APPENDIX A - DRAFT

Maidstone Borough Council

Green Infrastructure Mitigation – Phase 1 Feasibility Study

Upper Stone Street, Maidstone

Project No. 443847/FS01 (00)

AUGUST 2020

RSK

APPENDIX A - DRAFT

RSK GENERAL NOTES

Project No.:	443847/FS01 (00)
Title:	Green Infrastructure Mitigation Feasibility Study - Upper Stone Street, Maidstone
Client:	Maidstone Borough Council
Date:	4th August 2020
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Signature		Signature	
Date:	3rd August 2020	Date:	4th August 2020

CONTENTS

1 INTRODUCTION

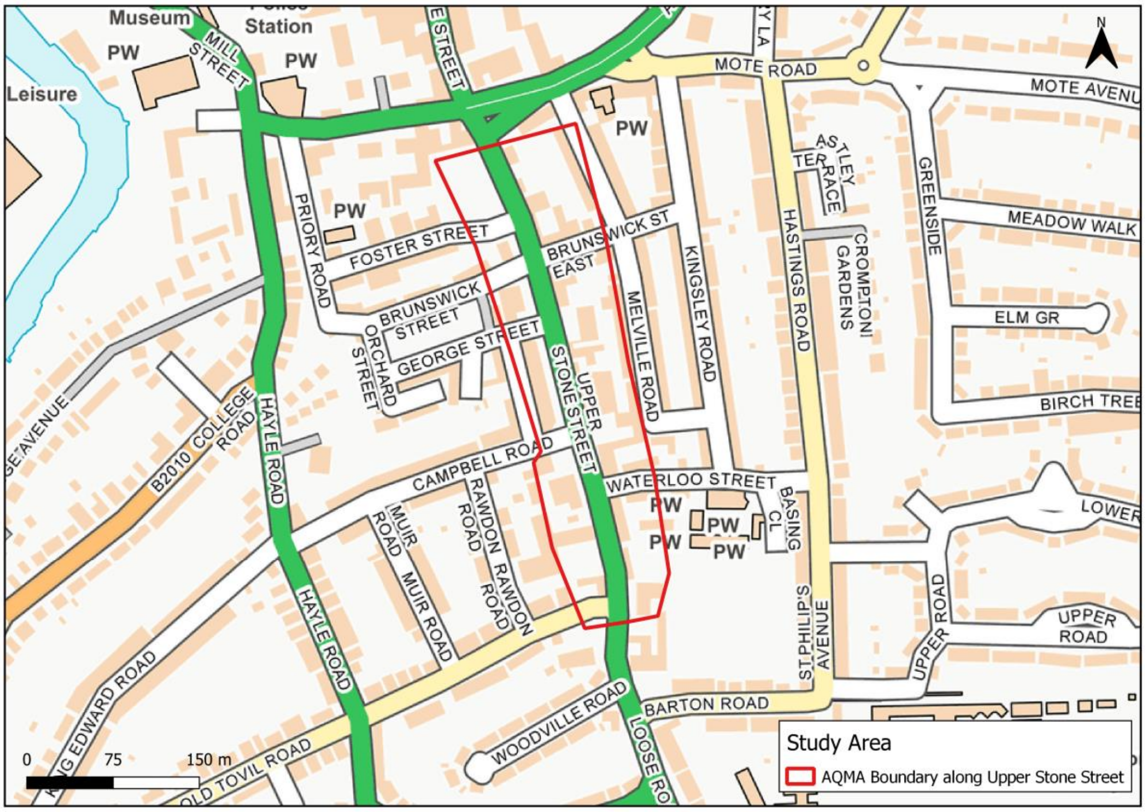
1.1 Background

RSK Environment Limited (RSK) was commissioned by Maidstone Borough Council (MBC) to undertake a Feasibility Study (FS), to identify how Green Infrastructure (GI) could help to reduce nitrogen dioxide (NO_2) concentrations at the Upper Stone Street, Maidstone.

The Upper Stone Street is a street in Maidstone and measures approximately 463 metres long. The approximate grid reference for the centre of Upper Stone Street is 576348, 155162. The study area (i.e. the Upper Stone Street) is shown in **Figure 1.1**.

The Upper Stone Street is a one way street with two lanes, which runs roughly north to south. Upper Stone Street has a steep uphill gradient (the average slope is approximately 6.7%[1]). Along the Upper Stone Street, there are buildings located on either side of the road, some of which form as street canyons along the street. It is also noted that vehicles traveling along Upper Stone Street could be parked on the double yellow lines for pickups/drop offs, which could cause traffic congestion.

Figure 1.1: Study Area



[1] Measured using Google Earth Pro

1.2 Purpose and Scope

Following consultation with MBC and a review of the local air quality, it is understood that the major concern with regards to air quality in Maidstone is the exceedance of the annual mean NO_2 objective, and Upper Stone Street is the main area of concern.

Air quality monitoring undertaken in Upper Stone Street and relevant modelling studies suggest that annual mean NO_2 concentrations along Upper Stone Street are above 60 $\mu g/m^3$ and therefore there is a risk of exceedances of the 1-hour mean NO_2 objective along this road. It is also noted that, a new MBC Air Quality Action Plan was introduced in 2017. The relevant air quality modelling assessment undertaken for the Air Quality Action Plan suggested that the annual mean NO_2 objective would not be met in Upper Stone Street till 2028.

