

M2 Junction 5 improvements scheme

Scheme Assessment Report



TABLE OF CONTENTS

| | |
|--|-----------|
| EXECUTIVE SUMMARY | 1 |
| 1 SUMMARY OF EXISTING CONDITIONS | 4 |
| 1.1 INTRODUCTION | 4 |
| 1.2 PROJECT LOCATION | 4 |
| 1.3 STATEMENT OF THE PROBLEM | 6 |
| 1.4 SCHEME BRIEF | 7 |
| SCHEME OBJECTIVES | 7 |
| PCF STAGE 2 BRIEF | 7 |
| 1.5 PLANNING CONSTRAINTS | 8 |
| 1.6 EXISTING HIGHWAYS NETWORK | 10 |
| ACCIDENTS | 12 |
| STATUTORY UNDERTAKERS | 13 |
| 1.7 EXISTING OPERATION AND MAINTENANCE REGIME | 14 |
| CURRENT OPERATING REGIME | 14 |
| 1.8 EXISTING GROUND CONDITIONS | 16 |
| SUPERFICIAL GEOLOGY | 16 |
| SOLID GEOLOGY | 16 |
| ARTIFICIAL GROUND | 16 |
| SUPERFICIAL DEPOSITS | 17 |
| BEDROCK GEOLOGY | 17 |
| 1.9 EXISTING TRAFFIC CONDITIONS | 18 |
| SUMMARY | 22 |
| 1.10 EXISTING ENVIRONMENTAL CONDITIONS | 23 |
| AIR QUALITY | 23 |
| CLIMATE CHANGE | 24 |
| NOISE | 24 |
| LANDSCAPE | 25 |
| CULTURAL HERITAGE | 27 |
| BIODIVERSITY | 28 |
| WATER ENVIRONMENT | 30 |
| PEOPLE AND COMMUNITIES | 31 |
| GEOLOGY AND SOILS | 36 |
| MATERIALS | 37 |
| 2 PLANNING FACTORS | 39 |
| 2.1 INTRODUCTION | 39 |

| | | |
|------------|---|-----------|
| 2.2 | PCF STAGE 0 | 40 |
| | PURPOSE OF PCF STAGE 0 | 40 |
| | OPTIONEERING | 40 |
| 2.3 | PCF STAGE 1 | 41 |
| | PURPOSE OF PCF STAGE 1 | 41 |
| | OPTIONEERING | 41 |
| | OPTION TESTING..... | 42 |
| | VALUE MANAGEMENT & CONCLUSION | 42 |
| 2.4 | PCF STAGE 2 | 44 |
| | PURPOSE OF PCF STAGE 2 | 44 |
| | OPTION TESTING AND OPTIONEERING | 44 |
| | VARIABLE DEMAND MODELLING..... | 46 |
| | ENVIRONMENTAL ASSESSMENT | 46 |
| | CONCLUSION | 46 |
| 3 | SUMMARY OF DO NOTHING CONSEQUENCES .. | 47 |
| 3.1 | DESCRIPTION OF DO NOTHING OPTION | 47 |
| 3.2 | ECONOMIC IMPACT | 47 |
| 3.3 | ENVIRONMENTAL IMPACT | 48 |
| | AIR QUALITY | 48 |
| | CLIMATE CHANGE | 49 |
| 3.4 | SUMMARY | 49 |
| 4 | SUMMARY OF ALTERNATIVE SCHEMES..... | 50 |
| 4.1 | INTRODUCTION | 50 |
| 4.2 | ALTERNATIVE OPTIONS | 50 |
| | OPTION 4..... | 50 |
| | OPTION 10..... | 51 |
| | OPTION 12..... | 51 |
| | OPTION 12A | 52 |
| 4.3 | ENGINEERING CHALLENGES OF ALTERNATIVE SCHEMES..... | 53 |
| | ALL FOUR OPTIONS | 53 |
| | GEOTECHNICAL..... | 56 |
| | OPTION 4..... | 57 |
| | HIGHWAYS..... | 57 |
| | DEPARTURES FROM STANDARD | 57 |
| | PROPOSED STRUCTURES | 58 |

| | |
|--|-----------|
| COMPLIANCE WITH SCHEME OBJECTIVES | 58 |
| OPTION 10..... | 59 |
| HIGHWAYS..... | 59 |
| PROPOSED STRUCTURES | 60 |
| COMPLIANCE WITH SCHEME OBJECTIVES | 60 |
| OPTION 12..... | 61 |
| HIGHWAYS..... | 61 |
| DEPARTURES FROM STANDARD..... | 62 |
| COMPLIANCE WITH SCHEME OBJECTIVES | 62 |
| OPTION 12A | 63 |
| PROPOSED STRUCTURES | 65 |
| COMPLIANCE WITH SCHEME OBJECTIVES | 65 |
| 5 SUMMARY OF TABLES OF TRAFFIC, ECONOMICS AND COSTS | 67 |
| 5.1 TRAFFIC MODEL | 67 |
| STAGE 1 | 67 |
| STAGE 2 | 67 |
| MODEL TIME PERIODS | 69 |
| MODELLED SCENARIOS | 69 |
| 5.2 TRAFFIC ASSESSMENT | 70 |
| CORE SCENARIO..... | 70 |
| ALTERNATIVE SCENARIO | 79 |
| HIGH / LOW LEVEL GROWTH SCENARIO..... | 87 |
| HIGH GROWTH..... | 87 |
| LOW GROWTH..... | 88 |
| SUMMARY AND CONCLUSION | 93 |
| 5.3 ECONOMICS ASSESSMENT PROCESS..... | 94 |
| TUBA | 95 |
| COBALT | 95 |
| ECONOMIC ASSESSMENT PROCESS – PUBLIC MODES | 96 |
| ESTIMATION OF COSTS | 97 |
| 5.4 ECONOMIC ASSESSMENT RESULTS..... | 98 |
| BENEFITS PROFILE TO HORIZON YEAR | 98 |
| ACCIDENT RESULTS..... | 99 |
| MONETISED ENVIRONMENTAL ASSESSMENT RESULTS | 100 |
| ANALYSIS OF MONETISED COSTS AND BENEFITS | 101 |
| COST SENSITIVITY TESTS..... | 103 |
| SUMMARY | 105 |

| | | |
|-----|---|-----|
| 6 | SUMMARY OF OPERATIONAL ASSESSMENT ... | 106 |
| 6.1 | INTRODUCTION | 106 |
| 6.2 | SCHEME'S OPERATING REGIME | 106 |
| 6.3 | DRIVER COMPLIANCE..... | 107 |
| 6.4 | CONCLUSION | 107 |
| 7 | SUMMARY OF TECHNOLOGY AND MAINTENANCE ASSESSMENT | 108 |
| 7.1 | INTRODUCTION | 108 |
| 7.2 | TECHNOLOGY ASSESSMENT | 108 |
| | OPTION DESIGN IMPLICATIONS ON EXISTING TECHNOLOGY | 108 |
| | CONCLUSION | 109 |
| 7.3 | MAINTENANCE ASSESSMENT | 110 |
| | MAINTENANCE SERVICE PROVIDER CONSULTATION | 110 |
| | MAINTENANCE LIABILITY | 111 |
| | CONCLUSION | 111 |
| 8 | SUMMARY OF ENVIRONMENTAL ASSESSMENT AND ENVIRONMENTAL DESIGN | 112 |
| 8.1 | INTRODUCTION | 112 |
| 8.2 | ENVIRONMENTAL OBJECTIVE..... | 113 |
| | COMPLIANCE WITH STANDARDS..... | 113 |
| | COMPLIANCE WITH PLANNING POLICY | 121 |
| 8.3 | AIR QUALITY..... | 122 |
| | CONSTRUCTION PHASE IMPACTS..... | 122 |
| | OPERATIONAL PHASE IMPACTS | 122 |
| 8.4 | CLIMATE CHANGE | 124 |
| 8.5 | CULTURAL HERITAGE | 125 |
| | PHYSICAL IMPACTS | 125 |
| | IMPACTS ON SETTING..... | 126 |
| 8.6 | LANDSCAPE | 126 |
| | LANDSCAPE ASSESSMENT | 126 |
| | VISUAL ASSESSMENT | 127 |
| 8.7 | BIODIVERSITY | 127 |
| | HABITATS..... | 128 |
| | PROTECTED AND NOTABLE SPECIES | 129 |

| | | |
|-------------|--|------------|
| 8.8 | GEOLOGY AND SOILS..... | 130 |
| 8.9 | MATERIALS..... | 131 |
| 8.10 | NOISE AND VIBRATION..... | 132 |
| 8.11 | PEOPLE AND COMMUNITIES | 135 |
| | EFFECTS ON ALL TRAVELLERS | 135 |
| | EFFECTS ON PEOPLE AND HEALTH..... | 135 |
| | EFFECTS ON COMMUNITIES..... | 136 |
| 8.12 | ROAD DRAINAGE AND THE WATER ENVIRONMENT..... | 136 |
| | GROUNDWATER | 136 |
| | FLOODING..... | 137 |
| | DITCH ADJACENT TO MAIDSTONE ROAD..... | 137 |
| | POND AT THE GATE HOUSE | 137 |
| | SUMMARY | 137 |
| 9 | SUMMARY OF PUBLIC CONSULTATION | 138 |
| 9.1 | INTRODUCTION..... | 138 |
| 9.2 | CONSULTATION ARRANGEMENTS..... | 138 |
| | COMMUNICATION METHODS | 139 |
| | CONSULTATION EFFECTIVENESS..... | 140 |
| | RESPONSE AND ANALYSIS METHODOLOGY | 141 |
| 9.3 | TOPICS RAISED AT EXHIBITIONS..... | 142 |
| | TRAVEL BEHAVIOUR..... | 143 |
| | VIEWS ON THE PROPOSED OPTION 12A..... | 145 |
| | ALTERNATIVE IDEAS | 147 |
| 9.4 | STAKEHOLDER RESPONSES..... | 148 |
| 9.5 | CONCLUSION | 149 |
| 10 | POST-CONSULTATION ASSESSMENT | 150 |
| 10.1 | CONSULTATION FEEDBACK..... | 150 |
| 10.2 | VALUE MANAGEMENT | 150 |
| | M2 EASTBOUND TO A249 NORTHBOUND SLIP ROAD..... | 151 |
| | OAD STREET LINK..... | 154 |
| | MAIDSTONE ROAD LINK..... | 155 |
| | SUMMARY | 156 |
| | ESTIMATION OF COSTS | 157 |
| 10.3 | OPERATIONAL AND ECONOMIC ASSESSMENT: OPTIONS 4, 4H1 AND 12A | 158 |

| | |
|--|------------|
| TRAFFIC MODELLING | 158 |
| BENEFITS | 160 |
| WIDER BENEFITS | 163 |
| SUMMARY OF OPERATIONAL PERFORMANCE | 163 |
| 10.4 ENVIRONMENTAL ASSESSMENT: OPTIONS 4, 4H1 AND 12A | 164 |
| SUMMARY OF ENVIRONMENTAL ASSESSMENT | 165 |
| COMPLIANCE WITH SCHEME OBJECTIVES | 175 |
| COMPLIANCE WITH PLANNING POLICY | 176 |
| 11 APPRAISAL SUMMARY TABLE | 178 |
| 11.1 INTRODUCTION | 178 |
| 12 CONCLUSION | 179 |
| 12.2 RECOMMENDED OPTION..... | 184 |

TABLES

| | |
|--|----|
| TABLE 0-1 PCF 2 FINAL OPTION ESTIMATES RANGES (2016 BASE YEAR) | 1 |
| TABLE 0-2 OPTIONS 4H1 AND 12A COMPARATIVE PERFORMANCE REGARDING SCHEME OBJECTIVES | 2 |
| TABLE 1-1 HIGHWAYS ENGLAND DELIVERY PLAN 2015- 2020 OBJECTIVES AND METRICS | 7 |
| TABLE 1-2 C2 RESPONSES (PCF STAGE 2)..... | 13 |
| TABLE 1-3 STATUTORY AND NON-STATUTORY DESIGNATED SITES WITHIN THE ECOLOGICAL STUDY AREA | 28 |
| TABLE 2-1 PCF STAGE 1 INITIAL OPTION ESTIMATES (2014 BASE YEAR) | 42 |
| TABLE 2-2 PCF STAGE 1 FINAL OPTION ESTIMATES RANGES (2014 BASE YEAR)..... | 43 |
| TABLE 2-3 PCF STAGE 2 INTERIM NO. 1 OPTION ESTIMATES RANGES (2016 BASE YEAR) | 45 |
| TABLE 3-1 JOURNEY TIME INCREASES FROM 2021 TO 2041 (CORE SCENARIO) | 47 |
| TABLE 3-2 BASELINE GREENHOUSE GAS EMISSIONS DATA FOR END USER TRAFFIC IN THE REGION OF THE PROPOSED SCHEME | 49 |
| TABLE 5-1: MODEL CONVERGENCE CALIBRATION CRITERIA | 71 |
| TABLE 5-2 MODEL SUMMARY STATISTICS - CORE SCENARIO - 2021 | 72 |
| TABLE 5-3: MODEL SUMMARY STATISTICS - CORE SCENARIO – 2031 | 72 |
| TABLE 5-4: MODEL SUMMARY STATISTICS - CORE SCENARIO – 2036 | 73 |
| TABLE 5-5: MODEL SUMMARY STATISTICS - CORE SCENARIO – 2041 | 73 |
| TABLE 5-6 M2 JUNCTION 5 MODELLED TRAFFIC FLOWS - CORE SCENARIO - REFERENCE CASE | 74 |
| TABLE 5-7: M2 JUNCTION 5 MODELLED FLOWS BY OPTION - CORE SCENARIO - AM PEAK | 74 |
| TABLE 5-8: M2 JUNCTION 5 MODELLED FLOWS BY OPTION - CORE SCENARIO - INTERPEAK | 74 |
| TABLE 5-9: M2 JUNCTION 5 MODELLED FLOWS BY OPTION - CORE SCENARIO - PM PEAK | 75 |
| TABLE 5-10 MODEL SUMMARY STATISTICS - ALTERNATIVE SCENARIO 2021 | 81 |
| TABLE 5-11 MODEL SUMMARY STATISTICS - ALTERNATIVE SCENARIO – 2031 | 81 |
| TABLE 5-12: MODEL SUMMARY STATISTICS - ALTERNATIVE SCENARIO – 2036 | 82 |
| TABLE 5-13: MODEL SUMMARY STATISTICS - ALTERNATIVE SCENARIO – 2041 | 82 |

| | |
|---|-----|
| TABLE 5-14 M2 JUNCTION 5 MODELLED TRAFFIC FLOWS - ALTERNATIVE SCENARIO - REFERENCE CASE | 83 |
| TABLE 5-15: M2 JUNCTION 5 MODELLED FLOWS BY OPTION - ALTERNATIVE SCENARIO - AM PEAK | 83 |
| TABLE 5-16: M2 JUNCTION 5 MODELLED FLOWS BY OPTION - ALTERNATIVE SCENARIO - INTERPEAK | 83 |
| TABLE 5-17: M2 JUNCTION 5 MODELLED FLOWS BY OPTION - ALTERNATIVE SCENARIO - PM PEAK | 83 |
| TABLE 5-18 MODEL SUMMARY STATISTICS – HIGH GROWTH SCENARIO - 2021 | 89 |
| TABLE 5-19: MODEL SUMMARY STATISTICS – HIGH GROWTH SCENARIO – 2031 | 89 |
| TABLE 5-20: MODEL SUMMARY STATISTICS – HIGH GROWTH SCENARIO – 2036 | 90 |
| TABLE 5-21: MODEL SUMMARY STATISTICS – HIGH GROWTH SCENARIO – 2041 | 90 |
| TABLE 5-22: MODEL SUMMARY STATISTICS – LOW GROWTH SCENARIO - 2021 | 91 |
| TABLE 5-23: MODEL SUMMARY STATISTICS – LOW GROWTH SCENARIO – 2031 | 91 |
| TABLE 5-24: MODEL SUMMARY STATISTICS – LOW GROWTH SCENARIO – 2036 | 92 |
| TABLE 5-25: MODEL SUMMARY STATISTICS – LOW GROWTH SCENARIO – 2041 | 92 |
| TABLE 5-26 PCF STAGE 2 INTERIM NO. 2 OPTION ESTIMATES RANGES (2016 BASE YEAR) | 97 |
| TABLE 5-27 P10, P50 AND P90 COSTS | 98 |
| TABLE 5-28 COBALT ANALYSIS - CORE SCENARIO | 99 |
| TABLE 5-29 COBALT ANALYSIS - ALTERNATIVE SCENARIO | 100 |
| TABLE 5-30 CHANGE IN CO ₂ EMISSIONS (TONNES) - CORE SCENARIO | 100 |
| TABLE 5-31 CHANGE IN CO ₂ EMISSIONS (TONNES) - ALTERNATIVE SCENARIO | 100 |
| TABLE 5-32 ANALYSIS OF MONETISED COSTS AND BENEFITS TABLE – CORE SCENARIO | 101 |
| TABLE 5-33 – ANALYSIS OF MONETISED COSTS AND BENEFITS TABLE – ALTERNATIVE SCENARIO | 102 |
| TABLE 5-34 – P10, P50 AND P90 BENEFIT TO COST RATIOS FOR OPTION 4 – CORE SCENARIO | 103 |
| TABLE 5-35 – P10, P50 AND P90 BENEFIT TO COST RATIOS FOR OPTION 10 – CORE SCENARIO | 103 |
| TABLE 5-36 – P10, P50 AND P90 BENEFIT TO COST RATIOS FOR OPTION 12 – CORE SCENARIO | 103 |



| | |
|--|-----|
| TABLE 5-37 – P10, P50 AND P90 BENEFIT TO COST RATIOS FOR OPTION 12A – CORE SCENARIO | 103 |
| TABLE 5-38 – P10, P50 AND P90 BENEFIT TO COST RATIOS FOR OPTION 4 – ALTERNATIVE SCENARIO | 104 |
| TABLE 5-39 – P10, P50 AND P90 BENEFIT TO COST RATIOS FOR OPTION 10 – ALTERNATIVE SCENARIO | 104 |
| TABLE 5-40 – P10, P50 AND P90 BENEFIT TO COST RATIOS FOR OPTION 12 – ALTERNATIVE SCENARIO | 104 |
| TABLE 5-41 – P10, P50 AND P90 BENEFIT TO COST RATIOS FOR OPTION 12A – ALTERNATIVE SCENARIO | 104 |
| TABLE 8-1 COMPLIANCE WITH ENVIRONMENTAL OBJECTIVE FOR THE SCHEME | 115 |
| TABLE 8-2 SHORT TERM RECEPTOR IMPACT (NUMBER OF DWELLINGS IMPACTED BY OPTION AND SIGNIFICANCE) | 132 |
| TABLE 8-3 LONG TERM RECEPTOR IMPACT (NUMBER OF DWELLINGS IMPACTED BY OPTION AND SIGNIFICANCE) | 132 |
| TABLE 9-1 PUBLICITY COMMUNICATION METHODS..... | 139 |
| TABLE 9-2 PUBLIC EXHIBITION ATTENDANCE..... | 140 |
| TABLE 9-3 WEBSITE VISITOR FIGURES | 140 |
| TABLE 9-4 - ISSUES RAISED AT EXHIBITIONS | 142 |
| TABLE 9-5 ALTERNATIVE IDEAS | 147 |
| TABLE 10-1 PCF 2 FINAL OPTION ESTIMATES RANGES (2016 BASE YEAR) | 157 |
| TABLE 10-2 TOTAL JUNCTION FLOWS..... | 158 |
| TABLE 10-3 COLLISION AND CASUALTY SAVINGS..... | 160 |
| TABLE 10-4 CORE SCENARIO BENEFITS (REVISED OPTIONS) | 161 |
| TABLE 10-5 ALTERNATIVE SCENARIO BENEFITS (REVISED OPTIONS) | 162 |
| TABLE 10-6 OPTION 4H1 SHORT-TERM (OPENING YEAR 2021) TRAFFIC NOISE REPORTING TABLE..... | 171 |
| TABLE 10-7 OPTION 4H1 LONG TERM (YEARS 2021 – 2041) TRAFFIC NOISE REPORTING TABLE..... | 172 |
| TABLE 10-8 OPTION 12A SHORT-TERM (OPENING YEAR 2021) TRAFFIC NOISE REPORTING TABLE..... | 173 |
| TABLE 10-9 OPTION 12A LONG TERM (YEARS 2021 – 2041) TRAFFIC NOISE REPORTING TABLE..... | 173 |
| TABLE 12-1 PCF STAGE 2 FINAL OPTION ESTIMATES RANGES (2016 BASE YEAR)..... | 181 |

FIGURES

| | |
|---|-----|
| FIGURE 1-1 M2 JUNCTION 5 LOCATION PLAN | 5 |
| FIGURE 1-2 : M2 JUNCTION 5 STOCKBURY ROUNDAABOUT | 10 |
| FIGURE 1-3 : LOCATION OF ROAD TRAFFIC COLLISIONS..... | 12 |
| FIGURE 1-4 12 HOUR (07.00 – 19.00) TURNING MOVEMENTS..... | 18 |
| FIGURE 1-5 AM PEAK HOUR (07:15 – 08:15 HOURS) TURNING MOVEMENTS | 20 |
| FIGURE 1-6 INTER-PEAK HOUR (14:00 – 15:00 HOURS) TURNING MOVEMENTS | 21 |
| FIGURE 1-7 PM PEAK HOUR (17:00 – 18:00 HOURS) TURNING MOVEMENTS | 22 |
| FIGURE 2-1 : M2 JUNCTION 5 STOCKBURY ROUNDAABOUT | 39 |
| FIGURE 5-1 SERTM NETWORK AND M2 JUNCTION 5 CORDON AREA | 68 |
| FIGURE 5-2 COBALT SCHEME INFLUENCE AREA | 96 |
| FIGURE 5-3 GRAPH OF USER TIME BENEFITS AGAINST YEAR | 98 |
| FIGURE 9-1 WHAT TYPE OF JOURNEYS DO YOU USE THE M2 JUNCTION 5 FOR MOST OFTEN?..... | 143 |
| FIGURE 9-2 HOW DO YOU USUALLY TRAVEL THROUGH THIS AREA? (PLEASE SELECT ALL THAT APPLY). | 144 |
| FIGURE 9-3 HOW CONCERNED ARE YOU ABOUT THE FOLLOWING ISSUES RELATING TO THE M2 JUNCTION 5?..... | 145 |
| FIGURE 9-4 HOW MUCH DO YOU AGREE OR DISAGREE THAT THE PROPOSED OPTION WILL MEET THE SCHEME OBJECTIVES?..... | 146 |
| FIGURE 9-5 OVERALL TO WHAT EXTENT DO YOU SUPPORT THE PROPOSED OPTION (OPTION 12A) FOR THE M2 JUNCTION 5 IMPROVEMENTS?..... | 147 |
| FIGURE 10-1 CROSS-SECTION DIMENSIONS FOR RURAL CONNECTOR ROADS | 153 |

APPENDICES

- A** EXISTING CONDITIONS APPENDIX
- A-1** CLIENT SCHEME REQUIREMENTS
- A-2** ENVIRONMENTAL CONSTRAINTS MAP
- B** PLANNING FACTORS APPENDIX
- B-1** OPTIONS LOG
- B-2** VDM METHODOLOGY TECHNICAL NOTE
- B-3** PCF STAGE 2 INTERIM NO. 1 OPTIONS ESTIMATES (APRIL 2017)
- B-4** OPTIONEERING LOG (STAGES 0 TO 2)
- B-5** PCF STAGE 1 FINAL OPTION ESTIMATES
- C** NOT USED
- D** SUMMARY OF ALTERNATIVE SCHEME APPENDIX
- D-1** GENERAL ARRANGEMENTS (SEPTEMBER 2017)
- D-2** C3 BUDGET ESTIMATES
- E** SUMMARY TABLES TRAFFIC , COSTS AND ECONOMICS APPENDIX
- E-1** INTERIM NO. 2 OPTIONS ESTIMATES (OCTOBER 2017)
- E-2** CONVERGENCE TABLES (CORE)
- E-3** VOLUME TO CAPACITY RATIO
- E-4** QUEUE LENGTHS (CORE)
- E-5** JOURNEY TIME RESULTS (CORE)
- E-6** MODEL CONVERGENCE (ALTERNATIVE)
- E-7** VOLUME TO CAPACITY RATIO (ALTERNATIVE)
- E-8** QUEUE LENGTHS (ALTERNATIVE)
- E-9** JOURNEY TIMES (ALTERNATIVE)
- E-11** PROFILE BENEFITS SPLIT BY TIME PERIOD AND TRIP TYPE
- F** MAINTENANCE AREA MAP
- G** NOT USED
- H** NOT USED
- I** NOT USED
- J** POST-CONSULTATION ASSESSMENT APPENDIX



- J-1** GENERAL ARRANGEMENTS (REVISED LOCAL ROADS – NOVEMBER 2017)
- J-2** FINAL OPTIONS ESTIMATES (DECEMBER 2017)
- K** APPRAISAL SUMMARY TABLES

EXECUTIVE SUMMARY

During PCF¹ Stages 0 and 1 it was confirmed that given the scale of the problem identified at M2 Junction 5, there was little scope for alternative modes to play a part for providing sufficient congestion relief at the junction. In PCF Stage 0 various methods of improving road capacity at the junction were identified. At PCF Stage 1 the options were refined and tested within a VISSIM micro-simulation model of the M2 Junction 5, as there was no strategic model available at the time.

At the end of PCF Stage 1 it was recommended that Option 4 (A249 grade separated at existing junction location), Option 10 (A249 grade separated at M2 Stockbury Viaduct) and Option 12 (A249 at-grade improvement of existing junction) were to be progressed into PCF Stage 2. However, as Options 4 and 10 exceeded the capital funding budget allocation the decision was that Option 12 was the only viable option and should be developed further in PCF Stage 2; and Options 4 and 10 were only to be modelled in the SERTM², in addition to Option 12.

During PCF Stage 2, the SERTM was cordoned to the scheme area, to produce the M2 Junction 5 Model, and initial forecasting results indicated that Option 12 would not cope adequately with forecast traffic flows. Option 12A was therefore identified, based on evolving Option 12 to include an at-grade though-about. It was considered that, whilst there were options that would better address the schemes capacity and safety objectives, within the affordability constraint of the capital funding budget allocation (£70.6million) Option 12A would provide greater resilience for A249 traffic. Therefore, Option 12A was shown at the non-statutory public consultation in September / October 2017 as the only viable option. Options 4, 10 and 12 were shown as rejected options.

The feedback received from the public consultation was generally non-supportive of Option 12A. 68% of respondents indicated they would not support it and statutory stakeholders, such as Kent Area of Outstanding Natural Beauty, Local Authorities and the Members of Parliament for Sittingbourne and Sheppey, either opposed or did not support it.

The general consensus from the consultation responses was that the only option that would provide long-term benefits was a flyover. Therefore, a review of Option 4 was undertaken to determine if there were any further value management measures to reduce the cost of the option to be within the RIS 1³ funding range and closer to the capital funding budget allocation, whilst maintaining an acceptable level of benefits.

The value management review focussed on the elements of Option 4 that were considered to have the greatest potential to reduce costs whilst minimising any reduction in benefits. Option 4H1 included changes to the following elements of Option 4: M2 Eastbound to A249 Northbound offline, single lane slip road, Oad Street Link and Maidstone Road Link. The changes to the local road links were included within Options 4, 4H1 and 12A.

SCHEME OBJECTIVES/ AFFORDABILITY

Options estimates were produced for Options 4, 4H1 and 12A; please refer to the **Table 0-1**, identifying that only Option 12A was considered affordable, as its estimate range fell within both the RIS 1 budget range and the most likely estimated fell within capital baseline funding allocation.

Table 0-1 PCF 2 Final Option Estimates Ranges (2016 Base Year)

| Option | P10 | Most Likely | P90 |
|--------|-----|-------------|-----|
|--------|-----|-------------|-----|

¹ PCF – Project Control Framework

² SERTM - South East Regional Transport Model

³ Road Investment Strategy: for the 2015/16 – 2019/20 Road Period, Department for Transport, March 2015

| | | | |
|------------|------------|------------|-------------|
| 4 | £70million | £98million | £150million |
| 4H1 | £62million | £87million | £133million |
| 12A | £43million | £60million | £94million |

Traffic forecasting was produced for four scenarios. Of these the Alternative Scenario was considered to best represent current forecast growth for committed developments, as it was based on the latest local growth projections obtained from local authorities. All three options provided a clear and positive benefit against the Reference Case.

Option 4 provided the highest overall level of benefits of the three options; however, Option 4H1 had the highest accident savings, followed closely by Option 4. The BCR⁴ for Options 4 and 4H1 were similar, at 4.246 and 4.112 respectively. As Option 4H1 was considered to be a viable option in terms of operational performance, Option 4 was discounted as it was significantly more expensive.

Option 4H1 provided a higher overall level of benefits compared to Option 12A, including significantly higher accident savings. Option 12A accident savings were broadly 50% lower than for the two grade separated options, reflecting the increased number of potential conflict points in a through-about layout. The BCR for Option 12A was better than for 4H1, at 5.079, reflecting the lower estimated cost of the option, albeit the difference in BCRs was relatively small.

A comparison of how Options 4H1 and 12A compare, in terms of achieving the scheme objectives is given in **Table 0-2**.

Table 0-2 Options 4H1 and 12A Comparative Performance Regarding Scheme Objectives

| Scheme Objective / Affordability | Option 4H1 | Option 12A |
|---|-------------------|-------------------|
| Affordable | No | Yes |
| Supporting economic growth: | 1 st | 2 nd |
| A safe and serviceable network: | 1 st | 2 nd |
| A more free flowing network: | 1 st | 2 nd |
| An improved environment: | 2 nd | 1 st |
| A more accessible and integrated network: | Equal | Equal |

Based on a preliminary appraisal of the relevant policy guidance, as undertaken at PCF Stage 2, it is expected that Options 4H1 and 12A would be able to achieve compliance with the relevant Planning Policy in respect of air quality, geology and soils, materials, noise, people and communities and road drainage and the water environment. Both Options 4H1 and 12A have been screened as requiring statutory Environmental Impact Assessment as both are considered likely to result in significant adverse effects on the environment at this stage in the scheme assessment. These anticipated significant impacts are associated with landscape and visual effects during construction and in the short term (at year one), materials consumption, potential construction noise impacts associated with both junction options, and potential short term noise impacts (Opening Year 2021) at two sensitive receptors for Option 4H1.

Overall, Option 12A would potentially achieve slightly enhanced compliance with the environmental objective for the scheme over Option 4H1 for landscape reasons. However, at this stage compliance with the scheme environmental objective is not considered a clear differentiator between Options 4H1 and 12A and the delivery of this objective will need to be re-evaluated in PCF Stage 3 once the full environmental assessment for the preferred option is available.

⁴ BCR: Benefit to Cost Ratio

PREFERRED OPTION

Option 12A is considered a viable option as it is both within the current capital funding budget allocation and operationally achieves the scheme objectives. Whilst Option 4H1 delivers the scheme objectives more effectively there is currently insufficient funding available for this more expensive option. For Option 4H1 to be considered a viable option additional funding would need to be sourced and secured. Whether additional funding could be identified and secured is currently being investigated and until that process has completed a final decision regarding the preferred option for the scheme will not be made.

1 SUMMARY OF EXISTING CONDITIONS

1.1 INTRODUCTION

- 1.1.1 The M2 Junction 5 Improvements Scheme is currently in PCF⁵ Stage 2, Option Selection. The purpose of this stage is to announce the preferred option for the scheme. The purpose of this report is to provide a synopsis of the technical assessment and public consultation undertaken during the options phase, comprising PCF Stages 1 and 2, and to recommend a preferred option. The preferred option will then be developed in PCF Stage 3, including: completing any outstanding surveys; completing the environmental assessment and preparing the environmental statement; and preparing draft orders required in order to obtain planning consent to implement the scheme.
- 1.1.2 This section summarises the existing conditions at M2 Junction 5 in terms of the traffic, highways and environmental conditions. In order to avoid repetition of information in other PCF products, the purpose of this section is to provide an overview of features and information known up to this stage. For further information on the project please see the Stage 2 Client Scheme Requirements in **Appendix A-1**.

1.2 PROJECT LOCATION

- 1.2.1 The M2 Junction 5 is located approximately 58km from the centre of London, with the built up area of Sittingbourne approximately 5km north east of M2 Junction 5. The area is largely open countryside, with areas of woodland and farmland close to the motorway slip roads.
- 1.2.2 The M2 Junction 5 forms the intersection between the strategically important M2 corridor linking Dover with London and the A249.
- 1.2.3 The A249 links Sittingbourne to Maidstone and Sheerness on the Isle of Sheppey. The A249 also functions as an important link between the M2 and M20 motorways, and is the principal route for goods vehicle traffic to the port at Sheerness.

⁵ PCF – Project Control Framework

Figure 1-1 M2 Junction 5 Location Plan



1.3 STATEMENT OF THE PROBLEM

- 1.3.1 The Kent Corridors to M25 Route strategy⁶ completed during 2014 was a high-level route assessment and identified long-standing congestion hot spots and safety concerns on the Strategic Road Network. It confirmed the need for improvement options at the M2 Junction 5 / A249 Junction.
- 1.3.2 M2 Junction 5 forms part of the strategically important corridor linking Dover with London. Swale Borough Council⁷ is planning for an additional 14,124 dwellings and 130,000m² of employment land up to 2031. This scale of development will have a significant impact on M2 Junction 5 and the A249, which already have performance issues.
- 1.3.3 The M2 / A249 Stockbury Roundabout has capacity constraints resulting in unsatisfactory network performance. This affects M2 east-west movements and A249 north-south Sittingbourne/Maidstone movements, with current traffic demands significantly exceeding capacity in the peak periods. The approach to the junction from the east experiences high levels of delay and the junction is identified in the list of the top 50 national casualty locations⁸. It is also noted that growth plans, as set out in the Local Economic Partnerships' Strategic Economic Plan⁹, are likely to be inhibited by a lack of capacity at this junction.
- 1.3.4 Improvements to M2 Junction 5 were included in the Department for Transport Road Investment Strategy¹⁰. The scheme need was confirmed by the Autumn Statement 2014¹¹ and through inclusion in RIS 1 it forms part of Highways England Delivery Plan 2015-2020¹² with the following statement:
- “Additional capacity for the junction, through improvements to slip roads and enhanced junction approaches”.*
- 1.3.5 The improvements will contribute to national transport objectives by:
- Providing additional capacity;
 - Enhancing journey time reliability; and
 - Supporting the development of housing and the creation of jobs, as set out in the existing and emerging Local Plans.

⁶ Kent Corridors to M25 Route Study Evidence Report, Highways England, April 2014

⁷ Bearing Fruits 2031: The Swale Local Plan Main Modifications June 2016

⁸ Kent Corridors to M25 Route Study Evidence Report, Highways England, April 2014

⁹ South East Local Enterprise Partnership, Growth Deal and Strategic Economic Plan, 2014

¹⁰ Road Investment Strategy: for the 2015/16 – 2019/20 Road Period, Department for Transport, March 2015

¹¹ Autumn Statement 2014, HM Treasury, December 2014

¹² Highways England Delivery Plan 2015 – 2020, Highways England, March 2015

1.4 SCHEME BRIEF

SCHEME OBJECTIVES

1.4.1 In line with the Highways England Delivery Plan 2015-2020¹³, the strategic transport objectives as presented in the Client Scheme Requirements (please refer to **Appendix A-1**) are shown in **Table 1-1**.

Table 1-1 Highways England Delivery Plan 2015-2020 Objectives and Metrics

| Delivery Plan Objective | Metric for Meeting Objective |
|--|---|
| Supporting economic growth | Enhanced capacity, connectivity and resilience at Junction 5. Strengthen the local and regional economic base. Delivery of housing allocations from the Swale Local Plan . Promotion of economic growth across the region. |
| A safe and serviceable network | Improved safety and security for all road users. Reduction in the number of KSI ¹⁴ collisions and slight collisions. |
| A more free flowing network | Improved journey quality, journey time and reliability for all routes through Junction 5. |
| An improved environment | High standard of design reflecting the landscape and setting. Supports climate change, conserves natural resources, encourages bio-diversity and protects historic environments. |
| A more accessible and integrated network | Make changes at the junction that could benefit the community and provide a legacy, where reasonable and proportionate. |

PCF STAGE 2 BRIEF

1.4.2 The identification and assessment of scheme options up to and including the selection of the preferred option, to be announced in the PRA¹⁵, have been developed taking into account:-

- The Department for Transport RIS 1¹⁶ for the scheme;
- The project objectives, as set out in the Client Scheme Requirements¹⁷ (as included in **Appendix A-1**);
- The capital baseline funding budget allocated to the project, which sets the affordability limit;
- Department for Transport methodology for transport appraisal¹⁸, including evaluation of value for money;
- Appropriate environmental impact assessment.

1.4.3 The brief for PCF¹⁹ Stage 2 was that only Option 12 was to be taken forward from PCF Stage 1 into PCF Stage 2 for design development. However, due to the limitation of the local traffic

¹³ Highways England Delivery Plan 2015 – 2020, Highways England, March 2015

¹⁴ KSI – Killed or Seriously Injured

¹⁵ Preferred Route Announcement

¹⁶ Road Investment Strategy: for the 2015/16 – 2019/20 Road Period, Department for Transport, March 2015

¹⁷ M2 Junction 5 Improvements Scheme – PCF Stage 2 Client Scheme Requirements, Highways England, April 2017

¹⁸ <https://www.gov.uk/guidance/transport-analysis-guidance-webtag>

¹⁹ PCF - Project Control Framework

model used in PCF Stage 1, and the resulting uncertainty of the Stage 1 BCRs²⁰, Options 4 and 10 were to be assessed using the SERTM²¹ to obtain more comparable BCRs (please refer to the Option and Outputs section of the Client Scheme Requirements in **Appendix A-1**).

- 1.4.4 An Environmental Assessment Report²² has been produced for the scheme in PCF Stage 2, updating the PCF Stage 1 Environmental Studies Report²³ and demonstrating that the environmental impacts of the scheme have been appropriately assessed at this stage. It seeks to identify the environmental constraints and relative environmental benefits associated with the scheme options, and assess Options 4, 10 and 12 and variants to Option 12. It provides sufficient information to understand the likely significant effects of the scheme and an overview of any severe environmental constraints that could preclude further consideration of an option. It also identifies the further assessment that is likely to be required at PCF Stage 3.
- 1.4.5 The PCF Stage 2 Environmental Assessment Report sets out the objectives of the scheme, which have been identified to align with the policy direction established by the NN NPS²⁴ and the overarching objectives of the Department for Transport Road Investment Strategy.²⁵ The content of the PCF Stage 2 Environmental Assessment Report demonstrates how the scheme will meet these objectives and moreover, demonstrates the ability of the scheme to meet the requirements of the Highways England Licence.²⁶

1.5 PLANNING CONSTRAINTS

- 1.5.1 The Client Scheme Requirements (please refer to **Appendix A-1**) outlines the following key constraints of the scheme:
- Stakeholder expectations within the area are high and need to be managed carefully;
 - The scheme is partially located within Kent Downs Area of Outstanding Natural Beauty;
 - Areas of Ancient Woodland are located in close proximity to the scheme;
 - The WW1 Chatham Land Defences are located in the area with the majority of the defences located below ground level; and
 - Interface with Statutory Undertakers.

²⁰ BCR - Benefit to Cost Ratio

²¹ SERTM - South East Regional Transport Model

²² M2 Junction 5 Improvements Scheme - PCF Stage 2 Environmental Assessment Report (HE551521-WSP-HGN-PCF2-RP-E-00043), January 2018

²³ M2 Junction 5 Improvements Scheme – PCF Stage 1 Environmental Studies Report (Document number : HE551521-WSP-HGN-PCF2-RP-E-00043 , October 2016

²⁴ National Policy Statement for National Networks, Department for Transport, December 2014.

²⁵ Road Investment Strategy: for the 2015/16 – 2019/20 Road Period, Department for Transport, March 2015.

²⁶ Highways England: Licence Secretary of State for Transport statutory directions and guidance to the strategic highways company, Department for Transport, April 2015.

1.5.2 Furthermore, the following constraints have been identified:

- There are several designated nature conservation sites within 10km of the scheme, including a Ramsar sites, SPAs,²⁷ SACs,²⁸ SSSIs,²⁹ a Marine Conservation Zone, a Local Nature Reserve, Local Wildlife Sites and Roadside Nature Reserves.
- Habitats of Principal Importance, Protected and Notable Species (or habitat with the potential to support such species), and invasive plant species have been recorded within the scheme area such as hedgerows, invertebrate species, birds, dormice, bats, badgers and reptiles;
- A locally designated Area of High Landscape Value is located within 2km of the scheme;
- The scheme is located within three local Landscape Character Areas;
- There are several PRowS³⁰ within close proximity to the scheme;
- There are residential properties within close proximity to the scheme, which may be sensitive to changes in noise levels, air quality, visual amenity and surface water drainage;
- The scheme area is within Zone 3 (total catchment) and Zone 2 (outer zone) groundwater Source Protection Zones, and the scheme is underlain by a Principal Aquifer;
- There are two surface water bodies within the scheme area, including a disused well and a small attenuation pond;
- The scheme is located within Flood Zone 1 (land assessed as having a less than 0.1% (1 in 1,000) annual probability of fluvial (river) flooding in any year), however the area along the A249 and Maidstone Road is identified by the Environment Agency as being at high risk of flooding from surface water (considered likely associated with overland flows);
- There are potential contamination sources within close proximity to the scheme, including made ground and a disused filling station;
- There are six AQMA³¹ located within 200m of the defined Affected Road Network for the scheme,³²
- There are seven NIAs³³ located within 2km of the scheme; and
- There are 46 heritage assets located within 1km of the scheme:
 - (1) A Scheduled Monument;
 - (2) A Grade I Listed Building;
 - (3) A Grade II* Listed Building;
 - (4) 20 Grade II Listed Buildings;
 - (5) 2 World War II crash sites;
 - (6) One non-designated historical landscape;
 - (7) 19 non-designated assets; and
 - (8) A find spot.

²⁷ SPA – Special Protection Area.

²⁸ SAC – Special Area of Conservation.

²⁹ SSSI – Site of Special Scientific Interest.

³⁰ PRow – Public Right of Way.

³¹ AQMA – Air Quality Management Area.

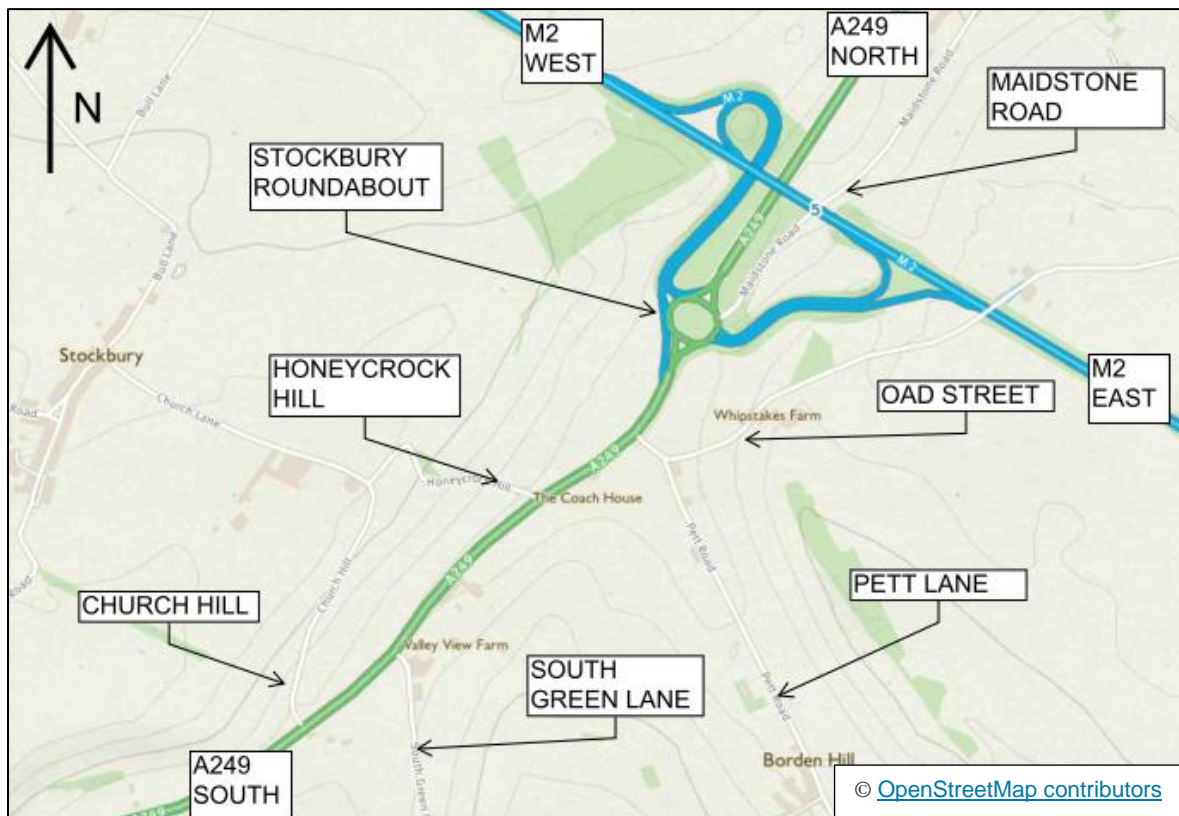
³² Affected Road Network - the affected road network has been defined in accordance with HA 207/07 scoping criteria as set out in the Design Manual for Roads and Bridges Section 3 Part 1 (HA207/07), former Highways Agency, May 2007.

³³ NIA – Noise Important Areas

1.6 EXISTING HIGHWAYS NETWORK

1.6.1 The existing M2 Junction 5 and its associated links are shown in **Figure 1-2**.

Figure 1-2 : M2 Junction 5 Stockbury Roundabout



1.6.2 The M2 is part of the Strategic Road Network serving east-west movements between the Port of Dover and London and also serving major urban areas around Canterbury, Medway, Gravesham and Dartford. The M2 through the study area is currently dual 2 lane motorway standard.

1.6.3 The A249 provides a local and strategic route between Maidstone and the Isle of Sheppey, serving a number of smaller villages and Sittingbourne along the way. The A249 crosses the M20 and M2 routes. The A249 is generally to dual 2 lane all-purpose carriageway standard except for single carriageway sections in Maidstone and on the Isle of Sheppey. The A249 from the Sheppey Crossing to the M20 Junction 7 is generally subject to the National Speed Limit with the section at Detling Hill operating at a reduced speed limit of 50mph.

1.6.4 There are four local access roads within the study area that are directly impacted on by the various scheme options:

— Maidstone Road (Unclassified³⁴):

- (1) Runs parallel and to the east of the A249, north of the M2, and provides access to Danaway village. Continuing northwards it becomes Chestnut Street and provides access to Chestnut Street village before connecting in to the A249 / A2 Key Street Junction. Maidstone Road also provides direct access onto Stockbury Roundabout.
- (2) Maidstone Road is subject to a 50 mph speed restriction through Danaway and a 30 mph speed restriction through Chestnut Street. There is also a 6 foot 6 inch (2 metre) width restriction through Chestnut Street due to the narrow lanes.
- (3) It also provides a potential alternative route for traffic from the A2 and Sittingbourne during the peak periods as it links Key Street Junction to Stockbury Roundabout.

— Oad Street (Classified unnumbered):

- (1) Provides access to the A249 approximately 250 metres south of Stockbury Roundabout, having served a number of small settlements and rural properties. At the eastern end it connects into the local road network serving the area south of Sittingbourne.
- (2) Vehicles are currently permitted to turn both left and right out of Oad Street onto the A249, whilst only left turns in from the A249 are enabled. The right turn out of Oad Street involves a manoeuvre crossing the southbound A249 dual carriageway, through the central reserve and joining the A249 northbound carriageway.
- (3) Oad Street provides an alternative route into the southern side of Sittingbourne and has traffic calming measures installed in the hamlet of Oad Street.
- (4) Oad Street is subject to the National Speed Limit, generally 60 mph on a single carriageway for cars and motorcycles, and has a 6 foot 6 inch (2 metre) width restriction.

— Church Hill (Unclassified):

- (1) Provides access to the A249 approximately 700 metres south of Stockbury Roundabout, serving Stockbury village and the surrounding area. At the A249 / Church Hill junction, vehicles are permitted to turn in from both A249 carriageways and turn out left onto the A249 northbound carriageway. The right turn in from the A249 southbound carriageway involves a manoeuvre crossing the A249 northbound carriageway.
- (2) Church Hill is subject to the National Speed Limit.

— Honeycrook Hill (Unclassified):

- (1) Provides access to the A249 approximately 400 metres south of Stockbury Roundabout, serving Stockbury village and the surrounding area. Vehicles are permitted to turn left out of Honeycrook Hill onto the A249 northbound carriageway, whilst right turns out onto the A249 southbound carriageway are prohibited. Access into Honeycrook is enabled for the A249 southbound traffic undertaking a right hand turn manoeuvre crossing the A249 northbound carriageway. Left turning traffic from the A249 northbound is prohibited.
- (2) Honeycrook Hill is subject to the National Speed Limit.

³⁴ Road classification in accordance with “Guidance on Road Classification and the Primary Network”, Department for Transport, January 2012, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/315783/road-classification-guidance.pdf

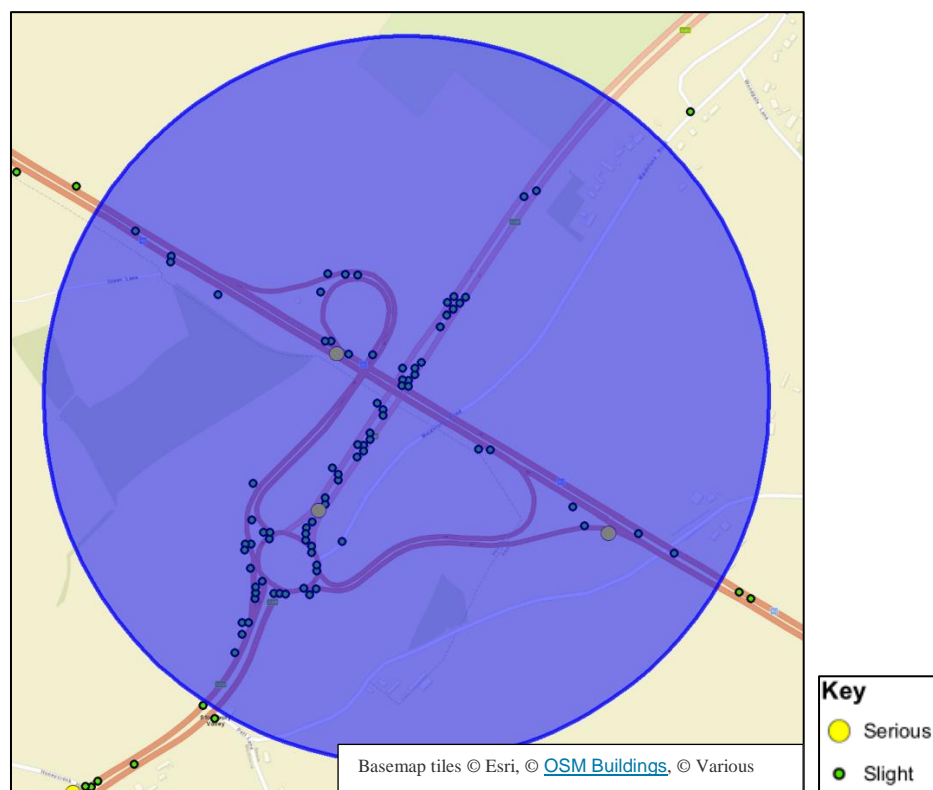
ACCIDENTS

1.6.5 Collision data was obtained from the Department for Transport's Road Safety Database for a period of January 2011 to December 2015. In the 1km radius area immediately around Stockbury Roundabout there were a total of 208 casualties which resulted in an above average PIA³⁵, of 41.6 casualties per year. The severity of the casualties were as follows:

- Zero fatal;
- Four serious; and
- 204 slight.

The location of the reported collisions within the study area is shown in **Figure 1-3**.

Figure 1-3 : Location of Road Traffic Collisions



1.6.6 Given the high traffic flows and queuing observed on the A249 during the peak periods, a high proportion of rear shunt collisions occur, where vehicles have failed to react to slow or stationary traffic. Additionally, due to the roundabout location, a number of poor observation or manoeuvre collisions would be expected due to the lane changing on approach to the roundabout and driver judgement errors in pulling out onto the roundabout.

1.6.7 Data indicates that 47% of all collisions occurred during the peak period when congestion and queuing is known to be at its highest. Data also shows a significant number of collisions on the roundabout itself, again fitting the anticipated pattern.

³⁵ PIA – Personal Injury Accident

STATUTORY UNDERTAKERS

1.6.8 The NRSWA³⁶ C2 preliminary enquiries from PCF Stage 1 were updated in PCF Stage 2 with responses received as seen in **Table 1-2** below:

Table 1-2 C2 Responses (PCF Stage 2)

| Statutory Undertaker | Apparatus Present | Apparatus Affected |
|------------------------------|-------------------|--------------------|
| Openreach - BT | Yes | Yes |
| Cityfibre | No | No |
| CA Telecom | No | No |
| Energetics | No | No |
| Engie | No | No |
| Genesys | Yes | Yes |
| GTC | No | No |
| Instalcom | No | No |
| KCOM | No | No |
| MBNL | No | No |
| Southern and Scottish Energy | No | No |
| Sky | No | No |
| South East Water | Yes | Yes |
| Southern Water | Yes | Yes |
| Southern Gas | No | No |
| Telent | No | No |
| Traffic Master | No | No |
| UK Power Networks | Yes | Yes |
| Verizon | No | No |
| Virgin Media | No | No |
| Vodafone | Yes | No |

1.6.9 At the scheme location there are High Voltage overhead cables and a pre-stressed concrete water trunk main that will be affected by the proposed scheme.

³⁶ NRSWA - New Roads and Street Works Act

1.7 EXISTING OPERATION AND MAINTENANCE REGIME

CURRENT OPERATING REGIME

- 1.7.1 The A249 between the M20 Junction 7 Maidstone and the A2 Sittingbourne is a dual two lane all-purpose carriageway with hard strips on either side. The A249 immediately north-east of the existing Stockbury Roundabout forms part of the A249 DBFO³⁷, held by Sheppey Route Limited with FM Conway as the Operations & Maintenance Contractor. The A249 immediately south-west of the existing Stockbury Roundabout is maintained by Kent County Council as the Highway Authority.
- 1.7.2 The M2 is a dual two lane motorway with hard shoulder on the nearside and hard strip against the central reserve. Over the M2 Stockbury Viaduct, the carriageway is widened to three lanes to provide slip roads from the Stockbury Roundabout. The M2, M2 Junction 5 slip roads and Stockbury Roundabout are part of Highways England Area 4 Asset Support Contract, for which AOne+ is currently the service provider.
- 1.7.3 The routine maintenance requirements for this section of the A249 are typical of other busy dual two lane all-purpose trunk roads. Access to undertake routine maintenance in the verge and central reserve requires the closure of live traffic lanes using TTM³⁸. A single, lane 1 closure is usually required to enable maintenance to be undertaken in the verge whilst lane 2 closures on both carriageways are required to enable routine maintenance works to be undertaken in the central reserve.
- 1.7.4 The operation of TTM is influenced by the following factors:
- Working Window:
 - (1) The high traffic volumes on the A249 of 45,000 vehicles per day means that TTM is usually only implemented during night time off peak traffic periods when the traffic demand can be accommodated within a single running lane. The time period of operation is usually 20:00 to 06:00 hours dependent on the actual traffic volume experienced. Implementation of lane closures during the day, that is 06:00 to 20:00 hours, would normally result in unacceptable congestion at peak periods.
 - Junction arrangements:
 - (1) The existing slip roads are largely single lane with short two lane sections approaching and leaving Stockbury Roundabout. Hard shoulders are provided on the slip roads in the vicinity of the M2, whilst a combination of hard strips or hatched margins on the offside are provided elsewhere. The single lane slip roads are of insufficient width to enable TTM to be implemented with adequate safe working areas and safety zones and so these will need to be closed to provide a safe working environment.
 - (2) Closures of slip roads necessitate the use of the established diversion routes (tactical diversion routes) developed by the Area 4 Service Provider re-routing traffic via the A228 between the M2 Junction 2 and M20 Junction 4. The high traffic volumes using these slip roads mean that TTM is usually only implemented during night time off peak traffic periods similar to the A249 above.

