Wellcome Genome Campus Expansion Planning Application S/4329/18/OL

Hinxton Parish Council's case for the construction of a compound weir as a Section 106 mitigation measure against increased flood risk arising from the proposed expansion

The proposed expansion of the Genome Campus by the Wellcome Trust would increase local flood risk. We argue here that mitigating this increased risk would be a legitimate Section 106 objective. The best mitigation measure would be the construction of a static compound side-weir on Wellcome land. This would improve the management of the River Cam with substantial long-term benefits to the Genome Campus, to Hinxton and to villages downstream. The capital cost would be relatively low and the running costs minimal.

Background

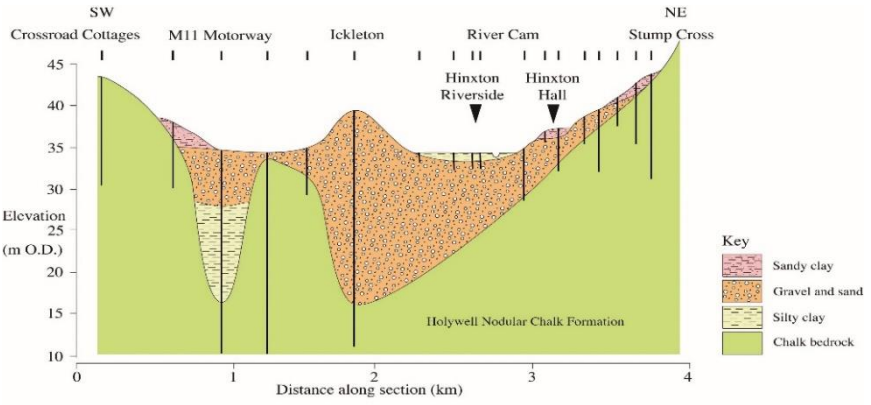
Wellcome's Genome Campus is situated at the edge of the flood plain of the River Cam. This Environment Agency map indicates areas of flood risk. The Genome Campus is at the bottom of the map. The river runs from the south, past Ickleton, through the Campus, past Hinxton, Duxford and Whittlesford Parkway and then onward north towards Cambridge. The yellow pointer indicates the position of Hinxton's historic Water Mill.

The Wellcome Trust owns almost all the land (apart from Hinxton village) between the railway and the A1301 as far north as the A505 near Whittlesford Parkway. It thereby owns most of the land that the Cam runs through over the 3 km from the Campus's southern boundary to the A505. The Trust also owns a triangle of land between the A1301 and the A11 immediately to the east of Hinxton village. This is the proposed 113 ha Expansion Land of the planning application.

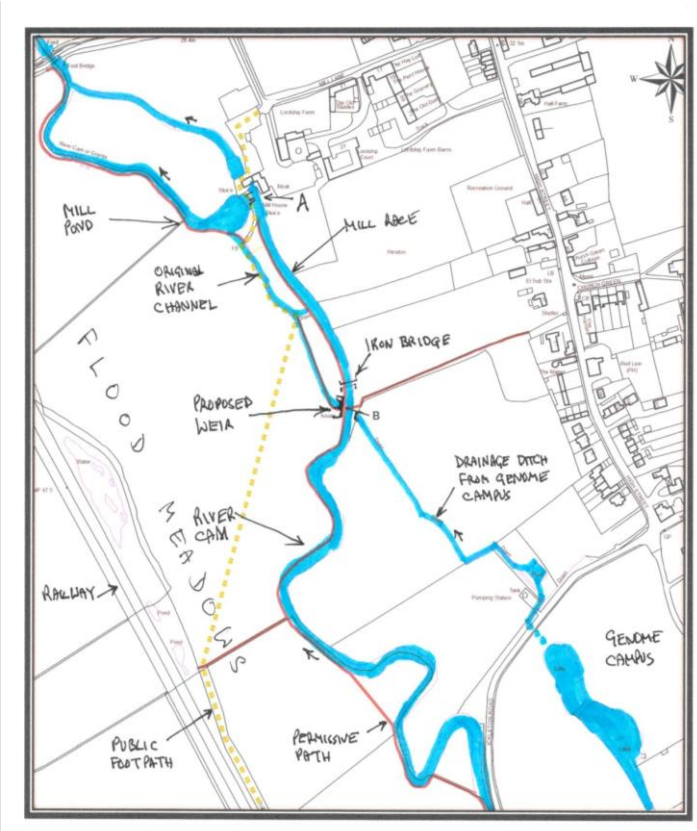
The areas of dark blue on the map are of 'high' flood risk. They are flood meadows and are managed as such by the Trust, being grazed by cattle and sheep in the summer months. They have flooded to the full extent indicated in two years out of the past six. The Genome Campus' Sanger Institute buildings were themselves flooded in 1996.

