p>The time taken to lower the water level in Highgate No.1 pond could be calculated, but it is likely that draining the pond will take longer than the time for a forecast flood to arrive.</p>															
Rob Mitchell, Brookfield Mansions 6 Aug 2013	129	At what height above normal water level will the proposed spillway begin passing water?	<p>The proposed spillway weir level is at 63.70m AOD, very close to the existing minimum crest level (63.77). Typical water level is 62.45m AOD so the water would have to rise 1.25m before it passes over the spillway weir. [Note 18th Oct – the spillway weir level of 63.70m mentioned here is only for Option 3, which has since been discounted. For Options 4 and 6, the current preferred options, the proposed spillway level is 64.45m AOD, greater than the existing dam crest level, so the water would have to rise 2.0m before the spillway operates.]</p>															

Source	Query Number	Query	Design Team Response
Rob Mitchell, Brookfield Mansions 6 Aug 2013	130	What are the proposed public facilities that are to be made available on HGNo1? Are there plans to introduce angling on this pond?	There are no proposals as part of the Ponds project regards future use of this pond for angling. The City have commenced discussions with the Hampstead Heath Angling Society on several issues relating to fishing on the ponds but these are at a very preliminary stage.
Rob Mitchell, Brookfield Mansions 6 Aug 2013	131	What dam raising can be achieved on this pond without affecting the tree cover of the pond?	<p>The minimum raising of the dam is 0.5m in Option 3 (where Model Boating Pond dam is raised by 3m). This 0.5m raising could be achieved with a short wall situated on the dam crest so as to avoid the trees on the upstream and downstream slopes of the dam.</p> <p>The maximum raising at the dam would be 2.0m in Option 5 (where the raising of Model Boating Pond dam is only 1.0m). This would have to be achieved with an earth embankment built on the pond side, which would require removal of all the trees on the upstream face, and an unknown number of trees on the north-east bank as it would have to tie into higher ground. Partly for these reasons, the preferred option is Option 3 which minimizes the tree loss at Highgate No.1 Pond.</p>
Rob Mitchell, Brookfield Mansions 6 Aug 2013	132	The Design Philosophy states "...the works to the ponds will not make the flooding situation downstream worse". Is this the case for all storm events and how will this be demonstrated/verified?	<p>This should be the case given the addition of storage. It is being verified using the modelling results.</p> <p>The shortlisted options have been checked to verify that the flow discharging from the proposed spillway at Highgate No.1 in the PMF event is less than the flow overtopping the bank in the existing scenario. Further checks have now been made on the volume being discharged (see response to question 13 below.) At the other end of the scale, no flood events up to and including the 1:100 year event cause the spillway to be overtopped, (which is the same as in the existing scenario), and peak water levels are lower.</p>
Rob Mitchell, Brookfield Mansions 6 Aug 2013	133	It is proposed to "...improve the discharge capacity..." at HGNo1 pond. How is this to be achieved and why? Our concern is that surface water will be discharged sooner than is currently the case and at a faster rate.	<p>The proposed spillway will improve the control of discharges, ie the new spillway will have much more capacity than the existing overflow pipe, which is currently inadequate; this will mean the embankment will overtop less frequently. The discharge over the proposed spillway will not occur earlier than the discharge from overtopping of the existing bank, because the spillway weir level is approximately the same as the minimum existing bank level, and because more flood water will be stored at this pond and at the next two ponds upstream.</p> <p>We have checked that the rate of discharge from the proposed spillway would be less than the discharge of flow overtopping the embankment in the largest flood events, see below</p>
Rob Mitchell, Brookfield Mansions 6 Aug 2013	134	Please provide us with a map of the drainage pipe system around the Heath and advise us how it is envisaged that water will drain through this system in different storm events.	<p>Currently we only have a services plan showing how the outlet pipes from Highgate No.1 ponds connect into the nearest surface water drains. Camden Council will have surface water drainage maps.</p> <p>However, the typical capacity of the surface water drains will be for around 1 in 30 year floods, so when floods larger than 1 in 100 occur and cause overtopping of the existing dam or the proposed spillway, the surface water drains will already be full. Therefore, we have not modelled how the discharges from dam overtopping would get into the drainage system, because we know that they wouldn't, in either the existing or proposed scenarios. Water overtopping the dam in large flood events would flow overland for considerable distances in either scenario.</p>

Source	Query Number	Query	Design Team Response
Rob Mitchell, Brookfield Mansions 6 Aug 2013	135	In the Assessment of Design Flood it anticipates 276,996 m3 total PMF volume entering the Highgate Chain and total available storage in the Highgate Chain of 42,518 m3. This means the Highgate Chain can only currently store 15% of the PMF. What is the proposed impact of the proposed scheme on the storage of the PMF in the Highgate Chain Ponds?	More of the PMF water will be stored in the proposed scheme.
Rob Mitchell, Brookfield Mansions 6 Aug 2013	136	What is the impact of the scheme on the smaller storm events? The implication is that they will overtop less frequently as more storage exists in the system.	In smaller storm events, ie up to and including the 1 in 100 year event, there would be no overtopping of the proposed spillway, just as the existing dam is not overtopped. In larger storm events, the increased storage upstream means that the peak water levels in Highgate No.1 pond would be lower than in the existing arrangement. Therefore, while the proposed spillway will still be operating in larger events, the spillway will be operating less frequently. For example, in Option 3, the 1 in 1000 year event does not cause the spillway to operate, whereas in the existing case it overtops the dam.
Rob Mitchell, Brookfield Mansions 6 Aug 2013	137	What is the impact of the scheme on the available storage in HGNo1?	Available storage will increase because in all options the dam crest level is raised.
Rob Mitchell, Brookfield Mansions 6 Aug 2013	138	Please provide figures for the proposed total volume and peak discharge flow rates of water passing through the overflow pipe during 1) normal conditions (i.e. when there isn't any rain) and 2) storm events of 1 in 10, 20, 30 and 50 and at the point when overtopping begins? We want to be sure that Camden and Thames Water have sufficient information to calculate the impact of this extra water on their drains and sewers.	The overflow pipe volumes and discharges for the events modelled to date (1 in 20 and 1 in 50) were not available at the present time. However, since the peak discharge through the overflow pipe is dependent on the water level in the pond, and these water levels are less in all flood events in Option 3, we would expect the peak discharges through the overflow pipes to be less.
Rob Mitchell, Brookfield Mansions 6 Aug 2013	139	Provide details of the proposed total volume, peak discharge flow rate, depth of overtopping and overtopping duration in 50, 75 and 100 year storm events.	The model is showing that the proposed spillway at Highgate No.1 Pond will not operate in the 1 in 50 year or the 1:100 year return period events in Option 3 (which is the same as in the existing scenario). For a comparison with the existing scenario, we ran the 1:1000 year event in the Option 3 model, but this also did not cause flow in the spillway. The peak water level was 62.83m, so was 0.87m below the proposed spillway weir level, and 1.05m below the peak water level in the same flood event in the existing scenario.
Rob Mitchell, Brookfield Mansions 6 Aug 2013	140	The positioning of the spillway and the nature of its discharge of water is a factor in determining liability if the water is caused to flow in a more concentrated form than it naturally would as the result of artificial alterations. Please advise us how this is being addressed?	The spillways are part of the reservoir structures and as such the City will be guided by the advice of the Panel Engineer.
Rob Mitchell, Brookfield Mansions 6 Aug 2013	141	Please provide us with a copy of CoL emergency action plan.	Release of the emergency action plan has to be approved as it contains both private and security information of a confidential nature. We are working on production of a public version.
Rob Mitchell, Brookfield Mansions 6 Aug 2013	142	Please advise us of CoL's legal responsibility to residents and properties on the Heath boundary with regard to the delivery of 1) surface water and 2) underground/piped water. Also, please clarify how the CoL's understanding of their responsibilities in this matter have changed, if at all, since the circulation to the WMSG of the "Position Statement on Discharge of Water (Overtopping of Ponds and Surface Water) from Hampstead Heath" on 28th November 2012.	The City of London's position hasn't changed from the Position Statement that has previously been issued and is appended to this document.
Rob Mitchell, Brookfield Mansions 6 Aug 2013	143	Does the proposed scheme comply with the requirements anticipated under the 2010 Act? If not in what way does it not comply?	This project has to be approved by the City's retained Panel Engineer who has to be satisfied that the City has "virtually eliminated" the risk of dams failing.

Source	Query Number	Query	Design Team Response
Rob Mitchell, Brookfield Mansions 6 Aug 2013	144	What is the essence of the legal dispute between Hampstead and Highgate Society and CoL?	There is no legal dispute, the City of London Corporation is endeavouring to host a meeting between legal parties including the City's retained QC and the Society's retained QC to discuss legal aspects associated with the project.
Rob Mitchell, Brookfield Mansions 6 Aug 2013	145	Please clarify what discussions have taken place with any concerned Authorities including Camden Council, Thames Water and Environment Agency.	The City of London Corporation has provided reports associated with the Ponds Project to the relevant authorities.
Rob Mitchell, Brookfield Mansions 6 Aug 2013	146	Does the scheme take into consideration the Preliminary Flood Risk Assessment prepared by Camden and Camden's study on surface water flooding?	It is recommended that residents liaise directly with Camden Council regarding their responsibilities.
Jane Shallice, Ladies Pond on Shortlist Options Report 21 Aug 2013	147	<p>More on de-silting</p> <ul style="list-style-type: none"> • Plans which show the detailed proposals, including the materials that are to be used. • Cross sections : <ul style="list-style-type: none"> - The longitudinal section through the pond, dam, meadow, stock pond, boating pond and men's pond. - Cross section down the middle of the access lane down to the dam and changing rooms. - Cross section through our meadow, the pond and the meadow to the West. - Detailed cross sections through the different conditions around the edge of the pond i.e. through the dam, the spillway, the West side, the North side and the East side. • Visualisations of the proposals from the path, the dam, the spillway, the lifeguards' lookout, the changing rooms, the water, and the meadow. 	<p>Information on the scope of de-silting that can be carried out to the Ladies Pond will be dependent on the results of bathymetric surveys which are ongoing. These will allow estimates of the quantities of silt on the pond bed. This information will be combined with an assessment of the treatment required to the silt if it is to be moved elsewhere on the Heath.</p> <p>Cross sections through the changing rooms and more detailed drawings will be worked up during the detailed design phase.</p> <p>The architect is currently working up outline design proposals for consideration and will be able to provide more detail on the proposed changing room construction.</p> <p>The environmental works are summarised in the Preferred Options report. The detail of these works will be developed in the next stage of design. The current proposals are to allow a public consultation which encompass the principle of minimising the impact on the Heath by focusing intervention in one main area (i.e. Model Boating).</p>
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	148	<p>The public have been invited to comment on this complex and detailed report, so there needs to be guidance on the key issues where comments are most sought. As this document may be read as a 'stand alone' report by the public, we consider that Section 2 'Brief Summary' is too condensed and does not provide a logical justification for the works, particularly for persons who have not read the preceding documents. In particular, the phrase 'Essentially, more storage is needed' is not a logical conclusion of what goes before in this section. Also, the primary objective of the project to prevent dam break is not stated, and the phrase '...to improve the resilience of the dams.....' is obscure to the uninformed. An additional two or three sentences might help considerably.</p>	<p>There will be a similar section summarising the problem definition in the forthcoming Preferred Options Report, where these comments can be addressed.</p> <p>This section of the report will include an explanation of 1) how increasing storage in one pond reduces the flow discharging from the next pond, and 2) how the "resilience of the dams" refers to the ability of the dams to withstand the erosive impact of floodwaters overtopping the dam crests and flowing down the downstream slope.</p>
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	149	<p>6, 8 and 9. We are somewhat bemused by the plethora of 'Design Principles', and fear that the general public will receive a confused message. We note the 4 principles on page 6, 3rd column, which are then supplemented by 2 more in column 4. These are then supplemented by a further 6 on page 8, column 3, and then on page 9 there are a further 3 'key objectives'. We suggest that it would be helpful to state one clear set of aims, consistent with duties under legislation.</p>	<p>This is noted and a clearer set of objectives, design principles and philosophy is set out in the Preferred Options report as suggested.</p>