³⁷ DBFO – Design, Build, Finance and Operate

³⁸ TTM - Temporary Traffic Management

1.7.5 Typical access arrangements to undertake maintenance activities include:

- Repair and replacement of steel VRS³⁹ –
 - (1) The maintenance of steel VRS in the central reserve normally requires the closure of the offside lanes both sides of the central reserve to undertake inspections, routine maintenance and repair. The maintenance of steel VRS in the verge requires closure of the nearside lane to undertake inspections, routine maintenance and repair. However, maintenance of steel VRS in the slip roads will require closure of the slip road as a consequence of the current provisions of single lane slip roads.
- M2 Stockbury Viaduct –
 - (1) Access to the substructure and piers to undertake inspections and routine bridge maintenance can be obtained from adjacent land and the central reserve on the A249 and by application of TTM⁴⁰ on the carriageway. AOne+ currently has a site compound located underneath the M2 Stockbury Viaduct on Maidstone Road for regular maintenance activities.
- M2 Stockbury pedestrian overbridge–
 - (1) Access to the substructure and piers to undertake inspections and routine bridge maintenance can be obtained from the central reserve and verges and by application of appropriate TTM on the main carriageways.
- Verge and pavement maintenance –
 - (1) Access to the verges, central reserve and the carriageway on the A249 and M2 all require lane closures with slip road maintenance activities requiring full closures of the slip road.

³⁹ VRS - Vehicle Restraint Systems

⁴⁰ TTM - Temporary Traffic Management

1.8 EXISTING GROUND CONDITIONS

SUPERFICIAL GEOLOGY

- 1.8.1 According to the desktop study undertaken as part of the Preliminary Sources Study in PCF⁴¹ Stage 1 the scheme's superficial geology consists of head deposits and clay-with-flints formations. These are characterised as:
- Head Deposits.
 - Head Deposits comprise sand and gravel, locally with lenses of silt, clay or peat and organic material. They can be red or brown silt and stony clay with cobbles of hard rock.
 - Head Deposits may also contain argillaceous frost-shattered rock debris either in-situ or soliflucted. Soliflucted deposits may have variable sand/clay content.
 - Clay with Flints.
 - The Clay-with-Flints Formation, underlying the Head Deposits, is a residual deposit, which is formed from the dissolution, decalcification and cryoturbation of bedrock strata of the Chalk Group and in the extreme west of the outcrop, the Upper Greensand Formation. It is unbedded and heterogeneous. The dominant lithology is orange-brown and red-brown sandy clay with abundant nodules and rounded pebbles of flint.
- 1.8.2 Although made ground was not found during the desktop study it is anticipated to be present at the site due to historic highway works.

SOLID GEOLOGY

- 1.8.3 The desktop study found that the areas solid geology consisted of:
- Thanet Formation
 - (1) The Thanet formation forms the uppermost solid geology in the study area and consists of glauconitic-coated, nodular flint underline at base by pale yellow-brown and green glauconitic fine-grained sand that can be clayey with rare calcareous or siliceous sandstones.
 - Seaford Chalk Formation (White Chalk)
 - (1) Firm white Chalk with conspicuous semi-continuous nodular and tabular flint seams. Hardgrounds and thin marls are known to be present in the lowest beds within the area with some flint nodules which are large to very large.
 - Lewes Nodular Chalk Formation (White Chalk)
 - (1) Composed of hard to very hard nodular chalks and hardgrounds with interbedded soft to medium hard chalks (some grainy) and marls; some griotte chalks. The softer chalks become less abundant towards the bottom. Nodular chalks are typically lumpy and iron-stained (usually marking sponges).

ARTIFICIAL GROUND

- 1.8.4 The scheme area comprises mixed agricultural land and woodland, with topsoil present to a typical depth of 0.3m below ground level according to British Geological Survey records⁴².

⁴¹ PCF – Project Control Framework

There is potential for localised areas of made ground to exist in agricultural land; for example, where depressions have been infilled to aid farming.

- 1.8.5 The presence of the Chatham Land Front World War I Defences has been confirmed in the scheme area and historically, contained crenelated trenches which were infilled in 1919. These made ground features have the potential to be present across the footprint of the scheme. British Geological Survey logs indicate that made ground is present with a variable thickness (up to 4.5 m) along the existing highways network, and typically comprises sandy silty clay or clayey sand, with chalk and flint gravel and inclusions of asphalt, brick, and metal.

SUPERFICIAL DEPOSITS

- 1.8.6 Stockbury Roundabout and the immediately adjacent sections of the A249 are underlain by a linear northeast to southwest orientated strip of Quaternary age head deposits (clay, silt, sand and gravel), likely reflecting the historical presence of a stream in Stockbury Valley. British Geological Survey logs suggest the head deposits range in thickness from less than 1.0 m to 5.6 m, and describe firm to stiff brown clay with gravels of flint and chalk and occasional lenses of brown sand. Where the deposits are relatively thick they are divided into upper cohesive deposits and lower more granular material (described as head gravel).
- 1.8.7 The land to the east and west of the Stockbury Roundabout is underlain by the Quaternary and Neogene age Clay-with-Flints Formation (clay, silt, sand and gravel). This is a residual deposit of subaerial and pedogenic origin formed from the dissolution, decalcification and cryoturbation⁴³ of bedrock.

BEDROCK GEOLOGY

- 1.8.8 The majority of the scheme area is underlain by the Seaford Chalk Formation (formed in the Cretaceous Period). The scheme area is located on the southern edge of the London Basin and is underlain in the north, northwest and south by the Thanet Formation (sand, silt, and clay, formed in the Palaeogene Period). Published stratigraphy indicates that the Seaford Chalk Formation underlies the Thanet Formation.
- 1.8.9 British Geological Survey logs⁴⁴ from within the Seaford Chalk describe 'structure less chalk' comprising silt-sized chalk with moderately weak sub angular fine to coarse gravel sized chalk fragments and occasional coarse gravel-sized flint. There is a potential for the Seaford Chalk to contain voids as a result of natural dissolution of the chalk or shallow chalk mining.
- 1.8.10 British Geological Survey logs from within the Thanet Formation describe compact grey-brown ironshot fine silty sand with clayey pockets. At TQ86SE6, located adjacent to the M2, the Thanet Formation is present from approximately 2.5 m below ground level to approximately 15 m below ground level, underlain by the Seaford Chalk Formation.

⁴² British Geological Survey logs, British Geological Survey, 2015.

⁴³ Note – the term cryoturbation describes soil movement due to frost action.

⁴⁴ British Geological Survey logs, British Geological Survey, 2015.

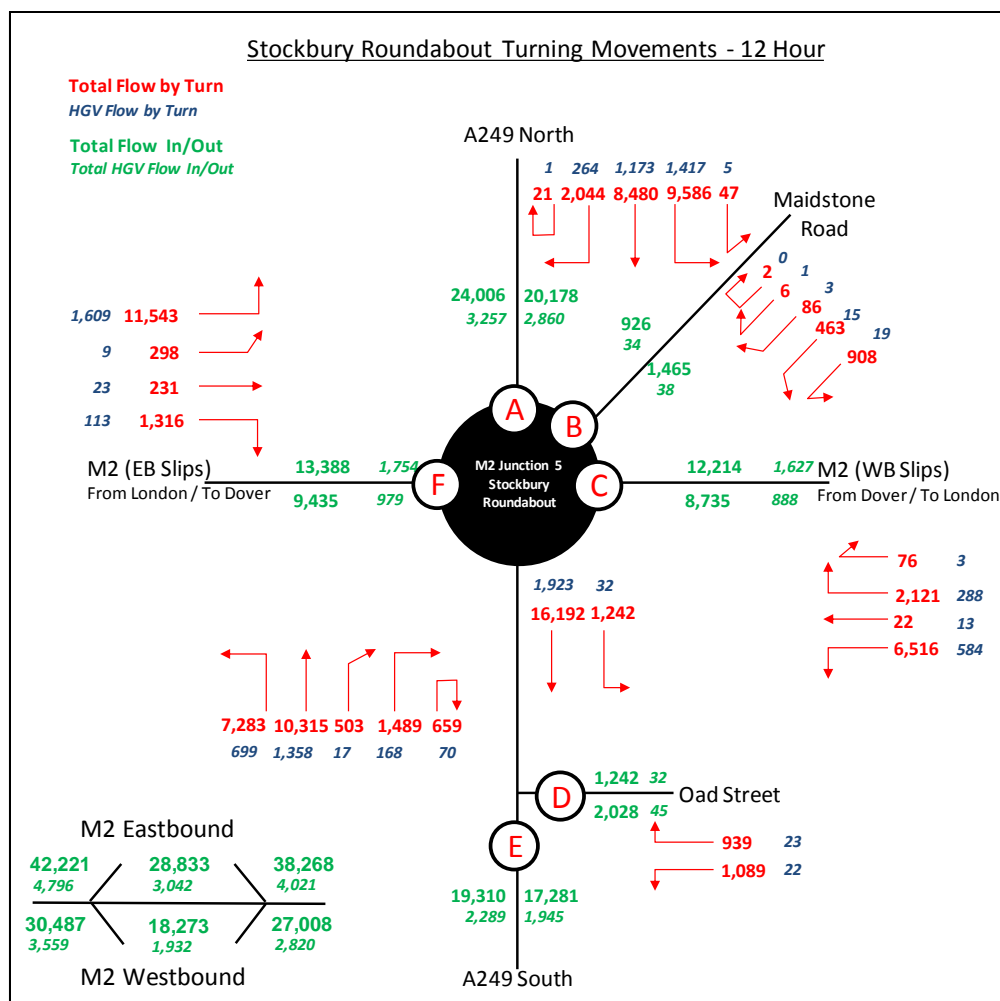
1.8.11 British Geological Survey logs TQ86SE4 and TQ86SE2, located within 250m of the scheme, describe cavities between 12.8 m and 22.5 m below ground level and between 13.4 m below ground level and 18.3 m below ground level respectively, within the upper surface of the chalk bedrock. These may be dissolution features or relicts of historical chalk mining. Envirocheck identifies 'solution pipes' (subcylindrical dissolution features) to the northeast of the scheme.

1.9 EXISTING TRAFFIC CONDITIONS

1.9.1 Manual turning counts were conducted on Wednesday 11 March 2015, Wednesday 18 March 2015 and Thursday 19 March 2015. Moving observer journey time surveys were also undertaken on Wednesday 11 March 2015 to support Traffic Master Data (derived from GPS vehicle tracks).

1.9.2 A summary of the turning counts during the study period (07:00 – 19:00 hours) on Wednesday 11 March 2015 is shown in **Figure 1-4**. Full details of the existing traffic conditions are documented in the PCF⁴⁵ Stage 1 Traffic Data Collection Report⁴⁶.

Figure 1-4 12 Hour (07.00 – 19.00) Turning Movements



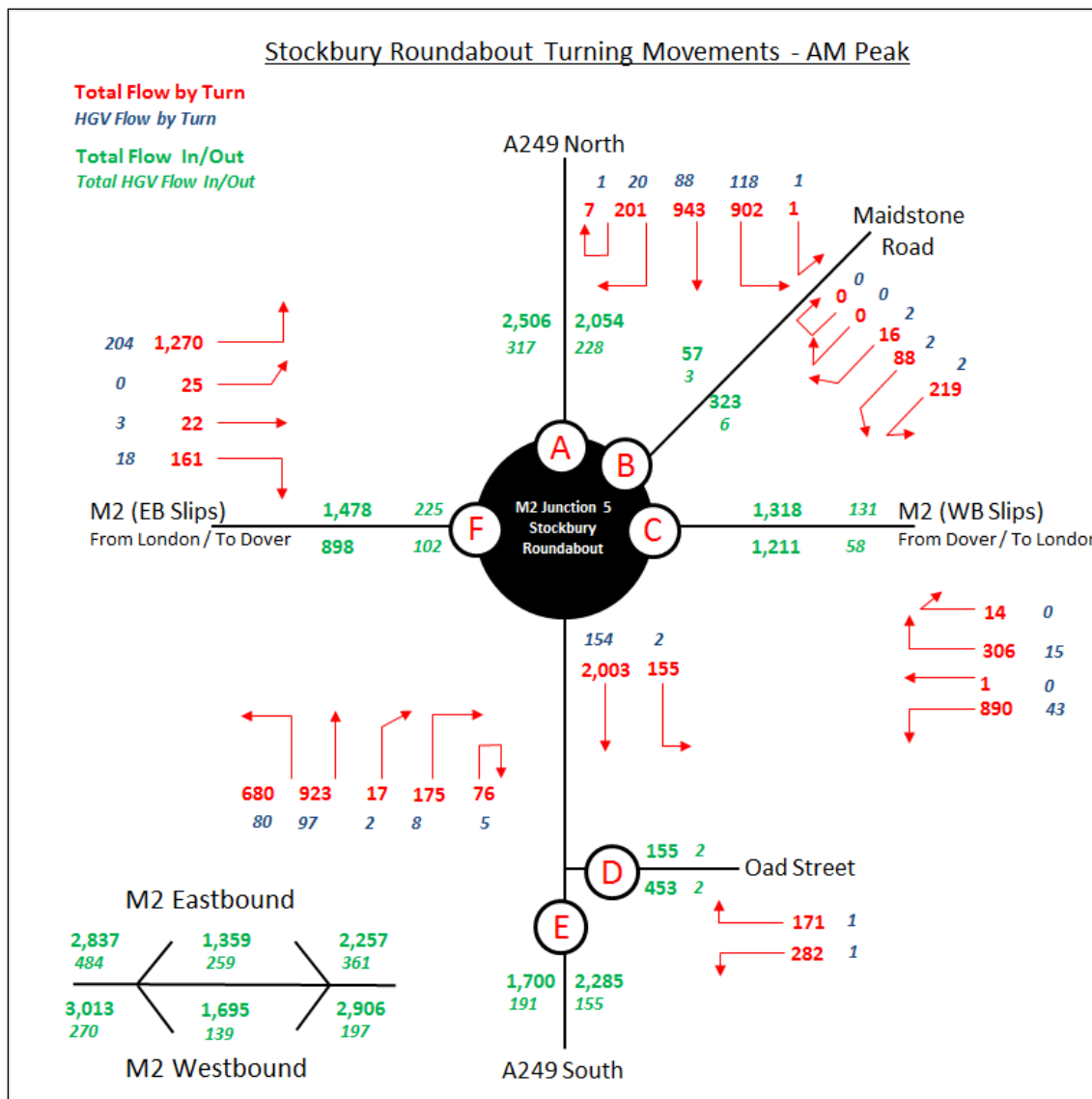
⁴⁵ PCF: Project Control Framework

⁴⁶ Traffic Data Collection Report - Document number:

551521_M2_J5_P013A_DATA_COLLECTION_REPORT_DRAFT_3.0DH2

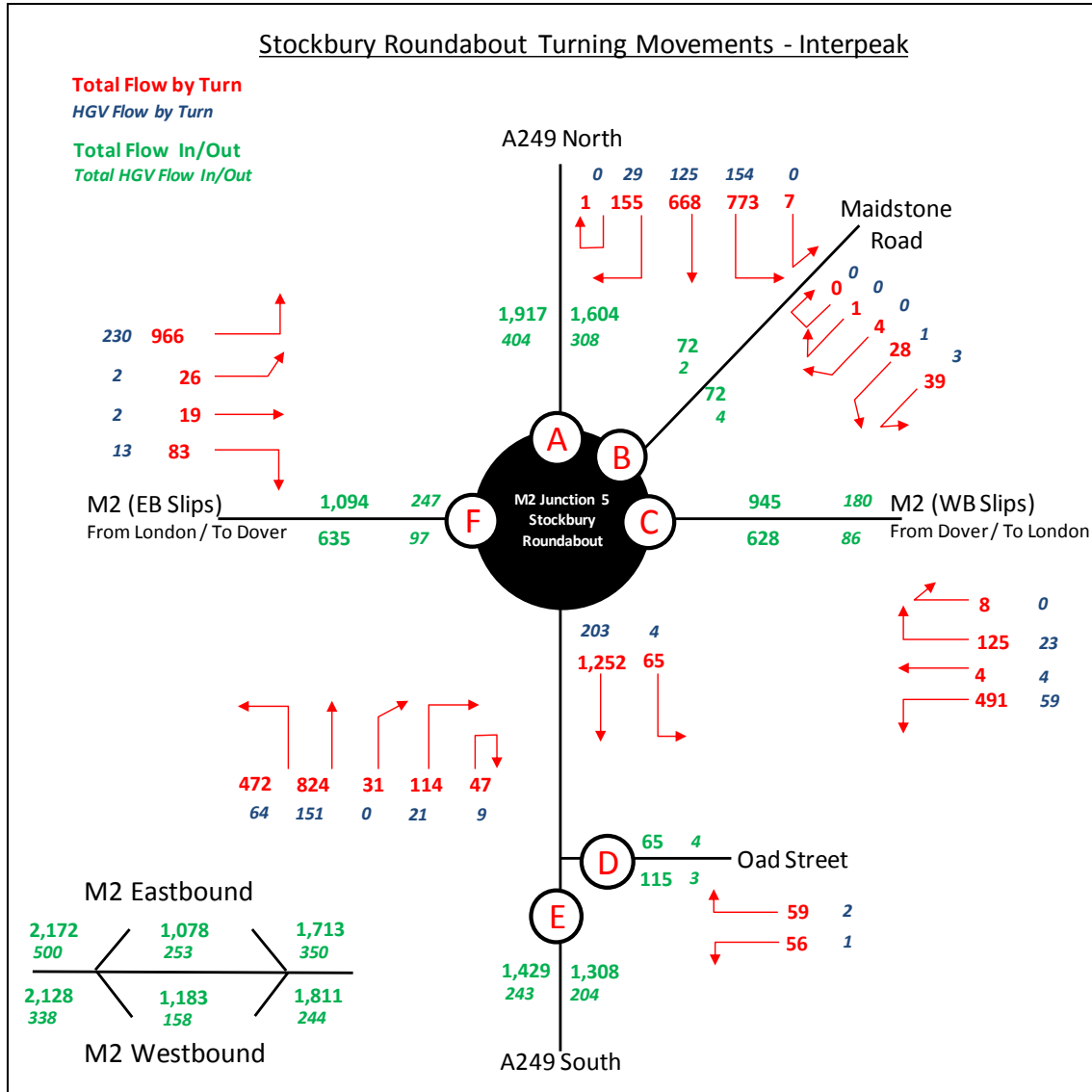
- 1.9.3 **Figure 1-4** also shows the Heavy Goods Vehicle flows in actual numbers (blue text), as well as the total all vehicle flows (red text).
- 1.9.4 It can be seen that the highest link flows (green text), excluding the M2 mainline, occur on the A249 north of Stockbury Roundabout (24,006 northbound plus 20,178 southbound = 44,184 2-way flow), followed by the A249 south of Stockbury Roundabout (19,310 northbound plus 17,281 southbound = 36,591 2-way flow). It can also be seen that the highest movements at the Stockbury Roundabout are as discussed below.
- 1.9.5 To facilitate the M2 eastbound to A249 northbound traffic and the A249 northbound to M2 eastbound, there are existing free-flow links to remove the need for vehicles to enter the roundabout. All other traffic movements are via the circulatory carriageway of the Stockbury Roundabout.
- 1.9.6 The major minor junction between the A249 and Oad Street allows for traffic to leave Oad Street and join the A249 in a northbound or southbound direction. Traffic seeking to enter Oad Street from the A249 has to approach Oad Street from the Stockbury Roundabout as a right turning movement from the A249 into Oad Street is not provided for.
- 1.9.7 The largest junction movement observed between Oad Street and the A249 was that from the A249 southbound into Oad Street, (as above this movement includes all A249 to Oad Street movements). Traffic movements from Oad Street to A249 were split 46% to the south and 54% to the north. Overall, there were a higher number of vehicles exiting Oad Street than entering throughout the day.
- 1.9.8 Given that there are a greater number of turns out of Oad Street than in, it is clear that this provides an alternative route to the A249 from the north of the study area. If these movements were attributable to local traffic only, a tidal pattern would be expected with entry and exit turns being similar.
- 1.9.9 **Figures 1-5 to 1-7** show the breakdown of total traffic flow over the AM, Inter and PM peak hour flows with the corresponding Heavy Goods Vehicle flows shown separately. It should be noted that the peak hours quoted here, as the surveyed peak period, differ from those reported in Section 5.1.10 which represent the modelled peak period and the wider model network peak period.
- 1.9.10 The AM peak hour counts, in **Figure 1-5**, show that the highest flows are the M2 eastbound (from London) to the A249 northbound (1,270) and from the A249 southbound to the M2 westbound (to London) (902) and on the A249 through route (943 southbound and 923 northbound). The flow out of Oad Street is greater than the flow in. The highest Heavy Goods Vehicle movements are from the A249 southbound to the M2 westbound (118) and from the M2 eastbound (from London) to the A249 northbound (204).

Figure 1-5 AM Peak Hour (07:15 – 08:15 hours) Turning Movements



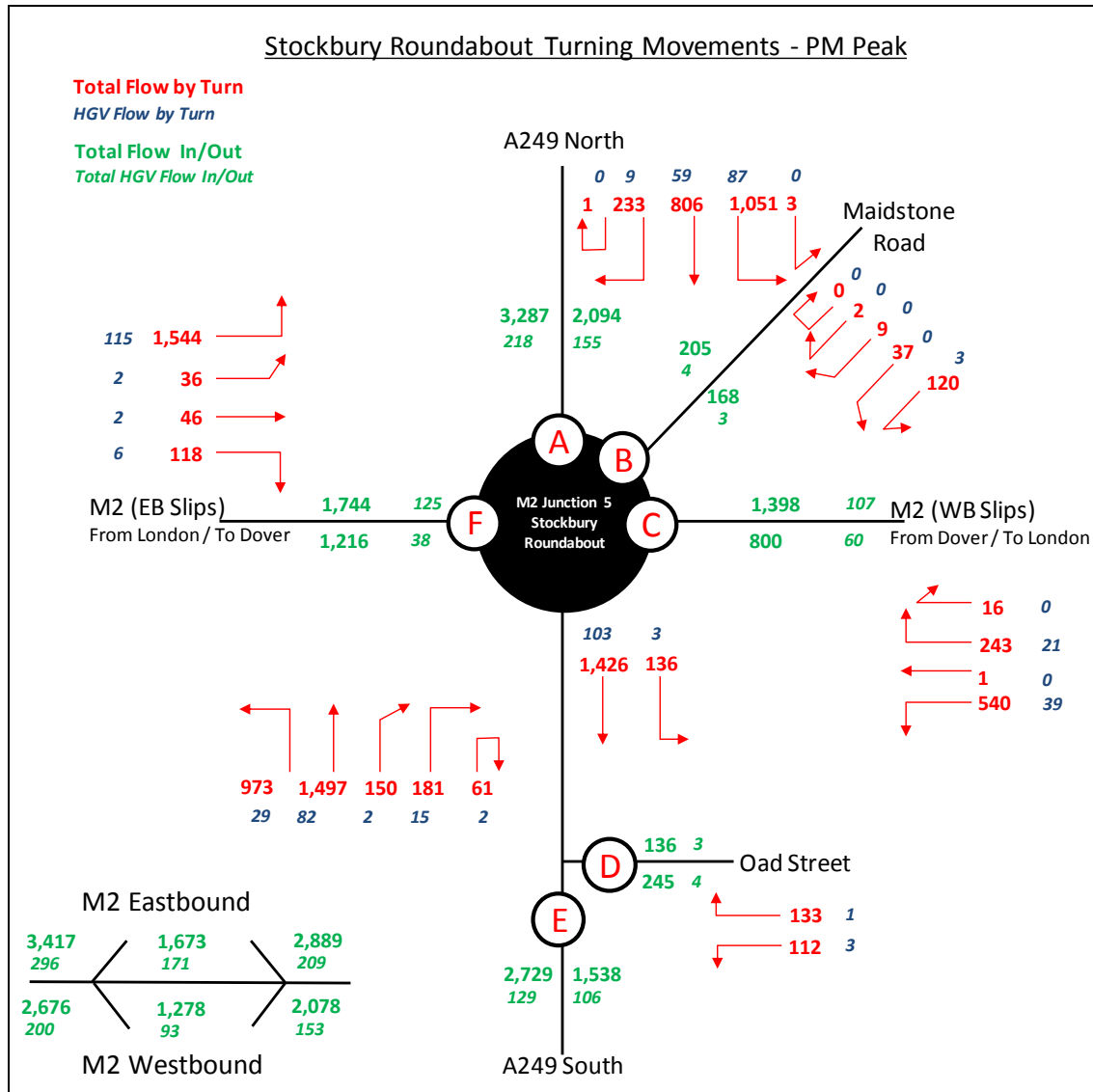
1.9.11 The Inter-peak hour counts, in **Figure 1-6**, show that the highest flows during the Inter-peak hour (14:00 – 15:00 hours) are from the M2 eastbound (from London) to the A249 northbound (966), from the A249 southbound to the M2 westbound (773) and on the A249 through route in both directions (668 s/b and 824 n/b). The highest Heavy Goods Vehicle flows are on the M2 eastbound to A249 northbound (230) and A249 southbound to M2 westbound (154) and the A249 through route (125 southbound and 151 northbound).

Figure 1-6 Inter-Peak Hour (14:00 – 15:00 hours) Turning Movements



1.9.12 The PM peak hour counts, in **Figure 1-7**, show that the highest vehicle flows are on the M2 eastbound to A249 northbound (1,544) and A249 southbound to M2 westbound (1,051) and on the A249 through route (806 southbound and 1,497 northbound). The flow out of Oad Street is significantly higher (109, 80%) than the flow into Oad Street. The highest Heavy Goods Vehicle flows are on the M2 eastbound to A249 northbound (115) and A249 southbound to M2 westbound (87) and on the A249 through route (59 southbound and 82 northbound).

Figure 1-7 PM Peak Hour (17:00 – 18:00 hours) Turning Movements



SUMMARY

1.9.13 In summary the peak hour turning count data shows that the highest flows are on the M2 eastbound (from London) to A249 northbound and A249 southbound to M2 westbound (to London) routes and on the A249 through route, with similar patterns observed for Heavy Goods Vehicles. Throughout all peak hours shown above, the flow out of Oad Street is greater than the flow in, indicating its use as an alternative route to the A249 out of Sittingbourne but not as popular as a route into Sittingbourne.

1.10 EXISTING ENVIRONMENTAL CONDITIONS

1.10.1 For a plan of the existing environmental constraints of the M2 Junction 5 Scheme please refer to **Appendix A-2**.

AIR QUALITY

- 1.10.2 Swale Borough Council currently has six AQMAs,⁴⁷ all due to exceedances of the 40 micrograms per cubic metre criterion for annual mean Nitrogen Dioxide. Five of these are within 200m of the defined Affected Road Network⁴⁸ for the scheme.
- 1.10.3 PM₁₀⁴⁹ concentrations are measured by Swale Borough Council at only one location, which is on the A2 in Faversham. Annual and 24-hour mean concentrations comfortably comply with the relevant criteria. PM_{2.5}⁵⁰ is not monitored within the Swale Borough Council area.
- 1.10.4 Maidstone Borough Council maintains a single AQMA due to exceedances of annual mean Nitrogen Dioxide and 24-hour mean PM₁₀ concentrations. However, there is no evidence to suggest that there has been non-compliance for PM₁₀ concentrations in recent years.
- 1.10.5 The Affected Road Network extends into the Medway Council administrative area. Medway Council has three AQMAs, all due to exceedances of the criterion for annual mean Nitrogen Dioxide. One of them (Rainham AQMA) is within 200m of the Affected Road Network.
- 1.10.6 PM₁₀ and PM_{2.5} are not monitored within 200m of the Affected Road Network in Medway. These pollutants are however monitored by Medway Council outside the study area at Chatham Automatic Urban and Rural Network roadside and Rochester Stoke Automatic Urban and Rural Network rural background sites. Concentrations well below the relevant criteria have been reported for all years since 2011, with some evidence of gradual reductions over time.
- 1.10.7 The AQMAs nearest the scheme are shown on the environmental constraints plan contained in **Appendix A-2**. Twelve months of air quality monitoring, for nitrogen dioxide concentrations, at a number of locations across the wider air quality study area has been undertaken with data from January 2017 to January 2018. Data obtained will be used as part of the air quality assessment to be undertaken at PCF Stage 3, including as input to the baseline and for model verification.

⁴⁷ AQMA – Air Quality Management Area.

⁴⁸ Affected Road Network - the affected road network has been defined in accordance with HA 207/07 scoping criteria as set out in the Design Manual for Roads and Bridges Section 3 Part 1 (HA207/07), former Highways Agency, May 2007. Affected roads are those that meet any of the following criteria:

- Road alignment will change by 5 m or more; or
- Daily traffic flows will change by 1,000 annual average daily traffic or more; or
- Heavy duty vehicle flows will change by 200 annual average daily traffic or more; or
- Daily average speed will change by 10 km per hour or more; or
- Peak hour speed will change by 20 km per hour or more.

⁴⁹ PM₁₀ – Particulate matter with a diameter of 10 micrometres or less.

⁵⁰ PM_{2.5} – Particulate matter with a diameter of 2.5 micrometres or less.

CLIMATE CHANGE

- 1.10.8 In the baseline (do nothing) scenario, greenhouse gas emissions occur constantly and widely as a result of human and natural activity including energy consumption (fuel, power), industrial processes, land use and land use change. Baseline data shows that, in the absence of the scheme, end-user traffic emissions will increase by 19% between 2021 and 2041 for the surrounding road network.⁵¹
- 1.10.9 The baseline for climate resilience comprises historical and future climate data taken from UKCP09 projections⁵² for Grid Box ID 1708. The latter covers the area of the scheme and the surroundings of North Kent.
- 1.10.10 The baseline climate projections show an increasing trend in temperatures both in terms of average daily conditions (during summer and winter) and the daily minimum and maximum temperature extremes. UKCP09 projections are probabilistic, however, focussing on the mid-point projections for the medium emissions scenario; the average daily minimum temperature over winter months is projected to increase from 1.4°C, for the recent historical baseline period, to 4.7°C by the 2080s. The average daily maximum over summer months is projected to increase from 20.4 to 25.1°C over the same period.
- 1.10.11 The baseline projections for average daily rainfall suggest wetter conditions over winter months, increasing from 2 mm to 2.3 mm per day (medium emission scenario, mid-point projection). The projections for summer months suggest a trend towards drier conditions, within average daily rainfall reducing from 1.6 mm to 1.3 mm per day).

NOISE

- 1.10.12 Baseline noise monitoring was undertaken on 10 March and 11 March 2016 to establish existing noise conditions at the noise sensitive receptors surrounding the M2 Junction 5, and to support the validation of the noise model at PCF Stage 2. The noise parameters recorded included L_{A10} , L_{A90} , L_{Aeq} and L_{Amax} . Based on the noise parameter L_{A10} , the noise survey results ranged between 72 $L_{A10,18h}$ dB and 81 $L_{A10,18h}$ dB across the three survey locations.
- 1.10.13 The noise study area for the operational phase was defined in accordance with the methodology set out in the Design Manual for Roads and Bridges⁵³. There are 210 noise sensitive receptors within the defined study area.

⁵¹ Note – this projection is based on Core Scenario Fixed Demand traffic forecasting data (version 9).

⁵² UKCP09 projections - UK Climate Projections, produced by British Atmospheric Data Centre, Environment Agency, Marine Climate Change Impacts Partnership, Met Office, National Oceanography Centre, Newcastle University, Tyndall Centre, University of East Anglia, 2009. UKCP09 projections are provided for the whole of the UK divided into a grid of 25km x 25km squares.

⁵³ Design Manual for Roads and Bridges Volume 11 Section 3 Part 7, former Highways Agency, 2011.

1.10.14 There are seven Noise Important Areas in close proximity to the junction options:

- Noise Important Area 4578 is located north of the Stockbury Roundabout along the A249 – the nearest receptor is approximately 1.60km from the closest extent of any of the junction options;
- Noise Important Area 4577 is located north of the Stockbury Roundabout along the A249 – the nearest receptor is approximately 1.25km from the closest extent of any of the junction options;
- Noise Important Area 4576 is located in Danaway, north of the Stockbury Roundabout along the A247 – the nearest receptor is approximately 250m from the closest extent of any of the junction options;
- Noise Important Area 4575 is located south of the Stockbury Roundabout along the A249 – the nearest receptor is approximately 19m from the closest extent of the junction options;
- Noise Important Area 4574 is located to the south of the Stockbury Roundabout along the A249 – the nearest receptor is approximately 30m from the closest extent of the junction options;
- Noise Important Area 12242 is located to the south of the Stockbury Roundabout along the A249 – the nearest receptor is approximately 300m from the closest extent of any of the junction options; and
- Noise Important Area 4573 is located to the south of the Stockbury Roundabout along the A249 – the nearest receptor is approximately 665m from the closest extent of the junction options.

1.10.15 The Noise Important Areas referenced above are shown on the environmental constraints plan contained in **Appendix A-2**.

LANDSCAPE

LANDSCAPE BASELINE

1.10.16 The M2 Junction 5 is located within a rural landscape. The nearest settlements with views of the M2 and/or the A249 are the small villages of Oad Street, Danaway, Borden Hill and Stockbury. Extensive woodland (screening) planting has been undertaken within the highway boundary next to the M2, the A249, and the Stockbury Roundabout.

1.10.17 The A249 runs north to south along the floor of the steep-sided, well-wooded Stockbury Valley where it is substantially screened from the surrounding landscape. The M2 runs broadly east to west and is mainly at-grade or extends over the Stockbury Valley on a viaduct in proximity to Junction 5.

1.10.18 Landcover surrounding the M2 Junction 5 comprises large arable fields, orchards, and extensive areas of downland woodland. Within the physical extent of the scheme, land within the M2 and the A249 highway boundary includes extensive woodland, shrub and scrub planting areas, with grass verges at the edge of the carriageway. The verges are closely mown to accommodate forward visibility of signs and junctions. The planting, which was undertaken over fifteen years ago following construction of both roads in the 1990s, has now established and achieved its design objectives. It comprises predominantly native species of trees and shrubs including oak, ash, beech, alder, field maple, hawthorn, blackthorn, goat willow, dogwood, elder and hazel. The highway landscape within the Stockbury Roundabout comprises a distinct structure of grass verge, woodland edge and woodland, with scrub / herbaceous vegetation beneath the viaduct.

1.10.19 The landscape study area for the scheme (2km from the scheme centre) is subject to the following statutory and non-statutory designations:

- Part of the landscape study area lies within the Kent Downs AONB⁵⁴ (refer to **Appendix A-2**);
- The southern half of the study area lies within National Character Area 119 – North Downs, and the northern half falls within National Character Area 113 – North Kent Plain;
- The scheme also lies within three LCAs⁵⁵ which are separated by the M2 and A249. These include Chatham Outskirts: Mid Kent Downs LCA, Bicknor: Mid Kent Downs LCA; and the Fruit Belt LCA;
- A locally designated Area of High Landscape Value at Lower Hartlip, which lies on the western edge of the study area; and
- One public footpath (ZR71) lies to the west of the A249 within the physical extent of the junction options and crosses over the M2 on a footbridge. Several other Public Rights of Way lie within the study area (refer to **Appendix A-2**).

VISUAL BASELINE

1.10.20 The zone of visual influence for the scheme was established through computer modelling and site survey.

1.10.21 The site survey identified that the current screen vegetation effectively screens views of the M2 viaduct making it relatively inconspicuous when viewed from within the surrounding area. However, it was identified that the intervening features were less effective at screening impacts attributed to moving vehicles, headlights and high-sided vehicles.

1.10.22 Road lighting on the A249 at the Stockbury Roundabout is set in a deep part of the Stockbury Valley where views are largely contained by the landform. Adjoining sections of the M2 and the A249 are not lit.

1.10.23 The sensitivity of the visual amenity receptors is dependent on the location and context of the view; the expectation, occupation or activity of the visual receptor; and the importance of the view, which may be determined by its popularity, the number of people affected, and whether it is a tourist attraction or has literary or artistic references.

1.10.24 High sensitivity residential receptors within one kilometre of the junction options include:

- Residential properties in Danaway village along Maidstone Road, south of the junction with Wormdale Hill;
- Church Farm on the eastern edge of Stockbury village;
- Bowl Reed and nearby residential properties on the south western edge of Oad Street village; and
- Whipstakes Farm and residential properties near the A249 to the north of Borden Hill village.

⁵⁴ AONB – Area of Outstanding Natural Beauty.

⁵⁵ LCA – Landscape Character Area.

1.10.25 High sensitivity recreational receptors include those using Public Rights of Way in close proximity to the M2 Junction 5. Similarly, people using the Sittingbourne and Milton Regis Golf Course, which adjoins the western side of the A249 to the north of the M2, have opportunities to view the M2 Junction 5. The most relevant PRowS⁵⁶ are shown on the environmental constraints plan included as **Appendix A-2** and listed as follows:

- ZR71 to the north west of the scheme;
- ZR73 to the north east;
- ZR135 to the south east; and
- KH85 to the south west.

1.10.26 Those using local roads are also potential receptors. However, the routes are characteristically narrow and winding, often single track, and enclosed by tall hedges that screen views of the M2 Junction 5. By contrast, panoramic views are available from local roads where they cross over the M2 and the A249.

1.10.27 Site surveys have confirmed that views of the scheme are not available from the Area of High Landscape Value within the landscape study area (i.e. at Lower Hartlip on the western edge of the study area).

CULTURAL HERITAGE

1.10.28 There are a total of 46 heritage assets identified within one km of the M2 Junction 5 as shown on the environmental constraints plan included as **Appendix A-2**, including:

- A Scheduled Monument (Stockbury Castle);
- A Grade I Listed Building;
- A Grade II* Listed Building;
- 20 Grade II Listed Buildings;
- Two World War II crash sites;
- One non-designated historical landscape (Chatham Land Front (Historical Landscape));
- 19 non-designated assets (including the Chatham Land Front World War I defences and the site of an Iron Age furnace within the extent of the scheme); and
- A find spot.

1.10.29 Evaluation trenching undertaken in October and November 2017 confirmed the presence of the Chatham Land Front World War I defences. The fieldwork report that will present the findings of the evaluation (including the confirmed location and significance of the asset) is under preparation at the time of writing. However, the potential locations of the Chatham Land Front World War I defences are indicated on the environmental constraints map included in **Appendix A-2**.

1.10.30 There is the potential for previously unknown heritage assets to be present within areas of previously undisturbed ground.

⁵⁶ PRow: Public Rights of Way

BIODIVERSITY

1.10.31 **Table 1-3** below provides a summary of the designated nature conservation sites within the ecological study area, comprising

- A two km radius from the scheme for protected species records;
- A two km radius from the scheme for statutory and non-statutory designated sites;
- A ten km radius from the scheme for International / European designated sites; and
- A 30 km radius from the scheme for European sites where bats are one of the qualifying interests.

Table 1-3 Statutory and non-statutory designated sites within the ecological study area

| Site Designation and Name | Approximate Distance and Aspect from Junction | Key Habitat Type | Designation Level |
|---|---|--|--------------------------------------|
| The Swale Ramsar Site and Special Protection Area | 8 km north east | Brackish and freshwater, floodplain grazing marsh, intertidal saltmarshes and mud-flats. | Statutory (International / European) |
| North Downs Woodland Special Area of Conservation / Wouldham and Delting Escapement Site of Special Scientific Interest | 7 km south west | Mature beech forest and yew woodland. | Statutory (European / National) |
| Medway Estuary and Marshes Ramsar Site and Special Protection Areas | 5.5 km north | Floodplain grazing marsh, intertidal saltmarshes and mud-flats. | Statutory (International / European) |
| Medway Estuary Marine Conservation Zone | 5 km north east | Estuary supporting a diverse range of habitats and species including the national scarce tentacle lagoon-worm (<i>Alkmaria romijni</i>). | Statutory (National) |
| Queendown Warren Special Area of Conservation | 1.9 km west | Unimproved chalk grassland and scrub. | Statutory (European) |
| Queendown Warren Local Nature Reserve | 1.9 km west | Unimproved chalk grassland and scrub. | Statutory (National) |
| Stockbury Wood Local Wildlife Site | 2 km south west | Yew, hornbeam and oak woodland. | Non-Statutory |
| Squirrel Wood Local Wildlife Site | 1.7 km south | Species-rich nature reserve; woodland habitat with key species including English oak, yew and beech. | Non-Statutory |

| Site Designation and Name | Approximate Distance and Aspect from Junction | Key Habitat Type | Designation Level |
|--|---|-----------------------------------|-------------------|
| MA04 Roadside Nature Reserve ⁵⁷ | 0.7 km south west | Unknown – likely to be grassland. | Non-Statutory |
| MA11 Roadside Nature Reserve | 1.4 km south west | Unknown – likely to be grassland. | Non-Statutory |

1.10.32 The dominant habitats identified during the Extended Phase 1 Habitat Surveys, undertaken in March 2015, May 2016, and May / June 2017, were:

- Semi-natural broad-leaved woodland including semi-natural Ancient Woodland;
- Broad-leaved plantation woodland;
- Scattered broad-leaved trees;
- Mixed plantation woodland;
- Dense/continuous and scattered scrub;
- Semi-improved neutral grassland;
- Species-poor semi-improved grassland;
- Amenity grassland;
- A single parcel of dense tall ruderal vegetation;
- Species-poor intact hedge;
- Species-poor defunct hedge;
- Hedgerow with trees;
- Arable land;
- Ephemeral / short perennial;
- Buildings and hard standing;
- Introduced shrub; and
- Standing water.

1.10.33 Two parcels of Ancient Woodland, Chestnut Wood and Church Wood, are located in close proximity to the scheme options.

⁵⁷ Note - roadside nature reserves are non-statutory designated sites of local importance. Roadside nature reserves are a network of roadside verges that have been identified through the Road Verge Project (a partnership between Kent County Council, Kent Highways and Kent Wildlife Trust) as containing scarce or threatened habitats or species.

1.10.34 The PCF⁵⁸ Stage 2 desk study, PCF Stage 2 ecology surveys and the preliminary results of the Advanced PCF Stage 3 ecology surveys indicate that the following protected or notable species are potentially present within one km of the scheme options:

- Invertebrates;
- Breeding birds;
- Dormice;
- Bats;
- Reptiles; and
- Badgers.

WATER ENVIRONMENT

1.10.35 The water resources described in the following paragraphs are shown on the environmental constraints plan provided as **Appendix A-2**.

SURFACE WATER

1.10.36 A shallow ditch was observed running along Maidstone Road to the north of the M2. The ditch was found heavily overgrown with vegetation, and was dry at the time of inspection. The ditch is likely to form part of the existing highway drainage system as no watercourse was identified in this area.

1.10.37 A small pond has been identified at the Gate House adjacent to the A249 to the north of the existing Oad Street junction, which is understood to form part of the surface water management system for the highway network.

1.10.38 There are no other known standing-water features (ponds, pools, reservoirs, lakes) within the maximum physical extent of the study area (the scheme options with a 500 m buffer) that may constitute potential receptors.

GROUNDWATER

1.10.39 The M2 Junction 5 is partially located within the Total Catchment (Zone 3) and Outer Zone (Zone 2) of a designated groundwater Source Protection Zone. The area further north between the M2 and the Key Street Junction is partially located within the Inner Zone (Zone 1) and Outer Zone (Zone 2) of a designated groundwater source protection zone.

1.10.40 The Groundwater Vulnerability Zones map indicates that the majority of the area beneath the scheme options is underlain by Principal Aquifer overlain with soils of high leaching potential.

1.10.41 Groundwater monitoring currently underway in Winter 2017/2018, to determine the presence and depth of groundwater in the scheme area. Data collected will be used to inform the design of the scheme at PCF Stage 3.

⁵⁸ PCF – Project Control Framework

FLOOD RISK

- 1.10.42 Consultation with the Environment Agency confirmed that the scheme lies within Flood Zone 1 (land assessed as having a less than 1 in 1,000 year annual probability of fluvial flooding in any year (i.e. less than 0.1%).
- 1.10.43 The Environment Agency Flood Risk from Surface Water map indicates that the area along the A249 and Maidstone Road is at high risk of flooding from surface water, most notably immediately to the south of the Stockbury Roundabout. Land at high risk of surface water flooding is described as having a 3.33% (1 in 30) or greater annual probability of flooding in any year. It is therefore likely that the indicated risk of flooding in this area is associated with overland flows from the surrounding land.
- 1.10.44 The Swale Surface Water Management Plan⁵⁹ also shows that there are records of highway flooding in the immediate vicinity of the junction, directly to the north of the Stockbury Roundabout and west of the A249.

PEOPLE AND COMMUNITIES

MOTORISED TRAVELLERS

- 1.10.45 A mix of restricted, open and intermittent views are available to motorised travellers in proximity to the M2 Junction 5. In general, views from the road of the surrounding area are considered to provide a positive experience for motorised travellers.
- 1.10.46 The M2 Junction 5 was identified in the top 50 national casualty locations as well as being one of the main areas within the Kent Corridors to the M25 study route which interacts with vulnerable road users. In total, 33 collisions with the highest severity rating occurred between 2009 and 2011.
- 1.10.47 Collision data obtained from Kent County Council for the period between 1 October 2009 and 31 September 2014 indicates that there were 92 collisions reported immediately around the M2 Junction 5, 88 being categorised as slight collisions and four being categorised as serious collisions.

⁵⁹ Swale Surface Water Management Plan, Kent County Council, April 2013.

PEDESTRIANS, CYCLISTS AND EQUESTRIANS

1.10.48 There are several PRoW⁶⁰ adjacent to or intersecting with sections of road within the scheme area. PRoWs within 500m of the scheme include:

- ZR71 - A footpath located to the north of the M2, and to the west of the A249 connecting Wormdale Hill Road outside Danaway, and Bridleway ZR72A, to the footpath ZR70.
- ZR70 – A footpath located to the west of the A249 and predominantly to the north of the M2, starting at the northern ends of byway KH653 and footpath KH85, passing over the M2 on the Stockbury pedestrian overbridge and then continuing westwards to connect to Bull Lane in Hartlip;
- KH653 - A BOAT⁶¹ along a section of Green Lane (a track) in Stockbury, connecting to footpath ZR70;
- KH85 - A footpath located to west of the A249 and to the south of the M2 connecting footpath ZR70 and BOAT KH553 to the A249 and passing through Church Wood. The footpath does not include a safe crossing point on the A249, and is considered to be a dead end at this location.
- ZR73 – A BOAT along Woodgate Lane, connecting to Maidstone Road and Oad Street.

1.10.49 The PRoWs described above are shown on the environmental constraints plan provided in **Appendix A-2**. No pedestrians were observed at the M2 Junction 5 during the NMU Context Report⁶² sampling and there are no pedestrian facilities on site relating to the existing highways infrastructure. Furthermore no desire lines were identified within the study area.

1.10.50 An average of two cyclists per day were observed during the NMU Context Report sampling; however there are no dedicated provisions for bicycles within the study area and cyclists were observed unsafely using the A249 carriageway. No formal numbered regional or national cycle routes are listed within the study area; however, there is one local route on Maidstone Road which terminates at the M2 Junction 5.

1.10.51 There are four bus stops within the study area. Two of these are located on either side of the A249, approximately 60 m south of where Oad Street meets the A249. Two others are located on either side of Maidstone Road approximately 800 m north of the M2 Junction 5. The NMU Context Report states that four bus services run through these bus stops on a daily basis, ranging from an hourly service to a once-per-day service. These bus stops were observed as being used sparingly by the public, with five passengers being recorded on the day of sample.

PEOPLE

1.10.52 The Indices of Multiple Deprivation use a combination of information relating to income, employment, education, health, skills and training, barriers to housing and services, and crime to create an overall score of deprivation. The Indices of Multiple Deprivation for the Lower Super Output Areas within the scheme area indicate that the scheme area is neither severely deprived nor overly affluent; however this may not be an accurate gauge of the deprivation level of the area as a whole due to the small number of dwellings in the area.

⁶⁰ PRoW – Public Rights of Way

⁶¹ BOAT: Byway Open to All Traffic

⁶² M2 Junction 5 Improvement Study PCF Stage 1 Non-Motorised User Context Report, October 2016.

1.10.53 Employment statistics⁶³ for the district of Swale show that the number of economically active employed and economically active unemployed residents is lower than both the regional and national average. The number of economically inactive residents is lower than the national average, but higher than the regional average. Key industries in the district include 'wholesale and retail trade' (16.5%), 'human health and social work activities' (10.9%), 'construction' (10.6%) and 'manufacturing' (10.3%).

1.10.54 Employment statistics⁶⁴ for the district of Maidstone show that the number of economically active employed is higher than the regional and nationally average at 72.9%, and the unemployment is the same as the regional average and slightly lower than the national average. The number of economically inactive residents is lower than the regional and national average.

1.10.55 Census information provided by the Office for National Statistics⁶⁵ provided the following information for the social profile of Swale:

- The gender composition of the Swale district is approximately 50.56% female and 49.44% male, which is comparable to the national average of 50.7% female and 49.3% male;
- The district is relatively under represented by ethnic minorities. Approximately 92.9% of the population of Swale district identifies as 'White British' compared to 87% in England. Other ethnic groups of notable size in the district include:
 - Other White Persons (2.5%);
 - Black/African/Caribbean (0.7%);
 - White Irish (0.6%); and
 - White Gypsy/Traveller (0.5%); and
- In terms of religion, the majority of the population of Swale district describe themselves as Christian (63%). Other faiths were largely under-represented when compared to regional and national averages.

1.10.56 Census information provided by the Office for National Statistics⁶⁶ provided the following information for the social profile of Maidstone:

- The gender composition of Maidstone district is approximately 50.7% female and 49.3% male, which is comparable to the national average of 50.7% female and 49.3% male.
- The district is relatively under represented by ethnic minorities. Approximately 89.1% of the population of Swale district identifies as 'White British' compared to 87% in England. Other ethnic groups of notable size in the district include:
 - Other White Persons (4.9%);
 - Mixed/multiple ethnic groups (1.5%);
 - Black/African/Caribbean/Black British (0.9%); and
 - Asian/Asian British (3.2%); and
- In terms of religion, the majority of the population of Maidstone district describe themselves as Christian (62.9%). Other faiths were largely under-represented when compared to regional and national averages, apart from the Buddhist faith which had a very slightly high representation in the district when compared to the regional average (+0.01%).

⁶³ Employment Statistics, Office for National Statistics, 2011.

⁶⁴ Labour Market Profile – Maidstone, Nomis Official Labour Market Statistics, 2016.

⁶⁵ 2011 Census, Office for National Statistics, 2011.

⁶⁶ Ibid.

- 1.10.57 The overall number of people in very good health in Swale district is below the national average. Furthermore, the number of people in bad and very bad health is above the national average.
- 1.10.58 The Public Health England Health Profile for Swale district⁶⁷ indicates that 23.6% of children within the district live in low income houses. Adult life expectancy within the more deprived areas of Swale is reduced by between 8.6 (male) and 4.2 (female) years when compared to more affluent areas.
- 1.10.59 As of 2017 28.0% of adults and 19.6% of children within the Swale district were classified as obese.⁶⁸
- 1.10.60 The overall number of people in very good health in Maidstone district is below the national average. Furthermore, the number of people in bad and very bad health is above the national average.
- 1.10.61 The Public Health England Health Profile⁶⁹ for Maidstone district indicates that 15% of children within the district live in low income houses. Adult life expectancy within the more deprived areas of Maidstone is reduced by between 6.4 (male) and 4.0 (female) years when compared to more affluent areas.
- 1.10.62 As of 2017, 18.6% of children within the Maidstone district were classified as obese.

COMMUNITIES

- 1.10.63 The scheme is located between Danaway and Stockbury villages, with the closest large settlement being Sittingbourne, which is located approximately five kilometres northeast of the existing M2 Junction 5. Other communities near to or within the study area include Borden, Oad Street, Newington, and South Green, among multiple other smaller settlements. It is likely that the M2 Junction 5 provides primary access to larger settlements such as Maidstone and Sittingbourne.
- 1.10.64 Sittingbourne is a large town with a population of approximately 62,500 people. Due to its size it contains a large number of community facilities including shops, places of worship, a rail link, multiple infant, primary and secondary schools, a number of post offices, and other facilities such as a leisure centre, parks, pharmacies, and a go-kart circuit.
- 1.10.65 Likely journeys expected to take place to and from Sittingbourne include:
- Journeys from smaller communities to Sittingbourne, in order to access the wide range of facilities within Sittingbourne that cannot be provided by smaller settlements;
 - Journeys to Sittingbourne from smaller local communities in order to access employment and education facilities;
 - Journeys from Sittingbourne to communities within the Kent Downs Area of Outstanding Natural Beauty in order to access leisure activities related to the Area of Outstanding Natural Beauty; and
 - Journeys to Sittingbourne from the local area for rail journeys, in particular trains connecting into London Victoria and London St Pancras.
- 1.10.66 Danaway is a very small community located approximately 500 m northeast of the M2 Junction 5. It is primarily residential and contains no community facilities. It is therefore expected that journeys will be made to surrounding larger settlements (for example, Newington and Sittingbourne) to meet the requirements of its small population.

⁶⁷ Health Profile for Swale District, Public Health England, 2017.

⁶⁸ Health Profile for Swale District, Public Health England, 2015.

⁶⁹ Health Profile for Maidstone District, Public Health England, 2017.

- 1.10.67 Stockbury is a village located within the Kent Downs AONB⁷⁰, approximately 1.3 km southwest of the M2 Junction 5. Stockbury is primarily residential but contains a small number of community facilities including a pub and a parish church. Due to the small number of facilities in the village, it is expected that trips to larger settlements will be required to meet the needs of the population. Trips to Maidstone or Sittingbourne are considered to be the most likely.
- 1.10.68 Borden is a village located approximately 2.85 km northeast of the M2 Junction 5 and has a population of approximately 2,500 people. The village contains a number of community facilities such as a parish hall, parish church, a pub, and a cricket ground. Due to the proximity of the village to Sittingbourne, it is expected that residents of Borden will travel to Sittingbourne to meet the majority of their needs.
- 1.10.69 Oad Street is a very small community located approximately 1.5 km east of the M2 Junction 5. It contains a small number of residential properties as well as a chapel, a pub and a craft centre which contains a café. It is expected that residents of Oad Street will travel to Sittingbourne along the A249, or Chatham along the M2, in order to meet their needs.
- 1.10.70 Newington is a village located approximately 2.75 km north of the M2 Junction 5. The village contains a rail link, post office, multiple restaurants, a supermarket, a church, and a village hall. Due to its size, it is expected that trips from Newington to local larger settlements will be less than when compared to smaller settlements in the area. Newington also has the potential to be seen as an alternate source of community facilities for local settlements. It is noted that Newington Train Station offers the same connection to London as trains servicing Sittingbourne Train Station, connecting with London Victoria, London St Pancras and London Cannon Street in between approximately 55 minutes and 75 minutes. This connection is expected to be utilised by a range of people, including commuters in particular. Buses also service Newington, providing connections with other communities in the south east of England, to London and beyond.
- 1.10.71 The scheme is located on the boundary of the Kent Downs AONB which is considered to have both tourism and recreational value. The AONB provides walking, cycling, and equestrian facilities, as well as a number of woods, hills, churches and other features that people may visit for recreation or tourism. The closest recreational attraction to the scheme is Sittingbourne and Milton Regis Golf Club, located approximately 1.2 km north of the M2 Junction 5. The M2 Junction 5 also provides direct links to Sittingbourne, which contains a number of recreational facilities such as the Sittingbourne Greyhound Track and Bayford Meadows Kart Circuit.
- 1.10.72 In terms of agricultural land classification, areas of land immediately adjacent to the junction options are classified as 'good to moderate'. Approximately 40 metres northwest of the M2 eastbound slip road and 40 m northeast of Maidstone Road, the agricultural land classification changes to 'very good'. Approximately 410 m northwest of the M2 eastbound slip road and 1.9 km east of Maidstone Road, the land is classified as 'excellent'. All these grades are considered to be best and most versatile agricultural land.

⁷⁰ AONB – Area of Outstanding Natural Beauty

GEOLOGY AND SOILS

GROUND CONDITIONS AND DESIGNATED GEOLOGICAL SITES

1.10.73 A description of the existing ground conditions in the scheme area is provided in **Section 1.8**.

1.10.74 There are no geological Sites of Special Scientific Interest or RIGS⁷¹ within the study area, which is defined as the extent of the scheme options plus a 250 m buffer zone.

SOILS

1.10.75 The strategic Agricultural Land Classification map for London and the South East (ALC007) published by Natural England in August 2011⁷² (based on data obtained between 1967 and 1974) shows the agricultural land within the study area is Grade 1 (excellent), Grade 2 (very good) and Grade 3 (good to moderate) agricultural land.⁷³

1.10.76 Land of Grades 1, 2, and 3a is defined as best and most versatile agricultural land by the National Planning Policy Framework.⁷⁴ The study area is therefore assumed to contain a proportion of best and most versatile agricultural land (Grades 3a and 3b are not differentiated in strategic scale agricultural land classification mapping). No detailed agricultural land classification mapping is available.

1.10.77 In groundwater vulnerability mapping, the study area is underlain primarily by soils of high leaching potential (H1). These are soils which readily transmit liquid discharges because they are either shallow or susceptible to rapid by-pass flow directly to rock, gravel or groundwater. The northern part of the study area is underlain by soils of intermediate (I1) leaching potential. These are soils which can possibly transmit a wide range of pollutants.

TOPOGRAPHY

1.10.78 The scheme area is located within Stockbury Valley. Ground elevation increases to the northwest and southeast. A north west to south east topographical profile along the M2 shows ground elevation varying from 80-100 m AOD⁷⁵ in the north west to 60 m AOD in the centre to 75-85 m AOD in the south east.

CONTAMINATED LAND

1.10.79 The study area contains potential sources of contamination (the disused filling station adjacent to Maidstone Road and made ground).

