## 1.0 INTRODUCTION

Some residents of recently built houses on Millers Vale, New Mills, High Peak, SK22 4QT have been experiencing ground movement in their back gardens which has been claimed to have been related to a re-laid section of sewer pipe. Following several surveys undertaken on the pipe, the customers have asked UU to provide a geotechnical engineer to assess the properties with a view to understanding the cause of the movement. This technical note is a record of the observations and provides a discussion of likely modes of failure and next steps.

## 2.0 BACKGROUND

Construction of 9no. new residential properties (Nos. 7 (E) to 23 (W)) located on the crest of a slope to the north of a new residential road, Millers Vale, commenced in 2017.

In January 2017, in anticipation of the rear gardens being landscaped over the line of the sewer, UUs contractor, Cara, proactively relayed 78m of 225mm vitrified clay gravity sewer with cast iron, which is considered a more durable material.

In 2025 – 'Following a report of subsidence, United Utilities carried out a CCTV survey of the combined sewer at the rear of 7 – 17 Millers Vale and this survey showed that the sewer is structurally sound and has no defects in the 70 metres surveyed.

January 2026 – A follow-up CCTV survey was undertaken on the new pipe. This was reviewed by UU Drainage Performance Engineer and was showing no signs of structural deformation.

## 3.0 SITE DESCRIPTION

A site layout plan is shown in **Figure 3.1** below, which is an extract from the UU Onemap, indicating the lines of the local sewer network (red) in relation to the residential properties.

The site is located at Millers Vale, New Mills, High Peak, SK22 4QT (NGR E:400422 , N:385684).

Wastewater assets

The previous sewer was laid between 1991 and 1999. It is noted that UU Onemap has not been updated with the new pipe material details and chamber / pipe depths and no information has been provided with regard to current manhole cover levels. However, it is confirmed that the sewer between the following manholes was relayed on previous line and level to the same diameter (225mm).

The upstream manhole MH 4601 (in garden of No. 17) is shown as having a downstream invert level of 153.34mOD (former pipe depth of 1.35mbgl).

Manhole 4682 (located at the boundary between No. 7 and 9) is shown as having a chamber depth of 3.3mbgl, with a former pipe depth (d/s of MH) of 3.05m.

Manhole 3601 (d/s section of relayed pipe) shows a former CL of 154.69 and former chamber depth of 1.37m. This is now understood to be deeper due to releveling by the developer.

Topography

Topographic levels are taken from Ordnance Survey data which shows the top of the slope to the rear of the gardens to be at 155mOD. The contours are shown on **Figure 3.1**. The topography falls steeply to the north down to a minor watercourse, flowing from east to west. At the narrowest point (behind No. 15) from top of slope to river channel, the horizontal distance, from mapping, is approximately 7.5m. The level of the riverbed at this point is unconfirmed, but further downstream is noted as 150mOD. Therefore, using this river level (worst case) the slope gradient is approximately 33 degrees (1 in 1.5). If further assessment is required, these levels should be confirmed by survey.

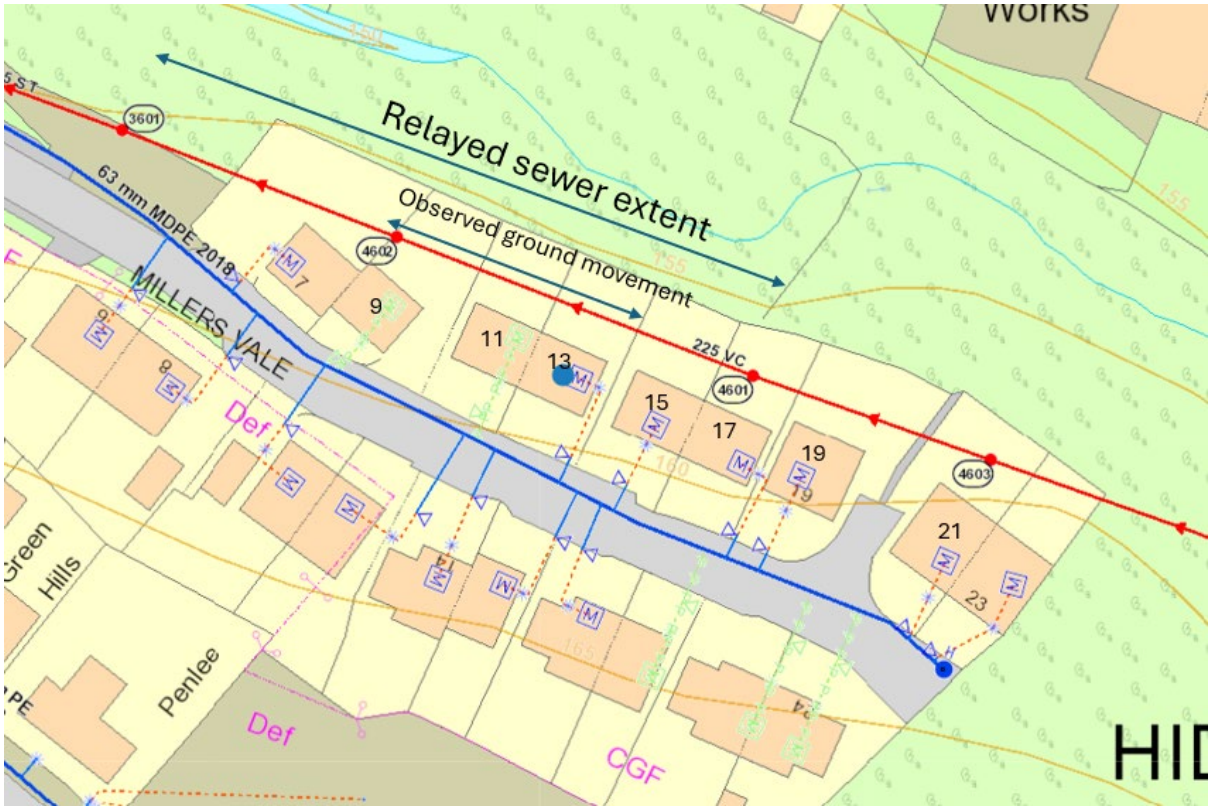



***Figure. 3.1*** *Site Layout Plan*

Topographical survey data have been requested from the developer, to cover both prior to landscaping and after landscaping, to understand level changes. However, these had not been received at the time of writing.

