

12016/GL  
27th April 2012

Hertsmere Borough Council  
Civic Offices  
Elstree Way  
Borehamwood  
Herts  
WD6 1WA

Dear Sir/Madam,

### **DAME ALICE OWEN'S SCHOOL - FLOOD RISK**

I refer to the proposed development at Dame Alice Owen's School, which includes a new science block. The site is located primarily in Flood Zone 1, however as the site area is greater than 1ha, flood risk needs to be considered as part of the application. An assessment of the risk of flooding from all sources has been considered in accordance with the National Planning Policy Framework (NPPF)<sup>1</sup> and the associated Technical Guidance<sup>2</sup>.

#### **SITE DESCRIPTION AND PROPOSED DEVELOPMENT**

Dame Alice Owen's School is located near Potter's Bar in Hertfordshire. It is proposed to construct a new two-storey science block. The science block will be constructed on currently undeveloped land adjacent to the sports hall. The building will be set into the slope of the land, with a new retaining wall required along the northern and eastern sides. A topographic survey has been undertaken with levels reference to Ordnance Datum Newlyn (see enclosures). The survey shows ground levels in the area proposed for the building varying between 102m AOD and 106m AOD. The finished ground floor level of the building will be set at 103.1m AOD, and the retaining wall will be approximately 3.5m at its highest in the northeast corner.

#### **HISTORICAL RECORDS OF FLOODING**

A Strategic Flood Risk Assessment for Hertsmere District Council was issued in May 2008. The SFRA includes a summary map showing the risk of flooding from all sources (see enclosures). The SFRA reports that there are no recorded incidents of flooding on the site.

#### **FLUVIAL AND TIDAL FLOOD RISK**

In October 2004, the Environment Agency released updated floodplain maps for the UK based on the 'JFLOW' project, a two-dimensional hydraulic modelling project. Figure 1 shows the latest 'Flood Zone Map' for the site, and the proximity to relevant water features.

The floodplain indicated in dark blue is the area that may be affected by the 1 in 100 year fluvial or 1 in 200 year tidal flooding event, neglecting the influence of any flood defences in the area. This is categorised by the Environment Agency as Flood Zone 3. The light blue colour shows the additional extent of an extreme flood (greater than 0.1% probability in any year) from rivers or the sea, and is categorised as Flood Zone 2. The solid blue lines indicate Environment Agency Main Rivers.

The site is located in Flood Zone 1, and the risk of the site being affected by fluvial or tidal flooding is therefore less than 0.1% in any given year. The site is not in close proximity of any Environment Agency Main Rivers, and separate consent is therefore not required from the Environment Agency.

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<sup>1</sup> Communities and Local Government (March 2012) National Planning Policy Framework

<sup>2</sup> Communities and Local Government (March 2012) Technical Guidance to the National Planning Policy Framework