Therefore, lowering the annual mean NO_2 along Upper Stone Street will be the focus and primary target for the GI mitigation scheme. The following scope has been adopted in this study:

- Literature research regarding GI mitigation.
- Detailed review of baseline air quality;
- Review of existing GI and local meteorological;
- Identify the potential impact of existing GI on air quality; and
- Recommendation of GI mitigation scheme.

2 LEGISLATION AND POLICY CONTEXT

2.1 Air Quality Strategy

UK air quality policy is published under the umbrella of the Environment Act 1995, Part IV and specifically Section 80, the National Air Quality Strategy. The latest *Air Quality Strategy for England, Scotland, Wales and Northern Ireland – Working Together for Clean Air*, published in July 2007 sets air quality standards and objectives for ten key air pollutants to be achieved between 2003 and 2020.

The Air Quality Framework Directive (1996) established a framework under which the European Commission (EC) could set limit or target values for specified pollutants. The directive identified several pollutants for which limit or target values have been, or will be set in subsequent 'daughter directives'. The framework and daughter directives were consolidated by Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe, which retains the existing air quality standards and introduces new objectives for fine particulates ($PM_{2.5}$).

2.2 Ambient Air Quality Standards

The ambient air quality standards (AQSs) in the United Kingdom are derived from European Commission (EC) Directives and are adopted into English law via the Air Quality (England) Regulations 2000, Air Quality (England) Amendment Regulations 2002, The Air Quality Limit Values Regulations 2003 and Air Quality Standards Regulations 2010. These criteria have been used within this assessment as appropriate.

The relevant[2] Air Quality Objectives (AQOs) and AQSs derived from the National Air Quality Strategy (NAQS) for England and Wales (and where they differ, AQSs derived from the Air Quality Standards Regulations 2010) are summarised in **Table 2.1**.

Table 2.1: Relevant Air Quality Objectives

Substance	Averaging period	Exceedances allowed per year	Ground level concentration limit ($\mu g/m^3$)
Nitrogen dioxide (NO_2)	1 calendar year	-	40
	1 hour	18	200
Fine particles (PM_{10})	1 calendar year	-	40
	24 hours	35	50
Fine particles ($PM_{2.5}$)	1 year	-	25

[2] Relevance, in this case, is defined by the scope of the assessment.

2.3 The Environment Act

The set AQS objectives are to be used in the review and assessment of air quality by local authorities under Section 82 of the Environment Act (1995). If exceedances are measured or predicted through the review and assessment process, the local authority must declare an Air Quality Management Area (AQMA) under Section 83 of the Act and produce an Air Quality Action Plan (AQAP) to outline how air quality is to be improved.

3 BASELINE REVIEW

3.1 Baseline Air Quality Characterisation

Existing or baseline air quality refers to the concentrations of relevant substances that are already present in ambient air. These substances are emitted by various sources, including road traffic, industrial, domestic, agricultural and natural sources.

A desk-based study was undertaken including a review of monitoring data available from MBC and estimated background data from the Local Air Quality Management (LAQM) Support website operated by the Department for Environment, Food and Rural Affairs (Defra).

3.1.1 Local Authority Review and Assessment of Air Quality

Following a review of MBC's draft 2020 Air Quality Annual Status Report, it is noted that there are currently two automatic monitoring stations, and 74 NO_2 diffusion tube monitoring sites in operation in 2019. The annual average NO_2 concentrations at all monitoring sites within the study area are presented in **Table 3.1**. The locations of these monitoring sites are shown in **Figure 3.1**. Among them, CM3, Maid 122-124 and Maid 128 were started in 2018, therefore, only 2018 and 2019 monitoring data is available for these locations. It is noted that 2016-2019 NO_2 monitoring data shows exceedance of the annual mean NO_2 objective at all monitoring locations within Upper Stone Street, apart from Maid124. When comparing the monitoring data between 2016 and 2019, it is noted that annual mean NO_2 concentrations at Maid 81 and Maid 92 showed a continuous improvement during 2016-2019, and the remaining locations (i.e. Maid 122-124, Maid 128 and CM3) showed a general improvement in 2019 compared to 2018.