General

An initial site walkover was undertaken on 3rd July 2024 by a Senior Geotechnical Engineer from UU, (author) guided by the developer of the properties, Gary Cullen, and the residents of the visited properties. Access to the rear gardens of 15 to 23 was not enabled during the visit, although brief observation over the back fence did not note any signs of ground movement. Access was available to inspect the rear gardens through the side gates to 11 and 13 and to the rear of the back fences (along

an informal grassed footpath at the crest of the slope) via a footpath between 19 and 21 and through rear gates to Nos. 7 and 9.

The following is a summary of the ground movement features observed during the walkover.

The location of ground movement features are plotted on **Figure 3.2.**

Rear of No. 17

Manhole MH 4601 was observed in the lawned garden of No. 17, with another unidentified manhole cover (possibly a surface water drain). No signs of obvious ground movement could be observed. See **Photo 3.1.**



***Photo 3.1*** *– Rear of No.17, showing position of upstream manhole MH 4601 (likely to be cast iron cover)*

Rear of No. 15

The rear of No. 15 showed very little signs of ground movement, except for some potential opening of the decking joints (See **Photo 3.2**)., which could indicate some movement towards the adjacent property (worst affected No. 13.) Although the shed situated to the back fence and immediately adjacent to the dividing fence to No. 13, showed no signs of deformation, appearing stable and level.

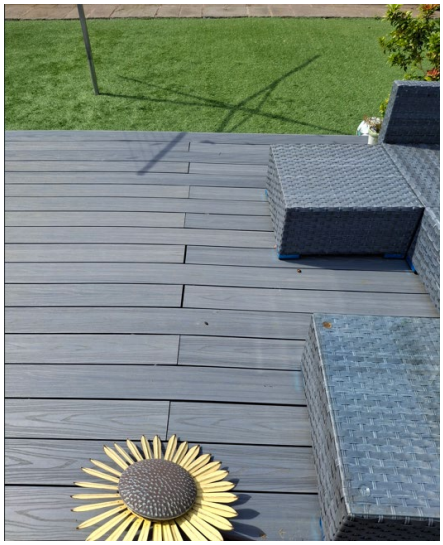


***Photo 3.2*** *– Rear of No.15, showing minimal deflection in decking*

Rear of No. 13

The rear garden of No. 13 exhibits the most ground movement both in the ground surface and the overlaying timber decking and fencing (rear and side fences).

Linear displacement indicative of a head/backscarp to slope movement, was evident across two thirds of the width of the garden, measured 200mm in height in the centre of garden, beneath synthetic grass covering (See **Photo 3.3**). At the west fenceline (adjoining No.11) a 6mm wide tension crack was measured at an edging stone, which had 100mm vertical displacement.

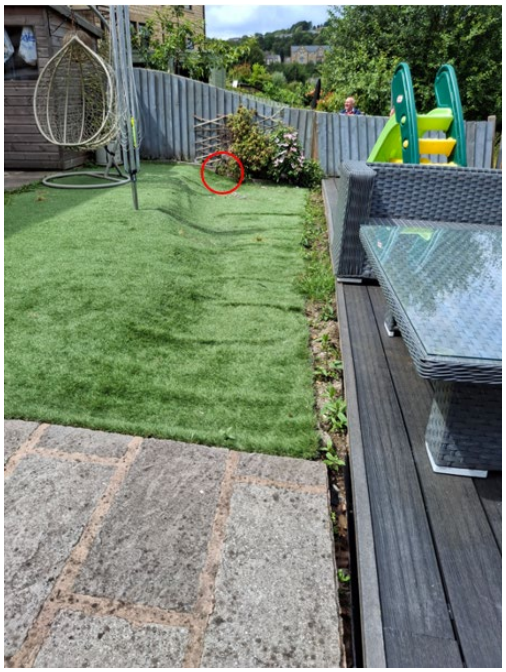




***Photo 3.3*** *Rear of No.13, showing 200mm of settlement* ***Photo 3.4*** *– Tension crack in red circle*

Significant deformation was observed in the rear fence, with movement of the whole fence across the full width of the garden to be tilting back towards the house. See **Photos 3.5 to 3.7**.

From the grassed path to the rear, the fence posts were observed to be distorted, leaning back towards the house measured at an angle of 5 degrees. This would indicate downslope movement of the ground, inducing a rotation of the post back to the house.





***Photos 3.5 and 3.6*** *Rear of No.13, inward deflection in back fencepost*





***Photo 3.7*** *Rear of No.13, inward deflection in back fenceposts* ***Photo 3.8*** *Rear of No.13, 700mm lateral void*

A 200mm deep surface void, was observed, 1m to the north of the back fence line in the grass path.

A 700mm lateral void, 400mm deep below a concrete fence post support, was observed to the rear of the fenceline, located c. 3.5m downslope from backscarp.