Source	Query Number	Query	Design Team Response
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	150	We note that the design team/Dr Hughes has said that some damage can be accepted . We also note that ICE 'Floods and Reservoir Safety' Table 1 recommends that spillways for Category A dams be designed for 1:10,000, with the remainder of the shorter duration and rarer surplus PMF spilling over the crest if overtopping is tolerable. We recognise that PMF spillways are a prudent design principle that would also avoid intrusive works to reinforce our existing and sensitive dams to take overtopping. However, if PMF overtopping could be tolerated on two dams, we suggest this could reduce dam raising by approx 1m, being the depth of spillways below the crest. We will address this in detail when we review options, specifically for the Model Boating pond, and the Mixed Bathing pond.	The reference to Table 1 of 'Floods and Reservoir Safety' is correct and its recommendations do inform our design principles. However, the decision on whether overtopping is tolerable or not depends on several factors including the nature of vegetation on the dam crest and downstream slope, and the depth and speed of flow over the dam crest and downstream slope. For example, the Panel Engineer has said that he would not accept overtopping of the dam at Hampstead No.2 pond because the plane trees would cause eddying and turbulence which would increase the erosion of the dam during overtopping. The dams which would be more resilient to overtopping are those which have a uniform grassy slope with no woody / bushy vegetation. This description would largely apply to the causeway dam at Mixed Bathing Pond, for example, but not to the dam at Model Boating Pond, which has several large trees on the downstream slope of the dam itself, or most of the other dams.
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	151	9, 25, 47 Please explain, if all the PMF is routed through spillways and does not overtop the crest, why crest restoration is required on many dams, with possible impact on crest vegetation, as their crests will normally be above water level. This query applies to Stock, Ladies, Bird, Vale and Viaduct ponds.	At Stock, Ladies, Vale of Health and Viaduct Ponds, crest restoration is proposed for the low spots (which tend to be in the middle of the dam) to bring the crest to uniform level so that the spillway can be located away from the middle, and also so that the weir level of the spillway can be kept above typical water level. We can therefore reduce tree loss on the dam (by locating the spillway away from the most valuable trees) and also have a normally dry spillway which can be lined with grass that can blend in with the surroundings. At Bird Sanctuary pond, the crest restoration is intended to fill in low spots so that if there is some overtopping in small floods, the risk of the flow concentrating into a narrow cut in the dam is reduced. In larger floods, water will be backing up on both sides of Bird Sanctuary dam, so it will become submerged. The crest restoration at Bird Sanctuary dam is relatively minor with only an 80mm increase required at the low spots, this could be achieved with resurfacing of the crest road without affecting the vegetation on either side.
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	152	9, 25, 47 Please clarify, as most existing dams will currently overtop in PMF, if the proposed spillway depth is say approx 1m and some dams have crest raising/restoration less than this, does this mean that these modified dams will store less water than the current existing dams?	Generally the crest restoration proposed for upstream dams allows the spillway weir level to be above the typical water level in the pond upstream and as close as possible to the existing ground level. However, this is not always possible, so to minimise raising works at these ponds, there is a slight reduction in storage capacity at some ponds. This is more than compensated for by the raising of dams (or building a new one) downstream, and this is why the whole chain of ponds should be considered as a system, where the raising of a dam in the middle of a chain can reduce the works required both upstream and downstream. Depths of proposed spillways will be shown on the options flowcharts for the next report.
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	153	10 Highgate chain flowchart: Please explain:- <ul style="list-style-type: none"> why are spillway widths on the Boating Pond identical for options 3, 4 and 6, rather than being tailored for the different surplus floods? Are they oversized for the higher dams? We note [p21] that spillway size is a key consideration, as vegetation clearance will be needed, hence we urge that these be the minimum size possible 	Currently, the peak water levels in Options 3, 4 and 6 are only around 300mm below the dam crest level during a PMF, which suggests that there is little scope for spillways to be made narrower without losing the freeboard required by the Panel Engineer to allow for wave surcharge. However, it may be possible to reduce the spillway size by adding another pipe through the dam. Refinements to the spillway size such as these will be tested using the model at the beginning of the outline design stage.

Source	Query Number	Query	Design Team Response
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	154	<ul style="list-style-type: none"> Men's and Highgate 1 spillways – why are these identical for all options, irrespective of the height of the Boating pond dam? 	<p>For the shortlist options report, spillway widths on the last 2 Highgate chain ponds were kept the same when modelling the Highgate chain options so that the degree of raising at each pond could be quantified and compared. This was intended to demonstrate the principle of trade-offs, so we could define the consequences of varying amounts of raising of the dam at Model Boating Pond.</p> <p>Further refinements will be carried out to investigate possibilities of reducing spillway size.</p>
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	155	<ul style="list-style-type: none"> Option 5 shows a 2.0m raising on Highgate 1, but only a 1.5m raising on the Men's pond. Both these raisings may require an earth dam to be built inside the ponds, [page 33], which may have a major impact on screening vegetation and trees on Highgate 1. Could you please test this option with a max 1.25m raising at Highgate 1 [ie. with a wall], to determine the amount of dam raising then needed on the Men's pond dam? 	<p>Option 5 has now been discounted due to the impact on screening vegetation mentioned.</p> <p>Option 6 has shown that when there is a 1.25m raising at Highgate No.1 Pond dam, 1.0m is required at Men's Pond dam, but only if there is a raising of 2.5m at Model Boating Pond.</p>
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	156	<p>9, 10, 25 We note, re 'standard of protection', that the return period.....that causes overtopping of the last dam in the existing scenario is compared with the flood event that causes the proposed spillway in each option to start to spill water. Despite major attenuation on each chain, the standard of protection and peak velocities appear from the flowcharts to remain virtually unchanged, without any improvement. To assess this, please supply the current and proposed rate of flow versus time graphs [hydrographs] for all options for the bottom 2 ponds, the Mixed Bathing Pond and the Boating pond, and also for all the ponds if possible.</p>	<p>The options flowchart in the Shortlist Options report had a slight error in the boxes stating standard of protection, in that all of them should have stated 'at least 1 in 50 year flood'. (At the time, only the PMF and a 1 in 50 year flood had been run through the options models). Since then, the models for Options 3, 3a, 4 and 6 (with 2.5m – 3.0m raising at Model Boating Pond) have been modelled with higher return period floods in order to find out the actual range of standards of protection. In all these 4 options, the spillway did not operate for floods up to and including a 1 in 1000 year flood, indicating that the standard of protection given by the last dam is better than existing, due to the net increase in storage in the pond chain.</p> <p>Hydrographs showing outflows from the Highgate No.1 Pond for the next larger floods (1:10,000 year and PMF) are included in the Preferred Options Report to allow comparison between existing scenario and one option for each chain.</p>
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	157	<p>12 Hampstead Chain Flowchart. Please explain:-</p> <ul style="list-style-type: none"> The chart shows Vale pond crest restoration as 0.2m max, whereas the text [p47] states 0.6m max. Please clarify <p>The chart shows Viaduct pond crest restoration as 0.5m, whereas the text [p47] states 0.18m max. Please clarify</p>	<p>The text in the report is correct, the proposed crest restoration is 0.6m at Vale of Health and 0.2m (0.18 m rounded up) at Viaduct.</p> <p>This has been corrected on the options flowcharts presented on 14th September and appears in the Preferred Options Report.</p>
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	158	<p>The Flowchart shows the Catchpit with three different options of pipe size through the same 5.6m high dam. Please explain the effect of these different options re timing, duration, velocity and total volume of flood water on the downstream dams. We do not understand the benefits of these different options</p>	<p>The different size of pipes in the dam were tested after it was found in an earlier iteration that a 7m high dam with a 600mm pipe through it would only impound 5.6m of water. Smaller pipes were then tried, to see if the volume of stored water could be maximized. While it would be possible to calculate all the exact data requested, the key variable for comparison between options was the water level downstream in Hampstead No.2 pond, when the dam was combined with differing spillway / culvert sizes at that pond. The key benefit of having smaller pipes was thought to be that the increased stored volume would reduce water levels downstream. However, reducing the pipe diameter did not have as much of an impact on downstream ponds as the amount of raising modelled at Mixed Bathing Pond.</p>

Source	Query Number	Query	Design Team Response
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	159	<ul style="list-style-type: none"> We much welcome the presentation of so many different options, but are puzzled at some of the figures presented. We would appreciate clarification. For example, referring to the spillway/culvert options for Hampstead No 2 pond:- why is Option J spillway significantly larger than Option H [where both have 1.5m raising of the Mixed Pond]? 	In Option H the proposed Catchpit dam had a larger pipe (600mm) than in Option J (400mm), and the peak water levels were different (being higher in Option H), which means it is not always easy to compare like for like. The options flowchart for the Hampstead chain did contain a lot of information so it was decided not to include spillway depths and modelled water levels. However, spillway depths will be shown in the Preferred Options Report.
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	160	why is Option N spillway almost the same size as Option C [which has much less stored water]?	There is an error in the text in the flowchart, the open channel spillway in Option N is actually modelled at 14.3m wide at the base, so is slightly wider than in the 11.9m wide spillway in Option C. Currently these options have been discounted in favour of those with box culvert spillways at Hampstead No.2 pond.
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	161	why are the cross sectional spillway areas [calculated up to crest level] significantly greater than the cross sectional areas of the culverts, when comparing pairs for the same flows? Spillway areas vary from 1.5x to 3.1x larger in area than the equivalent culverts. Surely spillway flow would be smoother and more efficient than culvert flow which could be turbulent, which could be expected to make spillway area less than culvert area?	<p>The flowchart does not show peak water levels and depths / invert levels, so it is not possible to make like for like comparisons on cross sectional areas of flow.</p> <p>Box culverts have been considered for Hampstead No.2 pond in order to reduce the width of spillways and therefore minimize tree loss.</p> <p>The flow rate over spillways is proportional to the driving head raised to the power of 1.5 and linearly proportional to the width. This means the head has a much greater influence on the flow rate than the width. In order to minimise the width of the box culverts, a greater head is applied to get the flow through the culvert.</p>
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	162	why is there this variation in the ratio of spillway areas to the equivalent culvert areas? Surely there should be the same ratio throughout? For example, the spillway area in Option L is 1.5x the area of the equivalent culverts in Option K, whereas the spillway area in Option J is 3.1x the area of the culverts in Option I. Is spillway J twice the size needed?	<p>The flowchart does not show peak water levels and depths / invert levels, so it is not possible to make like for like comparisons. The process of developing models was not based on ratios but on adjusting the spillway weir level and width of each option until the peak water level was below the minimum existing crest level.</p> <p>See also the comment above regarding the influences of head and width on flow rates.</p>
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	163	14, 22 We note in all cases it is assumed that water levels remain as today. We endorse this principle generally, as agreed at the 13 July workshop, as lowering could affect ecology and visual appearance. However, we query if a single exception might be made for the Boating Pond , as lowering the water level may enable the proposed dam to be reduced in height. We discuss this in detail later	<p>This is technically feasible, but there was a general consensus within the feedback from the early consultations that no typical (existing) water levels should be changed. It was also discussed at the 2nd PPSG workshop and most stakeholders were against lowering the water level.</p> <p>The recent silt testing has suggested that there could be up to 2.2m of silt in Model Boating Pond, and so the reduction in the depth of clear water could have a negative effect on fish populations which would need to be assessed by specialists.</p>
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	164	26 Viewpoint 6, 3m raising, still shows the canopy of a tree that would be removed with this option. There are similar instances in several photo visualisations. We urge for accurate imagery in the next report	This is noted, and the visualization will be corrected for the next report.
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	165	31 We note that most of the advantages and disadvantages quoted for Option 3 are changes that are irrelevant to dam height, and apply therefore to all the options, not just to Option 3.	This point is made on page 34 of the Shortlist Options Report and so the differences in advantages are given when discussing the next option.

Source	Query Number	Query	Design Team Response
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	166	<p>HIGHGATE CHAIN</p> <p>In assessing these options, we have considered the following key principles:-</p> <p>Store/attenuate as much of the PMF as possible at the Boating pond, but minimise landscape impact. This implies Option 3 [3.0m raising], but we have reservations, and suggestions as below. We would like to limit the apparent height to approx 1.5m</p>	<p>We note that the impact on landscape at Model Boating Pond is significant, but it is related to the need to source fill material as close as possible to the pond, in order to minimise the need for imported fill to be transported through residential areas around the Heath.</p> <p>The modelling of options has shown that a lower raising height at Model Boating Pond would have the consequence of a larger new embankment at Highgate No.1 Pond, thus spreading the area of major works and the impact on other ponds.</p>
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	167	<p>On Highgate 1, minimise any loss of trees and vegetation that screen the Heath from residential buildings, particularly Brookfield Mansions and the intrusive white blocks of West Hill Court [see comment on page 31]. Page 34 indicates that a 0.5m or 1.25m dam raising on Highgate 1 could be accommodated with a wall on the crest which would have less impact on the vegetation than an earth dam. However, this is partly contradicted by page 33, which implies that an earth dam might have to be built for the 1.25m dam raising, and any higher raising. This therefore implies Option 3, or perhaps Option 6, but we have queries.</p>	<p>In both the Preferred Options it is proposed that a wall be built at Highgate No. 1 pond.</p>
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	168	<p>1. Carry out the minimum possible work on all other dams</p> <p>We detail these principles on the following review of the proposals for each pond, based on Option 3 stored volume, but with a Boat Pond dam raising of much less than 3m if our suggestions are incorporated:-</p> <p>Highgate Chain – pond by pond review</p> <p>Spillways generally</p> <p>Spillways are described in outline on all the dams, dimensions are stated, but locations are rarely given. Consequently, the visual impact is difficult to assess. It is essential that we be provided urgently with simple plans showing the locations, with any significant tree and vegetation loss described. Where 'natural' spillways can be routed to avoid the dam slopes and toe, then we urge that no reinforcement is needed, and no trees, bushes or fences need be removed on the route. During a PMF spill, trees, bushes and fences may suffer some damage during this extremely rare event, but this would be acceptable, rather than unnecessarily clear and reinforce the spillway, as proposed on some dams.</p>	<p>We are not yet in a position to release outline design drawings, which are programmed to be developed in October. We can summarise the spillway location position as follows:</p> <p>Stock Pond: at the west end of the dam, to be shown in a new visualization.</p> <p>Ladies Bathing Pond: at the western half of the dam as mentioned in the Shortlist Option report.</p> <p>Model Boating Pond: at the west abutment of the new/existing dams.</p> <p>Men's Bathing Pond: at the west end of the dam, at the gap in trees where there is an existing grassy slope.</p> <p>Highgate No.1 Pond: partly on the west end of the dam, partly on the natural ground, as described on page 30.</p> <p>In terms of the location, these can be discussed in detail with the topographical surveys and tree survey information.</p> <p>We have tried to locate spillways in such a way as to minimize tree loss, using the methodologies described above, but due to the constraints of the existing ground levels and the locations of the most valuable trees it is not always possible to completely avoid the dams.</p> <p>It would be necessary to clear trees from the spillways where they are on the dam, since damage to any trees on the dams would not be acceptable, since trees in flow cause high turbulence immediately downstream of the tree with deep erosion. Trees can fall over due the downstream erosion and leave a significant void in the embankment where the root ball has been pulled out.</p>

