## Inland Waterways Association – Evidence on Route Selection & Subsidence Risk in Cheshire

### Introduction

IWA's Petition sets out our previous engagement with consultations on HS2 Phase 2 and Phase 2b West since 2014. IWA's concerns include landscape, visual, noise and heritage impacts on the Trent & Mersey Canal and the Shropshire Union Canal, Middlewich Branch.

The issues of route selection through the Cheshire salt district and the subsidence risk were addressed in IWA's detailed response to the HS2 Phase 2b Working Draft Environmental Statement consultation in December 2018, and also to the National Infrastructure Commission's Rail Needs Assessment for the Midlands and the North in May 2020 (see below).

However, in view of the lack of any response or any further information from HS2 on the subsidence issue in the 4 years since our representation, it was not specifically addressed in IWA's Petitions on the Crewe–Manchester Bill or the First Additional Provision.

### Understanding the Ground Risk

The belated publication in March 2023 of HS2's paper "Crewe to Manchester: Understanding the Ground Risk across the Cheshire Plain" (hereafter 'the Ground Risk paper'), after the petitioning period and after the Select Committee hearings had started, has introduced important new evidence. IWA therefore requests an opportunity to respond to this paper and to the related discussions that have taken place before the Committee on this issue.

If the Committee considers that its rules do not give it sufficient discretion to allow verbal presentation and examination of IWA's evidence on this matter, then it is requested that the following be accepted as written evidence.

In response to the Committee's request for clarity on what petitioners are requesting, we have inserted at appropriate points in the evidence some questions that we hope the Committee will ask of HS2.

### HS2 Phase 2b - Working Draft Environmental Statement

IWA's 2018 response included the following:

> **Subsidence Risk**
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> The Trent & Mersey Canal Underbridge is sited across part of Billinge Green Flash which is one of several large subsidence flashes in this area caused by salt mining, as elsewhere across the Cheshire salt field. The large imposed loads from the superimposition of embankments, the consolidation of the embankment fill, and vibrations from the pile driving for viaduct piers, could all re-activate the subsidence here and destabilise the ground. The records of mine working information are incomplete and in any case much of the subsidence is from historic 'wild brine' pumping, remote from the extraction points, unpredictable and still active.
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> The main reason given for realigning the preferred route in 2016 was to avoid known brining and gas storage infrastructure in the Lostock area, and minimise the risk of subsidence there due to the underlying geological conditions. However, the current route runs through an extensive area of unknown and unpredictable brine subsidence risk which is likely to prove much more problematic. The choice of this route will give rise to major ground stability risks during both construction and operation stages, will require expensive engineering to reduce those risks, and may ultimately prove impractical. This has been a problem for many centuries, well-known locally, but not apparently to HS2.
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> The currently proposed route poses a major threat to the stability of the Trent & Mersey Canal channel and structures, and to the construction and operation of HS2. It should not proceed further without a full geological assessment and extensive ground investigations, and the reappraisal of alternative routes between Crewe and Manchester avoiding the Cheshire saltfield.

The increased height of the current route appears to be based on the mistaken belief that avoiding cuttings through the unstable ground would limit the risk of subsidence, whereas in fact reduced ground loadings are likely to be less of a threat than increased ground loadings from the higher embankments. If this route does proceed then the vertical alignment should be reviewed to include cuttings through higher ground and to lower the embankments and viaducts, whilst maintaining necessary clearances over the canal, roads and railway. This will both reduce the risks of ground subsidence and significantly reduce the visual impact of the line on the Trent & Mersey Canal, the landscape and nearby properties.

**Rail Needs Assessment for The Midlands and The North**

IWA's 2020 response included the following:

