

AIR QUALITY BARRIER REPORT PRELIMINARY FEASIBILITY STUDY

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This report dated 10/01/2019 has been prepared for Highways England (the “Client”) in accordance with the terms and conditions of appointment dated 19th December 2017 (the “Appointment”) between the client and Arcadis Consulting (UK) Limited (“Arcadis”) for the purposes specified in the Appointment. For the avoidance of doubt, no other person(s) may use or rely upon this report or its contents, and Arcadis accepts no responsibility for any such use or reliance thereon by any other third party.

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1 Executive Summary

- 1.1.1 Arcadis were commissioned by Highways England to carry out initial investigations and site visits at 3 agreed locations to establish their suitability for the installation of an air quality barrier.
- 1.1.2 It was the intention of each site survey to identify suitable locations to position an environmental barrier type system. Each survey recorded existing highway features that would impact on the suitability of a system together with evidence photographs taken to record the visit.
- 1.1.3 Site visits were carried out between 9 January 2018 and 12 January 2018.
- 1.1.4 The site locations identified for the air quality barriers were:
- A38, Tideford, Gloucestershire, PL12 5JN
 - A35, Chideock, Dorset, DT6 6JR
 - A1, Sandy, Bedfordshire, SG19 1BT
- 1.1.5 The purpose of the site visit was to carry out physical measurements at each of the three areas visited. Based upon the collected data the site was assessed and a recommendation to Highways England whether a proposal to install environmental barriers at the roadside of each of the three sites is a feasible option to help keep the air quality levels in the area at an acceptable level.
- 1.1.6 The site visit included carrying out footway measurements (footway width, kerb height), gather other geographical information about the areas including gradient (slope) of the land, as well as recording data with regards to the number of man-made features in the area including overhead power lines, water drainage systems, lighting columns etc. The survey also makes a note of any local small businesses that may be affected by the proposals.
- 1.1.7 The site visits concluded that provision of a large air quality barrier at each location is not feasible due to the limited space available between the highway and the properties requiring protection. The main issues are identified in the report.
- 1.1.8 However this assumption is based upon a concept barrier solution, and therefore it is currently unknown if this type of system would be suitable in the space available. It is recommended that further investigation is carried out once full details are available.

2 Introduction

2.1 Overview

- 2.1.1 In the UK, exposure to outdoor air pollution is estimated to contribute to 40,000 deaths and cost the economy around £20 billion every year (Royal College of Physicians, 2016). Whilst there has been an aspiration to improve air quality over the past several decades, pollutant concentrations still exceed public health standards in many urban areas. The UK is currently failing to meet the EU Directive for ambient air quality, due to exceedances of the nitrogen dioxide (NO₂) limit value. There are also widespread areas of the UK which fail to meet National Air Quality Strategy Objectives for NO₂ and in a few cases, particulate matter less than 10 micrometers aerodynamic diameter (PM₁₀). Both these pollutants are strongly associated with road traffic emissions, for example 78% of NO₂ alongside the UK motorway network is estimated to originate from road traffic sources (Highways England, 2017).
- 2.1.2 In the Road Investment Strategy, government committed £100 million to improve air quality, on and around the strategic road network, through to 2021. Under this initiative, Arcadis has been commissioned by Highways England to undertake a review into the use of barriers as a mechanism of improving roadside air quality with a particular focus on NO₂.

2.2 Air Quality Regulations

- 2.2.1 In order to give context to the magnitude of air quality effects reported for green infrastructure, it is important to understand existing national and EU air quality regulations.
- 2.2.2 The ambient air quality standards and objectives are given statutory backing in England through the Air Quality (England) Regulations 2000, the Air Quality (England) (Amendment) Regulations 2002. The Air Quality (Standards) Regulations 2010 transpose into English law the requirements of Directives 2008/50/EC on ambient air quality. The Air Quality Strategy (AQS) objectives/EU Limit Values for the protection of human health for NO₂ and PM₁₀ are presented in Table 2-1. AQS objectives are not mandatory, but local authorities are required to work towards achieving them in order to meet mandatory EU limit values.