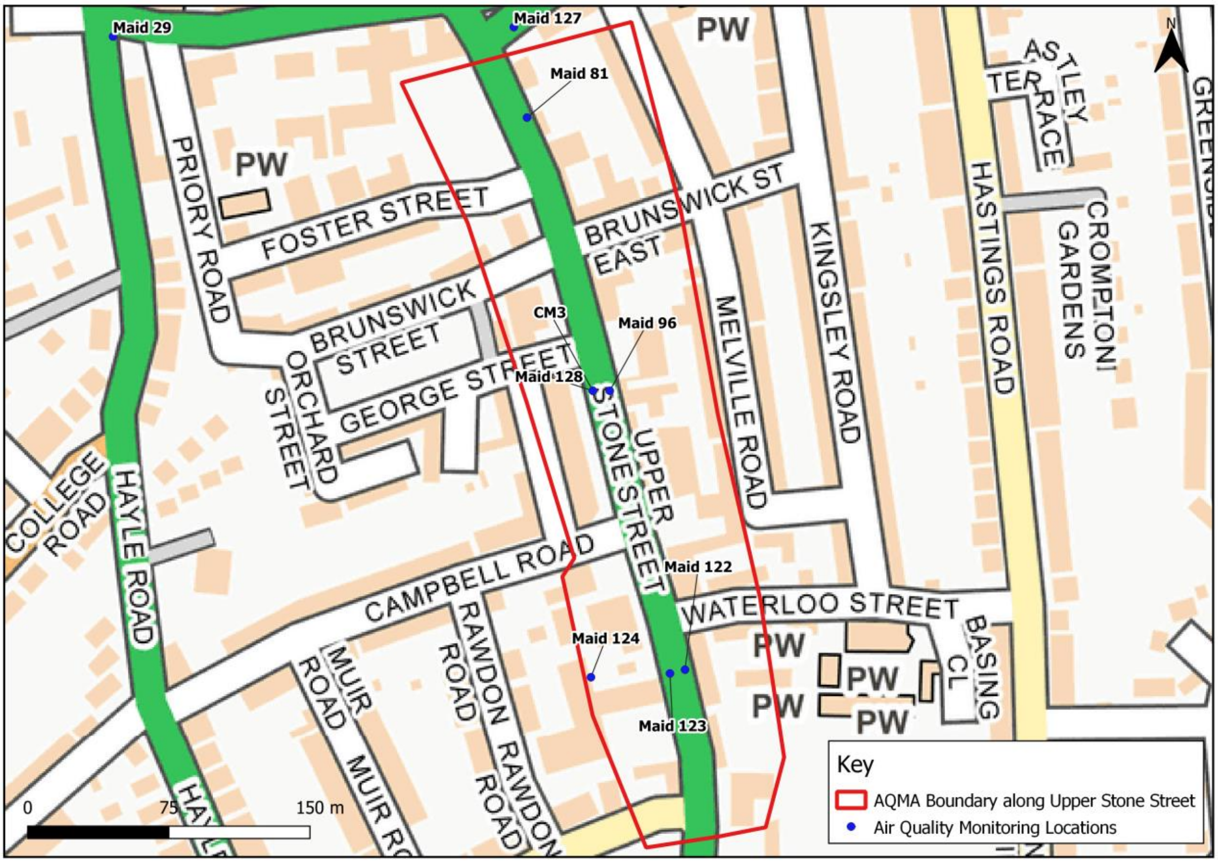
Table 3.1: Annual Mean NO_2 Concentrations for 2016-2018

Site ID	Site Name	Grid (x,y)	Site Type*	Annual Mean NO_2 Concentrations (µg/m^3)			
				2016	2017	2018	2019
CM3	Grass verge outside former Jubilee Church building	(576337, 155183)	Roadside	-	-	**70[(a)]**	**68**
Maid 81	The Pilot PH	(576302, 155328)	Roadside	**71.26**	**67.7**	**67.3**	**60.2**
Maid 96	Lamppost KUBT 512 in bracket for "One Way" sign outside Lashings Sports Club (opposite grassy area) Upper Stone St	(576346, 155183)	Roadside	**83.84**	**79.3**	**77.2**	**75.2**
Maid 122	Loading sign to the right of the front of the Papermakers Arms PH	(576386, 155035)	Roadside	-	-	**79.2**	**73.4**
Maid 123	Loading sign on opposite side of Upper Stone St to	(576378, 155033)	Roadside	-	-	**53.5**	**55.5**

Site ID	Site Name	Grid (x,y)	Site Type*	Annual Mean NO_2 Concentrations (μg/m³)			
				2016	2017	2018	2019
	Maid 122						
Maid 124	Fence pole at back of site for proposed development at 102 Upper Stone St (car wash site)	(576336, 155031)	Roadside	-	-	19.9	19.2
Maid 128.1	Site located in cage for air intake of new urban AQ station in Upper Stone Street	(576337, 155183)	Roadside	-	-	**67.7[(a)]**	**61.3**
Maid 128.2				-	-	**67.3[(a)]**	**61.7**
Maid 128.3				-	-	**68.1[(a)]**	**62.5**
Air Quality Strategy (AQS) Objective				40			

Results in **bold** indicate an exceedance of the AQS objective.
[(a)] Annualisation has been conducted by MBC where data capture is <75%
*Site type of the diffusion tubes are obtained from 2020 MBC Air Quality Annual Status Report.

Figure 3.2: Air Quality Monitoring Sites within Upper Stone Street



3.1.2 LAQM Background Data

Estimated background air quality data are available from the Local Air Quality Management (LAQM) website operated by the Department for Environment, Food &

Rural Affairs (Defra) (http://laqm.defra.gov.uk). The Defra LAQM website provides estimated annual average background concentrations of NO_2, PM_{10} and $PM_{2.5}$ on a 1km^2 grid basis with the latest maps using 2017 base year data and with data projected up to the year 2030. **Table 3.2** presents estimated annual average background NO_2, PM_{10} and $PM_{2.5}$ concentrations at Upper Stone Street.

Table 3.3: Defra LAQM Estimated Annual Average NO_2, PM_{10} and $PM_{2.5}$ Concentrations at Upper Stone Street (from 2017 base maps)

Year	Estimated Annual Average Background Pollutant Concentrations from the LAQM Support Website (µg/m^3)		
	NO_2	PM_{10}	$PM_{2.5}$
2017	17.75	16.77	11.61
2018	17.24	16.57	11.46
2019	16.72	16.38	11.31
2020	16.10	16.19	11.16
AQS Objectives	**40**	**40**	**25**

The estimated background concentrations at the study area are well below the relevant UK AQS objectives.

