14 September 2021

Environment Agency response to questions from the Chiltern Society (15 June 2021)

Question 1
With regard to HS2 tunnelling causing irreversible changes to groundwater flow, there are a number of issues

- *There is very little assessment of the impact of putting two solid 10.5m deep 16km concrete obstacles through the aquifer. The tunnels will be grouted into the aquifer rock and the grout is expected to fill fissures in the rock. This will almost certainly block existing groundwater flow routes. The assessment was that the water will divert either laterally or vertically.*
    - *Diverting the water laterally could mean the water following the line of the tunnel, or going further afield. This is likely to be a significant diversion of water in the aquifer.*
    - *Where the tunnel is in the groundwater, there is likely to be a vertical diversion. Has the impact of this been assessed throughout the length of the tunnel to see whether this will create surface water issues? E.g. at Chalfont St Giles where the groundwater is stated to be at 7m below the surface and at Little Missenden where it is stated to be 1m below the surface.*

Answer:
This is assessed in the document '200504 - GW Assessment for Construction Tasks - Tunnel & Cross Passages 1MC05-ALJ-EV-NOT-CS02_CL04-400048_C04', section 6.3.

Question 1 continued

- *The grout is stated to contain 19kg of Bentonite per M3 of grout and to contain 5-chloro-2-methyl-2H-isothiazol-3-one and 2- methyl-2H-isothiazol-3-one. Has the EA:*
    - *Assessed the risk from this quantity of bentonite in polluting drinking water in the aquifer?*
    - *Noted that Methyl Isothiazol is listed as a banned substance in the EU. Has the EA assessed the risks of using such substances?*
    - *Identified or asked to be identified areas the tunnels will be passing through, where there is a strong flow of water as this will significantly increase the risk of bentonite and Methyl Isothiazol entering the ground water.*
    - *Assessed the risks of dissolution features appearing along the tunnels route. Some have been identified, but not at the tunnel level. Will these risk introducing a lot of bentonite into the groundwater?*

Answer:
This is assessed in the document '210428 - Chiltern Tunnel Construction Water Environment Assessment 1MC05-ALJ-EV-REP-CS02_CL04-000142_C02, 28.04.2021', sections 2.2.8, 4.2.8, 4.2.9.

For clarity with regards to the 4th white bullet point: The tunnel boring machine does not use bentonite at the cutting face; the slurry at the cutting face is a mixture of chalk cuttings and water only. Bentonite forms approximately 1.5% of the grout mix used to fill the annulus between the cut tunnel bore and the concrete tunnel rings. This grout is very fast setting with a gel time of around 12 seconds and a cure time of around 30 minutes. There is therefore a low risk of migration even upon entry to any fissures.

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Question 2

There are a number of issues arising with regard to risk of loss to the Misbourne. You state that the tunnels will pass under the Misbourne in competent rock at a depth at which any vibration or cracks created by the TBMs will not spread the base of the river. There are two crossings of the Misbourne.

- *At Chalfont St Giles the tops of the tunnels are stated as being at 20m.*
    - *The ground analysis charts indicate that the structureless chalk goes down to 21.5m and thus the tunnel tops will pass through this. We understand that this significantly increases the risk of vibration causing settlement in the structureless chalk and gravel and of fracturing the river bed. What depth of competent chalk does the EA believe is needed to eliminate this risk? Previously it was believed that the tunnel tops were at least 3.5m below the structureless chalk.*
    - *There is also a statement that any settlement of the riverbed will be self-sealing through the alluvium and structureless chalk acting like a clay. Our Geological Advisor, Dr Haydon Bailey says that this is extremely unlikely as structureless chalk is incapable of "acting like a clay". The water table is shown to be at 7m below the surface. It would seem likely that any leakage from the River Misbourne would sink through the structureless chalk to join the groundwater. Depending on the severity of the rupture the flow in the river could be lost.*
    - *With two tunnels being bored, there is a risk of the second tunnel exacerbating the impacts of the first tunnel boring.*

Answer:

Please see section 8 of the document '200504 - GW Assessment for Construction Tasks - Tunnel & Cross Passages 1MC05-ALJ-EV-NOT-CS02_CL04-400048_C04'and section 4.4 of '210428 - Chiltern Tunnel Construction Water Environment Assessment 1MC05-ALJ-EV-REP-CS02_CL04-000142_C02, 28.04.2021'.

The level of the water table in relation to the River Misbourne at each crossing of the tunnel varies through the year and over longer periods of wetter / drier weather.

Question 2 continued

- *What steps are the EA taking to ensure the Misbourne is not lost? From the papers seen it looks like a 'wait and see' exercise.*

Answer:

Flows in the River Misbourne and groundwater along the route of the tunnel have been monitored for a number of years by both the Environment Agency and HS2. This monitoring will continue during and post-construction to assess if there are any impacts on the River Misbourne. Additionally settlement monitoring is being undertaken along the route of the tunnel. Where necessary mitigation measures will be implemented (see section 10 of the document '200504 - GW Assessment for Construction Tasks - Tunnel & Cross Passages 1MC05-ALJ-EV-NOT-CS02_CL04-400048_C04').