> **Geological Ignorance:** The whole HS2 project was designed without sufficient regard to geological factors. The safety of high speed railways depends fundamentally on track stability with tolerance limits for ground subsidence being only a few millimetres. However, the Phase 2b eastern leg was planned through the East Midlands and Yorkshire coalfield and the western leg through the Cheshire salt field without any detailed consideration of subsidence issues. The records of mine workings are incomplete and in Cheshire much of the subsidence is from historic 'wild brine' pumping, remote from the extraction points, unpredictable and still active.
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> The lack of engineering geology research was compounded by the decision that no Ground Investigation (GI) could be done until Royal Assent was received with compulsory access powers. Most other civil engineering projects do GI upfront by local agreement with landowners, but HS2 adopted a "cart before horse" approach of fixing the route before assessing its suitability. For Phase 1, the GI needed was largely for cuttings and tunnelling through chalk and clay, for which much experience exists, but in the absence of GI data the increased engineering risks have been reflected in higher construction cost estimates by contractors. The coal mining and salt solution subsidence risks with Phase 2b are much greater and it would be exceptionally foolish to confirm the currently proposed routes without sufficient research and GI data, which may well require further route changes, especially through Cheshire.
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> **Not Learning Lessons:** A characteristic of the whole HS2 programme has been the hubris shown in not accepting expert advice and learning the lessons from earlier errors. Despite problems coming to light with the western leg compromising existing salt mining and gas storage sites, route changes were made without a full investigation and the amended route and design changes make it even more susceptible to unpredictable subsidence.

**Previous Committee Evidence**

In addition to the Ground Risk paper, the Select Committee has now heard detailed evidence on the geology of the Cheshire brine field from Dr Rosalind Todhunter and on risk monitoring and mitigation from Professor Lord Mair (17/4/2023). IWA notes that Lord Mair accepted the general validity of Dr Todhunter's evidence, and that there is no doubt there will be future ground subsidence affecting the HS2 infrastructure, although he somewhat optimistically assumed it will be gradual and not sudden.

This may be resolved by the more detailed geotechnical and hydrological site investigation work that is now planned. But until sufficient data is available and there is a thorough and independent examination of all the evidence, the danger of sudden catastrophic collapse cannot be dismissed.

IWA does not propose to repeat or question the verbal evidence, nor the geological and mining information in the Ground Risk paper, but does wish to draw attention to the importance of matters that were not covered or are insufficiently explained. These include the possibility that the construction work itself, and associated drainage changes, could trigger movements of inherently unstable ground, and particularly in the area around Billinge Flash.

**Construction**

In between the detailed design of the proposed viaducts and embankments, with the incorporation of jacking points and soil reinforcement, and the completed railway with state-of-the-art movement monitoring as described by Lord Mair, comes the construction period.

As IWA commented in 2018, the large, superimposed weight of the embankments, the consolidation of the embankment fill, and disturbance from pile boring for the viaduct piers, on ground that has previously

subsided and may now be delicately balanced, could all re-activate the subsidence here and destabilise the ground during construction.

**Question 1:** What allowance has been made for the possible triggering of ground subsidence or collapse resulting from the raising of embankments and from the loading of bored piles under viaduct piers during the construction period ?

The increased height of the current route compared with the original proposal appears to be based on the mistaken belief that removing all cuttings through the unstable ground would limit the risk of subsidence. However, reduced ground loadings are likely to be less of a threat than increased ground loadings from the higher embankments.

**Question 2:** On what basis is it assumed that adding the extra weight of higher embankments is preferable to reducing overburden pressure with cuttings in avoiding re-activating subsidence of unstable ground ?

**Drainage**

The Ground Risk paper says that surface rainwater run-off from embankments and viaducts will be collected in lined ponds before discharge to river courses, preventing percolation that might give rise to salt dissolution. However, reducing percolation over an area could itself change the natural or stabilised groundwater regime, drawing in replacement water from adjacent areas and triggering increased salt dissolution. This will only be established by detailed hydrological investigation, and the assumption that discharge to rivers will in all cases be preferable to maintaining infiltration is unsound.

**Question 3:** On what basis is it assumed that piping surface water away to rivers is preferable to controlled local infiltration in minimising disturbance to groundwater flows and salt dissolution ?

**Billinge Flash**

The Ground Risk paper admits that Billinge Flash is the one major area of former high subsidence that is crossed by the Proposed Scheme. Although the paper provides schematic block diagrams of the geological hazards, there is no detailed assessment of the particular history or current stability of the Billinge Flash area. Dr Todhunter provided several plans and sections showing the subsiding area at Billinge Flashes due to a major Brine Run that has been active for more than a century. This is clearly a very unstable area where much more detailed ground investigation and hydrology research is needed to quantify the risk of rapid collapse and/or gradual subsidence. Whilst engineering solutions may be found these could be very expensive and there may be ongoing disruption to the operation of the railway.