Table 2-1: Air Quality Strategy Objectives and EU Limit Values for Human Health

Pollutant	Concentration	Averaging Period	AQS Compliance Date	EU Compliance Date
NO ₂	200 µg.m ⁻³	1-hour mean (not to be exceeded more than 18 times per year)	31 December 2005	1 January 2010
	40 µg.m ⁻³	annual mean	31 December 2005	1 January 2010
PM ₁₀	50 µg.m ⁻³	24-hour mean (not to be exceeded more than 35 times per year)	31 December 2010	1 January 2005
	40 µg.m ⁻³	annual mean	31 December 2004	1 January 2005

2.3 Air quality barrier systems

- 2.3.1 The purpose of this report is to investigate the feasibility of installing a 4m to 6m high vertical air quality barrier alongside the trunk road network at identified locations throughout the Highways England Network to address air quality issues.



- 2.3.2 The example barrier shown above consists of a Concrete barrier type base with clear Perspex panels attached by steel uprights as shown in the illustrative photograph above.
- 2.3.3 The example environmental barrier is currently a conceptual system that is anticipated to provide benefits to sites by helping the area to meet the annual mean air quality objectives set out by government policy. The barriers are designed to help reduce the NO₂ levels to an acceptable prescribed level. The areas surveyed in this report have been identified as exceeding the recommended air quality levels.
- 2.3.4 There are currently other systems on the market being promoted by manufacturers, *SmogStop Barrier^(tm)* by Gramm Barrier Systems for example achieves this using patented technology solutions. However, these systems require either substantial setback compared to the example barrier, a separate VRS system or alternate protection from vehicles and therefore not appropriate for the areas identified in this report.

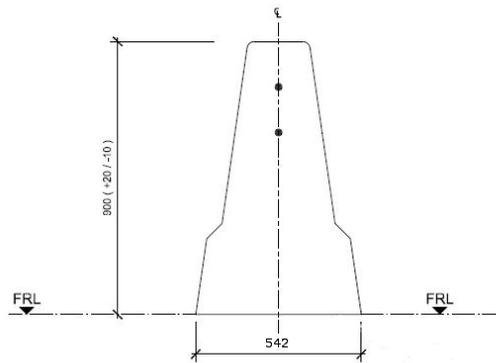
2.4 Design Assumptions

- 2.4.1 Given the limited space between the edge of carriage way and properties available on these 3 sites identified, the proposed air quality barrier system would be required to have the ability to be installed with minimal setback from the carriageway and therefore would be required to be an impact resistant system (complying to TD 19/06), and still provide the environmental benefits sought.

2.5 Design properties of the CSB element of the barrier

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- 2.5.1 The concept system consists of a Concrete Safety Barrier (CSB) style barrier, which is in itself a self-supporting Vehicle Restraint system, however this would also be required to accommodate the proposed uprights supporting the environmental panels.
- 2.5.2 It is anticipated that an additional piled foundation solution would be required to cope with the additional wind loading. Consideration of existing buried apparatus along the footpaths will need to be considered and would potentially require diversions.
- 2.5.3 The CSB barrier has an overall width of 542mm and a height of 900mm.



Typical Section

Figure 1.1 Typical CSB dimensions.

- 2.5.4 Based upon a CSB type system, this is a compliant Vehicle Restraint System that requires space behind the barrier in the event of being hit and is known as the working width. The working width of a CSB system alone is between 600mm to 800mm behind the foot of the barrier. Therefore, the minimum total area required to accommodate the deflection of a CSB type system would normally be between 1.142m and 1.342m. However, with the inclusion of the panels and the CSB requiring a piled foundation solution for stability, the anticipated working width of the CSB would be reduced to zero.

2.6 Design properties of the panels element of the barrier

- 2.5.5 The panels are fixed to the CSB using steel columns at 1m ctrs and would be between 4m to 6m high.
- 2.5.6 It is currently unknown how the panels would react if struck by high sided vehicles, for the purpose of this report it is assumed that the intrusion zone of the panels would be greater than 4m. Therefore, requiring an area behind the barrier greater than 4m between the edge of highway and properties of interest.
- 2.5.7 The concept barrier shown has a Perspex type construction, and currently it is unknown as to how this material would react as a result of vehicle impact. This would have to be taken into consideration once further information is available on this system and the potential risk to pedestrians behind the barrier.
- 2.5.8 Any system located in such close proximity to the highway would be required to be tested in accordance with BS EN 1317 to demonstrate its suitability on the Highways England network.

3 Site Surveys

3.1 A38 Tideford

3.1.1 The A38 Tideford site is located in the south west of the UK in the county of Cornwall. The site is identified as located on the Network Management Map within Area 1 & 2 and is currently managed by South West Asset Delivery on behalf of Highways England as an Asset Delivery Contract (ADC).