Source	Query Number	Query	Design Team Response
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	169	2. Stock Pond – crest restore 0.5m to 1.0m We presume that this height of dam raising is principally to allow a spillway to be inserted into the crest without unduly lowering the normal water level, rather than for crest restoration. Please clarify.	The level of crest restoration is intended to allow a new spillway and overflow pipe to be installed while keeping the spillway above typical water level.
	170	We would prefer timber facing to the proposed retaining wall which we consider more visually appropriate than brick. There could be planting in front as screening. English Heritage screened the raised Wood Pond dam like this, which seems visually acceptable. This remark also applies to the proposed walls at the Men’s Pond and Highgate No 1.	The preference for timber cladding has been noted and this was shown on the proposed walls in the new set of visualizations at the September 14 th workshop.
	171	We note that two [pond side?] trees may be lost in building the retaining wall [page 38] and query if this can be avoided through design	We have since relocated the spillway to the west side, so the tree loss only applies to a small cluster of trees with trunk diameters of less than 100mm.
	172	As the proposed spillway is to be reinforced, with topsoil and grass cover over, could there be some bushes or shrubs on its downstream slope?	As a general rule, the Panel Engineer has specified that planting of bushes or shrubs would only be acceptable on the upstream slope of any dam, and not within the spillway since this would affect the flow.
	173	Is it intended that this pond be dredged as part of the works [p44], as there is deep silt in this pond?	Stock Pond is one of the highest priority ponds in terms of plans for de-silting. The amount of desilting on this and other ponds will depend on the volume of silt, to be confirmed by bathymetric surveys, and the results of silt testing which is being carried out, since these both have a bearing on costs.
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	174	Ladies Bathing Pond – crest restore by 0.2m Please detail the position of the spillway, with any tree loss.	At the western half of the dam as mentioned in the Shortlist Option report. Tree loss to be confirmed once the results of the latest topographical survey are received as they will then be combined with the tree survey.
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	175	Bird Sanctuary Pond – crest restore by 0.1m Please clarify if there will be any tree loss when carrying out the crest restoration. If so, we query why any work needs to be carried out. This dam is the most robust on the Heath, there is a tarmac road on the crest which significantly will protect from any erosion, and under flood conditions the dam will probably be overwhelmed by rising water in the Boat pond before formation of any small gullies	No tree loss due to crest restoration work is anticipated at Bird Sanctuary Pond. The restoration work would be confined to the width of the existing road surface.

Source	Query Number	Query	Design Team Response
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	176	<p>Model Boating Pond – raise dam to store equivalent volume of water of a 3.0m raising</p> <p>It appears desirable to store approx 106,000 cu m or more if possible behind this dam, as in Option 3 which has 3m dam raising. However, we consider that this extra height could severely impact on the landscape, and suggest that the raising ideally be limited to an apparent 1.5m, whilst still storing this volume of water. We suggest that this might be achieved by the following three measures:-</p> <p>1. Design the spillway to discharge the 1:10,000 year flood only, with the surplus PMF water being allowed to overtop the crest. This might reduce the raising by approx 1.1m, being the height of the spillway. Please clarify and confirm</p> <p>The old and new dams would then have to be protected from erosion from the overtopping PMF, and the need for this will depend on the rate of flow and duration, hence please supply the hydrograph.</p> <p>The new raised earth dam could have all slopes and the crest easily protected with reinforced grass [plastic Enkamat or similar] installed during construction and this would present a similar surface to that proposed for Option 3, ie. uniform grass, with possibly a berm/path and some bushes or shrubs on the upstream face to soften the appearance.</p> <p>The crest/cycle track on the existing dam is already in hard tarmac construction, but this could be re-laid in harder construction to ensure that it would not be eroded or undermined. It will then form a berm on the downstream slope,</p>	<p>Reducing the upper crest of the raising dam by 1.1m would effectively reduce storage capacity since the peak water levels are 0.7m above the spillway crest during the PMF event, because the spillway causes the water to back up behind it (the throttling effect). This would represent a loss of storage capacity of at least 17,300m³ based on an estimate using the surface areas of Bird and Model ponds (likely to be more since the areas increase with height). This loss of storage capacity would have consequences on the works required on downstream ponds to achieve no net increase in flooding downstream.</p>
	177	<p>The downstream slope of the existing dam into the Men's Pond is broadly uniform grass with some specimen trees which are to be retained. If the hydrograph indicates that this downstream slope needs to be protected, then reinforced grass could be laid on it and around the trees without significantly altering the appearance. We accept that this may not provide the same protection as on a new dam, but suggest that it should be adequate, taking into account the fully protected crest, and the massive thickness of the combined existing and new dams. There could perhaps be some surface damage but no structural damage, and we understand that some damage can be accepted.</p>	<p>The Panel Engineer would not accept overtopping of the main dam due to the trees on the downstream slope which are to be retained. These trees would cause eddying and turbulence which would increase the erosion of the dam during overtopping.</p> <p>The kind of damage that would be accepted would be minor wear and tear of turf which could be replaced after a flood event. Erosion of channels around trees, or trees being pushed over and removing the root ball from the dam, would not be acceptable.</p>
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	178	<p>Lower the water level in the pond by say, 0.5m max, and hence trim further height off the raised dam.</p> <p>As stated above, we absolutely agree that water levels should remain unchanged on all other ponds, due to the adverse effect on ecology and visual aspects. However, we suggest that the Boating pond is a special case. It is an artificial looking pond, of no significant ecological value. To construct the new dam, we believe that the pond may have to be completely drained with areas dredged for the new dam, and the two small reed beds and other planting will not survive. It is also proposed to cut back the west slopes significantly into the rising land, to win fill and create a more natural edge. Whilst this work is being carried out, it would be extremely simple to dredge the pond deeper and lower the water level permanently without reducing the surface area of the pond. We suggest this be limited to say 0.5m max. We accept that disposal of silt, particularly if contaminated, may be a problem, but significant quantities may have to be disposed anyway, even if the water level is not reduced. The design of the dam and west slopes can easily be adjusted for a lower water level. However, this could leave the untouched east and north edges higher above and slightly more remote from the water. We therefore suggest that the existing east and north perimeter path could be re-constructed to the same height above the lowered water level as now. Alternatively, these paths could remain as now, but a new stepped water's edge could be formed advanced into the pond, broadly as on page 16, but with a walkway just above water level. Some marginal plants could be added if required to soften and conceal the walkway, but full access would still exist for model boats. We suggest that this could further 'naturalise' the pond attractively. A similar suggestion was also made at the Stakeholders workshop on 16 July 2013 [p45].</p>	<p>As mentioned above, it is unlikely that other stakeholders will make this exception. While it is technically feasible to increase storage capacity by lowering the overflow level, there would be stakeholders who would not like the visual impact of exposing 0.5m of the sheet piles for the whole perimeter, or the loss of access for model boaters.</p> <p>Dredging the pond is unlikely to be simple considering the quantities involved, the costs and the amount of plant movements. Currently the cost estimate only includes an allowance for 20% of the pond area to be dredged (to allow construction of the new bund), but increasing this to 100% would significantly increase costs. The issue of where to locate the removed silt is already associated with high risks and unknowns.</p>

Source	Query Number	Query	Design Team Response
<p>Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013</p>	<p>179</p>	<p>The additional area of the pond, formed by excavating the west bank, may allow the raised dam to be trimmed further in height. We await calculations on this with interest [page 31]. However, we are very concerned at the possible visual impact of extending the pond width by up to 70m, which we understand may be mainly at the north end. This would double the width of the pond. We are also concerned at the proposed steepening of the west bank slopes from 1:13 to 1:5, which could look very artificial. We are also concerned at any tree loss that would be caused by this widening, please clarify.</p>	<p>We have modelled a variation of one of the Highgate chain Options with the additional storage volume achieved from the excavations above water level, but it made very little difference to flood levels downstream (around 20 – 30mm). The primary reason for the widening is therefore to provide material without importing large quantities through residential areas.</p> <p>The current design for the west bank slope has a maximum slope of 1:8, where the existing slope is around 1:10.</p> <p>Tree loss due to the excavation will be avoided by working around the trees, leaving the group of lime trees as an island, and having the widest excavation at the area of open grassland towards the north west.</p>
<p>Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013</p>	<p>180</p>	<p>This major widening of the pond is not reflected in the plan-diagram on page 41. If this enlarged width is proposed mainly to win earth for the dam construction, rather than import earth, we strongly suggest that serious consideration be given to the option of digging deeper into the pond, rather than making it wider. Also, if suitable and unobtrusive locations can be found for borrow pits to obtain fill for the dam, these may possibly be backfilled with unsuitable soil and silt if ponds are de-silted, rather than transport off-site.</p> <p>In summary, we hope that these three measures will enable the apparent dam raising to be limited to approx. 1.5m, whilst still storing the same volume of water as Option 3. Because the footprint of the dam would be reduced, we hope that both mature willows at the west end just north of the ancient oak could then be retained. Please also advise if the large and the medium hornbeams at the west end of the causeway can be retained.</p> <p>We are concerned at suggested tree loss for the proposed spillway works on the downstream slope of the existing dam [p28/29]. It is essential that a detailed plan be provided showing tree loss. P29 states that a low earth bund would train the [water] flow away from the dam and therefore avoid the need to line[reinforce] a wider area or cut into the ground to form a spillway chute. Excellent! However, we therefore feel that there should be no need to touch any trees on this spillway route, and we contest that two London planes have to be felled to form this corridor for the lower spillway.</p>	<p>A visualization of the pond widening has since been presented on the 14th September workshop and will be included in the next report.</p> <p>Digging deeper into the pond is less viable because of the layer of silt in the pond, recently estimated to be up to 2.2m deep in places.</p> <p>The dredged silt will not be suitable for use in dam construction, and it would take some months to dry out material obtained from the hard bed below the silt. This material would need to be temporarily stored on site which could be unsightly. Dredging will also not provide any more floodwater storage capacity. The City of London are working with Atkins to identify borrow pit locations but suitable locations are limited.</p> <p>None of the hornbeams on the dam would be affected. Currently the only tree that has been identified for removal is a willow, which is north of the dam (between the upper and lower paths). Some discussion using maps and photos would be needed to confirm whether this willow is one of the two referred to.</p> <p>A detailed plan showing tree loss can be provided in the near future once all the new topographical survey information is combined with the tree survey information and the outline designs. This is likely to be during the outline design phase, programmed for October / early November.</p>
<p>Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013</p>	<p>181</p>	<p>Men’s Swimming Pond – raise dam 0.5m We prefer timber facing for the proposed wall on the dam crest rather than brickwork which would be unacceptable, screened with marginal vegetation.</p> <p>We request a plan showing the layout of the proposed spillway, and then have a joint review on site. We are surprised at the large width [25m/43m]. However, if it is sited partly on the west bank, by the rangers’ bothy, we believe that it could follow a natural slope over shallow ground down to the next pond and no reshaping of the ground would be needed. As this natural route completely avoids the dam toe, no reinforcement of the spillway is needed, except at the dam crest and spillway mitres. Also, no trees, bushes or fences need be removed on this route. During a PMF spill, trees, bushes and fences may suffer some damage during this extremely rare event, but this would be acceptable, rather than unnecessarily clear and reinforce the spillway as proposed.</p>	<p>This preference has been noted and incorporated into the updated visualizations shown at the 14th September workshop. We are not yet able to issue detailed plans of spillways but may be able to discuss the outline sketches to be tabled at offline meetings.</p> <p>For information on spillway location please see the Preferred Options Report. The reinforcement of any slope would have minimal visual impact since whatever reinforcement material is used there will be turf and grass covering it.</p> <p>The proposed spillway level at this pond in Option 4 is 68.91mAOD. The ground levels between the dam and the path running NW – SE past the pond are up to 68.97mAOD so the natural ground is not as shallow as is required and would not be a natural route for water to flow down without some excavation of the area. Such an excavation would require tree loss which is opposed by the Mens Bathing Pond Association.</p>