The ground surface beneath the decking was observed as a sloping profile covered with geotextile, resulting in a c. 0.5m gap beneath the decking at the line of the back fence. This slope gradient

continues across the grass footpath to the rear for approximately 2m before the crest of the steeper slope. Coarse stone and demolition fill could be seen protruding locally from the grass footpath.

Rear of No. 11

In the garden of No. 11 movement was less pronounced than that of No.13, and more difficult to see due to gravel surfacing. Obvious linear displacement, however, (shown as yellow dotted line in **Photo 3.9a**) was across the full width of the garden. Evidence of movement in decking toe boards upslope (towards house) was observed and separation of the side fence panels on both sides. The decking boards were weak to the eastern boundary (upslope). Pronounced settlement of the ground downslope in slate cover was observed on western boundary (See, **Photo 3.9b**).

Vertical distortion on the back fence could be observed. Behind the back fence the ground had visibly settled away by 300mm into the grassed footpath beyond, exposing a concrete support to a timber decking post. See **Photo 3.10.**

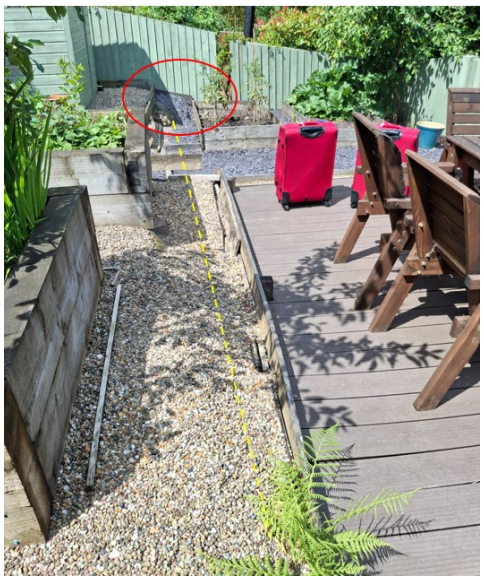




***Photo 3.9a*** *Rear of No.11, linear displacement downslope of yellow line,* ***Photo 3.9b*** Detail in red circle



***Photo 3.10*** *Ground loss to decking support at back fence*

Rear of No. 9

A tension crack in the lawn, measured 150mm deep, and open 1cm wide was observed in the centre of the garden (See **Photos 3.11 and 3.12**). Approximately 300mm of vertical displacement in a sleeper was communicated by the resident to the western boundary (seen in foreground in **Photo 3.11**), which had been observed over recent years. The joints on the edging sleepers on the western fenceline appeared to be open, indicating signs of movement on the downslope half of the garden. See **Photo 3.13.**

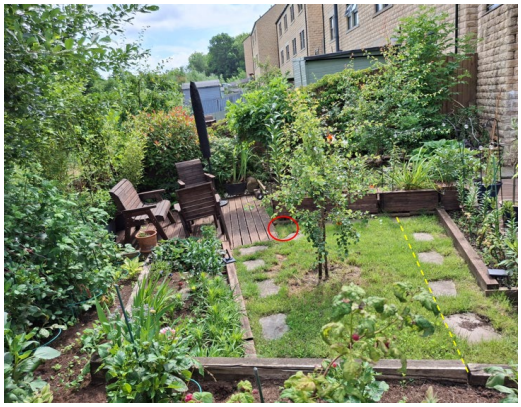






***Photo 3.11*** *Rear of No.9, displacement downslope of yellow line*

***Photo 3.12*** *Rear of No.9, tension crack red circle in Photo 3.11*

***Photo 3.13*** *Rear of No.9, western fence, movement observed in sleeper, fence less distorted than elsewhere.*

Manhole 4602 could not be seen in the garden. It is presumed to be covered by the shed. The back fence of No. 9 was not visibly distorted compared with those of 11 and 13. A semi mature tree was observed at the crest of the slope behind the fence.

Minimal visible signs of movement were observed or reported by the residents of No. 7, except for a small surface settlement feature / void in the gravel towards the eastern fenceline to No.9. See **Photo 3.14**.



***Photo 3.14*** *Rear of No.7, eastern fence, minor voiding*

Slope to watercourse.

The slope down to the watercourse could not be fully observed due to the density of vegetation, which included semi mature trees including willow. On the walkover, the developer suggested that the UU contractor end-tipped material onto this slope during pipe laying. This has not been substantiated.

The watercourse was observed to be free flowing at a reasonable gradient with evidence of coarse stone used to stabilise the banks from bank failures that had occurred on the opposite (right) bank. No additional reinforcement could be observed at the toe of the slope (left bank) due to dense vegetation. See **Photo 3.15.**



***Photo 3.15*** *Watercourse at toe of slope*

Indicative locations of the ground movement features observed during the site walkover is provided on **Figure 3.2** below which uses present day aerial photography with the UU mapped sewer network (red).

