Response to EA letter dated 24th December 2021

Dear Sam

Thank you for your letter dated 24 December 2021. Where we have commented on extracts our comments are in *italics*.

Risk of diversion of water away from the Public Water Supply (PWS)
You state that you maintain that it was appropriate to provide us with 200504 - GW Assessment for Construction Tasks - Tunnel & Cross Passages 1MC05-ALJ-EV-NOT-CS02_CL04- 400048_C04. We agree that Section 7.1 considers potential impacts at individual Affinity Water abstraction points of the PWS with the likely risk to the PWS (from turbidity or reduction in abstraction rates) being assessed as low to moderate. However, we would point out that this document was last updated on 1 May 2020 to take into account revised lubricants for TBM and update to CP water management and leakage. The previous update addressing the EA and Affinity concerns was 4 June 2019. Since then, there have been a number of other documents produced, updated for more recent ground investigation work.

Chiltern Tunnel Construction Water Environment Assessment 1MC05-ALJ-EV-REP-CS02_CL04-000142 updated 28 April 2021.

This sets outs a number of risks

- Section 4 sets out **risks to groundwater and surface water**. Table 2 sets out potential effects from Tunnel Boring and Lining. This includes Permanent Effects
    - Changes to vertical groundwater movement
    - Changes to lateral groundwater movement
    - Changes to river flow due to tunnelling induced fractures
    - Changes to river flow due the presence of the tunnel
- 4.1.10 sets out the range of ground conditions likely to be encountered. This states
    - 'There is unlikely to be any significant active conduit flow along the alignment of the tunnel as it is normally (but not always) associated with either sinking streams and/or springs / risings, neither of which are extensive in this area'.
      However, as we have pointed out previously at Little Missenden there are springs still although less than before the introduction of the main sewer down the valley.
    - 'The main concern for contaminant migration, especially chalk turbidity, is the fracture networks in the Misbourne Valley, estimated at 4 to 5 per m^3 (Mortimore 2021, QJEGH) as these are likely to have flow rates sufficient to sustain turbulent flow'.
      This again confirms HS2's understanding that there is a fast movement of water in the Misbourne Valley. This water is shown in other reports to support the Amersham PWS.
- 4.1.12 talks about connectivity.
    - 'However, at Little Missenden shaft, which is in the Misbourne Valley a high permeability was calculated from the pumping test and good connectivity is likely. At Amersham shaft, where a full pumping test was not conducted, short term

pumping suggests a high permeability although as the test was of very short duration little can be determined regarding the connectivity'.
This is more evidence of the risk to flow of water to the Amersham PWS.

- 4.1.13 states
  - 'The heterogeneity of the Chalk introduces uncertainty into the risk assessment. However, as a generalisation, along the tunnel alignment the risks of rapid groundwater movement and high connectivity are greater at shallow depths in the Misbourne valley and least at greater depths beneath the interfluves.
    This identifies that the risks are greater at shallow depths i.e., when tunnelling under the MIsbourne'. Both for water diversion and the risk of grout not setting, introducing the risk of high alkali content in the water at the Amersham PWS.
- 4.1.14 talks about Receptors. *This recognises risks to the Amersham and Missenden PWSs*
  - XXXX SPZ lies adjacent to the tunnel alignment, but the tunnel will not actually pass through it although the SPZ is not thought to be accurate and there is potentially a risk to the PWS from the tunnel boring. *Relates to Amersham*
  - XXXX SPZ which lies adjacent to the tunnel alignment, but the tunnel will not actually pass through it although the SPZ is not thought to be accurate and there is potentially a risk to the PWS from the tunnel boring. *Relates to Missenden*
- 4.1.16 identifies
  - 'The greatest potential for a significant connection between the tunnel and a PWS occurs where the tunnel passes through the XXXX PWS SPZ for some distance and crosses through the Misbourne valley (which is likely to be a high flow – fissure network) at relatively shallow depth (c.20mbgl) upgradient of the XXXX abstraction boreholes.
    This again refers to Amersham. Thus HS2 recognise the risk.
  - 'Although the tunnel will pass very close to the XXXX PWS (the closest of the PWS) it is down / cross gradient and not within the SPZ for that water supply, although the SPZ is not considered accurate, and it is more than likely that the tunnel will pass through the area which contributes water to that abstraction'.
    We believe this refers to CSG PWS. Again demonstrating a risk to the PWS.
  - 'In addition, the tunnel will pass beneath several dry valleys, including significant features at Chalfont St Giles shaft and Amersham shaft, both of which could act as preferential flow zones towards the PWS'.
    This demonstrates that there are further risks of water diversion from these PWSs*. It is now also recognised that several fault lines run NW-SE following the trend of the Misbourne valley from Great Missenden to Old Amersham (BGS Report CR/16/165). These, plus associated jointing/fracturing, enhance the flow of water through to the Amersham PWS and tunnelling through them will potentially impact on the associated groundwater flow.*
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- 7.1.17 (p43) states
  - MWH's review of available pumping test hydraulic data indicated the presence of "…strong anisotropy with high transmissivity aligned along the valley. Within the valley MWH contend that both the hydraulic and turbidity responses provide strong evidence for a karst conduit that extends for more than 3.7 km both upstream and downstream from the Amersham site". It was interpreted that a well-developed