Source	Query Number	Query	Design Team Response
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	182	<p>Highgate No 1 Pond – raise dam 0.5m</p> <p>We prefer timber facing for the proposed wall on the dam crest rather than brickwork which would be unacceptable. We urge that this wall be hand constructed so that there is no tree loss on the crest or dam slopes which would expose West Hill Court and Brookfield Mansions from the Heath. As the wall is on the crest with a sloping upstream face, we urge that it be concealed with vegetation and shrubs on both sides.</p> <p>We are greatly surprised that the spillway is proposed to be 60m/74m long, and ask that calculations be provided to substantiate this extraordinary width. This spillway [p30] would be partly on the west end of the dam and partly along the natural ground to the west of the dam. At this position two large trees [including a very large horse chestnut adjacent to the path,] and a smaller lime and two alders would be felled. There is also a veteran oak adjacent, about which the report is silent [except for mention on page 33].</p> <p>We consider this tree loss to be unacceptable, and query if fewer trees would be lost if the raised dam is continued round the waters edge almost to the dog swimming area. The west bank from this point northwards would then form a 'natural' spillway which could flood across the path to the low lying area to the west, and then fill up before overflowing south through a natural depression broadly along the line of the existing footpath. As most of this natural route, which is further to the west than proposed in the report, would avoid the dam toe, then little or no reinforcing may be required. It may also slightly reduce any impact of the flood to Brookfield Mansions.</p> <p>We request a plan showing the layout of the proposed spillway with trees that would be lost, and a detailed level survey and plan of our alternative proposal above. There should then be a joint review on site. On these plans, please indicate the general direction this overtopping surface water will take after leaving the dam.</p> <p>Please clarify what is intended by - new spillway could be planted as a bioswale feature [p43]</p>	<p>This preference has been noted.</p> <p>No tree loss is anticipated along the dam crest due to constructing the raising walls in options 3 and 6.</p> <p>Some planting of bushes / shrubs is possible on the upstream face.</p> <p>The spillway width was tested in the hydraulic model so there are no calculations as such, although the inputs to the model (the hydrology used to calculate the inflows, and the dimensions used for the design spillway) are auditable.</p> <p>The spillway width and depth could be refined at the next design stage and there may be scope for reduction.</p> <p>The current spillway route avoids the veteran oak.</p> <p>The natural ground described in this proposal is higher than the spillway level (eg in Option 4) and would require excavation. While the ground appears to be lower at the path near the west end of the dam, it is close to the minimum existing ground level of the crest of the dam. A copy of the topographical survey can be sent to the H&HS to allow a review of these levels.</p> <p>The spillway location and tree loss plans will be made available at outline design stage (October). Topographical survey information on tree locations is expected soon and this will be combined with the tree survey to allow a more detailed assessment of tree loss.</p> <p>It is suggested that there would be planting at the pond and upstream face of the dam near the spillway out of Highgate No.1 Pond, in order to screen the feature. It may be possible to add some more planting into the spillway channel when it is sufficiently beyond the downstream toe of the dam, but this will depend on the specific alignment over / around the dam.</p>
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	183	<p>Environmental Management Options [p44/45]</p> <p>We note the extensive toolbox of options for pond, water quality and ecology, but feel that we cannot offer any opinions at this stage. It is essential that every pond is visited and detailed discussions held on site before any options can be supported or discarded.</p>	<p>Discussions on site can be arranged.</p>
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	184	<p>CONSIDERATION OF OPTIONS – HAMPSTEAD CHAIN (see particularly pages 11-12, 47-61)</p> <p>Key Principles and Selected Options</p> <p>In assessing these options, we have considered the following key principles:-</p> <ol style="list-style-type: none"> 1. To minimize tree loss on Hampstead No 2 pond 2. To attenuate/store more flood water than proposed in the report, provided that this would reduce the tree loss on Hampstead No 2. We particularly query if more storage is possible at the Catchpit, the Mixed pond, and at Hampstead No 2 3. To minimize the visual impact of the works at all ponds 	<p>Slightly more storage may be achievable at the proposed Catchpit dam by raising the spillway level by around 50mm (the current overtopping depth), or more if the pipe through the dam is reduced again from 300mm to 250mm. The only way to store significantly more than this would be to have an automated valve or penstock system which would close the pipe going through the dam. However, the City of London prefer not to rely on any automated / mechanical systems. In terms of passive systems, a further refinement could be achieved with a hydrobrake, which is a vortex shape within the pipe (with no moving parts), that can maximise the storage. This could be investigated at outline or detailed design stage.</p>

Source	Query Number	Query	Design Team Response
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	185	<p>Hampstead Chain – pond by pond review</p> <p>Spillways generally</p> <p>Spillways are described in outline on all the dams, dimensions are stated, but locations are rarely given. Consequently, the visual impact is difficult to assess. It is essential that we be provided urgently with simple plans showing the locations, with any significant tree and vegetation loss described. Where 'natural' spillways can be routed to avoid the dam slopes and toe, then we urge that no reinforcement is needed, and no trees, bushes or fences need be removed on the route. During a PMF spill, trees, bushes and fences may suffer some damage during this extremely rare event, but this would be acceptable, rather than unnecessarily clear and reinforce the spillway, as proposed on some dams.</p>	<p>For information on spillway location please see the Preferred Options Report. Tree loss plans will be made available at outline design stage (October). Topographical survey information on tree locations is expected soon and this will be combined with the tree survey to allow a more detailed assessment of tree loss.</p> <p>The damage to trees during a flood is not so much of an issue as the damage to dam material or spillway that might be caused by a tree overturning during a flood, and this is the damage that would not be acceptable.</p> <p>Please also see answer to query 168.</p>
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	186	<p>Vale of Health Pond – crest restoration 0.2m max [or 0.6m?]</p> <p>It has been stated that this pond has never overflowed and is spring fed with a small catchment area. The irregular tarmac crest has not been noted as of any concern. We therefore query why crest restoration is needed, with possible impact on crest trees</p> <p>Please clarify if use of a pipe larger than 500mm would avoid the use of a spillway with consequent tree loss. We would prefer this</p> <p>Please clarify proposed spillway and pipe discharge routes re the large sequoia tree, and detail any tree loss.</p>	<p>The Vale of Health pond dam has been considered in the context of its place in a chain of ponds. If it were to fail, the stored volume released (estimated at 17,800m³ at crest level) would be too much for the downstream dams to store (even in the proposed design options), causing overtopping at the 3 downstream dams and the associated risk of erosion and further failure. The return period of overtopping is estimated at between a 1 in 100 and 1 in 1,000 years, and the risk of failure due to overtopping is therefore too high to be acceptable.</p> <p>While the proposed 3rd overflow pipe could not be larger than 500mm without increasing the raising of the dam crest, it is possible to model the effects of adding a 4th pipe in terms of a possible reduction of the open channel spillway size.</p> <p>For information on spillway location please see the Preferred Options Report.</p>
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	187	<p>Viaduct Pond – crest restoration 0.5m [or 0.18m?]</p> <p>Please clarify spillway route and tree loss</p>	<p>For information on spillway location please see the Preferred Options Report.</p> <p>The tree loss can't be confirmed until we combine the topographical survey information on tree locations with the tree survey.</p>

Source	Query Number	Query	Design Team Response
<p>Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013</p>	188	<p>Catchpit – suggest 5.8m dam</p> <p>We note that a 5.6m dam is proposed because the 7.2m dam reached a max water level only 160mm higher than with the 5.6m dam. Why not increase the proposed dam to 5.8m, in order to store the absolute maximum volume of flood? The Flowchart [p12] indicates the value of more storage, when one compares the 4.4m and 5.6m dams.</p> <p>We have considered the two positions suggested for the dam – a) a sinuous curve on the S side of the valley, or b) moving the dam c.25m back upstream. Before giving a view, it is essential that detailed plans of these options be provided, showing trees that would be lost. We would then like again to view these options on site, as option b) was not considered at the last site visit.</p> <p>We initially favour Option a), but only if it can be designed not to endanger the two hybrid black poplars and hornbeams. This option would hold more flood water than option b).</p> <p>If Option b) is constructed, we presume the oak that would be lost is just inside the Catchpit fence. However, it is essential that a mature oak at the top of the west slope near the Catchpit be retained, as this should significantly screen the new works from Pryors Field. Many willows on the Catchpit boundary on the east side may be lost, - there should be replacement planting on the dam toe.</p> <p>We note on p49 that an advantage of Option b) appears to be that the Catchpit infrastructure could be rebuilt and improved, with potential for creation of a wetland habitat upstream. If this is desirable, we suggest that it could be carried out irrespective of the position of the new dam</p> <p>Option b) on the north side will store less water than option a). Please re-calculate storage volumes, and indicate what adjustments should be made to this and other dam heights to compensate.</p> <p>As this dam is a 'dry' dam, we presume that shrubs and bushes can be planted on the slopes. Please confirm. If the slopes are in woodland, then we would want bushes for screening. If the slope faces grassland, then we wish to review on site</p>	<p>It is possible to increase the height of the dam to retain the extra 40mm which is the current modelled height of overtopping over the spillway.</p> <p>The possible dam positions will be redrawn on the finalised topographical survey and tree survey plan when this is available and a more detailed assessment of tree loss will then be possible.</p> <p>We will soon be able to confirm if a sinuous route avoiding these particular trees is possible. If not, the position of the dam further upstream (over the current location of the catchpit) will be modelled. However, it is not anticipated that the reduction in storage capacity will be significant, so the tree loss and quantities are likely to be the determining criteria when deciding on the exact dam location.</p> <p>Some replacement planting will be possible on the upstream toe of the dam, away from the central core.</p> <p>This point is noted, although there may be cost considerations if the catchpit is removed while being outside of a dam footprint.</p> <p>We will check the impact on storage volumes at outline design stage, although it is not thought that the impact of moving the dam upstream will be great.</p> <p>The Panel Engineer has advised that some planting is allowable on the lower part of the upstream slope of the dam, in the form of bushes and shrubs with gaps between to allow inspection of the surface condition. Both slopes would face woodland.</p>

Source	Query Number	Query	Design Team Response
<p>Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013</p>	<p>189</p>	<p>Mixed Bathing Pond Options K, I and M indicate that two plane trees may be lost on Hampstead 2 Pond dam. If this loss could be reduced to only one tree by increasing the flood storage at the Mixed Pond more than proposed, then we would support this option. This short dam is already an artificial looking causeway with steep descents onto it at both ends, and raising it significantly should be simple. However, the key issues to consider include:-</p> <ul style="list-style-type: none"> pedestrians on the causeway should still be able to view the water on this pond and Hampstead No 2 pond at the same time, which implies raising the crest road to enable one to look north over the crest of the new dam which would be built within the Mixed Pond, similarly to the proposed Boat Pond dam loss of the glimpse of water of the Mixed Pond when viewed from Hampstead No 2 Pond causeway. However, this glimpse will be lost if the dam is raised less than 1/2m, so a greater raising would not affect this aspect. The effect of the raised dam when viewed from the swimming enclosure, although we presume it could have some shrubs, and a wildflower seed mix. We note from the Flowchart [p12] that 1.5m raising is suggested without qualification, but a 2.0m raising is not preferred by some stakeholders. <p>Ultimately, the amount the dam is raised may be a balance between saving one plane trees on Hampstead No 2 and the feelings of the swimmers re a raised dam to the south. To make this decision, we need information on how more water storage at the Mixed Pond might influence loss of plane trees on No 2 dam.</p> <p>However, assuming the spillway is designed for PMF [as on the Highgate chain], then if the spillway is re-designed to discharge the 1:10,000 year flood only, with the surplus PMF water being allowed to overtop the crest, this might reduce the raising by approx 1m, being the height of the spillway. Please refer to our comments re the Boating Pond, clarify and confirm.</p> <p>If this option is selected, then the whole dam may have to be reinforced to take overtopping. This should be very simple, as the slopes are short, and the existing downstream slope is already uniform grass and has no trees along its critical length. Also, this dam is the second most robust dam on the Heath [after the Bird Sanctuary dam]. This option may therefore enable more water to be stored without further raising the dam</p> <p>Will the pond be dredged, as it is very shallow, particularly along the whole of the west bank?</p>	<p>In any configuration of a 2m raising, the causeway road surface would be raised, so that pedestrians will have a clear view of the ponds on both sides.</p> <p>This is noted.</p> <p>This appears to be the key issue for many stakeholders and we are looking at different designs for raising the dam 2m, eg with a 1m high wall above 1m of earth embankment above the existing causeway level. We are aiming to include some cross section sketches of these options in the next report.</p> <p>The options flow chart can be amended to state that 2 trees are expected to be lost at Hampstead No.2 in Option M, but 1 plane tree would be lost in Option P, the new option introduced at the 14th September workshop.</p> <p>There is scope to widen the proposed spillway at Mixed Bathing Pond, which may allow the upper raised crest either side to be lowered. However, the spillway crest level is currently only 300mm below the upper crest level, so the net reduction in the upper raised section could only be between 0 and 300mm.</p> <p>Agreed that most of the downstream slope could be reinforced, except for the two mature trees at the west end (on the dam itself) and the large veteran oak at the east end which would be affected.</p> <p>There are discussions about the possibility of dredging the upstream end. The pond is one of the highest priority ponds for de-silting.</p>