All the proposed Expansion Land is in this Cam watershed, draining into the river or the underlying aquifer. All grey water from the present Campus also drains into the Cam, via the sewage treatment works abutting the Campus south boundary, as will all grey water from the proposed Expansion Land buildings.

The Hinxton water meadows are of special importance for flood control further down the Cam valley because of the unusual geological configuration of the Ickleton/Hinxton area. The diagram shows a NE to SW section drawn from Stump Cross, through Hinxton Hall (on the Genome Campus) to just beyond the M11, derived from borehole records.[1] Underneath the area there is a deeply buried 'tunnel valley' incised in the chalk bedrock, filled with up to 23m of coarse gravel and sand. **The Hinxton meadows are consequently particularly important in absorbing Cam flood waters and in minimising and slowing their downstream travel.**



The critical position of Hinxton Mill



The only obstruction to the River Cam downstream of the Genome Campus until Duxford is Hinxton's historic Water Mill. There was a mill recorded on this site in the Domesday Book and the present 17th century building was operating commercially until the 1960s. It is owned by the charity Cambridge Past Present and Future (CPPF). CPPF regularly demonstrates it as a working mill during summer months.

The map shows the existing waterways from where the Cam leaves the Genome Campus under the Hinxton-to-Ickleton Road (at the bottom of the map) to where it crosses over the Hinxton-to-Duxford Road as a ford (at the top). The site of the Mill is marked A. The water turbine of the Mill is driven from a raised artificial mill race drawn off to the east side of the Cam at B. It discharges into a channel which rejoins the main river just before the ford on the Duxford Road.

[1] Boreham, S. and Rolfe, C. J. (2009), Holocene, Weichselian Late-glacial and early Pleistocene deposits of the upper Cam valley at the Hinxton Genome Campus, Cambridgeshire,UK, *Netherlands Journal of Geosciences*, 88-2, 117-125.

The overflow from the ornamental lakes on the Genome Campus is directed under the Ickleton road, through a buffer lagoon and via a ditch to a pipe under the Cam at B, where it empties into the old channel of the Cam at the point where the mill race was diverted from it some centuries ago. This water then travels down the old river channel to the join the main river at the mill pond.

At the Mill all water not directed through the turbine is released into a mill pond through two sluices, one large and one small, close to each other by the Mill. At times of high water the sluices are opened in order to divert excess water away from the Mill. They thereby protect the Mill (and the listed buildings of Miller's Cottage and Lordship Farm) from flooding. The sluices also reduce the risk of flooding upstream by reducing the extent to which water backs up. These sluices are operated manually. Martin Fordham, whose family has controlled them over many decades, has retired and moved from Lordship Farm. At present the sluices are operated by a rota of village volunteers, advised by him. Raising the sluices is a heavy job and the timing of it relies on his experience and judgement. The option of automating these sluices would be prohibitively expensive, involving substantial construction work. The main sluice is somewhat decrepit and will need replacing soon. Its failure would have serious consequences both upstream and downstream.

One option would be to remove the sluices altogether, letting the river run freely along the mill race and down into the mill pond. There are several disadvantages with this, quite apart from making it no longer possible for CPPF to demonstrate the working watermill. There would be unpredictable environmental consequences. Water falling rapidly into the mill pond would have scouring effects. The cessation of flow through the Mill would lead to silting there and the present eastern exit channel would stagnate. The fall in the level of the river, by at least a metre at point A, would lower the water level upstream as far as the Hinxton-to-Ickleton Road. River banks and some water meadows on that stretch would dry out, reducing their stability and absorbency value for flood regulation. It would jeopardise the several cattle watering places upstream upon which the proper grazing management of the water meadows depends.