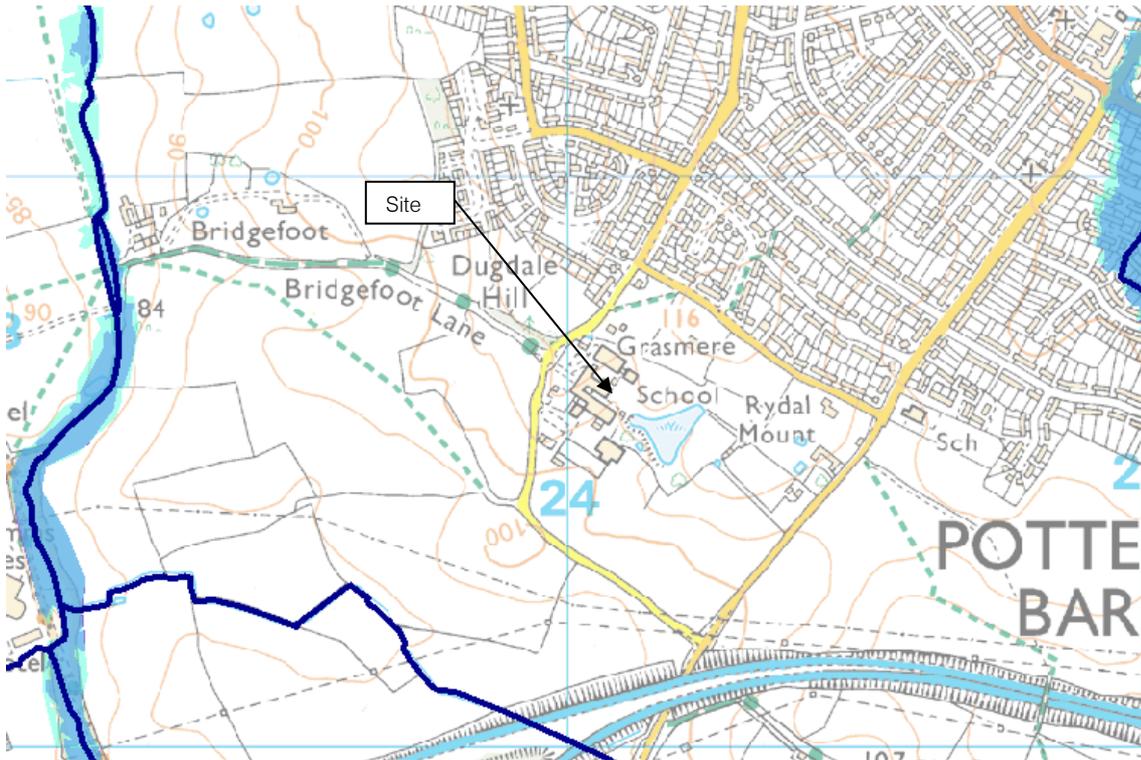


Figure 1 - Environment Agency Flood Zone Map

**GROUNDWATER**

The site is not within an Environment agency Source Protection Zone. The Environment Agency Aquifer maps indicate that neither the superficial drift deposits, nor the bedrock, are designated as aquifers.

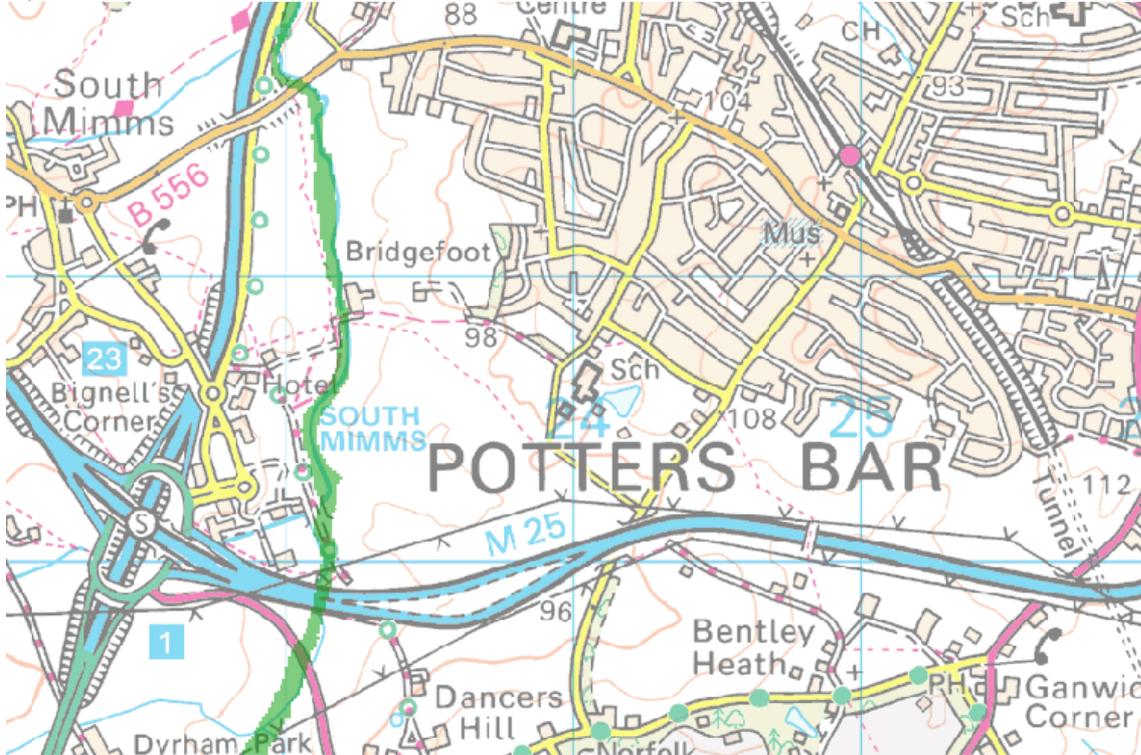


Figure 2 - Environment Agency 'Risk of flooding from Reservoirs'

A ground investigation was carried out by STATS in 2004, with a focus to investigate the slope stability of the reservoir on the site. As part of the study, it was reported that the underlying ground conditions at the site comprise of London Clay.

Based on the underlying ground conditions, the risk of the site being affected by groundwater flooding is considered very low.