Figure 3.1 – Tideford Location map



Figure 3.2 – A38 Tideford Proposed air quality barrier locations

- 3.1.2 There are approximately 17 houses within the area, outlined in red in Figure 3.2 above, located at the roadside to the south of the A38 in Tideford. Air quality monitoring at this location indicates that the annual mean air quality objective of $40\mu\text{g}/\text{m}^3$ is being exceeded. In order to address the air quality at these properties air quality mitigation measures are to be considered.
- 3.1.3 Traffic data provided by highways England webtris are as follows:-
- Eastbound: 12,736 AADT (7.0% >6,6m)
 - Westbound: 12,387 AADT (6.5% > 6.6m)
- 3.1.4 None of these properties are listed, however there are some other listed properties within the village on the opposite side of the A38.
- 3.1.5 The A38 has a 40mph speed limit through Tideford Village.

3.2 Site visit

- 3.2.1 The site visit was carried out on 9 January 2018 at 10am.

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A38 Tideford footpath (East of Bridge Road looking East)



A38 Tideford footpath (West of Bridge Road looking West)



Uncontrolled Pedestrian Crossing Facility

- 3.2.2 Footway measurements were taken at regular intervals along the section of the road in front of the houses identified in figure 2.2. These measurements included: footway widths and kerb height levels, gradient (slope of the land), noting any overhead power lines, drainage gullies and any affected local businesses (See Appendix A).
- 3.2.3 Footpath width measurements ranged from 1m to 2.35m. Additional hardened areas are evident along the back of the footway varying between 0.25m to 1m wide. These are assumed to be private and not part of Highway land. However, they do provide additional setback from the carriageway edge.
- 3.2.4 The footway falls towards the carriageway throughout the area of interest and the highway is drained by traditional gullies positioned along the kerb line at carriageway level.
- 3.2.5 There is an existing uncontrolled pedestrian crossing facility within the area of interest which would impact on the installation of any proposed barrier system. If the crossing facility is maintained there would be a visibility/awareness issue for both pedestrians and drivers.
- 3.2.6 There are existing telegraph poles positioned at the back of the footway in a couple of locations along with overhead telephone cables connected to local properties. These would need to be taken into consideration and would impact on the height of the proposed barrier system.
- 3.2.7 Some manhole covers are also present along the footpaths and it is anticipated these would clash with the proposed barrier system. Diversions of statutory undertakers equipment would be required to allow a maintainable access to their apparatus.
- 3.2.8 At the most northerly section of the area the footway drops down below the level of the highway to facilitate access to properties along with a 30m length of pedestrian handrail installed adjacent to the kerb line.



- 3.2.9 This arrangement will not facilitate the proposed barrier system to be installed without substantial changes to the current layout.
- 3.2.10 The site is divided into 2 sections with a cross road arrangement. The A38 is the priority route with give way arrangements for existing vehicles onto the A38. There is a central island formed by road markings for right turning vehicles from the A38 into both side roads. The main interaction for this site is Bridge road.

3.3 Findings

- 3.3.1 There is insufficient space between the front of the houses and the edge of the A38 carriageway for the majority of the length of footway to install and maintain an Air Quality Barrier whilst providing sufficient pedestrian access. It was noted that residents do park vehicles along the footpath, whilst this may not be a permitted action, it is considered that the proposals would cause issues with residents gaining access to properties with their vehicles.
- 3.3.2 The junction with Bridge Road was found to be very busy during the site visit, and it is considered that a large air quality barrier would interfere with visibility splays required for vehicles entering the A38 carriageway from Bridge Road and awareness of sideroad traffic to vehicles on the mainline carriageway. It is considered that there would be a risk of increased accidents in this location.
- 3.3.3 It would be anticipated that departures from standard for visibility would be required if a proposed barrier was to proceed to installation at this location.

3.4 A35 Chideock

3.4.1 The A35 Chideock site is located in the south west of the UK in the county of Cornwall. The site is identified as located on the Network Management Map within Area 1 & 2 and is currently managed by Connect A30/A45 Ltd on behalf of Highways England as DBFO Contract.