Removal of the Mill sluices would also harm short-term flood control. The combined sluices have a width only one-third of that of the river. In extreme weather conditions this constitutes a substantial bottleneck in the river. Removing the sluices would be no better than having them fully open at present; widening them would be difficult because the river at this point cannot be accessed by heavy construction equipment. Although it would require a detailed survey to calculate how far upstream the bottleneck effect of the Mill sluices would be felt in severe conditions, we can estimate it. The OS map has a spot-height of 28 m by the ford on the Hinxton-to-Duxford road and the 30 m contour line runs through the river at the southern end of the Campus, near where a wooden bridge crosses the river to the Wetlands. The natural fall in the river between the Campus and the Mill is thus likely to be between 1.5 m and 2 m. Mr Fordham, who until recently lived all his life in Lordship Farm by the Mill, and the Elliotts, who live in the Miller's Cottage, report that the river can rise at least a metre at the Mill in a very short time and have seen eventual rises of up to 2 m. In short, as was evident when the Sanger Institute was flooded in 1996, **the bottleneck effect of the Mill in flood conditions causes flooding as far upstream as into the Campus.**

Estimating the increase in flood impact of the Wellcome Expansion Site

The proposed Wellcome Expansion would have two effects on the River Cam. First, the additional people living and working on the site will produce waste water from the imported mains water and other liquids used in washing, cooking, laboratories etc. Second, a proportion of normal rainwater that would otherwise be absorbed into the aquifers via the arable fields will run off from impervious surfaces as 'grey' water. All this will pass into the Cam either directly through drainage ditches or

indirectly through the sewage treatment works on the Campus southern boundary. The additional 1500 dwellings (assuming 2.5 persons per household and 150 litres per day per person) would produce about 600 m^3/day. The additional 4000 employees (assuming 50 litres each per day) would produce about 200 m^3/day. The research and other activities in the proposed leased commercial buildings would add an amount of additional grey water that we cannot estimate but may be substantial.

Annual average rainfall for Cambridge in recent decades has been 568 mm per year[2], which for a surface area of 100 ha implies an average of about 1600 m^3/day falling on the Expansion Land. Assuming the proposed building design would be more effective than normal housing in returning water run-off to aquifers, so that only, say, 10 per cent is not absorbed, that would add 160m^3/day. This implies a total average increase in flow into the Cam as a result of the development of the order of at least 960 m^3/day. According to a study carried out for Wellcome in 2011 the average flow rate of the Cam at Great Chesterford is 52,700 m^3/day. This implies that the average annual increase in water flowing into the Cam as a direct result of the Wellcome Expansion would be of the order of at least 2 per cent.

This annual increase may appear to be relatively minor. The issue, however, is the magnitude of short-term fluctuations. The added run-off of rain would fluctuate very substantially according to the vagaries of the weather and seasons. The rate and duration of these fluctuations would be moderated to some degree, insofar as part of the added water would pass through the sewage treatment works. But consideration of their effect downstream would also have to take into account independent fluctuations in the depth of the Cam, and hence its flow, which over short periods can increase several times over its 'usual' range[3]. Compounding this, the added flow arising from the additional households and employees will be subject to diurnal cycles with much of the flow coming in peaks twice a day, falling away at night. On a longer perspective, global warming can be expected to produce periods of much more intense rainfall than in the past, punctuated by periods of much less rainfall. There have recently been frequent reports in the press of localities in Britain receiving a month's worth of rain in 24 hours. These circumstances, which increase percentage run-off and decrease infiltration, will greatly increase the likelihood of floods. A more realistic estimate of the additional effect of the Wellcome Expansion on the flow of the Cam at those periods of heavy rainfall when exceptional flooding becomes an issue is likely to be not the annual average 2 per cent but one of peaks over periods of hours or days of 5 per cent or possibly substantially more.

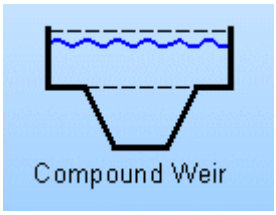
The significance of this estimate is best appreciated when it is recalled that the critical issue is the extent to which the existing sluices at Hinxton Mill act as a bottleneck, causing the level of the Cam upstream of the Mill to rise by what, as we have said, appears in the past to have been one or two metres. The estimated additional 5 per cent or more on top of this from the Wellcome Expansion would imply water levels raised 5 to 10 centimetres or more, higher than would otherwise be the case. **This constitutes a significantly heightened flood threat that requires mitigation.**