1.10.80 Asbestos was discovered in close proximity to the AOne+ site compound underneath the M2 Stockbury Viaduct during the preliminary stages of the archaeology intrusive surveys being undertaken by Hochtief. The details of the discovery will be covered in the Health and Safety File to be produced by Hochtief as Principal Contractor for the intrusive survey works.

⁷¹ RIGS - Regionally Important Geological and Geomorphological Site.

⁷² Agricultural Land Classification map for London and the South East, Natural England, 2011.

⁷³ Note - the agricultural land classification map on which this review is based (published in 2010) is part of a series at 1:250 000 scale and is not sufficiently accurate for use in the assessment of individual sites.

⁷⁴ National Planning Policy Framework, Department for Communities and Local Government, March 2012.

⁷⁵ AOD – Above Ordnance Datum.

MATERIALS

- 1.10.81 The operation, maintenance and management of the current M2 Junction 5 assets requires a small number of specialist components (for example, light bulbs, signage steelwork for replacement barriers) as well as some bulk material (asphalt for minor re-surfacing) for routine works and repairs of the highway and ancillary infrastructure. The current consumption of construction and other materials within the current scheme footprint is, however, deemed negligible.
- 1.10.82 2015-2017 data^{76,77,78,79,80,81} on the general availability of construction materials in the south east of England and across the UK indicate that the scheme should be delivered without serious detriment to stocks / production / sales.
- 1.10.83 It is expected that in order to operate and manage the current M2 Junction 5 asset, the generation of site arisings is negligible. Department for Environment, Food and Rural Affairs data⁸² shows that within England, the recovery rate for non-hazardous construction and demolition arisings have remained above 90% since 2010. This exceeds the EU target of 70%, which the UK must meet by 2020. No regional data for CDE⁸³ production or recovery rates are currently available for the south east of England.
- 1.10.84 A number of licensed recovery facilities (all waste types) were available in the south east in 2016,⁸⁴ as follows:
- 405 transfer facilities (334 accepted inputs in 2016);
 - 394 treatment facilities (309 accepted inputs in 2016);
 - 202 metal recovery facilities (121 accepted inputs in 2016); and
 - 18 use of waste⁸⁵ facilities (6 accepted inputs in 2016).
- 1.10.85 The operation and management of the M2 Junction 5 is likely to generate small amounts of waste from littering, light replacement, signage replacement, replacement of reflective road studs (cats' eyes), and minor barrier refurbishments. The anticipated effects of disposing of this waste are deemed to be negligible in the context of available regional capacity.
- 1.10.86 Environment Agency data⁸⁶ demonstrates an increasing shortage of landfill capacity in England: 723 million m³ of capacity was recorded in 1998/ 99, and 464 million m³ in 2016, representing a 36% reduction over a period of 16 years.

⁷⁶ Monthly Bulletin of Building Materials and Components, Department for Business Innovation & Skills, January 2016.

⁷⁷ Annual Aggregates Monitoring Report 2015, North East Aggregates Working Party, 2015.

⁷⁸ Monthly Bulletin of Building Materials and Components, Department for Business Innovation & Skills, January 2016.

⁷⁹ Minerals produced in the UK, British Geological Society, 2014.

⁸⁰ The Mineral Products Industry at a Glance, Mineral Products Association, 2016.

⁸¹ Forestry Statistics, Chapter 2 UK-Grown Timber + Data Downloads, Forestry Commission, 2017.

⁸² UK Statistics on Waste, Defra, December 2016.

⁸³ CDE – construction, demolition and excavations.

⁸⁴ Waste Management Information 2016 (England), Data Tables, Environment Agency, 2016.

⁸⁵ Use of waste facilities abide by standard rules permits for the use of waste in construction, reclamation and manufacture of timber

⁸⁶ Waste Management Information 2016 (England), Data Tables, Environment Agency, 2016.

1.10.87 At the end of 2015, 91 landfill sites in the South East were recorded as having 75.19 megatonnes of remaining capacity.⁸⁷ Approximately 29.8 megatonnes of this remaining capacity was landfill capacity for inert waste, approximately 46.6 megatonnes was landfill capacity for non-hazardous waste and 560,000 m³ was landfill capacity for hazardous waste.

⁸⁷ Environment Agency, 2015 Remaining Landfill Capacity – Operator Site Submissions [[link](#)]

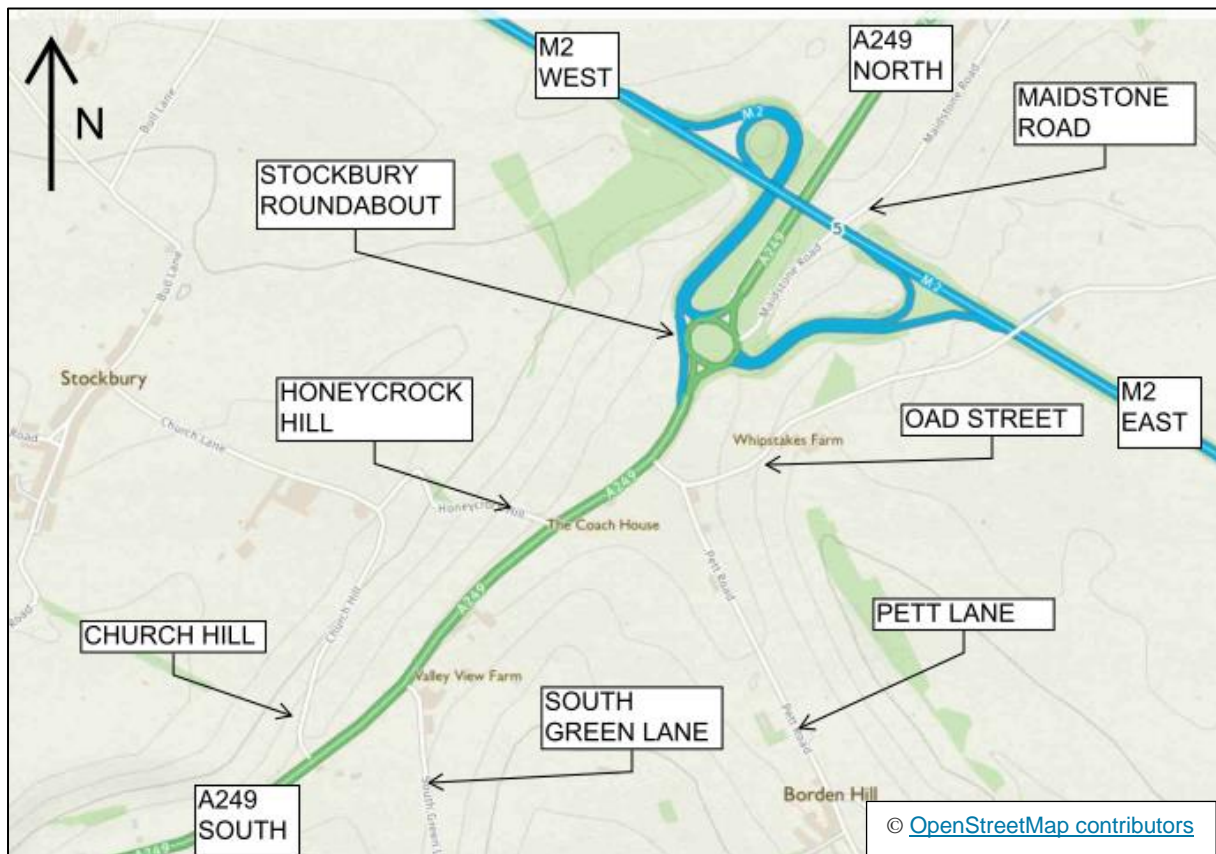
2 PLANNING FACTORS

2.1 INTRODUCTION

2.1.1 This section of the report explains the development of the scheme options up to the PCF⁸⁸ Stage 2 public consultation. The scheme options were developed taking into account the scheme objectives and Road Investment Strategy Statement as stated in **Section 1.4**.

2.1.2 **Figure 2-1** shows a plan of the existing route and its associated links.

Figure 2-1 : M2 Junction 5 Stockbury Roundabout



⁸⁸ PCF: Project Control Framework

2.2 PCF STAGE 0

PURPOSE OF PCF STAGE 0

- 2.2.1 The purpose of PCF⁸⁹ Stage 0, from the PCF guidance is:
- Identify whether there is a transport issue;
 - Identifying whether there are viable transport scheme solutions to the problem, and whether these include a road improvement project; and
 - Initiate a roads improvement project, if appropriate.

OPTIONEERING

- 2.2.2 It was confirmed in PCF Stages 0, that given the scale of the problem identified at M2 Junction 5, there was little scope for alternative modes to play a part for providing sufficient congestion relief at the junction. The assessments to date have therefore been limited to only highways solutions.
- 2.2.3 During PCF Stage 0 a range of junction improvement options were considered, identifying various different ways of providing additional capacity at the junction. These options are shown in the Options Log and Optioneering Log included in **Appendix B-1** and **Appendix B-4**, and covered aspects such as those listed below:
- Additional capacity on the A249 approaches to the junction;
 - Free flow links for the dominant traffic movements;
 - Additional capacity at the roundabout via at-grade improvements; and
 - Additional capacity at the roundabout via grade separated improvements.
- 2.2.4 Four options, as listed below, were selected covering the range of options, in terms of size, scale and operation. These four options were assessed as described in the Strategy, Shaping and Prioritisation Report⁹⁰.
- Option 4 – A249 Flyover / Fly-under;
 - Option 6 – A249 Through-about (Hamburger);
 - Option 7 – Two-tier Dumbbell (east-west);
 - Option 10 – Three-tier intersection.
- 2.2.5 To ensure the options above were viable from a cost point of view; an initial order of magnitude estimate was produced by Benchmark Estimating Limited in September 2015 for Option 7. Option 7 was considered the medium complexity option and provided a median cost estimate for all options. The order of magnitude estimate was £25million.

⁸⁹ Project Control Framework

⁹⁰ PCF Stage 0 Report – Strategy, Shaping and Prioritisation, September 2015, WSP / Atkins

2.3 PCF STAGE 1

PURPOSE OF PCF STAGE 1

2.3.1 The purpose of PCF⁹¹ Stage 1, from the PCF guidance is:

- Identify options to be taken to public consultation in PCF Stage 2;
- Assess options in terms of environmental impact, traffic forecasts and economic benefits; and
- Refine the cost estimate of options (including an allowance for risk).

OPTIONEERING

2.3.2 In PCF Stage 1 a number of variants and layouts based around Options 4, 6, 7, 8 and 10 from PCF Stage 0 were developed and evaluated. The optioneering consisted of looking at improvements to the following elements of the scheme:

- A249 Carriageways:
 - (1) At-Grade;
 - (2) Grade-Separated;
- M2 and M2 Slip-Roads:
 - (1) M2 Mainline;
 - (2) M2 Slip Roads
 - (a) Free-flow links;
 - (b) Improved alignments (merge / diverge improvements);
 - (3) M2 / A249 Interchanges
- Local Road Network:
 - (1) Maidstone Road;
 - (2) Oad Street;
 - (3) Honeycrook Hill;
 - (4) Church Hill.

2.3.3 A more detailed account of the optioneering of each element of the scheme for PCF Stage 1 can be found in **Appendix B-4**.

⁹¹ PCF: Project Control Framework

OPTION TESTING

- 2.3.4 As part of the development of the options they were tested in a local traffic model of the junction, as summarised in the Options Log included in **Appendix B-1**.
- 2.3.5 Option testing during PCF⁹² Stage 1 was undertaken using a VISSIM micro-simulation model of the M2 Junction 5 as there was no strategic model available at the time. This local model covered the M2 Junction 5 / A249 Stockbury Roundabout, a section of the M2 motorway and all the slip roads, the A249 approaches from both the north (Sittingbourne) and south (Maidstone) and the Maidstone Road approach to Stockbury Roundabout. The A249 junction with Oad Street to the south of Stockbury Roundabout was also included due to its interactions with the roundabout.
- 2.3.6 Whilst this VISSIM model was sufficiently robust to assess the performance of various scheme options at a localised level it was not possible to assess the impact of the options on the wider network due to its limited network coverage. Hence this micro simulation model of the junction could not assess the potential re-assignment of traffic across the wider highway network, such as the transfer of vehicle trips between the modelled network and alternative routes, in particular the A2. This meant the dis-benefits relating to trips that needed to be re-assigned could not be adequately taken into account in the economic evaluation, including the BCR⁹³.
- 2.3.7 Options 4, 8 and 10 were considered to be the core options, as they covered the range of options, both in terms of size, scale and operation, so they were submitted for initial cost estimation. Following the initial estimates produced by Benchmark Estimating Limited in April 2016, which were based to 2014 (Quarter 1), it became apparent that all three options were likely to exceed the RIS 1⁹⁴ funding range of £50 million to £100 million (See **Table 2-1** below). A value management exercise was undertaken in the middle of PCF Stage 1 to further review and refine the options.

Table 2-1 PCF Stage 1 Initial Option Estimates (2014 Base Year)

| Option | Option 4 | Option 8 | Option 10 |
|-----------------------------|-------------|-------------|-------------|
| Most likely cost (£million) | £145million | £180million | £132million |

VALUE MANAGEMENT & CONCLUSION

- 2.3.8 Following the value management process Options 4 and 10 were refined, with the aim of getting them to fall within the original RIS 1 budget range. It was agreed that the remaining option, Option 8, would not be taken further due to complexity and anticipated cost. A new option was developed, Option 12, that would meet the objective of being both within the RIS 1 budget range and within the capital baseline funding allocation of £70.6 million (please see **Appendix A-1**), which was subsequently allocated to the project in early 2016.
- 2.3.9 Therefore, budget constraints influenced option identification in PCF Stage 1, with work focused onto identifying solutions that would maximise the benefits whilst also being affordable.

⁹² PCF – Project Control Framework

⁹³ BCR - Benefit Cost Ratio

⁹⁴ Road Investment Strategy: for the 2015/16 – 2019/20 Road Period, Department for Transport, March 2015

2.3.10 Option 12 is an at-grade (Low Cost) option, maintaining a similar layout to the existing Stockbury Roundabout but providing slip arrangements and free flow links, in the form of :

- Segregated left turn lanes, for the following traffic movements:
- A249 northbound to M2 eastbound; and
- A249 southbound to M2 westbound.
- A dedicated slip road, for the M2 eastbound to A249 northbound traffic movement.

2.3.11 Option Estimates were produced for the options above by Benchmark Estimating Limited in September 2016, which were based to 2014 (Quarter 1). More details of the estimates and general arrangements can be seen in **Appendix B-5**.

Table 2-2 PCF Stage 1 Final Option Estimates Ranges (2014 Base Year)

| OPTION | P10 | MOST LIKELY | P90 |
|-----------|------------|-------------|-------------|
| Option 4 | £64million | £81million | £113million |
| Option 10 | £72million | £89million | £132million |
| Option 12 | £35million | £46million | £66million |

2.3.12 The PCF Stage 1 Final Options Estimates ranges showed that:

- The three point range estimates for Options 12 were within the RIS 1⁹⁵ budget range and the Most Likely estimates for the option was below the capital baseline funding allocation. Options 12 was therefore considered affordable and as such viable options in terms of cost;
- Options 4 and 10's Most Likely and P90 estimates exceeded the capital baseline funding allocation and their P90 estimates exceeded the RIS 1 funding range. Therefore, Options 4 and 10 were considered not to be affordable.

2.3.13 From an environmental impact point of view, potentially significant adverse impacts were identified in PCF⁹⁶ Stage 1 in relation to cultural heritage, landscape (visual impacts), nature conservation, materials and waste, and road drainage and the water environment (impacts to groundwater).

⁹⁵ Road Investment Strategy: for the 2015/16 – 2019/20 Road Period, Department for Transport, March 2015

⁹⁶ PCF - Project Control Framework

2.3.14 At the end of PCF Stage 1 the TAR⁹⁷ concluded that:-

- Option 4 and Option 10 provide the greatest capacity improvements compared with Option 12, and therefore fully meet the scheme objectives. However, they both exceed the scheme budget, whilst Option 12 is within the scheme budget but fails to meet the full scheme objectives.
- Due to the varying degrees the options address the scheme objectives and comply with the scheme budget it was not possible to confirm a preferred solution at this stage. Therefore, it was proposed that all three options are taken forward in to PCF Stage 2 for further assessment and public consultation.

2.3.15 At the end of PCF Stage 1 Highways England concluded that of the three options only Option 12 was affordable and, as it was considered to be compliant with the RIS 1⁹⁸ statement, it was to be the only option taken forward into PCF 2 for further development. However, due to uncertainties regarding the PCF Stage 1 BCR's⁹⁹ Options 4 and 10 were to be modelled in the SERTM¹⁰⁰ as well as Option 12.

2.4 PCF STAGE 2

PURPOSE OF PCF STAGE 2

2.4.1 The purpose of PCF¹⁰¹ Stage 2, from the PCF guidance is:

- Carry out public consultation including exhibitions;
- Analyse comments received and select a preferred route;
- Refine the cost estimate for the preferred option (including allowance for risk);
- Refine the environmental impacts assessment, traffic forecasts, and economic benefits following public consultation if required;
- Produce an outline business case; and
- Announce the preferred route.

OPTION TESTING AND OPTIONEERING

2.4.2 For PCF Stage 2, a cordoned project specific traffic model based on the Highways England SERTM¹⁰² was developed for the purpose of option testing and economic and environmental assessment. This model would now be known as the M2 Junction 5 model. Three options (Options 4, 10 and 12) were assessed within the M2 Junction 5 Model. Initial results, from the M2 Junction 5 Model without VDM¹⁰³, showed that Option 12 provided significantly less benefits than Options 4 and 10.

2.4.3 A potential improvement to Option 12 was therefore identified, based on evolving Option 12 to include the at-grade though-about concept of Option 6 (please refer to the Options Log in

⁹⁷ M2 Junction 5 Improvements Scheme – Technical Appraisal Report, Highways England, November 2016, Doc No. HE551521_M2J5_TAR_PCF-S1_V2.1

⁹⁸ Road Investment Strategy: for the 2015/16 – 2019/20 Road Period, Department for Transport, March 2015

⁹⁹ BCR - Benefit to Cost Ratio

¹⁰⁰ SERTM - South East Regional Transport Model

¹⁰¹ PCF - Project Control Framework

¹⁰² SERTM - South East Regional Traffic Model

¹⁰³ VDM - Variable Demand Modelling

Appendix B-1). It was considered that, whilst there are options that would better address the schemes capacity and safety objectives, within the affordability constraint of the capital baseline funding allocation this would provide greater resilience for A249 traffic and as such would optimise the benefits that could be achieved with an at-grade solution.

2.4.4 A value management workshop was held in February 2017 where the decision was made to progress the design of Option 12A to the same standard as the PCF Stage 1 options and model its viability within the M2 Junction 5 Model.

2.4.5 The four options under consideration were then submitted for interim Options Estimates in March 2017 based on the PCF¹⁰⁴ Stage 1 concept designs for Options 4, 10 and 12 and a concept design for Option 12A. The interim estimates were produced by the Highways England Commercial team in May 2017 (See **Table 2-3** below) with the estimates having a base year of 2016 (Quarter 1); more details of the Options Estimates can be found in **Appendix B-3**.

Table 2-3 PCF Stage 2 Interim No. 1 Option Estimates Ranges (2016 Base Year)

| OPTION | P10 | MOST LIKELY | P90 |
|------------|------------|-------------|-------------|
| Option 4 | £68million | £98million | £157million |
| Option 10 | £78million | £112million | £184million |
| Option 12 | £35million | £51million | £84million |
| Option 12A | £43million | £62million | £102million |

2.4.6 The budget ranges are given as three point ranges, P10, Most Likely and P90. The Most Likely represents the estimated budget required for the scheme to have a 50% chance of being completed within budget. P10 and P90 estimates have also been generated as part of the estimation of costs; these represent the budget required for the scheme to have a 10% and 90% chance respectively of being completed within budget.

2.4.7 The PCF Stage 2 Interim No. 1 Options Estimates ranges showed that:

- The three point range estimates for Options 12 and 12A were within, or close to, the RIS 1¹⁰⁵ budget range and the Most Likely estimates for both options were below the capital baseline funding allocation. Options 12 and 12A were therefore considered affordable and as such viable options in terms of cost;
- The Option 10 Most Likely and P90 estimates exceeded the RIS 1 funding range and all three range estimates exceeded the capital baseline funding allocation. Option 10 was therefore considered not to be affordable and as such not a viable option;
- The Option 4 P90 estimate exceeded the RIS 1 funding range and the Most Likely and P90 estimates exceeded the capital baseline funding allocation. Option 4 was therefore considered not to be affordable and as such not a viable option.

¹⁰⁴ PCF - Project Control Framework

¹⁰⁵ Road Investment Strategy: for the 2015/16 – 2019/20 Road Period, Department for Transport, March 2015

VARIABLE DEMAND MODELLING

- 2.4.8 The M2 Junction 5 Model required VDM¹⁰⁶ due to the elasticity of the model approaching elasticity thresholds. VDM is used to predict and quantify changes in the travel demand for the cordon area due to changes in variables such as an increase in fuel prices and changes in trip types. A more detailed explanation of VDM is given in **Section 5.1**.
- 2.4.9 The VDM methodology was agreed with Highways England Transport Planning Group and is included in the VDM technical note in **Appendix B-2**. VDM was undertaken using the Department for Transport DIADEM¹⁰⁷ software (version 6.3.3) which satisfies the requirements of WebTAG TAG Unit M2¹⁰⁸.
- 2.4.10 The modelling of the four options within the M2 Junction 5 Model with VDM identified that:
- Of the two at-grade options, Option 12A performed better than Option 12; with the benefits of Option 12A being higher in both the Core and Alternative Scenarios (see **Tables 5-32 and 5-33** in **Section 5.4**), roughly double in the Alternative Scenario.
 - Of the two grade separated options, Option 4 performed better than Option 10, with the benefits of Option 4 being higher in both the Core and Alternative Scenarios.

ENVIRONMENTAL ASSESSMENT

- 2.4.11 How Option 12A performs with respect to the environmental objectives for the scheme, which were developed in line with the National Policy Statement for National Networks¹⁰⁹ and the RIS 1¹¹⁰, is summarised in **Section 8.2**. Overall Options 4, 10 and 12 are not considered to achieve the environmental objectives to the same extent as Option 12A, due primarily to the direct impact on Ancient Woodland. However, Option 12A would result in greater impact on one farm and have more substantial landscape changes than the other three options; it would also have more substantial impacts on the setting of the Chatham Land Front Work War 1 defence landscape than Option 10.

CONCLUSION

- 2.4.12 There were only two affordable options, Option 12 and 12A. Option 12A was considered to be a development of Option 12 and, as the traffic modelling showed it to perform significantly better and would have no direct impact on Ancient Woodland, Option 12A was considered to supersede Option 12.
- 2.4.13 Option 12A was therefore presented at the PCF Stage 2 public consultation as the only viable option.
- 2.4.14 Further development of options took place once the feedback from the public consultation was received. This is covered in **Section 10**.

¹⁰⁶ VDM - Variable Demand Modelling

¹⁰⁷ DIADEM – Dynamic Integrated Assignment and Demand Modelling

¹⁰⁸ TAG Unit M2 Variable Demand Modelling, Department for Transport, March 2017

¹⁰⁹ National Policy Statement for National Networks, Department for Transport, December 2014

¹¹⁰ Road Investment Strategy: for the 2015/16 – 2019/20 Road Period, Department for Transport, March 2015

3 SUMMARY OF DO NOTHING CONSEQUENCES

3.1 DESCRIPTION OF DO NOTHING OPTION

3.1.1 For the assessment of the scheme using the traffic model, the do nothing network has been used as the Reference Case. This was formed from the base year of 2015 with the following modelled forecast years (Core Scenario Variable Demand Model traffic forecasting data (version 16)):

- 2021 - Assumed scheme opening year;
- 2031 - Interim forecast year (end of Local Plan);
- 2036 - Additional modelled year;
- 2041 - Additional modelled year.

3.2 ECONOMIC IMPACT

3.2.1 The economic impact of the do nothing scenario on the M2 Junction 5 is a worsening of the existing conditions in terms of existing capacity at the junction being fully utilised, additional demand causing congestion and subsequent journey time and queue length increases.

3.2.2 For the do nothing scenario the results indicate that:

- In 2021 the A249 southbound approach to the Stockbury Roundabout and the circulatory carriageway between Maidstone Road and the M2 westbound on-slip are likely to operate over capacity;
- From 2031, the M2 Junction 5 eastbound off-slip and the Oad Street junction right turn waiting area also operate over capacity;
- From 2041, the Oad Street approach to the A249 is shown to be over capacity; and
- From 2031 onwards the M2 in both directions between junctions 4 and 5, M2 Junction 5 westbound on-slip and the M2 eastbound to A249 northbound dedicated slip road are shown to be operating close to capacity.

3.2.3 The worsening of condition will lead to additional journey time for the following key movements of the junction:

Table 3-1 Journey Time Increases from 2021 to 2041 (Core Scenario)

| Movement | | Increase in Journey Time from 2021 to 2041 | | |
|--|----------------------|--|-----------|----------|
| A | B | AM Peak | Interpeak | PM Peak |
| A249 N (Sittingbourne) | M2 W (London) | 00:03:31 | 00:01:06 | 00:02:37 |
| A249 N (Sittingbourne) | M2 E (Coast) | 00:04:55 | 00:02:39 | 00:02:44 |
| A249 N - A249 S (through route) | | 00:03:04 | 00:01:01 | 00:01:47 |

- 3.2.4 The Swale Local Plan¹¹¹ describes the M2 Junction 5 as “the single greatest transport constraint in the Borough” and if no improvements were made to the junction it would likely inhibit the Local Plan growth aspirations due to the worsening traffic conditions.
- 3.2.5 The additional congestion at the junction and associated increase in queue lengths will also likely result in an increase in number of accidents due to stop-start traffic and related shunts.

3.3 ENVIRONMENTAL IMPACT

- 3.3.1 There are environmental impacts associated with the do-nothing scenario across all of the topics considered at PCF¹¹² Stage 2. While it should be noted that a full environmental assessment of the do-nothing scenario was not part of the PCF Stage 2 assessment, it is possible to provide commentary on potential impacts related to some topic areas based on the assessment presented in the PCF Stage 2 Environmental Assessment Report.¹¹³
- 3.3.2 The following sections provide commentary regarding air quality and climate change impacts in the do nothing scenario. It is important to note that the commentary provided in the following paragraphs is based on an appraisal of the scheme in isolation, in the absence of consideration of external factors which could change the impact on the environment in the do nothing scenario.

AIR QUALITY

- 3.3.3 Nitrogen Dioxide and PM₁₀¹¹⁴ concentrations have been predicted at 51 discrete human receptors in the opening year of 2021 in the do nothing scenario. In the do nothing scenario in 2021, considering the results of gap analysis¹¹⁵ as worst case, almost all receptors are predicted to experience an increase in annual mean Nitrogen Dioxide concentrations (with the exception of one receptor which is predicted to experience a small decrease). In 2021, 37 receptors are predicted to experience slight decreases in annual mean PM₁₀ concentrations in the do nothing scenario, while 11 receptors would experience slight increases and three receptors would experience no change.
- 3.3.4 None of the pollution climate modelling links within the air quality study area for the scheme have roadside exceedances of the EU limit value for annual mean Nitrogen Dioxide in 2015 (40 micrograms per cubic metre). By 2021, concentrations are lower - reflecting the Department for Environment, Food and Rural Affairs emissions projections. Further reductions are predicted by the Department for Environment, Food and Rural Affairs out to 2030, which is the limit of the current set of forecasts. By 2028, the Department for Environment, Food and Rural Affairs predict that all 43 UK reporting zones for EU limit value compliance will be compliant and this will be the position in 2030 and beyond.

¹¹¹ Bearing Fruits 2031: The Swale Borough Local Plan, Full Council Item, 26th July 2017

¹¹² PCF – Project Control Framework

¹¹³ M2 Junction 5 Improvements Scheme Environmental Assessment Report, prepared by WSP on behalf of Highways England, January 2018.

¹¹⁴ PM₁₀ - Particulate matter with a diameter of 10 micrometres or less.

¹¹⁵ HA_Long-Term_Gap_Analysis_Calculator_v1-0_LTTE6, former Highways Agency, November 2013.

3.3.5 In 2021, considering the results of the gap analysis¹¹⁶ as worst-case, Nitrogen Oxides concentrations above the annual mean critical level of 30 micrograms per cubic metre occur in the do nothing scenario at two transect receptors within the Wouldham to Detling Escarpment Site of Special Scientific Interest and North Downs Woodlands Special Area of Conservation (refer to **Appendix A-2**). These receptors are closest to the A249 at 16 metres (R63_16) and 26 metres (R63_26) from the road centreline. The assessment on the basis of the Department for Environment, Food and Rural Affairs emission factors alone also indicates concentrations above the critical level at these receptors, although the concentrations are lower.

CLIMATE CHANGE

3.3.6 Total end-user greenhouse gas emissions are presented in **Table 3-2** for 2021 and 2041. In the do nothing scenario, total traffic emissions for the area of the model increase by 19% during this period, The average annual end-user traffic emissions for the 60 year operational life of the scheme (2021 to 2080) are also presented along with the total emissions for that period.

Table 3-2 Baseline greenhouse gas emissions data for end user traffic in the region of the proposed scheme

| Scenario | Total greenhouse gas emissions for all traffic in the traffic model area (thousand tonnes of carbon dioxide equivalent) | | | |
|----------------------------|--|-------|---------------------------------|----------------------|
| | 2021 | 2041 | Average per year (2021-2041) | Total (2021-2041) |
| Baseline (‘do nothing’) | 383.2 | 441.0 | 430.9 | 25,851 |

3.3.7 An increasing trend in temperatures both in terms of average daily conditions (during summer and winter) and the daily minimum and maximum temperature extremes, have the potential to impact the M2 Junction 5 in the do nothing scenario. Similarly, predicted wetter conditions over winter months, with average daily rainfall increasing from 2 mm to 2.3 mm per day (medium emission scenario, mid-point projection), and drier conditions in summer months, with average daily rainfall reducing from 1.6 mm to 1.3 mm per day, have the potential to impact the M2 Junction 5 in the do nothing scenario. There is an opportunity to improve the climate resilience of the M2 Junction 5 with the scheme.

3.4 SUMMARY

3.4.1 The consequences of the do nothing scenario will lead to the steady worsening of travel conditions with journey time and queue lengths increasing which will likely have a negative impact on the local economy, environment and inhibit growth aspirations.

¹¹⁶ HA_Long-Term_Gap_Analysis_Calculator_v1-0_LTTE6, former Highways Agency, November 2013.

4 SUMMARY OF ALTERNATIVE SCHEMES

4.1 INTRODUCTION

- 4.1.1 This section of the report identifies alternative options considered in PCF¹¹⁷ Stage 2 up to the public consultation and the degree to which they solve the existing problem.
-

4.2 ALTERNATIVE OPTIONS

- 4.2.1 Evaluation of four alternative schemes, referred to in this report as options, was undertaken in PCF Stage 2, as listed below. The drawings of each option can be seen in **Appendix D-1**:
- Option 4;
 - Option 10;
 - Option 12;
 - Option 12A.
-

OPTION 4

- 4.2.2 Two-bridge grade-separated junction. This option proposes that the existing Stockbury Roundabout remains in a similar location.
- 4.2.3 The A249 has a dedicated through link over Stockbury Roundabout on embankments, with two bridges over the circulatory carriageway of the roundabout.
- 4.2.4 Stockbury Roundabout remains at-grade and is enlarged to accommodate connections to the roundabout. The roundabout would not be signalised.
- 4.2.5 Free-flow links, in the form of dedicated left turn lanes, to be provided as list below:
- A249 southbound to M2 westbound; and
 - A249 northbound to M2 eastbound;
- 4.2.6 Off-line slip road provided for the M2 eastbound to A249 northbound traffic movements.
- 4.2.7 The Maidstone Road connection to Stockbury Roundabout to be closed/ severed. A new Maidstone Road Link to be provided to the north of the M2, to connect Maidstone Road to Oad Street.
- 4.2.8 Oad Street Link provided, to connect Oad Street directly into Stockbury Roundabout. Oad Street will remain open for local access to properties but will not have direct access onto the A249 as currently exists.
- 4.2.9 The Honeycrook Hill connection to A249 to be closed/ severed.
- 4.2.10 The existing M2 Stockbury pedestrian bridge over the M2, to the west of M2 Junction 5, to be demolished and replaced to accommodate the widened M2 eastbound diverge.

¹¹⁷ PCF – Project Control Framework

OPTION 10

- 4.2.11 Three-tier grade-separated junction. This option proposes that the existing layout is replaced by a conventional three-tier grade separated junction under the M2 Stockbury Viaduct; thereby removing the unusual geometry of the junction and slip road alignments.
- 4.2.12 The A249 has a dedicated through link at the lower level providing free flow movements between the north and south of the junction.
- 4.2.13 A roundabout will be at mid-level to allow interchange between the M2 and A249 as well as the local road network. It is proposed that the roundabout is three lanes in width with widening in the north and south quadrants. The roundabout will be signalised on two arms, the A249 southbound approach and the A249 northbound approach.
- 4.2.14 Free-flow links, in the form of dedicated left turn lanes, to be provided as listed below:
- M2 eastbound to A249 northbound;
 - M2 westbound to A249 southbound;
 - A249 northbound to M2 westbound.
- 4.2.15 Local network connections to be provided to the roundabout in the north east quadrant, with a new link from Oad Street provided to the roundabout parallel to the M2. Maidstone Road to be revised to connect into the new Oad Street Link.
- 4.2.16 Oad Street to the south of the M2 will remain open for local access to properties but will not have direct access onto the A249 as currently exists.
- 4.2.17 The Honeycrook Hill connection to A249 to be closed/ severed.
- 4.2.18 The existing M2 Stockbury pedestrian bridge over the M2, to the west of M2 Junction 5 to be demolished and replaced to accommodate the widened M2 eastbound diverge.
- 4.2.19 The existing Oad Street bridge over the M2, to the east of M2 Junction 5, to be demolished and replaced with a longer spanning bridge to accommodate the proposed M2 eastbound merge and M2 westbound diverge widening.

OPTION 12

- 4.2.20 At grade option. This option proposes that the existing Stockbury Roundabout remains in a similar location and it is enlarged and widened to three lanes to accommodate increased traffic volumes.
- 4.2.21 The roundabout is proposed to be fully signalised apart from the link from Oad Street and the M2 eastbound diverge onto Stockbury Roundabout, although this may be signalised at a later date dependant on demand.
- 4.2.22 Free-flow links, in the form of dedicated left turn lanes, to be provided as listed below.
- A249 southbound to M2 westbound; and
 - A249 northbound to M2 eastbound.
- 4.2.23 Off-line slip road provided for the M2 eastbound to A249 northbound traffic movements.
- 4.2.24 The Maidstone Road connection to Stockbury Roundabout to be closed/ severed. A new Maidstone Road Link to be provided to the north of the M2, to connect Maidstone Road to Oad Street.

- 4.2.25 Oad Street Link provided, to connect Oad Street directly into Stockbury Roundabout. Oad Street will remain open for local access to properties but will not have direct access onto the A249 as currently exists.
- 4.2.26 The Honeycrook Hill connection to A249 to be closed/ severed.
- 4.2.27 The existing M2 Stockbury pedestrian bridge over the M2, to the west of M2 Junction 5, to be demolished and replaced to accommodate the widened M2 eastbound diverge.
-

OPTION 12A

- 4.2.28 At grade, through-about. This option proposes that the existing Stockbury Roundabout remains in a similar location. It would be enlarged and revised to provide a signalised roundabout with at grade through lanes for the A249 mainline. It is a design assumption, for this type of layout in this location, that the A249 mainline speed limit would be reduced from 70mph to 50mph in advance of the roundabout. Please see **Section 4.3.57** for more detail.
- 4.2.29 The roundabout is proposed to be fully signalised apart from the link from Oad Street and the M2 eastbound diverge onto Stockbury Roundabout, although this may be signalised at a later date dependant on demand.
- 4.2.30 Free-flow links, in the form of dedicated left turn lanes, to be provided as listed below:
- A249 southbound to M2 westbound; and
 - A249 northbound to M2 eastbound.
- 4.2.31 Off-line slip road provided for the M2 eastbound to A249 northbound traffic movements.
- 4.2.32 The Maidstone Road connection to Stockbury Roundabout to be closed/ severed. A new Maidstone Road Link to be provided to the north of the M2 to connect Maidstone Road to Oad Street.
- 4.2.33 Oad Street Link provided, to connect Oad Street directly into Stockbury Roundabout. Oad Street will remain open for local access to properties but will not have direct access onto the A249 as currently exists.
- 4.2.34 The Honeycrook Hill connection to A249 to be closed / severed.
- 4.2.35 The existing M2 Stockbury pedestrian bridge over the M2, to the west of M2 Junction 5, to be demolished and replaced to accommodate the widened M2 eastbound diverge.

4.3 ENGINEERING CHALLENGES OF ALTERNATIVE SCHEMES

ALL FOUR OPTIONS

STRUCTURES

- 4.3.1 The existing M2 Stockbury pedestrian bridge over the M2, to the west of M2 Junction 5, will need to be replaced with a longer spanning bridge to accommodate the proposed changes to the M2 slip-roads. It is currently anticipated that replacing the bridge will not be an unusually complex engineering problem.
- 4.3.2 The M2 currently passes over Maidstone Road, the A249, the M2 eastbound on slip and M2 eastbound off slip on the M2 Stockbury Viaduct, which is approximately 20m above the existing A249. This viaduct constrains the alignment design for options, and any changes to the loadings to the viaduct piers and foundations will need to be taken into consideration as the scheme develops in PCF¹¹⁸ Stage 3 and beyond.

M2 SLIP ROADS

- 4.3.3 The existing junction and its associated M2 slip-roads were constructed in 1963¹¹⁹ and since construction there appears to have been no major upgrades to these slip-roads. This means that the existing merges, diverges, gradients, forward visibility and radii of curves have not been designed in accordance with current design standards. All options apart from Option 10 do not propose improvements to the existing M2 slip-roads as the development of options was focused onto identifying solutions that would maximise the benefits gained whilst staying within the budget constraints (please see **Section 2.3**). However, a set of value management options were identified, aiming to improve the safety of the junction by improving the visibility and horizontal alignment of the slip-roads. These can be found in the PCF Stage 2 Departures from Standard Checklist¹²⁰ and will need to be considered further during the development of the scheme in PCF Stage 3.
- 4.3.4 The split of traffic flows at the diverges from the M2 at Junction 5, between those wanting to continue on the M2 mainline and those wanting to exit at Junction 5 are such that, in accordance with TD22/06¹²¹, there should be a lane drop at the diverges, which would require an additional lane to be provided on the M2 upstream of each of the diverges. This falls outside the scheme brief.
- 4.3.5 All options include a free flow link for the M2 eastbound to A249 northbound traffic movement. For Options 4, 12 and 12A, the layout of the eastbound offslip and onslip remains predominantly unchanged resulting in a safety aspect to be addressed, relating to the layout of the eastbound offslip in the immediate approach to the tight horizontal curve and the fact that this is located adjacent to the diverge layout issue discussed above. The introduction of the M2 eastbound to A249 northbound off line, single lane slip road in Options 4, 12 and 12A, means that there is a section where the M2 eastbound offslip has two lanes, from the M2 mainline up to where it divides shortly after the nosing, after which one lane continues to connect to the A249 northbound carriageway and the other to Stockbury Roundabout via a tight curve. Within this short section of 2 lanes drivers may try to change lanes at a point

¹¹⁸ PCF - Project Control Framework

¹¹⁹ The Ridgeway (M2 Junction 5), The Sabre, https://www.sabre-roads.org.uk/wiki/index.php?title=The_Ridgeway

¹²⁰ Departures from Standard Checklist: HE551521-WSP-HGN-PCF2-RP-D-00046

¹²¹ Design Manual for Roads and Bridges, Volume 6, Section 2, TD 22/06 - Layout of Grade-Separated Junctions

where drivers continuing to Stockbury Roundabout will need to be slowing down to negotiate the tight bend.

- 4.3.6 These safety aspects will need to be assessed, discussed with relevant stakeholders and appropriate mitigation measures that could reasonably be included within the scheme identified as part of the ongoing development of the scheme in PCF¹²² Stage 3.

KEY STREET JUNCTION

- 4.3.7 The Key Street Junction is located less than 2Km to the north of Stockbury Roundabout. This close proximity between the two grade separated junctions, and their associated slip road diverges and merges, means that the requirements of current standard for the design of grade separate junctions on the strategic road network, TD22/06¹²³, need to be taken into account. Design aspects such as weaving distances between successive merges and diverges, and layout of successive merges or diverges are influencing option design.
- 4.3.8 The existing layby on the northbound A249 is located 1.5km north of the existing Stockbury Roundabout and 1.2km south from Key Street Junction. The four options propose a new merge onto the northbound A249, which will reduce the weaving distance between the merge and the layby diverge. TD22/06 (Paragraph 4.38) states that the minimum distance between a grade-separated junction and an at-grade junction should be 1km. This will need to be assessed and discussed with the various stakeholders during PCF¹²⁴ Stage 3 to determine whether the layby should be closed.

LOCAL ROADS

- 4.3.9 There are a number of local roads that connect either directly onto Stockbury Roundabout (i.e. Maidstone Road) or onto the A249 in close proximity to the roundabout (i.e. Oad Street and Honeycrock Hill). This provides an engineering challenge as an appropriate balance needs to be reached taking into account safety, connectivity for local communities, environmental impact, maximising capacity on the strategic road network, cost and not encouraging use of local roads by long distant traffic. A number of different ways to solve the challenge of local road connectivity were considered during PCF Stages 0 to 2, as recorded in the Options Log **Appendix B-1** and the Optioneering Log in **Appendix B-4**. Some of these developments took place after the PCF Stage 2 Public Consultation, and more information about this is included in **Section 10**. The proposed changes to the local road network will need to be consulted on with the relevant local authority, and with the relevant bus operators and emergency services, as the scheme develops through PCF Stage 3 and beyond.
- 4.3.10 The Maidstone Road connection to Stockbury Roundabout is to be closed / severed in Options 4, 12 and 12A, in order to provide a dedicated left turn lane for the dominant A249 southbound to M2 westbound traffic movement. A new Maidstone Road Link is provided in all three options, to maintain connectivity for local traffic to M2 Junction 5 via Oad Street. In Option 10 Maidstone Road connects to a proposed Oad Street Link, which is located to the north of the M2 and connects Oad Street to the new roundabout. All four options therefore include a junction between a proposed link and Oad Street located to the north of Oad Street Bridge over the M2. When determining the route to be taken by this link an appropriate balance needs to be reached taking into account safety, impact on landowners / tenants / occupiers, environmental impact and cost. At the junction of the proposed link and Oad Street, forward visibility is affected by the Oad Street bridge over the M2, private accesses along Oad Street and the horizontal curve on Oad Street. This has been considered further in **Section 10**.

¹²² PCF – Project Control Framework

¹²³ Design Manual for Roads and Bridges, Volume 6, Section 2, TD 22/06 - Layout of Grade-Separated Junctions

¹²⁴ PCF – Project Control Framework

- 4.3.11 The existing Oad Street/ A249 junction allows all turning movements to take place, albeit that the A249 northbound to Oad Street movement is via Stockbury Roundabout. A key balance to be reached here is to safely maintain an appropriate level of connectivity for local traffic using Oad Street without having a detrimental impact on the capacity of the strategic road network. A new Oad Street Link is provided in all four options, connecting directly into the M2 Junction 5 roundabout.
- 4.3.12 The proposed Oad Street Link included in Options 4 and 12 at the end of PCF¹²⁵ Stage 1 was developed in PCF Stage 2, to ensure that the vertical alignment of the link had an appropriate gradient. The current design standard TD9/93¹²⁶ allows a maximum gradient of 6% for this type of road. The options listed below were considered, based on the assumption that the existing speed limit on Oad Street would be retained. This has been considered further in **Section 10**.
- Option A – PCF Stage 1 Oad Street Link alignment; as shown in Options 4 Revised and 12 Revised in the Options Log in **Appendix B-1**;
 - Option B – PCF Stage 2 Oad Street Link alignment to the south of Whipstakes Farm; as shown in Option 12A(B), in the Options Log in **Appendix B-1**;
 - Option C – PCF Stage 2 Oad Street Link alignment through Chestnut Wood (Ancient Woodland); as shown in Options 4, 12(C) and 12A(C) in the Options Log in **Appendix B-1**;
 - Option D – PCF Stage 2 alignment through Whipstakes Farm; as shown in Option 12A(D) in the Options Log in **Appendix B-1**;
- 4.3.13 During the initial development it was considered appropriate to consider Option C even though it had a direct impact on Chestnut Wood, an identified Ancient Woodland, as it was a small, isolated stand of woodland (around 0.6Ha) of unknown value with an existing mobile phone mast located within it. Option C was considered to provide an optimum solution in terms of cost and safety. However, after undertaking an Ancient Woodland survey, Option B was identified as the optimum option, as it avoided direct impact on this stand of Ancient Woodland.
- 4.3.14 The Honeycrock Hill junction with the A249 is to be closed / severed in Options 4, 10, 12 and 12A for safety reasons, given its close proximity to M2 Junction 5 and its associated merges and diverges to and from the A249 mainline. The A249 / Church Hill junction will therefore become the closest junction on the A249 for local traffic wanting to access Stockbury Village and the surrounding area from the A249. The existing junction includes: a diverge taper and auxiliary lane on the A249 northbound carriageway for left turning traffic; and a diverge taper and auxiliary lane on the A249 southbound carriageway, along with a gap in the central reserve, for right turning traffic. What safety improvements could be made to this junction layout will form part of the development of the scheme in PCF Stage 3.

BUILDABILITY

- 4.3.15 The scheme options require construction work to be undertaken on the Strategic Road Network, which will impact the effectiveness of the network. At PCF Stage 3, a buildability review will be undertaken to determine how to construct the scheme whilst minimising impact on the network. This will need to be discussed with the relevant stakeholders and taken into account when determining land required for the scheme both during construction and for operation and maintenance.

¹²⁵ PCF – Project Control Framework

¹²⁶ Design Manual for Roads and Bridges, Volume 6, Section 1, TD 9/93 – Highway Link Design

GEOTECHNICAL

OVERVIEW

- 4.3.16 The scheme will likely require excavation and foundations in Made Ground, Head Deposits, Weathered Chalk and / or structured chalk. This section summarises the engineering challenges associated with the geotechnical aspects of the scheme for all options.

EXCAVATABILITY – MADE GROUND AND HEAD DEPOSITS

- 4.3.17 Excavation through the Made Ground and/or Head Deposits using conventional hydraulic excavators is unlikely to present issues. The presence of large obstructions associated with the Made Ground should however be anticipated and allowance for breaking out and removal of such obstructions should be made with any over digging should be backfilled with suitable engineered fill.

EXCAVATABILITY – CHALK BEDROCK

- 4.3.18 It is likely that this scheme will require excavation into the Chalk; however excavation in such material will be achieved by conventional excavator methods and should not present an engineering challenge.

EARTHWORKS

- 4.3.19 Any vertically sided excavations will require support to ensure stability and to provide safe person access and supports should be installed as the excavation proceeds. For service excavations overlapping trench sheets could be used as close support in the unconsolidated deposits to minimise ground loss. Alternatively; consideration could be given to the use of trench boxes, provided excavations take place within the boxes.
- 4.3.20 The excavation of cuttings is unlikely to offer any significant engineering difficulties. Likely slope angles in the order of 30° to 45° should be achieved and within good quality Chalk slope angles up to 70° could be achieved. The construction of embankments is unlikely to offer any significant engineering difficulties with likely batter angles in the order of 30° to 35° achievable.

SUBGRADE

- 4.3.21 Likely CBR¹²⁷ values will be lower than 5 and it is considered that existing ground will require re-work to be reused and/or excavation/replacement with and appropriate engineering fill.

MATERIAL CLASSIFICATION AND RE-USE

- 4.3.22 Materials encountered during the construction phase have the potential to be reused and consideration must be given to cut and fill volumes and the ability for materials to achieve reuse classifications.
- 4.3.23 Any placement of materials as earthworks fill should be in accordance with a carefully prepared earthworks specification with appropriate control and placement of materials. Where possible, earthworks should be programmed to take place in the drier months.

¹²⁷ CBR – California Bearing Ratio

SOLUTION FEATURES / DENE HOLES

- 4.3.24 The desktop study has identified that there is a high potential for the occurrence of solution features or man-made voids (Dene Holes) within the site. Dissolution features and Karstic features must be fully considered at preliminary design. Depending on the nature of the void the treatment methods may involve, but not limited to, backfilling with foam concrete, grout or compacted chalk (if shallow). A Ground Investigation Survey has been undertaken and the Ground Investigation Report is expected to be completed by March 2017 and available for Preliminary Design, to be undertaken as part of PCF¹²⁸ Stage 3.
- 4.3.25 There is a potential solution feature on the M2 westbound slip roads, which needs to be considered further during the development of the design in PCF Stage 3.

OPTION 4

HIGHWAYS

- 4.3.26 The existing Stockbury Roundabout will be enlarged to accommodate the proposed A249 slip roads, connecting the A249 mainline to the revised Stockbury Roundabout. This will lead to increased carriageway runoff in the area that will need to be taken into account in the surface water drainage design undertaken in PCF Stage 3.

DEPARTURES FROM STANDARD

- 4.3.27 This section summarises the departures from standard for Option 4 identified during PCF Stage 1, as recorded in the PCF Stage 1 Departures from Standard Checklist¹²⁹.
- 4.3.28 The proposed M2 eastbound diverge (Type B (Option 1) Ghost Island diverge) is a departure from standard (TD22/06¹³⁰ Paragraph 2.29) because the traffic flows dictate a Type D – Ghost Island diverge for lane drop with 3 lanes on the M2 mainline. However, the existing M2 mainline is only 2 lanes and would require widening to 3 lanes for the design to be compliant, which is outside of the scheme brief.
- 4.3.29 The A249 northbound diverge has two, three-step departures on the immediate approach to the roundabout for stopping sight distances (TD9/93¹³¹ Paragraph 2.1) and its sag curve (TD9/93 Paragraph 4.5). The departure is required to enable the scheme to tie in with the proposed roundabout and to produce a design that would comply with the standards would require additional costs for earthworks and / or retaining structures.
- 4.3.30 The M2 eastbound diverge slip-road, on the immediate approach to Stockbury Roundabout, has a three-step stopping sight distance relaxation, which is a departure as this is not compliant with the standards on the immediate approach to a junction (TD9/93 Paragraph 2.1). To produce a compliant design would require additional costs for earthworks and / or retaining structures.

¹²⁸ PCF - Project Control Framework

¹²⁹ PCF Stage 1 Departures from Standard Checklist - HE551521-WSP-HAC-M2J9PCF1-RP-D-DFS02

¹³⁰ Design Manual for Roads and Bridges, Volume 6, Section 2, TD 22/06 - Layout of Grade-Separated Junctions

¹³¹ Design Manual for Roads and Bridges, Volume 6, Section 1, TD 9/93 – Highway Link Design

- 4.3.31 The proposed Maidstone Road Link, to connect to Oad Street, was designed to follow the existing ground profile and therefore requires three departures from standard for its alignment:
- One-step sag curve departure (TD9/93¹³² Paragraph 4.5);
 - The gradient of 8.5% is greater than the acceptable 8% (TD9/93 Paragraph 4.1);
 - Two-step stopping sight distance departure on the immediate approach to the junction (TD9/93 Paragraph 2.1); and
 - Three-step sag curve departure on the immediate approach to the proposed Oad Street Junction (TD9/93 Paragraph 4.5).
-

PROPOSED STRUCTURES

- 4.3.32 The proposed A249 flyover requires two bridges, and associated earthworks, to take the A249 over the circulatory carriageway of the Stockbury Roundabout.
- 4.3.33 The current, indicative design for Option 4 includes four retaining walls in relation to the proposed flyover, estimated to have the following average dimensions:
- | | |
|-----------------|---------------|
| — Length = 55m | Height = 1.5m |
| — Length = 110m | Height = 1.4m |
| — Length = 120m | Height = 1.7m |
| — Length = 130m | Height = 1.4m |
-

COMPLIANCE WITH SCHEME OBJECTIVES

- 4.3.34 Option 4 complies with the scheme objectives as discussed below:
- Supporting economic growth
 - (1) The grade separated route for the A249 and the free flow links provide additional capacity and improve connectivity and resilience at the junction, which will support economic growth.
 - A safe and serviceable network
 - (1) The A249 flyover reduces the volume of traffic using the circulatory carriageway and therefore reduces the flow of traffic through the conflict points at the roundabout. In addition, the removal of the traffic signals from Stockbury Roundabout will reduce the stop / start nature of traffic at the junction. These features will improve the operational safety at the junction.
 - A more free flowing network
 - (1) The A249 flyover and free flow links provide more free flowing capacity, which will improve the journey quality, time and reliability through the junction.

¹³²Design Manual for Roads and Bridges, Volume 6, Section 1, TD 9/93 – Highway Link Design

- An improved environment
 - (1) A full appraisal of Option 4 against this objective is provided in **Section 8.2**. In summary, Option 4 would comply with some components of the objective of an improved environment; however would not fully comply with the specific components of the objective which seek to achieve the protection of historic and archaeological environments and the conservation of natural resources. This is due to likely adverse impacts on the setting of designated heritage assets and the Chatham Land Front World War I defences historic landscape and the direct loss of Ancient Woodland. It is noted that the direct impact on the Ancient Woodland could be designed out. Option 4 complies with this objective to a lesser degree than Option 12A and Option 10, and to a similar degree as Option 12.
 - A more accessible and integrated network
 - (1) All options are expected to reduce driver stress as a result of increased journey time reliability, reduced journey times and the potential for improved safety at the junction. Results from surveys indicated that M2 Junction 5 does not currently have a high NMU¹³³ presence. All options are expected to result in slight operational benefits as a result of increased quality of Public Rights of Way facilities. Opportunities to improve NMU accessibility will be considered as part of the design development in PCF¹³⁴ Stage 3, aiming to make changes that could benefit the community and provide a legacy where reasonable and proportionate.
- 4.3.35 Option 4 generally complies with the scheme objectives however, it would not comply with two components of the objective of an improved environment (refer to **Section 8.2**) and it is not affordable (refer to **Section 2.4**) it is not considered a viable option.

OPTION 10

HIGHWAYS

- 4.3.36 The M2 and A249 merges and diverges include free-flow links to bypass the mid-tier circulatory carriageway. The proposed M2 eastbound to A249 northbound free-flow link and A249 northbound to M2 westbound free-flow link could cause a safety issue as the proposed design includes an unconventional diverge link. The mainline diverge divides again shortly after the nosing; with one lane continuing into the free-flow link and the other continuing to the mid-tier roundabout. This may also cause a safety issue due to late turning manoeuvres at the end of the nosing.

DEPARTURES FROM STANDARD

- 4.3.37 This section summarises the departures from standard for Option 10 identified during PCF Stage 1, as recorded in the PCF Stage 1 Departures from Standard Checklist¹³⁵.
- 4.3.38 The proposed M2 merges and diverges would require a departure from standard because the mainline flow of the M2 dictates that there should be 3 lanes on the mainline (TD22/06¹³⁶ Paragraph 2.29). However, as the existing M2 mainline is only 2 lanes it would require widening to 3 lanes for the design to be compliant which is outside of the scheme brief.

¹³³ NMU – Non-Motorised user.

¹³⁴ PCF – Project Control Framework

¹³⁵ Stage 1 Departures from Standard Checklist - HE551521-WSP-HAC-M2J5PCF1-RP-D-DFS02

¹³⁶ Design Manual for Roads and Bridges, Volume 6, Section 2, TD 22/06 - Layout of Grade-Separated Junctions

- 4.3.39 The proposed A249 northbound merge requires a three-step sag curve departure from standard to tie in with the existing road level (TD9/93¹³⁷ Paragraph 4.5). To produce a compliant design would require a longer slip road and additional earthworks.
- 4.3.40 The proposed Maidstone Road Link, to connect to Oad Street, was designed to follow the existing ground profile and therefore requires three departures from standard for its alignment:
- Two three-step departures for the sag curve (TD9/93 Paragraph 4.5); and
 - Two-step stopping sight distance departure on the immediate approach to the junction (TD9/93 Paragraph 2.1).
- 4.3.41 The realigned Maidstone Road requires two departures from three-step sag curve relaxation (TD9/93 Paragraph 4.5) and a gradient greater than the maximum allowed (TD9/93 Paragraph 4.1). To produce a design compliant would require additional earthworks and / or retaining structures.

PROPOSED STRUCTURES

- 4.3.42 The proposed gyratory located between the A249 mainline and M2 viaduct requires two new bridges, and associated earthworks, to take the circulatory carriageway over the A249.
- 4.3.43 A new bridge is required where Oad Street passes over the M2, to accommodate the changes to the M2 westbound offslip.
- 4.3.44 The current, indicative design for Option 10 includes four retaining walls in relation to the proposed flyover, estimated to have the following average dimensions:
- Length = 350m Height = 4.8m
 - Length = 125m Height = 0.9m
 - Length = 75m Height = 2.7m
 - Length = 175m Height = 2.5m
 - Length = 230m Height = 2.1m
 - Length = 200m Height = 3.0m
 - Length = 145m Height = 1.0m

COMPLIANCE WITH SCHEME OBJECTIVES

- 4.3.45 Option 10 complies with the scheme objectives as discussed below:
- Supporting economic growth
 - (1) The three-tier intersection provides a grade separated route for the A249 as well as additional free flow links for some of the key turning movements. This will provide additional capacity and improve connectivity and resilience at the junction, which will support economic growth.