Figure 3.3 – Chideock Location map

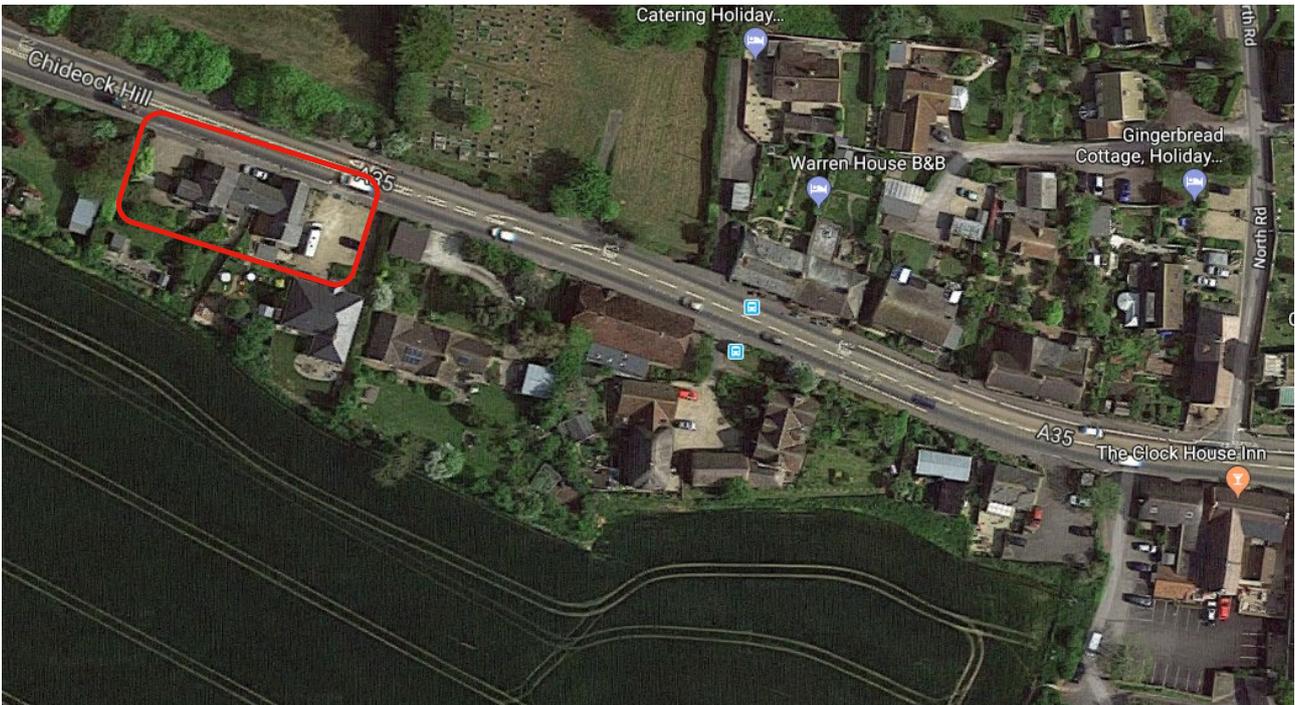


Figure 3.4 – A35 Chideock Proposed air quality barrier location

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- 3.4.2 There are approximately 3 houses, outlined in red in the figure 3.4, located at the roadside to the south of the A35 in Chideock. Air quality monitoring at this location indicates that the annual mean air quality objective of $40\mu\text{g}/\text{m}^3$ is being exceeded. This is likely due to their proximity to the roadside and the incline of the road. In order to address the air quality at these properties air quality mitigation measures are to be considered.
- 3.4.3 Traffic data provided by highways England webtris are as follows:
- Eastbound: 6,674 AADT (6.9% >6.6m)
 - Westbound: 6,612 AADT (6.9% > 6.6m)
- 3.4.4 None of these properties are listed, however there are some other listed properties within the village on the opposite side of the A35. The properties also lie to the west of a Conservation Area designated by West Dorset District Council, and is noted within the West Dorset, Weymouth and Portland Local Plan 2015.
- 3.4.5 The A35 has a 30mph speed limit through Chideock village.

3.5 Site Visit

- 3.5.1 A site visit was carried out on 11 January 2018.



A35 Chideock footpath looking Westbound



A35 Chideock footpath looking Eastbound

- 3.5.2 Footway measurements were taken at regular intervals along the section of the road in front of the houses identified in figure 3.2. These measurements included: footway widths and kerb height levels, gradient (slope of the land), noting any overhead power lines, drainage gullies and any affected local businesses (See Appendix B).
- 3.5.3 Footpath width measurements range from 1.45m to 1.7m. Additional hardened areas are evident along the back of the footway varying between 0.65m to 2.1m wide. These are assumed to be private and not part of Highway land. However, they do provide additional setback from the carriageway edge to the properties.
- 3.5.4 The footway along the area of interest has sections falling towards the carriageway and also sections where the footway falls towards the properties, it is unknown if there are issues with highway drainage fouling private land.
- 3.5.5 The highway is drained by traditional gullies positioned along the kerb line at carriageway level. There appears to be issues with regards to drainage along a section of dropped kerbs for a residential vehicular access as there is an ACO style drainage system installed along this section.