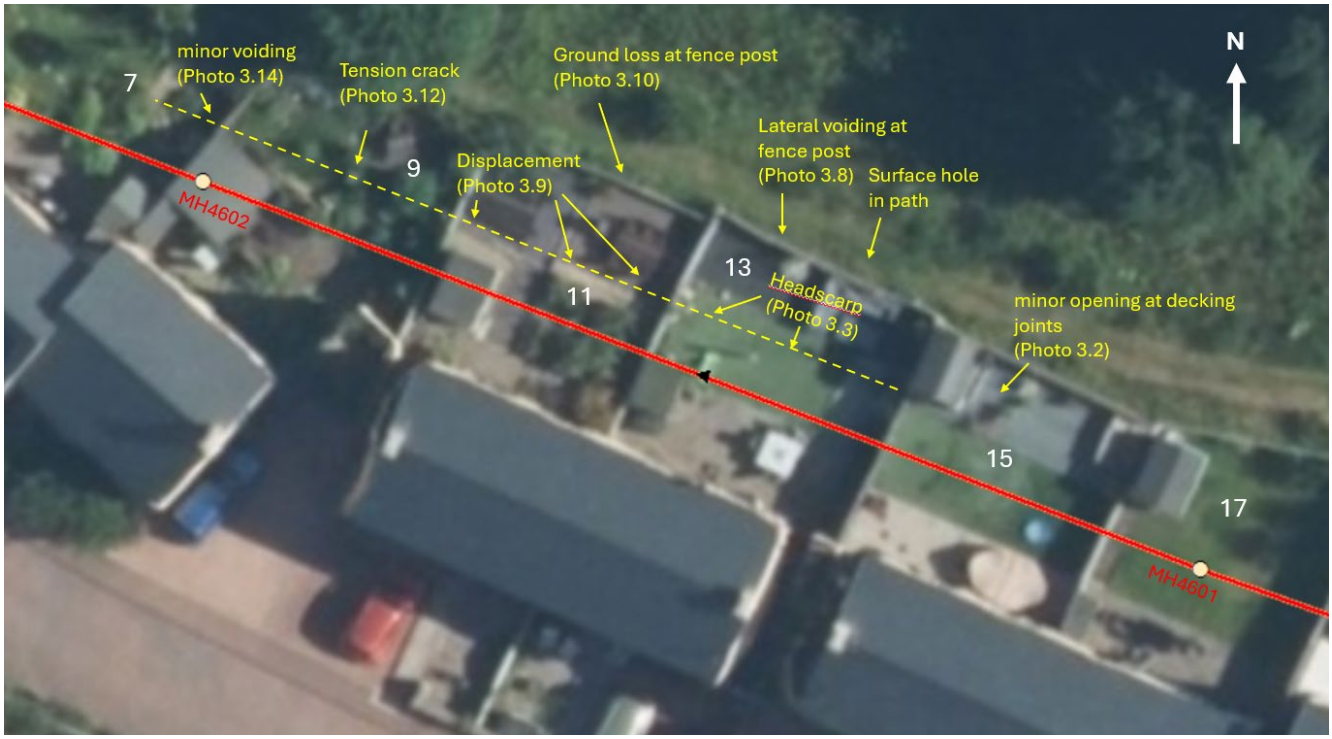



***Figure. 3.2*** *Observed ground movement Location Plan*

## 4.0 GEOLOGICAL CONDITIONS

The geology at the site has been inferred from British Geological Survey (BGS) online Geoindex Digital 1 to 50,000 scale mapping. 1:10,000 scale mapping is not covered for the site.

There are no relevant historic boreholes on the BGS Geoindex to assist in confirming the geological material at the site.

### 4.1 Superficial Geology

The superficial deposits across the developed site, including the back gardens at Millers Vale and the slope to the north, are indicated to comprise Glacial Till deposits. (Blue – **Figure 4.1**).

These materials commonly comprise firm to stiff consolidated (cohesive) clays with granular bands and inclusions of varying grade.

Along the corridor of the watercourse, Alluvial deposits are mapped (yellow – **Figure 4.1**), which extend to the toe of the bottom half of the slope to the north of the properties, indicating a broader width of the channel than present day. These deposits typically comprise unconsolidated sediments of soft clays and loose silts and sands, occasionally with organic material.

There is no data on the BGS online resource to suggest the presence of any land slipped material, or material that could be susceptible to mass movement.