3.2 Existing Green Infrastructure

A site visit to the Upper Stone Street was undertaken in June 2020. It is noted that there is currently very limited green space along Upper Stone Street. The main green space is the grass verge and trees next to the CareCo Mobility Showroom and the SC Motor Factory store. **Figure 3.2** below shows the location and condition of the exiting GI.

Figure 3.2 Existing GI Along Upper Stone Street

4 GREEN INFRASTRUCTURE MITIGATION FEASIBILITY STUDY

As discussed in section 3, there is limited green space available along the Upper Stone Street, which will limit the scope of any planting scheme. Furthermore, following consultation with MBC, it is understood that premises along the road are mostly private, it will be therefore difficult to obtain permission to implement GI planting schemes on these premises. However, it is understood that the grass verge next to the CareCo Mobility Showroom and the SC Motor Factory store, is owned by Kent County Council, which could be considered and used for GI planting. Therefore, this feasibility study focuses on this section of the road and the potential GI mitigation scheme that could be implemented.

4.1 Valuation of the Existing GI and Potential Impact

GI mitigation could include trees, vegetation barriers (such as hedges), green walls, and green roofs. GI could be used in different built environment and it could have both positive and negative impacts on air quality at street level, depending on the urban and vegetation characteristics[3]. For example, recent research shows that the presence of trees could increase the pollution concentration in a street canyon[4], as trees can reduce the wind speed in a street canyon, resulting in reduced air exchange between the air above the roof and within the canyon and hence leading to accumulation of pollutants inside the street canyon[5].

When reviewing the characteristics of Upper Stone Street, it is noted that it is a narrow road with buildings on either side of the road. The tress that are located next to the CareCo Mobility Showroom is situated adjacent to the kerb and in summertime the tree canopy creates a narrow asymmetric street canyon with the building on the other site of the road. Therefore, the trees in this area will likely to worsen the air pollution rather than mitigate, as the tree canopy will reduce the wind speed in the canyon, slow down the dispersion of air pollutants and lead to pollutants accumulation within the canyon.

To investigate this further, a detailed review of monthly air quality monitoring data along this section of the road (i.e. the grass verge area) has been undertaken to compare the NO_2 concentrations in summertime (referred as the season May-September when trees have leaves and tree canopy exists) and wintertime (referred as the season October-

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[3] K.V. Abhijith, Prashant Kumar, John Gallagher, Aonghus McNabola, Richard Baldauf, Francesco Pilla, Brian Broderick, Silvana Di Sabatino, Beatrice Pulvirenti, 'Air pollution abatement performances of green infrastructure in open road and built-up street canyon environments – A review', *Atmospheric Environmen*t, 162 (2017), pp. 71-86

[4] Riccardo Buccolieri, Christof Gromke, Silvana Di Sabatino, Bodo Ruck, 'Aerodynamic effects of trees on pollutant concentration in street canyons', *Science of The Total Environment*, 407, no.19 (2009), pp. 5247-5256.

[5] Riccardo Buccolieri, Pietro Salizzoni, Lionel Soulhac, Valeria Garbero, Silvana Di Sabatino, 'The breathability of compact cities', *Urban Climate*, 13 (2015), pp. 73-93

April when trees lose leaves therefore no canopy exists). Data summary can be found in **Table 4.1** – **Table 4.3** as below. CM3 and Maid 128 were started in 2018, therefore a full year data was only available for 2019. As a result, only 2019 data has been considered for CM3 and Maid 128 in this study.

Following a review of the monitoring data in **Table 4.1** – **Table 4.3**, it is noted that Maid 96 monitored higher NO_2 concentrations than CM3 and Maid 128. Maid 96 is situated next to the left lane, while CM3 and Maid 128 are located next to the right lane. It is considered possible that the left lane may experience higher traffic flow volume than the right lane. As a result, Maid 96 may experience more traffic emissions than CM3 and Maid 128. Additionally, Maid 96 is located very close to the façade of the adjacent building, which would cause worse dispersion condition compared to open space at CM3 and Maid 128, and lead to accumulation of pollutants.

When looking into the seasonal mean, it is noted that Maid 96 monitored higher NO_2 concentrations in summertime during 2016-2019 (as shown in Appendix A), however, CM3 and Maid 128 monitored higher NO_2 concentrations in wintertime during 2019. As Maid 96, CM3 and Maid 128 are located in the same area, the same seasonal trend in monitored NO_2 concentrations is expected, however, the monitoring data from two sides of the road shows different seasonal trend.