- 3.5.6 As well as traditional gullies along the kerb line, there are also side inlet gullies present, however it is not known if these are redundant and have been replaced by the traditional gullies and so further investigations would be required.
- 3.5.7 There are existing telegraph poles positioned at the back of the footway in a couple of locations along with overhead cables (BT and Overhead Power) connected to local properties. These would need to be taken into consideration and would impact on the height of the proposed barrier system.

3.6 Findings

- 3.6.1 There is insufficient space between the front of the houses and the edge of the A35 carriageway for the majority of the footway in Chideock to install and maintain an Air Quality Barrier whilst maintaining sufficient pedestrian access. If the side inlet gullies are still used, this would increase the setback of a barrier system to maintain access to them.
- 3.6.2 It is considered that a large air quality barrier would also interfere with visibility splays required for vehicles exiting the residential driveways along the area and reduce awareness of emerging vehicles to traffic on the mainline carriageway. This would have a potential to increase accidents in relation to this.
- 3.6.3 The potential impact on the Chideock Conservation Area would need to be considered to protect the integrity and character of this area.

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3.7 A1 Sandy

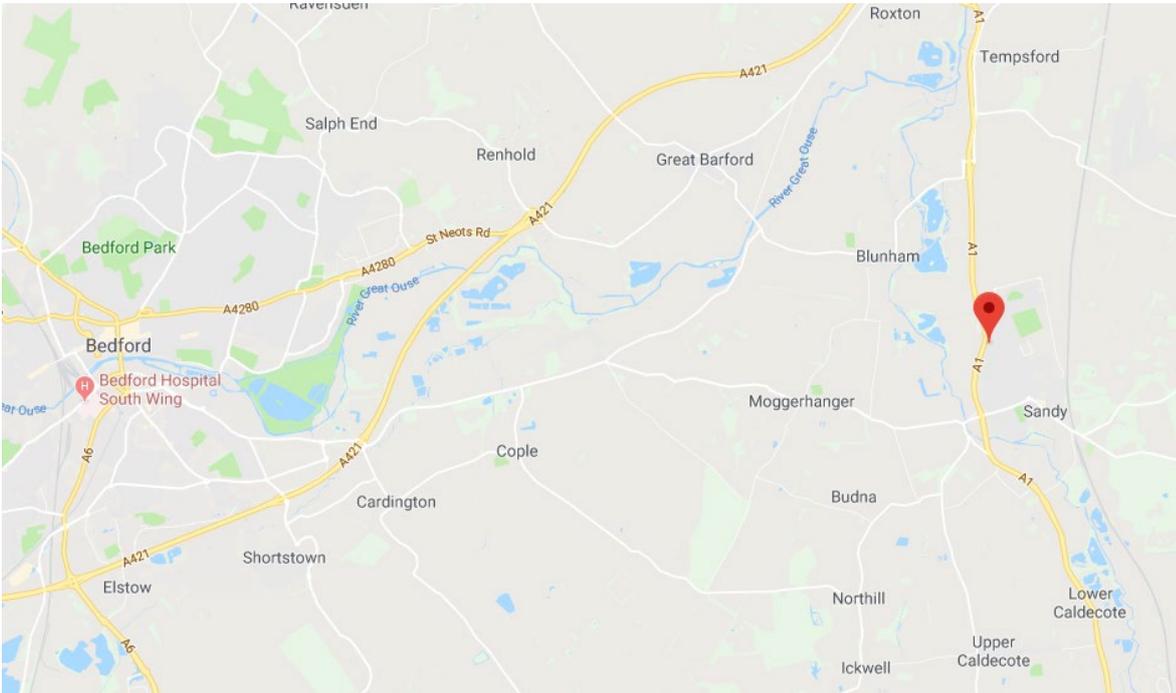


Figure 4.1 – A1 Sandy Location map

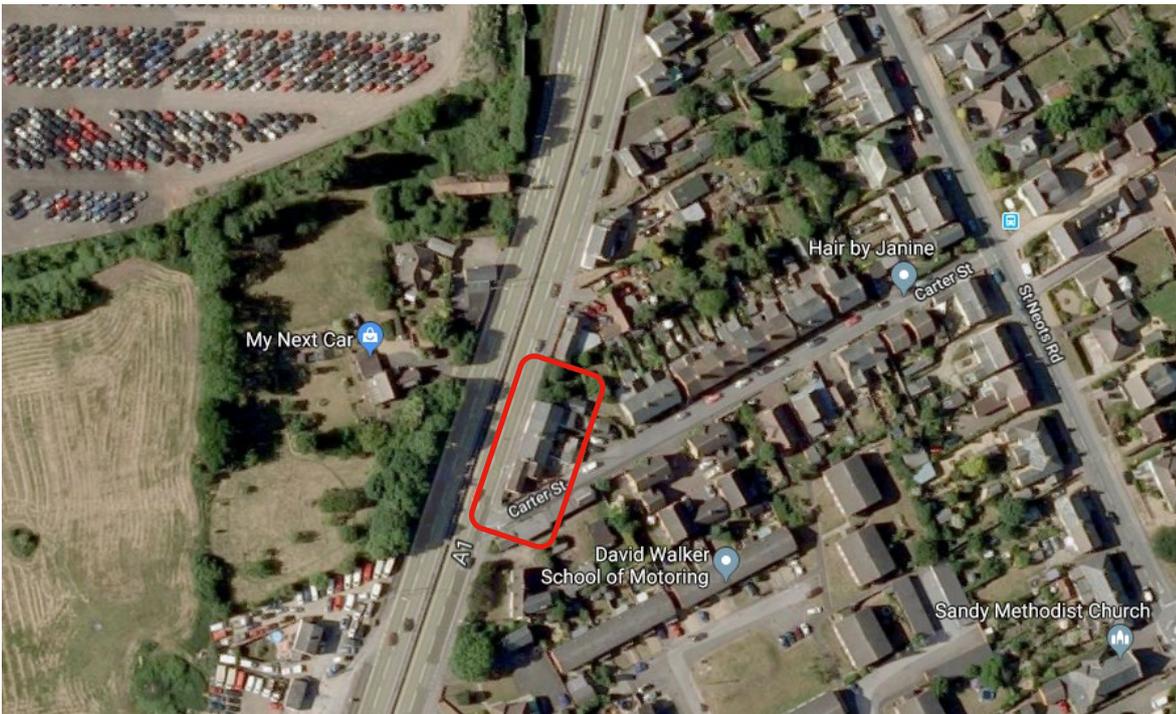


Figure 4.2 – A1 Sandy Proposed air quality barrier location

3.7.1 There are approximately 4 properties, outlined in red in the images above, located at the roadside to the south of the A1 in Sandy, Bedfordshire. Air quality monitoring at this location indicates that the annual mean air quality objective of $40\mu\text{g}/\text{m}^3$ is being exceeded. This is likely due to their proximity to