A Superficial Geology Plan is provided as **Figure. 4.1** below

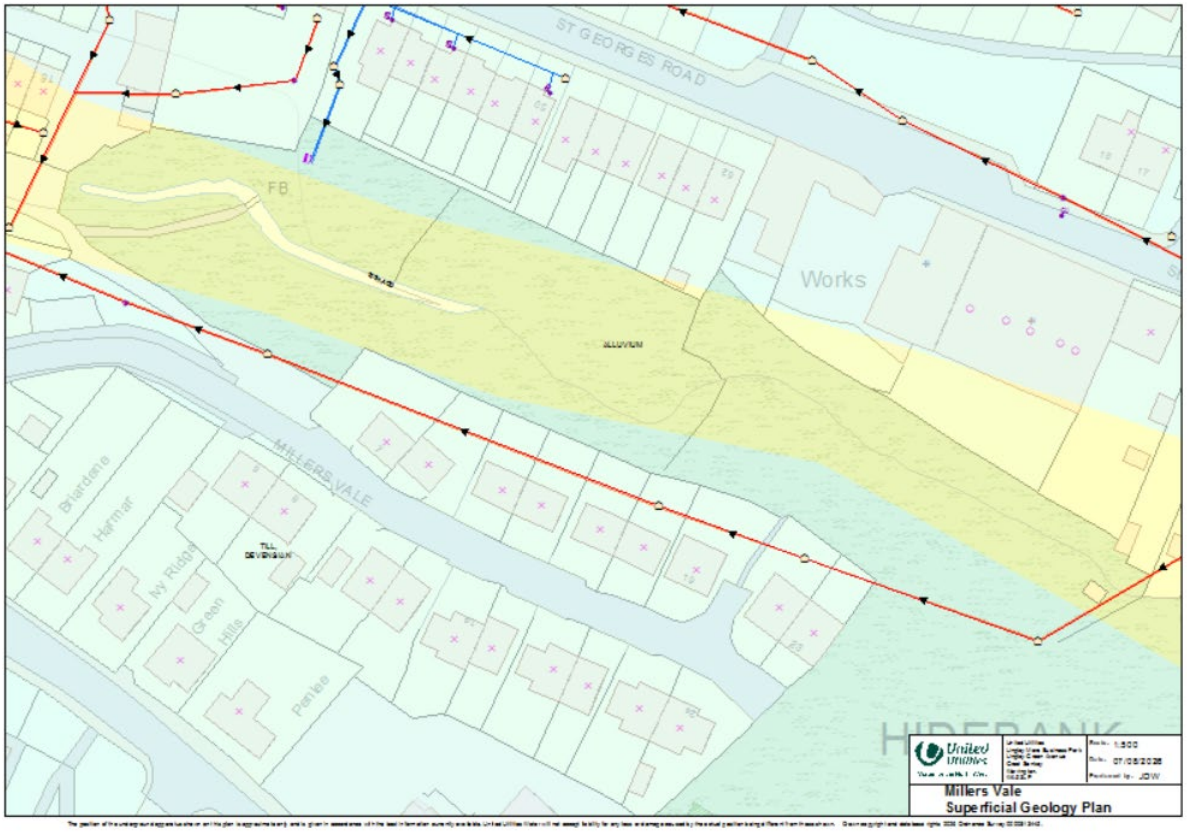



***Figure. 4.1 Superficial Geology Plan***

### 4.2 Bedrock Geology

BGS mapping indicates that the bedrock geology present beneath the superficial deposits across the site and slope is strata of the Pennine Lower Coal Measures.

### 4.3 Mining

On review of the Mining Remediation Authority online web map viewer, the site under consideration is not shown to be affected by past coal mining and no abandoned mine shafts are located within 20m of the site.

## 5.0 SITE HISTORY / CONSTRUCTION RECORDS

### 5.1 Site History

Online historical mapping has been reviewed through the online resource https://maps.nls.uk/ , which doesn't document any change of the site since development of the houses commenced.

The 1912 edition Ordnance Survey map shows the presence of a Mill Pond at the base of the slope covering the level area in which the minor watercourse now flows. An extract of the map has been overlaid against present day mapping and is presented as **Figure 5.1** below. The southern boundary of the millpond is indicated to lie across the present-day slope, suggesting that the slope is likely to have been reprofiled at some point historically. The nature of the backfill to the millpond is unknown.

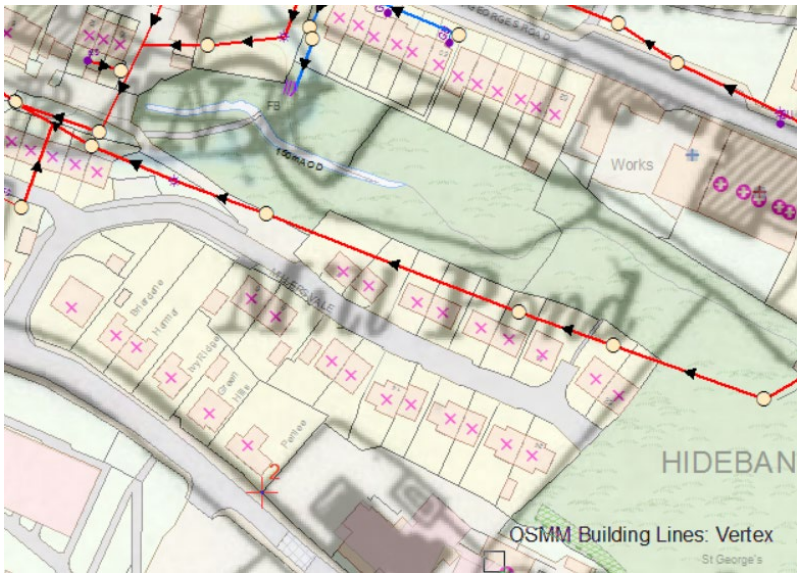



***Figure. 5.1*** *OS 1912 historical mapping overlay*

Aerial photography has been reviewed using historic Google Earth imagery.

Photo 5.1 shows aerial imagery of the site in June 2009 (observed with north at the base of the image), prior to construction. A retaining wall can be seen retaining the hillslope from the watercourse, to the east (downstream) of the new development. The image of the site shows mostly undeveloped grass hillside with some ripples evident along the contours of the slope which are indicative of shallow surface movement. Evidence of vehicle movements down the slope and across the watercourse can be seen in the centre of the site.




***Photo 5.1*** *June 2009 Aerial Imagery (note: north is at the base of the image)*

**Photo 5.2** shows an aerial image of the site under construction in June 2017, post pipe-laying. An indicative line of the retaining wall is shown in purple. Evidence of fill on the slope to the north can be seen.




***Photo 5.2*** *June 2017 –Aerial Imagery Mid construction of houses (note: north is at the base of the image)*

**Photo 5.3** shows an aerial image of the site in June 2018, with the houses built and landscaping of the gardens to No.7 and 9 (to the east complete).




***Photo 5.3*** *June 2018 –Aerial Imagery Landscaping (note: north is at the base of the image)*

**Photo 5.4** shows an aerial image of the site in April 2020, the red line is the indicative line of the sewer. Coarse fill is indicated at the base of the slope opposite No. 13.




***Photo 5.4*** *April 2020 –Aerial Imagery c.1 year post construction (note: north is at the base of the image)*

### 5.2 Construction History

UU Onemap indicates the original sewer pipe was laid between 1991 and 1999.