To investigate this discrepancy in the seasonal trend, a review of the 2017-2019 windroses (as shown in **Appendix A**) for the EAST_MALLING meteorological station has been undertaken. It is noted that the prevailing wind direction is from the southwest. Therefore Maid 96 is located at the windward side of the canyon; CM3 and Maid 128 are located at the leeward side of the canyon. In summertime, the tree canopy will create a barrier along the street and will likely to slow down the wind speed and have a negative impact on dispersion. In wintertime, due to the absence of the tree canopy (much smaller number of leaves or no leaves), the street canyon effect is not expected to be significant in winter when compared to the summertime. That possibly explains the lower NO_2 concentrations measured at Maid 96 during wintertime. Therefore, it is considered likely that the seasonal trend identified at Maid 96 may be due to the tree canopy and street canyon effect on this section of the road. The aerodynamic effect appears to outweigh the filtering capacity of the trees. Furthermore, recent research shows that, trees in street canyons could cause an average increase of 20-96% in air pollutant concentrations, compared to those canyons without the trees[6]. Based on above, it is considered likely that the trees outside the CareCo Mobility Showroom are having a negative impact on NO_2 concentrations due to their close proximity to the kerb. It is proposed that the tress outside the CareCo Mobility Showroom are removed or relocated further away from the road.

[6] K.V. Abhijith, Prashant Kumar, John Gallagher, Aonghus McNabola, Richard Baldauf, Francesco Pilla, Brian Broderick, Silvana Di Sabatino, Beatrice Pulvirenti, 'Air pollution abatement performances of green infrastructure in open road and built-up street canyon environments – A review', *Atmospheric Environmen*t, 162 (2017), pp. 71-86

Table 4.1 Monthly and Seasonal Monitoring Data – Maid 96

Year	Diffusion Tube Maid 96 - Raw Monthly NO_2 Monitoring Data (µg/m^3)												Raw Seasonal Monitoring Data (µg/m^3)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Summer***	**Winter****
2016	-	108.3	110.4	116.8	124	117.8	96.2	93.5	128.5	117.4	106.4	48.2	112.0	101.3
2017	91.8	104.4	77.9	123	115.4	102	112.2	105.8	97.7	98.9	110.1	80.7	106.6	98.1
2018	88	114.9	89	99.6	117.8	108.1	108.9	95.7	91.2	119.9	99.6	85.9	104.3	99.6
2019	110.1	85.2	89.1	114.1	107.4	110.4	110.9	97.5	90.4	101.2	113.9	73.3	103.3	98.1

*Summer referred to as May-September in this study **Winter referred to as October -April in this study

Table 4.2 2019 Monthly and Seasonal Monitoring Data – CM3

Site ID	Automatic Monitoring Station CM3 - Raw Monthly Monitoring NO_2 Data (µg/m^3)												Raw Seasonal Monitoring Data (µg/m^3)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Summer***	**Winter****
CM3	68	76	56	70	63	56	56	63	59	72	93^	105^	59.4	77.1

*Summer referred as to May-September in this study **Winter to referred as October -April in this study

^Data should be treated with caution, as the monitor broke down on 18th December 2019, and it's likely that an analyser fault was developed in the later weeks of October 2019

Table 4.3 2019 Monthly and Seasonal Monitoring Data – Maid 128.1, 128.2 and 128.3

Site ID	Diffusion Tube Maid 128.1,128.2 and 128.3 - Raw Monthly Monitoring NO_2 Data (µg/m^3)												Raw Seasonal Monitoring Data (µg/m^3)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Summer***	**Winter****
Maid 128.1	84.3	85.8	-	79	72.3	81.4	85.7	88.8	76.9	74.7	85.9	83.8	81.0	82.3
Maid 128.2	84	74.3	-	88.9	78.6	80.9	83.5	85.2	77	82.2	82.6	87.2	81.0	83.2
Maid 128.3	86.7	83	-	88.7	78.1	81.9	83.7	88.2	74.9	78.2	86	86.6	81.4	84.9

*Summer referred to as May-September in this study **Winter referred to as October -April in this study

4.2 Proposed GI and Potential Impact

As discussed above, the aspect ratio (H/W) of the studied canyon is estimated to be 12m/9m=1.3. Recent research shows that, the aspect ratio is critical to determine the appropriate GI form for street canyons[7], which states that:

> "*In deep street canyons (H/W ⩾2), only green walls are recommended; in mid-depth street canyons (H/W 0.5–2), low-level vegetation (shrubs and low hedges) may also be implemented; and in shallow street canyons (H/W ⩽0.5), small and open-crowned trees may be additionally planted on the windward side of the canyon, spaced broadly apart.* "

Given that the aspect ratio of the study canyon is approximately 1.3, it is considered that low-level vegetation (shrubs and low hedges) could be implemented to reduce air pollution. It is proposed that low-level hedges could be planted along the edge of the grass verge. The use of low-level hedges could provide screening from road vehicle exhaust emissions and help to minimise the potential advise canyon effects on air pollutant dispersion along the road.

A research undertaken by Lancaster University & Centre of Ecology and Hydrology, named '*Trees and Sustainable Urban air Quality*' provides guidance of the potential impact of different tree species on air quality, which ranked tree species based on their effect on air quality. A summary is provided in Table 4.4 as below.