fracture network was present around the Amersham supply, but that the boreholes were not directly connected to the valley conduit, as early time-drawdown data indicated radial flow to the boreholes. Nevertheless, it was considered likely that the PWS would draw the majority of its flow from this "karst conduit"

- 7.1.1 (p45) states
    - The tunnel would cross beneath the River Misbourne 2.8km north-west of the Amersham PWS. At this location the tunnel is within SPZ1 for the PWS and crosses the high transmissivity horizons that supply the majority of water to the abstraction. The tunnel at this location is approximately 69-79mAOD and groundwater is approximately 99mAOD. The current base of the abstraction borehole is at some 25mAOD so the tunnel would pass through the flow zone that supplies the Amersham PWS.

7.1.2 to 7.1.5 attempt to assess the level of impact of a reduction in flow to the PWS. This is estimated at 21% but then assumes that the impact would only be a reduction of 50m^3/d.
7.1.4 the throws doubt on the accuracy of this number as it talks about Amersham PWS supplying 7000m^3/d.
7.1.7 states that the PWS would draw the majority of its flow from this "karst conduit". This raises the question of which is right. A loss of 21% of 7000m^3/d would be more than significant. And this is without an assessment of direct diversion of water away from the PWS.

We believe that these concerns need to be investigated with further GI to establish the exact depth of the "karst conduit" to ensure that the tunnel will not impact this important source of water for Amersham PWS and that there is not a system of fractures running southwest that would provide a natural route for the water to follow in the event of being blocked by the tunnels.

Tunnelling Methodology
Thank you for confirming that for your purposes there is no minimum thickness of competent rock that is required to be present between the tunnel and weathered / structureless chalk. In previous correspondence you have always referred to the tunnel being in competent rock.

We appreciate that Align JV are responsible for determining the tunnelling methodology. However, given that we are advised that structureless chalk does not act like clay, we would expect the EA to have verified the method used. We will take this up with Align JV.

Management Strategy
This is clearly a "wait and see" strategy. Should the settlement be more severe than anticipated, we agree that it would be possible to reline the Misbourne at the affected crossing points. However, how will the unexpected diversion of water in the aquifer be dealt with?

Cement and Grout
Thank you for confirming your experts' opinion. However, as we set out in our letter of 7th December and we have repeated above, in our opinion, there has been insufficient investigation of

- the risks of water diversion away from the Amersham PWS.
- The risks of grout being washed away in fast flowing water and substantially increasing the PH of the water to be abstracted at the PWSs at Amersham and Chalfont St Giles.

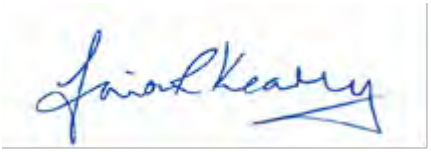
Bentonite
Thank for your comments that you consider Bentonite not to be hazardous.

Flood Risk Reassessment

With regard to Flood Risk, we will contact Buckinghamshire Council with our concerns.

We appreciate you engaging with us in this series of letters and clearly you do not wish to engage further. As we have set out in this letter our main concern relates to the risks to the Amersham PWS and we would appreciate you confirming that having considered the results of ground investigations in the last year, you are still satisfied that there is no risk to the Amersham PWS and little additional risk of settlement in the Misbourne.

Yours Sincerely



Simon Kearey

Chairman

cc Tom Beeston

John Gladwin

Affinity Water