Question 2 continued

- *At Little Missenden, the tops of the tunnels are stated at being 18m below the surface.*
    - *The bore records show that the structureless chalk goes to a depth of 21.5m. This is consistent with the latest survey information that there are extreme fault lines running along the valley. As such the tops of the tunnels will be approximately 3.5m above the competent chalk. This again raises the question as to what depth of competent rock the EA considers necessary to prevent fracturing of the competent rock above the tunnels to avoid settlement from vibration etc?*

Answer:

Please see section 8 of the document '200504 - GW Assessment for Construction Tasks - Tunnel & Cross Passages 1MC05-ALJ-EV-NOT-CS02_CL04-400048_C04'and section 4.4 of '210428 - Chiltern Tunnel Construction Water Environment Assessment 1MC05-ALJ-EV-REP-CS02_CL04-000142_C02, 28.04.2021'.

Question 2 continued

- *Has any assessment been made of the risk of diversion of the water running in the joints and fractures associated with the major fault lines known to occur through this part of the valley? As the Little Missenden Vent shaft is expected to create turbidity affected the Amersham PWS, is there a risk that damage to the faulting, arising from tunnelling, could divert water from the Amersham PWS?*

Answer:
Please see section 7.1.17 onwards of the document '200504 - GW Assessment for Construction Tasks - Tunnel & Cross Passages 1MC05-ALJ-EV-NOT-CS02_CL04-400048_C04'and sections 4.3 and 4.4 of '210428 - Chiltern Tunnel Construction Water Environment Assessment 1MC05-ALJ-EV-REP-CS02_CL04-000142_C02, 28.04.2021'.

Question 3

- *Will there be pollution in the aquifer?*
  - *Your answer deals with the question of turbidity and the creation of a turbidity treatment plant at the Amersham PWS. Clearly turbidity is expected to arise from the creation of the Little Missenden Vent Shaft and from tunnelling close to the Chalfont St Giles PWS as witnessed by the creation of a pipeline to transfer water for treatment at Amersham.*

Answer:
Please see section 6.2 of the document '200504 - GW Assessment for Construction Tasks - Tunnel & Cross Passages 1MC05-ALJ-EV-NOT-CS02_CL04-400048_C04' and section 4.2 of '210428 - Chiltern Tunnel Construction Water Environment Assessment 1MC05-ALJ-EV-REP-CS02_CL04-000142_C02, 28.04.2021'.

Question 3 continued

- *The use of bentonite to grout the vent shaft walls and the tunnels has hardly been addressed. Nor has the potential use of Bentonite at the Chiltern Railway Crossing despite this being close to the Deep Mill Lane PWS. We would appreciate an understanding of what analyses the EA have carried out or asked to be carried out to assess this risk.*
- *See Question 1 re the risks of impact from Bentonite.*

Answer:
For discussion of the use of bentonite in construction of vent shaft walls please refer to the Water Environment Assessments for construction of the vent shaft e.g. Construction of Little Missenden Ventilation Shaft WEA 1MC05-ALJ-EV-REP-CS02_CL04-000131_C01, 24.05.2021.

As explained in the Water Environment Assessments for ground improvement at the vent shafts (e.g. Ground Improvement at Little Missenden D-Wall Water Environment Assessment 1MC05-ALJ-EV-REP-CS02_CL04-000167_C01, 12.05.2021) pre-treatment grouting has been undertaken at the vent shafts prior to diaphragm wall installation to limit the potential loss of bentonite support fluid.

A slurry formed of chalk cuttings and water is used at the cutting face of the TBMs. The only exception to this is during the crossing of the M25 when bentonite was used at the cutting face due to the shallow depth of the tunnel at this point and the need to ensure protection of the overlying infrastructure (see document '200318 - Use of bentonite during tunnelling under the M25 1MC05-ALJ-TN-NOT-CS02_CL04-000001, C01'). Both TBMs have completed this work – which took place above the water table – with no loss of slurry identified by the monitoring systems within the TBMs.

The use of bentonite for the Chilterns Railway Crossing has not been confirmed as the decision will be informed by the findings from the approximate 2 years' worth of tunnelling which will take place leading up to that point. The risk associated with this is discussed in

the document '210428 - Chiltern Tunnel Construction Water Environment Assessment 1MC05-ALJ-EV-REP-CS02_CL04-000142_C02, 28.04.2021', see sections 2.2.4, 4.2 and 4.3.

The tunnel is located down hydraulic gradient from the Deep Mill Lane PWS as discussed in section 7.1 of the document '200504 - GW Assessment for Construction Tasks - Tunnel & Cross Passages 1MC05-ALJ-EV-NOT-CS02_CL04-400048_C04'.