¹³⁷Design Manual for Roads and Bridges, Volume 6, Section 1, TD 9/93 – Highway Link Design

- A safe and serviceable network
 - (1) The introduction of the three-tier reduces the volume of traffic using the circulatory carriageway and therefore reduces the flow of traffic through the conflict points at the roundabout. In addition, the existing unusual motorway slip road arrangement is replaced with a more conventional layout. These features will improve the operational safety at the junction.
- A more free flowing network
 - (1) The three-tier intersection with associated grade separation and free-flow links will improve the journey quality, time and reliability through the junction.
- An improved environment
 - (1) A full appraisal of Option 10 against this objective is provided in **Section 8.2**. In summary, Option 10 would comply with some components of the objective of an improved environment; however would not fully comply with the specific components of the objective which seek to achieve the protection of historic and archaeological environments and the conservation of natural resources. This is due to likely residual adverse impacts on the setting of designated heritage assets and the Chatham Land Front World War I defences historic landscape and the direct loss of Ancient Woodland. It is noted that the direct impact on the Ancient Woodland could be designed out. Option 10 complies with this objective to a greater degree than Options 4 and 12.
- A more accessible and integrated network
 - (1) All options are expected to reduce driver stress as a result of increased journey time reliability, reduced journey times and the potential for improved safety at the junction. Results from surveys indicated that M2 Junction 5 does not currently have a high NMU¹³⁸ presence. All options are expected to result in slight operational benefits as a result of increased quality of Public Rights of Way facilities. Opportunities to improve NMU accessibility will be considered as part of the design development in PCF¹³⁹ Stage 3, aiming to make changes that could benefit the community and provide a legacy where reasonable and proportionate.

4.3.46 Option 10 achieves four of the five scheme objectives. It would not comply with two components of the objective of an improved environment (refer to **Section 8.2**) and it is also not affordable (refer to **Section 2.4**) and as such is not considered a viable option.

OPTION 12

HIGHWAYS

- 4.3.47 The existing Stockbury Roundabout will be enlarged to accommodate the proposed A249 slip roads, connecting the A249 mainline to the revised Stockbury Roundabout. This will lead to increased carriageway runoff in the area that will need to be taken into account in the surface water drainage design undertaken in PCF Stage 3.
- 4.3.48 This option maintains the signalisation of Stockbury Roundabout, which contributes to the level of accidents at the junction (please refer to **Figure 1-3**).

¹³⁸ NMU - Non-Motorised user.

¹³⁹ PCF – Project Control Framework

DEPARTURES FROM STANDARD

- 4.3.49 This section summarises the departures from standard for Option 12 identified during PCF Stage 1, as recorded in the PCF Stage 1 Departures from Standard Checklist¹⁴⁰.
- 4.3.50 The proposed M2 eastbound diverge (Type B (Option 1) Ghost Island diverge) is a departure from standard because the traffic flows dictate a Type D – Ghost Island diverge for lane drop with 3 lanes on the M2 mainline (TD22/06¹⁴¹ Paragraph 2.29). However, the existing M2 mainline is only 2 lanes and would require widening to 3 lanes for the design to be compliant which is outside of the scheme brief.
- 4.3.51 The proposed M2 westbound merge and diverge slip-roads require a two-step sag curve departure (TD9/93 Paragraph 4.5) to enable the slip-roads to tie in with the existing roundabout level.
- 4.3.52 The proposed Maidstone Road Link, to connect to Oad Street, was designed to follow the existing ground profile and therefore requires three departures from standard for its alignment:
- One-step sag curve departure (TD9/93¹⁴² Paragraph 4.5);
 - A gradient of 8.5% which is greater than the acceptable 8% (TD9/93 Paragraph 4.1);
 - Two-step stopping sight distance departure on the immediate approach to the junction (TD9/93 Paragraph 2.1); and
 - Three-step sag curve departure on the immediate approach to the proposed Oad Street Junction (TD9/93 Paragraph 4.5).

COMPLIANCE WITH SCHEME OBJECTIVES

- 4.3.53 Option 12 complies with the scheme objectives as discussed below:
- Supporting economic growth
 - (1) Whilst Option 12 provides increased capacity at the junction during both the Core Scenario and the Alternative Scenario the junction does not fully cater for the forecast demand. Benefits of the option are also reduced as the option cannot provide enough capacity for the increased traffic flows. Therefore, it is considered that Option 12 does not meet this objective.
 - A safe and serviceable network
 - (1) The introduction of the free-flow links and severing the Maidstone Road arm from the roundabout will change the flow of traffic at the key conflict points on the circulatory roundabout. These features will improve the operational safety at the junction.
 - A more free flowing network
 - (1) The M2 eastbound to A249 northbound dedicated slip road and other free-flow links provide more free flowing capacity. However, the A249 through-traffic, which is one of the dominant traffic flows at the junction, continues to use the circulatory carriageway. Therefore, it is considered that Option 12 does not fully satisfy this objective.
 - An improved environment

¹⁴⁰PCF Stage 1 Departures from Standard Checklist - HE551521-WSP-HAC-M2J5PCF1-RP-D-DFS02.

¹⁴¹ Design Manual for Roads and Bridges, Volume 6, Section 2, TD 22/06 - Layout of Grade-Separated Junctions

¹⁴²Design Manual for Roads and Bridges, Volume 6, Section 1, Design Manual for Roads and Bridges, Volume 6, Section 1, TD 9/93 – Highway Link Design

- (1) A full appraisal of Option 12 against this objective is provided in **Section 8.2**. In summary, Option 12 would comply with some components of the objective of an improved environment; however would not fully comply with the specific components of the objective which seek to achieve the protection of historic and archaeological environments and the conservation of natural resources. This is due to likely residual adverse impacts on the setting of designated heritage assets and the Chatham Land Front World War I defences historic landscape and the direct loss of Ancient Woodland. It is noted that the direct impact on the Ancient Woodland could be designed out. Option 12 complies with this objective to a lesser degree than Option 10 and Option 12A, and to a similar degree to Option 4.
- A more accessible and integrated network
- (1) All options are expected to reduce driver stress as a result of increased journey time reliability, reduced journey times and the potential for improved safety at the junction. Results from surveys indicated that M2 Junction 5 does not currently have a high NMU¹⁴³ presence. All options are expected to result in slight operational benefits as a result of increased quality of Public Rights of Way facilities. Opportunities to improve NMU accessibility will be considered as part of the design development in PCF¹⁴⁴ Stage 3, aiming to make changes that could benefit the community and provide a legacy where reasonable and proportionate.

4.3.54 Option 12 achieves four of the five scheme objectives, with the limited amount of future growth that the junction can accommodate, when compared with Option 12A, resulting in it not achieving all five. As Option 12 was considered to be superseded by Option 12A, it was discounted from further consideration.

OPTION 12A

HIGHWAYS

4.3.55 The existing Stockbury Roundabout will be enlarged to accommodate the proposed A249 slip roads, connecting the A249 mainline to the revised Stockbury Roundabout. This will lead to increased carriageway runoff in the area, that will need to be taken into account in the surface water drainage design undertaken in PCF Stage 3.

4.3.56 The Oad Street Link passes to the south of Whipstakes farm in a cutting generally 12metres deep, with a maximum depth of 15metres. This is therefore a significant cutting in terms of both an environmental impact and construction point of view. Further development related to this layout took place once the feedback from the public consultation was received. This is covered in **Section 10**.

SPEED LIMIT

4.3.57 For Option 12A it has been assumed that a speed limit of 50 mph would be applied to the A249 on the approaches to the roundabout. This would be in keeping with the approach taken on the recently-installed through-about in Basingstoke at the A339/A30 junction (Black Dam Roundabout), adjacent to M3 Junction 6, where a 50mph speed limit was applied on the approaches as part of the through-about scheme.

¹⁴³ NMU - Non-Motorised user.

¹⁴⁴ PCF – Project Control Framework

- 4.3.58 This is a key mitigation measure to minimise the risk for frequent high-speeds and “racing the green light”, especially during off-peak periods, on the A249 northbound and southbound approaches to the through-about. There is considered to be an increased risk of such driver behaviour as the roundabout central island is to be replaced with carriageway for the A249 through traffic. The precise extent of this speed limit would form part of the ongoing development of the scheme in PCF¹⁴⁵ Stage 3; however, an indication is that as a minimum it would be applied from around the Key Street Junction to around the Church Hill junction. Please refer also to **Section 6**.
- 4.3.59 Should Option 12A be the preferred option the scheme development in PCF Stage 3 should include undertaking a DMRB GD04¹⁴⁶ risk assessment (standards for safety risk assessment on the strategic road network), to assist in the decision making regarding appropriate measure to be adopted to reduce risks related to a through-about at this location. Camera enforcement of the speed limit should be one of the measures considered.

DEPARTURES FROM STANDARD

- 4.3.60 This section summarises the departures from standard for Option 12A identified during PCF Stage 2, as recorded in the PCF Stage 2 Departures from Standard Checklist¹⁴⁷.
- 4.3.61 The proposed M2 eastbound diverge (Type B (Option 1) Ghost Island diverge) is a departure from standard because the traffic flows dictate a Type D – Ghost Island diverge for lane drop with 3 lanes on the M2 mainline (TD22/06¹⁴⁸ Paragraph 2.29). However, the existing M2 mainline is only 2 lanes and would require widening to 3 lanes for the design to be compliant which is outside of the scheme brief.
- 4.3.62 The M2 eastbound diverge slip-road requires a departure for SSD¹⁴⁹ below the desirable minimum (TD9/93 Paragraph 2.1) on a left hand bend prior to the loop as it can currently only achieve an SSD of 120m with standard 2.5m verges. To achieve the standard would require additional verge widening to 10.5m in advance of the loop.
- 4.3.63 The M2 eastbound diverge approach to the loop requires a one-step SSD departure (TD9/93¹⁵⁰ Paragraph 2.1) due to the existing horizontal alignment being below the desirable minimum at the back of the diverge nose. To achieve a complaint design would require major verge widening to approximately 30m and additional earthworks.
- 4.3.64 The proposed Maidstone Road Link junction with Oad Street also requires a departure from standard for reduced visibility to the right for approaching Oad Street traffic (TD42/95¹⁵¹ Paragraph 7.6). This is due to the existing road’s alignment and to produce a complaint standard would require a re-alignment of the Maidstone Road Link and / or widening of the existing Oad Street bridge over the M2.
- 4.3.65 The proposed Oad Street Link alignment, to the south of Whipstakes farm, requires a four-step horizontal curvature departure (TD9/93 Table 3), which would require additional land take and earthworks to produce a compliant design. To mitigate this departure appropriate signage and road markings should be provided.

¹⁴⁵ PCF – Project Control Framework

¹⁴⁶ Design Manual for Roads and Bridges, Volume 0, Section 2, GD 04/12 – Standard for Safety Risk Assessment on the Strategic Road Network

¹⁴⁷ PCF Stage 2 Departures from Standard Checklist - HE551521-WSP-HGN-PCF2-RP-D-00046.

¹⁴⁸ Design Manual for Roads and Bridges, Volume 6, Section 2, TD 22/06 - Layout of Grade-Separated Junctions

¹⁴⁹ SSD - Stopping Sight Distance

¹⁵⁰ Design Manual for Roads and Bridges, Volume 6, Section 1, TD 9/93 – Highway Link Design

¹⁵¹ Design Manual for Roads and Bridges, Volume 6, Section 2, TD42/95 – Geometric Design of Major / Minor Priority Junctions

PROPOSED STRUCTURES

4.3.66 The indicative design for Option 12A included for a new structure to take Oad Street over the proposed Oad Street Link. Further development related to this layout took place once the feedback from the public consultation was received. This is covered in **Section 10**.

COMPLIANCE WITH SCHEME OBJECTIVES

4.3.67 Option 12A complies with the scheme objectives as discussed below:

- Supporting economic growth
 - (1) The proposed through-about and free flow links provide additional capacity at the junction, which will support economic growth.
- A safe and serviceable network
 - (1) The option provides free-flow links as well as new carriageway for the A249 through traffic. These features will improve the overall operational safety at the junction the proposed layout does however, also introduce more conflict points, which are controlled via additional traffic signals at the junction. This has the potential for increased collisions compared to other options, albeit less than the existing layout. There is also the potential for increased collisions whilst users learn how to use the new junction following its commissioning.
- A more free flowing network
 - (1) The free-flow links and new carriageway for the A249 through traffic provide more capacity at the junction, which will improve the journey quality, time and reliability through the junction.
- An improved environment
 - (1) A full appraisal of Option 12A against this objective is provided in **Section 8.2**. In summary, the current design of Option 12A would comply with all components of the objective of an improved environment with the potential exception of the specific component which seeks to achieve the protection of historic and archaeological environments. This is due to likely residual adverse impacts on the setting of designated heritage assets and the Chatham Land Front World War I defences historic landscape associated with the current design. Opportunities may be available to avoid or otherwise minimise these impacts as the design progresses, to improve or potentially achieve full compliance with this component of the objective. Option 12A complies with this objective to a greater degree than Options 10, 4 and Option 12.
- A more accessible and integrated network
 - (1) All options are expected to reduce driver stress as a result of increased journey time reliability, reduced journey times and the potential for improved safety at the junction. Results from surveys indicated that M2 Junction 5 does not currently have a high NMU¹⁵² presence. All options are expected to result in slight operational benefits as a result of increased quality of Public Rights of Way facilities. Opportunities to improve NMU accessibility will be considered as part of the design development in PCF¹⁵³ Stage 3, aiming to make changes that could benefit the community and provide a legacy where reasonable and proportionate.

¹⁵² NMU - Non-Motorised user.

¹⁵³ PCF – Project Control Framework

4.3.68 Although Option 12A achieves the scheme objectives with the exception of one component of the objective of achieving an improved environment (refer to **Section 8.2**), however opportunities may be available to avoid or minimise impacts on heritage and archaeology as the design progresses to achieve improved compliance. Option 12A is affordable (refer to **Section 2.4**) it is considered that the introduction of the through about, could introduce potential safety issues through the increased conflict points and relatively unusual junction layout on what is a rural location. Therefore, Option 12A is not considered a fully viable option at this stage.

5 SUMMARY OF TABLES OF TRAFFIC, ECONOMICS AND COSTS

5.1 TRAFFIC MODEL

STAGE 1

- 5.1.1 Option testing during PCF¹⁵⁴ Stage 1 was undertaken using a VISSIM micro-simulation model of the M2 Junction 5 as described in **Section 2.3.5**.
-

STAGE 2

- 5.1.2 As instructed by Highways England, the SERTM¹⁵⁵ was used for the PCF Stage 2 assessment. The model adopts a base year of 2015. When PCF Stage 2 started in December 2016 the SERTM was still being finalised, therefore to minimise delay to the PCF Stage 2 delivery schedule Highways England provided WSP with the latest version, Design Freeze 3, of the model on 1 February 2017.
- 5.1.3 Following the issue of Design Freeze 3 of the SERTM by Highways England it was agreed that a cordon area would be extracted and be used to form the PCF Stage 2 M2 Junction 5 Regional Traffic Model (here after referred to as the M2 Junction 5 Model), enabling full assessment of the junction improvement on the wider network to be undertaken.

ALTERNATIVE MODES AND VARIABLE DEMAND MODELLING

- 5.1.4 During PCF Stages 0 and 1 it was confirmed that, given the scale of the problems identified at M2 Junction 5, there was little scope for alternative modes to play a part for providing sufficient congestion relief at the junction. Hence the PCF Stage 2 assessment is limited to highways only modelling.
- 5.1.5 Given that the road network around M2 Junction 5 encompasses no significant pedestrian or cyclist provisions and there is limited pedestrian demand; no inclusion has been made for pedestrians or cyclists within the model.
- 5.1.6 Any change to transport conditions will, in principle, cause a change in demand. The purpose of Variable Demand Modelling is to predict and quantify these changes. A technical note on assessing a need for a Variable Demand Modelling for this project has been prepared and agreed separately, a copy of which is included within **Appendix B-2** of this report. A simple elasticity test was undertaken to determine the need for VDB¹⁵⁶. Although the test was subject to a number of limitations the results on the need for VDM were borderline in terms of WebTAG thresholds.

¹⁵⁴ PCF – Project Control Framework

¹⁵⁵ SERTM – South East Regional Transport Model

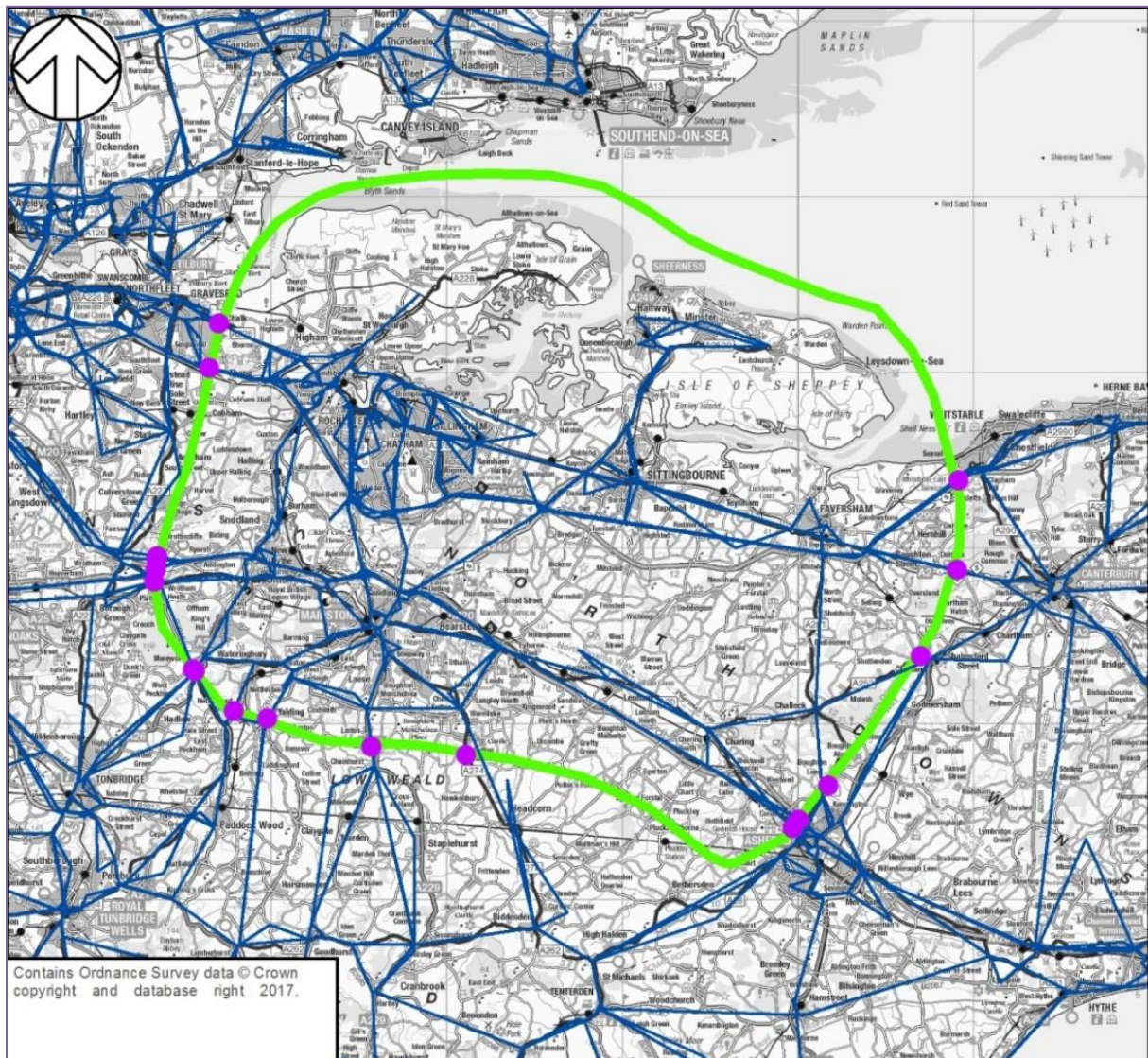
¹⁵⁶ VDM - Variable Demand Modelling

5.1.7 It was however discussed and agreed with Highways England in June 2017 that VDM would be undertaken during this stage to ensure a robust assessment was undertaken. VDM reduces demand where links or junctions are reaching capacity and increases it where there is spare capacity. Consequently, forecast demand varies between improvement options, which makes direct comparisons of detailed operational performances difficult. Within this report a number of detailed metrics, including queuing lengths, are presented and discussed. However, the more strategic metrics of junction throughput, journey times and the value of benefits for an option are the best metrics to use when looking at the comparative performance of options.

STUDY AREA

5.1.8 In discussion with Highways England's Transport Planning Group, formerly the Traffic Appraisal Modelling and Economics, in June 2017 the boundary of the study area was redefined. This study area superseded the area agreed in January 2017 prior to the need for Variable Demand Modelling.

Figure 5-1 SERTM Network and M2 Junction 5 Cordon Area



5.1.9 **Figure 5-1** depicts the SERTM¹⁵⁷ network (blue lines) and the boundary of the cordoned area (green line) for the M2 Junction 5 Model. To the west, the study area extends up to the A226 (west of A289), A2 (west of M2 Junction 1) and M20 (east of M26). To the north it's bounded by the English Channel and Thames estuary respectively. To the east the study area extends towards the west side of both Whitstable (A299) and Canterbury (A2, A28), whilst to the south, it includes Maidstone and the boundary line runs south of the M20/A20 to Dover. Hence the defined study area demonstrates that not only the alternative traffic routes are encompassed within it, but also ensures that traffic to and from the M25 and M26 is also captured. The network links cut by the cordon area are also shown (purple dots).

MODEL TIME PERIODS

5.1.10 The M2 Junction 5 Model is based on 2015 base year, in line with the SERTM¹⁵⁸. Matrices are based on the following time periods covering average peak hour flows:

- AM Peak (07:00 – 10:00);
- Interpeak (10:00 – 16:00);
- PM Peak (16:00 – 19:00).

5.1.11 These model time periods allow for a full 12-hour (07:00 – 19:00) assessment to be undertaken for the purposes of economic and environmental assessment.

5.1.12 The modelled forecast years are outlined below:

- 2021 - Assumed scheme opening year
- 2031 - Interim forecast year (end of Local Plan)
- 2036 - Additional modelled year (15 years post opening)
- 2041 - Additional modelled year (20 years post opening)

5.1.13 For the purposes of economic assessment, a horizon year of 2080 has been used in accordance with WebTAG guidance¹⁵⁹. This assesses the level of benefit of the scheme over a 60 year lifespan.

MODELLED SCENARIOS

5.1.14 As with the forecasting undertaken during PCF¹⁶⁰ Stage 0 and Stage 1, the PCF Stage 2 forecasting was produced using a combination of TEMPro¹⁶¹ growth projections, National Traffic Model forecasts and Local Plan allocations. Four scenarios were developed in accordance with WebTAG guidance, as outlined below:

- Core Scenario (TEMPro / NTM¹⁶² derived);
- Alternative Scenario (Local Plan allocations for Maidstone, Medway and Swale Local Authorities, with adjusted TEMPro and NTM background growth);
- High growth (based on the Core Scenario);
- Low growth (based on the Core Scenario).

¹⁵⁷ SERTM – South East Regional Transport Model

¹⁵⁸ SERTM – South East Regional Transport Model

¹⁵⁹ WebTAG Unit M4 Forecasting and Uncertainty, Department for Transport, July 2017

¹⁶⁰ PCF – Project Control Framework

¹⁶¹ TEMPro – Trip End Model Presentation Programme

¹⁶² NTM – National Traffic Model

- 5.1.15 The development of each of these scenarios is discussed in greater detail in the Traffic Forecasting Report¹⁶³.
- 5.1.16 The Core Scenario provides projected growth based on the national forecasting models produced by the Department for Transport – TEMPro for cars and NTM¹⁶⁴ for goods vehicles. This is a standard approach as outlined in WebTAG guidance¹⁶⁵ and provides a standard approach across all traffic forecasting.
- 5.1.17 The Alternative Scenario forecasts growth based on the latest local growth projections obtained from local authorities, being more up to date than the national forecast models in the Core Scenario. The approach taken was as outlined in WebTAG guidance.
- 5.1.18 The High and Low Growth Scenarios were developed from the Core Scenario in accordance with WebTAG guidance. This High and Low Growth Scenarios test the impact of lower or higher traffic flows than the Core Scenario.

5.2 TRAFFIC ASSESSMENT

- 5.2.1 This section presents the results of the forecasting and testing of options. The results for the Core Scenario are presented first, followed by the Alternative Scenario. For both scenarios, forecasts have been produced for Options 4, 10, 12 and 12A and for the four forecast years 2021, 2031, 2036 and 2041. The performance of the Reference Case and the option models are presented in terms of the following criteria:
- Model Convergence;
 - Model Summary Statistics;
 - M2 Junction 5 Modelled Traffic Flows;
 - Volume to Capacity Ratio;
 - Queue Lengths;
 - Journey Times.

CORE SCENARIO

MODEL CONVERGENCE

- 5.2.2 The importance of achieving model convergence at a required level is necessary to demonstrate stability, robustness and reliability of the model outputs in the economic assessment. When model outputs are being used to compare the with-scheme and without-scheme cases, and when estimating the Transport Economic Efficiency impacts of a scheme, it is important to be able to distinguish differences due to the scheme from those associated with different degrees of convergence.
- 5.2.3 Similar considerations apply when the costs (dis-benefits) and benefits of different interventions are being compared. Model convergence is therefore integral to a robust Transport Economic Efficiency appraisal.
- 5.2.4 The criteria used to assess convergence are outlined in **Table 5-1** and are as outlined in WebTAG Unit M3.1.

¹⁶³ M2 Junction 5 Improvements Scheme - PCF Stage 2 Traffic Forecasting Report, Highways England, October 2017. (HE551521-WSP-HGN-PCF2-RP-T-00010)

¹⁶⁴ NTM – National Traffic Model

¹⁶⁵ WebTAG Unit M4 Forecasting and Uncertainty, Department for Transport, July 2017

Table 5-1: Model Convergence Calibration Criteria

| Measure of Convergence | Purpose / Measure | Acceptance Criteria |
|------------------------------|---|---|
| Delta (δ) | Difference between costs on chosen routes and costs on minimum costs paths. | Less than 0.1% or at least stable with convergence fully documented and all other criteria met. |
| %GAP | Generalisation of δ to include the interaction effects within the simulation. | |
| % links with flow change <1% | Proportion of links in the network with flows changing by less than 1% from the previous iteration. | Four consecutive iterations greater than 97.5%. |

5.2.5 The convergence result tables for the Core Scenario can be found in **Appendix E-2**.

5.2.6 Overall the convergence indicates a good level of convergence for all years and all scenarios. The exception to this is Option 10 2041 PM Peak which fails both the 4 consecutive runs > 97.5% and the % Gap <0.1% criteria. Option 12 does not meet the 4 consecutive runs > 97.5% criteria for some modelled years and peak periods. Where the criteria are not met, this is due to a congested network with little or no practical reserve capacity in multiple areas of the models during these scenarios. However, this is not considered a significant issue as it is in the last modelled year, 20 years post-opening.

MODEL SUMMARY STATISTICS

5.2.7 A number of overall statistics from the model provide an overall indication of the operation of the model as a whole. The following statistics have been used in this report:

- Total Travel Time;
- Total Delay;
- Total Travel Distance;
- Average Speed;
- Total Trips.

5.2.8 The summary results presented show that across all options, the average model speed decreases steadily in both the AM and PM peak periods. Whilst there is little variation in model speed between the options, Options 4 and 12A show the highest modelled speeds in all modelled years. The Reference Case shows the lowest speed in each modelled year.

5.2.9 In terms of total travel time, all options show a similar total travel time per PCU¹⁶⁶ across all modelled years and time periods. Option 10 performs the best of all options, with the worst performing options being Options 12 and 12A.

5.2.10 In terms of total trips, all options show similar numbers. In the AM Peak period, Option 4 and Option 10 show the highest number of trips across all modelled years. In the PM Peak, Option 4 and 10 show the highest in 2021, but by 2041 Options 12 and 12A show the greatest number of trips.

¹⁶⁶ PCU: Passenger car unit

Table 5-2 Model Summary Statistics - Core Scenario - 2021

| Peak | AM Peak | | | | | PM Peak | | | | |
|---|-----------|-----------|-----------|-----------|-----------|------------|-----------|-----------|-----------|-----------|
| | Option | Ref | Option 4 | Option 10 | Option 12 | Option 12A | Ref | Option 4 | Option 10 | Option 12 |
| Total Travel Time per PCU ¹⁶⁷ (Mins) | 15.70 | 15.62 | 15.58 | 15.65 | 15.63 | 16.51 | 16.49 | 16.45 | 16.48 | 16.49 |
| Total Delay per PCU (Sec) | 52 | 52 | 51 | 54 | 52 | 58 | 58 | 58 | 58 | 58 |
| Total Distance (PCU Km) | 1,449,015 | 1,459,862 | 1,451,357 | 1,453,423 | 1,458,110 | 1,436,337 | 1,438,772 | 1,434,980 | 1,436,083 | 1,437,570 |
| Average Speed (KPH) | 52 | 53 | 52 | 52 | 52 | 49 | 49 | 49 | 49 | 49 |
| Total Trips (PCUs) | 106,803 | 106,880 | 106,881 | 106,821 | 106,866 | 106,968 | 106,992 | 106,993 | 106,985 | 106,983 |

Table 5-3: Model Summary Statistics - Core Scenario – 2031

| Peak | AM Peak | | | | | PM Peak | | | | |
|----------------------------------|-----------|-----------|-----------|-----------|-----------|------------|-----------|-----------|-----------|-----------|
| | Option | Ref | Option 4 | Option 10 | Option 12 | Option 12A | Ref | Option 4 | Option 10 | Option 12 |
| Total Travel Time per PCU (Mins) | 16.47 | 20.65 | 16.45 | 16.50 | 20.68 | 21.41 | 17.08 | 17.00 | 21.40 | 17.10 |
| Total Delay per PCU (Sec) | 59 | 75 | 58 | 61 | 75 | 86 | 69 | 69 | 86 | 69 |
| Total Distance (PCU Km) | 1,548,999 | 1,260,609 | 1,508,641 | 1,565,287 | 1,265,301 | 1,263,145 | 1,509,908 | 1,563,254 | 1,263,195 | 1,511,691 |
| Average Speed (KPH) | 50 | 58 | 46 | 50 | 59 | 58 | 47 | 50 | 58 | 47 |
| Total Trips (PCUs) | 114,100 | 91,044 | 113,968 | 114,202 | 91,068 | 91,061 | 113,986 | 114,183 | 91,063 | 113,985 |

¹⁶⁷ PCU – Passenger Car Unit

Table 5-4: Model Summary Statistics - Core Scenario – 2036

| Peak | AM Peak | | | | | PM Peak | | | | |
|---|-----------|-----------|-----------|-----------|-----------|------------|-----------|-----------|-----------|-----------|
| | Option | Ref | Option 4 | Option 10 | Option 12 | Option 12A | Ref | Option 4 | Option 10 | Option 12 |
| Total Travel Time per PCU ¹⁶⁸ (Mins) | 16.88 | 21.15 | 16.94 | 16.95 | 21.19 | 21.74 | 17.39 | 17.32 | 21.69 | 17.42 |
| Total Delay per PCU (Sec) | 63 | 79 | 62 | 65 | 79 | 94 | 76 | 76 | 94 | 76 |
| Total Distance (PCU Km) | 1,598,177 | 1,308,442 | 1,543,424 | 1,615,030 | 1,313,772 | 1,310,979 | 1,546,042 | 1,614,305 | 1,312,143 | 1,547,702 |
| Average Speed (KPH) | 48 | 57 | 45 | 49 | 57 | 57 | 45 | 49 | 57 | 45 |
| Total Trips (PCUs) | 117,801 | 94,241 | 117,418 | 117,914 | 94,266 | 94,257 | 117,441 | 117,897 | 94,260 | 117,438 |

Table 5-5: Model Summary Statistics - Core Scenario – 2041

| Peak | AM Peak | | | | | PM Peak | | | | |
|----------------------------------|-----------|-----------|-----------|-----------|-----------|------------|-----------|-----------|-----------|-----------|
| | Option | Ref | Option 4 | Option 10 | Option 12 | Option 12A | Ref | Option 4 | Option 10 | Option 12 |
| Total Travel Time per PCU (Mins) | 17.26 | 21.59 | 17.35 | 17.35 | 21.61 | 21.97 | 17.67 | 17.56 | 21.98 | 17.70 |
| Total Delay per PCU (Sec) | 66 | 83 | 66 | 68 | 83 | 100 | 82 | 81 | 100 | 82 |
| Total Distance (PCU Km) | 1,638,204 | 1,348,205 | 1,573,024 | 1,655,174 | 1,352,677 | 1,349,575 | 1,574,109 | 1,654,294 | 1,351,162 | 1,578,185 |
| Average Speed (KPH) | 47 | 56 | 44 | 47 | 56 | 56 | 44 | 47 | 56 | 45 |
| Total Trips (PCUs) | 120,936 | 96,961 | 120,317 | 121,050 | 96,986 | 96,974 | 120,345 | 121,034 | 96,981 | 120,336 |

¹⁶⁸ PCU – Passenger Car Unit

MODELLED TRAFFIC FLOWS

5.2.11 To aid a better understanding and provide context to the options assessed, total inbound traffic flows for the M2 Junction 5 Junction were extracted from the model. The results from the Reference Case are shown in **Table 5-6**, with a comparison for each option included in **Table 5-7** to **Table 5-9**. Percentage increases indicate a greater flow through the junction.

Table 5-6 M2 Junction 5 Modelled Traffic Flows - Core Scenario - Reference Case

| Modelled Year | M2 Junction 5 - Vehicle Flow (PCU ¹⁶⁹) | | |
|---------------|--|-----------|---------|
| | AM Peak | Interpeak | PM Peak |
| 2021 | 10,016 | 7,660 | 10,770 |
| 2031 | 10,661 | 8,599 | 11,246 |
| 2036 | 10,871 | 8,823 | 11,479 |
| 2041 | 11,094 | 9,058 | 11,588 |

Table 5-7: M2 Junction 5 Modelled Flows by Option - Core Scenario - AM Peak

| Modelled Year | Option 4 | | Option 10 | | Option 12 | | Option 12A | |
|---------------|-------------|---------------------|-------------|---------------------|-------------|---------------------|-------------|---------------------|
| | Actual Flow | % Diff to Ref. Case | Actual Flow | % Diff to Ref. Case | Actual Flow | % Diff to Ref. Case | Actual Flow | % Diff to Ref. Case |
| 2021 | 10,527 | 4.9% | 10,318 | 2.9% | 10,122 | 1.0% | 10,399 | 3.7% |
| 2031 | 11,412 | 6.6% | 11,152 | 4.4% | 11,055 | 3.6% | 11,389 | 6.4% |
| 2036 | 11,748 | 7.5% | 11,518 | 5.6% | 11,340 | 4.1% | 11,679 | 6.9% |
| 2041 | 12,041 | 7.9% | 11,736 | 5.5% | 11,515 | 3.7% | 11,894 | 6.7% |

Table 5-8: M2 Junction 5 Modelled Flows by Option - Core Scenario - Interpeak

| Modelled Year | Option 4 | | Option 10 | | Option 12 | | Option 12A | |
|---------------|-------------|---------------------|-------------|---------------------|-------------|---------------------|-------------|---------------------|
| | Actual Flow | % Diff to Ref. Case | Actual Flow | % Diff to Ref. Case | Actual Flow | % Diff to Ref. Case | Actual Flow | % Diff to Ref. Case |
| 2021 | 8,194 | 6.5% | 8,186 | 6.4% | 8,114 | 5.6% | 8,030 | 4.6% |
| 2031 | 9,166 | 6.2% | 8,964 | 4.1% | 8,958 | 4.0% | 8,977 | 4.2% |
| 2036 | 9,408 | 6.2% | 9,333 | 5.5% | 9,249 | 4.6% | 9,298 | 5.1% |
| 2041 | 9,645 | 6.1% | 9,540 | 5.1% | 9,460 | 4.2% | 9,557 | 5.2% |

¹⁶⁹ PCU – Passenger Car Unit

Table 5-9: M2 Junction 5 Modelled Flows by Option - Core Scenario - PM Peak

| Modelled Year | Option 4 | | Option 10 | | Option 12 | | Option 12A | |
|---------------|-------------|---------------------|-------------|---------------------|-------------|---------------------|-------------|---------------------|
| | Actual Flow | % Diff to Ref. Case | Actual Flow | % Diff to Ref. Case | Actual Flow | % Diff to Ref. Case | Actual Flow | % Diff to Ref. Case |
| 2021 | 11,205 | 3.9% | 11,105 | 3.0% | 10,864 | 0.9% | 11,017 | 2.2% |
| 2031 | 11,700 | 3.9% | 11,559 | 2.7% | 11,476 | 2.0% | 11,601 | 3.1% |
| 2036 | 11,873 | 3.3% | 11,780 | 2.6% | 11,591 | 1.0% | 11,805 | 2.8% |
| 2041 | 12,045 | 3.8% | 11,996 | 3.4% | 11,716 | 1.1% | 11,920 | 2.8% |

5.2.12 The tables above present the total flow through M2 Junction 5 for each forecast year and each option. Overall they indicate that Option 4 accommodates the highest total flow with Option 12A following very closely. The highest increases are seen in the AM and Inter Peak periods with almost 8% increase in total flows for Option 4 2041 AM peak.

VOLUME TO CAPACITY RATIO

5.2.13 A summary of the Volume to Capacity Ratio results for the Core Scenario are shown in **Appendix E-3**. Where the Volume/Capacity Ratio exceeds 85% for a link, the link is deemed to be reaching theoretical capacity, whilst links close to or above 100% are considered to be at or above theoretical link capacity.

5.2.14 For the Reference Case, the results indicate that:-

- Likely to be operating over capacity in 2021 are:
 - (1) The A249 southbound approach to the M2 Junction 5 Roundabout; and
 - (2) The circulatory carriageway between Maidstone Road and the M2 westbound on-slip.
- Likely to be operating close to capacity from 2031 are:-
 - (1) The M2 in both directions between Junctions 4 and 5.
 - (2) The M2 Junction 5 eastbound off-slip.
 - (3) M2 eastbound to A249 northbound free-flow link.
 - (4) The M2 Junction 5 westbound on-slip.
 - (5) The Oad Street junction right-turn waiting area.
- Likely to be over capacity from 2041 are:-
 - (1) The Oad Street approach to the A249.

5.2.15 For Option 4 the results indicate that:-

- Likely to be operating over capacity from 2021 are:-
 - (1) The Oad Street Link connection to the M2 Junction 5 roundabout (AM Peak only);
 - (2) The A249 southbound to M2 westbound free-flow link (PM Peak only); and
 - (3) M2 westbound on-slip and merge on to the M2 at Junction 5 (PM Peak only).
- Likely to be operating close to capacity from 2031 in the AM and PM peaks are:-
 - (1) The M2 eastbound prior to M2 Junction 5;
 - (2) M2 eastbound to A249 northbound free-flow link;
 - (3) A249 northbound from M2 Junction 5; and
 - (4) A249 southbound approaching the M2 Junction 5 roundabout.
- Likely to be over capacity from 2036 are:-
 - (1) The A249 southbound to M2 westbound free-flow link; and
 - (2) The M2 westbound on-slip and merge on to the M2 at Junction 5.

5.2.16 For Option 10 the results indicate that:-

- Likely to be operating over capacity from 2021 are:-
 - (1) Oad Street Link / Maidstone Road approach to the M2 Junction 5 roundabout; and
 - (2) A249 northbound approaches to the M2 Junction 5 roundabout.
- Likely to be operating over capacity from 2031 are:-
 - (1) The A249 northbound approach slip road to the roundabout; and
 - (2) The A249 southbound approach slip road to the roundabout.
- Likely to be close to capacity from 2031 are:-
 - (1) A249 southbound prior to the diverge for the M2 Junction 5 roundabout (AM Peak only).
- Likely to be close to capacity from 2036 are:-
 - (1) A249 southbound diverge for the M2 Junction 5 roundabout (AM Peak only); and
 - (2) M2 westbound diverge off-slip to M2 Junction 5 roundabout prior to free-flow to A249 southbound (AM Peak only).

5.2.17 For Option 12 the results indicate that:-

- Likely to be operating over capacity from 2031 for both the AM and PM Peaks are:-
 - (1) The Oad Street Link connection to M2 Junction 5;
 - (2) M2 westbound off-slip and on-slip;
 - (3) M2 eastbound on-slip; and
 - (4) A249 northbound approach to M2 Junction 5.

5.2.18 For Option 12A the results indicate that:-

- Likely to be operating over capacity from 2031 are:-
 - (1) Free-flow between A249 southbound and M2 westbound (PM Peak only); and
 - (2) The M2 Junction 5 westbound on-slip (PM Peak only).
- Likely to be operating close to capacity from 2031 for the AM and PM Peaks are:-
 - (1) The M2 eastbound and westbound merges and diverges.
- Likely to be operating over capacity from 2041 are:-
 - (1) Free-flow between A249 southbound and M2 westbound (AM Peak); and
 - (2) The M2 Junction 5 westbound on-slip (AM Peak).

QUEUE LENGTHS

5.2.19 The number of vehicles queuing at the end of the modelled period were also extracted from the M2 Junction 5 Model. Queue length results can be a useful indicator to demonstrate the link between capacity and traffic demand at the end of the modelled period. The queue lengths for the Reference Case and options can be seen in **Appendix E-4**.

5.2.20 Where there are network capacity issues and flows close to or exceeding capacity, queuing on the link is expected. When comparing between options, an examination of the queue lengths can provide an indication on the performance of the junction. Whilst this is true for a fixed demand model, the application of VDM¹⁷⁰ results in each option having a different demand set. Therefore it is advised that caution is applied in the comparison of queueing. Queue lengths should not be referenced in isolation.

5.2.21 The introduction of VDM results in each options demand set being different. As a result the level of demand on M2 Junction 5 varies between options, directly impacting the potential for queueing at the junction. In order to provide context it is suggested that the junction flow should also be taken in to account when reviewing any queue length. For example **Table 5-7** shows that Option 4 accommodates higher demand than Option 12A and operates is less queueing.

5.2.22 The Queue at End of Time Period results indicate that Options 4 and 12A would perform with the least queueing across all time periods and all forecast years and offer a significant improvement over the Reference Case, which indicates queueing in excess of 250 vehicles in the 2041 PM Peak period.

5.2.23 The Reference Case queueing is predominantly shown to be on the A249 southbound approach to M2 Junction 5, whilst Option 4 and Option 12A queueing, which is significantly reduced, is located on the M2 westbound merge and M2 mainline.

5.2.24 Option 12A indicates no queuing in all time periods at the opening year, 2021, whilst Option 4 indicates some minor queuing on the A249 southbound to M2 westbound free-flow link in the PM Peak, it should be noted that the traffic flows on the free-flow link are greater for Option 4 than for Option 12A, so this should be taken into account.

¹⁷⁰ VDM – Variable Demand Modelling

JOURNEY TIME

5.2.25 To aid option assessment, journey times for key routes through M2 Junction 5 were extracted from the model. The graphical results are shown in **Appendix E-5**. The routes studied are outlined below:

- From M2 Eastbound to:
 - (1) A249 Northbound;
 - (2) A249 Southbound;
- From M2 Westbound to:
 - (1) A249 Northbound;
 - (2) A249 Southbound;
- From A249 Northbound to:
 - (1) M2 Eastbound;
 - (2) M2 Westbound;
- From A249 Southbound to:
 - (1) M2 Eastbound;
 - (2) M2 Westbound;
 - (3) M2 through route (both directions); and
 - (4) A249 through route (both directions).

5.2.26 During 2021, Options 4, 10 and 12A are shown to perform the best, especially on journeys originating on the A249 southbound prior to M2 Junction 5. Despite similar overall journey time benefits between Option 4 and Option 10, Option 10 shows a large dis-benefit on the A249 northbound to M2 eastbound route. This is due to the need to travel around the roundabout rather than using the existing free-flow link and the addition of two sets of traffic signals compared to the free-flow link. Option 12 generally indicates the lowest journey time benefit, with the PM Peak showing a number of dis-benefits.

5.2.27 The introduction of the free-flow link between the M2 eastbound and the A249 northbound sees a reduction in the journey time on this route for all options when compared to the Reference Case. The M2 eastbound to A249 southbound movement also shows a large reduction in journey time compared to the Reference Case for all options. This is due to the introduction of the free-flow links removing some of the key movement traffic flows from the circulatory carriageway, freeing up capacity on the circulatory carriageway.

5.2.28 For the 2031 AM Peak, routes from the A249 southbound prior to the M2 Junction 5 roundabout show significant journey time savings compared to the Reference Case for all options, with Options 4 and 10 demonstrating the greatest benefits. During the PM Peak, large journey time savings are seen for all options for the M2 eastbound to A249 southbound route. Journey time reductions are also seen on routes starting from the A249 southbound prior to the roundabout.

5.2.29 The large dis-benefit shown by Option 10 on the A249 northbound to M2 eastbound route is again evident in 2031, with the increase in journey time greater than 20% due to the introduction of two sets of traffic signals. Slight dis-benefits are also seen on the route between the A249 northbound and the M2 westbound. Other routes indicate slight dis-benefits during the AM or PM Peaks, these are generally shown by Options 12 and 12A.

- 5.2.30 By 2036, routes from the A249 southbound prior to Junction 5 continue to show significant journey time savings for all options compared to the Reference Case in both the AM and PM Peaks. During the AM Peak, Option 4 generally performs the best, followed by Options 10 and 12A. The large dis-benefit shown with Option 10 on the A249 northbound to M2 eastbound route remains for both peak periods due to the addition of two sets of traffic signals and the loss of the free-flow link.
- 5.2.31 Compared to the Reference Case, routes to the A249 in both directions from the M2 eastbound at Junction 5 continue to show journey time savings in both peaks, with a large benefit seen in the PM Peak to the A249 southbound for all options.
- 5.2.32 In 2041, a similar picture is evident with Options 4, 10 and 12A generally performing significantly better than Option 12. Option 4 is generally the best performing option. A greater level of dis-benefit is seen on routes from the M2 westbound in the AM peak. In the PM Peak, most routes show a journey time saving for all routes except for the A249 northbound to M2 westbound (Option 12 only), A249 northbound to M2 westbound (Option 12 only), A249 northbound through route (Option 12 only), A249 northbound to M2 eastbound (Option 10 only) and on the M2 eastbound (all options).

ALTERNATIVE SCENARIO

5.2.33 This section presents the results of the forecast year modelling and option testing (Options 4, 10, 12 and 12A) undertaken for the three modelled years using the Alternative Scenario. As with the Core Scenario, the following results are reported on:

- Model Convergence;
- Model Summary Statistics;
- M2 Junction 5 Modelled Traffic Flows;
- Volume to Capacity Ratio;
- Queue Lengths; and
- Journey Times.

MODEL CONVERGENCE

5.2.34 The convergence results tables for the Alternative Scenario can be seen in **Appendix E-6**.

5.2.35 Overall the convergence tables presented above indicate a good level of convergence for all years and all scenarios. The exception to this are: Option 10 2041 PM Peak which fails both the 4 consecutive runs > 97.5% and the % Gap <0.1%; and also Option 12 which fails the 4 consecutive runs > 97.5% on certain peak periods. These are not considered a significant issue but do reflect a congested network with no practical reserve capacity during these scenarios.

MODEL SUMMARY STATISTICS

5.2.36 A number of overall statistics from the model provide an overall indication of the operation of the model as a whole. The following statistics have been used in this report:

- Total Travel Time;
- Total Delay;
- Total Travel Distance;
- Average Speed; and
- Total Trips.

5.2.37 The model summary results for the Alternative Scenario are presented in **Tables 5-10 to 5-13**, for each modelled year and time period for the Reference Case and the four options. Presented next are the model summary results by modelled year and time period for the Reference Case and the four options.

5.2.38 The summary results presented show that across all options, the average model speed decreases steadily in both the AM and PM peak periods. Whilst there is little variation in model speed between the options, Options 4 shows the highest modelled speeds in all modelled years, with Options 10 and 12A showing slightly lower speeds. The Reference Case shows the lowest speed in each modelled year.

5.2.39 In terms of total travel time, all options show a similar total travel time per PCU¹⁷¹ across all modelled years and time periods. Option 10 performs the best of all options in the AM Peak and Option 12 in the PM Peak. The worst performing option being Option 12A.

5.2.40 In terms of total trips, all options show similar numbers. In the AM Peak period, Option 4 and Option 10 show the highest number of trips across all modelled years, except for 2014, where Options 4 and 12A show the greatest. In the PM Peak, Option 4 and 12 generally show the highest number of trips throughout.

¹⁷¹ PCU – Passenger Car Unit

Table 5-10 Model Summary Statistics - Alternative Scenario 2021

| Peak | AM Peak | | | | | PM Peak | | | | |
|---|-----------|-----------|-----------|-----------|-----------|------------|-----------|-----------|-----------|-----------|
| | Option | Ref | Option 4 | Option 10 | Option 12 | Option 12A | Ref | Option 4 | Option 10 | Option 12 |
| Total Travel Time per PCU ¹⁷² (Mins) | 15.62 | 15.58 | 15.56 | 15.62 | 15.60 | 16.48 | 16.48 | 16.41 | 16.47 | 16.48 |
| Total Delay per PCU (Sec) | 52 | 52 | 51 | 53 | 52 | 57 | 58 | 57 | 57 | 58 |
| Total Distance (PCU Km) | 1,485,547 | 1,498,499 | 1,490,555 | 1,490,836 | 1,497,239 | 1,474,898 | 1,479,995 | 1,474,954 | 1,477,138 | 1,478,691 |
| Average Speed (KPH) | 51 | 51 | 51 | 51 | 51 | 47 | 47 | 47 | 47 | 47 |
| Total Trips (PCUs) | 112,588 | 112,642 | 112,638 | 112,598 | 112,636 | 114,266 | 114,287 | 114,286 | 114,284 | 114,282 |

Table 5-11 Model Summary Statistics - Alternative Scenario – 2031

| Peak | AM Peak | | | | | PM Peak | | | | |
|----------------------------------|-----------|-----------|-----------|-----------|-----------|------------|-----------|-----------|-----------|-----------|
| | Option | Ref | Option 4 | Option 10 | Option 12 | Option 12A | Ref | Option 4 | Option 10 | Option 12 |
| Total Travel Time per PCU (Mins) | 16.46 | 16.54 | 16.47 | 16.56 | 16.59 | 17.25 | 17.30 | 17.27 | 17.19 | 17.33 |
| Total Delay per PCU (Sec) | 58 | 59 | 57 | 60 | 59 | 66 | 68 | 68 | 66 | 68 |
| Total Distance (PCU Km) | 1,599,442 | 1,619,131 | 1,607,753 | 1,606,322 | 1,618,004 | 1,536,712 | 1,553,738 | 1,548,366 | 1,543,507 | 1,551,953 |
| Average Speed (KPH) | 47 | 47 | 47 | 47 | 47 | 43 | 43 | 43 | 43 | 43 |
| Total Trips (PCUs) | 123,762 | 123,842 | 123,843 | 123,785 | 123,832 | 124,166 | 124,183 | 124,181 | 124,187 | 124,173 |

¹⁷² PCU – Passenger Car Unit

Table 5-12: Model Summary Statistics - Alternative Scenario – 2036

| Peak | AM Peak | | | | | PM Peak | | | | |
|---|----------------|-----------------|------------------|------------------|-------------------|----------------|-----------------|------------------|------------------|-------------------|
| Option | Ref | Option 4 | Option 10 | Option 12 | Option 12A | Ref | Option 4 | Option 10 | Option 12 | Option 12A |
| Total Travel Time per PCU ¹⁷³ (Mins) | 16.92 | 16.96 | 16.90 | 17.03 | 17.02 | 17.38 | 17.49 | 17.38 | 17.37 | 17.50 |
| Total Delay per PCU (Sec) | 61 | 62 | 60 | 63 | 62 | 70 | 73 | 73 | 71 | 73 |
| Total Distance (PCU Km) | 1,648,356 | 1,672,134 | 1,659,286 | 1,658,534 | 1,672,250 | 1,595,216 | 1,612,784 | 1,611,448 | 1,602,673 | 1,611,783 |
| Average Speed (KPH) | 45 | 46 | 46 | 45 | 46 | 41 | 41 | 42 | 41 | 41 |
| Total Trips (PCUs) | 129,244 | 129,321 | 129,318 | 129,268 | 129,317 | 133,793 | 133,812 | 133,808 | 133,810 | 133,805 |

Table 5-13: Model Summary Statistics - Alternative Scenario – 2041

| Peak | AM Peak | | | | | PM Peak | | | | |
|----------------------------------|----------------|-----------------|------------------|------------------|-------------------|----------------|-----------------|------------------|------------------|-------------------|
| Option | Ref | Option 4 | Option 10 | Option 12 | Option 12A | Ref | Option 4 | Option 10 | Option 12 | Option 12A |
| Total Travel Time per PCU (Mins) | 17.25 | 17.32 | 17.27 | 17.40 | 17.39 | 17.59 | 17.69 | 17.67 | 17.66 | 17.71 |
| Total Delay per PCU (Sec) | 64 | 64 | 62 | 64 | 64 | 75 | 78 | 78 | 76 | 78 |
| Total Distance (PCU Km) | 1,693,391 | 1,711,464 | 1,698,739 | 1,696,410 | 1,712,731 | 1,630,280 | 1,652,799 | 1,644,131 | 1,630,304 | 1,651,176 |
| Average Speed (KPH) | 44 | 44 | 44 | 44 | 44 | 40 | 40 | 40 | 40 | 40 |
| Total Trips (PCUs) | 134,221 | 134,298 | 134,285 | 134,250 | 134,288 | 139,629 | 139,633 | 139,631 | 139,641 | 139,627 |

¹⁷³ PCU – Passenger Car Unit

MODELLED TRAFFIC FLOWS

5.2.41 To aid option assessment, total traffic flows for M2 Junction 5 were extracted from the model. The results from the Reference Case are shown in **Table 5-14**, with a comparison for each option included in **Table 5-15** to **Table 5-17**. Percentage increases indicate a greater flow through the junction.

Table 5-14 M2 Junction 5 Modelled Traffic Flows - Alternative Scenario - Reference Case

| Modelled Year | M2 Junction 5 - Vehicle Flow (PCU ¹⁷⁴) | | |
|---------------|--|-----------|---------|
| | AM Peak | Interpeak | PM Peak |
| 2021 | 10,334 | 8,467 | 11,148 |
| 2031 | 11,234 | 9,450 | 11,609 |
| 2036 | 11,658 | 9,743 | 11,670 |
| 2041 | 11,732 | 9,911 | 11,655 |

Table 5-15: M2 Junction 5 Modelled Flows by Option - Alternative Scenario - AM Peak

| Modelled Year | Option 4 | | Option 10 | | Option 12 | | Option 12A | |
|---------------|-------------|---------------------|-------------|---------------------|-------------|---------------------|-------------|---------------------|
| | Actual Flow | % Diff to Ref. Case | Actual Flow | % Diff to Ref. Case | Actual Flow | % Diff to Ref. Case | Actual Flow | % Diff to Ref. Case |
| 2021 | 10,955 | 5.7% | 10,784 | 4.2% | 10,566 | 2.2% | 10,814 | 4.4% |
| 2031 | 12,328 | 8.9% | 11,919 | 5.7% | 11,719 | 4.1% | 12,297 | 8.6% |
| 2036 | 12,569 | 7.2% | 12,107 | 3.7% | 11,979 | 2.7% | 12,643 | 7.8% |
| 2041 | 12,709 | 7.7% | 12,179 | 3.7% | 12,145 | 3.4% | 12,795 | 8.3% |

Table 5-16: M2 Junction 5 Modelled Flows by Option - Alternative Scenario - Interpeak

| Modelled Year | Option 4 | | Option 10 | | Option 12 | | Option 12A | |
|---------------|-------------|---------------------|-------------|---------------------|-------------|---------------------|-------------|---------------------|
| | Actual Flow | % Diff to Ref. Case | Actual Flow | % Diff to Ref. Case | Actual Flow | % Diff to Ref. Case | Actual Flow | % Diff to Ref. Case |
| 2021 | 8,939 | 5.3% | 8,915 | 5.0% | 8,760 | 3.3% | 8,821 | 4.0% |
| 2031 | 10,273 | 8.0% | 9,981 | 5.3% | 9,949 | 5.0% | 10,204 | 7.4% |
| 2036 | 10,735 | 9.2% | 10,372 | 6.1% | 10,306 | 5.5% | 10,683 | 8.8% |
| 2041 | 11,068 | 10.5% | 10,633 | 6.8% | 10,513 | 5.7% | 11,002 | 9.9% |

Table 5-17: M2 Junction 5 Modelled Flows by Option - Alternative Scenario - PM Peak

| Modelled Year | Option 4 | | Option 10 | | Option 12 | | Option 12A | |
|---------------|-------------|---------------------|-------------|---------------------|-------------|---------------------|-------------|---------------------|
| | Actual Flow | % Diff to Ref. Case | Actual Flow | % Diff to Ref. Case | Actual Flow | % Diff to Ref. Case | Actual Flow | % Diff to Ref. Case |
| 2021 | 11,660 | 4.4% | 11,467 | 2.8% | 11,331 | 1.6% | 11,529 | 3.3% |
| 2031 | 12,598 | 7.9% | 12,309 | 5.7% | 11,609 | 0.0% | 12,472 | 6.9% |
| 2036 | 12,822 | 9.0% | 12,403 | 5.9% | 11,839 | 1.4% | 12,683 | 8.0% |
| 2041 | 12,888 | 9.6% | 12,591 | 7.4% | 11,971 | 2.6% | 12,802 | 9.0% |

¹⁷⁴ PCU – Passenger Car Unit

- 5.2.42 The tables above present the total flow through M2 Junction 5 for each forecast year and each option. Overall they indicate that Option 4 accommodates the highest total flow with Option 12A following very closely. The highest increases are seen in the Interpeak and PM Peak periods with almost 10% increase in total flows for Option 4 2041 AM peak.
- 5.2.43 During the AM Peak, the flow increases compared to the Reference Case are in between 4% and 9% for Options 4 and 12A, Options 10 and 12 typically perform to a lower level, between 2% and 6%.
- 5.2.44 Across all peaks, Option 12 typically performs the worst, with Option 10 showing a slight improvement. Options 4 and 12A are the best performing options with Option 4 generally slightly better than Option 12A.