[7] Kumar, P., Abhijith, K. V. & Barwise, Y. Implementing Green Infrastructure for Air Pollution Abatement: General Recommendations for Management and Plant Species Selection (2019). <https://doi.org/10.6084/m9.figshare.8198261.v1.> [accessed 16 July 2020]

Table 4.4 Capacity of Different Tree Species on Air Quality Improvement

Category Based on The Capacity to Improve Air Quality		
Category 1 Trees that have the greatest capacity to improve air quality	Category 2 Trees that have a smaller capacity to improve air quality	Category 3 Trees that have the potential to worsen air quality
• Ash • Common Alder • Field Maple • Larch • Norway Maple • Scots Pine • Silver Birch	• Apple • **Cherry Laurel** • Common Elm • Common Lime • Elder • Grey Alder • Hawthorn • Hazel • Holly • Italian Alder • **Lawson Cypress** • **Leyland Cypress** • **Lilac** • Mountain Ash • Sycamore • Wild Cherry	• Crack Willow • English Oak • Goat Willow • Poplar • Red Oak • Sessile Oak • White Willow
Bold indicates species could be planted as hedge.		

Following a review of the tree species detailed as above, it is noted that none of the Category 1 species could be implemented as low-level hedge. Among Category 2 species, Cherry Laurel, Lawson Cypress, Leyland Cypress and Lilac could be planted as hedges.

Furthermore, recent research identified that small, stiff and complex leaves tend to be more effective than larger, less rigid and less complex leaves[8]. Lawson Cypress and Leyland Cypress have smaller, stiffer and more complex leaves compared to Cherry Laure and Lilac. Therefore, it is recommended that Lawson Cypress and Leyland Cypress are planted as hedge for air pollution mitigation.

It is recommended that Category 3 trees may not be used for air pollution mitigation purposes.

[8] Barwise, Y., Kumar, P. 'Designing vegetation barriers for urban air pollution abatement: a practical review for appropriate plant species selection'. *npj Clim Atmos Sci* 3, 12 (2020). <https://doi.org/10.1038/s41612-020-0115-3> [accessed 20 July 2020]

4.3 GI Implementation

As discussed above, it is proposed that the tress outside the CareCo Mobility Showroom (circled in **Figure 4.1** as below) may be removed or relocated further away from the road. It is proposed that hedges could be planted on the boundary of the grass verge, the proposed area is shown in **Figure 4.2** and **Figure 4.3** as below. Additionally, it is recommended that climbing plants such as ivy could be planted to create a green wall on the façade of the building used by Lashings Bar & Grill, if possible.

Currently, there were only a few studies examined the air pollution reduction potential of hedges in street canyons[9]. Some studies observed that hedges could reduce pollutant exposure by 24-61% at the footpath areas in street canyons[10,11,12], and green wall in a street canyon could reduce NO_2 concentration by up to 35%, PM_{10} concentration by up to 50%[13]. However, other studies reported that under certain scenarios, hedge could cause an increase in pollutant concentration in street canyons[14]. It has not been possible to determine how much the propose GI mitigation scheme could reduce NO_2 concentrations in the study area without detailed modelling work. It is recommended that a more detailed modelling assessment using ENVI-met software is undertaken to further investigate the potential impact of the proposed GI mitigation scheme and identify the appropriate height and width for the proposed hedges before the implementation of GI planting.

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[9] K.V. Abhijith, Prashant Kumar, John Gallagher, Aonghus McNabola, Richard Baldauf, Francesco Pilla, Brian Broderick, Silvana Di Sabatino, Beatrice Pulvirenti, 'Air pollution abatement performances of green infrastructure in open road and built-up street canyon environments – A review', *Atmospheric Environmen*t, 162 (2017), pp. 71-86

[10] Xiaoping Chen, Tingting Pei, Zhixiang Zhou, Mingjun Teng, Liang He, Man Luo, Xinxing Liu, 'Efficiency differences of roadside greenbelts with three configurations in removing coarse particles (PM10): A street scale investigation in Wuhan, China', *Urban Forestry & Urban Greening*, 14, no. 2 (2015), pp 354-360

[11] Christof Gromke, Nabaraj Jamarkattel, Bodo Ruck, 'Influence of roadside hedgerows on air quality in urban street canyons', *Atmospheric Environment*, 139 (2016), pp 75-86

[12] Xiao-Bing Li, Qing-Chang Lu, Si-Jia Lu, Hong-Di He, Zhong-Ren Peng, Ya Gao, Zhan-Yong Wang, 'The impacts of roadside vegetation barriers on the dispersion of gaseous traffic pollution in urban street canyons', *Urban Forestry & Urban Greening*, 17 (2016), pp 80-91

[13] Thomas A. M. Pugh, A. Robert MacKenzie, J. Duncan Whyatt, and C. Nicholas Hewitt, 'Effectiveness of Green Infrastructure for Improvement of Air Quality in Urban Street Canyons', *Environmental Science & Technology*, 46 (2012), pp 7692-7699

[14] Peter E.J. Vos, Bino Maiheu, Jean Vankerkom, Stijn Janssen, 'Improving local air quality in cities: To tree or not to tree?', Environmental Pollution, 183 (2013), pp 113-122