May to August 2016 – A significant vertical crack developed, observed in the concrete retaining wall where the watercourse historically had migrated south, to the west of the site. A historic photograph dated 18/5/16 shows significant stone filling above the retaining wall prior to deformation. See **Photo 5.5** below. Photos of the development of cracking are provided in Appendix B.



***Photo 5.5*** *18/5/16 Retaining wall*

Construction commenced in 2017 by developer Treville Properties, of 9no. new residential properties (Nos. 7 (E) to 23 (W)) located on the slope to the north of Church Road, with a new residential road, Millers Vale.

The developer, during the site walkover, confirmed that the retaining wall was stabilised by them using granular buttressing, prior to backfilling and repositioning of the watercourse further north.

In January to February 2017, in anticipation of the rear gardens being developed over the line of the sewer, UUs contractor Cara, proactively relayed 78m of 225mm vitrified clay gravity sewer with a more durable cast iron pipe material to the same diameter.

Nick O' Rourke (UU Ww Drainage Performance Engineer) reported: 'Cara just backfilled to the level in the pictures (See **Photo 5.8**) and Gary Cullen (developer) was going to build up the soil level/reinstate to the new development garden level'.

It is not known whether the coarse stone was removed from site, or if remained that a filter (geotextile or other) was applied to prevent migration of fines from successive landscaping by the developer on top.

2025 – 'Following a report of subsidence, United Utilities carried out a CCTV survey of the combined sewer at the rear of 7 – 17 Millers Vale and this survey showed that the sewer is structurally sound and has no defects in the 70 metres surveyed.

20th January 2026 - CCTV survey undertaken on new pipe and reviewed by Drainage Performance Engineer and was showing no signs of structural deformation.

### *5.3* Construction Records

It has not been possible to obtain any as-built records from Cara, the contractor who re-laid the sewer, to be able to verify the quality of the compaction of backfill material of the pipe.

Photographs taken from UU's Construction Supervisor at the time of the re-laid pipe are given below.

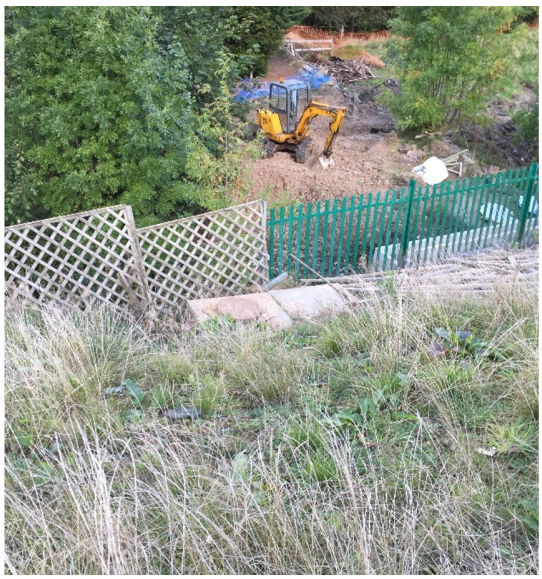




**Photo 5.6** Pre-pipe relaying, showing position of Manhole 3601, with developer diverting the watercourse away from failed retaining wall.

**Photo 5.7** Pre-pipe relaying, upslope of Manhole 3601 showing displacement in ground

Prior to the UU pipe laying contractor commencing on site, evidence of significant ground movement was recorded, See **Photo 5.7**.

A stone access road was laid to facilitate safe plant movements and to protect the ground during pipe relaying. See **Photo 5.8**.



**Photo 5.8** Installation of large stone access road

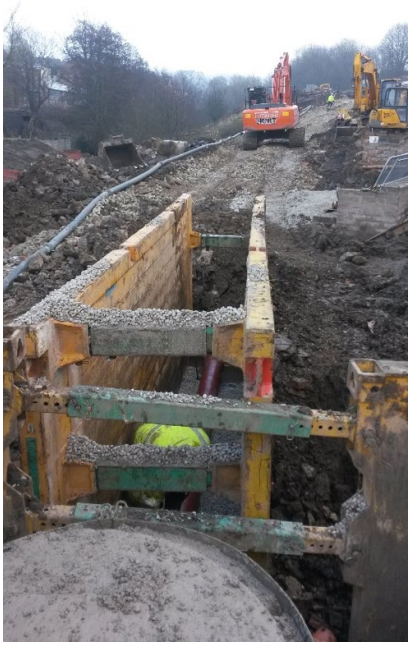


**Photo 5.9** Cara pipe relaying phase, (looking west)



**Photos 5.10 to 5.14** Cara pipe relaying phase, showing manhole construction, trench support, pipe surround backfill and proximity to new houses being built



**Photo 5.15** Section of laid pipe post backfilling

It has not been possible to obtain any construction records from the developer of the landscaping details, including; i). pre and post construction topographic surveys to verify the thickness and extent of filling subsequent to the relaying of the sewer pipe, or ii). the nature and specification of landscaping materials, including the presence of a filter on top of the stone fill (if left in place). However, during the walkover the developer indicated that the thickness of the landscape fill was in the region of 300mm.