VOLUME TO CAPACITY RATIO

- 5.2.45 A summary of the Volume to Capacity Ratio results for the Alternative Scenario are shown in **Appendix E-7**. Where links are between 85% and 100%, they are considered to be close to capacity and could lead to delay. Where the Volume to Capacity Ratio exceeds 100%, the link is said to be operating over capacity and delay is highly likely.
- 5.2.46 For the Reference Case, the results indicate that:-
- Likely to be operating over capacity in 2021 are:-
 - (1) The A249 southbound approach to the M2 Junction 5 Roundabout; and
 - (2) The circulatory carriageway between Maidstone Road and the M2 westbound on-slip.
 - Likely to be operating over capacity from 2031 are:-
 - (1) The M2 Junction 5 eastbound off-slip; and
 - (2) The Oad Street junction.
- 5.2.47 For the Option 4, the results indicate that:-
- Likely to be operating over capacity from 2021 are:-
 - (1) The Oad Street Link connection to the M2 Junction 5 roundabout (AM Peak only);
 - (2) The A249 southbound to M2 westbound free-flow link (PM Peak only); and
 - (3) M2 westbound on-slip and merge on to the M2 at Junction 5 (PM Peak only).
 - Likely to be operating close to capacity from 2031 in the AM and PM peaks are:-
 - (1) The M2 eastbound prior to M2 Junction 5;
 - (2) M2 eastbound to A249 northbound free-flow link;
 - (3) A249 northbound from M2 Junction 5; and
 - (4) A249 southbound approaching Junction 5.

5.2.48 For the Option 10, the results indicate that:-

- Likely to be operating over capacity from 2021 for all modelled peaks are:-
 - (1) Oad Street Link / Maidstone Road approach to the M2 Junction 5 roundabout; and
 - (2) A249 northbound approaches to the M2 Junction 5 roundabout.
- Likely to be operating over capacity from 2031 for all modelled peaks are:-
 - (1) The Oad Street link to Maidstone Road; and
 - (2) The A249 southbound approach slip road to the roundabout.
- Likely to be close to capacity from 2031 in the AM and PM Peaks are:-
 - (1) M2 eastbound approach to the M2 Junction 5 roundabout; and
 - (2) M2 westbound approach to the M2 Junction 5 roundabout.

5.2.49 For the Option 12, the results indicate that:-

- Likely to be operating over capacity from 2031 for both the AM and PM Peaks are:-
 - (1) The Oad Street Link connection to M2 Junction 5;
 - (2) M2 westbound off-slip;
 - (3) Circulatory carriageway between M2 westbound slips; and
 - (4) A249 northbound approach to M2 Junction 5.

5.2.50 For the Option 12A, the results indicate that:-

- Likely to be operating over capacity from 2031 are:-
 - (1) Free-flow between A249 southbound and M2 westbound; and
 - (2) The M2 Junction 5 westbound on-slip.

QUEUE LENGTHS

5.2.51 End of modelled period queue length results were also extracted from the model for the M2 Junction 5 study area. Queue length results can be a useful indicator to demonstrate the link between capacity and traffic flow.

5.2.52 Where there are network capacity issues and flows close to or exceeding capacity, queuing on the link is expected. When comparing between options, an examination of the queue lengths can provide an indication on the performance of the junction. Whilst this is true for a fixed demand model, the application of VDM¹⁷⁵ results in each option having a different demand set. Therefore it is advised that caution is applied in the comparison of queueing. Queue lengths should not be referenced in isolation.

5.2.53 The introduction of VDM results in each options' demand set being different. As a result the level of demand on M2 Junction 5 varies between options, directly impacting the potential for queueing at the junction. In order to provide context it is suggested that the junction flow should also be taken in to account when reviewing any queue length.

5.2.54 The results are shown **Appendix E-8**. The queue lengths are presented as the number of vehicles.

5.2.55 With the Alternative Scenario, the Reference Case is showing queuing on the A249 southbound approach to M2 Junction 5, the Oad Street approach to the A249 and the

¹⁷⁵ VDM – Variable Demand Modelling

circulatory carriageway between Maidstone Road and the M2 westbound diverge across all modelled years and time periods. Queuing on the M2 Junction 5 eastbound off-slip is shown to develop from 2031 onwards for during all peak periods. Queuing on the A249 southbound approach is significant, rising from a 61 vehicle queue in 2021 to 402 vehicles in 2041.

- 5.2.56 Queuing in Option 4 shows a significant reduction compared to the Reference Case. There is queuing across most time periods and modelled years on the Oad Street Link connection to the roundabout. Four other links are showing sporadic queuing in the PM Peak; these are the A249 southbound to M2 westbound free-flow link, M2 westbound roundabout exit and the A249 southbound before and after the free-flow link to the westbound M2.
- 5.2.57 With Option 10, two links are showing queuing from 2021, the A249 northbound and the Oad Street Link / Maidstone Road entry to the roundabout. By 2031, queuing is also showing on the Oad Street Link upstream of the junction with Maidstone Road, A249 northbound diverge to the roundabout and the A249 southbound approach to the roundabout (significant queuing). From 2036, sporadic queuing is seen on the A249 southbound diverge to the roundabout, A249 northbound after the roundabout and on Maidstone Road.
- 5.2.58 Option 12 shows significant queuing on the A249 northbound, especially from 2031 onwards in the AM and PM peaks where queue lengths range from 124 to 309 vehicles. Queuing from 2031 is also seen on the M2 westbound off-slip, Oad Street Link connection to the roundabout and on the circulatory carriageway between the A249 and the M2 westbound entry slip.
- 5.2.59 With Option 12A, queuing is generally limited to during the AM and PM Peak periods only from 2031, on the free-flow link between the A249 southbound and M2 westbound and on the M2 westbound exit slip from the roundabout. Sporadic queuing is also seen on the A249 southbound prior to the free-flow link, Maidstone Road on the approach to the junction with the Oad Street Link and on the circulatory carriageway between the A249 southbound and the M2 westbound slips. Across all modelled years, the longest queues are shown to be a maximum of 46 vehicles.

JOURNEY TIMES

- 5.2.60 To aid option assessment, journey times for key routes through M2 Junction 5 were extracted from the model. The graphical results are shown in **Appendix E-9**. The routes studied are the same as the Core Scenario (please see **Section 5.2.25**).
- 5.2.61 With the Alternative Scenario in 2021, routes from the M2 eastbound to the A249 and routes from the A249 southbound prior to the roundabout show significant journey time reductions compared to the Reference Case, with Option 4 performing the best, followed by Options 10 and 12A. During the AM Peak, a slight dis-benefit is seen with Options 12 and 12A on routes from the M2 westbound, and from the A249 northbound in the PM Peak. The A249 northbound to M2 eastbound route shows a large dis-benefit with Option 10 due to the need to use the roundabout.
- 5.2.62 In 2031, journey time reductions are seen on routes from the M2 eastbound to the A249 and all routes from the A249 southbound. Options 4, 10 and 12A perform at a similar level, with Option 12 often performing at a significantly lower level. The M2 through routes in both directions show journey time increases in both peaks.
- 5.2.63 The level of dis-benefit seen has generally increased compared to 2021. For routes from the M2 westbound to the A249 in both directions, a dis-benefit is seen with Options 12 and 12A, Options 4 and 10 show minimal change in both peaks. During the AM Peak, if travelling from the A249 northbound to the M2 westbound, a dis-benefit is seen with all options except Option 10, and on the A249 northbound to M2 eastbound with Option 10 only, this is due to the need to travel round the roundabout. During the PM Peak, large increases in journey time are seen on two routes with Option 12.

- 5.2.64 As with previous years, the 2036 journey time results indicate that where the dedicated movements have been provided for there is a large reduction in the journey time compared to the Reference Case in both peak periods. Option 12 shows reduced reductions on routes from the M2 eastbound and large dis-benefits in the PM Peak on routes from the A249 northbound to M2 westbound and through routes. The M2 through routes show a slight dis-benefit for all options during both peak periods.
- 5.2.65 By 2041, routes from the A249 southbound continue to show significant journey time savings compared to the Reference Case despite the high level of demand from the Alternative Scenario. In addition to the A249 southbound routes, during the PM Peak routes from the A249 northbound also show large journey time savings, especially with Options 4 and 12A. Where dis-benefits have been seen previously, the level of dis-benefit has generally increased further in 2041 compared to previous years.

HIGH / LOW LEVEL GROWTH SCENARIO

- 5.2.66 In addition to the Core and Alternative Scenarios, additional testing of the options was carried out with the high and low growth scenarios. A number of high level statistics from the high and low growth model runs are presented next to provide an overall indication of the operation of the options.
- 5.2.67 The following statistics are presented next; full results can be found in the Traffic Forecasting Report¹⁷⁶:
- Total Travel Time;
 - Total Delay;
 - Total Travel Distance;
 - Average Speed; and
 - Total Trips.

HIGH GROWTH

- 5.2.68 The summary results presented in **Tables 5-18 to 5-21** show that across all options, the average model speed decreases steadily in both the AM and PM peak periods. Whilst there is little variation in model speed between the options, Options 4 and 12A show the highest modelled speeds in all modelled years, with the Reference Case performing the worst.
- 5.2.69 In terms of total travel time, all options show a similar total travel time per PCU¹⁷⁷ across all modelled years and time periods. Option 10 performs the best of all options in both the AM and PM Peaks. Option 12 in the AM Peak and Option 12A in the PM Peak generally perform the worst in terms of total travel time per PCU across all modelled years.
- 5.2.70 In terms of total trips, all options show similar numbers. In the AM Peak period, Option 4 and Option 10 show the highest number of trips across for 2021 and 2031. For 2036 and 2041, Options 4 and 12A show the greatest number of trips. In the PM Peak, the best performing options are generally Options 4, 10 and 12.

¹⁷⁶ M2 Junction 5 Improvements Scheme - PCF Stage 2 Traffic Forecasting Report, Highways England, October 2017. (HE551521-WSP-HGN-PCF2-RP-T-00010)

¹⁷⁷ PCU – Passenger Car Unit

LOW GROWTH

- 5.2.71 The summary results presented in **Tables 5-22 to 5-25** show that across all options, the average model speed decreases steadily in both the AM and PM peak periods. Whilst there is little variation in model speed between the options, Options 4 and 12A show the highest modelled speeds in all modelled years in the AM Peak. During the PM Peak, Options 10 and 12 show the highest modelled speed, with Options 4 and 12A showing the lowest.
- 5.2.72 In terms of total travel time, all options show a similar total travel time per PCU¹⁷⁸ across all modelled years and time periods. Option 10 performs the best of all options in both the AM and PM Peaks Options 4 and 12A perform the worst in the AM Peak, however in the PM Peak, performance is improved.
- 5.2.73 In terms of total trips, all options show similar numbers. In the AM Peak period, Option 4 and Option 10 show the highest number of trips in 2021, from 2031, Option 12 and the Reference Case show the greatest flows. In the PM Peak, Options 4 and 10 generally show the highest number of trips throughout.

¹⁷⁸ PCU – Passenger Car Unit

Table 5-18 Model Summary Statistics – High Growth Scenario - 2021

| Peak | AM Peak | | | | | PM Peak | | | | |
|---|-----------|-----------|-----------|-----------|------------|-----------|-----------|-----------|-----------|------------|
| Option | Ref | Option 4 | Option 10 | Option 12 | Option 12A | Ref | Option 4 | Option 10 | Option 12 | Option 12A |
| Total Travel Time per PCU ¹⁷⁹ (Mins) | 16.03 | 15.95 | 15.93 | 16.00 | 15.98 | 16.71 | 16.69 | 16.66 | 16.71 | 16.71 |
| Total Delay per PCU (Sec) | 55 | 55 | 54 | 56 | 55 | 61 | 62 | 62 | 61 | 62 |
| Total Distance (PCU Km) | 1,501,633 | 1,514,985 | 1,504,719 | 1,507,644 | 1,512,829 | 1,481,389 | 1,485,397 | 1,481,575 | 1,482,700 | 1,483,040 |
| Average Speed (KPH) | 50 | 51 | 51 | 50 | 51 | 47 | 48 | 48 | 47 | 47 |
| Total Trips (PCUs) | 112,099 | 112,186 | 112,185 | 112,122 | 112,169 | 112,280 | 112,300 | 112,298 | 112,293 | 112,293 |

Table 5-19: Model Summary Statistics – High Growth Scenario – 2031

| Peak | AM Peak | | | | | PM Peak | | | | |
|----------------------------------|-----------|-----------|-----------|-----------|------------|-----------|-----------|-----------|-----------|------------|
| Option | Ref | Option 4 | Option 10 | Option 12 | Option 12A | Ref | Option 4 | Option 10 | Option 12 | Option 12A |
| Total Travel Time per PCU (Mins) | 16.97 | 16.99 | 16.95 | 17.04 | 17.01 | 17.48 | 17.45 | 17.47 | 17.48 | 17.48 |
| Total Delay per PCU (Sec) | 62 | 63 | 61 | 64 | 63 | 76 | 77 | 76 | 76 | 77 |
| Total Distance (PCU Km) | 1,619,123 | 1,635,136 | 1,625,082 | 1,628,609 | 1,633,113 | 1,565,013 | 1,570,939 | 1,565,593 | 1,566,595 | 1,569,465 |
| Average Speed (KPH) | 47 | 47 | 47 | 47 | 47 | 44 | 44 | 44 | 44 | 44 |
| Total Trips (PCUs) | 122,734 | 122,850 | 122,842 | 122,778 | 122,838 | 122,594 | 122,618 | 122,622 | 122,622 | 122,615 |

¹⁷⁹ PCU – Passenger Car Unit

Table 5-20: Model Summary Statistics – High Growth Scenario – 2036

| Peak | AM Peak | | | | | PM Peak | | | | |
|---|----------------|-----------------|------------------|------------------|-------------------|----------------|-----------------|------------------|------------------|-------------------|
| Option | Ref | Option 4 | Option 10 | Option 12 | Option 12A | Ref | Option 4 | Option 10 | Option 12 | Option 12A |
| Total Travel Time per PCU ¹⁸⁰ (Mins) | 17.44 | 17.47 | 17.45 | 17.54 | 17.48 | 17.86 | 17.85 | 17.83 | 17.83 | 17.84 |
| Total Delay per PCU (Sec) | 67 | 68 | 66 | 69 | 68 | 83 | 84 | 84 | 84 | 85 |
| Total Distance (PCU Km) | 1,671,618 | 1,688,957 | 1,677,841 | 1,681,316 | 1,688,471 | 1,608,485 | 1,614,472 | 1,610,863 | 1,612,533 | 1,617,070 |
| Average Speed (KPH) | 45 | 45 | 45 | 45 | 45 | 43 | 43 | 43 | 43 | 43 |
| Total Trips (PCUs) | 127,688 | 127,815 | 127,803 | 127,738 | 127,804 | 127,298 | 127,313 | 127,325 | 127,324 | 127,312 |

Table 5-21: Model Summary Statistics – High Growth Scenario – 2041

| Peak | AM Peak | | | | | PM Peak | | | | |
|----------------------------------|----------------|-----------------|------------------|------------------|-------------------|----------------|-----------------|------------------|------------------|-------------------|
| Option | Ref | Option 4 | Option 10 | Option 12 | Option 12A | Ref | Option 4 | Option 10 | Option 12 | Option 12A |
| Total Travel Time per PCU (Mins) | 17.85 | 17.89 | 17.83 | 17.94 | 17.90 | 18.16 | 18.16 | 18.14 | 18.14 | 18.17 |
| Total Delay per PCU (Sec) | 70 | 70 | 68 | 71 | 70 | 90 | 91 | 91 | 90 | 91 |
| Total Distance (PCU Km) | 1,710,529 | 1,726,626 | 1,715,127 | 1,719,523 | 1,725,738 | 1,644,427 | 1,654,808 | 1,649,110 | 1,649,542 | 1,652,968 |
| Average Speed (KPH) | 44 | 44 | 44 | 44 | 44 | 41 | 42 | 42 | 42 | 42 |
| Total Trips (PCUs) | 131,934 | 132,066 | 132,052 | 131,993 | 132,053 | 131,303 | 131,324 | 131,316 | 131,333 | 131,316 |

¹⁸⁰ PCU – Passenger Car Unit

Table 5-22: Model Summary Statistics – Low Growth Scenario - 2021

| Peak | AM Peak | | | | | PM Peak | | | | |
|---|-----------|-----------|-----------|-----------|------------|-----------|-----------|-----------|-----------|------------|
| Option | Ref | Option 4 | Option 10 | Option 12 | Option 12A | Ref | Option 4 | Option 10 | Option 12 | Option 12A |
| Total Travel Time per PCU ¹⁸¹ (Mins) | 15.29 | 15.25 | 15.24 | 15.28 | 15.27 | 16.36 | 16.33 | 16.29 | 16.36 | 16.36 |
| Total Delay per PCU (Sec) | 50 | 49 | 48 | 50 | 49 | 55 | 55 | 55 | 55 | 55 |
| Total Distance (PCU Km) | 1,392,846 | 1,401,164 | 1,394,068 | 1,393,932 | 1,398,505 | 1,392,463 | 1,394,529 | 1,391,251 | 1,392,604 | 1,392,963 |
| Average Speed (KPH) | 54 | 54 | 54 | 54 | 54 | 50 | 50 | 50 | 50 | 50 |
| Total Trips (PCUs) | 101,495 | 101,563 | 101,562 | 101,508 | 101,550 | 102,172 | 102,187 | 102,189 | 102,182 | 102,180 |

Table 5-23: Model Summary Statistics – Low Growth Scenario – 2031

| Peak | AM Peak | | | | | PM Peak | | | | |
|----------------------------------|-----------|-----------|-----------|-----------|------------|-----------|-----------|-----------|-----------|------------|
| Option | Ref | Option 4 | Option 10 | Option 12 | Option 12A | Ref | Option 4 | Option 10 | Option 12 | Option 12A |
| Total Travel Time per PCU (Mins) | 15.96 | 19.93 | 15.90 | 15.92 | 19.94 | 20.97 | 16.71 | 16.65 | 20.95 | 16.74 |
| Total Delay per PCU (Sec) | 55 | 69 | 54 | 57 | 69 | 77 | 62 | 62 | 77 | 62 |
| Total Distance (PCU Km) | 1,465,291 | 1,188,643 | 1,448,367 | 1,477,983 | 1,190,293 | 1,189,503 | 1,449,204 | 1,476,564 | 1,188,601 | 1,449,254 |
| Average Speed (KPH) | 52 | 62 | 49 | 53 | 62 | 62 | 49 | 53 | 62 | 49 |
| Total Trips (PCUs) | 105,446 | 84,102 | 105,320 | 105,532 | 84,122 | 84,118 | 105,339 | 105,517 | 84,117 | 105,336 |

¹⁸¹ PCU – Passenger Car Unit

Table 5-24: Model Summary Statistics – Low Growth Scenario – 2036

| Peak | AM Peak | | | | | PM Peak | | | | |
|---|-----------|-----------|-----------|-----------|------------|-----------|-----------|-----------|-----------|------------|
| Option | Ref | Option 4 | Option 10 | Option 12 | Option 12A | Ref | Option 4 | Option 10 | Option 12 | Option 12A |
| Total Travel Time per PCU ¹⁸² (Mins) | 16.32 | 20.35 | 16.31 | 16.34 | 20.37 | 21.21 | 16.97 | 16.89 | 21.18 | 16.99 |
| Total Delay per PCU (Sec) | 58 | 74 | 58 | 60 | 74 | 83 | 68 | 67 | 84 | 67 |
| Total Distance (PCU Km) | 1,507,868 | 1,233,036 | 1,477,435 | 1,523,053 | 1,236,000 | 1,234,239 | 1,480,907 | 1,521,022 | 1,234,063 | 1,479,948 |
| Average Speed (KPH) | 51 | 61 | 48 | 52 | 61 | 61 | 49 | 52 | 61 | 49 |
| Total Trips (PCUs) | 107,890 | 86,288 | 107,509 | 107,984 | 86,310 | 86,303 | 107,531 | 107,969 | 86,304 | 107,529 |

Table 5-25: Model Summary Statistics – Low Growth Scenario – 2041

| Peak | AM Peak | | | | | PM Peak | | | | |
|----------------------------------|-----------|-----------|-----------|-----------|------------|-----------|-----------|-----------|-----------|------------|
| Option | Ref | Option 4 | Option 10 | Option 12 | Option 12A | Ref | Option 4 | Option 10 | Option 12 | Option 12A |
| Total Travel Time per PCU (Mins) | 16.64 | 20.71 | 16.65 | 16.66 | 20.74 | 21.41 | 17.18 | 17.07 | 21.36 | 17.22 |
| Total Delay per PCU (Sec) | 61 | 77 | 61 | 63 | 77 | 89 | 73 | 72 | 89 | 72 |
| Total Distance (PCU Km) | 1,542,177 | 1,266,671 | 1,500,574 | 1,559,903 | 1,269,754 | 1,267,712 | 1,503,137 | 1,558,664 | 1,267,949 | 1,503,912 |
| Average Speed (KPH) | 51 | 60 | 48 | 51 | 60 | 60 | 48 | 51 | 60 | 48 |
| Total Trips (PCUs) | 109,910 | 88,106 | 109,292 | 110,011 | 88,130 | 88,123 | 109,318 | 109,996 | 88,125 | 109,315 |

¹⁸² PCU – Passenger Car Unit

SUMMARY AND CONCLUSION

MODEL ROBUSTNESS

- 5.2.74 The network surrounding the M2 Junction 5 has been enhanced in the M2 Junction 5 Model, the SERTM¹⁸³ zone structure has been retained in full by only making changes to zone centroid connectors. Whilst this approach enables better representation of zone loadings on to most likely links, zones within the study area could have been disaggregated to better reflect the local network and detailed local loading for the demand.
- 5.2.75 Changes have been made in this respect to improve the zone loading locations relevant to the scheme to better reflect the observed network. This has also improved the model's level of calibration and validation resulting in a more representative performance for the M2, A249 and local roads of Oad Street and Maidstone Road to an acceptable standard. In the M2 Junction 5 Model wider, the Sittingbourne area is not modelled in detail with only a skeletal network provided. As a result distribution of local traffic is mainly limited to feeder routes on to the main corridors.
- 5.2.76 Whilst the M2 Junction 5 Model is limited by its relatively poor representation of local road networks i.e. within Sittingbourne, the traffic to and from these areas on to the strategic network, i.e. the M2 and A249, is well represented through feeder routes and zone connectors. This is evidenced by a good match between the modelled and observed traffic flows through the M2 Junction 5, as demonstrated in the Local Model Validation Report¹⁸⁴.

GENERAL SUMMARY

- 5.2.77 The 'without scheme' model (also referred to in this report as the Reference Case) results indicate significant queuing in all peaks and modelled years, in excess of 250 vehicles on the A249 southbound carriageway on the approach to the Stockbury Roundabout. All options show no or limited queuing in the year of opening, where selected queuing is shown this is on selected movements due to wider network congestion; small queues of up to 30 vehicles are indicated on the M2 westbound on slip due to M2 mainline congestion. This queuing is not related to the design of the schemes options.
- 5.2.78 In the Core Scenario, modelling indicates that options are likely to operate close to or within theoretical link capacity up to 2036/2041 for the key movements at M2 Junction 5. In the Alternative Scenario, options are likely to operate close to or within theoretical capacity up to 2031/2036 for the key movements at M2 Junction 5, exceeding capacity on certain key movements by 2041.
- 5.2.79 The maximum level of queuing predicted in the Alternative Scenario for Option 4 equates to approximately 55 vehicles on the Oad Street Link to the roundabout. Queuing is also seen on movements on to the M2 eastbound (approximately 30 vehicles) and M2 westbound (approximately 49 vehicles).
- 5.2.80 The maximum level of queuing predicted in the Alternative Scenario for Option 12A equates to a maximum of 46 vehicles on the free-flow link between A249 Southbound and M2 J5 Westbound. Queuing is also seen on the A249 Southbound prior to the free-flow link to M2 Westbound (approximately 44 vehicles) and on the M2 Westbound onslip exit from the M2 Junction 5 roundabout (approximately 27 vehicles).

¹⁸³ SERTM – South East Regional Transport Model

¹⁸⁴ M2 Junction 5 Improvements Scheme - PCF Stage 2 Local Model Validation Report, Highways England, October 2017. Document no. HE551521-WSP-HGN-PCF2-RP-T-00009

- 5.2.81 Overall, in the Alternative Scenario journey time savings are highest with Option 4 with particular improvements on the A249 southbound through route and the A249 southbound to M2 westbound route.
- 5.2.82 Alternative Scenario Journey Times for the A249 southbound through route from Sittingbourne (A2) to Maidstone (M20 Junction 7) would decrease by 7 minutes in Option 4, almost 1 minute faster than in Option 12A on average during the AM Peak period. This equates to a 56% improvement for Option 4 and 46% for Option 12A.
- 5.2.83 Alternative Scenario Journey Times for the A249 southbound to M2 westbound to London are shown to decrease by almost 7 minutes with Option 4; almost 1 minute faster than Option 12A on average in the 2041 AM Peak period. This equates to an approximate 31% improvement for Option 4 and 26% for Option 12A.
- 5.2.84 With the Core scenario, Option 4 is shown to accommodate the highest total flow followed closely by Option 12A. The highest increases are seen in the AM and Inter Peak periods with almost 8% increase in total flows for Option 4 2041 AM Peak.
- 5.2.85 Across all peaks, Option 12 typically performs the worst among other options, with Option 10 showing a slight improvement on this, although both indicate some large dis-benefits. The largest disbenefits for Option 10 are shown on A249 northbound entry immediately before the M2 Junction 5 Roundabout with capacity exceeded and significant queuing. While the largest disbenefits for Option 12 are seen on the A249 northbound approach to M2 Junction 5 Roundabout after M2 eastbound freeflow diverge with capacity exceeded and significant queuing. Options 4 and 12A are the best performing options, with Option 4 generally better than Option 12A.

CONCLUSION

- 5.2.86 Despite the high level of growth demonstrated in both the Core and Alternative Scenarios, all options considered generally show an improvement in terms of junction operation compared to the Reference Case, if no improvement scheme in place at M2 Junction 5. Of the options, Option 4 and Option 12A are generally the best performing options, with significant journey time and queue reduction benefits seen. Option 10 performs to a similar level as Options 4 and 12A in many areas, however there are some large dis-benefits seen on specific routes. Option 12 is the worst performing option.
- 5.2.87 When looking at the operation of the wider network, capacity constraints away from M2 Junction 5 are shown to have a limiting factor on the operation of the junction potentially restricting the amount of traffic reaching M2 Junction 5 or restricting traffic leaving the junction and thus causing blocking back issues. The significant congestion shown on the wider network, especially on the M2 mainline and local junctions such as at A249 / A2 Key Street junction indicate the need for significant improvement on a number of nearby links and junctions in the future in addition to improvements at M2 Junction 5.

5.3 ECONOMICS ASSESSMENT PROCESS

- 5.3.1 The appraisal of the economic elements associated with the scheme was undertaken using the Department for Transport's standard appraisal software TUBA¹⁸⁵ version 1.9.9 and COBALT¹⁸⁶ 2013. Both appraisals were undertaken in accordance with WebTAG guidance¹⁸⁷.

¹⁸⁵ TUBA – Transport Users Benefit Appraisal

¹⁸⁶ COBALT – Cost and Benefit to Accidents - Light Touch

¹⁸⁷ WebTAG unit A1.1 – Section 2.4

Further detail on the economic assessment work undertaken is included in the Economic Assessment Report¹⁸⁸.

- 5.3.2 The economic assessment undertaken used TUBA for the estimation of benefits, resulting from scheme compared to doing nothing, and COBALT to assess the likely change in the number of collisions and the associated monetised benefits (accident savings) as a result of the scheme. By comparing the level of benefits achieved to the cost of the scheme, a Benefit-Cost Ratio was determined. This allows an assessment of options. The economic appraisal was carried out over a 60 year period, from 2021 (opening year) to 2080, this assesses the level of benefit of the scheme over a 60 year lifespan.

TUBA

- 5.3.3 TUBA¹⁸⁹ is a computer program developed for the Department for Transport. It stands for transport user benefit appraisal and has been developed to undertake economic appraisals for transport schemes. TUBA takes trip, time, distance and charge matrices from a transport model and then calculates the user benefits and costs of the scheme, in terms of the following elements

- Time Savings;
- Vehicle Operating Costs;
- Carbon Savings;
- Scheme Costs; and
- Indirect Tax Revenue.

- 5.3.4 The TUBA results are summarised in the Analysis of Monetised Cost and Benefit table. Here, the results are summarised by:

- User class benefit;
- Public finance benefit;
- Collision benefit;
- Scheme Cost;
- Net Present Value (Total Benefit – Total Cost); and
- Benefit-Cost Ratio.

COBALT

- 5.3.5 COBALT¹⁹⁰ is a computer program developed by the Department for Transport to undertake the analysis of the impact on accidents as part of the economic appraisal for a road scheme. It allows users to define affected road links and junctions separately or combine links and junctions.

- 5.3.6 For the purpose of this assessment both methods, combined links and junctions and links and junctions separately, were used. The assessment is based on a comparison of accidents by severity and associated costs across an identified network in 'Without-Scheme' and 'With-Scheme' forecasts, using details of link and junction characteristics, relevant accident rates, local accident data and costs and forecast traffic volumes by link and junction. The accident

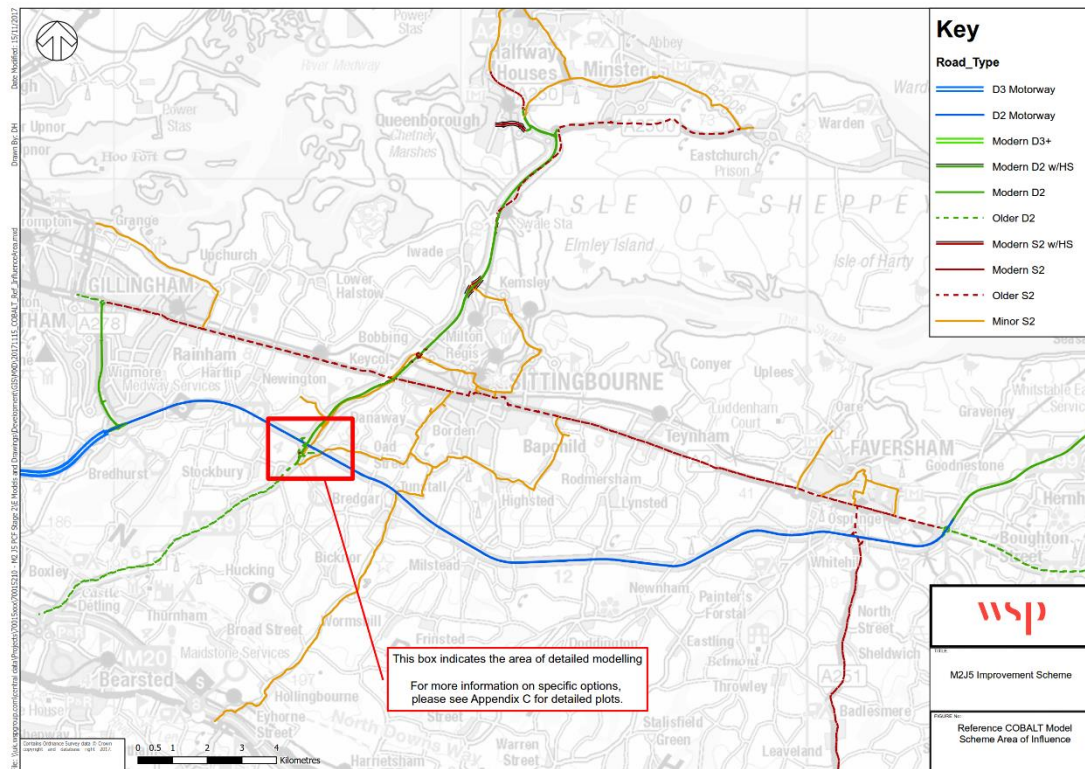
¹⁸⁸ M2 Junction 5 Improvements Scheme - PCF Stage 2 Economic Assessment Report, Highways England, October 2017. (HE551521-WSP-HGN-PCF2-RP-T-00007)

¹⁸⁹ TUBA – Transport Users Benefit Appraisal

¹⁹⁰ COBALT – Cost and Benefit to Accidents - Light Touch

severity categories are fatal, severe and minor. Cobalt is used to assess the potential benefits that a scheme may bring through improvements to road safety and a reduction in accidents.

Figure 5-2 COBALT¹⁹¹ Scheme Influence Area



ECONOMIC ASSESSMENT PROCESS – PUBLIC MODES

- 5.3.7 The M2 Junction 5 Model used in the economic assessment is a highway assignment model and therefore does not include public transport as part of the assignment process.
- 5.3.8 No rail modes are likely to be impacted by the scheme. Two bus routes traverse the junction, but it is intended that the routes will not be significantly affected by the proposed improvement scheme and the necessary change in route.
- 5.3.9 It is therefore proposed that no public transport model will be developed as part of the assessment of the scheme, and public transport benefits will not be included in the overall economic assessments.

¹⁹¹ COBALT – Cost and Benefit to Accidents - Light Touch

ESTIMATION OF COSTS

5.3.10 The Options Estimates in Table 5-26 below were produced by the Highways England Commercial Team in October 2017 and are to a base financial year of 2016 (Quarter 1). More details of the Options Estimates can be found in **Appendix E-1**. These estimate supersede those produced in May 2017 (please refer to **Table 2-2**) and were based on Oad Street Link Option B, to the south of Whipstakes Farm, being included within Options 4, 12 and 12A.

Table 5-26 PCF Stage 2 Interim No. 2 Option Estimates Ranges (2016 Base Year)

| OPTION | P10 | MOST LIKELY | P90 |
|------------|------------|-------------|-------------|
| Option 4 | £72million | £102million | £161million |
| Option 10 | £77million | £110million | £176million |
| Option 12 | £41million | £59million | £96million |
| Option 12A | £51million | £72million | £113million |

5.3.11 These PCF Stage 2 Interim No. 2 Options Estimates ranges show that:

- The three point range estimates for Option 12 remain within the RIS 1¹⁹² budget range and the Most Likely estimate remains below the capital baseline funding allocation. Options 12 remains affordable;
- The Option 12A P90 estimate exceeds the RIS 1 budget range and the Most Likely estimate is close to, but exceeds the capital baseline funding allocation. Option 12A is therefore borderline affordable. It is still considered a viable options in terms of cost, on the assumption that value management could be applied as the scheme is developed in PCF Stage 3 and beyond, to keep the option within the affordability limit;
- The Option 10 Most Likely and P90 estimates exceed the RIS 1 funding range and all three range estimates exceed the capital baseline funding allocation. Option 10 therefore remains unaffordable;
- The Option 4 P90 estimate exceeds the RIS 1 funding range, with the Most Likely estimate being close to, but still exceeding the range. All three range estimates exceed the capital baseline funding allocation. Option 4 therefore remains unaffordable.

5.3.12 Economic output tables were also received from the Highways England Commercial Team in October 2017 for these four scheme options, and are provided in **Appendix E-1**. **Table 5-27** shows the total cost for each option in terms of both 2016 prices and 2010 factor cost unit of account for input into TUBA. To obtain the present value of the scheme cost, the cost estimates were input into TUBA¹⁹³ to produce the Present Value of Costs.

¹⁹² Road Investment Strategy: for the 2015/16 – 2019/20 Road Period, Department for Transport, March 2015

¹⁹³ TUBA – Transport Users Benefit Appraisal

Table 5-27 P10, P50 and P90 Costs

| Option | P10 Costs | | Most Likely (P50 Costs) | | P90 Costs | |
|------------|-------------|-------------|-------------------------|-------------|--------------|--------------|
| | 2016 Prices | 2010 Prices | 2016 Prices | 2010 Prices | 2016 Prices | 2010 Prices |
| Option 4 | £71,778,060 | £55,406,514 | £102,367,235 | £79,018,739 | £160,745,878 | £124,082,050 |
| Option 10 | £77,333,995 | £59,725,221 | £110,147,996 | £85,067,549 | £176,366,573 | £136,208,307 |
| Option 12 | £41,217,456 | £31,695,858 | £59,345,504 | £45,636,166 | £95,782,187 | £73,655,652 |
| Option 12A | £50,732,485 | £39,086,617 | £72,078,355 | £55,532,448 | £112,796,148 | £86,903,290 |

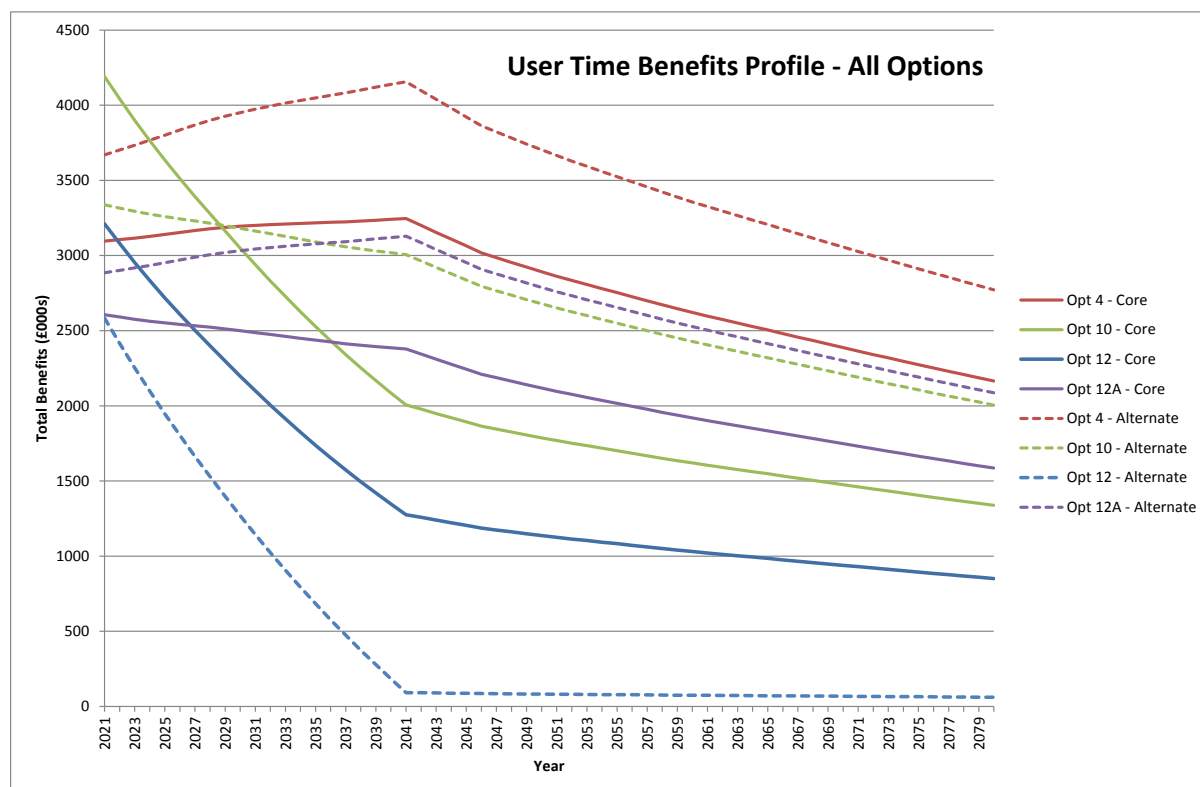
5.4 ECONOMIC ASSESSMENT RESULTS

5.4.1 The profile of benefits for the options split by time period and trip type can be found in **Appendix E-11**.

BENEFITS PROFILE TO HORIZON YEAR

5.4.2 **Figure 5-3** shows the profile of benefits over 60 years (2021 to 2080) for the four options considered, including Core and Alternate scenarios.

Figure 5-3 Graph of User Time Benefits against Year



5.4.3 The figure shows that out of all the options Option 4 provides the most benefits across the entire duration of the forecast period, whereas Option 12 provides the least. In general terms, Option 12A is the second-best performing option in both the Core and Alternate Scenarios across the full 60 year horizon period.

- 5.4.4 Option 10 provides the most benefits in the opening year, but provides significantly less in terms of benefits by the forecast year of 2041. This suggests that this option will reach capacity before the other options such as Option 4.
- 5.4.5 Option 12A provides the least benefits in the opening year, but does provide a consistent level of benefit up to the forecast year of 2041. This suggests that this option may have lower capacity than Options 4 and 10, but by 2041 this capacity is better managed through the signalised design.
- 5.4.6 Comparing the Core Scenario with the Alternative Scenario shows that most options can cope with the increase in traffic demand, as they deliver a noticeable increase in benefits. Option 12 however is the exception, with a significant drop in benefits expected by the forecast year of 2041. This would be indicative of a design that is over capacity by 2041 should the Swale Local Plan be fully realised.

ACCIDENT RESULTS

CORE SCENARIO

5.4.7 The results from the COBALT¹⁹⁴ analysis for all options are shown in **Table 5-28** below.

Table 5-28 COBALT Analysis - Core Scenario

| Option | Collisions Saved | Casualties Saved (Fatal) | Casualties Saved (Serious) | Casualties Saved (Slight) | Monetised Benefit |
|------------|------------------|--------------------------|----------------------------|---------------------------|-------------------|
| Option 4 | 1,074.0 | 18.7 | 127.9 | 1,544.6 | £53million |
| Option 10 | 793.3 | 19.1 | 107.7 | 1,064.0 | £44million |
| Option 12 | 829.7 | 19.1 | 112.9 | 1,124.6 | £46million |
| Option 12A | 346.0 | 18.8 | 90.9 | 351.9 | £32million |

- 5.4.8 All the options perform similarly in terms of the number of fatal and serious casualties saved. The main difference between options is from the number of slight casualties saved. This is primarily due to the location and the number of signals that are present within each given option layout. Signalised junctions have a propensity towards low speed accidents due to the stop-start nature of the traffic flow.
- Option 4 has no traffic signals included within the design and therefore can be seen to perform the best out of all options.
 - Option 10 and 12 include a partially signalised roundabout, leading to accidents around these areas. However, as there are only two conflicting flows of traffic at each of these signalised junctions the relative accident risk is low.
 - Option 12A relies on multiple signalised junctions to properly manage the through-about. The traffic that will use the signalised junctions is therefore much higher, and the junctions are more complex with three or more conflicting streams of traffic. As a result the number of slight casualties that are saved in Option 12A is significantly less compared to all other options.

¹⁹⁴ COBALT – Cost and Benefit to Accidents - Light Touch

ALTERNATIVE SCENARIO

5.4.9 The results from the COBALT¹⁹⁵ analysis for all options are shown in **Table 5-29** below.

Table 5-29 COBALT Analysis - Alternative Scenario

| Option | Collisions Saved | Casualties Saved (Fatal) | Casualties Saved (Serious) | Casualties Saved (Slight) | Monetised Benefit |
|------------|------------------|--------------------------|----------------------------|---------------------------|-------------------|
| Option 4 | 1,172.3 | 19.6 | 137.1 | 1,666.5 | £57million |
| Option 10 | 925.6 | 21.6 | 124.6 | 1,241.9 | £51million |
| Option 12 | 1,079.2 | 23.1 | 144.9 | 1,441.9 | £57million |
| Option 12A | 232.0 | 18.9 | 83.9 | 124.3 | £29million |

5.4.10 In the Alternative Scenario a similar pattern occurs to the Core Scenario. The increased traffic flows present within the Alternative Scenario means that the number of collisions that are saved is greater and thus the monetised benefits are higher. The only exception is Option 12A, where the number of casualties saved is lower in the Alternative Scenario despite the higher traffic flow.

MONETISED ENVIRONMENTAL ASSESSMENT RESULTS

CORE SCENARIO

5.4.11 **Table 5-30** shows the change in CO₂¹⁹⁶ for all options by time period.

Table 5-30 Change in CO₂ Emissions (tonnes) - Core Scenario

| Period | Option 4 | Option 10 | Option 12 | Option 12A |
|------------|----------|-----------|-----------|------------|
| AM Peak | 6,824 | -16,327 | -21,904 | -5,432 |
| Inter Peak | -16,114 | -46,301 | -28,719 | -13,257 |
| PM Peak | -8,142 | --29,939 | -10,620 | -27,197 |

ALTERNATIVE SCENARIO

5.4.12 **Table 5-31** shows the change in CO₂ for all options by time period.

Table 5-31 Change in CO₂ Emissions (tonnes) - Alternative Scenario

| Period | Option 4 | Option 10 | Option 12 | Option 12A |
|------------|----------|-----------|-----------|------------|
| AM Peak | 7,287 | -11,367 | -12,249 | 6,213 |
| Inter Peak | 15,233 | -11,458 | -23,448 | 1,320 |
| PM Peak | 28,622 | -80 | 19,592 | 18,222 |

¹⁹⁵ COBALT – Cost and Benefit to Accidents - Light Touch

¹⁹⁶ CO₂ – Carbon Dioxide

ANALYSIS OF MONETISED COSTS AND BENEFITS

5.4.13 **Table 5-32** provides a summary of the results for each option in the Analysis of Monetised Costs and Benefits table for the two scenarios. Values are discounted to 2010 prices.

Table 5-32 Analysis of Monetised Costs and Benefits Table – Core Scenario

| | Option 4 | Option 10 | Option 12 | Option 12A |
|--|---------------------|---------------------|---------------------|---------------------|
| Noise | - | - | - | - |
| Local Air Quality | - | - | - | - |
| Greenhouse Gases | £834,000 | £4,172,000 | £2,770,000 | £2,098,000 |
| Journey Quality | - | - | - | - |
| Physical Activity | - | - | - | - |
| Accidents | £53,044,300 | £44,053,800 | £45,616,000 | £31,751,000 |
| Economic Efficiency: Consumer Users (Commuting) | £53,049,000 | £49,703,000 | £31,003,000 | £41,016,000 |
| Economic Efficiency: Consumer Users (Other) | £24,677,000 | £18,314,000 | £20,667,000 | £18,758,000 |
| Economic Efficiency: Business Users and Providers | £111,939,000 | £89,829,000 | £57,765,000 | £92,494,000 |
| Wider Public Finances (Indirect Taxation Revenues) | £361,000 | £8,788,000 | £5,632,000 | £3,565,000 |
| Present Value of Benefits (see notes) (PVB) | £243,904,300 | £214,859,800 | £163,453,000 | £189,682,000 |
| Broad Transport Budget | £65,070,000 | £73,024,000 | £39,567,000 | £40,036,000 |
| Present Value of Costs (see notes) (PVC) | £65,070,000 | £73,024,000 | £39,567,000 | £40,036,000 |
| OVERALL IMPACTS | | | | |
| Net Present Value (NPV) | £178,834,300 | £141,853,800 | £123,886,000 | £149,646,000 |
| Benefit to Cost Ratio (BCR) | 3.748 | 2.942 | 4.131 | 4.738 |

ALTERNATIVE SCENARIO

5.4.14 **Table 5-33** provides a summary of the results for each scheme in the Analysis of Monetised Costs and Benefits table for each scenario. Values are discounted to 2010 prices.

Table 5-33 – Analysis of Monetised Costs and Benefits Table – Alternative Scenario

| | Option 4 | Option 10 | Option 12 | Option 12A |
|--|--------------|--------------|--------------|--------------|
| Noise | - | - | - | - |
| Local Air Quality | - | - | - | - |
| Greenhouse Gases | -£2,329,000 | £949,000 | £693,000 | -£1,202,000 |
| Journey Quality | - | - | - | - |
| Physical Activity | - | - | - | - |
| Accidents | £57,035,100 | £50,890,900 | £57,489,800 | £28,712,300 |
| Economic Efficiency: Consumer Users (Commuting) | £79,448,000 | £67,287,000 | £4,100,000 | £58,099,000 |
| Economic Efficiency: Consumer Users (Other) | £18,699,000 | £20,356,000 | £7,920,000 | £13,489,000 |
| Economic Efficiency: Business Users and Providers | £129,621,000 | £98,592,000 | £34,675,000 | £107,597,000 |
| Wider Public Finances (Indirect Taxation Revenues) | -£6,213,000 | £2,491,000 | £1,406,000 | -£3,346,000 |
| Present Value of Benefits (see notes) (PVB) | 276,261,100 | £240,565,900 | £106,283,800 | £203,349,300 |
| Broad Transport Budget | £65,070,000 | £73,024,000 | £39,567,000 | £40,036,000 |
| Present Value of Costs (see notes) (PVC) | £65,070,000 | £73,024,000 | £39,567,000 | £40,036,000 |
| OVERALL IMPACTS | | | | |
| Net Present Value (NPV) | £211,191,000 | £167,541,900 | £66,716,800 | £163,313,300 |
| Benefit to Cost Ratio (BCR) | 4.246 | 3.294 | 2.686 | 5.079 |

COST SENSITIVITY TESTS

CORE SCENARIO

5.4.15 Benefit to Cost Ratios have been derived for each of the options based on the P10, P50 and P90 costs. **Table 5-34** to **Table 5-37** show the different ratios that result when the different costs are considered for each option in relation to the Core Scenario.

Table 5-34 – P10, P50 and P90 Benefit to Cost Ratios for Option 4 – Core Scenario

| Option 4 | P10 | P50 | P90 |
|------------------------------|--------------|--------------|--------------|
| Present Value of Benefits | £261,204,341 | £261,204,341 | £261,204,341 |
| Present Value of Costs | £47,579,000 | £67,856,000 | £106,553,000 |
| Net Present Value | £213,625,341 | £193,348,341 | £154,651,341 |
| Benefit to Cost Ratio | 5.490 | 3.849 | 2.451 |

Table 5-35 – P10, P50 and P90 Benefit to Cost Ratios for Option 10 – Core Scenario

| Option 10 | P10 | P50 | P90 |
|------------------------------|--------------|--------------|--------------|
| Present Value of Benefits | £197,283,800 | £197,283,800 | £197,283,800 |
| Present Value of Costs | £51,269,000 | £73,024,000 | £116,924,000 |
| Net Present Value | £146,014,800 | £124,259,800 | £80,359,800 |
| Benefit to Cost Ratio | 3.848 | 2.702 | 1.687 |

Table 5-36 – P10, P50 and P90 Benefit to Cost Ratios for Option 12 – Core Scenario

| Option 12 | P10 | P50 | P90 |
|------------------------------|--------------|--------------|--------------|
| Present Value of Benefits | £152,189,000 | £152,189,000 | £152,189,000 |
| Present Value of Costs | £27,480,000 | £39,567,000 | £63,860,000 |
| Net Present Value | £124,709,000 | £112,622,000 | £88,329,000 |
| Benefit to Cost Ratio | 5.538 | 3.846 | 2.383 |

Table 5-37 – P10, P50 and P90 Benefit to Cost Ratios for Option 12A – Core Scenario

| Option 12A | P10 | P50 | P90 |
|------------------------------|--------------|--------------|--------------|
| Present Value of Benefits | £182,132,547 | £182,132,547 | £182,132,547 |
| Present Value of Costs | £33,747,000 | £47,946,000 | £75,031,000 |
| Net Present Value | £148,385,547 | £134,186,547 | £107,101,547 |
| Benefit to Cost Ratio | 5.397 | 3.799 | 2.427 |

ALTERNATIVE SCENARIO

5.4.16 Benefit to Cost Ratios have been derived for each of the options based on the P10, P50 and P90 costs. **Table 5-38** to **Table 5-41** show the different ratios that result when the different costs are considered for each option in relation to the Alternative Scenario.

Table 5-38 – P10, P50 and P90 Benefit to Cost Ratios for Option 4 – Alternative Scenario

| Option 4 | P10 | P50 | P90 |
|------------------------------|--------------|--------------|--------------|
| Present Value of Benefits | £288,687,100 | £288,687,100 | £288,687,100 |
| Present Value of Costs | £47,579,000 | £67,856,000 | £106,553,000 |
| Net Present Value | £241,108,100 | £220,831,100 | £182,134,100 |
| Benefit to Cost Ratio | 6.068 | 4.254 | 2.709 |

Table 5-39 – P10, P50 and P90 Benefit to Cost Ratios for Option 10 – Alternative Scenario

| Option 10 | P10 | P50 | P90 |
|------------------------------|--------------|--------------|--------------|
| Present Value of Benefits | £235,583,900 | £235,583,900 | £235,583,900 |
| Present Value of Costs | £51,269,000 | £73,024,000 | £116,924,000 |
| Net Present Value | £184,314,900 | £162,559,900 | £118,659,900 |
| Benefit to Cost Ratio | 4.595 | 3.226 | 2.015 |

Table 5-40 – P10, P50 and P90 Benefit to Cost Ratios for Option 12 – Alternative Scenario

| Option 12 | P10 | P50 | P90 |
|------------------------------|--------------|--------------|--------------|
| Present Value of Benefits | £103,471,800 | £103,471,800 | £103,471,800 |
| Present Value of Costs | £27,480,000 | £39,567,000 | £63,860,000 |
| Net Present Value | £75,991,800 | £63,904,800 | £39,611,800 |
| Benefit to Cost Ratio | 3.765 | 2.615 | 1.620 |

Table 5-41 – P10, P50 and P90 Benefit to Cost Ratios for Option 12A – Alternative Scenario

| Option 12A | P10 | P50 | P90 |
|------------------------------|--------------|--------------|--------------|
| Present Value of Benefits | £210,041,300 | £210,041,300 | £210,041,300 |
| Present Value of Costs | £33,747,000 | £47,946,000 | £75,031,000 |
| Net Present Value | £176,294,300 | £162,095,300 | £135,010,300 |
| Benefit to Cost Ratio | 6.224 | 4.381 | 2.799 |

SUMMARY

- 5.4.17 In the Core Scenario, Option 4 presents the greatest overall benefit in economic terms, with over £244million in expected benefits. Option 10 and 12A are comparable, providing £190 - £215million in expected benefits. Option 12 provides the least amount of benefits, around £163million.
- 5.4.18 In the Alternative Scenario, the order of options in terms of benefits remain the same, with Option 4 providing the most benefits, Option 10 and 12A being comparable and Option 12 providing the least.
- 5.4.19 The change in benefits between the Core and Alternative Scenarios show that the benefits for Option 4 increase by over £32million, Option 10 by almost £26million and Option 12A by almost £14million. However, Option 12 shows that the benefits decrease by over £57million in the Alternative Scenario. These results suggest that Option 4 has the greatest capacity for future traffic growth accommodation in 2041, whereas Option 12 is already over capacity by 2041 and therefore is unable to fully cope with the additional traffic demand.
- 5.4.20 The COBALT¹⁹⁷ analysis shows that Option 4 provides the greatest amount of accident savings, primarily as a result of the signal free design and incorporation of a flyover to remove the A249 mainline traffic flows from the junction. Option 12A on the other hand provides significantly less in terms of accident savings in part because of the relatively unique arrangement of a signalised through-about junction design and the introduction of more conflict points.
- 5.4.21 In terms of benefit to cost ratios it can be seen that Option 12A offers the highest level with an adjusted BCR of 4.738 in the Core Scenario and 5.079 in the Alternative Scenario. However this performance is closely matched by Option 4 with 3.748 in the Core Scenario and 4.246 in the Alternative Scenario. The value for money shown for Options 4 and 12A in particular is high with BCR¹⁹⁸ ratios exceeding 4.0.
- 5.4.22 Based on the combination of the assessments above, it is concluded that all options achieve good value for money and deliver on the scheme objectives with the exception of Option 12. Out of the four options, Option 4 and Option 12A provide the greatest level of benefits and provide a high value for money once the Swale, Maidstone and Medway Local Plans have been realised. Option 12A provides the highest BCR with 4.738 in the Core Scenario and 5.079 in the Alternative Scenario, compared to 3.748 and 4.246 for Option 4. However, Option 4 provides the highest benefit with over £276million of present value of benefits, some £73million more than Option 12A in the Alternative Scenario.
- 5.4.23 Taking into account the economic assessment, and wider affordability constraints:
- Option 10 has the highest scheme cost, the level of benefit achieved is lower than other options and it is not affordable;
 - Option 12 fails to meet the scheme objectives in full, being unable to cater for the demand and thus support economic growth;
 - Option 4 and Option 12A are the best performing options, but Option 4 is not affordable and Option 12A is borderline affordable.