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the roadside and the incline of the road. In order to address the air quality at these properties, air quality mitigation measures are to be considered.

3.7.2 Traffic data provided by highways England webtris are as follows:

- Northbound: 21,894 AADT (9.9% >6,6m)
- Southbound: 17,472 AADT (11.7% > 6.6m)

3.7.3 None of the properties are listed.

3.7.4 The A1 has a 50mph speed limit at this location.

3.8 Site Visit

3.8.1 A site visit was carried out on the 12 January 2018.



A1 Sandy Footpath Looking South



A1 Sandy Footpath Looking North

- 3.8.2 Footway measurements were taken at regular intervals along the section of the road in front of the houses identified in Figure 4.2. These measurements included: footway widths and kerb height levels, gradient (slope of the land), noting any overhead power lines, drainage gullies and any affected local businesses (See Appendix C).
- 3.8.3 Footpath width measurements range from 1.65m to 1.85m. There are no additional hardened areas along the back of the footway providing additional setback from the carriageway edge to the properties.
- 3.8.4 The footway falls towards the carriageway throughout the area of interest and the highway is drained by traditional gullies positioned along the kerb line at carriageway level.
- 3.8.5 At the southern end of the area of interest is a sideroad, Carter Street with access from and onto the A1.



Carter Street junction with the A1.

3.8.6 There are existing lighting columns in the area of interest which would need to be taken into consideration and may impact on the height of the proposed barrier system.

3.9 Findings

3.9.1 There is insufficient space between the houses and the edge of the A1 carriageway for all of the footway in Sandy to install and maintain an Air Quality Barrier whilst maintaining sufficient pedestrian access.