### ARTIFICIAL WATERBODIES

According to the Environment Agency, the site is not at risk of flooding from artificial waterbodies, as shown in Figure 2. However, the Environment Agency are the enforcement authority for the Reservoirs Act 1975 which only covers large reservoirs that hold over 25,000m<sup>3</sup> of water.

A reservoir exists to the east of the main school buildings as shown in figure 1 below. Water levels in the reservoir are significantly higher than the existing and proposed school buildings.



Figure 3 - location of reservoir showing key features

The reservoir has a surface area of approximately 4,500m<sup>2</sup> with a maximum depth of approximately 3.5m (providing an approximate volume of 5,200m<sup>3</sup>). On this basis it is not registered under the Reservoirs Act (1975).

The dam itself is an earth embankment structure (photograph 1) with two (approximately 300mm from observation) overflow pipes at the eastern end. There is no emergency spillway. The overflow pipes discharge to an overflow channel (at a gradient of approximately 1:12) which turns sharply to the north-west and descends at a gradient of approximately 1:10. Flow is then conveyed via a 150mm pipe, to another section of open channel and into a 225mm diameter pipe in a north-westerly direction and beneath the existing buildings.

The site was visited on the 12th April 2012. At the time of the visit, the following points were noted:

1. The earth embankment dam is well established with trees (photograph 2) and the downward slope had apparently been subject to various earthworks. There were concerning signs of seepage at the toe of the dam (photograph 3). Concerns were shared by GCG geotechnical engineers in a later discussion.

2. There are two overflow pipes, one PVC and the other clay approximately 300mm in diameter (the topographic survey records only a single outflow pipe 300mm in diameter, which conveys water beneath the gravel pathway before outcropping as 2 No. 250mm diameter pipes). The PVC pipe has a steel grate in place to prevent blockage (photograph 4) and appeared to be clear and in reasonable condition. The clay pipe is severely damaged, has no grate and at the time of the visit was blocked by a football (photograph 5). The caretaker was immediately notified of this blockage and the associated dangers for the dam structure.
3. The overflow channel (photograph 6) should have capacity to convey any flow from the two overflow pipes, however it is a steep gradient and it is not reinforced against erosion and there are no structures in place to dissipate energy and trap silt. This arrangement will lead to siltation and eventual blockage of the downstream sewer infrastructure, and erosion of the channel banks.
4. The pipe inlet at the base of the overflow channel is 150mm in diameter (significantly smaller than the capacity of the channel upstream and the 2 No. 250mm diameter pipes feeding the channel). The pipe was blocked with leaves and debris. In the event that the overflow channel comes into use while the inlet is in this condition, flow into the pipe will be severely impeded or blocked. If this occurs, water will overflow at this point and flow overland into the sports hall.
5. The condition and outlet of the pipe could not be verified at the time of the visit.

The proposed works should not increase the likelihood of dam failure, provided they do not alter the groundwater flow regime and associated pore pressures within the wall. This is a matter for a separate study of the earth embankment stability which is underway by GCG geotechnical engineers. Although the likelihood of failure should not change (or even improve subject to remedial measures carried out as part of the science block project), the consequences of flooding would be increased through the installation of new buildings in the potential path of flood flows.

With the wall and overflow structures in their current state, the most likely flood scenario is when the reservoir is full to the point of overflowing (resulting from a wet season or artificial filling). Once the reservoir is overflowing a quick burst of rainfall will result in a large volume of water passing through the overflow. Once the system is overflowing, given the reservoir surface area of 4,500m<sup>2</sup>, each millimetre of rainfall on the reservoir will result in a direct overflow volume of 4.5m<sup>3</sup> not counting any contributions from the rest of the catchment. As an example, a 100-year 6-hour rainfall event of 83.2mm would result in 375m<sup>3</sup> of water. If this is unable to remain in bank at the 90 degree bend in the open channel, or enter the pipe at the base of the overflow channel, the natural overland route will be overland across the land proposed for the new science block and into the existing sports hall.

In order to address the existing risk of flooding, the following further work needs to be undertaken:

1. Structural assessment of the earth-embankment dam (given that it is seeping at the toe of the dam) to update the study undertaken in 2004, and any remediation works. We understand that this assessment is already underway by GCG geotechnical engineers.
2. Repair and maintenance of the overflow pipes (removal of the football),
3. Design and installation of a grill on reservoir side of the clay overflow (to prevent future blockage).
4. Maintenance of the existing overflow channel to remove debris and obstructions, and where necessary installation of reinforcement and energy dissipation to resist erosive forces.
5. Hydrological assessment and level-pool routing to establish flow rates in the overflow channel assuming the arrival of a 100-year storm event (including an allowance for climate change) when the reservoir is full.
6. Where necessary following the hydrological review, removal of the 150mm diameter pipe connecting two sections of open channel, and replace with open channel to increase capacity.