¹⁹⁷ COBALT – Cost and Benefit to Accidents - Light Touch

¹⁹⁸ BCR - Benefit to Cost Ratios

6 SUMMARY OF OPERATIONAL ASSESSMENT

6.1 INTRODUCTION

- 6.1.1 The operational assessment outlines the road characteristics and option design implications for the;
- Scheme's operating regime; and
 - Driver Compliance.
- 6.1.2 The operational assessment for the scheme in PCF¹⁹⁹ Stage 2 was based on Option 12A as presented at the PCF Stage 2 public consultation, as it was the only viable option at the time the assessment was undertaken.

6.2 SCHEME'S OPERATING REGIME

- 6.2.1 The existing operational regime has been outlined in **Section 1.7**. The proposed improvements will operate in a similar manner to the existing regime.
- 6.2.2 All options propose an increased junction capacity with increased slip road widths and enlarged circulatory carriageway areas. The provision of the additional traffic lanes and circulatory areas will result in less risk of flow breakdown due to congestion and vehicle stoppages in live lanes. It will also reduce the impact of stoppages as the additional road capacity will usually enable traffic to pass such vehicles.
- 6.2.3 The Highways England Traffic Officer Service does not operate along the A249 though does operate along the M2, M2 slip roads and in this instance, Stockbury Roundabout. It is not currently envisaged that the scheme proposals will impact on the resource needs of the Traffic Officer Service or the Highways England Regional Control Centre as the services provided will continue as existing. The deployment of additional technology in the form of MIDAS²⁰⁰ and queue protection will be considered as part of the next design stage, PCF Stage 3, together with the impact on the Regional Control Centre resource requirements to operate the new systems.
- 6.2.4 The provision of additional carriageway and junction capacity will impact on winter maintenance services in that the increased road area will require additional quantities of salt for precautionary treatments. This will not require additional winter maintenance vehicles as a single gritter can adequately treat up to four lanes in a single pass
- 6.2.5 Methods of snow clearance will also be affected by the provision of the additional carriageway. Snow clearance currently involves moving snow both to the verge and to the central reserve. The provision of the additional traffic lane may require changes to the method of clearance.

¹⁹⁹ PCF - Project Control Framework

²⁰⁰ MIDAS - Motorway Incident Detection and Automatic Signalling

- 6.2.6 Option 12A proposes a speed limit on the approach to the through-about (please see **Section 4.3.57** for more detail). The A249 south of the junction is the responsibility of Kent County Council so any proposal to apply a speed limit on this section would require their agreement. Similarly, any proposal to apply a speed limit to the A249 north of the junction will impact on a section of road that is currently the responsibility of Sheppey Route Ltd, a DBFO²⁰¹ company.
- 6.2.7 Should Option 12A be the preferred option, it is recommended that at PCF²⁰² Stage 3 discussions whether camera enforcement is appropriate should be had between Highways England, Kent Police, Kent County Council and Medway Safety Camera Partnership.
-

6.3 DRIVER COMPLIANCE

- 6.3.1 The existing strategic roads are operated at the national speed limit. It is proposed that this would remain unchanged for the scheme options. Maintaining the existing speed limit regime is warranted primarily by the need to be compatible with the existing speed limits at tie-in points. It is recognised that the scheme option (designs for the strategic roads are based on standard rural cross sections and standard lane widths, similar to the existing roads, and that this may create a tendency for increased vehicle speeds during low traffic periods. However, this situation would appear to be similar to the existing situation. It is not anticipated that any additional speed enforcement measures will be required
- 6.3.2 The exception to this is Option 12A. For Option 12A it has been assumed that a 50mph speed limit would be applied on the approaches to the through-about junction, to minimise the risk for frequent high-speeds and “racing the green light” during off-peak periods (please refer to **Section 4.3.57**). For instance, Black Dam Roundabout in Basingstoke (M3 Junction 6) was downgraded from a 70mph through-about junction to 50mph due to its poor accident record.
- 6.3.3 The need for gantries has not been established at the current stage of the project and will be assessed during PCF Stage 3.
-

6.4 CONCLUSION

- 6.4.1 Based on the PCF Stage 2 assessment, it is considered that Option 12A will not have a significant impact on the existing operating regime or have a detrimental impact on driver compliance, on the assumption that appropriate mitigation measures will be incorporated within the scheme design during PCF Stage 3 and beyond. .

²⁰¹ DBFO – Design, Build, Finance and Operate

²⁰² PCF – Project Control Framework

7 SUMMARY OF TECHNOLOGY AND MAINTENANCE ASSESSMENT

7.1 INTRODUCTION

- 7.1.1 This section focuses on the impact the options will have on roadside technology and the ability to provide maintenance to these in a safe manner.
- 7.1.2 The technology and maintenance assessment²⁰³ for the scheme in PCF²⁰⁴ Stage 2 was based on Option 12A as presented at the PCF Stage 2 public consultation, as it was the only viable option at the time the assessment was undertaken.
-

7.2 TECHNOLOGY ASSESSMENT

- 7.2.1 The technology assessment outlines the option design implications for the utilisation of technology in terms of:
- ITS²⁰⁵ Systems;
 - RCC²⁰⁶ Systems and Sub-systems; and
 - Communication Network.
-

OPTION DESIGN IMPLICATIONS ON EXISTING TECHNOLOGY

- 7.2.2 The ITS equipment currently identified in the region of the scheme includes the following:
- Traffic signal equipment;
 - FPTZ²⁰⁷ high mast camera;
 - Communications equipment (including MIDAS²⁰⁸ loops); and
 - Communication station and weathering monitoring (on the M2).

²⁰³ Maintenance and Repair Strategy Statement, document number: HE551521-WSP-HGN-PCF2-RP-D-00033

²⁰⁴ PCF – Project Control Framework

²⁰⁵ ITS – Intelligent Transportation Systems

²⁰⁶ RCC – Regional Control Centre

²⁰⁷ FPTZ – Full pan, tilt and zoom

²⁰⁸ MIDAS - Motorway Incident Detection and Automatic Signalling

7.2.3 The existing FPTZ²⁰⁹ camera and communications equipment will be retained, or replaced, within the scheme for continued traffic monitoring. The following equipment will be considered for inclusion in PCF Stage 3:

- Signal Control - to operate safely and efficiently traffic signal controlled junctions should operate under Vehicle Actuated control to accommodate traffic and pedestrians / cyclists. This is considered the minimum ITS requirement, but Highways England guidance states that traffic signals should utilise either local MOVA²¹⁰ or centralised Split Cycletime Offset Optimisation Technique control on their network, in preference to vehicle actuated or fixed time signals.
- CCTV²¹¹ – the existing CCTV station should be retained, or replaced, and if possible CCTV should be installed on the other parts of the junction, for example on the approaches to the junction from the M2, to allow a degree of operational monitoring. As a minimum, static fixed lens cameras could be used to monitor the main approaches. If the traffic signals are MOVA controlled, it will not be possible to adjust the traffic signal timings remotely. However, alternative data sets can be triggered to deal with specific traffic situations. Ideally, full monitoring of all approaches would be required. CCTV communications in this situation should be via fibre-optic or ADSL²¹² fixed line. This will need to be reviewed during the later design stages.
- Red Light Cameras (camera enforcement) – these should only be installed where there is a proven need on safety grounds. There are currently no red light cameras installed and this will need to be reviewed during the later design stages in conjunction with the proposed reduction in speed limit from 70mph to 50mph for the A249 mainline on the approaches to the junction. It is recommended that at PCF²¹³ Stage 3 discussions whether camera enforcement is appropriate should be had between Highways England, Kent Police, Kent County Council and Medway Safety Camera Partnership.
- Communications – dial up communications are adequate for the Vehicle Actuation or MOVA traffic signals. However as CCTV is already present either 3/4G mobile communications or an ADSL would be better.

CONCLUSION

7.2.4 At this Stage of the scheme it is not anticipated that Option 12A would have a significant impact on the need for road-side technology.

²⁰⁹ FPTZ – Full pan, tilt and zoom

²¹⁰ MOVA - Microprocessor Optimised Vehicle Actuation

²¹¹ CCTV - Closed Circuit Television

²¹² ADSL - Asymmetric digital subscriber line

²¹³ PCF – Project Control Framework

7.3 MAINTENANCE ASSESSMENT

- 7.3.1 A Maintenance and Repair Strategy Statement²¹⁴ has been developed for the scheme in consultation with the MSPs²¹⁵ for the area (the Highways England Area 4 Asset Support Contract service provider AOne+, Kent County Council and Sheppey Route Ltd, the DBFO²¹⁶ Company). Although not intended as a detailed statement on how maintenance will be undertaken it will be used to support the operational and maintenance handover of the scheme and contribute to meeting the requirements of the Designer of CDM 2015²¹⁷; IAN 69/15²¹⁸; IAN 182/14²¹⁹; and CIRIA C686²²⁰.
- 7.3.2 **Appendix F** shows the maintenance boundary for AOne+ highlighted in blue and green. The A249 north of Stockbury Roundabout is managed by Sheppey Route Ltd and any other areas on the map are maintained by Kent County Council.

MAINTENANCE SERVICE PROVIDER CONSULTATION

- 7.3.3 No specific maintenance activities for assets were identified through consultation with the MSPs although the following potential maintenance considerations were recognised:
- Installation of TTM²²¹:
 - (1) Although it is anticipated that the current approaches to TTM will not change significantly, as the current maintenance service providers utilise fixed taper positions, the provision of remotely activated temporary traffic management signs will be considered as detailed in IAN 180/14²²². In addition, consideration should be given to IAN 150/16²²³, which provides guidance for alternative TTM techniques for relaxation schemes on dual carriageways.
 - Winter Maintenance Activities:
 - (1) The free-flow links and through-about lanes will extend the maintenance area for winter maintenance on the strategic road network, which needs to be considered in PCF²²⁴ Stage 3.
 - (2) The Maidstone Road Link and Oad Street Link together will increase the maintenance area for winter maintenance on the local road network.
 - Boundary lines:
 - (1) The revised and additional free-flow links and the through-about lanes will mean that the existing MSP boundary lines will need to be revised. Further consideration is required a PCF Stage 3 to determine who would be responsible for the maintenance of each section of road.

²¹⁴ Maintenance and Repair Strategy Statement, Document number: HE551521-WSP-HGN-PCF2-RP-D-00033

²¹⁵ MSP - Maintenance Service Providers

²¹⁶ DBFO Co. – Design, Build, Finance and Operate Company

²¹⁷ Construction (Design and Management) Regulations 2015

²¹⁸ Interim Advice Note 69/15 - Designing for Maintenance

²¹⁹ IAN 182/14 – Major Schemes: Enabling Handover into Operation and Maintenance

²²⁰ CIRIA C686 – Safe access for maintenance and repair

²²¹ TTM - Temporary Traffic Management

²²² IAN 180/14 - Guidance for the selection of remote controlled temporary traffic management signs for use on the Highways Agency trunk road and motorway network

²²³ IAN 150/16 - Guidance on Alternative Temporary Traffic Management Techniques for Relaxation Works on Dual Carriageways

²²⁴ PCF – Project Control Framework

— Maidstone Road / Chestnut Street Diversion route:

- (1) During routine maintenance of the M2 Stockbury Viaduct traffic is currently routed around Stockbury Roundabout along Maidstone Road and Chestnut Street up to Key Street Junction. The MSPs proposed that within Option 12A this route should be maintained and be suitable for all vehicles in times of routine maintenance. This will need to be reviewed at PCF Stage 3 as the existing Maidstone Road's access to Stockbury Roundabout will be closed / severed, so a suitable alternative route will need to be identified.

7.3.4 The MSPs will be consulted further in PCF²²⁵ Stage 3 after the preferred route announcement.

MAINTENANCE LIABILITY

7.3.5 Option 12A includes a new bridge, to take Oad Street over the Oad Street Link, on the local road network. This will increase the Kent County Council's local road network maintenance liability.

7.3.6 Option 12A will increase the number of traffic signals at the junction, which will have an impact on the associated maintenance liability.

CONCLUSION

7.3.7 At this Stage of the scheme it is not anticipated that Option 12A would have a significant impact on the ability to provide maintenance in a safe manner.

²²⁵ PCF – Project Control Framework

8 SUMMARY OF ENVIRONMENTAL ASSESSMENT AND ENVIRONMENTAL DESIGN

8.1 INTRODUCTION

- 8.1.1 This section seeks to identify how well Option 12A aligns with the environmental objectives for the scheme and whether Options 4, 10 and 12 would align significantly better or worse than Option 12A. It also provides a summary of the environmental assessment undertaken for the four options at PCF²²⁶ Stage 2.
- 8.1.2 Section 8 is set out as follows:
- Section 8.2: Provides an appraisal of Option 12A against the environmental objectives for the scheme and draws conclusions as to whether Option 4, Option 10 or Option 12 would have achieved the objectives to a lesser or greater degree than Option 12A..
 - Sections 8.3 to 8.12: Provide a summary of the assessment presented in the PCF Stage 2 Environmental Assessment Report²²⁷ for Option 12A, drawing comparisons to the assessments for Options 4, 10 and 12, for Air Quality, Climate Change, Cultural Heritage, Landscape, Biodiversity, Geology and Soils, Materials, Noise and Vibration, People and Communities, and Road Drainage and the Water Environment. These sections are set out in terms of construction and operational impacts, and where relevant, they are broken down into sub-topics by heading.
- 8.1.3 Of note, the labels used in this report and the PCF Stage 2 Environmental Assessment Report are different for Option 12A, reflecting different options for the Oad Street Link. For consistency, within this **Section 8**, Option 12A is as presented at the PCF Stage 2 public consultation, and includes the Oad Street Link Option B, to the south of Whipstakes Farm. The PCF Stage 2 Environmental Assessment Report however, uses the label: Option 12A for the layout with the Oad Street Link Option C, through the Chestnut Wood stand of Ancient Woodland; and Option 12A Oad Street Alignment Route B for the layout with Oad Street Link option B.
- 8.1.4 The option drawings can be found in **Appendix D-1**.
- 8.1.5 The main assessment presented in the PCF Stage 2 Environmental Assessment Report and summarised in this report is based on fixed demand Core Scenario (TEMPro / National Traffic Model derived growth) (version 9) traffic forecasting data sets (please refer to **Section 5**). Specifically, the Air Quality, Noise and Vibration, and consequentially Biodiversity and greenhouse gas emission assessments are predicated on this data.

²²⁶ PCF – Project Control Framework.

²²⁷ M2 Junction 5 Improvements Scheme - PCF Stage 2 Environmental Assessment Report (HE551521-WSP-HGN-PCF2-RP-E-00043), December 2017.

- 8.1.6 The PCF Stage 2 Environmental Assessment Report²²⁸ includes commentary on the potential Air Quality and Noise and Vibration impacts for the variable demand Core Scenario (version 9) traffic forecasting data set. This commentary is based on analysis of the results of a sensitivity test undertaken for Air Quality and a data comparison for Noise and Vibration (refer to sections 5.6 and 12.6 of the PCF²²⁹ Stage 2 Environmental Assessment Report for a full description of the methodologies applied). The results of the variable demand Core Scenario traffic forecasting data analysis undertaken for Air Quality and Noise and Vibration are summarised under the relevant sub-headings of this section.
- 8.1.7 How the Alternative Scenario traffic forecasting data sets have been taken into account with respect to the PCF Stage 2 environmental assessment is described in **Section 10**.

8.2 ENVIRONMENTAL OBJECTIVE

COMPLIANCE WITH STANDARDS

- 8.2.1 The overarching objectives for the scheme were developed in line with the National Policy Statement for National Networks²³⁰ and the Road Investment Strategy²³¹. The objectives include consideration of the environment, specifically:
- An improved environment – To deliver a high standard of design for any M2 Junction 5 improvement that reflects the quality of the landscape and setting, and that minimises the adverse environmental impact of new construction and supports the following objectives:
 - (1) Plan for climate change;
 - (2) Work in harmony with the environment to conserve natural resources and encourage biodiversity; and
 - (3) Protect and enhance countryside and historic and archaeological environments
- 8.2.2 **Table 8-1** seeks to demonstrate the level of compliance with the above objective achieved by the four junction options. The compliance appraisal is based on the main environmental assessment presented in the PCF Stage 2 Environmental Assessment Report, which is based on fixed demand (Core Scenario) (version 9) traffic modelling data.
- 8.2.3 In summary, at this stage it is expected that Option 12A would better achieve compliance with the above policy than Options 10, 4 and 12. Option 10 would achieve better compliance with the policy than Options 4 and 12.
- 8.2.4 Options 12, 10 and 4 would not achieve compliance with the component of the above objective that seeks to “work in harmony with the environment to conserve natural resources...” because they would all result in the direct loss of Ancient Woodland, which is an irreplaceable natural resource. Conversely, Option 12A avoids direct impacts to Ancient Woodland and would, therefore, be expected to comply with this component of the objective.

²²⁸ M2 Junction 5 Improvements Scheme - PCF Stage 2 Environmental Assessment Report (HE551521-WSP-HGN-PCF2-RP-E-00043), December 2017.

²²⁹ PCF – Project Control Framework

²³⁰ National Policy Statement for National Networks, Department for Transport, December 2014.

²³¹ Road Investment Strategy: for the 2015/16 – 2019/20 Road Period, Department for Transport, March 2015.

- 8.2.5 It is noted that in the case of all options, the component of the objective that seeks to achieve the protection and enhancement of historic and archaeological environments presents an area of possible non-compliance for the current option designs. This is due to potential residual adverse effects on the setting of designated heritage assets, including (but not limited to) the Chatham Land Front World War I historic landscape. Options 12A, 4 and 12 are expected to result in an adverse effect of moderate significance, which could be reduced to slight adverse with appropriate mitigation and/or enhancement measures, while Option 10 is expected to result in an adverse effect of slight significance. There may be an opportunity to achieve improved compliance as design work progresses and mitigation and/or enhancement proposals are developed in consultation with Historic England.
- 8.2.6 The potential for direct archaeological impacts presents a possible area of non-compliance with the above objective for all options. Specifically, all options have the potential to result in permanent adverse impacts to the buried Chatham Land Front World War I heritage assets. At this stage, it is envisaged that avoidance of these potential impacts could be achieved through design development, or otherwise, impacts could be appropriately mitigated through preservation in situ if feasible or appropriate archaeological investigation (such as recording). However, if appropriate mitigation cannot be achieved such that the significance of the residual direct impact is reduced to neutral, there would be further non-compliance with the component of the above objective that seeks to protect archaeological environments.

Table 8-1 Compliance with environmental objective for the scheme

| Component of objective | Compliance Comment | | | |
|--|--|---|---|---|
| | Option 12A | Option 12 | Option 10 | Option 4 |
| To deliver a high standard of design for any M2 Junction 5 improvement that reflects the quality of the landscape and setting... | <p>Option has potential to result in impacts to landscape amenity (including landscape impacts on the Kent Downs AONB) and visual amenity from certain viewpoints. However, landscaping proposals would be designed to complement existing landscape elements and integrate the scheme into the surrounding landscape.</p> <p>Opportunities for landscape enhancement, such as additional offsite planting to screen views of the M2 from adjoining rural areas and residential properties would be considered.</p> <p>Option considered to achieve this component of the objective.</p> | <p>Option has potential to result in impacts to landscape amenity (including landscape impacts on the Kent Downs AONB) and visual amenity from certain viewpoints. However, landscaping proposals would be designed to complement existing landscape elements and integrate the scheme into the surrounding landscape.</p> <p>Opportunities for landscape enhancement, such as additional offsite planting to screen views of the M2 from adjoining rural areas and residential properties would be considered.</p> <p>Option considered to achieve this component of the objective</p> | <p>Option has potential to result in impacts to landscape amenity (including landscape impacts on the Kent Downs AONB) and visual amenity from certain viewpoints. However, landscaping proposals would be designed to complement existing landscape elements and integrate the scheme into the surrounding landscape.</p> <p>Alternatives to masonry retaining walls, such as gabion basket or timber crib retaining walls (potentially with planting), would be considered. The design and materiality of new gyratory structures would reflect the design and materiality of the adjacent M2 viaduct.</p> <p>Opportunities for landscape enhancement, such as additional offsite planting to screen views of the M2 from adjoining rural areas and residential properties would be considered.</p> <p>Option considered to achieve this component of the objective</p> | <p>Option has potential to result in impacts to landscape amenity (including landscape impacts on the Kent Downs AONB) and visual amenity from certain viewpoints. However, landscaping proposals would be designed to complement existing landscape elements and integrate the scheme into the surrounding landscape.</p> <p>Alternatives to masonry retaining walls, such as gabion basket or timber crib retaining walls (potentially with planting), would be considered. The design and materiality of new gyratory structures would reflect the design and materiality of the adjacent M2 viaduct.</p> <p>Opportunities for landscape enhancement, such as additional offsite planting to screen views of the M2 from adjoining rural areas and residential properties would be considered.</p> <p>Option considered to achieve this component of the objective</p> |

| Component of objective | Compliance Comment | | | |
|---|---|-----------|-----------|----------|
| | Option 12A | Option 12 | Option 10 | Option 4 |
| To deliver a high standard of design for any M2 Junction 5 improvement that...minimises the adverse environmental impact of new construction... | <p>Air Quality - During construction, mitigation and management measures, to be detailed within a Construction Environmental Management Plan, would be implemented to reduce dust generation and exhaust emissions to an environmentally acceptable level in the case of all options.</p> <p>Climate Change - Options would be designed to minimise greenhouse gas emissions associated with the construction phase where practicable and not at the expense of greater emissions at other lifecycle stages, through selection of construction material, construction processes and methods, and construction plant selection.</p> <p>Cultural Heritage - It is expected that adverse impacts on buried archaeology during construction, including the Chatham Land Front World War I defences, will be avoided or otherwise adequately mitigated for all options through appropriate archaeological investigation or other appropriate mitigation developed in consultation with the county archaeologist.</p> <p>Landscape - Existing planting within the highway boundary would be retained during construction where practicable to screen views to the highway reserve, thereby providing a visual buffer during construction activity for all options.</p> <p>Biodiversity - The construction phase would be planned to avoid key periods for particular species (for example, avoiding habitat clearance during bird nesting season) and appropriate mitigation would be implemented to minimise the impacts of construction activities on ecological resources in the area (for example, temporary fencing to exclude species from construction areas). The implementation of construction best practice would minimise the risk of ecological impacts during construction (for example, tool box talks to inform staff of key ecological constraints in the area. A Construction Environmental Management Plan would be produced to document all mandatory ecological avoidance and mitigation measures and methodologies and identifying those responsible for implementation. It is noted that Option 12A avoids direct impacts to Ancient Woodland, while Option 10 would require the removal of approximately 0.3 ha of Ancient Woodland from Church Wood and Options 4 and 12 would require the removal of approximately 0.5 ha of Ancient Woodland from Chestnut Wood. Option 12A therefore achieves the objective of minimising the adverse environmental impacts of new construction on biodiversity to a greater degree than the other options.</p> <p>Geology and Soils - A Construction Environmental Management Plan would be implemented, outlining the mitigation, control and monitoring measures to be put in place during the construction phase to manage the potential risk to human health and other receptors from contaminated land.</p> <p>Materials - Opportunities would be identified to minimise the export and import of materials during construction and stockpiling areas would be identified that minimise quality degradation, leachate, damage and loss of site arisings. All options would accord with the Proximity Principle and a Materials Management Plan would be implemented in accordance with the CL:AIRE Definition of Waste: Code of Practice.</p> <p>Noise and Vibration - During the construction phase, the contractor would apply Best Practicable Means, to be detailed within a Construction Environmental Management Plan, to minimise any residual noise impact for all options.</p> | | | |

| Component of objective | Compliance Comment | | | |
|--|--|--|--|--|
| | Option 12A | Option 12 | Option 10 | Option 4 |
| | <p>People and Communities - Impacts to people and communities as a result of temporary closures or diversions to PRoWs, local roads and bus stops/services during construction would be minimised for all options, through the provision of temporary alternatives.</p> <p>Road Drainage and the Water Environment - Impacts to the quality of water resources and on flood risk during construction would be minimised through the adoption of management and mitigation measures, to be detailed within a Construction Environmental Management Plan. Construction works would be expected to be undertaken in accordance with CIRIA 532 'Control of water pollution from construction sites' and good site practice. Options 4 and 10 would be likely to require additional pollution prevention measures to Options 12 and 12A, due to the requirement for deep excavations and piling works, and potential impacts to groundwater quality and associated potential impacts to human health.</p> <p>Compliance summary - All options are considered to meet this component of the objective. However, given the strong planning policy direction directing the avoidance of impacts to Ancient Woodland,²³² the potential loss of Ancient Woodland is viewed as a key differentiator and overall, Option 12A is considered to meet this component of the objective to a greater degree than Options 4, 10 and 12 as would avoid direct impacts to Ancient Woodland during construction.</p> | | | |
| <p>To deliver a high standard of design for any M2 Junction 5 improvement that...supports the following objectives:</p> <ul style="list-style-type: none"> - Plan for climate change; | <p>Resilience to climate change would be a key consideration in the design of the option.</p> <p>Option considered to achieve this component of the objective.</p> | <p>Resilience to climate change would be a key consideration in the design of the option.</p> <p>Option considered to achieve this component of the objective.</p> | <p>Resilience to climate change would be a key consideration in the design of the option.</p> <p>Option considered to achieve this component of the objective.</p> | <p>Resilience to climate change would be a key consideration in the design of the option.</p> <p>Option considered to achieve this component of the objective.</p> |

²³² Refer to paragraph 118 of the National Planning Policy Framework (Department for Communities and Local Government, 2012) and paragraph 5.32 of the National Policy Statement for National Networks (Department for Transport, 2014).

| Component of objective | Compliance Comment | | | |
|--|--|--|--|---|
| | Option 12A | Option 12 | Option 10 | Option 4 |
| <p>To deliver a high standard of design for any M2 Junction 5 improvement that...supports the following objectives:</p> <ul style="list-style-type: none"> - Work in harmony with the environment to conserve natural resources and encourage biodiversity; | <p>The detailed design of the option and the construction methods and practices adopted would seek to avoid or otherwise minimise any impacts to natural resources. Mitigation (such as landscaping and habitat creation) would be implemented to minimise impacts to, and potentially enhance, existing natural resources, thereby conserving existing natural resources as far as practicable.</p> <p>A biodiversity net gain preliminary baseline calculation has been undertaken at PCF Stage 2²³³ to serve as a basis for achieving a net gain in biodiversity overall, should this option be progressed to PCF Stage 3.</p> <p>Overall, this option is considered to achieve this component of the objective.</p> | <p>Construction methods would seek to avoid or minimise impacts to natural resources. Mitigation (such as landscaping and habitat creation) would be implemented to minimise impacts to, and in some areas potentially enhance, existing natural resources.</p> <p>A biodiversity net gain preliminary baseline calculation has been undertaken to serve as a basis for achieving a net gain in biodiversity overall, should this option be progressed to PCF Stage 3.</p> <p>Option 12 would, however, result in direct impacts to the Chestnut Wood stand of Ancient Woodland. It would not therefore, work in harmony with the existing environment, resulting in the direct loss of an irreplaceable natural resource.</p> <p>While it is expected that net gain in biodiversity could be achieved, the loss of an irreplaceable habitat that cannot</p> | <p>Construction methods would seek to avoid or minimise impacts to natural resources. Mitigation (such as landscaping and habitat creation) would be implemented to minimise impacts to, and in some areas potentially enhance, existing natural resources.</p> <p>A biodiversity net gain preliminary baseline calculation has been undertaken to serve as a basis for achieving a net gain in biodiversity overall, should this option be progressed to PCF Stage 3.</p> <p>Option 10 would, however, result in direct impacts to the Church Wood stand of Ancient Woodland. It would not therefore, work in harmony with the existing environment, resulting in the direct loss of an irreplaceable natural resource.</p> <p>While it is expected that net gain in biodiversity could be achieved, the loss of an irreplaceable habitat that cannot</p> | <p>Construction methods would seek to avoid or minimise impacts to natural resources. Mitigation (such as landscaping and habitat creation) would be implemented to minimise impacts to, and in some areas potentially enhance, existing natural resources.</p> <p>A biodiversity net gain preliminary baseline calculation has been undertaken to serve as a basis for achieving a net gain in biodiversity overall, should this option be progressed to PCF Stage 3.</p> <p>Option 4 would, however, result in direct impacts to the Chestnut Wood stand of Ancient Woodland. It would not therefore, work in harmony with the existing environment, resulting in the direct loss of an irreplaceable natural resource.</p> <p>While it is expected that net gain in biodiversity could be achieved, the loss of an irreplaceable habitat that cannot</p> |

²³³ Note – the biodiversity net gain baseline for Option 12A is not expected to differentiate significantly from that for a variant of Option 12A, which the calculation presented in the PCF Stage 2 Environmental Assessment Report is based upon (refer to Section 9.9 of the Environmental Assessment Report (HE551521-WSP-HGN-PCF2-RP-E-00043)).

| Component of objective | Compliance Comment | | | |
|--|---|---|---|---|
| | Option 12A | Option 12 | Option 10 | Option 4 |
| | | be mitigated for, would not achieve the conservation of natural resources. On this basis, the option would not achieve this component of the objective. | be mitigated for, would not achieve the conservation of natural resources. On this basis, the option would not achieve this component of the objective. | be mitigated for would not achieve the conservation of natural resources. On this basis, the option would not achieve this component of the objective. |
| <p>To deliver a high standard of design for any M2 Junction 5 improvement that...supports the following objectives:</p> <ul style="list-style-type: none"> - Protect and enhance countryside, historic and archaeological environments. | <p>At this stage Option 12A is considered likely to result in a residual adverse effect on the setting of a number of designated heritage assets and the non-designated Chatham Land Front World War I Historic Landscape. The significance of the effect on designated heritage assets in the absence of mitigation is likely to be slight adverse, while the significance of the effect on the Chatham Land Front World War I Defences Historic Landscape is likely to be moderate adverse. There may be an opportunity to implement mitigation and/or enhancement measures, in consultation with Historic England, to reduce this level of impact; however, it is possible that a residual slight adverse effect will remain. On this basis, the current design of Option 12A may not achieve full compliance with this component of the</p> | <p>At this stage Option 12 is considered likely to result in a residual adverse effect on the setting of a number of designated heritage assets and the non-designated Chatham Land Front World War I Historic Landscape. The significance of the effect on designated heritage assets in the absence of mitigation is likely to be slight adverse, while the significance of the effect on the Chatham Land Front World War I Defences Historic Landscape is likely to be moderate adverse. There may be an opportunity to implement mitigation and/or enhancement measures, in consultation with Historic England, to reduce this level of impact; however, it is possible that a residual slight adverse effect will remain. On this basis, the current design of Option 12 may not achieve full compliance with this component of the</p> | <p>At this stage Option 10 is considered likely to result in a residual adverse effect on the setting of a number of designated heritage assets and the non-designated Chatham Land Front World War I Historic Landscape. The significance of the effect on designated heritage assets and the Chatham Land Front World War I Defences Historic Landscape in the absence of mitigation is likely to be slight adverse. There may be an opportunity to implement mitigation and/or enhancement measures, in consultation with Historic England, to reduce this level of impact; however, it is possible that a residual adverse effect will remain. On this basis, the current design of Option 10 may not achieve full compliance with this component of the objective.</p> <p>At this stage it is expected that mitigation, such as preservation</p> | <p>At this stage Option 4 is considered likely to result in a residual adverse effect on the setting of a number of designated heritage assets and the non-designated Chatham Land Front World War I Historic Landscape. The significance of the effect on designated heritage assets in the absence of mitigation is likely to be slight adverse, while the significance of the effect on the Chatham Land Front World War I Defences Historic Landscape is likely to be moderate adverse. There may be an opportunity to implement mitigation and/or enhancement measures, in consultation with Historic England, to reduce this level of impact; however, it is possible that a residual slight adverse effect will remain. On this basis, the current design of Option 4 may not achieve full compliance with this component of the</p> |

| Component of objective | Compliance Comment | | | |
|------------------------|---|---|--|---|
| | Option 12A | Option 12 | Option 10 | Option 4 |
| | <p>objective.</p> <p>At this stage it is expected that mitigation, such as preservation in situ if feasible or appropriate archaeological investigation, could be adopted to reduce the significance of potential direct impacts on archaeology to neutral, thereby protecting the existing historic and archaeological environment in this respect. However, in the case that appropriate mitigation cannot be achieved, direct impacts present a potential further area of non-compliance with this component of the objective.</p> | <p>objective.</p> <p>At this stage it is expected that mitigation, such as preservation in situ if feasible or appropriate archaeological investigation, could be adopted to reduce the significance of potential direct impacts on archaeology to neutral, thereby protecting the existing historic and archaeological environment in this respect. However, in the case that appropriate mitigation cannot be achieved, direct impacts present a potential further area of non-compliance with this component of the objective.</p> | <p>in situ if feasible or appropriate archaeological investigation, could be adopted to reduce the significance of potential direct impacts on archaeology to neutral, thereby protecting the existing historic and archaeological environment in this respect. However, in the case that appropriate mitigation cannot be achieved, direct impacts present a potential further area of non-compliance with this component of the objective.</p> | <p>objective.</p> <p>At this stage it is expected that mitigation, such as preservation in situ if feasible or appropriate archaeological investigation, could be adopted to reduce the significance of potential direct impacts on archaeology to neutral, thereby protecting the existing historic and archaeological environment in this respect. However, in the case that appropriate mitigation cannot be achieved, direct impacts present a potential further area of non-compliance with this component of the objective.</p> |

COMPLIANCE WITH PLANNING POLICY

- 8.2.7 The PCF²³⁴ Stage 2 National Policy Statement for National Networks Accordance Table and Planning Statement²³⁵ product provides a summary of the planning policy framework applicable to the scheme, considering compliance of the scheme against the relevant planning policy. The product focuses on Option 12A, as the viable option selected to progress to public consultation at PCF Stage 2; however, it identifies key areas of potential policy non-compliance that are common across the other junction options. The key areas of potential policy non-compliance, are as follows:
- Biodiversity – the NNNPS²³⁶ and NPPF²³⁷ afford a strong policy direction to the protection of designated ecological sites and irreplaceable habitat, including Ancient Woodland. Options 10, 12 and 4 would result in direct loss of Ancient Woodland. While Option 12A avoids direct impacts to Ancient Woodland, as with Options 12, 10 and 4 it has the potential to result in deterioration of Ancient Woodland habitat due to dust deposition and root compaction associated with construction activities. With appropriate mitigation and management during construction it is expected that these could be mitigated, in light of the above, there is a potential planning policy compliance issue in terms of biodiversity for all options.
 - Cultural Heritage – the NNNPS and NPPF seek to avoid substantial harm to or total loss of significance of designated heritage assets and non-designated heritage assets of equal significance to Scheduled Monuments. At this stage it has not yet been possible to determine whether any adverse impacts would constitute “substantial harm” in policy terms, as the results of the intrusive evaluation that will be used to inform a determination of asset significance and mitigation recommendations are pending. However, all options have the potential to result in harm to the Chatham Land Front World War I defences and, therefore, there is potential for all options to result in non-compliance with the relevant planning policy in this respect.
 - Landscape – the NNNPS and NPPF afford a strong policy direction to the protection of nationally designated landscape areas (including AONBs²³⁸), stating a strong presumption against any significant road widening or the building of new roads in these areas unless there are demonstrable compelling reasons for new or enhanced capacity and any benefits very significantly outweigh the costs. All options involve development within the Kent Downs AONB and would, therefore, need to demonstrate compelling reasons for the planned capacity enhancements and that the benefits very significantly outweigh the costs. Given that the M2 Junction 5 is an established feature in the landscape, it is expected that a sensitive design and appropriate mitigation will enable all options to achieve policy compliance.
- 8.2.8 Based on a preliminary appraisal of the relevant policy guidance, as appropriate for PCF Stage 2, it is expected that all options would also be able to achieve compliance with the relevant NNNPS and NPPF policy in respect of air quality, geology and soils, materials, noise, people and communities, and road drainage and the water environment.

²³⁴ PCF – Project Control Framework

²³⁵ M2 Junction 5 Improvements Scheme National Policy Statement for National Networks Accordance Table and Planning Statement (HE551521-WSP-HGN-PCF2-RP-PM-00049), prepared by WSP on behalf of Highways England, January 2018.

²³⁶ National Policy Statement for National Networks, Department for Transport, December 2014.

²³⁷ National Planning Policy Framework, Department for Communities and Local Government, March 2012.

²³⁸ AONB – Area of Outstanding Natural Beauty.

8.3 AIR QUALITY

CONSTRUCTION PHASE IMPACTS

- 8.3.1 Adverse impacts from dust and exhaust emissions could potentially occur at sensitive receptors (including human receptors and ecological receptors) within 200m of worksites during construction. However, the risk of such impacts can be minimised with appropriate mitigation. The options would be expected to affect sensitive residential receptors in the following order from high to low:
- There are 68 properties within the physical extent of Options 4 and 12A;
 - There are 67 properties within the physical extent of Option 12; and
 - There are 64 properties within the physical extent of Option 10.
- 8.3.2 The locations of the above properties are indicated on **Figures 5-5 to 5-8** of the PCF²³⁹ Stage 2 Environmental Assessment Report.²⁴⁰
- 8.3.3 There are no designated ecological receptors within 200m of worksites and, therefore, significant adverse Air Quality effects on designated ecological receptors during construction are not anticipated.
-

OPERATIONAL PHASE IMPACTS

LOCAL AIR QUALITY

- 8.3.4 The assessment of operational impacts on air quality, based on fixed demand traffic modelling data (Core Scenario) (version 9), considered the change in total traffic emissions resulting from the junction options in the opening year of 2021, and the proximity of sensitive human receptors to each junction option. The assessment found that in the opening year of 2021, none of the local air quality impacts determined for the junction options will give rise to significant effects on human receptors.
- 8.3.5 The sensitivity test undertaken for variable demand traffic modelling data set (Core Scenario) (version 9) demonstrates that with the possible exception of Option 10, the variable demand modelling forecasting would not materially change the findings from the main assessment for human receptors. For Option 10, the test indicated that there was potential for exceedance of the annual mean Nitrogen Dioxide concentration criterion threshold at one receptor on the A2 London Road. The main assessment did not demonstrate an exceedance at this receptor and the sensitivity test for variable demand modelling resulted in a 0.7 microgram per m³ increase). With reference to Interim Advice Note 174/13²⁴¹, a significant effect in terms of worsening air quality could occur where 30 or more receptors have a small increase in annual mean Nitrogen Dioxide concentrations. This particular receptor may represent no more than 10 adjacent receptors with relevant exposure at worst. On this basis alone, the effect would not be considered significant.

COMPLIANCE RISK

- 8.3.6 In the opening year of 2021, based on fixed demand traffic modelling data (Core Scenario) (version 9), none of the predicted increases in concentrations of Nitrogen Dioxide due to

²³⁹ PCF – Project Control Framework

²⁴⁰ M2 Junction 5 Improvements Scheme Environmental Assessment Report, prepared by WSP on behalf of Highways England, January 2018.

²⁴¹ Interim Advice Note 174/13, former Highways Agency, June 2013.

emissions from road traffic at the sensitive receptors along pollution climate mapping model links will give rise to a risk of non-compliance with the EU limit value for annual mean Nitrogen Dioxide (as at 2015) for any of the four options. In accordance with Interim Advice Note 174/13, it can be concluded that the junction options are Low Risk in terms of compliance.

- 8.3.7 The differences in concentrations determined by the sensitivity test for variable demand modelling (Core Scenario) (version 9) would not give rise to a risk of non-compliance with EU limit values.

IMPACTS ON DESIGNATED ECOLOGICAL SITES

- 8.3.8 During operation, based on fixed demand traffic modelling data (Core Scenario) (version 9), the potential impacts of Options 10, 12 and 12A on North Downs Woodlands Special Area of Conservation (which overlaps with the Wouldham to Detling Escarpment Site of Special Scientific Interest) represent reductions in concentrations of nitrogen oxides, with Option 12 having the most pronounced reductions and some tangible benefit at a distance of up to 16 metres from the A249 centreline. The impacts beyond this distance can be considered to be imperceptible.
- 8.3.9 During operation, based on fixed demand traffic modelling data (Core Scenario) (version 9), Option 4 has the potential to result in increased concentrations of nitrogen oxides, which have the potential to adversely impact sensitive vegetation within North Downs Woodlands Special Area of Conservation (overlapping the Wouldham to Detling Escarpment Site of Special Scientific Interest) (refer to Appendix A-2). In particular, there is potential for the increased nitrogen oxides concentrations to have an impact on sensitive vegetation within 26 m of the road centreline. The increase in nitrogen oxide concentration would lead to deposition of nitrogen that, when compared to reference data on the response of habitats to nitrogen deposition,²⁴² falls below the threshold at which the most nitrogen sensitive habitat types in the UK lose one species due to the increased nutrient load. Thus it would not be expected that North Downs Woodland Special Area of Conservation would lose any plant species due to deposition of nitrogen, and thus would not receive significant adverse effects due to the impacts of air quality change from traffic changes on the Affected Road Network. Therefore it is concluded that impacts will not be significant. At the other designated sites within the study area, the annual mean Nitrogen Oxides concentrations in 2021 are well below the critical level for all options at all receptor locations and the impacts can be considered as very unlikely to give rise to a significant effect.
- 8.3.10 Apart from Option 12, the sensitivity test undertaken for the variable demand traffic modelling data (Core Scenario) (version 9), would result in increases to annual mean Nitrogen Oxides at North Downs Woodlands Special Area of Conservation (overlapping the Wouldham to Detling Escarpment Site of Special Scientific Interest) that could not be discounted as imperceptible. As with the main assessment based on fixed demand traffic modelling data (Core Scenario) (version 9), Option 4 would result in the greatest impacts. With the possible exception of one receptor location within the North Downs Woodlands Special Area of Conservation and Wouldham to Detling Escarpment Site of Special Scientific Interest, impacts on Nitrogen deposition are likely to be less than one percent of the lower critical load of five kilograms of Nitrogen per hectare per year. It would not be expected that North Downs Woodland Special Area of Conservation would lose any plant species due to deposition of nitrogen (refer section 8.3.9), and thus would not receive significant adverse effects due to the impacts of air quality change from traffic changes on the Affected Road Network. Regional Air Quality
- 8.3.11 The operational impact assessment, based on fixed demand modelling traffic data (Core Scenario) (version 9) also considered the potential for improvements to regional air quality across the full extent of the traffic model network, due to differences in emissions of Nitrogen

²⁴² Assessing the effects of small increments of atmospheric nitrogen deposition (above the critical load) on semi-natural habitats of conservation importance (NECR210). Caporn, S. et al, 2016. Peterborough: Natural England.

Oxides, PM₁₀ and Carbon Dioxide in the base year 2015 and the forecast years of 2021 and 2041.

- 8.3.12 In the long-term, Option 10 gives rise to lower emissions than without the scheme (0.4% lower Nitrogen Oxides emissions, 1.3% lower PM₁₀ emissions and 0.9% lower Carbon Dioxide emissions) and is the most beneficial of the options.
- 8.3.13 Option 4 is also beneficial but to lesser degrees (0.2% lower Nitrogen Oxides emissions, 1.9% lower PM₁₀ emissions and 0.5% lower Carbon Dioxide emissions).
- 8.3.14 Option 12 results in slightly higher emissions than without the scheme (0.5% higher Nitrogen Oxides emissions, 0.1% lower PM₁₀ emissions and 0.4% higher Carbon Dioxide emissions).
- 8.3.15 Option 12A results in higher emissions than without the scheme and increases emissions more than Option 12. The regional emissions results for Option 12A have been estimated based on the results for a prior alignment design of Option 12A (refer section 8.1.3). The alignments are similar and it is considered that emissions associated with Option 12A will only be marginally higher than those for the prior alignment design, which compared to the 2041 without the scheme scenario, would be 1.5% higher for Nitrogen Oxides, 1.0% higher for PM₁₀ and 1.3% higher for Carbon Dioxide.

8.4 CLIMATE CHANGE

- 8.4.1 Greenhouse gas emissions associated with the construction phase relate to the manufacture and delivery of materials, as well as the construction process itself. Only limited information is available in respect of the construction phase at this early stage; however, the new carriageway surface area for each option and earthworks volumes have been used to estimate greenhouse gas emissions associated with the construction phase of each of the junction options.
- 8.4.2 Based on the information available, and the methodology set out in **section 6.6** of the PCF Stage 2 Environmental Assessment Report,²⁴³ the options would provide the following greenhouse gas emissions during construction from least favourable to most favourable, with respect to magnitude of greenhouse gas emissions:
- Option 12A = 4.9 kTCO₂e²⁴⁴;
 - Option 4 = 4.3 kTCO₂e;
 - Option 10 = 2.9 kTCO₂e; and
 - Option 12 = 2.3 kTCO₂e.
- 8.4.3 Operationally, greenhouse gas emissions are altered when the flow of traffic is changed in terms of speed and/or volume. Increased speeds and stop/start traffic would have an adverse effect on emissions due to vehicles operating at lower fuel efficiency. Conversely, a reduction in queuing vehicles would have an overall beneficial impact on greenhouse gas emissions as vehicles are operating at higher levels of efficiency. Based on the information available the operational greenhouse gas emissions are ranked least favourable to most favourable below, in terms of magnitude of greenhouse gas emissions (based on fixed demand Core Scenario traffic forecasting data (version 9):
- Option 12A = 5.0 kTCO₂e/year;
 - Option 12 = 1.9 kTCO₂e/year;

²⁴³ M2 Junction 5 Improvements Scheme - PCF Stage 2 Environmental Assessment Report (HE551521-WSP-HGN-PCF2-RP-E-00043), December 2017.

²⁴⁴ kTCO₂e – kilo tonnes of carbon dioxide equivalents.

- Option 4 = -1.1 kTCO₂e/year (a beneficial impact); and
- 8.4.4 Option 10 = -3.3 kTCO₂e/year (a beneficial impact). Overall, considering both the construction phase and the operational phase of each of the junction options (for the period 2020-2080), the options would rank from least favourable to most favourable as follows, in terms of magnitude of greenhouse gas emissions (based on fixed demand Core scenario traffic forecasting data (version 9):
- Option 12A = 304.2 kTCO₂e²⁴⁵;
 - Option 12 = 115.3 kTCO₂e
 - Option 4 = -64.2 kTCO₂e (a net reduction in greenhouse gas emissions);
 - Option 10 = -196.0 kTCO₂e (a net reduction in greenhouse gas emissions).
- 8.4.5 The design of each junction option is not sufficiently advanced to complete any comparative assessment of climate change resilience at this stage of the scheme. However, it is considered entirely feasible for the design of the scheme to accommodate predicted future changes to climate, such that no significant adverse effect on the M2 Junction 5 itself would result due to increased rainfall variability, increased average/peak rainfall, increased peak temperatures and/or increased peak winds or extreme weather events.
-

8.5 CULTURAL HERITAGE

- 8.5.1 Key impacts have been identified as those that would potentially harm the significance of a heritage asset within the cultural heritage one kilometre study area. Two types of Cultural Heritage impact have been considered, physical impacts to assets and impacts on the setting of assets.
- 8.5.2 Physical impacts to assets may arise from intrusive construction activity. Impacts to the setting of a heritage asset relate to how it is perceived within the wider landscape, and may arise where there are discernible changes in noise, light, vibration, movement or activity (including patterns of movement), air quality, or key views or views through, from or to the setting of an asset operationally. A full Cultural Heritage Setting Assessment, considering these factors, is included as Appendix 7.1 to the PCF Stage 2 Environmental Assessment Report.²⁴⁶ This assessment is summarised below.
-

PHYSICAL IMPACTS

- 8.5.3 All four junction options require land-take across areas where geophysical survey, archaeological walkover survey and intrusive archaeological evaluation have confirmed the presence of the archaeological remains of features associated with the Chatham Land Front World War I Defences. This asset is identified as potentially holding national significance and, therefore, all junction options have the potential to result in a large / very large adverse impact, though this effect could potentially be reduced to neutral through avoidance or appropriate mitigation such as archaeological excavation.
- 8.5.4 Baseline data suggests that there is also potential for hitherto unknown archaeological remains associated with historical periods from the Prehistoric through to the Modern period to be present. All junction options have the potential to result in a moderate / large adverse impact, though this effect can potentially be reduced to neutral through appropriate archaeological investigation. Further, all options are likely to disturb remains associated with an Iron Age furnace, which was identified within the north-west quadrant of the scheme during the October to November 2017 archaeological field evaluation. At the time of writing, evaluation and reporting of the archaeological field evaluation is underway.

²⁴⁵ kTCO₂e – kilo tonnes of carbon dioxide equivalents.

²⁴⁶ M2 Junction 5 Improvements Scheme Environmental Assessment Report, January 2018.

IMPACTS ON SETTING

8.5.5 All junction options have the potential to have a slight adverse impact on the setting of:

- Stockbury Castle (DKE19098);
- The Grade I Listed St Mary Magdalene's Church (MKE8527);
- The Grade II Listed Church Farmhouse and Church Farm Cottage (MKE29329);
- Three Grade II Listed headstones (MKE28548, MKE28905 and MKE28904);
- One Grade II Listed table tomb (MKE29482).

8.5.6 Options 4, 12 and 12A are likely to have a moderate adverse impact on the Chatham Land Front World War I Defence landscape due to the interruption of a key view southwards. Option 10 is considered to have slight impact upon this landscape as it would not interrupt any key views, however it would likely result in an increase in noise pollutants in the vicinity of the World War I pill box (MK4061).

8.5.7 It is anticipated that there may be opportunities to develop mitigation and/or enhancement measures in consultation with Historic England to reduce the level of impact on setting to no more than Slight Adverse effect during PCF Stage 3.

8.6 LANDSCAPE

8.6.1 Landscape and visual assessments are separate, although linked procedures:

- Landscape assessments are concerned with effects on the landscape resource (i.e. landscape elements and character); and
- Visual effects are assessed as one of the interrelated impacts on people.

LANDSCAPE ASSESSMENT

8.6.2 In landscape terms, the preferred option is Option 10 because it concentrates development into one area within the local landscape when compared to the slight sprawl of the free flow and local road links and the roundabout required for the other options. The remaining options are ranked equally second.

8.6.3 The level of effect on the high sensitivity Kent Downs AONB²⁴⁷ from the removal of the Stockbury Roundabout in Option 10 would be slight beneficial. The level of effect of Option 10 on the Chatham Outskirts: Mid Kent Downs LCA,²⁴⁸ the Fruit Belt LCA and the Bicknor: Mid Kent Downs LCA would be slight adverse. The overall level of effect for Option 10 would be a slight adverse localised effect at year one, reducing to neutral at year 15 when mitigation planting had matured.

8.6.4 The level of effect of Option 4 on the high sensitivity Kent Downs AONB and the Chatham Outskirts: Mid Kent Downs LCA, the Fruit Belt LCA and Bicknor: Mid Kent Downs LCA would be slight adverse. At operation, the overall significance of landscape effects from Option 4 on high sensitivity landscape receptors either without landscape mitigation or immediately after planting is considered to be a slight adverse effect. This would reduce over time, although it would remain slight adverse by year 15 when mitigation planting had matured due to unavoidable changes to the landscape pattern.

²⁴⁷ AONB – Area of Outstanding Natural Beauty

²⁴⁸ LCA – Landscape Character Area.

- 8.6.5 The level of effect of Options 12 and 12A on the high sensitivity Kent Downs AONB²⁴⁹ and the Chatham Outskirts: Mid Kent Downs LCA²⁵⁰, the Fruit Belt LCA and Bicknor: Mid Kent Downs LCA would be slight adverse. At operation, the overall significance of landscape effects from Options 12 and 12A on high sensitivity landscape receptors either without landscape mitigation or immediately after planting is considered to be a slight adverse effect reducing to neutral at year 15 when mitigation planting had matured.
- 8.6.6 None of the options will give rise to significant landscape effects on the Kent Downs Area of Outstanding Natural Beauty as a whole or to any of the local Landscape Character Areas within the Landscape study area (Please see **Section 1.10 - Landscape**).

VISUAL ASSESSMENT

- 8.6.7 In visual terms, Option 12 is preferred over the other junction options as it will give rise to significant adverse effects on the least number of residential and recreational receptors. Option 10 would result in beneficial effects for the greatest number of receptors but would result in significant adverse effects on a greater number of residential and recreational receptors than Option 12 and is, therefore, ranked second. Option 4 is ranked third with Option 12A being least preferred due to the potential for overbearing visual dominance at Whipstakes Farm.

8.7 BIODIVERSITY

- 8.7.1 Four international statutory designated sites are present within the ecological study area (defined in **Section 1.10 - Biodiversity**). None of the junction options will result in direct impacts on any international statutory designated sites.
- 8.7.2 The closest national statutory designated site is the Queendown Warren Local Natural Reserve, which also overlaps the Special Area of Conservation of the same name. Construction impacts (such as dust, noise and lighting) are expected to dissipate a short distance from the area surveyed as part of PCF²⁵¹ Stage 2 and, therefore, adverse impacts on the Queendown Warren Local Natural Reserve and Special Area of Conservation are considered highly unlikely.
- 8.7.3 The North Downs Woodland Special Area of Conservation is located approximately seven kilometres to the south west of the M2 Junction 5. The construction footprint does not overlap with the North Downs Woodland Special Area of Conservation and, therefore, there will be no direct impacts that could lead to significant adverse effects on its qualifying features during construction. Indirect air quality impacts during construction are considered unlikely, however, until an assessment of potential changes in traffic volumes and flows, and the resulting air quality changes has been undertaken, and the detailed construction methods are available at PCF Stage 3, it is not possible to discount indirect impacts on this designated site.
- 8.7.4 Options 10, 12 and 12A are not anticipated to result in significant operational air quality effects on the North Downs Woodland Special Area of Conservation operationally due to traffic changes within the Affected Road Network (based on Core Scenario fixed demand traffic modelling).²⁵² The air quality assessment indicated that Option 4 could result in air

²⁴⁹ AONB – Area of Outstanding Natural Beauty

²⁵⁰ LCA – Landscape Character Area.

²⁵¹ PCF – Project Control Framework.

²⁵² Affected Road Network - the affected road network has been defined in accordance with HA 207/07 scoping criteria as set out in the Design Manual for Roads and Bridges Section 3 Part 1 (HA207/07), former Highways Agency, May 2007. Affected roads are those that meet any of the following criteria:

— Road alignment will change by 5 metres or more; or

quality impacts at both 16 metres and 26 metres from the Affected Road Network into the Special Area of Conservation, with the nitrogen oxide concentrations at these two locations above the annual mean critical level. The increase in nitrogen oxide concentration would lead to deposition of nitrogen that, when compared to reference data on the response of habitats to nitrogen deposition,²⁵³ falls below the threshold at which the most nitrogen sensitive habitat types in the UK lose one species due to the increased nutrient load. Thus it would not be expected that North Downs Woodland Special Area of Conservation would lose any plant species due to deposition of nitrogen, and thus would not receive significant adverse effects due to the impacts of air quality change from traffic changes on the Affected Road Network.

- 8.7.5 Significant effects on any non-statutory designated sites are considered highly unlikely to arise as a result of any of the junction options during both construction and operation.

HABITATS

ANCIENT WOODLAND

- 8.7.6 Option 10 would likely result in the direct loss of approximately 0.3 ha of Ancient Woodland in the north-east of Church Wood while Options 4 and 12 would result in the direct loss of approximately 0.5 ha of Ancient Woodland within the central section of Chestnut Wood (refer to Appendix A-2). Option 12A would not result in the direct loss of any areas of Ancient Woodland. All options could result in indirect impacts on Ancient Woodland during construction, as a result of air quality deterioration and root compaction. Permanent loss of Ancient Woodland habitat and/or indirect impacts on Ancient Woodland during construction (associated with all junction options), is likely to result in a permanent adverse effect of very large significance. Option 12A would result in the least impacts on this habitat type as a result of avoiding the direct loss of any Ancient Woodland from Chestnut Wood.

SEMI-NATURAL BROAD-LEAVED AND BROAD-LEAVED PLANTATION WOODLAND

- 8.7.7 Option 10 would result in the complete loss of the southern cutting slope woodland. This impact would be of slight adverse significance. Other junction options would not affect this woodland and, therefore, impacts would be considered of neutral significance. All junction options would result in the permanent loss of small and narrow areas of semi-natural broadleaved woodland bordering the M2 carriageway and associated eastbound on-slips and off-slips. There will also be the loss of small and narrow areas of broadleaved plantation woodland adjacent the M2 and A249 carriageway and associated eastbound and westbound on-slips and off-slips. This would result in a slight adverse effect.

MIXED PLANTATION WOODLAND

- 8.7.8 Option 10 would likely result in the permanent loss of small and narrow areas of mixed plantation woodland adjacent the M2 carriageway. This would constitute an impact of neutral significance. There will be no loss of this habitat type from any other junction option.