3.9.2 The junction with Carter Road is a local residential access off the A1 carriageway with no acceleration/deceleration lanes. It is considered that a large air quality barrier would interfere with visibility splays required for vehicles entering the A1 carriageway from Carter Road and also awareness of sideroad traffic to vehicles on the mainline carriageway. It is considered that there would be a risk of increased accidents in this location.

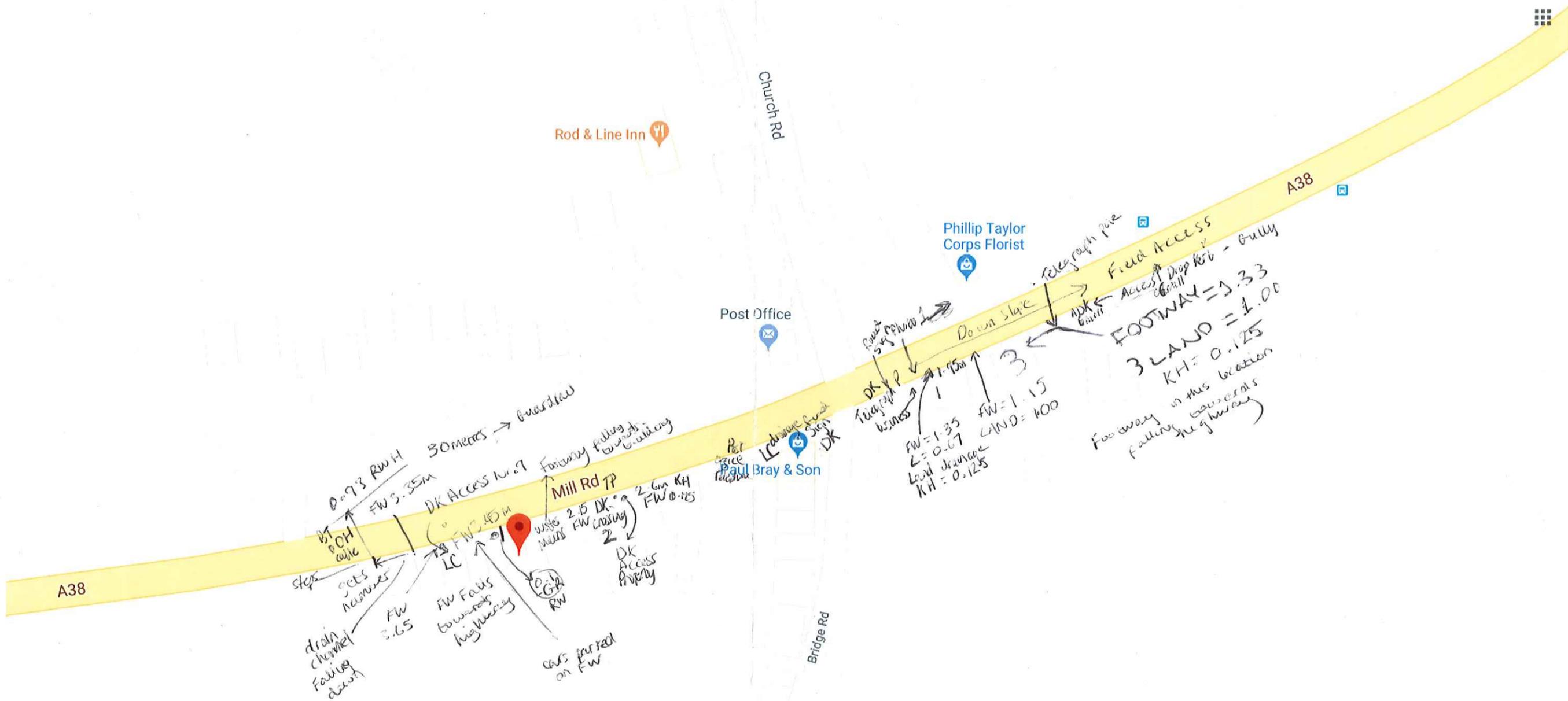
3.9.3 It would be anticipated that departures from standard for visibility would be required if the proposed barrier was installed at this location.

4 Conclusion

- 4.1.1 Based upon the site visits and dimensions taken following the surveys at the 3 locations, none have sufficient space to install a combined barrier and environmental system based on the current level of information available, and still maintain a suitable pedestrian footpath outside the safe zone of the proposed system and/or maintain adequate access to properties.
- 4.1.2 We therefore conclude that none of the identified sites are suitable for this type of environmental system based upon the data available and would recommend further investigation into the types of systems available and how they would be installed in constrained locations.