Figure 4.1 Existing Trees to be Removed

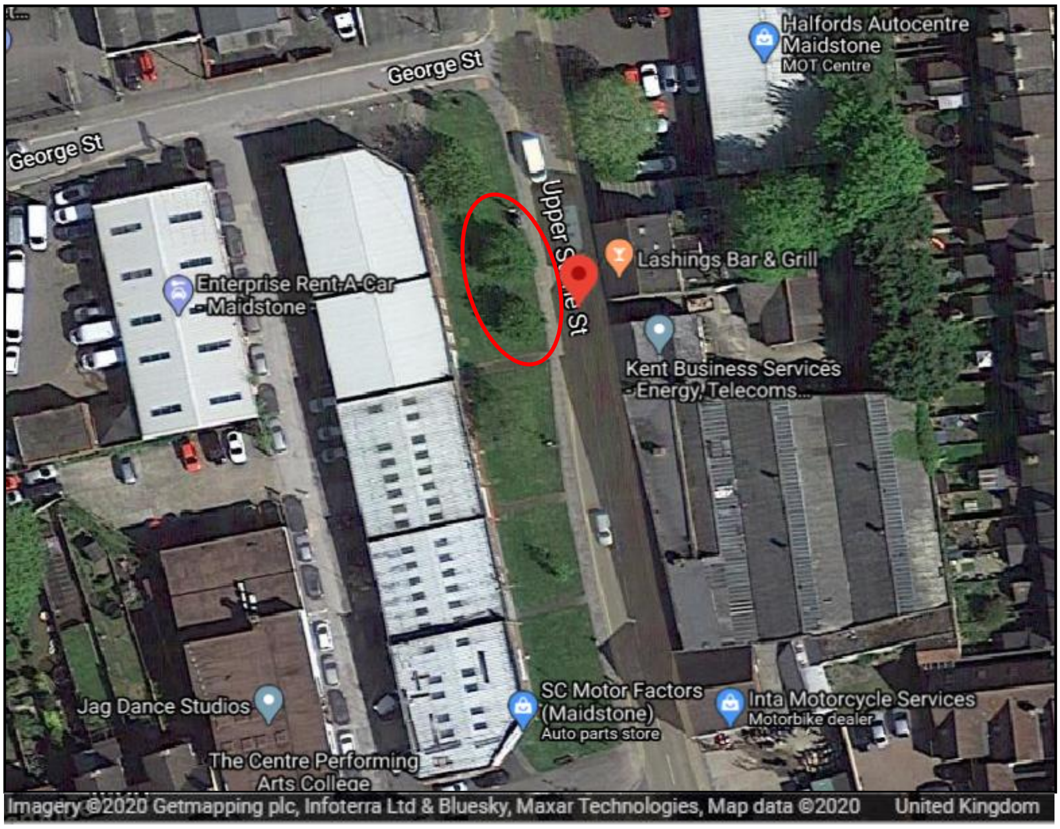


Figure 4.2 Proposed Hedge Location

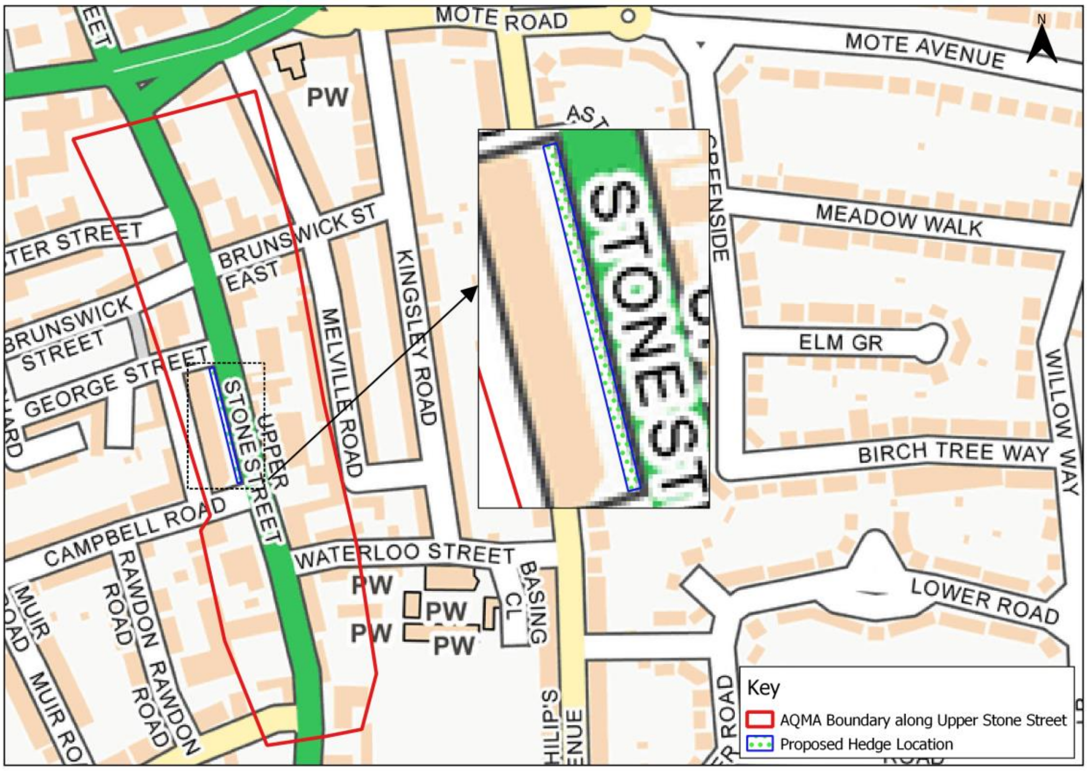


Figure 4.3 Proposed Hedge

Note: please do not scale, this figure is for illustrative purpose only

4.4 Limitations

- It should be noted that November and December monitoring data for CM3 should be treated with caution, as the monitor broke down on 18th December 2019, and it's likely that an analyser fault was developed in the later weeks of October 2019.
- As discussed in Section 4, CM3 and Maid 128 were started in 2018, therefore a full year data was only available for 2019. Due to the lack of multiyear monitoring data for CM3 and Maid 128, it was not possible to undertake further detailed review of the seasonal trend of NO_2 concentrations for CM3 and Maid 128.
- The tree species specified in Table 4.4 are based on research of trees in the West Midlands, which introduce a level of limitation with regards to the potential options for tree species section.
- The conclusion and recommendations made in this feasibility study are based on relevant research and a review of local air quality data and meteorological data. It is recommended that a more detailed modelling assessment using ENVI-met software is undertaken to further investigate the potential impact of the proposed GI mitigation scheme and identify the appropriate height and width for the proposed hedges before the implementation of GI planting.

5 CONCLUSION

RSK Environment Limited (RSK) was commissioned by Maidstone Borough Council (MBC) to undertake a Feasibility Study (FS), to identify how Green Infrastructure (GI) could help to reduce NO_2 concentrations at the Upper Stone Street, Maidstone.