HEDGEROWS

- 8.7.9 All junction options are likely to result in the permanent loss of hedgerow habitats, with Options 4 and 10 resulting in the greatest loss of hedgerow habitat. This would constitute an adverse impact of moderate significance. However, there may be opportunities to offset this

-
- Daily traffic flows will change by 1,000 annual average daily traffic or more; or
 - Heavy duty vehicle flows will change by 200 annual average daily traffic or more; or
 - Daily average speed will change by 10 kilometres per hour or more; or
 - Peak hour speed will change by 20 kilometres per hour or more.

²⁵³ Assessing the effects of small increments of atmospheric nitrogen deposition (above the critical load) on semi-natural habitats of conservation importance (NECR210). Caporn, S. et al, 2016. Peterborough: Natural England.

effect and reduce this impact to slight adverse through planting of replacement hedgerows as the scheme progresses.

BUILDINGS

8.7.10 All junction options have the potential to result in indirect impacts on buildings that have potential for bats during both construction and operation. Option 10 potentially has the largest impacts due to the permanent loss of a disused petrol station, on Maidstone Road, towards the northern extent of the survey area and a small isolated building used to house highways infrastructure / services between the M2 eastbound carriageway and the M2 eastbound off-slip. However, further surveys are required at PCF²⁵⁴ Stage 3 to determine the likelihood and extent of such impacts.

BIODIVERSITY NET GAIN

8.7.11 Based on the results of the preliminary biodiversity net gain calculation undertaken at PCF Stage 2, Option 10 is considered to be the least damaging to biodiversity overall. Option 12 is ranked second least damaging, while Option 4 has the most significant impacts on biodiversity with the highest number of biodiversity units and the highest number of linear habitat units affected. At the time of writing, the biodiversity net gain preliminary baseline calculation has not been carried out for Option 12A due to access restrictions, and is recommended to be undertaken at PCF Stage 3 if Option 12A is progressed as the preferred option. The full results of the preliminary biodiversity net gain calculation are presented in section 9.9 of the PCF Stage 2 Environmental Assessment Report.²⁵⁵

PROTECTED AND NOTABLE SPECIES

INVERTEBRATE SPECIES

8.7.12 Options 4, 10 and 12 would result in the permanent loss of Ancient Woodland in Church Wood or Chestnut Wood, which were identified as potential suitable habitat for notable invertebrate species. Therefore, these options may result in impacts of moderate adverse significance, should a notable assemblage of invertebrates be present in Church Wood or Chestnut Wood. However, it is expected that appropriate mitigation would be implemented. Option 12A would not result in the loss of any Ancient Woodland habitat and, as such, this option would be unlikely to result in direct adverse impacts upon protected or notable invertebrate species.

REPTILES

8.7.13 All junction options could result in the permanent loss of habitats that are potentially utilised by reptiles for basking, commuting, foraging and hibernating. Habitat identified as having the highest potential importance for reptiles is the parcel of grassland and scrub directly north of the M2 carriageway between the A249 and Maidstone Road. At the time of writing, the presence of common lizard and slow worm has been confirmed, with further analysis ongoing of data collected during this advanced PCF Stage 3 survey. Options 4 and 10 would both result in losses of this parcel of grassland, with Option 10 resulting in the loss of a greater extent of this area. This would constitute a slight adverse effect.

BREEDING BIRDS

8.7.14 Permanent loss of breeding and foraging habitats for commonplace bird species and loss of bird habitat associated with all junction options is only expected to result in a slight adverse effect.

²⁵⁴ PCF - Project Control Framework

²⁵⁵ M2 Junction 5 Improvements Scheme - PCF Stage 2 Environmental Assessment Report (HE551521-WSP-HGN-PCF2-RP-E-00043), December 2017.

BATS

- 8.7.15 Based on present survey information, Option 12A has the potential to result in the permanent loss of two trees identified as having moderate bat roost potential. Option 10 would have the potential to result in indirect impacts on two trees identified as having moderate potential for roosting bats (both located within approximately 20 metres of the option alignment). However, further survey work is required at PCF²⁵⁶ Stage 3 to confirm the presence or absence of bat roosts within these trees. Options 4 and 12 are unlikely to result in adverse impacts on any trees identified as moderate or high suitability for bats. All junction options have the potential to result in either direct loss of, and / or adverse impacts on a number of trees assessed as having low potential for roosting bats.
- 8.7.16 At PCF Stage 3 emergence surveys are required in respect of one building (with moderate - high potential) that will be in close proximity to the works (in particular associated with Options 4 and 12A) in order to ascertain if a bat roost is present and to determine the conservation status of any roost before a robust impact assessment may be completed.
- 8.7.17 Indirect damage of a bat roost relating to uncommon bat species, removal of hedgerow vegetation associated with all junction options and removal of Ancient Woodland vegetation associated with Options 4, 10 and 12 have potential to trigger a moderate adverse effect. However it is expected that with appropriate measures, this effect could be appropriately avoided and mitigated.
- 8.7.18 At the time of writing, analysis of data collected from the advanced PCF Stage 3 bat survey effort is ongoing. This assessment will be reviewed and updated based on the results of the advanced Stage 3 surveys and at PCF Stage 3.

DORMICE

- 8.7.19 All junction options would likely result in the permanent loss of small areas of habitats (hedgerows, woodland of all types and scrub) that are potentially utilised by dormice. However, this is not likely to result in a significantly adverse effect on dormice conservation status given that Kent is a recognised national stronghold for this species and that appropriate mitigation would be implemented.
- 8.7.20 At the time of writing, analysis of data collected during the advanced PCF Stage 3 dormice survey effort is underway. This assessment will be reviewed and updated based on the findings at PCF Stage 3.

BADGERS

- 8.7.21 At this stage, no badger setts have been identified that will be lost as a result of any junction option. In addition, Options 4, 12 and 12A are not anticipated to result in indirect disturbance to badger setts given the absence of setts within 30m of these junction options.
- 8.7.22 Option 10 will result in the loss of 0.3 ha of woodland habitat from Church Wood, which is considered to be the territory of a single badger clan. The relatively small extent of this habitat loss, in comparison to the wide availability of suitable badger foraging habitat, is unlikely to result in a significantly adverse effect. However, it is noted that the legal protection afforded to badgers may necessitate mitigation.

8.8 GEOLOGY AND SOILS

- 8.8.1 The effects from a Geology and Soils perspective are likely to be similar for all junction options.

²⁵⁶ PCF - Project Control Framework

- 8.8.2 There are no geological Sites of Special Scientific Interest or Regionally Important Geological Sites within the 250m study area for Geology and Soils. Therefore, there will be no change to these geological and geomorphological attributes, and accordingly, the effects from all junction options are considered to be neutral during both construction and operation.
- 8.8.3 The potential effects resulting from the loss of best and most versatile agricultural land for all junction options will be slight adverse in the construction phase and neutral in the operational phase. This will be further investigated as a result of the agricultural land classification assessment that is currently scheduled to be undertaken at PCF²⁵⁷ Stage 3.
- 8.8.4 During construction, there is potential for the creation of new migratory pathways for contaminants relating to made ground and the disused filling station adjacent to Maidstone Road. These could impact the underlying Seaford Chalk Formation (Principal Aquifer), located within a source protection zone, which could result in a slight or moderate adverse effect during both the construction and operational phase. However, it is expected that appropriate mitigation will be adopted such that it is slight adverse and not significant.
- 8.8.5 During construction, there is a potential for remobilisation of contaminants which might impact on a small pond adjacent to the A249 at 'The Gate House' with the potential magnitude of this impact being negligible adverse. There will be no change during the operational phase.
- 8.8.6 A ground investigation has been undertaken at PCF Stage 2. The results will inform design development and the data obtained will be used to design out adverse effects on the built environment. Therefore there will be no change to the built environment receptors and effects for all junction options on the built environment will be neutral in both the construction and operational phases.
- 8.8.7 During construction and operation, it is considered unlikely that end users including human health receptors (drivers, pedestrians using Public Rights of Ways, construction workers and the like) will be exposed to contaminants. The effects for all junction options will therefore be neutral in both phases.

8.9 MATERIALS

- 8.9.1 In the absence of detailed construction information at this stage of the scheme, the assessments of effects from materials consumption and site arisings are based on cut and fill balances for each of the options.
- 8.9.2 After mitigation measures have been applied, the significance of effect from materials consumption for Option 12 is likely to be minor adverse. All other junction options are expected to result in an effect from materials consumption of moderate adverse significance. Option 12 is expected to result in a lesser impact on materials on the basis of the smaller size of the option footprint relative to Options 4, 10 and 12A.
- 8.9.3 Options 12 and 12A are likely to have a moderate or large beneficial effect from site arisings after mitigation and enhancement measures have been applied, while Options 4 and 10 are likely to have a very large beneficial impact from site arisings after the application of mitigation and enhancement measures.
- 8.9.4 After mitigation, the significance of effect on inert landfill capacity is likely to be neutral for all options, while the significance of effect on non-inert waste landfill capacity is expected to be neutral or slight adverse.

²⁵⁷ PCF – Project Control Framework.

8.10 NOISE AND VIBRATION

- 8.10.1 It would be expected that the noise and vibration impacts as a result of the construction phase are likely to be classified as of medium or high significance; however no quantitative assessment has been undertaken at this stage of the scheme, the construction phase impacts will be quantified at PCF²⁵⁸ Stage 3. Dwellings potentially affected would be those located immediately south of the A249, to the south of the junction, and north of Maidstone Road, to the north of the junction. Once mitigation is implemented, including Best Practicable Means, it is likely that the noise impact arising from construction will be minor to moderate adverse.
- 8.10.2 Based on fixed demand traffic modelling data (Core Scenario) (Version 9) all of the junction options are likely to result in negligible noise impacts on most sensitive receptors operationally. The impacts each option would have on dwellings in the short and long term, during daytime hours (06:00 to 00:00 hours) ($L_{A10,18h}$), are shown in the tables below. It is noted that these tables do not present the full noise assessment (refer to Chapter 12 of the PCF Stage 2 Environmental Assessment Report²⁵⁹), which includes consideration of other sensitive receptors (including Noise Important Areas) and night time impacts, but are intended to provide a comparative overview of the options from a daytime noise perspective for residential receptors only. These tables present the findings of the noise assessment for the fixed demand traffic modelling data (Core Scenario) (version 9), rather than the variable demand modelling data (Core Scenario); however, it is noted that a comparison between the two data sets suggests that the noise impacts using variable demand traffic model data would be no worse than the impacts presented below.

Table 8-2 Short Term Receptor Impact (number of dwellings impacted by option and significance)

| Option | Major Adverse | Moderate Adverse | Minor Adverse | Negligible adverse | No Change | Negligible Beneficial | Minor Beneficial | Moderate Beneficial | Major Beneficial |
|--------|---------------|------------------|---------------|--------------------|-----------|-----------------------|------------------|---------------------|------------------|
| 4 | 0 | 3 | 6 | 118 | 0 | 41 | 5 | 1 | 5 |
| 10 | 0 | 2 | 13 | 123 | 29 | 32 | 4 | 5 | 1 |
| 12 | 6 | 2 | 14 | 82 | 13 | 90 | 1 | 1 | 0 |
| 12A | 5 | 2 | 26 | 87 | 22 | 62 | 4 | 1 | 0 |

Table 8-3 Long Term Receptor Impact (number of dwellings impacted by option and significance)

| Option | Major Adverse | Moderate Adverse | Minor | Negligible | No Change | Negligible | Minor Beneficial | Moderate Beneficial | Major Beneficial |
|--------|---------------|------------------|-------|------------|-----------|------------|------------------|---------------------|------------------|
| | | | | | | | | | |

²⁵⁸ PCF: Project Control Framework

²⁵⁹ M2 Junction 5 Improvements Scheme - PCF Stage 2 Environmental Assessment Report (HE551521-WSP-HGN-PCF2-RP-E-00043), December 2017.

| | | | Adverse | adverse | | Beneficial | | | |
|-----|---|---|---------|---------|---|------------|---|---|---|
| 4 | 0 | 1 | 5 | 191 | 0 | 6 | 1 | 5 | 0 |
| 10 | 0 | 0 | 4 | 195 | 0 | 4 | 5 | 1 | 0 |
| 12 | 0 | 6 | 2 | 199 | 0 | 2 | 0 | 0 | 0 |
| 12A | 0 | 5 | 3 | 191 | 0 | 10 | 0 | 0 | 0 |

8.10.3 With regard to the results presented above, and the full suite of results presented in section 12.9 of the PCF Stage 2 Environmental Assessment Report²⁶⁰, based on fixed demand traffic modelling data (Core Scenario) (version 9) the following conclusions are drawn:

- The results for Option 4 demonstrate that most of receptors would be subject to a negligible impact and that there would be no noise sensitive receptors subject to a major adverse impact. A moderate adverse impact is likely to occur at properties on Maidstone Road, east of the A249, in the short and long term. The installation of a noise barrier in the correct location (i.e. along the edge of the westbound A249 carriageway to the north of the M2) would typically reduce the noise levels by approximately 10 dB. Therefore, all moderate increases would likely fall to minor. At the same time, the results show that there could be a beneficial impact, reduction in noise levels, on Noise Important Area 4575, located south of the junction.
- The results for Option 10 demonstrate that most of receptors would be subject to a negligible impact and that there would be no noise sensitive receptors subject to a major adverse impact. A minor adverse impact is likely to occur at properties on Maidstone Road, east of the A249. The results demonstrate that two receptors would likely be subject to a moderate adverse impact in the short term only. The installation of a noise barrier in the correct location (i.e. along the edge of the westbound A249 carriageway to the north of the M2) would typically reduce the noise levels by approximately 10 dB. Therefore, these moderate increases would likely fall to minor. At the same time, results show that there could be a beneficial impact, reduction in noise levels, on Noise Important Area 4575, located south of the junction.
- The results for Option 12 demonstrate that most of receptors would be subject to a negligible impact and that there would be six noise sensitive receptors subject to a major adverse impact, during short term only. This is likely to occur at properties on Maidstone Road, east of the A249. The results also demonstrate that there would be six receptors subject to a moderate adverse impact in the long term. The installation of a noise barrier in the correct location (i.e. along the edge of the westbound A249 carriageway to the north of the M2) would typically reduce the noise levels by approximately 10 dB. Therefore, all major increases in the short term would fall to moderate short term and all moderate long term increases would fall to minor. With mitigation, it is likely that there would be no sensitive receptors with a significant effect in the long term. At the same time, results show that there could be a minor / moderate beneficial impact in the short term only, reduction in noise levels, at one property on NIA 4575, located south of the junction.

²⁶⁰ M2 Junction 5 Improvements Scheme - PCF Stage 2 Environmental Assessment Report (HE551521-WSP-HGN-PCF2-RP-E-00043), December 2017.

- The results for Option 12A demonstrate that most of receptors would be subject to a negligible impact and that there would be five noise sensitive receptors subject to a major adverse impact during the short term. This is likely to occur at properties on Maidstone Road, east of the A249. The results also demonstrate that there would be five receptors subject to a moderate adverse impact in the long term. The installation of a noise barrier in the correct location (i.e. along the edge of the westbound A249 carriageway to the north of the M2) would typically reduce the noise levels by approximately 10 dB. Therefore, all major increases in the short term would fall to moderate short term and all moderate long term increases would fall to minor. With mitigation, it is likely that there would be no sensitive receptors with a significant effect in the long term. At the same time, results show that there could be moderate beneficial impact in the short term only, reduction in noise levels, at one property on noise important area 4575, located south of the junction.

8.11 PEOPLE AND COMMUNITIES

EFFECTS ON ALL TRAVELLERS

- 8.11.1 Options 4 and 10 are expected to result in a moderate beneficial impact of moderate significance on motorised travellers operationally. All other options are expected to result in a minor beneficial impact of slight significance on motorised travellers operationally. These beneficial impacts are primarily as a result of reduction of driver stress as a result of increased journey time reliability, reduced journey times and the potential for improved safety at the junction.
- 8.11.2 During construction, Public Rights of Way are likely to be impacted by all options, resulting in minor adverse impacts of slight significance for all options while temporary routes are set up or diversions are provided. All options are expected to result in slight operational benefits as a result of increased quality of Public Rights of Way facilities.
- 8.11.3 All options are expected to result in operational safety benefits and reduce the risk of major road accidents at the M2 Junction 5. Option 4 is expected to result in the greatest number of accident savings, followed by Option 12, Option 10 and Option 12A. The full results are presented in **section 5.4** of this report.

EFFECTS ON PEOPLE AND HEALTH

- 8.11.4 None of the junction options result in land take from any strategically allocated employment land, therefore a neutral impact on development land is expected during both construction and operation.
- 8.11.5 Disruption is expected to impact local bus stops and services during construction which has the potential to negatively impact local people and in particular, the health and well-being of the young and elderly. However due to the current usage of the bus stops as identified by the NMU Context Report²⁶¹, disruption is expected to be limited to small number of individuals. Appropriate mitigation, such as temporary bus stops or altered routes may need to be implemented in order to limit the adverse impact on these vulnerable groups. With appropriate mitigation in place, the significance of this impact is considered likely to be neutral.
- 8.11.6 Where options move the carriageway further from dwellings this is likely to have a positive impact on health and wellbeing operationally. The retention and possible improvement of pedestrian facilities also has a potential to have a benefit on health and well-being operationally. Overall, the impacts on health and well-being from all the junction options are considered to be neutral during construction and operation.

²⁶¹ M2 Junction 5 Improvement Study – PCF Stage 1 Non-Motorised User Context Report HE551521 M2J5_NMU_PCF-S1_V1.0), October 2016.

EFFECTS ON COMMUNITIES

CONNECTIVITY

- 8.11.7 Option 10 provides greater connectivity with the local roads immediately surrounding the junction than Option 4 operationally, with new carriageways being constructed to the north east of the junction which link Maidstone Road and Oad Street and directly to the M2 Junction 5; although as with Option 4, direct access from Oad Street to the A249 is removed under Option 10. Options 12 and 12A provide local link roads, which will generally maintain connectivity in the area operationally. Overall, it is anticipated that the level of severance experienced by local communities for all options would be neutral operationally, with the potential for slight operational benefits due to increased local accessibility to the strategic road network.
- 8.11.8 It is expected that any temporary loss of access during construction will be mitigated appropriately through the implementation of appropriate, effective diversions.

AGRICULTURAL LAND

- 8.11.9 Overall, Option 4 results in the loss of 13.0 ha of agricultural land outside the existing highway boundary (Grades 2 and 3 classified agricultural land). The loss of agricultural land under Option 10 is anticipated to be marginally less when compared to Option 4, with an overall land take of 11.1 ha outside the existing highway boundary.
- 8.11.10 The loss of agricultural land under Options 12 and 12A is anticipated to be significantly less when compared to Options 4 and 10. There would be an overall estimated land take of 2.7 ha associated with Option 12. Agricultural land take required for Option 12A was not quantified at the time of preparing the people and communities assessment within the PCF Stage 2 Environmental Assessment Report²⁶²; however, it is expected to be in the order of approximately 4.5 to 6.5 ha. The loss of agricultural land for all options is likely to result in a slight adverse effect.

8.12 ROAD DRAINAGE AND THE WATER ENVIRONMENT

- 8.12.1 All of the options have the potential to result in adverse effects on groundwater quality, increased flood risk associated with changes to overland flow paths and an increase in impermeable surface area, impacts to the quality of the ditch adjacent to Maidstone Road and impacts to the quality of the pond next to the Gate House adjacent to the A249 during both construction and operation.

GROUNDWATER

- 8.12.2 During construction, Options 4 and 10 are expected to result in an increased risk to groundwater quality and associated potential impacts to human health, particularly to the north of the junction, of moderate adverse magnitude and slight significance with mitigation (additional pollution prevention measures likely to be required). This is due to the deep excavations / foundations and proposed retaining walls and excavation zones required for the new roundabout and overpass, particularly in the area around Maidstone Road to the north of the M2 as this is located in the Inner Zone of the groundwater Source Protection Zone. All other options are expected to result in increased risk to groundwater quality during construction and associated potential impacts to human health of minor adverse magnitude and slight significance with mitigation, particularly on groundwater to the north of the M2. Operationally, all options are expected to result in risks to groundwater quality, and

²⁶² M2 Junction 5 Improvements Scheme Environmental Assessment Report (HE551521-WSP-HGN-PCF2-RP-E-00043), December 2017.

associated human health impacts of minor adverse magnitude and slight significance with mitigation.

FLOODING

8.12.3 During both construction and operation, all options are expected to increase the risk of flooding to adjacent properties as a result of changes to overland flow paths. This is expected to result in a minor adverse impact on road users, people and property neutral significance. Operationally, a negligible impact of neutral significance is also anticipated for all options due to increased impermeable area resulting in an increased risk of flooding. The drainage design, developed during PCF²⁶³ Stage 3 and beyond will need to accommodate these changes to maintain or improve flood risks associated with the junction.

DITCH ADJACENT TO MAIDSTONE ROAD

8.12.4 All options are expected to result in a neutral impact on the quality of the ditch if diversion / realignment is required during construction. If diversion / realignment of the ditch is required operationally, this would result in a minor adverse impact of neutral significance in the case of all options.

POND AT THE GATE HOUSE

8.12.5 During construction, Options 4 and 10 are expected to result in risks to the quality of the pond of minor adverse magnitude and neutral significance. All other options will result in risk to the quality of the pond of negligible magnitude and neutral significance during construction. Operationally, all options are expected to result in risk to the quality of the pond of negligible magnitude and neutral significance.

SUMMARY

8.12.6 At this early stage of assessment, and based on the information available at PCF Stage 2, impacts on groundwater quality and risk to the quality of the pond next to the Gate House adjacent to the A249 during construction appear to be the notable differentiators between the options.

8.12.7 The magnitude of impact on groundwater quality during construction for Options 4 and 10 are assessed as likely to be larger than that for Options 12 and 12A (moderate adverse for Options 4 and 10 versus minor adverse for Options 12 and 12A); however it is noted that with likely mitigation the significance of impact is expected to be slight adverse for all options.

8.12.8 The magnitude of impact regarding risk to water quality of the pond during construction for Options 4 and 10 is likely to be larger than that for Options 12 and 12A (minor adverse versus negligible). However, as with groundwater quality impacts, the significance of impact is expected to be the same for all options with the likely mitigation in place, being neutral.

²⁶³ PCF - Project Control Framework

9 SUMMARY OF PUBLIC CONSULTATION

9.1 INTRODUCTION

9.1.1 The Report on the Public Consultation²⁶⁴ for the M2 Junction 5 Improvement scheme is a key product required in Stage 2 (option selection) of the Project Control Framework. It summarises the options presented to the public at the non-statutory public consultation and the manner in which the consultation was undertaken. It analyses the views received from the public and stakeholders, summarises the findings and makes recommendations for further actions.

9.1.2 This section provides a summary of the Report on Public Consultation.

9.2 CONSULTATION ARRANGEMENTS

9.2.1 The public consultation took place over a six-week consultation period from Wednesday 6 September to until 11.59pm on Tuesday 17 October 2017. Providing an important opportunity to gain a better understanding of the views and expectations of local people, stakeholders, landowners, businesses, public authorities, communities and road-users.

9.2.2 In preparation for the non-statutory public consultation, Highways England implemented a targeted Public Consultation Strategy²⁶⁵, which clearly set out the aims of the consultation, target audiences, key messages and identified stakeholders of interest. It was important that the approach enabled stakeholders to be meaningfully and continuously involved with the scheme from an early stage.

²⁶⁴ Report on Public Consultation - HE551521-WSP-HGN-PCF2-RP-PM-00021

²⁶⁵ Public Consultation Strategy - HE551521-WSP-HGN-PCF2-RP-PM-00053

COMMUNICATION METHODS

9.2.3 The following methods were used to communicate with the public and advertise the public exhibition events.

Table 9-1 Publicity Communication Methods

| Communication Type | Purpose |
|----------------------------------|--|
| Materials | |
| Letters and emails | Informed residents, landowners, businesses, MPs / Councillors, key stakeholders and wider stakeholders about the public consultation. |
| Brochure and questionnaire | Brochure provided concise information about the proposals. Questionnaire was the main method of gathering feedback. |
| Leaflets | Miniature version of the poster given out at the shopping centres exhibitions, for those members of the public who just wanted the information to complete the questionnaire online. |
| Deposit points | Made consultation materials (brochures, questionnaires, posters and background information) available in local, publicly accessible locations. |
| Highways England project website | Made consultation materials (brochures, questionnaires, background information, exhibition displays) available online. Anyone registered to receive updates about the scheme received an email on the consultation launch date inviting them to take part. |
| Press release | Issued on the consultation launch day to secure widespread press coverage and therefore raise awareness of the consultation. |
| Newspaper advertising | Raised awareness of the consultation amongst the general public, including those from a wider area throughout the consultation period. |
| Posters | Displayed on council and local community notice boards, etc. to raise awareness of the consultation more locally. |
| Highways England contact details | Provided in case of queries or for those requiring the information in a different format. |
| Existing communication channels | Established communications channels (Chamber of Commerce, Local Authority distribution lists and wider stakeholder organisations including equalities groups) used to extend the consultation reach. |
| Variable Message Signs | Displayed messages on signs throughout Kent to inform drivers that a consultation was being undertaken and to visit Highways England website |
| Events | |
| Public exhibition events | Provided opportunity for interested groups, local residents, landowners and businesses to view the proposals and discuss them with members of the project team. |
| Business Breakfast events | Provided opportunity for local businesses to view the proposals and discuss them with members of the project team |
| Preview events | Provided opportunity for the media, MPs / Councillors and Key Stakeholders to view the proposals prior to the general public and discuss them with members of the project team. |

CONSULTATION EFFECTIVENESS

- 9.2.4 In total, 518 questionnaire responses were received during the consultation period. Just under a third (29%; 150) were hard copy responses, with the majority (71%; 368 responses) completed online. A further 47 written responses received from stakeholders and the general public expressing their views on the proposed scheme, in the form of letters and emails.
- 9.2.5 Additionally there were 37 enquires for further information regarding either the scheme or the consultation process. These have not been included in the analysis and replies where sent in response to the requests.
- 9.2.6 A further six responses were received after the consultation closing date (by Thursday 19 October) which were not analysed as part of the Report on Consultation.
- 9.2.7 There were 1,307 visitors to the public consultation exhibitions, as seen in **Table 9-2**.

Table 9-2 Public Exhibition Attendance

| Date of Event | Location | Attendance |
|------------------------|--|------------|
| Wednesday 6 September | Holiday Inn (otherwise known as Coniston Hotel), 70 London Road, Sittingbourne, Kent, ME10 1NT | 412 |
| Monday 11 September | Stockbury Memorial Hall (Cricket Club), The Street, Stockbury, Kent, ME9 7UD | 250 |
| Saturday 16 September | Forum Shopping Centre, High Street, Sittingbourne, Kent, ME10 3DL | 242 |
| Wednesday 20 September | Sheppey Gateway, 38 - 42 High Street, Sheerness, Kent, ME12 1NL | 137 |
| Saturday 23 September | The Mall Maidstone, Pads Hill, Maidstone, Kent, ME15 6AT | 266 |
| Total | | 1307 |

- 9.2.8 The business breakfast meetings were poorly attended and did not attract the numbers of businesses as originally anticipated. Only 9 attended the Maidstone Business Breakfast and 12 attended the Swale Business Breakfast.
- 9.2.9 **Table 9-3** below presents the number of visitors to both the project webpage and consultation webpage, with the average time spent on the webpages during the consultation period.

Table 9-3 Website Visitor Figures

| WEBPAGE | TOTAL VISITS | TOTAL UNIQUE VISITORS | AVERAGE TIME SPENT ON THE PAGE |
|-------------------|--------------|-----------------------|--------------------------------|
| Scheme Page | 8,224 | 6,986 | 3 minutes 12 seconds |
| Consultation Page | 2,975 | 2,403 | 3 minutes 41 seconds |

9.2.10 The consultation webpage received 2,403 unique visitors, 1,307 visitors attended the consultation events in person. It is noted that people could attend more than one exhibition and also visit the website so overall reach of the consultation cannot be calculated.

RESPONSE AND ANALYSIS METHODOLOGY

9.2.11 Before any analysis could take place, all data contained in the paper questionnaires required input to an electronic dataset (spreadsheet) which could subsequently be interrogated and merged with the online questionnaire data. Data entry adheres to a thorough and robust process which ensures maximum accuracy. The following quality checking procedures were employed:

- The data entry programme incorporates full range checks for each question – making it impossible for any numeric values to be present outside the specified range.
- 100% verification – whereby data is input twice by two different operators and the files are subsequently compared. Where inconsistencies are identified, the entries are checked against the original questionnaire and the correct data is recorded.
- Spot checks of data carried out by data processing staff.
- The coded data was subject to rigorous quality control procedures, for example checking 20% of the coded data to ensure accuracy of code application.

9.2.12 The paper questionnaire data has subsequently been combined with the online questionnaire data, to produce a single file containing all responses. A series of logic and range checks were conducted on the data prior to analysis.

9.2.13 The combined dataset was analysed using SPSS, a statistical software package designed for the analysis of questionnaire data, along with Microsoft Excel and the ArcGIS mapping software. The results of this analysis are summarised below and further discussed in the Report on Public Consultation²⁶⁶.

EFFECTIVENESS OF COMMUNICATION METHODS

9.2.14 The majority of respondents (52%) had found out about the consultation via the letter drop (269 respondents). Local news articles 26% and 'word of mouth' 17% also proved popular means of communication.

²⁶⁶ Report on Public Consultation - HE551521-WSP-HGN-PCF2-RP-PM-00021

9.2.15 The vast majority of respondents are local residents, with 76% of respondents (372 respondents) describing themselves as such. A far smaller proportion 17% (81 respondents) described themselves as travelling through the area, while a further 2% (11 respondents) responded on behalf of a local business, 2% work in the area and 1% (7 respondents) responded as other. In all, 36 respondents did not provide a response to this question and 2 preferred not to say.

9.2.16 While the vast majority of responses are from the general public, it should be noted that a number came from stakeholders, including:

- 1 response from a Member of European Parliament;
- 3 responses from local authorities;
- 7 responses from Councillors (Borough and County);
- 3 Statutory Environmental Bodies;
- 9 responses from parish councils;
- 9 business organisations; and
- 3 community organisations.

9.3 TOPICS RAISED AT EXHIBITIONS

9.3.1 A number of topics were raised during the public exhibitions by attendees, the below **Table 9-4** highlights the topics that were most frequently by more than a single individual.

9.3.2 The frequency of mentions by attendees is denoted by the 'star' rating, with ★★★ denoting that an issue was raised very frequently, while a single ★ denotes that the issue was raised several times, but not by many attendees. It is noted that an attendee may have made multiple comments about different (or the same) topic.

Table 9-4 - Issues raised at exhibitions

| Issue Raised | Star Rating |
|--|-------------|
| Introduce a fly-over with no other improvements i.e. M2 eastbound to A249 Northbound free-flowing link | ★★★ |
| Members of the public were concerned that the Oad Street arm being un-signalised would cause safety and traffic issues | ★★ |
| Turn off traffic signals at existing junction as will perform better - reference made to period when control box was hit and needed to be replaced and so was not working for a number of weeks. | ★★★ |
| Proposed Maidstone Road and Oad Street Links will encourage / facilitate more rat-running from the Key Street development. | ★ |
| The through-about will cause accidents as people will cut in at last moment at point 3 lanes drop into 2 lanes. | ★★ |
| Is there enough capacity on the existing Oad Street bridge over the M2? Will the proposed un-signalised entry at the Stockbury Roundabout be able to cope with the volumes of traffic? | ★★ |
| More traffic onto unsuitable local roads, as only the proposed Oad Street Link is being upgraded and not other sections of the Local Road network that feed into it. | ★★ |
| Safety concerns relating to entry into and exit from Church Lane. | ★★★ |

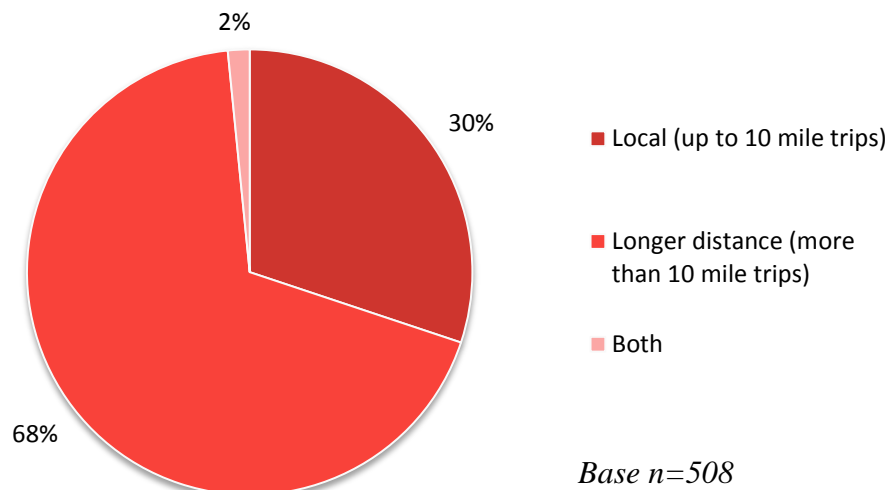
TRAVEL BEHAVIOUR

9.3.3 Question 4 of the questionnaire asked the following question:

— What type of journeys do you use the M2 Junction 5 for most often?

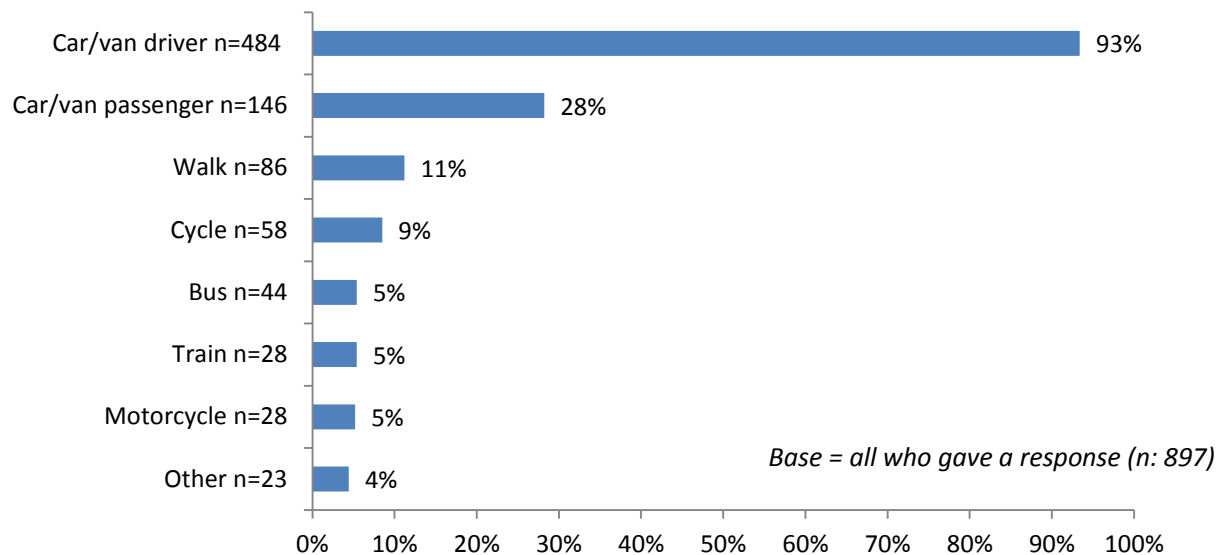
9.3.4 The results indicate that 30% of respondents mainly use the junction for local trips, while the remaining 68% of respondents use the road as part of a longer distance journey. The remaining 2% used it for both. Ten respondents didn't answer the question. It is therefore important to note the strategic interest in the proposal and the importance of this junction for trips being made within the local area.

Figure 9-1 what type of journeys do you use the M2 Junction 5 for most often?



9.3.5 Question 19 asked respondents what mode of transport they use in order to travel through the area local to M2 Junction 5. Respondents were able to select all modes that applied to them, so it was possible for more than one answer to be selected. The results are shown in **Figure 9-2** and are shown for each mode as a proportion of all 518 respondents so the sum total of percentages exceeds 100%.

Figure 9-2 How do you usually travel through this area? (Please select all that apply).



9.3.6 By far the greatest proportion of respondents travel through the area as car or van drivers (93%; 484 people). Around a third (28%; 146 respondents) travel as a passenger in a motor vehicle. However, respondents also walk (11%; 86 respondents) and cycle (9%; 58 respondents). Around a fifth of respondents (5%) travel through the area by bus, and 28 (5%) travel by train. Five percent of respondents are motorcyclists. The other responses consisted of HGV²⁶⁷ drivers, coach drivers, farm vehicles, disabled and equestrian users.

9.3.7 The results indicate that respondents comprise a large proportion of car/van drivers, but also a good representation of people who walk and cycle (non-motorised users).

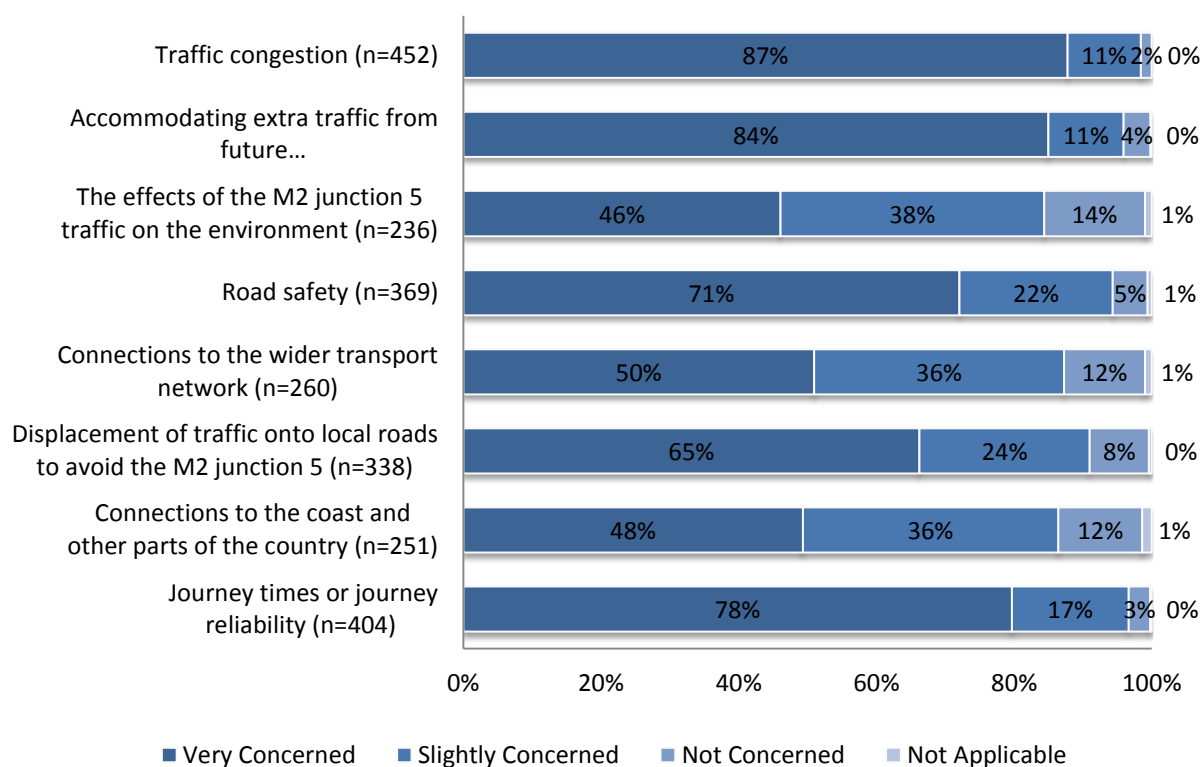
JUNCTION CONCERNS

9.3.8 Respondents were also asked about what their major concerns with the junction were. The biggest concern was 'Traffic Congestion' with 98% of respondents being very concerned or concerned about the subject.

9.3.9 Traffic growth and journey time reliability were also big concerns with the respondents with 96% and 97% respectively being concerned about these issues. The figure below highlights the other concerns that respondents had.

²⁶⁷ HGV – Heavy Goods Vehicle

Figure 9-3 How concerned are you about the following issues relating to the M2 Junction 5?



VIEWS ON THE PROPOSED OPTION 12A

9.3.10 Question 6 asked respondents whether they consider there to be a need for a scheme to improve the M2 Junction 5. **Figure 9-4** 1 shows that there is a substantial amount of support to improve the M2 Junction 5, with 94% of respondents in agreement (83% strongly agree and 11% agree). Conversely, only 4% of respondents do not believe there is a need to improve the junction (1% disagree and 3% strongly disagree). The remaining 2% of respondents expressed a neutral opinion.

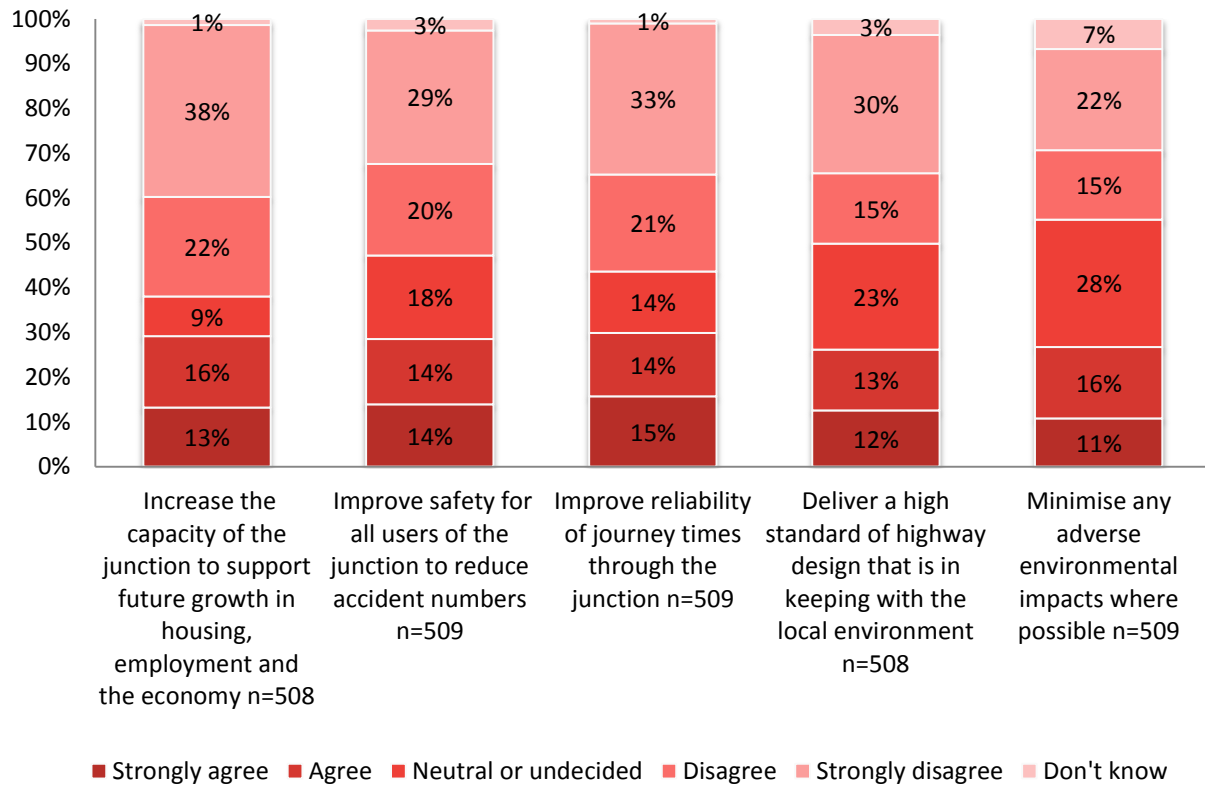
9.3.11 Respondents were subsequently asked to what extent they believe that the proposed option (Option 12A) would meet the five scheme objectives. The results are shown in **Figure 9-4**.

9.3.12 The majority of respondents (approximately half of respondents in each case) feel that the proposed Option 12A will not meet the scheme objectives:

- 60% of respondents do not believe that the proposed Option 12A will increase capacity enough to support the future growth in housing, employment and the economy, while 29% feel that the proposed option will have this effect.
- 49% do not believe that the scheme will improve safety for all users of the junction to reduce accidents, while 28% believe the scheme will improve safety.
- 54% do not believe that the scheme will provide more reliable journey times through the junction while a lesser 29% agree it will.
- 45% disagree that the scheme will deliver a high standard of highway design that is in keeping with the local environment while 25% believe it will.
- 37% disagree that the proposed option will minimise any adverse environmental impacts where possible while 27% agree it will.

9.3.13 A significant proportion, around 20% for each objective, were neutral or undecided on whether the proposed option 12A met the objectives.

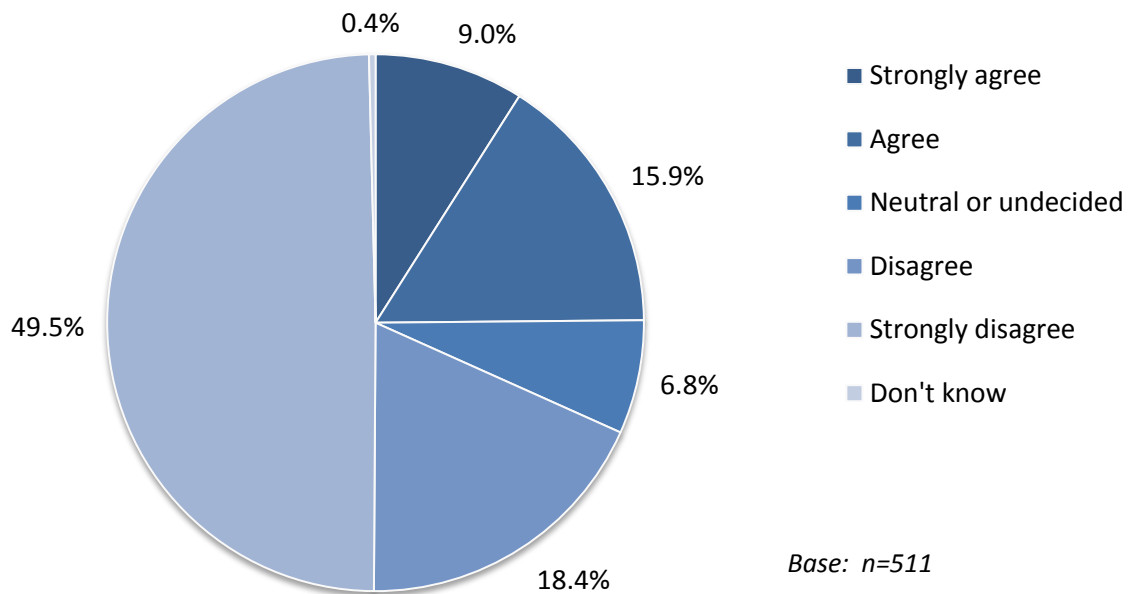
Figure 9-4 How much do you agree or disagree that the proposed option will meet the scheme objectives?



OVERALL VIEWS ON PROPOSAL

9.3.14 Question 8 then asked respondents to indicate their views on the proposed Option 12A for the M2 Junction 5 overall. The results in **Figure 9-5** indicate that there is a low level of support for the proposed scheme. As shown, 68% of respondents overall do not support the proposed option (50% strongly disagree, 18% disagree). Meanwhile, 25% of respondents support the proposed Option 12A (9% strongly agree and 16% agree with the proposed scheme). A further 7% of respondents expressed a neutral opinion and 0.4% answered 'don't know'.

Figure 9-5 Overall to what extent do you support the proposed option (Option 12A) for the M2 Junction 5 improvements?



9.3.15 The results above clearly indicate that while there is very strong support for improving the M2 Junction 5 (94%), the proposed solution (Option 12A) is not supported (68% of respondents disagree with Option 12A).

ALTERNATIVE IDEAS

9.3.16 Question 11 sought to understand from respondents whether they had any other ideas that should be considered relating to this scheme having read the brochure and taken account of the constraints. In total, 390 comments were coded in response to this question, with the top five most common codes presented in **Table 9-5** below.

Table 9-5 Alternative Ideas

| DESCRIPTION | FREQUENCY |
|--|-----------|
| Flyover/Underpass is only solution that will work longer term | 140 |
| Do not use traffic lights / remove traffic signals | 39 |
| Option 4 is the preferred option | 34 |
| Option 10 is the preferred option | 29 |
| Would require further improvements (and therefore expenditure) in the future | 22 |

9.4 STAKEHOLDER RESPONSES

9.4.1 The following local councils in the area expressed opposition to the scheme:

- Kent County Council opposes Option 12A and sees it as a missed opportunity to address and mitigate existing congestion. They believe that Option 4 is the only feasible option that would increase capacity.
- Swale Borough Council opposes Option 12A as it believes that it will not provide a long-term solution. The Council believes that the current scheme would only provide a short-term mitigation and that Options 4 and 10 provide unimpeded movements for the critical north-south movements of the A249.
- Maidstone Borough Council objects to Option 12A.

9.4.2 The following local parish councils expressed opposition to the scheme:

- Stockbury Parish Council objects to Option 12A and believe that only Option 10 would successfully deal with the existing traffic problem.
- Minster on Sea Parish Council opposes Option 12A as it believes that it does not offer a solution or take into consideration the impact of the Lower Thames Crossing.
- Bobbing Parish Council neither support nor oppose the scheme but are concerned that it won't provide enough capacity for future developments.
- Iwade Parish Council objects to Option 12A as they believe that the proposed scheme will need to be revisited in a few years' time.
- Hartlip Parish Council objects to Option 12A as they believe that it will not provide sufficient capacity. Their preferred option is Option 10 with Option 4 second.
- Tunstall Parish Council objects to Option 12A as they believe the benefits of the road improvements will be short lived following the significant increase in housing locally.
- Bredgar Parish Council objects to Option 12A as they believe the scheme will only provide short-term benefits.

9.4.3 Along with the local council feedback, the Member of Parliament for Sittingbourne and Sheppey, Gordon Henderson, objects to the scheme for the following reasons:

- I do not believe option 12A, as proposed, is the right option for the following reasons:
- It does not provide a flyover to allow traffic travelling north and south on the A249 to bypass the junction.
- It adds to the number of traffic lights on the junction, which will cause more hold ups. The current junction runs far more freely when the traffic lights are not operating.
- Tailbacks along the southbound A249 approach to the roundabout caused by the traffic lights are a factor in many accidents and this option does not address that issue.
- It does not, in my view, provide capacity either for the planned economic and housing growth in the Swale Local Plan or the proposed development of the port at Sheerness as set out in the port's 20-year plan. Neither does it, in my view, provide for the growth in traffic that will come from the new Lower Thames Crossing.
- It risks increasing rat-running in rural lanes and through the villages of Oad Street and Borden.

9.4.4 The following Statutory Environmental Bodies also provided written responses:

- The Kent Downs Area of Outstanding Natural Beauty Unit is of the view that the proposed alterations to Junction 5 of the M2 as proposed in Options 4, 10 and 12A, would significantly change the landscape resulting in a loss of existing rural character to the detriment of the local environment and significant harm to the Area of Outstanding Natural Beauty.
- Natural England are concerned about the proposal's impact on the environment with the proposed cutting for Oad Street considered to potentially result in significant impacts to the landscape character of this area of the Area of Outstanding Natural Beauty. In addition, the cuttings are likely to result in significant visual impacts for both near and more distant visual receptors.
- Natural England objects to Option 12A as the proposed scheme options are all likely to cause some harm to the heritage significance of Stockbury Castle, St Mary Magdalene's Church, Church Farmhouse and Church Farm Cottage.

9.5 CONCLUSION

- 9.5.1 Over 1,300 people attended the 5 public events; and 518 responses (368 online and 150 paper ones) have been logged. The majority of respondents believe that there is a need to undertake improvement works to M2 Junction 5, with 94%, due to concerns regarding traffic congestion and journey times. Although just over two thirds (68%) of respondents disagree with Option 12A as being the solution that will solve the current problems on the junction.
- 9.5.2 The majority of the written responses from local councils, parishes and the Member of Parliament for Sittingbourne and Sheppey objected to Option 12A as they believe that it only offers a short-term solution that does not cater for future growth.
- 9.5.3 The alternative solutions proposed by respondents steered towards a fly-over of the roundabout for the A249 as it is thought that this is the main cause of delays.

10 POST-CONSULTATION ASSESSMENT

10.1 CONSULTATION FEEDBACK

10.1.1 The PCF²⁶⁸ Stage 2 non-statutory public consultation responses and analysis of the results (as shown in **Section 9**) has indicated that the majority of respondents (68%) would not support Option 12A. The most common alternative idea proposed was a flyover / fly-under, as the public and other stakeholders considered that this was the solution that would work in the long-term.

10.1.2 The project team reviewed all of the feedback received during the public consultation. In response to the lack of support for Option 12A, including the local authority opposition, and the alternatives suggested the project team identified the items listed below for further consideration. The review and identification of items for further, value management, consideration took into account the project objectives and affordability limit.

- Could Option 4 be revised to reduce the cost of the option, whilst maintaining an acceptable level of benefits?
- Could the proposed changes to Oad Street and Maidstone Road be revised to: reduce costs, reduce the risk of rat running by strategic traffic on local roads; and/or reduce the impact on the surrounding environment?
- Could the Maidstone Road Link be revised to address safety concerns at the Maidstone Road Link / Oad Street junction?
- Could the proposed changes to the local road network be revised to improve connectivity for the nearby villages of Stockbury and Oad Street?

10.2 VALUE MANAGEMENT

10.2.1 The value management review focussed on the elements of Option 4 that were considered to have the greatest potential to reduce costs whilst minimising the reduction in the benefits. This included the elements of Option 4 listed below. The issues relating to the local roads formed part of this assessment.

- M2 Eastbound to A249 Northbound off line, single lane slip road;
- Oad Street Link;
- Maidstone Road Link.

²⁶⁸ PCF – Project Control Framework

M2 EASTBOUND TO A249 NORTHBOUND SLIP ROAD

10.2.2 Option 4, as well as Options 12 and 12A, shown at the public consultation proposed the following improvements to the M2 eastbound diverge off slip road:

- Improvement from a single lane diverge (Type A – Taper Diverge – TD22/06²⁶⁹ Figure 2.6) to a two-lane ghost island diverge (Type B – Ghost Island Diverge – TD 22/06 Figure 2.6); and
- An off-line free flow link, in the form of a single lane dedicated slip road, between the M2 eastbound and A249 northbound carriageways.

10.2.3 To reduce the costs of Option 4 removing the proposed off-line slip road for the M2 eastbound to A249 northbound traffic movements and replacing it with an on-line improvement to the existing slip road was assessed. The existing slip road was revised to be two lanes, as opposed to the current one lane layout, and a similar dedicated left turn lane was provided at the M2 Junction 5 Roundabout. This hybrid variation to Option 4 can be seen in Option 4H1 in the Options Log (please refer to **Appendix B-1**) and the general arrangement can be seen in **Appendix J-1** (Drawing number: HE551521-WSP-HGN-M2J5-DR-D-0150).

10.2.4 As part of the evaluation two hybrid variants were considered:- (1) Option 4H1 One lane; and (2) Option 4H1 Two lanes. The two variants differed in the number of lanes provided on the on-line improvement to the M2 eastbound offslip:- (1) one with a single lane offslip widening to two lanes on the approach to the roundabout, similar to the existing layout; and (2) with two lanes throughout. The viability of these two variants was assessed in terms of operational performance, under the forecast traffic flow scenarios, and compliance with design standards.

10.2.5 In order to determine which of these two variant arrangements provided the highest benefit in terms of overall traffic performance an assessment using the key metrics listed below were undertaken, in both the Core and Alternative Scenario traffic forecasting demand sets.

- Traffic flow on the slip road;
- Link saturation (Volume to Capacity Ratio) on the slip road;
- Queue length, at the diverge from the M2 mainline and on the slip road.

10.2.6 In terms of traffic throughput on the slip road in each variant, Option 4H1 (Two lanes) generally shows greater flows in the AM and PM peak periods across all modelled years and growth scenarios.

10.2.7 Link saturation is also a useful measure to determine the suitability of each hybrid variant. Link saturation is the ratio between demand flow and link capacity, where the ratio is between 85% and 100%, the link is operating close to or at theoretical capacity, anything greater than 100% is over capacity. Where saturation issues are evident, it is likely that queuing, delay and flow breakdown will occur. In terms of delay, this is typically seen at the diverge from the M2 and at the entry to the roundabout.

- 2021: With the Core Scenario, in the PM Peak, the one lane variant is operating close to / at the theoretical capacity throughout its length, with volume/capacity ratios between 85% and 99%, compared to 49% to 66% in the two lane variant. With the Alternative Scenario, the one lane variant of Option 4H1 shows that it would operate close to / at theoretical capacity in both the AM and PM peaks, whilst the two lane variant would be operating between 42% and 68% of theoretical capacity.
- 2041: With the Core Scenario, the one lane variant is shown to be close to / at theoretical capacity in both peaks, with saturation between 95% and 100%, compared to between

²⁶⁹ Design Manual for Roads and Bridges, Volume 6, Section 2, TD 22/06 - Layout of Grade-Separated Junctions

49% and 69% in the two lane variant. The two lane variant would be operating between 51% and 68% of theoretical capacity.