Appendix A - A38 Tideford Survey Notes

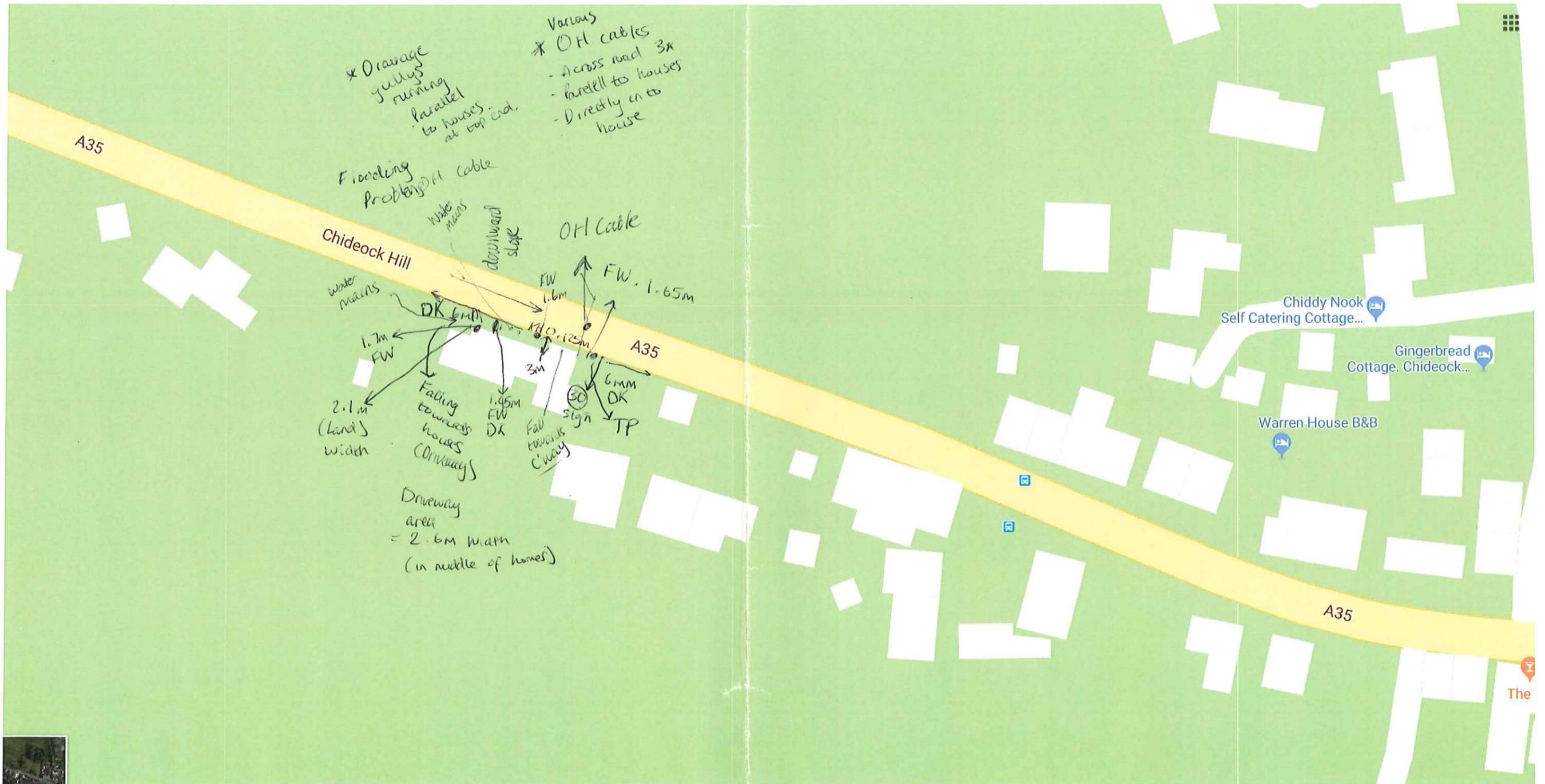
Barrier Feasibility Site Plan: A38, Tideford, Cornwall



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Appendix B - A35 Chideock Survey Notes

Barrier Feasibility Site Plan: A35, Chideock, Dorset



Appendix C - A1 Sandy Survey Notes