Source	Query Number	Query	Design Team Response
Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013	190	<p>Hampstead No 2 Pond</p> <p>1. Options K, I and M indicate that two plane trees may be lost on this dam. If this loss could be reduced to only one tree by increasing the flood storage at this pond, then we would support this option, but as a last resort only if necessary, after our other suggestions have been adopted.</p> <p>We note that Haycock proposed to raise the crest by 1.0m, and Colvin and Moggridge, Landscape Architects, suggested in Nov 2010 that one could replace the existing fence [posts 900mm high] with a buttressed wall 1m high. This will raise the level of the dam with minimum impact on tree roots. Access could be provided to the fishermen's path at the waters edge. This option might cause flood water to enter the lowest part of the gardens of some houses in South Hill Park, but if so, this would be briefly during exceptionally rare extreme flood events, and the houses should not be affected. This suggestion would require very careful landscaping so as not to be intrusive when viewed from the north. The path may have to be raised, and the wall may need to be screened with vegetation on the north side. In order to assess this option, please provide details on whether storage at this pond would be beneficial.</p> <p>2. We have considered the options of spillways versus culverts. Please provide details of your investigation of the possibility of splitting up the spillways to run between the trees. However, we initially favour culverts, to be sited as far west as possible.</p> <p>3. Your View Point 3 [page 52] shows two trees would be lost. If the tree on the east is removed, then the Royal Free Hospital will become visible through the gap when viewed from the west end of the Mixed Pond causeway, much further west than View Point 4 which is from the east end of the causeway. However, if only the tree on the west is removed, then the hospital will not be visible as the gap will be screened by trees overhanging the west bank of Hampstead No 2 pond. We therefore urge that only the west tree be removed.</p> <p>4. We therefore query if the wide but shallow box culvert could be constructed with a taper in plan to form a narrow waist but deeper section as it passes between the trees so that only the west tree need be removed.</p> <p>5. We also hope that more storage at the Catchpit, Mixed Pond and Hampstead No 2 pond, when combined, might result in the reduction of the number of 3m wide culvert to two, which presumably will have a width of 6.5m. If so, we suggest that only one plane need be lost, as they are at 8m centres</p> <p>6. If two trees will still be lost with shallow culverts, we query if a letterbox drop culvert, with a low level thrust bored or tunnelled culvert could be constructed below the tree roots, to save one or both of the trees proposed for felling with shallow culverts</p> <p>7. We note suggestion for an island [p58]. We would like to meet on site to discuss details and particularly the size of any proposals</p>	<p>A new option, Option P, has been introduced to investigate whether a small amount of raising at Hampstead No.2 can reduce the width of the box culvert spillway in order to reduce the plane tree loss down to 1 (when combined with a 2m raising at Mixed Bathing Pond). The dam crest could be raised by 0.5m by a short wall situated above the sheet piles on the upstream face. The top of this wall is below the highest part of the dam at the eastern abutment, but we will check that the threshold levels of the houses to the east are not below this level.</p> <p>The modelling of the option indicated that the PMF peak water levels were below the raised crest wall level, so this option is now on the shortlist.</p> <p>Option P has been presented at the 14th September workshop and will be described further in the next report.</p> <p>The open channel spillways were modelled extensively, but they were either too wide (if trees are cleared) or would spread the risk of damage to more trees even if none are felled, by overloading the structural roots with soil or reinforcement materials. Agreed that the ideal location of the culvert spillway would be at the west end of the dam.</p> <p>Agreed that if 1 tree should be removed then the western tree would be the better one.</p> <p>The narrowest point in the culvert would constrain the flow so would cause water to back up more upstream in the pond. At outline design stage we will look at more ways to reduce the culvert width, including the maximizing of storage at Catchpit dam as described above.</p> <p>This scenario has been modelled as the new Option P, which has been found to work with a 5m wide x 400mm high box culvert.</p> <p>The Panel Engineer has expressed concerns that a thrust bored culvert could cause damage to the dam by creating preferential flow paths around the outside of the tunnel. The dam crest level is around 500mm above typical water level so any pipe would be small and would have to drop very sharply to get below the tree roots.</p> <p>A site meeting can be arranged.</p>

Source	Query Number	Query	Design Team Response
<p>Jeremy Wright, H&HS on Shortlist Options Report 24 Aug 2013</p>	<p>191</p>	<p>Hampstead No 1 Pond We presume the outflow will be sited at the extreme east end of the dam. If so, then this should be concealed from the footpath on the south by the belt of trees and shrubs at the dam toe, which widens out at the east end. We would therefore prefer a spillway which should be less intrusive when viewed from upstream. However, we suggest that this should be made as narrow as possible, and query if the side slopes could be made steeper, as access to the crest is private We note suggestion for an island [p59]. We would like to meet on site to discuss details and particularly the size of any proposals.</p> <p>Environmental Management Options [p60/61] We note the extensive toolbox of options for pond, water quality and ecology, but feel that we cannot offer any opinions at this stage. It is essential that every pond is visited and detailed discussions held on site before any options can be supported or discarded.</p>	<p>This is correct. The preferred option at Hampstead No.1 pond is a narrow box culvert which we believe could be screened by locating it at the east end of the dam.</p> <p>A site meeting with our environmental and dam engineers can be arranged.</p>
<p>Michael Hammerson, Highgate Society on Shortlist Options Report 26 Aug 2013</p>	<p>192</p>	<p>Western "roadway". The pathway/road along the western side of the boating pond is one of the Heath's major thoroughfares, for people and Heath vehicles. It is far from clear how it will be reconfigured and what will be its subsequent relationship with any new edge to the pond. Drawings are required.</p>	<p>Visualisations were presented at the Stakeholder Workshop on the 14th September for consideration.</p>

Source	Query Number	Query	Design Team Response
Marc Hutchinson, Highgate Men's Pond Association on Shortlist Options Report 27 Aug 2013	193	We have assumed – but ask for this to be confirmed – that this raised path will not go up and over or around the crescent-shaped westward continuation of the raised BP dam.	Re-routed path routes have not yet been confirmed and can be discussed as part of the ongoing non-statutory consultation.
	194	Men's Bathing Pond 1. Is the proposed spillway on the dam of the MP to be a hard spillway on which trees cannot grow?	The spillway will not be a hard surface but lined with topsoil and grass. Some planting can be considered for the parts of the spillway which are beyond the downstream toe of the dams, but trees will not be planted on spillways generally.
	195	2. Is it the case that a broader spillway on the Men's Pond would result in a lesser raised dam on the Men's Pond while retaining the existing trees?	No, it is the other way round. The lesser the raising, the wider the spillway would have to be, because increasing storage capacity reduces the outflow to be routed through a spillway and so the spillway can be reduced.
	196	We would like to see a plan and picture showing the returns on the east and west of the MP dam as well as the full "brick" wall. Why is brick chosen? To conceal concrete?	The details of the returns of the raising wall on the Men's Pond dam will be developed in the outline design phase. The cladding of the wall would be to conceal a concrete core, but can be any material eg timber, subject to agreement with the City of London and stakeholders.
	197	On page 29 of the Report there is a reference to the dam slope needing to be 1:12. We do not understand the need for this in the absence of an accessible path to the top of the dam.	The 1:12 slope would be for the side slopes of the spillway along the crest line of the dam. There is a path on the crest, but not a formalised one, so it may be possible to justify a steeper slope.
	198	Will it be necessary to close the MP facility in order to construct the proposed spillway and/or raise the MP dam? If so, why?	The proposed works to the dam at the Men's Pond would not require lowering of the water level, so it may be possible to keep part or all of the pond open during works, but this will be confirmed once construction phasing is planned by the appointed constructors.
	199	Regardless of the actual works at the MP, is it intended, in any circumstances, to use the MP facility as an engineering compound for the storage of plant or material?	This has not been planned, with other locations elsewhere on the Heath being considered for site compounds.
	200	We still consider that insufficient thought has been given to the construction of a side channel which, making the best use of the natural contours of the Heath, would carry the excess water down the side of No. 1 and No. 2 Ponds rather than through them. The channels could be where the existing north/south paths are (and these could remain in use as paths) and creation of the channels would not involve the felling of trees. We anticipate they might be approximately 60 metres wide but would not need to be excavated as channels. Rather a reinforced bund could be constructed on the pond side of the channel with the natural slope of Parliament Hill providing the "bund" on the east side. Drains on either side of the path could deal with mild flooding. The reinforced bund would prevent the water in the channel from flowing over and into the pond.	The proposal of a dry diversion channel and reinforced bund has been considered in detail in the Preferred Options Report.
Rob Mitchell, EGOVRA and Brookfield on Shortlist Options Report 27 Aug 2013	201	The Report specifies that "Less severe floods have also been used to assess the system response to ensure that the options for passing the PMF do not exacerbate the flows downstream during lesser floods." We would like to see the results of this work as it may go some way to satisfy us that these options do not result in worse floods arising in lower return periods than at present. Intuitively the increased storage in the pond system should reduce the potential of flooding, however, the design team have not been able to confirm this for us.	The standard of protection would be increased on Highgate Chain to at least a 1:1,000 year flood event (both preferred options). Options for the Hampstead Chain either maintain the standard of protection at minimum 1:1,000 year event (Option M) or increase it to at least 1:10,000 year (Option P).

Source	Query Number	Query	Design Team Response
Fitzroy Park RA	202	Actual data for expected attenuation down the chain, presented as %age of PMF, and other 1:1000 or 1:5000 year floods, is critical in justifying these significant works.	<p>Hydrographs for Highgate No.1 Pond have been included in the Preferred Options Report to illustrate this attenuation. These hydrographs show the difference between the existing peak outflows from the last pond and the outflows from the last pond spillway in one of the preferred options (Option 4). This option would achieve a reduction in outflows in a 1:10,000 year flood and a PMF flood. All of the floodwater in a 1:1,000 year flood is attenuated (or stored) within the pond system in Options 4 and 6, so the spillway would not operate. The 1:5,000 year flood has not been calculated.</p> <p>Information on the reduction in volumes being discharged from the last pond (in the 1:10,000 year and PMF events) will follow separately.</p>
Prem Holdaway	203	Nowhere is the current outflow of both number one ponds quoted. Each pond needs to be quoted individually.	<p>The capacity of the existing 0.46m diameter overflow pipe at Highgate No.1 Pond has been calculated at 0.9m³/s. The outflow in the existing scenario peaks at over 17m³/s (in a 1:10,000 year event) and 38m³/s in a PMF event, which means that the overflow pipe would be insufficient and floodwater would be back up and flow over the dam.</p> <p>At Hampstead No.1 Pond, the capacity of the existing 0.31m diameter overflow pipe at Hampstead No.1 Pond is 0.48m³/s. The PMF event outflow is around 8m³/s which again means that the dam would be overtopped.</p>
	204	Nowhere is the maximum outflow of both number one ponds quoted. Again each pond needs to be quoted individually. All options so far seem to be only designed for storing water.	<p>The above overflow capacities are effectively the maximum outflow of the No.1 Ponds.</p> <p>Temporary additional water storage is required to cope with the design flood. The proposals also include crest restoration, new spillways etc. If the additional storage was not included additional engineering works would be required at all ponds in the chain. Without adding storage capacity to some ponds in the chain, the spillways would have to be much larger and would require removal of many more trees.</p>
	205	What happens if there is another 1 in 10,000 year storm, the day after. Where is that water going to go?	<p>The spillways in the preferred options would be overtopped if a second large flood occurred, since the floodwater stored during the first flood would take some days to drain away into the sewer system. However, in the existing scenario, more water would overtop the dams in both the first and second flood.</p>
	206	What are the options for designing the outflow of each pond to its eventual target. The River Thames. So that no additional water is stored.	<p>This option would involve many very large diameter pipes running through central London so it unlikely to be feasible.</p>
David Lewis, Protect Our Ponds on Shortlist Options Report 19 Aug 2013	207	Water Quality Is this water quality standard compulsory? Is it possible to obtain an exemption?	<p>EU bathing directives are compulsory if bathing ponds are to be used as such.</p>

Source	Query Number	Query	Design Team Response
Ken Blyth on Shortlist Options Report 27 Aug 2013	208	<p>I am puzzled by the statement in the section of the Summary about Assessment of Design Flood that, although the data from the Hampstead Scientific Society "provided a useful record of rainfall over about 100 years....it is not suitable to provide design rainfall depths for the 1 in 1000 period events up to the PMF needed for this study i.e. up to the 10,000 year flood, as this would involve significant extrapolation beyond the useful range of the rainfall data". This does not make clear why the Hampstead data are considered useless for statistical purposes, nor what data extending over <u>more</u> than 100 years have in fact been used. It is not clear either why data from other parts of England (or elsewhere in the UK - and Europe) are thought relevant to Hampstead Heath. The report blinds by mathematical formulae and does not say enough about the data that are fed into them.</p>	<p>See methodology in Problem Definition Report.</p> <p>The statement points to the fact that statistically, the HHSS rainfall record is too short to give a reliable estimate of large rainfall events on its own. The FEH DDF curves are available for the UK which allows for statistically reliable estimates of rainfall for large events as it is based on data from more than one rain gauge. Hampstead Heath Scientific Society rainfall gauge is listed as one of the rain gauges used in the FEH DDF rainfall model (HHSS data from 1933-1995 is used). The DDF curves we used, are therefore likely to incorporate HHSS rainfall observations, complemented by other rain gauges to provide a more statistically reliable estimate of rainfall. With regard to data used in the analysis, the FEH manuals, CDs and reports set out all data used and all underlying methodologies applied, in a very transparent manner. The reader is referred to the FEH manuals for further information.</p> <p>Our assessment has applied the Defra, Flood and reservoir safety Revised guidance for panel engineers to calculate the hydrological inflows to the Hampstead Heath ponds. This includes the Flood Studies Report (FSR) and Flood Estimation Handbook (FEH) methodologies for deriving flood event rainfall hyetographs and flow hydrographs. The FSR and FEH manuals set out the data used in both developing and applying the methodologies.</p>