7. CCTV survey of the pipe into which the overflow channel drains (commencing at the back of the sports hall) to ensure it is clear and in good condition (if not, this will need to be jetted, repaired and re-surveyed).
8. Design and installation of a stilling apron and grated inlet headwall for this pipe (water coming down the overflow channel will have a lot of energy and will probably not get into the pipe in its current state, instead it will spill out and flood the sports hall and the proposed new buildings).
9. Scheduling of regular inspection and maintenance to be managed by the caretaker to ensure that the system is in good working order.

Given the sensitive nature of the existing and proposed development, this work should be carried out without delay.

The reservoir is near to the summit of a hill and therefore has a very small catchment with no defined inflow channel. The risk of an overwhelming inflow leading to overtopping has not yet been quantified. However, on the basis of the small catchment and the fact that the dam has been in place for several decades without such incident, provided the dam structure is in good condition and the overflow system is properly maintained, there is expected to be a low risk of overtopping based on the current configuration. The study noted in (5) above may recommend additional remedial works for the reservoir wall, which if implemented could further reduce the risk of overtopping to negligible.

In order to reduce the potential consequences of flooding on the proposed science block, the proposed retaining structure will extend 500mm above the upslope ground levels. This will prevent any flood water originating from the reservoir, from directly spilling over the retaining wall. Instead flood water would follow existing ground levels to the west and south around the new building. The finished floor level of the proposed new building will be set at 103.1m AOD, which is higher than the existing sports hall floor levels and external ground levels between the two buildings. Therefore, it is unlikely that any flood water pooling in this area will enter the new building. On this basis the consequences of flood water flooding the proposed new science block are considered minor.

### **SURFACE WATER MANAGEMENT**

The Technical Guidance to the NPPF requires that *'the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a flood risk assessment'*, and the Hertsmere Local Plan requires that *'Developments that could result in an increased flood risk will be required to incorporate measures designed to control the rate of run-off from within the site. This will involve the application of flow control plus attenuation storage to contain excessive runoff in storm conditions.'*

Subject to satisfactory ground conditions and ensuring no risk of polluting the aquifer, infiltration devices such as soakaways are the preferred method of disposing surface water as it recharges the aquifer and reduces the burden on surface water features. However, based on the underlying London Clay, soakaways are unlikely to be feasible.

The proposed development involves construction of a new building on currently undeveloped land, but on school premises with existing surface water infrastructure. The new surface water infrastructure for the science block will therefore connect to the existing system on-site.

The development will increase surface water runoff rates and volumes. Attenuation measures will therefore be incorporated to ensure that the peak rate of runoff is no greater for the developed site than it was for the pre-development site. The surface water system will be designed in detail following planning to ensure that: (as per Environment Agency guidance)

- There will be no surface flooding resulting from surcharge of the new drainage system for events with return periods up to 1 in 30 years,
- The system may surcharge for more extreme rainfall events and water will be routed away from buildings, access ways and will not increase risk off-site, and
- There will be no flooding of buildings for the 1 in 100 year + climate change event

The NPPF recommends a national precautionary sensitivity range for peak rainfall intensities. A design life of 100 years is used for 'more vulnerable' type uses such educational establishments, and the rainfall intensities will therefore be factored up by 30%.

#### SUMMARY AND CONCLUSIONS

All sources of potential flooding have been assessed, and the primary risk of flooding is from failure of the existing reservoir. The proposed development should not increase the risk of flooding, and provided remedial action is implemented and maintenance conducted on a regular basis, the risk of flooding from the reservoir is considered low. This risk could be reduced to negligible if additional remedial measures are implemented where recommended by the hydrological study. The risk of flooding from all other sources of flooding is considered negligible.

Yours faithfully,



Guy Laister  
MSc Eng, BSc Eng (Civil)

#### ENCLOSURES:

Topographic survey  
Hertsmere District Council SFRA Summary Map

#### PHOTOGRAPHS



Photograph 1 - Earth embankment dam



Photograph 2 - Earth embankment wall well established with trees



Photograph 3 - Seepage at the toe of the dam, also showing large tree growth on the earth embankment wall



Photograph 4 - PVC pipe at reservoir side looking through grate (spot of daylight at the far end showing that it is clear)



Photograph 5 - Damaged clay pipe overflow, blocked with football



Photograph 6 - Overflow channel looking towards sports hall