[2] https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/

[3] The usual range of the River Cam at the nearest gauge at Great Chesterford in more extreme weather conditions is between 0.11 m and 0.33 m. It has been between these levels for 90% of the time since monitoring began. The most recent high is 0.65 m, reached on Friday 7th February 2014. Over the past twenty years, the highest level recorded at the River Cam at Great Chesterford is 0.70 m, reached on Monday 5th February 2001. https://www.metoffice.gov.uk/research/climate/

Why a weir would be the solution

The best long-term solution to these problems would be to allow partial diversion of the river back into its old river bed during high water conditions using a static compound side-weir. It would be static in that it would be a concrete structure without any moving parts. It would be compound in the sense that it would have, in effect, a shaped notch designed to permit greater flows at higher water levels (as illustrated). It would be a side-weir in that it would be in the bank of the Cam spilling sideways rather than across the river. This would be built in the left (west) river bank about 200 m upstream of the Mill, positioned where the mill race was originally diverted away. This point, B on our map, just upstream of the Iron Bridge, is important to the wider system because, as has been said, it is where the drainage from the north end of the Genome Campus feeds in. Excess water flowing from the Campus ornamental lakes ends up diverted underneath the river by a pipe, and emerging in the old river bed a metre or so beyond. The side-weir would be sited where the river was originally dammed to create the mill race some centuries ago.



The sluices at the Mill could be closed permanently although the smaller one could be kept openable for maintenance purposes. The compound weir would be designed so that in times of normal flow it would divide the water of the Cam, to allow some water to flow down through the mill race and thence through the mill and beyond, with the remaining water spilling over the proposed weir into the old river bed. When river levels rise, more excess water would spill through the broader upper section of the weir into the old river bed and thus be diverted away from the mill race, joining any water coming down the pipe under the river from the Genome Campus. It would then proceed onwards down the old river bed to the mill pond and beyond. In times of even higher water, it would flood out across the water meadows to the west according to their intended purpose. At low water levels, the bottom notch could be sufficient size to maintain a steady flow down the old river channel. At high water levels the overall width of the top of the weir could be sufficient (perhaps 10 m?) to take the full flow of the river and prevent any bottleneck effects upstream.

Benefits of a weir

The weir would substantially mitigate the flood consequences of increased water flow arising from the Wellcome Expansion by removing any risk of water backing up upstream of the Mill in times of high rainfall. A weir, unlike sluices, would involve no moving parts, no motors, no electricity supply, minimal maintenance, and no-one would be required to be on call for flood control responsibility. The Wellcome Trust's recent replacement (in May 2019) of the Iron Bridge, just a few metres from the proposed weir site, demonstrated that at this point the river is readily accessible by heavy construction equipment.

Other benefits include:

- More efficient use of Hinxton flood meadows for water retention at times of flooding by releasing water onto them higher upstream.
- Maintenance of sufficient head of water in the mill race to permit CPPF to continue milling demonstrations and Mill conservation.
- Protection of the cattle watering places along the river upstream by means of the controlled head of water, which is important for maintaining the functionality of the water meadows.
- Sufficient flow through the Mill to prevent silting and to keep water sweet above and below.
- Benefit to plant and aquatic life because flows would be maintained both along the old river bed and along the mill race and through Mill and beyond.
- A permanent fish and eel ladder which sluices do not provide.

- Better control of the flow of water across the ford on the Hinxton-to-Duxford Road, as surges arising from the intermittent closing and opening of the sluices would be eliminated, making closures of the road more manageable for CCC Highways Department.
- Substantial amenity value to the local community. The public and permissive footpaths would be protected from scouring that would arise from removing the sluices and a riverside footbridge along the weir could easily be integrated into its design.

This proposal has long been advocated by Mr Fordham, the controller of the sluices for many decades. It is supported by the Elliott family who live in Millers's Cottage and by the Nichols family, who have recently restored Lordship Farm. It is supported by The Cambridge Trout Club who have the relevant fishing rights and by Cambridge Past Present and Future who own and maintain the Mill. No objections have been raised to this proposal by the Chairs of the immediately affected Parish Councils of Ickleton, Duxford, Whittlesford or Pampisford. It was agreed by Hinxton Parish Council at its meeting on 8 July 2019.

We request SCDC and the Wellcome Trust to agree to the construction of a static compound side-weir as a legitimate Section 106 measure to mitigate the heightened flooding threat posed by the planning application.

William Brown and Steve Trudgill[4] on behalf of Hinxton Parish Council

9 July 2019

[4] Former Member British Hydrological Society (Institute of Civil Engineers)