### 5.4 Resident observations – No. 13

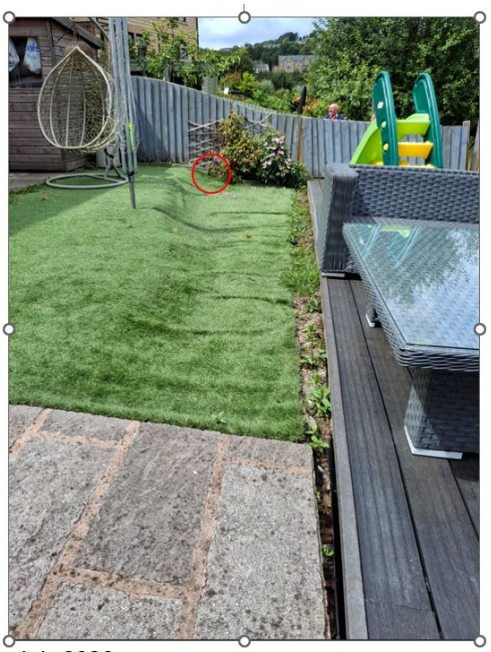
The owner of No.13 stated, during the walkover survey, that he had purchased and moved into the property in September 2019 and started to see noticeable ground movement 6 months after moving in. He submitted a photographic record (3/8/26) of the movement with slight opening in decking boards and moderate opening between paving slabs and edging stones alongside artificial grass recorded in October 2021. See Appendix A.

The next set of photographs, dated 14th March 2024 show a view of the back garden of No.13 from above showing the garden with no visible signs of deformation to the hard landscaping or fencing. It is assumed that at this point the garden had been re-instated from any previous signs of movement.

By 29th January 2025 a visible tension crack is seen beneath the artificial grass and movement of the back fence posts by detachment to the side panels.

By June 2025, a clear loss of ground downslope of the tension crack line noted above, is seen under the artificial grass, resulting in a headscarp feature extending almost the full width of the garden, indicative of slope instability.

A comparison of when the garden was reinstated in March 2024 and present day, clearly shows the movement of the ground downslope, with the linear gap between the artificial grass and adjacent paving, and the decking being indicative of the magnitude of movement over this time period.



July 2026



10 March 2024

**Photo 5.16 and 5.17** Comparison photographs of No.13 garden showing progressive slope movement

## 6.0 Engineering Assessment

### 6.1 Observations and measurements

The ground surface beneath sections of decking to the north of the houses and UU sewer, is sloping, compared to that of the rest of the gardens, back to the houses which is comparatively level.

A comparison of UU Onemap mapped sewer position, against observed deformation features, measured in the garden of No. 13, during the walkover survey shows a disparity, as illustrated in Figure 6.1 below.

The linear headscarp feature, which is observed running across the width of No.13's garden, was measured on site during the walkover to be 5.55m at its centre to the wall of the house. The line of the sewer, as mapped on UU Onemap, is measured as 3.81m. This disparity should be checked by survey to understand if the ground movement features observed in all the rear gardens are related to the actual line of the sewer.

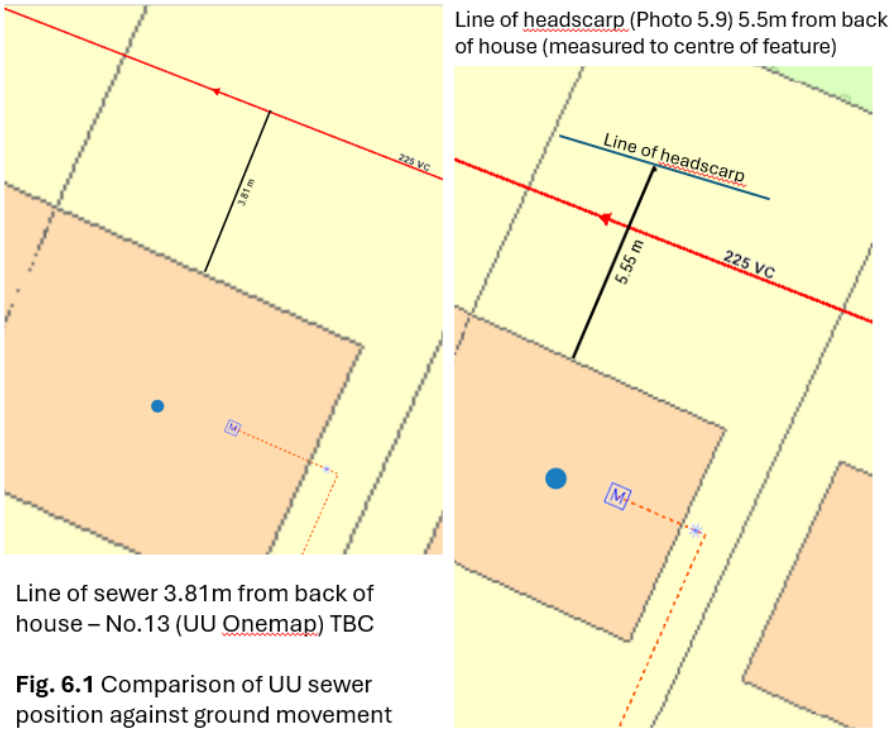



**Fig. 6.1** Comparison of UU sewer position against ground movement feature

### 6.2 Possible failure mechanisms

1). Hillslope instability

There is evidence of historic slope instability seen locally in photographs taken pre-pipelaying (**Photo 5.7**) and potentially seen across the site in historic aerial photography.

Tension cracks and head scarp features in the gardens of 13, 11 and 9 are indicative of progressive slope movement, typically observed in relation to rotational slips (slope failures) in cohesive (clayey) materials. Although there have been no historic monitoring surveys which could be used as a baseline to monitor the progressive failure from, the photographs provided by the resident of No.13 show on-going (progressive) movement over time. In addition, all of the residents (predominantly 13, 11, and 9) communicated similar on-going movement over the last 5 years.