A site visit to the Upper Stone Street was carried out in June 2020, it is noted that there is limited green space available along the Upper Stone Street, which will limit the scope of any planting scheme. Following consultation with MBC, it is understood that the grass verge next to the CareCo Mobility Showroom and the SC Motor Factosr store, is owned by Kent County Council, which could be considered and used for GI planting. Therefore, this feasibility study focuses on this section of the road and the potential GI mitigation scheme that could be implemented.

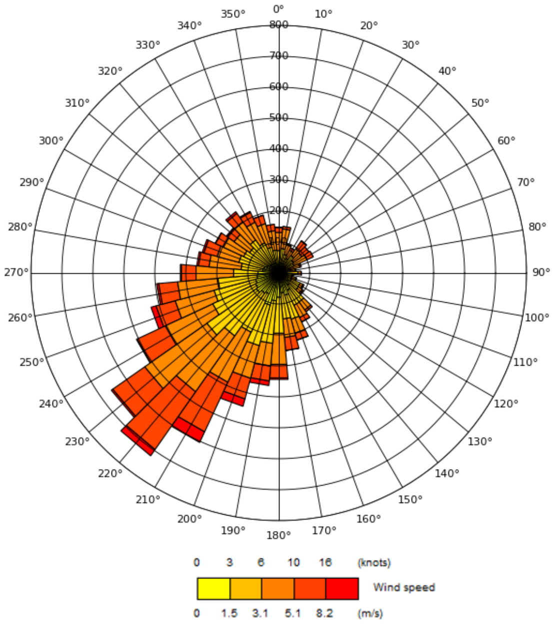
It is considered that, during summertime, the trees outside the CareCo Mobility Showroom create a narrow asymmetric street canyon with the building on the other site of the road. In addition, the tree canopy creates a barrier along the street and is likely to slow down the wind speed and have a negative impact on air pollutant dispersion within the canyon. Therefore, it is considered that the trees outside the CareCo Mobility Showroom are having a negative impact on NO_2 concentrations. As a result, it is recommended that the tress outside the CareCo Mobility Showroom (as shown in **Figure 4.1**) are removed or relocated further away from the road.

To further mitigate NO_2 concentrations in the study area, it is recommended that low-level Lawson Cypress hedge or Leyland Cypress hedge could be planted at the edge of the grass verge. The use of low-level hedges could provide screening from road vehicle exhaust emissions, and also help to minimise the potential advise canyon effects on air pollutant dispersion along the road.

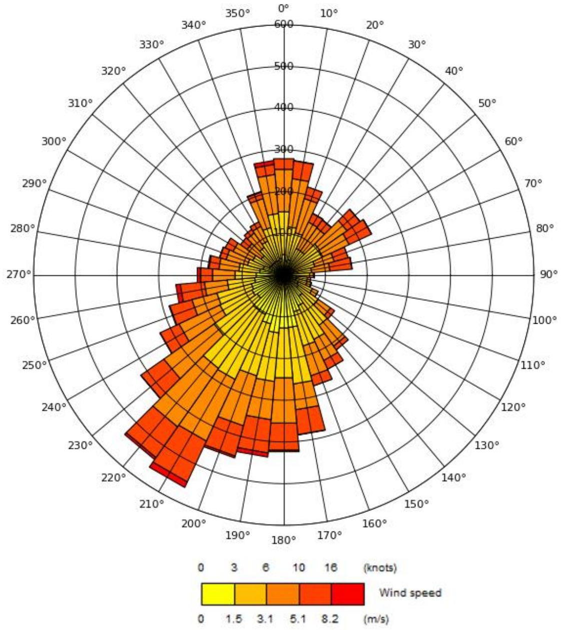
Without detailed modelling, it was not possible to determine how much the proposed GI mitigation scheme could help to improve air quality in quantitative terms. It is recommended that a more detailed modelling assessment using ENVI-met software is undertaken to further investigate the potential impact of the proposed GI mitigation scheme and identify the appropriate height and width for the proposed hedges before the implementation of GI planting.

APPENDIX A – WINDROSES (EAST MALLING STATION)

2017 Windrose



2018 Windrose



2019 Windrose