Source	Query Number	Query	Design Team Response
<p>West Hill Court RA on Shortlist Options Report 27 Aug 2013</p>	209	<p>We would like to know whether there has been a study of previous flooding in the area? We appreciate that this will not help predict the future, but it may inform solutions. We understand, for instance that inadequate drainage at lower levels was an important factor in the 1975 floods.</p>	<p>Previous studies used in the Atkins work:</p> <ul style="list-style-type: none"> • Hydrological and Water Quality Investigation and Modelling of the Hampstead Heath Lake Chains and Associated Catchments, Haycock Associates Limited, 2006; • Hydrology Improvements Detailed Evaluation Process (HiDEP): Hydrology and Structure Hydraulics, Haycock Associates Limited, 2010; • Hampstead Heath Dam 3D Topographic Survey, Plowman Craven, 2010; • Haycock Hampstead Heath Stella model, 2010; and • Hampstead Heath Reservoirs On-Site Emergency Response Plan for Reservoir Dam Incidents. City of London, November 2012. <p>We have not modelled previous flood events on the Heath as part of our study as, there is very little calibration data for previous other than whether dams overtopped or not. Also, the focus of our work was on deriving events of different return periods to assess the overtopping risk of the dams under these types of events. We have undertaken a review of other studies which have investigated previous flood events.</p>
	210	<p>We are also concerned that there may not be adequate collaboration between the agencies responsible for flood issues. Could it be that stronger joint work between The City of London, Thames Water and Camden Council might enable a modification of the works?</p>	<p>Thames Water are not responsible for the safety of the dams or for the water normally stored in the dams that could be breached. Their sewer systems are only designed for small flood events up to around a 1:75 year return period event. Standard guidance on dam safety requires that dams can safely pass floodwater from a PMF, with spillways able to pass the floodwater from a 1:10,000 year event, so the existing sewer system cannot accommodate these kinds of floods. There is no opportunity to provide sufficient storage of the excess floodwater downstream of the ponds in Camden.</p>
		<p>The City's intention appears to be simply to increase the height of the dams so far that much more water is stored and there is less risk of overspill. Our residents have raised a number of questions in this respect:</p>	<ol style="list-style-type: none"> 1. Storage capacity has been added to some of the dams until the design flood (the PMF) is safely passed without overtopping the dam crest as this could cause dam failure.
	211	<ol style="list-style-type: none"> 1. How much is 'high enough'? 	<ol style="list-style-type: none"> 2. A safe volume would be the amount that leaves a small enough excess floodwater that can be passed through the spillway.
	212	<ol style="list-style-type: none"> 2. What is a 'safe volume' of water to store? 	<ol style="list-style-type: none"> 3. By improving the safety of the dams with adequate spillways and extra storage capacity, the possibility of the dams breaching is much reduced. Ground investigation early next year will provide information to allow the analysis of the stability of dams when loaded with higher water levels. Any issues will be remedied in the detailed design of the safety works.
213	<ol style="list-style-type: none"> 3. Is it not the case that increasing the height of the dam means that if the dam did breach, the volume of water released would be larger and cause more damage? 	<ol style="list-style-type: none"> 4. The principles that decide which aspect is the highest priority are constrained by law and standard industry guidance (see the problem definition section in the Shortlist Options report). In the 1:10,000 year event, it is estimated that around 107,000m³ of excess floodwater will overtop the dam at Highgate No. Pond in the first 14 hours. This is too much volume to be stored in the Dukes Field area of the Heath, as it would require a new reservoir with twice the capacity of Highgate No.1 Pond. It is therefore more feasible to design the existing dam to pass water safely without collapse. Overtopping could still occur but will not result in dam failure. 	
214	<ol style="list-style-type: none"> 4. Given that nobody could guarantee the rainfall in a 1 in 10,000 disaster, should not the priority be to manage the water that would, or does, spill over? In some other areas we gather that there are now 'sumps', dedicated wetlands or flood plains to absorb extra water in exactly the way that people in the past managed variations in weather. There is some recognition of this in the report with the use of spillways etc - could not more use of these systems be made on the Heath? Creating more wetlands has improved the situation in many areas of Sussex, protected houses, crops and livestock from serious flooding and had the added bonus of improving the range of wildlife and plants in the areas affected. 		

Source	Query Number	Query	Design Team Response																																												
Harriet King at PPSG meeting 30/09/13	215	Requested a contour map of the Highgate No. 1 area.	This can be provided separately.																																												
Jeremy Wright at PPSG meeting 30/09/13	216	Requested cross sections of the proposals at Mixed Bathing Pond.	Indicative cross sections of the options for raising Mixed Bathing Pond are given in the Preferred Option report.																																												
Harriet King at PPSG meeting 30/09/13	217	Requested more visuals of the Highgate No. 1 pond area – showing what wall would look like.	A new visual of the view on the spillway and raising wall looking north from downstream is given in the Preferred Option report.																																												
Geoff Goss at PPSG meeting 30/09/13	218	Cross sections of Model Boating Pond and Men’s Bathing pond dam	Cross sections of the raising dam at Model Boating Pond (for Options 4 and 6) are given in the Preferred Option report.																																												
Prem Holdaway at PPSG meeting 30/09/13		Requested the diameter of pipes on both Highgate No.1 and Hampstead No. 1, plus length and angle.	See above response to similar query by Mr Holdaway. Length and angle are not as critical as the diameter of the existing overflow pipes, which are inadequate for dealing with the larger flood events which must be considered.																																												
Harriet King Via email 2 October 2013	219	Please confirm the sizes of all historical events (for which data is available) over the last 100 years.	<p>We have extracted the 10 largest recorded rainfall events from the HHSS record and estimated return period of rainfall, based on the 24-hour DDF rainfall curves derived for the Heath. Please notes that, because the rainfall record is daily, we do not know the exact duration of the event. Hence the return period would be different when the correct storm duration is taken into consideration. The results in the table are therefore rough estimates only. The one event that we do know the duration of is the 1975 event which was 2 hours 35 mins. in duration (highlighted in red). This return period of this event was recently re-estimated by CEH and found to be 19,000 years.</p> <table border="1"> <thead> <tr> <th>Year</th> <th>Date</th> <th>24-hour observed rainfall (mm)</th> <th>Estimated Ref. Period (based on PDF rainfall)</th> </tr> </thead> <tbody> <tr> <td>2009</td> <td>15-Sep-09</td> <td>53.2</td> <td>5-10 years</td> </tr> <tr> <td>2008</td> <td>31-Aug-08</td> <td>35.2</td> <td>< 5 years</td> </tr> <tr> <td>2002</td> <td>07-Aug-02</td> <td>71.5</td> <td>10-20 years</td> </tr> <tr> <td>2001</td> <td>29-Oct-00</td> <td>47</td> <td>< 5 years</td> </tr> <tr> <td>2000</td> <td>15-Sep-00</td> <td>42.2</td> <td>< 5 years</td> </tr> <tr> <td>1994</td> <td>10-Aug-94</td> <td>45.2</td> <td>< 5 years</td> </tr> <tr> <td>1992</td> <td>22-Sep-92</td> <td>60.3</td> <td>10 years</td> </tr> <tr> <td>1988</td> <td>09-Oct-87</td> <td>48.8</td> <td>approx 5 years</td> </tr> <tr> <td>1977</td> <td>16-Aug-77</td> <td>79.6</td> <td>20-50 years</td> </tr> <tr> <td>1975</td> <td>14-Aug-75</td> <td>170.8</td> <td>500-1000 years</td> </tr> </tbody> </table>	Year	Date	24-hour observed rainfall (mm)	Estimated Ref. Period (based on PDF rainfall)	2009	15-Sep-09	53.2	5-10 years	2008	31-Aug-08	35.2	< 5 years	2002	07-Aug-02	71.5	10-20 years	2001	29-Oct-00	47	< 5 years	2000	15-Sep-00	42.2	< 5 years	1994	10-Aug-94	45.2	< 5 years	1992	22-Sep-92	60.3	10 years	1988	09-Oct-87	48.8	approx 5 years	1977	16-Aug-77	79.6	20-50 years	1975	14-Aug-75	170.8	500-1000 years
Year	Date	24-hour observed rainfall (mm)	Estimated Ref. Period (based on PDF rainfall)																																												
2009	15-Sep-09	53.2	5-10 years																																												
2008	31-Aug-08	35.2	< 5 years																																												
2002	07-Aug-02	71.5	10-20 years																																												
2001	29-Oct-00	47	< 5 years																																												
2000	15-Sep-00	42.2	< 5 years																																												
1994	10-Aug-94	45.2	< 5 years																																												
1992	22-Sep-92	60.3	10 years																																												
1988	09-Oct-87	48.8	approx 5 years																																												
1977	16-Aug-77	79.6	20-50 years																																												
1975	14-Aug-75	170.8	500-1000 years																																												
Harriet King Via email 2 October 2013	220	The scour pipe has historically been used to prevent the flooding of Brookfield and immediate neighbourhood. The effect of the scour pipe in carrying excess water to the drainage system should be included in your assessment of the existing situation. Please give us the data on the discharge rate of the scour pipe (CoL agreed to this on 30/9/13).	It is City of London’s policy not to use the scour pipe at Highgate No.1 Pond since permission is required from Thames Water. While it has been used in the past, this was not authorized. The capacity of the 350mm diameter scour pipe is likely to be less than 1m ³ /s and so it will take many hours more to empty this pipe into the sewer system (if this was theoretically allowed) than the time to peak of the flood from a 1:10,000 year storm event (around 3 hours).																																												

Source	Query Number	Query	Design Team Response
Harriet King Via email 2 October 2013	221	Please give us the data on the discharge rate of the scour pipe	See above (response to query 220). The scour pipe will not have the capacity to deal with the 17m ³ /s inflow expected at Highgate No.1 Pond in a 1:10,000 year event.
Harriet King Via email 2 October 2013	222	Please confirm the peak discharge in the overflow pipe (Atkins' figures show 0.53m ³ /sec) and how this figure is derived- ie what formula has been used and what coefficient of discharge. As this data is vital, it should be confirmed with a field measurement.	<p>We understand this refers to the Highgate 1 overflow pipe which leads into the sewer system.</p> <p>We assumed in our model, that the [<i>scour outlet</i>] pipe will not be available (i.e. no one to open [<i>the valve</i>], or sewer capacity exceeded and pipe cannot discharge).</p> <p>The pipe we have modelled is the small overflow pipe. Discharge through the pipes was calculated using information on the length and diameter of pipes.</p> <p>Volume of water that can flow through <i>both pipes</i> is very small compared with the inflows in the PMF event. [Note 18th Oct – clarifications made above].</p>
Harriet King Via email 2 October 2013	223	Outflows from HG1 assume all characteristics of the higher ponds are modelled correctly, can this be achieved without extensive field monitoring?	Our assessment has applied the Defra, Flood and reservoir safety Revised guidance for panel engineers to calculate the hydrological inflows to the Hampstead Heath ponds. This includes the Flood Studies Report (FSR) and Flood Estimation Handbook (FEH) methodologies for deriving flood event rainfall hyetographs and flow hydrographs. The FSR and FEH manuals set out the data used in both developing and applying the methodologies.
Harriet King Via email 2 October 2013	224	What is meant by 'first point of connection with another drain'? Where are these connection points?	The overflow pipe discharges into surface water drainage system close to the Highgate No.1 Pond.
	225	How do CoL co operate with TWA?	See above response (to query 210) to similar query from West Hill Court RA on Shortlist Options Report, dated 27 Aug 2013.
	226	Has CoL considered increasing the size of the overflow pipe from HG1 to increase its capacity and to compensate for the possible loss of use of the scour pipe?	The capacities of even a large number of larger pipes would be unlikely to deal with the large excess floodwater volumes for which the dams must be made safe according to the ICE guidelines.
Harriet King Via email 2 October 2013	227	Some form of sluice which would allow the discharge of water to be triggered by a rise in water level of 450mm above TWL of HG1 (300mm below the proposed spillway) would be a straightforward solution to allowing the scour pipe to discharge water before the spillway is overtopped. This option must be considered rather than uncontrolled delivery of water to downstream areas.	The City of London are seeking to avoid mechanical systems which have the risk of breaking down and would be difficult to access during flood events.
Harriet King Via email 2 October 2013	228	At what size event does water leave the HIghgate chain in an uncontrolled way ie over the spillway as surface water?	In both Options 4 and 6, the spillway would be operated in a flood of return period between 1:1,000 and 1:10,000 years. In comparison, any flood event larger than a 1:100 year event would cause overtopping of the existing dam at Highgate No.1 Pond.
Harriet King Via email 2 October 2013	229	Please provide a detailed plan of the area showing contours at 0.2m intervals of the area to the S, W and E of HG1. This must show local changes in level. Intelligent conventional surveying can be used to obtain reliable results rather than the remote sensing techniques proposed.	A plan showing 1m contours can be provided separately. While it is true that LiDAR data (obtained from aircraft) is not as accurate as conventional topographical surveying, comparisons of the LiDAR level data with the results of topographical surveying has shown a close match. Further topographical surveying of the area around Highgate No.1 Pond is being carried out and will inform the outline and detailed design stages.