The slope instability features observed in the gardens could be related to either of the following:

a). Pre-existing / ongoing slope instability of the natural clay soils (Glacial Till)

b). Pre-existing / ongoing slope instability of the manmade slope to the river (reprofiling to millpond)

c). Post-construction failure of the landscaping materials that may not have been keyed in adequately to the existing slope.

d). A combination of the above.

2). Migration of fines into voids

If the coarse quarry stone used as construction access was left in place, it is possible that washout of any fine- grained (clay to sand sized) landscaping materials placed by the developer to create the gardens, into the void spaces of the stone could have occurred over time, leading to superficial voids and movement of the landscape materials.

3). Settlement of trench backfill

There is a potential, as is claimed by the developer and the residents, that poor compaction to the pipe trench backfill during relaying of the sewer pipe has led to settlement of the surface materials above the trench. However, if a similar poor construction method was used, it would be seen across the whole relayed pipe section, not just limited to a shorter section, and similar ground movement features across the width of the trench.

### 6.3 Discussion / likely cause of ground movement

The cracking in the concrete retaining wall is more than likely to have been caused by undercutting of its foundation, and thus loss of support, likely by varying flow in the minor watercourse at the toe of the slope. It is likely that the wall had no scour protection designed when it was constructed and the watercourse had laterally migrated over time. Movement seemed to have developed quickly and may have been a result of a significant flow event in 2015/2016. In addition, the stone filling evident at the top of the retaining wall may have contributed to the failure due to overloading, exceeding the designed capacity. This deformation is considered to be separate from the movement observed in the gardens.

There is historic evidence of slope instability prior to the relaying of the sewer. Refer to Photo 5.7.

The observed ground movement features (tension cracks and headscarps) are seen more significantly in No 13. The features are then seen less significantly in No. 11 and further reduced evidence seen in No. 9 and minor evidence in No.7 (eastern fence only). These features are indicative of slope instability, particularly that experienced in clay slopes. The features occur in a single linear form across the mid-section of the gardens only, that is commensurate with a head / backscarp of a slip surface. These features are not seen further back at the houses. It could be that slope related movement might be reduced in the west (properties No. 9 and 7) as the retaining wall (in its remediated form) and the tree observed could have provided an improvement in slope stability here. There is less horizontal distance to the toe of the slope adjacent to No. 11 and 13. There is evidence of historic toe support from the aerial photography which could indicate a concern here, historically.

With regards to the potential for the ground movement to be related to the pipe trench settlement, it would be reasonable to observe consistent localised deformation in a linear trough across the pipe trench (perhaps 1 to 1.5m in width). This is not seen in surface observations, particularly equally back towards the houses, but cannot be discounted at this stage until correlated with the position of the pipe trench.

If the position of the sewer on UU Onemap is correctly mapped, the observed features are further to the north (downslope) than where the backfilled pipe trench is located. Therefore, the observed ground movement cannot be attributed to the settlement of poorly compacted pipe trench backfill. This needs to be verified.

Apart from the granular pipe bedding and side fill material (as seen in the construction photographs) it is not known with what or how the pipe trench was backfilled. However, if poor compaction were undertaken and / or unsuitable backfill material were to have been used, then ground settlement would have been observed immediately after construction, not 6 months after the residents moved in. If this was the case, then it would be reasonable to have reported it during landscaping.

Voids observed in the footpath to the rear of the back fenceline of No. 13 may be indicative of washout of reinstated fill material into the stone provided as construction access.

The holes in the grassed footpath and around fence posts behind No.13 garden are likely to be indicative of voiding related to migration / washout of fine-grained soils (most likely of landscaping fill) into the underlying stone road. This is assuming that the landscaping fill was placed directly onto the stone fill without a barrier to prevent migration.

### 6.4 Data gaps

At the time of writing the following data gaps exist:

There is no current topographic data.

The line of the sewer in relation to the ground movement features observed is undetermined.

The level and the depth of the sewer is unknown.

There is no ground investigation data to confirm ground conditions

There are no construction records from either the developer, or from UU contractor, Cara.

There are no historic monitoring records or observations from the developer.

## 7.0 NEXT STEPS

Initially, a topographic survey of the affected properties should be undertaken, which would aim to determine the line and depth of the sewer and map the ground movement features in relation to it. This would also pick up the other known features as part of a geomorphological survey, acting as a baseline to further movement. The profile of the slope to the north could also be ascertained if future slope stability assessment were to be undertaken.

Following topographic survey, ground investigation could be undertaken, which would aim to:

- confirm the position of pipe trench
- establish the state of compaction and nature of materials used for the trench backfill,

- characterise the material properties and groundwater conditions that could enable slope stability checks
- establish the presence of coarse stone access road materials and any filter materials used
- expose slope stability features for further assessment

Due to access constraints to the rear of the residential properties, initial ground investigation may be limited to hand dug trial trenches dug through the known features / suspected pipe trench backfill within the worst affected properties (principally No.13) and the grassed path to the rear. This could be supplemented by hand-held window sampling boreholes to establish continuous core samples for assessment of ground conditions.

## 8.0 References

British Geological Survey (BGS) Geoindex, http://mapapps2.bgs.ac.uk/geoindex/home.html [accessed July 2024]

Google Earth Aerial photography (Accessed July 2026)

National library of Scotland mapping archive https://maps.nls.uk/ (Accessed July 2026)

APPENDIX A – Residents (No.13) Photographic Records

APPENDIX B – Development of cracking in the retaining wall

**APPENDIX B** – Development of cracking in retaining wall



Picture 1 taken 18/05/16 showing no signs of movement.



Picture 2 taken 12/07/16 showing signs of movement.



Picture 3 taken 25/08/16 showing further signs of movement.