**Question 4:** When will the necessary detailed GI and hydrology study of the Billinge Flash area be done and will the results be open to public scrutiny and independent assessment ?

**Remedial Engineering**

The Ground Risk paper proposes deep, bored piles to support the viaduct piers with viaduct spans and bridge decks able to be jacked up to counteract subsidence, with embankments stiffened with geogrid reinforcing. However, there is no information on how much localised subsidence to viaducts or embankments can be tolerated before remedial intervention is necessary.

As HS2 uses concrete slab track rather than ballast, it is difficult to see how the rail level on embankments could be raised following subsidence without complete removal and replacement of large lengths of the track.

Also, given the very different ‘stiffness’ characteristics between viaduct decks and adjacent embankments, special measures will be needed to manage differential movement at the interfaces.

**Question 5:** How much localised subsidence, in millimetres, is tolerable before remedial work is required?

**Question 6:** How can track on embankments be raised after subsidence without complete replacement?

**Question 7:** How will differential subsidence at the viaduct/embankment interfaces be managed ?

This latter question is particularly pertinent to Billinge Flash where the interface between the 12 metre high Trent & Mersey Canal Viaduct and the Whatcroft North Embankment is directly over the line of the Brine Run along the main subsidence trough connecting the three aligned flooded sink holes at Billinge Flash, Oakwood Marina and the flash by Little Grebe Cottage.

At the very least, the Trent & Mersey Canal Viaduct should be extended north by several spans to move this interface out of the subsidence trough. This will also help reduce the visual intrusion of the embankment somewhat by maintaining more open views from the canal.

**Question 8:** If the current route can be shown to be constructable, will the Trent & Mersey Canal Viaduct be extended with extra spans to the north to minimise risk and limit visual impact ?

**Route Modification**

Given that the Billinge Flash area presents by far the greatest hazard to the construction, operation and safety of the railway, consideration should be given to a route modification that would avoid it. The Solid Geology map at Figure 3 of the Ground Risk paper shows that by moving the route to the east of Billinge Flashes towards the King Street Fault the length of the line crossing the Northwich Halite would be reduced. Figure 6 shows that this would then avoid all the major karst subsidence features.

Starting from the south, the River Dane viaduct would curve eastwards to cross the valley at a less acute angle, shortening the length of the viaduct and crossing the Trent & Mersey Canal further south. Continuing progressively further east of the Proposed Scheme across open ground it would cross the Puddinglake Brook further upstream and avoid both the Puddinglake Brook Viaduct crossing of the Trent & Mersey Canal and the Trent & Mersey Canal Viaduct at Billinge Flash. Bridges over the Sandbach-Northwich railway line and Whatcroft Lane would still be needed. The route would then curve back towards the west, passing east of Pear Tree Farm Cottages and converging on the Proposed Scheme around the King Street crossing.
For a sketch map of this proposal see IWA Alternative Route (drawn on CT-10-307 Environmental Baseline Plan)

This route modification would provide significant cost savings by shortening the River Dane Viaduct, removing the Trent & Mersey Canal Viaduct entirely, and avoiding expensive engineering work most likely to be needed around the uniquely hazardous Billinge Flash area. It would also greatly reduce the visual and noise impacts of both construction and operation on the heritage, wildlife and recreational corridor of Trent & Mersey Canal and its users.

**Question 9:** Will HS2 fully investigate and consider the benefits of this proposed route modification ?

**Shropshire Union Canal**

The Clive Green Lane area including the Shropshire Union Canal viaducts has also been identified as requiring mitigation for ground movements. Although measures for the new Clive Green Lane HS2 Overbridge are described there is no mention of the new Canal Overbridge on Clive Green Lane which will presumably require similar provisions.

**Conclusions**

The route through the Cheshire brine field, and in particular the section around Billinge Flash, was fixed prematurely without understanding the geological, geotechnical, and hydrological challenges it poses. The production of the Ground Risk paper at such a late stage, and the continued absence of sufficient detailed ground investigation work to validate its assumptions that this part of the route is constructable undermines confidence in the Bill.

IWA requests that the Select Committee seek answers to the questions indicated above.

IWA also requests that the Select Committee requires HS2 to conduct a full assessment of the route modification proposed herein and, if justified, its adoption through an Additional Provision.

IWA considers that unless and until the Select Committee is fully satisfied on these matters, it should decline to recommend third reading of the Bill.

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