Source	Query Number	Query	Design Team Response
Harriet King Via email 2 October 2013	230	<p>The ground to the north of the dog access to the pond does not rise immediately, please place posts showing proposed level of the western edge of the pond which must (obviously) be at least as high as the proposed wall on the dam. The fence at present is largely below the dam crest, please confirm the location of the proposed new wall (dimensioned, on a plan).</p> <p>How thick will the wall be?</p>	<p>Placing posts along this publicly accessible area at 300mm height might be quite difficult; the posts in the water at the Model Boating Pond are not accessible to the public nor do they present a trip hazard.</p> <p>The proposed level of the spillway at Highgate No.1 Pond where it crosses the path near the dog access will only be up to 300mm above the existing ground levels. The proposed wall to raise the dam would start on the crest beyond the locked gate on the fence across the dam crest.</p> <p>The thickness of the wall would depend on nature of the cladding which is to be discussed with stakeholders. The concrete core would be between 250 and 300mm thick.</p>
Harriet King Via email 2 October 2013	231	<p>Please provide updated figures for table 5.7 of the DFA for the 2 proposed options for 1:100; 1:1,000; 1:5,000 and 1:10,000 events, together with the forecast flood volumes.</p>	<p>This table has not been updated with proposed options and would need to be instructed separately by CoL if required.</p> <p>Please note that storage volumes would be increased in all options and therefore all options would benefit people downstream in all sizes of flood.</p> <p>Note a 1:5,000 year flood event has not been calculated.</p>
Harriet King Via email 2 October 2013	232	<p>The TWA map (which we have had before) does not show diameters, capacities, chambers or connections. Please provide these.</p>	<p>Details of all of these have not been made available yet. However, we know that the sewer systems are only designed for small flood events up to around a 1:75 year return period event. Standard guidance on dam safety requires that dams can safely pass floodwater from a PMF, with spillways able to pass the floodwater from a 1:10,000 year event, so the existing sewer system cannot accommodate these kinds of floods.</p>
Harriet King Via email 2 October 2013	233	<p>The storm water sewer is capable of taking controlled discharge of water from the Highgate chain and should be taken into account in assessing the outflow capacity of existing drains beyond HG1.</p> <p>A map showing drains, culverts and streams on Col's land should also be provided, including the stream/ culvert blocked by works to the secret garden and park keeper's house (historically, these took flood water to lower ponds further down Highgate Road).</p> <p>Please provide a section at 1:50 through the proposed wall and foundation on the dam of HG1 and a section parallel to this through the proposed spillway. Please indicate TWL and the level of the existing overflow.</p>	<p>See above responses (to query 232) relating to the inadequate capacity of existing pipes / drains, in the context of the design flood for dam safety standards.</p> <p>See above response (to query 232) relating to the inadequate capacity of existing pipes / drains.</p> <p>Outline designs showing this kind of information will be made available during the non-statutory public consultation.</p>
Harriet King Via email 2 October 2013	234	<p>What is the actual capacity of existing drains rather than typical capacity? Has this been modelled?</p> <p>Please confirm the capacity of TWA's new storm water relief sewers (70 years was quoted at the meeting on 30/9/13). If these had been in place for historic events eg 1975, what effect would they have had?</p>	<p>See above response (to query 232) relating to the inadequate capacity of existing pipes / drains.</p> <p>See above response (to query 232) relating to the inadequate capacity of existing pipes / drains.</p>
Harriet King Via email 2 October 2013	235	<p>Please examine this using real historical data or generated realistic data for lesser floods to establish characteristics of when the water will come down the spillway at HG1.</p>	<p>You have stated (query 234) that the capacity of the sewer system is 1 in 70 years, however the capacity of the overflow pipe is much smaller. Flood water is therefore restricted by the overflow pipe, rather than the sewer capacity. It should be noted that examination of the capacity of the sewer is beyond the scope of our work.</p>

Source	Query Number	Query	Design Team Response
Harriet King Via email 2 October 2013	236	We understand that the Environment Agency usually expects most of the water resulting from a flood to be stored in that locality and released slowly afterwards. The intention is to protect life and property downstream from flooding. Whether or not the Ponds fall within this definition, the principle should apply.	<p>As the Environment Agency is the Enforcement Authority for the 1975 Reservoir Act, and the streams are not classed as 'main' rivers, their only interest in this project is in seeing that works to ensure dam safety are carried out.</p> <p>In the proposed options, floodwater will be stored as much as possible. By adding storage capacity, more floodwater will be released slowly after floods into the sewer system via the existing overflow pipes, instead of overtopping the dams.</p>
	237	Please confirm that CoL is keeping the EA informed of the proposals	In terms of the Reservoirs Act the only role that the EA perform is as an enforcement authority.
Harriet King Via email 2 October 2013	238	Can you clarify why the scour pipe [at Highgate No.1 Pond] (457m diameter, 6m head of water) has a discharge capacity of 0.01m ³ /s whereas the overflow pipe (310mm diameter, head of water very much less- I'm not sure what this is), has a discharge capacity of 0.53m ³ /s ie >50 times as large? This doesn't make sense to me.	<p>The figure of 0.01m³/s for the scour outlet pipe at Highgate No.1 Pond was quoted in the Emergency Response Plan. A more likely capacity would be in the region of 0.5 – 1.0 m³/s. However, this still means that a) the pipe would not cope with the very large inflows expected in the design flood (the PMF), and b) it would probably take too long to drain the pond using this outlet considering the likely warning time available from the beginning of an extreme storm event.</p> <p>The discharge capacity of the outlet pipe will be calculated and the result of this calculation will be confirmed in the near future. However, the result is not expected to change the position on the usefulness of the scour pipe in flood events.</p>
Harriet King Via email 10 October 2013	239	1. TWL describes Top Water Level in the DFA but is now used to describe Typical Water Level. Are these the same?	1. Typical Water Level and Top Water Level are the same, both relate to the invert level of the overflow at a pond (or the proposed spillway).
	240	2. From the DFA I understand that the cumulative % of pmf inflow that can be stored in the Highgate chain is 56%, can you tell me what the relevant figures are for the 2 preferred options for the Highgate chain (and where I can find this)? I'm sure this is somewhere in the information you've sent us but at present I can't find it.	2. The figure of 56% was only the percentage of PMF inflow from the sub-catchment and direct rainfall at Highgate No.1 Pond stored in the pond, ie it did not include the inflows from spilling from the upstream ponds. The equivalent percentage has not been calculated for the current preferred options (4 and 6). However, we have calculated the total increase in storage across the Highgate chain in Option 4 (including the 2.0m raising at Model Boating Pond), this increase is 133,300m ³ . (A similar but larger increase would be achieved by the proposed works in Option 6). This increase in storage in the chain explains why the peak water level in Highgate No.1 Pond is lower than in the existing scenario in all flood events in both options 4 and 6, so that the standard of protection is increased by both options.

Source	Query Number	Query	Design Team Response
<p>Dr Geoff Goss & other PPSG members, Preferred Options Workshop, 14th September 2013</p>	<p>241</p>	<p>Has the 1975 flood been run through the model in order to test and calibrate it?</p>	<ul style="list-style-type: none"> - The 1975 return period flood has not been used to test the model because apart from the fact that the dams were all overtopped, there is not much data that could allow an accurate comparison of model results. In particular, the depths of water overtopping the dams were not recorded. - The 1975 return period flood was examined along with other historical events such as the storms of 1970 and 2010, and their return periods were estimated using depth duration frequency (DDF) curves provided by the Institute of Hydrology for the local area. (See response to query 219 about historical data for the full table of events). The 1975 event was estimated as either a 1 in 500 - 1000 year event, (using the FEH DDF curve), or a 1 in 19,000 year event, (using the FSR DDF curve). The FSR DDF curve is considered to be a more appropriate DDF curve for deriving the return period of the 1975 event given its extreme nature. The calculated 1:10,000 year flood in the hydraulic model causes the overtopping of all the dams in both chains, so if a 1:19,000 year flood was to be calculated and run through in the model, it would lead to overtopping of all the dams again. Similarly, the calculated 1:1,000 year flood causes overtopping of all the dams on the Highgate chain in the model, with a 1:100 year flood just overtopping Highgate No.1 Pond by a few mm, so if a 1:500 year flood was calculated and ran through the model it would also cause overtopping. The estimations of the return periods of the 1975 flood data therefore validate the model, in that the model predicts overtopping of all dams for anything bigger than a 1 in 100 year flood. Any further runs of return periods such as 1:500 or 1:19,000 years would therefore not produce any useful results or increased precision in the model.

Source	Query Number	Query	Design Team Response
<p>Susan Rose Email 14th October 2013</p>	<p>242</p>	<p>RE: Preferred Options Report I am confused by these documents; I have asked at least once if not more often for calculations re the difference in capacity between the boat pond as it exists and the boat pond as extended but with raised dame inside the existing dam but can find no record of this in either document.</p>	<p>The existing flood storage capacity of Model Boating Pond is 4,379m³, if the volume stored is taken as the space between the top water level (the invert level of the existing overflow pipe) and the auxiliary spillway level (the lowered ground on the west bank). (This value was originally quoted in table 5-7 of the Design Flood Assessment Report.) The actual storage may be slightly higher than this since the path west of the dam is slightly higher than the spillway level. If this value is used, the existing capacity is 8,717m³. However, the capacity of the pond in Option 4 is increased to at least 56,585m³ by raising the dam by 2.0m. This is an increase in capacity of 52,122m³ (between the existing spillway level and the proposed raised dam crest level). Also, since the Bird Sanctuary Pond would be submerged in a flood event with the raised bank in place in Model Boating Pond, a further 15,007m³ above the Bird Sanctuary Pond would be added, so in effect the total extra capacity of the combined ponds is at least 67,129m³. While we have not yet calculated the increase in storage at the two ponds in the other preferred option, Option 6 (with 2.5m raising at Model BP), it would be a value between 67,129m³ and the 106,000m³ previously calculated as the extra storage in Option 3 (the option with 3.0m raising that has since been discounted). The total increase in storage across the whole of the Highgate Chain in Option 4 is 133,317m³.</p>
<p>Harriet King telecon with Ben Jones of Atkins, 18/10/2013</p>	<p>243</p>	<p>1) What is the level of the top of the proposed raising wall at Highgate No.1 Pond (HG1) in Options 4 and 6? 2) What is of the level of the proposed spillway depth in Options 4 and 6 at HG1. 3) Is a 'spillway weir' the same as a spillway? 4) What is the PMF volume? 5) How would the spillway be lined where it is in natural ground on the west bank?</p>	<p>1) 65.02mAOD (1.25m above the minimum dam crest level). 2) The spillway weir level would be 570mm below the top of the proposed raising wall, not 670mm as it says in the Preferred Options report text, this was a typo error. 3) The weir is just the flat base section of the spillway, at the top. 4) PMF volume TBC. 5) The section of spillway on the natural ground would be lined with a shallow turf reinforcement mat, then the turf reinstated on top at the same gradient as existing (about 1:10). The TRM would be to prevent erosion near the abutment of the dam. The trees on the natural ground part of the spillway would not have to be removed, only the trees on the downstream slope of the west end of the dam itself (maximum 4) would have to be removed for the spillway).</p>

Position Statement on Discharge of Water (Surface Water and Overtopping of Ponds) from Hampstead Heath

With the introduction of the Flood and Water management Act 2010, there has been a change in emphasis from flood defence to flood risk management, as it is now accepted that it is not possible to defend against the full range of natural disasters that could occur. This paper sets out the current position and responsibilities of major agencies in relation to flood risk management.

Common Law

The rule in *Rylands v Fletcher* will apply to the man-made dams on the Heath, and strict liability without any proof of negligence will arise if the water *escapes* and causes damage on neighbouring land.

The water which the City Corporation are 'keeping' on the Heath, is the water held back behind the dams – it only 'escapes' if a dam fails, not when additional water overtops a dam.

In relation Clerk & Lindsell on Torts (the most authoritative guidance available on all aspects of the law of tort) the position in relation to land downstream is set out at para 21-30, where it states that, "*The owner of land on a lower level cannot complain of water naturally flowing or percolating to his land from a higher level.*" The para goes on to say, "*Nevertheless, the higher proprietor is liable if he deliberately drains his land on to his lower neighbour's land, and this appears to be so if the water is caused to flow in a more concentrated form than it naturally would as the result of artificial alterations in the levels and contours of the higher land.*"

Two other paras from Clerk & Lindsell are relevant - para 21-32 states that, "*It is the duty of anyone who interferes with the course of a natural stream to see that the works which he substitutes for the channel provided by nature are adequate to carry off the water brought down even by extraordinary rainfall...*" Para 21-33 states that, "*Even if a stream is diverted, there will be no liability if it can be shown that the injured party would have suffered the same damage if the stream had not been diverted.*" Halsbury's Laws helpfully states that, "*A riparian owner... has the right to have the water go from his land without obstruction... Conversely, a lower riparian owner is under an obligation to receive the natural flow of water...*"

It cannot be right that the City should be responsible at common law for all of the water passing through the ponds from upstream, and for downstream flooding that would occur whether the ponds were there or not. The owner of land on a lower level cannot complain of water naturally flowing or percolating to his land from a higher level.

There is no liability arising at common law from the natural flow of water downstream, and the City is under no duty to mitigate this.

Reservoir Act 1975

The Reservoirs Act 1975 provides the legal framework to ensure the safety of UK reservoirs that hold at least 25,000 cu m of water above natural ground level.

'Undertakers' are generally the owners or operators of the reservoir, and have ultimate responsibility for the safety of the reservoir. The Heath currently has three designated statutory reservoirs, Model Boating Pond and Men's Bathing Pond on the Highgate chain of ponds and Hampstead No. 1 Pond.

The Enforcement Authority is responsible for ensuring that the Undertakers observe and comply with the requirements of the Act. The Water Act 2003 transferred responsibility for enforcing the Reservoirs Act 1975 to the Environment Agency in England and Wales. It also gave the Government the power to issue a Ministerial Direction to reservoir undertakers (i.e. owners) to produce reservoir flood plans (i.e. emergency action plans). Since 1 October 2004 the Environment Agency has been the Enforcement Authority for England and Wales. The City's statutory duties under the Reservoirs Act 1975 are very specifically in relation to ensuring the structural integrity of the dams. The Act does not however contain any details as to the works that may be required.