Question 5

- *Water for the TBMs. You state that this will be supplied by Affinity and Thames Water, without an increase in abstraction in the Colne Catchment Area. We are pleased to see this. However we would like to understand where Affinity will abstract their share of the water supplied to the TBMs, as this could impact other chalk streams in the Chilterns.*

Answer:
Affinity Water have abstraction licences to abstract water from various points in the Chilterns and Colne Valley. They vary the sources they use (within the limits on their abstraction licences) in response to local demands, weather conditions and maintenance work on their assets.

Affinity Water will not increase abstraction beyond the limits on their abstraction licences in order to supply HS2 water demands.

The majority of water abstracted by Affinity Water is used to meet Public Water Supply requirements but a proportion is used for commercial water supply. Affinity Water have a legal requirement to prioritise Public Water Supply over commercial water supply and consequently during dry periods (when Public Water Supply demands increase) it may be that Affinity Water cannot meet HS2's water requirements. If such periods occur during HS2 construction works water will be imported from Thames Water.

Question 6

- *With regard to Monitoring, your answer seems to indicate that you are leaving the monitoring to HS2/Align.*
    - *Will the EA require regular reports from HS2/Align or will the EA carry out independent inspections?*

Answer:
We receive monthly monitoring reports from Align. However, more frequent reporting occurs for certain activities such as construction of vents shafts (for which daily reports are provided).

We continue to monitoring groundwater and surface water through the Misbourne Valley. HS2's baseline data has been assessed against data held by the Environment Agency and Affinity Water to ensure that their monitoring is representative.

Question 6 continued

- *With regards to faulting / fractures along the route, we understand that you have received the latest British Geological Survey of the Misbourne Valley. Can you confirm that this shows no major faults, although the depth of unstructured chalk at Little Missenden is consistent with major faulting? The geological cross section presented in the HS2 documentation to the EA indicates the presence of at least 28 major faults along the length of the Chiltern Tunnel.*
- *Where there is evidence of faults, please explain actions to be taken to ensure that the tunnelling of the vent shaft construction will not impact these faults, and where it does what steps have been laid out to mitigate this risk?*

Answer:
We have access to the British Geological Survey mapping including updates for part of the Chilterns covering the upper River Misbourne. The updated mapping that we have access to does not extend as far south at Little Missenden vent shaft.

It should be noted that HS2 data forms a significant data source for the updated mapping by the British Geological Survey and consequently the data has already been taken into account in the tunnelling risk assessment where applicable.

It is not possible to know the location of all features within strata such as Chalk. Therefore a TBM type has been selected which is able to continuously monitor ground conditions and react appropriately. This is discussed in section 5.2 of the document '200504 - GW Assessment for Construction Tasks - Tunnel & Cross Passages 1MC05-ALJ-EV-NOT-CS02_CL04-400048_C04'

Question 7

- *Baseline Monitoring*
    - *You state that HS2/Align has been undertaking baseline monitoring of groundwater and surface water along the route. Have you compared this with the long-term monitoring undertaken by the EA and Affinity Water? Looking at HS2/Align results for the Chalfont St Giles vent shaft in the Vent Shaft Construction Report, there appears to a significant difference between their figures and those taken monthly by the Chiltern Society and shared with you. Please confirm that these two sets of data have been compared and are consistent.*

Answer:
Please see the response to the first part of Question 6

Question 7 continued

- *You confirm that both HS2/Align and the EA will continue baseline monitoring. Please confirm that these two datasets will be compared monthly.*

The Environment Agency and Affinity Water continue to share data with HS2 and this be will reviewed with HS2's data periodically.

Question 7 continued

- *4.4.5 states that there no evidence of springs at Little Missenden. As you will be aware the groundwater at Little Missenden is about 1m from the surface. According to local landowners there were a lot of springs here prior to the construction of the main sewer. This appears to have acted as a conduit for much of this water. They also state that there is evidence of springs currently, although landowners confirm the presence of springs.*

Answer:
The level of the water table in relation to the River Misbourne at crossing of the tunnel at Little Missenden varies through the year and over longer periods of wetter / drier weather.

Paragraph 4.4.5 of the document '210428 - Chiltern Tunnel Construction Water Environment Assessment 1MC05-ALJ-EV-REP-CS02_CL04-000142_C02, 28.04.2021' is making the point that flows in this part of the watercourse increase via a series of minor inflows / seepages as opposed to via one or two large springs / resurgences such as occurs in karstic geology such as limestone. Therefore, as explained in the subsequent paragraphs, even if some of the minor inflows / seepages were blocked by the tunnel the watercourse would still receive groundwater from the aquifer (and even the water potentially blocked by the tunnel would ultimately still reach the watercourse under the influence of gravity and in the absence of any new abstraction activity associated with the tunnel).