The Supervising Engineer can call for an inspection by an Inspecting Engineer at any time under section 10(2) of the Reservoirs Act 1975. Under section 10(3) the Inspecting Engineer can make any recommendations he sees fit in the interests of safety. If the City is aggrieved by a recommendation of the Inspecting Engineer, it can refer the matter to an independent qualified civil engineer under section 19. If the City fail to comply with a recommendation of the Inspecting Engineer, the enforcement authority have the power under section 15 to carry out the works in default and to recharge the City. Failure to comply with a recommendation of the Inspecting Engineer without reasonable excuse is a criminal offence under section 22 of the Act.

Guidance set out by The Institution of Civil Engineers publication Floods and reservoir safety 3rd edition, 1996 states that, "*Its main intentions are to ensure that, where a community could be endangered by the breach of a dam, the risk of any breach caused by flood is virtually eliminated.*"

The Heath reservoirs are currently designated as a Category A and to quote the guidance for Category A dams: "*It is considered that public opinion will not accept conscious design for a specific threat to a community, even though it tolerates to an extent both random and accidental loss of life. Consequently, no dam above a village or town should be designed knowingly with a finite chance of a disastrous breach due to the under-provision of*

spillway capacity.” A community in this context is considered to be not less than 10 persons who could be affected.

The design standards for Category A reservoir require that to be tolerant of overtopping, the spillway structure(s) should be capable of safely passing a 1:10,000 year rainfall event.

As an Undertaker the City Corporation has in accordance with the Water Act 2003 prepared an on-site emergency action plan.

Flood and Water Management Act 2010

The Floods and Water Management Act was brought into UK law in 2010 to improve flood risk management and support continuity of water supply. Within Government the Department of Environment, Food and Rural Affairs is the lead Department.

A key feature of the Act is the implementation of recommendations from the Pitt Review into the summer 2007 flooding, thus increasing the emphasis on sources of flooding other than fluvial and tidal, in particular surface water which featured heavily in the 2007 flooding. The Act also updates the Reservoirs Act 1975 to reflect a more risk-based approach to reservoir regulation.

The Act gives a number of responsibilities and powers to both the Environment Agency and the Lead Local Flood Authorities (LLFA). LLFA are made responsible for local flood risk and main rivers (this includes responsibility for managing flood risk from surface water and ground water), the sea and large reservoirs are the responsibility of the Environment Agency. The LLFA for the majority of Hampstead Heath is Camden Council. The reservoir sections of the Act are dependent upon on the development of secondary legislation (regulations and orders) before the law can be fully implemented. Some of the proposed changes include:

- Reducing the capacity at which a reservoir will be regulated from 25,000m3 to 10,000m3; and
- Ensuring that only those reservoirs assessed as a higher risk are subject to regulation
- All undertakers with reservoirs over 10,000m3 must register their reservoirs with the Environment Agency
- Inspecting engineers must provide a report on their inspection within 6 months
- All undertakers must prepare a reservoir flood plan
- All incidents at reservoirs must be reported

The secondary legislation is being introduced in Stages; recent advice from DEFRA to the Heath & Hampstead Society has indicated that Stage 1 is likely to result in a change of classification of reservoirs from the current A-D (the Heath reservoirs are currently Category A), to a single “High Risk” category [where likely loss of life is 1 or more] with a high level of supervision and control, and a “Not High Risk” category with less control. It is likely that the Heath dams will be reclassified as High Risk.

It was anticipated that Stage 1 would also introduce the concept of cascade of reservoirs with an aggregate volume in excess of 25,000 cubic metres, resulting in potentially more of the Heath ponds being subject to reservoir legislation. It is now considered unlikely that this will form part of Stage 1. Officers are seeking a meeting with DEFRA to try and clarify the position will include the redesignation of dams.

Environment Agency

Following the Pitt Review, Defra, instructed the Environment Agency to produce simplified inundation maps for all 2,092 large raised reservoirs regulated by the Reservoirs Act 1975. Local Resilience Forums (LRFs) and reservoir undertakers have now received these maps to help them produce emergency action plans.

Thames Water Authority

Camden Council is responsible for the maintenance of gullies up to the point where they connect to the main sewer, which is then the responsibility of Thames Water Authority. Thames Water Authority sewers are designed to cope with the majority of storms, but occasionally storms are so heavy that they overwhelm the system.

London has a combined sewer system that takes in both sewage and rainfall - which means during a heavy storm, the flow in the sewer is much greater. London also has a high number of basement flats below street level, which are at greater risk of sewer flooding.

Thames Water Authority installed a flood alleviation system that runs across the Heath, the exact location and details of which are currently being investigated.

Camden Council

Under the 2010 Act Camden Council has a duty ‘to identify where flooding risks are present’.

A Preliminary Flood Risk Assessment (PFRA) has been undertaken for the London Borough of Camden. It has been carried out to assist the London Borough of Camden to meet its duties as a LLFA, with the delivery of the first stage of the Flood Risk Regulations (2009). These regulations implement the EU Floods Directive in the UK.

This study for the London Borough of Camden forms part of the wider Drain London project, which is a wider initiative that involves the undertaking of Surface Water Management Plans and Preliminary Flood Risk Assessments for each of the thirty three London Boroughs.

An important principle of the method for assessing the significance of surface water flooding, is of it occurring in 100 chance in any given year.

Funding for any flood defences is not specified within the Act, but the Environment Agency is specified as the lead funding body for flood risk management and is able to make grants in respect of expenditure incurred or expected to be incurred with flood risk management in England.

It is understood that Camden are proceeding with a more detailed study on surface water flooding issues that have been identified within the Borough. This includes areas around Gospel Oak, just south of the Heath. At this stage solutions regarding potential surface water flooding have not been identified or whether these might involve schemes of water attenuation on Hampstead Heath.

Civil Contingencies Act 2004

In London, the Community Risk Registers have been created to provide public information about hazards identified which could potentially have an impact upon London. The registers have been published in response to the Civil Contingencies Act 2004.

Camden's local Risk Register is designed to provide information about hazards identified which could possibly have an impact upon the local area. There is a specific risk associated with local urban flooding and as a result major dam failure.

Ref No:	Hazard	Outcome description extracted from the London Community Risk Register version 1 (issued 2011)	Likelihood and Impact	Risk Rating	Camden responders commentary
HL18	Local / Urban flooding (fluvial or surface runoff).	<p>Outcome Description A sustained period of heavy rainfall extending over 2 weeks, perhaps combined with snow melt, resulting in flash flooding and steadily rising river levels over entire counties, could threaten a large urban town.</p> <p>Localised flooding of 1,000 to 10,000 properties for 2-7 days. Up to 15 fatalities & 150 casualties. Up to 15,000 people evacuated. Up to 500 people stranded over a large area and in need of rescue. There would be a major impact road and rail links, making them impassable for up to 5 days.</p> <p>Impact on infrastructure includes: some buildings collapse, water damage, road and bridge damage. Sediment movement and contamination of water supplies. Loss of essential services (gas, electricity & telecoms) to 20,000 homes for up to 14 days. Widespread disruption for 7-14 days, significant debris and pollutants from affected businesses. Up to 1,000 people needing assistance with sheltering for up to 12 months.</p> <p>Rural impacts include widespread livestock carcasses, waterborne disease. Sewage treatment works flooded. Up to 50 properties destroyed and many more uninhabitable. Up to 2,000 people needing assistance with sheltering for up to 12mths.</p> <p>Variation & Further Information The flooding event would have a regional impact, possibly translating into loss of lives, localised economic damage and need between 6 and 18 months recovery before business as usual conditions are restored. The depth and velocity of water flows will vary. Significant mutual aid would be deployed from neighbouring regions, although other regions are also likely to be at risk or impacted at the same time.</p>	3 and 4	Very High	Risk rating identified for Camden 9/12/2010
H44	Major	Outcome Description Collapse without warning resulting in almost	1 and 5	Medium	The down

reservoir dam failure / collapse	<p>instantaneous flooding. Significant movement of debris (including vehicles) and sediment. Complete destruction of some residential and commercial properties and serious damage of up to 500 properties. Several thousand other properties could be flooded. Up to 200 fatalities, up to 1000 casualties. Up to 50 missing persons and people stranded. Hazardous recovery amongst collapsed infrastructure and debris. Water supply to homes and businesses is lost. Up to 200 people need temporary accommodation for 2 – 18 months.</p> <p>Variation and further information Assumes: No time to evacuate, flooding lasts less than 24 hours. Emergency services not pre-warned. Extent of downstream effect could reach 50-60km. Significant damage to gas, electricity supplies, telecommunications, road and rail links.</p>		stream effect of the very unlikely event of the Hampstead or Highgate dams breaching remains in Camden. The effect of the Islington dam has the potential to impact Islington and Camden.
----------------------------------	--	--	---

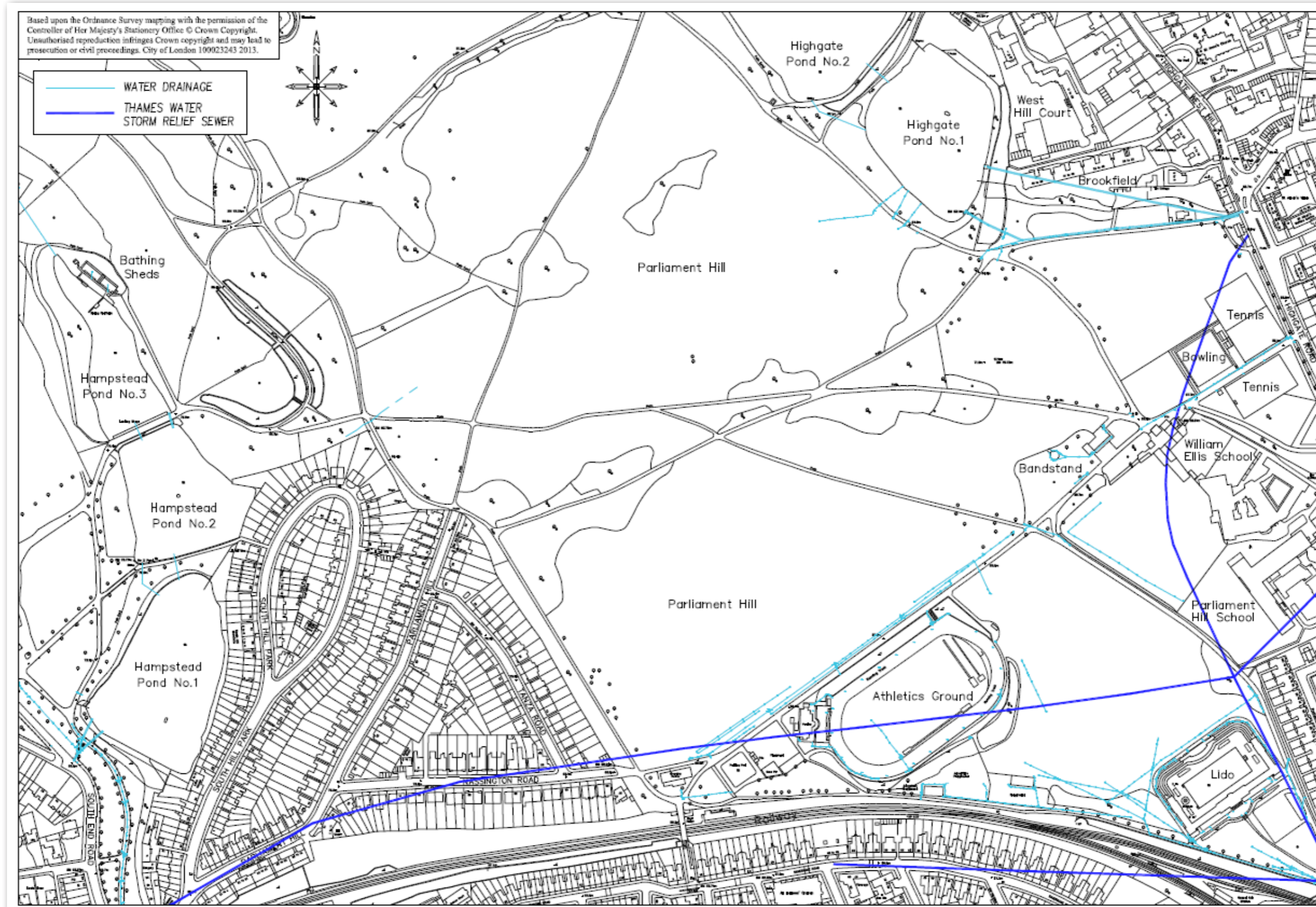
Camden has responsibilities under this legislation to prepare off-site emergency action plans. The City Corporation have been liaising with Camden Council on the preparation of their off-site emergency action plans in relation to the above risks.

Health and Safety at Work Act 1974

Employers also have a duty for the welfare of others under current health and safety legislation. Section 3 states the duty of all employers and self-employed persons *“is to ensure, as far as is reasonably practicable the safety of persons other than employees, for example, contractors, visitors, the general public and clients”*.

References:

- British Property Federation - The Flood and Water Management Act 2010 - 21st April 2010
- London Borough of Camden - Preliminary Flood Risk Assessment – 13th April 2011
- London Borough of Camden - Borough Risk Register – March 2012
- The British Dam Society – website Reservoir Safety - http://www.britishtdams.org/reservoir_safety/default.htm#bill2010





ATKINS

Epsom Gateway
2 Ashley Avenue
Epsom
Surrey
KT18 5AL
England

Telephone +44 (0) 1372 75 6280
Mobile +44 (0) 7710 36 3354
Email: mike.woolgar@atkinsglobal.com

www.atkinsglobal.com