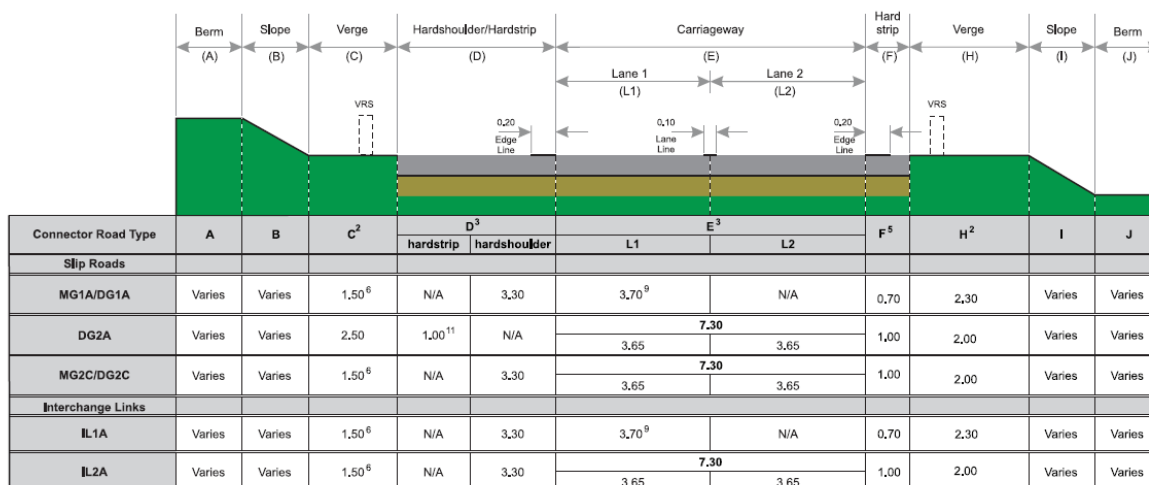
- 10.2.8 As outlined earlier, where capacity issues are seen, delay, queuing and flow breakdown are often also seen. Queuing on the M2 eastbound offslip from the roundabout could back up towards the M2 eastbound mainline, and capacity issues immediately after the diverge from the M2 mainline could also cause queuing on the M2 eastbound carriageway prior to the junction. The results of the assessment show that with the Core Scenario there is limited queuing in both variants in both 2021 and 2041. However, with the Alternative Scenario, the one lane variant shows significant queuing from 2031, at the diverge from the M2 mainline as the one lane section of the offslip restricts flow. With two lanes, no queuing is predicted at the diverge from the M2 mainline or at the roundabout.
- 10.2.9 The conclusion of the operational performance assessment was that with Option 4H1 (one lane) capacity issues and queuing are seen across the modelled forecast years. The queuing seen in the Alternative Scenario equates to around 340m, queuing back from the diverge point on the M2 mainline. When the extra capacity is provided through the provision of the additional lane in Option 4H1 (two lanes) no capacity issues or queuing are predicted. The Alternative Scenario is based on the latest growth projections as outlined in the adopted Swale Local Plan and is therefore considered a likely scenario.
- 10.2.10 The hybrid variant with a two lane offslip will therefore provide the higher level of operational performance of the two variants, accommodating traffic flows within the available capacity on the slip road and minimising the risk of vehicles exiting the motorway at this offslip queuing back onto the M2 eastbound carriageway.
- 10.2.11 The existing slip-road is currently a single lane. The paragraphs below discuss the viability of widening to two lanes in terms of compliance with design standards.
- 10.2.12 The observed and forecast flows for the M2 eastbound diverge falls within the range of a DG2A connector road (2 lanes connector road as shown in **Figure 10-1**, according to TD27/05²⁷⁰).
- 10.2.13 The existing slip-road is a D1GA with offside hatching around the right hand horizontal curve. The existing carriageway from under the M2 Stockbury Viaduct up to Stockbury Roundabout varies between 8.4metres and 9.2metres in width with a D2GA cross-section provided approximately 100metres downstream of the M2 Stockbury Viaduct. Therefore, some local widening would be required to provide a compliant D2GA cross-section in this location. The existing carriageway width around the right hand horizontal curve is sufficient for a D2GA cross-section with the width varying between 9.36metres and 11.36metres from the diverge nose to the M2 Stockbury Viaduct. However, the right hand horizontal curve has a sub-standard radius of 60metres, compared with the current design standard of 75metres (TD22/06²⁷¹ Table 4/2). This raises concerns associated with providing two running lanes around this horizontal curve, relating to the risk of an increase in accidents.

²⁷⁰ Design Manual for Roads and Bridges, Volume 6, Section 1, Design Manual for Roads and Bridges, Volume 6, Section 1, TD 27/05 – Cross-Sections and Headrooms

²⁷¹ Design Manual for Roads and Bridges, Volume 6, Section 2, TD 22/06 - Layout of Grade-Separated Junctions

10.2.14 There is, therefore, a balance to be reached regarding safety concerns at this offslip, between providing two lanes on the horizontal curve and queueing traffic backing up onto the M2 mainline with one lane on the slip road. This diverge slip road has a good safety record with only 4 slight accidents occurring in the five year period from 2011 to 2015. There is also an example of a similar two lane layout on the existing strategic road network, at the M6 Junction 5 in Stoke-on-Trent. It is reasonable to assume that the speed of traffic on the slip road would be slower than that on the M2 mainline, as the geometry of the right hand horizontal curve is such that a safe speed to negotiate it is approximately 40mph. There would therefore be a higher safety risk associated with queueing back onto the M2 mainline; and appropriate mitigation measure could be included within the two lane layout, such as a higher standard diverge layout and improved traffic signs and road markings. Therefore, two lanes on this diverge slip road is considered to be a viable variant.

Figure 10-1 Cross-Section Dimensions for Rural Connector Roads



10.2.15 Option 4H1 as shown in the Options Log in **Appendix B-1**, includes the two lane variant for the M2 eastbound offslip. How this Option 4H1 compares with Option 4 and Option 12A, in terms of operational, economic and environmental impact terms, is discussed later in this Section 10.

10.2.16 Should Option 4H1 with a 2 lane provision on the M2 eastbound off slip go forward into PCF²⁷² Stage 3 as the preferred option, a DMRB GD04²⁷³ risk assessment should be undertaken to assist in the decision making regarding appropriate mitigation measure to be adopted to reduce risks related with this layout, including whether a larger diverge (i.e. Type B – ghost island with 2 lanes) should be provided and whether this could be provided via a discontinued hard shoulder.

²⁷² PCF - Project Control Framework

²⁷³ Design Manual for Roads and Bridges, Volume 0, Section 2, GD 04/12 – Standard for Safety Risk Assessment on the Strategic Road Network

OAD STREET LINK

10.2.17 The Oad Street Link alignment Option B, to the south of Whipstakes Farm, as included in Option 12A(B) in the Options Log in **Appendix B-1**, was the layout included in Option 12A at the PCF²⁷⁴ Stage 2 public consultation. This layout was based on maintaining the existing speed limit regime along Oad Street and providing a direct, free-flow connection into the M2 Junction 5 roundabout. As part of the value management review, to reduce the cost of Option 4 and address rat-running, environmental impact and safety concerns raised during the public consultation, these constraints were relaxed and further options identified for the Oad Street Link. The options considered are discussed below and can be seen in the Options Log in **Appendix B-1** as variations of Option 12A.

- Option E– PCF Stage 2 Oad Street Link alignment; as shown in Option 12A(E) in the Options Log. Oad Street connected to the M2 Junction 5 roundabout via a proposed two-way link adjacent to the A249 at the southern end of Oad Street. This option proposes a speed limit of 30mph, from Stockbury Roundabout to the Maidstone Road Link / Oad Street junction, which would require agreement with Kent County Council. The option would cost less than Option B, due to the reduced length of new road, reduced earthworks volumes and no bridge being required, and would have less impact on the Kent Downs AONB²⁷⁵ and Whipstakes Farm. It is also considered that this option would be less attractive to rat-running by strategic traffic, due to the indirect connection to the M2 Junction 5 roundabout and the application of the speed limit on Oad Street. This Oad Street Link option includes a two-step relaxation for horizontal curvature to TD9/93²⁷⁶.
- Option F - PCF Stage 2 Oad Street Link alignment; as shown in Option 12A(F) in the Options Log; Oad Street connected to the M2 Junction 5 roundabout via a proposed one-way link adjacent to the M2 westbound off slip, for traffic wanting to enter onto the roundabout from Oad Street, and a left-turn only from the A249 southbound carriageway south of the roundabout, for traffic wanting access onto Oad Street. This option was rejected primarily because: it would need to be signal-controlled adding an additional green light phase to the traffic signals at the roundabout for Option 12A thereby reducing the available capacity for the strategic traffic at the roundabout; it is an unusual layout with higher safety risks; and it may have a direct impact on Ancient Woodland.
- Option G - PCF Stage 2 Oad Street Link alignment; as shown in Option 12A(G) in the Options Log; Oad Street connected to the A249 to the south of the M2 Junction 5 roundabout via: a proposed link parallel to the A249; a bridge over the A249; and left in and out provisions to both the northbound and southbound A249 carriageways. This Option would improve the connectivity between the villages of Stockbury and Oad Street by providing a direct, local road connection, and would improve the connection between Stockbury village and the A249. This option was discounted primarily as: it would be more expensive than Options B, E and F, due to the significantly longer sections of off-line, new road and the structure over the A249; and it is considered to be outside the scope of the project objectives.

10.2.18 Oad Street Link Option E was identified to be the optimum option for this link, taking into account the project objectives and affordability, and as such was included within Options 4, 12A and 4H1. Please refer to Options 4 (revised local roads), 4H1 and 12A(E) in the Options Log in **Appendix B-1**.

²⁷⁴ PCF - Project Control Framework

²⁷⁵ AONB - Area of Outstanding Natural Beauty

²⁷⁶ Design Manual for Roads and Bridges, Volume 6, Section 1, TD 9/93 – Highway Link Design

MAIDSTONE ROAD LINK

10.2.19 Options 4, 12 and 12A, as shown at the PCF²⁷⁷ Stage 2 public consultation, showed Maidstone Road being severed from the M2 Junction roundabout with a Maidstone Road Link to connect Maidstone Road to Oad Street routed adjacent and parallel to the M2, as can be seen in Options 4, 12 and 12A(B) in the Options Log in **Appendix B-1**. As part of the value management review, to reduce the cost of Option 4 and address rat-running, environmental impact and safety concerns raised during the public consultation, further options were identified for the Maidstone Road Link. The options considered are discussed below and can be seen in the Options Log in **Appendix B-1**.

- Sever Maidstone Road from Stockbury Roundabout and provide a one-way link to the A249 southbound carriageway on the immediate approach to the M2 Junction 5 roundabout. PCF Stage 2 Maidstone Road Link revised to connect to the A249 southbound carriageway as shown in Option 12A(H) in the Options Log. This option was rejected:- on the grounds of safety because the merge onto the A249 would only leave 200metres of weaving length, which is well below the standard of 1km identified within TD22/06²⁷⁸; and because it would only provide connectivity for southbound traffic from Chestnut Street / Maidstone Road, northbound traffic from M2 Junction 5 wishing to go to Chestnut Street or Maidstone Road would need to go via the A2 / A249 Key Street Junction. The option introduces a local road free-flow link onto the A249, which will impact on the safety and capacity of the strategic road network. It was also considered that this option would encourage rat-running by strategic traffic, given that the A2 and the Key Street junction already suffer from peak congestion issues.
- Sever Maidstone Road from Stockbury Roundabout and provide a one-way link to the A249 southbound carriageway between the A2/A249 Key Street Junction and the M2 Junction 5 roundabout. PCF Stage 2 Maidstone Road Link revised to connect to the A249 southbound carriageway as shown in Option 12A(I) in the Options Log. This option was rejected:- because of the sub-standard weaving lengths resulting from the close proximity of the A2/A249 Key Street Junction and the M2 Junction roundabout (refer to Section 4.3); and because it would only provide connectivity for southbound traffic from Chestnut Street / Maidstone Road, northbound traffic from M2 Junction 5 wishing to go to Chestnut Street or Maidstone Road would need to go via the A2 / A249 Key Street Junction. The option introduces a local road free-flow link onto the A249, which will impact on the safety and capacity of the strategic road network. It was also considered that this option would encourage rat-running by strategic traffic on local roads, given that the A2 and the Key Street junction already suffer from peak congestion issues.
- Sever Maidstone Road from Stockbury Roundabout and provide a link to Oad Street, routed along Woodgate Lane (BOAT²⁷⁹ ZR73 – please refer to **Section 1.10**). PCF Stage 2 Maidstone Road Link revised northwards as shown in Option 12A(J) in the Options Log. This option was rejected because the width and horizontal alignment of sections of Woodgate Lane are inadequate even for a road with a 30mph speed limit. To upgrade Woodgate Lane to an appropriate standard would impact on the properties fronting onto this lane and the length of the link would be longer than the links shown in Options 12A(B) and 12A(E). As such, it is considered that upgrading Woodgate Lane would cost more than other options identified and would have a greater impact on people and property.

²⁷⁷ PCF - Project Control Framework

²⁷⁸ Design Manual for Roads and Bridges, Volume 6, Section 2, TD 22/06 - Layout of Grade-Separated Junctions

²⁷⁹ BOAT - Byway Open to All Traffic

- Sever Maidstone Road from Stockbury Roundabout and provide a link to Oad Street, parallel to the M2 and connecting to Oad Street on the horizontal curve to the north of the Oad Street bridge over the M2. PCF Stage 2 Maidstone Road Link revised northwards as shown in Option 4H1 in the Options Log. The location for the Maidstone Road Link / Oad Street junction in this option has improved sight lines for traffic exiting from the Maidstone Road Link onto Oad Street. The option complies with current visibility design standards, as per TD42/95²⁸⁰; it does however, still require a two-step relaxation (refer to TD9/93²⁸¹) for the horizontal curve at the western end of the Maidstone Link, where the link connects into the existing Maidstone Road alignment. This option was considered to be the optimum solution for Maidstone Road, taking into account the project objectives and affordability.
- Sever Maidstone Road from Stockbury Roundabout without providing a link to Oad Street. PCF Stage 2 Maidstone Road revised to be a cul-de-sac as shown in Option 4H2 in the Options Log. A proposed Maidstone Road cul-de-sac with turning head, refer to Option 4H2 in the Options Log. This option was rejected primarily because the likely impact on the local community. Local traffic wishing to access M2 Junction 5 would need to re-route via the A2 / A249 Key Street Junction that already suffers from peak congestion issues and for which there are currently no committed improvements schemes included within the Swale Local Plan. The operational assessment predicted that there would be a significant loss of benefits associated with this. There would also be loss of connectivity between local villages, and bus operators would need to find alternative routes for some of their services.

10.2.20 Maidstone Road Link revised northwards to connect to Oad Street on the horizontal curve to the north of the Oad Street bridge over the M2 was identified to be the optimum option for this link, taking into account the project objectives and affordability. As such it was to be included within Options 4, 12A and 4H1. Please refer to Options 4 (revised local roads), 4H1 and 12A(E) in the Options Log in **Appendix B-1**.

SUMMARY

10.2.21 The conclusion from the value management review was that:-

- Option 4H1, a hybrid, reduced cost version of Option 4, was identified, which includes revised layouts for the Maidstone Road and Oad Street Links and a revised layout for the M2 eastbound to A249 traffic flow. This option also generally reduces the impact on the surrounding environment.
- Rat running along Maidstone Road and Oad Street has been made less attractive by changes to the Oad Street Link. These changes comprise a less direct route along local roads to the M2 Junction 5 roundabout and applying a speed limit from the M2 Junction 5 roundabout to the Maidstone Road Link / Oad Street junction. If connectivity to M2 Junction 5 for local traffic is to be maintained, then it is not feasible within the scope of this project to prevent rat running from occurring.
- The Oad Street Link has been revised to reduce both its impact on the surrounding environment and to reduce costs.
- The Maidstone Road Link has been revised to address safety issues at the Maidstone Road Link / Oad Street junction.

²⁸⁰ Design Manual for Roads and Bridges, Volume 6, Section 2, TD 42/95 – Geometric Design of Major / Minor Priority Junctions

²⁸¹ Design Manual for Roads and Bridges, Volume 6, Section 1, TD 9/93 – Highway Link Design

10.2.22 There are therefore, three options to be assessed in terms of their cost, operational performance with respect to achieving the project objectives and likely environmental impact as listed below, please also refer to the Option Log in **Appendix B-1** and **Appendix J-1** for General Arrangement drawings.

- Option 4 (revised local roads), referred to hereafter in this report as Option 4;
- Option 4H1;
- Option 12A(E) referred to hereafter in this report as Option 12A.

ESTIMATION OF COSTS

10.2.23 The Options Estimates in **Table 10-1** below were produced by the Highways England Commercial Team in December 2017, and are to a base financial year of 2016, Quarter 1. More details are shown in **Appendix J-2**. These estimate supersede those produced in October 2017 (please refer to **Table 5-26**) and were based on the revisions to the options as described earlier in this section.

Table 10-1 PCF 2 Final Option Estimates Ranges (2016 Base Year)

| Option | P10 | Most Likely | P90 |
|--------|------------|-------------|-------------|
| 4 | £70million | £98million | £150million |
| 4H1 | £62million | £87million | £133million |
| 12A | £43million | £60million | £94million |

10.2.24 These PCF²⁸² Stage 2 Final Options Estimates ranges show that:

- The three point range estimates for Option 12A are within the RIS 1²⁸³ budget range and the Most Likely estimate is below the capital baseline funding allocation. Options 12A is therefore considered affordable;
- The Option 4H1 P90 estimate exceeds the RIS 1 budget range and the Most Likely estimate exceeds the capital baseline funding allocation. Option 4H1 is therefore not considered affordable. For this option to be chosen as the preferred option either the capital baseline funding allocation would need to be revised and/or additional funding would need to be found from another source;
- The Option 4 P90 estimate exceeds the RIS 1 funding range and the Most Likely estimate exceeds the capital baseline funding allocation. Option 4 is therefore not considered affordable. It is also more expensive than Option 4H1.

²⁸² PCF – Project Control Framework

²⁸³ Road Investment Strategy: for the 2015/16 – 2019/20 Road Period, Department for Transport, March 2015

10.3 OPERATIONAL AND ECONOMIC ASSESSMENT: OPTIONS 4, 4H1 AND 12A

TRAFFIC MODELLING

10.3.1 Options 4, 4H1 and 12A were modelled in the M2 Junction 5 model with VDM²⁸⁴. The traffic modelling assessment results are presented below for the key metric listed below.

- Total number of vehicles served;
- Queuing/volume to capacity;
- Key Journey times;
- Highway Safety;
- Benefits.

TOTAL NUMBER OF VEHICLES SERVED

10.3.2 Using a metric of total number of vehicles served, which indicate the junction's vehicle throughout, it can be seen that the total flows through M2 Junction 5 increase by over 1,200 vehicles per hour in the 2041 PM peak with Option 4 and 4H1 against the Reference Case. This is up to 140 vehicles more per hour for Option 4 and 4H1 than Option 12A, equating to almost 215,000 additional AM and PM peak period vehicle movements for Option 4 in 2021 and 145,000 additional AM and PM peak period vehicle movements for Option 4H1 in 2021. Whilst the table below indicates Option 4H1 performs less well during the AM peak period it should be noted that the option does not have the M2 westbound to A249 northbound off-line free flow link and thus offers less capacity for that key movement compared to Option 12A.

Table 10-2 Total Junction Flows

| Forecast Year | AM Peak | | | | Interpeak | | | | PM Peak | | | |
|---------------|---------|--------|---------|---------|-----------|--------|---------|---------|---------|--------|---------|---------|
| | Ref | Opt 4 | Opt 12A | Opt 4H1 | Ref | Opt 4 | Opt 12A | Opt 4H1 | Ref | Opt 4 | Opt 12A | Opt 4H1 |
| 2021 | 10,334 | 10,955 | 10,814 | 10,957 | 8,467 | 8,939 | 8,821 | 8,841 | 11,148 | 11,660 | 11,529 | 11,570 |
| 2031 | 11,234 | 12,328 | 12,297 | 12,274 | 9,450 | 10,273 | 10,204 | 10,223 | 11,609 | 12,598 | 12,472 | 12,536 |
| 2036 | 11,658 | 12,569 | 12,643 | 12,538 | 9,743 | 10,735 | 10,683 | 10,690 | 11,670 | 12,822 | 12,683 | 12,764 |
| 2041 | 11,732 | 12,709 | 12,795 | 12,671 | 9,911 | 11,068 | 11,002 | 11,014 | 11,655 | 12,888 | 12,802 | 12,918 |

²⁸⁴ VDM – Variable Demand Modelling

10.3.3 The results therefore indicate that Options 4 and 4H1 accommodate the highest increase of junction throughput, largely due to the grade separated provision for the A249 through movements.

QUEUEING / VOLUME TO CAPACITY

10.3.4 The Reference Case shows significant (> 250 vehicle) queues on the A249 southbound with all options showing significant reductions of this queue.

10.3.5 All options show no or limited queuing in year of opening with selected movements showing queueing due to wider network congestion; small queues (<30 vehicles) are indicated on the M2 westbound on-slip due to M2 mainline congestion.

10.3.6 In the Core Scenario all options are likely to operate close to / within theoretical capacity up to 2036 / 2041 for key movements.

10.3.7 In the Alternative Scenario all options are likely to operate close to / within theoretical capacity up to 2031 / 2036 for key movements with certain key movements exceeding capacity in 2041.

10.3.8 The maximum level of queuing predicted in the Alternative Scenario for Option 4 is approximately 55 vehicles on the Oad Street Link to the M2 Junction 5 roundabout, followed by movements on to the M2 eastbound carriageway (approximately 30) and westbound carriageway (approximately 49). Option 12A indicates a similar level of queuing. For Option 4H1 a similar level of queuing is seen in the early modelled years, however by 2041, a 90 vehicle queue is seen on the Oad Street Link during the AM Peak, with the PM Peak being similar to Options 4 and 12A.

10.3.9 Overall the results indicate all options would see less queuing and congestion compared against the Reference Case in all scenarios and forecast years. Whilst Option 4 indicates significantly less queueing and congestion than Option 12A for the key movements. Option 4H1 indicates similar results to Option 4.

10.3.10 For example Option 4H1 indicates a queue of 33 vehicles on the A249 southbound to M2 westbound free flow link in the 2041 PM peak hour, however Option 12A shows 44 AM and 18 PM vehicles in each peak hour. Confirming that Option 4H1 would operate with significantly less queuing than Option 12A.

KEY JOURNEY TIMES

10.3.11 Overall journey time savings are highest in Options 4 and 4H1 with particular improvements on the A249 southbound through route and A249 southbound to M2 westbound route.

10.3.12 Journey times for the A249 southbound through route from Sittingbourne (A2) to Maidstone (M20 Junction 7) would decrease by 7 minutes in Option 4, almost 1 minute faster than Option 12A on average in the AM peak period. This equates to approximately 56% improvement for Options 4 and 4H1 with a 46% improvement for Option 12A.

10.3.13 Journey times for another key movement, the A249 southbound to M2 westbound to London would decrease by between 4 and 5 minutes, with Options 4 and 4H1 demonstrating the greatest savings – approximately 30% reduction in journey time with Option 4H1 compared to 25% with Option 12A in the AM Peak period for the 2041 Core Scenario.

10.3.14 During the 2041 PM peak period, journey time reductions of approximately 28-30% are seen on the A249 south to north through movement for Option 4 and Option 4H1. With Option 12A, this saving is typically 4% lower, due to the signalisation of the through movement. This picture is seen in both the Core and Alternative Scenarios.

HIGHWAY SAFETY

10.3.15 Options 4 and 4H1 both provide almost £30million more accident saving benefits in the Alternative Scenario than Option 12A, this equates to a collision saving of more than five times that saved with Option 12A. Options 4 and 4H1 accident savings both equate to a reduction of approximately 1,200 collisions, whilst Option 12A sees a reduction of approximately 230, some 80% less than Option 4 and 4H1 in the Alternative Scenario.

10.3.16 Whilst Option 12A provides good accident savings, Options 4 and 4H1 removes the A249 mainline from the junction and thus reduces the number of vehicles potentially in conflict with each other.

10.3.17 The table below indicates the collision and casualty savings following the COBALT²⁸⁵ analysis:

Table 10-3 Collision and Casualty Savings

| Scenario | | Core | | | Alternative | | |
|-------------------------|----------------|---------|---------|---------|-------------|---------|---------|
| Option | | Opt 4 | Opt 12A | Opt 4H1 | Opt 4 | Opt 12A | Opt 4H1 |
| Collisions | Saved | 1,074.0 | 346.0 | 1,029.5 | 1,172.3 | 232.0 | 1,222.4 |
| Casualties Saved | Fatal | 18.7 | 18.8 | 17.8 | 19.6 | 18.9 | 20.1 |
| | Serious | 127.9 | 90.9 | 120.8 | 137.1 | 83.9 | 143.6 |
| | Slight | 1,544.6 | 351.9 | 1,489.6 | 1,666.5 | 124.3 | 1,728.4 |

BENEFITS

10.3.18 **Table 10-4** and **Table 10-5** present the benefits for the Core and Alternative Scenarios for the revised options.

10.3.19 Option 4H1 provides the highest level of benefits in the Core Scenario, whilst Option 4 provides the highest level of benefits in the Alternative Scenario, up to £73million or 36% more than Option 12A.

10.3.20 In the Core Scenario Option 12A provides a slightly better BCR²⁸⁶ of 4.727 compared with Options 4 (3.748) and Option 4H1 (4.475).

10.3.21 In the Alternative Scenario Options 12A provides a better BCR of 5.079 compared to 4.246 for Option 4 and 4.112 for Option 4H1.

²⁸⁵ COBALT – Cost and Benefits to Accidents – Light Touch

²⁸⁶ BCR – Benefit to Cost Ratio

Table 10-4 Core Scenario Benefits (Revised Options)

| | Option 4 | Option 12A | Option 4H1 |
|--|---------------------|-------------------|-------------------|
| Noise | - | £32,997 | £48,207 |
| Local Air Quality | - | -£452,450 | -£692,481 |
| Greenhouse Gases | £834,000 | £2,098,000 | -£219,000 |
| Journey Quality | - | - | - |
| Physical Activity | - | - | - |
| Accidents | £53,044,300 | £31,751,000 | £50,526,200 |
| Economic Efficiency: Consumer Users (Commuting) | £53,049,000 | £41,016,000 | £62,605,000 |
| Economic Efficiency: Consumer Users (Other) | £24,677,000 | £18,758,000 | £30,505,000 |
| Economic Efficiency: Business Users and Providers | £111,939,000 | £92,494,000 | £116,699,000 |
| Wider Public Finances (Indirect Taxation Revenues) | £361,000 | £3,565,000 | -£1,367,000 |
| Present Value of Benefits (see notes) (PVB) | £243,904,300 | £189,262,547 | £258,104,926 |
| Broad Transport Budget | £65,070,000 | £40,036,000 | £57,683,000 |
| Present Value of Costs (see notes) (PVC) | £65,070,000 | £40,036,000 | £57,683,000 |
| OVERALL IMPACTS | | | |
| Net Present Value (NPV) | £178,834,300 | £149,226,547 | £200,421,926 |
| Benefit to Cost Ratio (BCR) | 3.748 | 4.727 | 4.475 |

Table 10-5 Alternative Scenario Benefits (Revised Options)

| | Option 4 | Option 12A | Option 4H1 |
|--|---------------------|---------------------|---------------------|
| Noise | - | - | - |
| Local Air Quality | - | - | - |
| Greenhouse Gases | -£2,329,000 | -£1,202,000 | -£3,663,000 |
| Journey Quality | - | - | - |
| Physical Activity | - | - | - |
| Accidents | £57,035,100 | £28,712,300 | £59,097,700 |
| Economic Efficiency: Consumer Users (Commuting) | £79,448,000 | £58,099,000 | £61,823,000 |
| Economic Efficiency: Consumer Users (Other) | £18,699,000 | £13,489,000 | £14,088,000 |
| Economic Efficiency: Business Users and Providers | £129,621,000 | £107,597,000 | £114,374,000 |
| Wider Public Finances (Indirect Taxation Revenues) | -£6,213,000 | -£3,346,000 | -£8,502,000 |
| Present Value of Benefits (see notes) (PVB) | £276,261,100 | £203,349,300 | £237,217,700 |
| Broad Transport Budget | £65,070,000 | £40,036,000 | £57,683,000 |
| Present Value of Costs (see notes) (PVC) | £65,070,000 | £40,036,000 | £57,683,000 |
| OVERALL IMPACTS | | | |
| Net Present Value (NPV) | £211,191,100 | £163,313,300 | £179,534,700 |
| Benefit to Cost Ratio (BCR) | 4.246 | 5.079 | 4.112 |

WIDER BENEFITS

- 10.3.22 The consultation feedback indicated that the public generally oppose Option 12A and support an option with a flyover, because it was perceived that it would offer a more strategic, long-term improvement for the wider stakeholders.
- 10.3.23 The journey time reliability associated with Options 4 and 4H1 would be greater due to the free-flowing A249 movement and reduction in traffic through the M2 Junction 5 roundabout.
- 10.3.24 Options 4 and 4H1 offer a more future proofed solutions because they offer a greater resilience compared with Option 12A.

SUMMARY OF OPERATIONAL PERFORMANCE

- 10.3.25 Options 4, 4H1 and 12A all provide a clear and positive benefit against the Reference Case.
- 10.3.26 Option 4 provides the highest level of benefits in the Alternative Scenario, followed by Option 4H1. However, Option 4H1 has the highest accident savings in the Alternative Scenario, followed closely by Option 4. The Alternative scenario BCR²⁸⁷ for Options 4 and 4H1 are similar, at 4.246 and 4.112 respectively. Option 4H1 is therefore considered to be a viable option in terms of operational performance consequently; Option 4 was discounted as it is significantly more expensive.
- 10.3.27 Due to its lower cost Option 12A has the best BCR²⁸⁸ in the Alternative Scenario, albeit the difference in BCRs is relatively small.
- 10.3.28 In the year of opening there will be no queueing in any of the options, except on select links with the queueing caused by the M2 mainline congestion.
- 10.3.29 In the Core Scenario all three options are likely to operate close to / within theoretical capacity up to 2036 / 2041 for key movements. Whilst in the Alternative Scenario all three options are likely to operate close to / within theoretical capacity up to 2031 / 2036 for key movements with certain key movements exceeding capacity in 2041.

²⁸⁷ BCR: Benefit to Cost Ratio

²⁸⁸ BCR – Benefit to Cost Ratio

10.4 ENVIRONMENTAL ASSESSMENT: OPTIONS 4, 4H1 AND 12A

- 10.4.1 An assessment of the likely environmental impacts of Option 4H1 and the revised version of Option 12A has been undertaken at PCF Stage 2. This is presented as an addendum²⁸⁹ to the main PCF Stage 2 Environmental Assessment Report.²⁹⁰ An assessment of the likely environmental impacts of the revised version of Option 4 has not been undertaken at PCF Stage 2 because it was considered the least likely of the revised options to be progressed to PCF Stage 3, and the impacts would be expected to be largely consistent with those identified for the pre-consultation version of Option 4. Option 4 is not discussed further from an environmental perspective in this section.
- 10.4.2 For clarity, it is noted that the Environmental Assessment Report Addendum refers to the revised version of Option 12A as “Revised Option 12A”. It refers to Option 4H1 as “Option 4H1”.
- 10.4.3 The environmental assessment presented in the Environmental Assessment Report Addendum is based on variable demand modelling traffic forecasting data (Core Scenario) (version 16). This data set was considered the best available Core Scenario data at the time of preparation of that report. It is noted that the main environmental assessment, presented in the main Environmental Assessment Report, is based on fixed demand modelling traffic forecasting data (Core Scenario) (as the best available data at the time of commencing the environmental assessment presented in that report). Therefore, direct comparisons should not be drawn between the environmental assessment for the revised version of Option 12A and Option 4H1 presented here, and the assessments of the options presented in Section 8. This is of relevance to Air Quality, Climate Change, Biodiversity, and Noise and Vibration.
- 10.4.4 The following sections present a summary of the environmental assessment contained in the Environmental Assessment Report Addendum and provide an overview of the key planning policy compliance issues for Option 12A and Option 4H1. They also provide an appraisal of likely compliance with the environmental objective for the scheme – “an improved environment.”
- 10.4.5 The following sections also present the results of a sensitivity test undertaken for Air Quality and data comparison undertaken for Noise and Vibration, which sought to provide a preliminary indication of the potential impacts using the variable demand modelling (Alternative Scenario) traffic forecasting data set (version 16) compared to the variable demand modelling (Core Scenario) traffic forecasting data set (version 16).
- 10.4.6 It is noted that both Option 4H1 and Option 12A have been screened as requiring statutory Environmental Impact Assessment as both are considered likely to result in significant adverse effects on the environment at this stage of assessment.

²⁸⁹ M2 Junction 5 Improvements Scheme Environmental Assessment Report Addendum, January 2018.

²⁹⁰ M2 Junction 5 Improvements Scheme Environmental Assessment Report, January 2018.

SUMMARY OF ENVIRONMENTAL ASSESSMENT

AIR QUALITY

10.4.7 Construction Impacts:

- During the construction phase, adverse impacts from dust and exhaust emissions could potentially occur at sensitive receptors within 200 metres of worksites. However, with appropriate mitigation, the risk of such impacts can be minimised. There are 68 properties within 200 metres of both Option 12A and Option 4H1.
- There are no designated ecological receptors within 200 metres and, therefore, significant adverse impacts on ecological receptors during construction are not anticipated.

10.4.8 Operational Impacts (Human Receptors):

- Nitrogen Dioxide and PM₁₀²⁹¹ concentrations have been predicted at 51 discrete human receptors in the opening year of 2021.
- Taking the results of the gap analysis²⁹² as the worst-case, the greatest increase in annual mean Nitrogen Dioxide concentration is 0.6 micrograms per cubic metre at receptor R22 on Dover Street, Sittingbourne (refer to Figure 5.2.5 accompanying the Main Environmental Assessment Report²⁹³) with Option 4H1. The magnitude of change is 'small'. This receptor also experiences a 'small' increase of 0.4 micrograms per cubic metre with Option 12A.
- Receptor R6 at the A2 More Street/High Street Junction, Rainham (refer to Figure 5.2.5 accompanying the Main Environmental Assessment Report) also has an increase in annual mean Nitrogen Dioxide of 0.6 micrograms per cubic metre with Option 4H1. The magnitude of change is 'small'. This receptor experiences an 'imperceptible' increase of 0.1 micrograms per cubic metre with Option 12A.
- With the gap analysis there are six receptors that experience exceedances of the criterion threshold for annual mean Nitrogen Dioxide; these are R1, R2, R3, R6, R22 and R24 (refer to Figure 5.2.1 accompanying the Main Environmental Assessment Report). These exceedances occur with the do minimum and do something Option 4H1 and Option 12A. Neither option gives rise to new exceedances.
- With gap-analysis the greatest reduction in concentration (beneficial impact) with the scheme occurs with Option 4H1 where there is a 'large' reduction of 7.4 micrograms per cubic metre at receptor R16 (refer to Figure 5.2.1 accompanying the Main Environmental Assessment Report), which is south of the M2 Junction 5. Option 12A also shows a 'large' decrease of 6.7 micrograms per cubic metre. These large reductions are due the junction options increasing the source to receptor distance by moving the road sources away and a reduction in traffic on the A249.
- Annual and 24-hour mean concentrations of PM₁₀ are compliant with the relevant criteria (refer to Table 5-1 of the Main Environmental Assessment Report) at all receptors with the do minimum and with Option 4H1 or Option 12A.
- None of the local air quality impacts determined for Option 4H1 and Option 12A will give rise to a significant effect. No significant operational health impacts as a result of increased concentrations of annual mean Nitrogen Dioxide at these receptors are considered likely at this stage.

²⁹¹ PM₁₀ - Particulate matter with a diameter of 10 micrometres or less.

²⁹² HA_Long-Term_Gap_Analysis_Calculator_v1-0_LTTE6, former Highways Agency, November 2013.

²⁹³ M2 Junction 5 Improvements Scheme Environmental Assessment Report, January 2018.

10.4.9 Operational Impacts (Compliance Risk):

- None of the predicted increases in concentrations at any of the receptors along pollution climate mapping links will give rise to a compliance risk with the EU limit value for annual mean Nitrogen Dioxide in 2015 (40 micrograms per cubic metre) with either of the junction options. In accordance with Interim Advice Note 175/13, the junction options are considered to be Low Risk in terms of compliance.

10.4.10 Operational Impacts (Designated Ecological Sites):

- In 2021, considering the results of the gap analysis²⁹⁴ as worst-case, Nitrogen Oxides concentrations above the annual mean critical level of 30 micrograms per cubic metre occur with and without the junction options at two transect receptors within the Wouldham to Detling Escarpment Site of Special Scientific Interest and North Downs Woodlands Special Area of Conservation (refer to Appendix A-2).
- The gap analysis indicates that Option 4H1 results in an exceedance of the annual mean critical level at 36 metres from the A249 centreline in Wouldham to Detling Escarpment Site of Special Scientific Interest and North Downs Woodlands Special Area of Conservation due to an increase in concentration of 0.5 micrograms per cubic metre, which cannot be discounted as imperceptible. Changes at closer distances also cannot be discounted as imperceptible. Beyond 46 metres all impacts are imperceptible and annual mean Nitrogen Oxides concentrations remain below the critical level. For Option 12A the concentrations increase by 0.9 micrograms per cubic metre at 16 metres compared to without the scheme, on the basis of the gap analysis. This change cannot be discounted as imperceptible. The change at 26 metres is 0.3 micrograms per cubic metre and less at points beyond this and, therefore, impacts beyond 26 metres can be discounted as imperceptible. The ecological impacts anticipated in association with these air quality impacts at this stage are discussed in section 10.4.4.
- The Nitrogen deposition rate in Wouldham to Detling Escarpment Site of Special Scientific Interest and North Downs Woodlands Special Area of Conservation without the scheme exceeds both the lower and upper critical loads at 16 metres from the A249 centreline, and the lower critical load only at 23 metres and 26 metres from the centreline. Option 4H1 would result in an increase at 16 metres of more than one percent of the lower critical load. The increases in nitrogen deposition rate for Option 12A at 16 metres is less than 1 percent of the lower critical load. The ecological impacts anticipated in association with these air quality impacts at this stage are discussed in section 10.4.4.
- At the other designated sites within the study area (refer to Appendix A-2) the annual mean Nitrogen Oxides concentrations in 2021 are well below the critical level and the impacts of Option 4H1 and Option 12A can be considered as very unlikely to give rise to a significant effect.

10.4.11 Operational Impacts (Regional Air Quality):

- In 2021, the differences in emissions for Option 4H1 and Option 12A compared to the do nothing scenario, are relatively small and no more than +0.9% for Nitrogen Oxides (with Option 12A), +1.2% for PM₁₀ (with Option 4H1) and +0.6% for Carbon Dioxide (both junction options).
- In 2041, the differences in emissions for Option 4H1 and Option 12A compared to the do nothing scenario are relatively small and no more than +1.6% for Nitrogen Oxides (both junction options), +2.1% for PM₁₀ (with Option 4H1) and +1.4% for Carbon Dioxide (both junction options).
- Overall, and in the long-term, the differences in regional emissions between the two junction options are likely to be marginal.

²⁹⁴ HA_Long-Term_Gap_Analysis_Calculator_v1-0_LTTE6, former Highways Agency, November 2013.

10.4.12 Operational Impacts (Variable Demand Modelling (Alternative Scenario) traffic forecasting data set (version 16) sensitivity test):

- The traffic flows derived from the variable demand (Alternative Scenario) traffic model (version 16) are generally slightly higher than for the variable demand (Core Scenario) traffic model (version 16). Consequently, the predicted concentrations are generally slightly higher. The results show that the impacts are not substantially different and do not contradict the findings of the assessment presented above.

CLIMATE CHANGE

10.4.13 Construction Impacts (Greenhouse Gas Emissions) – Option 4H1 would be expected to result in higher total greenhouse gas emissions during the construction phase than Option 12A. Based on the preliminary calculation undertaken for the purpose of PCF Stage 2, Option 4H1 would result in 5.6 kTCO₂e²⁹⁵ during the construction phase, while Option 12A would result in 3.6 kTCO₂e during the construction phase.

10.4.14 Operational Impacts (Greenhouse Gas Emissions) – Option 4H1 would be expected to result in slightly higher total greenhouse gas emissions operationally than Option 12A, at 5.6 kTCO₂e per year and 5.4 kTCO₂e per year, respectively. This would equate to 336 kTCO₂e and 325 kTCO₂e over the total design life of the scheme (2021-2080).

10.4.15 Climate Resilience – the design of the junction options is not sufficiently progressed to complete an assessment of their resilience to the effects of climate change at this stage.

CULTURAL HERITAGE

10.4.16 Option 4H1 and Option 12A require land-take across areas of undisturbed ground, within which a geophysical survey, walkover survey and intrusive evaluation have confirmed the presence of the below-ground archaeological remains that range from the Prehistoric to the Modern period. Significant findings include Mesolithic flint work, in addition to Upper Palaeolithic, Neolithic and Bronze Age assemblages. The remains of an Iron Age furnace were exposed in the north-west area of the M2 Junction 5 and earthworks associated with the Chatham Land Front World War I defences have been identified across the scheme area, with the most complex arrangement of associated features in the north-west area.

10.4.17 The Chatham Land Front World War I defence features are considered to hold National (High) importance and, therefore, the significance of impact would be very large adverse in the absence of mitigation. Other archaeological remains are considered to hold Local (Low) to Regional (Medium) importance and, therefore, the significance of effect would range from moderate to large adverse in the absence of mitigation. It is anticipated that a mitigation strategy can be developed to reduce the significance of this impact. The mitigation strategy is currently under discussion with the Principal Archaeological Officer at Kent County Council.

10.4.18 Option 4H1 and Option 12A have the potential to have a slight adverse impact upon the setting of Stockbury Castle (DKE19098), the Grade I Listed St Mary Magdalene's Church (MKE8527), the Grade II Listed Church Farmhouse and Church Farm Cottage (MKE29329), three Grade II Listed headstones (MKE28548, MKE28905 and MKE28904) and one Grade II Listed table tomb (MKE29482). It may be possible to mitigate this potential impact to some degree. The mitigation strategy will be developed in consultation with Historic England. However, a residual impact of slight adverse significance is anticipated.

10.4.19 Option 4H1 and Option 12A are considered likely to have a moderate adverse impact (significant) upon the Chatham Land Front World War I defence landscape in the absence of mitigation due to the interruption of a key view southwards. Mitigation could be implemented to reduce the level of impact on the setting of the historical landscape to slight adverse. However, if appropriate mitigation cannot be achieved, the impact on setting would remain

²⁹⁵ kTCO₂e – kilo tonnes of carbon dioxide equivalents.

moderate adverse. The mitigation strategy for setting will be devised in consultation with Historic England at PCF Stage 3.

10.4.20 There may be opportunities to develop measures to enhance the setting of the above cultural heritage assets and historic landscape as the scheme develops. These potential opportunities will be explored with Historic England.

LANDSCAPE

10.4.21 Construction Impacts –From a landscape perspective, the construction phase will necessitate the removal of existing landscape elements including existing roadside planting. The scheme will introduce temporary stock pile mounds beyond that of the operational footprint of the scheme, along with temporary site compounds. From a visual perspective, Option 4H1 and Option 12A would result in up to moderate adverse and significant impacts to visual receptors during construction.

10.4.22 Operational Impacts (Option 4H1) –

- Landscape: Option 4H1 would not quite be in keeping with the character of the immediate landscape and would include noticeable new features; however, due to the scale of the proposed alteration in context with existing transport infrastructure, the magnitude of impact would be considered to be no greater than minor. At Year of Opening, the predicted effect on the high sensitivity Kent Downs AONB and all three County level LCAs would be slight adverse. During the operational phase of Option 4H1, roadside screen planting will establish and serve to screen vehicle movement along the A249. Permanent effects would remain in the form of the new raised road embankment and retaining structures that cannot be easily screened due to their proximity to the carriageway. The magnitude of impact at the Design Year is considered to remain minor and adverse, resulting in a slight adverse effect.

10.4.23 Visual: Option 4H1 would result in up to moderate adverse and significant visual effects at Year of Opening. These would generally reduce to slight adverse (worst case scenario) at Design Year. Operational Impacts (Option 12A) –

- Landscape: Option 12A would not quite be in keeping with the character of the immediate landscape and would include noticeable new features; however due to the scale of the proposed alteration in context with existing transport infrastructure the magnitude of impact would be considered to be no greater than minor. At Year of Opening, the predicted effect on the high sensitivity Kent Downs AONB and all three County level LCAs would be slight adverse. During the operational phase of Option 12A, at Design Year, and on the establishment and integration of roadside mitigation planting, the predicted effect is considered to be neutral.
- Visual: Option 12A would result in up to moderate adverse and significant visual effects at Year of Opening. These would reduce to slight adverse at Design Year.

10.4.24 In summary, Option 10 and Option 12A are ranked equally as preferred options from a landscape perspective. Option 12A is preferred from a visual perspective.

BIODIVERSITY

10.4.25 Impacts to Designated Sites:

- Option 4H1 and Option 12A have the potential to result in adverse effects on the North Downs Woodlands Special Area of Conservation through nitrogen deposition increases associated with traffic volume changes on the affected road network. As a Natura 2000 site, it is of international importance.
- Option 4H1 could result in air quality impacts at both 16 metres and 36 metres into the site from the affected road network (specifically traffic along the A249 to the south of the junction), with the nitrogen oxide concentrations at these two locations above the annual

mean critical level of 30 micrograms per cubic metre. While Nitrogen deposition concentrations already exceed the lower critical load of five kilograms per hectare at 16 metres from the affected road network, Option 4H1 will result in an increase in these concentrations of more than 1.5%. These effects cannot be discounted as imperceptible based on current assessments. The increase in nitrogen oxide concentration would lead to deposition of nitrogen that, when compared to reference data on the response of habitats to nitrogen deposition,²⁹⁶ falls below the threshold at which the most nitrogen sensitive habitat types in the UK lose one species due to the increased nutrient load. Thus it would not be expected that North Downs Woodland Special Area of Conservation would lose any plant species due to deposition of nitrogen, and thus would not receive significant adverse effects due to the impacts of air quality change from traffic changes on the Affected Road Network. Therefore it is concluded that effects will not be significant.

- Revised Option 12A could result in air quality impacts at both 16 metres into the site from the affected road network (specifically traffic along the A249 to the south of the junction), with the nitrogen oxide concentrations at this location above the annual mean critical level. Therefore, effects cannot be discounted as imperceptible based on current assessments. The concentrations at 36 metres and further into the site can be discounted as imperceptible. Revised Option 12A will result in increased in Nitrogen deposition concentrations of less than 1% of the lower critical load of five kilograms per hectare at all locations. The increase in nitrogen oxide concentration would lead to deposition of nitrogen that, when compared to reference data on the response of habitats to nitrogen deposition,²⁹⁷ falls below the threshold at which the most nitrogen sensitive habitat types in the UK lose one species due to the increased nutrient load. Thus it would not be expected that North Downs Woodland Special Area of Conservation would lose any plant species due to deposition of nitrogen, and thus would not receive significant adverse effects due to the impacts of air quality change from traffic changes on the Affected Road Network associated with Revised Option 12A. Therefore it is concluded that effects will not be significant.

10.4.26 Impacts to Habitats:

- Ancient Woodland – Option 4H1 and Option 12A do not result in the direct loss of Ancient Woodland, however a section of broadleaved woodland adjacent to Chestnut Wood would be lost in both cases. Option 4H1 would result in a lesser impact upon this habitat type than Option 12A however as the adjacent broadleaved woodland supports Ancient Woodland both could lead to indirect adverse effects of very large significance. However, it is anticipated that mitigation and management measures could be developed and implemented to reduce the adverse impact such that it is not significant. Similar to the pre-consultation junction options, there is potential for indirect impacts as a result of deterioration in air quality and root compaction during construction. This would result in a permanent adverse effect of very large significance. However, as the scheme progresses it is expected that construction management measures could be developed and implemented to avoid and mitigated these potential effects such that they are not significant.
- Semi-Natural Broadleaved Woodland - Option 4H1 and Option 12A would result in a small loss of semi-natural woodland, which would constitute a slight adverse impact.
- Broadleaved Plantation Woodland - Option 4H1 and Option 12A would result in the permanent loss of small and narrow areas of broadleaved plantation woodland, which would constitute a slight adverse effect.
- Mixed Plantation Woodland - Option 4H1 and Option 12A are not anticipated to affect mixed plantation woodland.
- Hedgerows – Option 4H1 and Option 12A are likely to result in the loss of hedgerow habitat. Option 12A is likely to result in a greater loss of hedgerow habitat than Option

²⁹⁶ Assessing the effects of small increments of atmospheric nitrogen deposition (above the critical load) on semi-natural habitats of conservation importance (NECR210). Caporn, S. et al, 2016. Peterborough: Natural England.

²⁹⁷ Ibid.

4H1. Construction of either junction option is likely to result in an adverse impact of moderate significance, however there may be an opportunity to offset this effect to some extent through planting of replacement hedgerows.

- Buildings and Hardstanding - Option 4H1 and Option 12A would not result in the loss of any buildings. Hardstanding is a habitat of negligible ecological importance and any small areas affected by the junction options would only lead to impacts on wildlife that are of neutral significance. Option 4H1 and Option 12A have the potential to result in indirect impacts on buildings that have potential for bats; however, further survey at PCF²⁹⁸ Stage 3 is required to determine the likelihood and extent of such impacts.

10.4.27 Biodiversity Net Gain Preliminary Baseline Calculation - The results of the biodiversity net gain preliminary baseline calculation show that Option 4H1 has a lesser impact on biodiversity than Option 12A. Impacts to Protected and Notable Species:

- Invertebrates - As neither Option 4H1 nor Option 12A results in direct loss of Ancient Woodland, no direct adverse impacts on protected or notable invertebrate species in Church Wood and Chestnut Wood are anticipated.
- Reptiles – Option 12A and Option 4H1 could result in the permanent loss of habitats that are potentially utilised by reptiles for basking, commuting, foraging and hibernating. Habitat identified as having the highest potential importance for reptiles is the parcel of grassland and scrub directly north of the M2 carriageway between the A249 and Maidstone Road. At the time of writing, the presence of common lizard and slow worm has been confirmed, with survey data analysis ongoing as part of advanced PCF²⁹⁹ Stage 3. Option 4H1 would result partial loss of this parcel of grassland. Option 12A would not result in the loss of any of this parcel of grassland. At this stage, Option 12A and Option 4H1 are expected to result in a slight adverse effect on reptiles. This conclusion should be verified at PCF Stage 3.
- Breeding Birds - The effects of Option 4H1 and Option 12A on breeding birds are expected to be of slight adverse significance at this stage. This conclusion should be verified at PCF Stage 3.
- Bats – Option 4H1 and Option 12A have the potential to result in significant adverse effects to bats. However, with appropriate mitigation and management it is expected that any adverse effect could be reduced such that it is not significant. Further consideration will be given to bats as part of PCF Stage 3 in light of the advanced PCF Stage 3 survey data and reporting.
- Dormice - Option 4H1 and Option 12A have the potential to result in significant adverse effects to dormice. However, with appropriate mitigation and management it is expected that any adverse effect could be reduced such that it is not significant. Further consideration will be given to dormice as part of PCF Stage 3 in light of the advanced PCF Stage 3 survey data and reporting.
- Badgers - Option 4H1 and Option 12A would likely result in the permanent loss of woodland, scrub and hedgerow habitats that are likely to be used by badgers for foraging and commuting. However, at the time of writing, no badger setts have been identified within the area that will be lost as a result of either junction option. Additionally, Option 4H1 and Option 12A are not anticipated to result in indirect disturbance to badger setts given the absence of setts within 30 metres of these junction options. One badger clan was found to be inhabiting Church Wood and its surrounding broadleaved woodland. However, as neither option would affect this woodland Option 4H1 and Option 12A are unlikely to result in any significant adverse effect to the badger clan's territory. This conclusion should be verified at PCF Stage 3.

GEOLOGY AND SOILS

10.4.28 The assessment of the likely Geology and Soils effects associated with Option 4H1 and Option 12A is consistent with the summary presented in Section 8.8 of this report.

²⁹⁸ PCF – Project Control Framework.

²⁹⁹ PCF – Project Control Framework

MATERIALS

10.4.29 In the absence of detailed construction information at this stage of the scheme, the assessments of effects from materials consumption and site arisings are based on cut and fill balances for each of the options.

10.4.30 Materials - After mitigation measures have been applied, the significance of effect from materials consumption for Option 4H1 and Option 12A is likely to be moderate adverse.

10.4.31 Site Arisings – Option 12A is likely to have a moderate or large beneficial effect from site arisings after mitigation and enhancement measures have been applied, while Option 4H1 is likely to have a very large beneficial impact from site arisings after the application of mitigation and enhancement measures.

10.4.32 Waste to Landfill - After mitigation, the significance of effect on inert landfill capacity is likely to be neutral for Option 12A and Option 4H1, while the significance of effect on non-inert waste landfill capacity is expected to be neutral or slight adverse.

NOISE AND VIBRATION

10.4.33 Construction Impacts –

- It is expected that the noise and vibration impacts as a result of the construction phase are likely to be classified as moderate or major for Option 4H1 and Option 12A. Dwellings potentially affected would be those located immediately south of Sittingbourne Road, to the south of the junction, and north of Maidstone Road, to the north of the junction. Once mitigation is implemented, including Best Practicable Measures, it is likely that the noise impact arising from construction will be minor to moderate adverse.

10.4.34 Operational Impacts (Option 4H1) –

- The short term operational impacts of Option 4H1 in the opening year of 2021, based on variable demand modelling (Core Scenario) traffic forecasting data (version 16) and in the absence of mitigation are presented in **Table 10-6**.

Table 10-6 Option 4H1 Short-term (Opening Year 2021) Traffic Noise Reporting Table

| Impact; change in noise level | | | Daytime L _{A10,18h} (0600-0000hrs) | | Noise Important Areas |
|---|------------|-----------|---|-------------------------------------|------------------------|
| | | | Number of Dwellings | Number of other sensitive receptors | |
| Adverse; Increase in noise level, dB | Negligible | 0.1 - 0.9 | 159 | 1 | 4574,12242, 4576, 4577 |
| | Minor | 1 - 2.9 | 11 | 0 | |
| | Moderate | 3 - 4.9 | 4 | 0 | |
| | Major | 5 + | 2 | 0 | |
| No Change | | 0 | 9 | 0 | |
| Beneficial; Decrease in noise level, dB | Negligible | 0.1 - 0.9 | 13 | 1 | |
| | Minor | 1 - 2.9 | 4 | 0 | |
| | Moderate | 3 - 4.9 | 0 | 0 | |
| | Major | 5 + | 6 | 0 | |

| | | | | | |
|--------|--|--|-----|---|--|
| Totals | | | 208 | 2 | |
|--------|--|--|-----|---|--|

10.4.35 The long term operational impacts of Option 4H1 for the years 2021 to 2041, based on variable demand modelling (Core Scenario) traffic forecasting data (version 16) and in the absence of mitigation are presented in **Table 10-7**.

Table 10-7 Option 4H1 Long term (Years 2021 – 2041) Traffic Noise Reporting Table

| Impact; change in noise level | | | Daytime L _{A10,18h} (0600-0000hrs) | | Night-time L _{night} (2300-0700hrs) | Noise Important Areas |
|---|------------|-----------|---|-------------------------------------|--|-------------------------|
| | | | Number of Dwellings | Number of other sensitive receptors | Number of dwellings (≥55 dB only) | |
| Adverse; Increase in noise level, dB | Negligible | 0.1 - 2.9 | 187 | 2 | 62 | 4574, 12242, 4576, 4577 |
| | Minor | 3 - 4.9 | 4 | 0 | 3 | |
| | Moderate | 5 - 9.9 | 4 | 0 | 0 | |
| | Major | 10 + | 0 | 0 | 0 | |
| No Change | | 0 | 2 | 0 | 0 | |
| Beneficial; Decrease in noise level, dB | Negligible | 0.1 - 2.9 | 5 | 0 | 1 | |
| | Minor | 3 - 4.9 | 0 | 0 | 0 | |
| | Moderate | 5 - 9.9 | 2 | 0 | 2 | |
| | Major | 10 + | 4 | 0 | 4 | 4575 |
| Totals | | | 208 | 1 | 72 | |

10.4.36 For Option 4H1, **Tables 10-6** and **10-7** demonstrate that most receptors would be subject to a negligible impact and that there would be two noise sensitive receptors subject to a major adverse impact, during short term only. This is likely to occur at properties on Maidstone Road, east of the A249. Impacts during the long term will be mostly negligible, with four dwellings experiencing a moderate adverse impact, and two dwellings experiencing a moderate beneficial impact. The installation of a noise barrier in the correct location (i.e. along the edge of the westbound A249 carriageway to the north of the M2) would typically reduce the noise levels by approximately 10 dB. Therefore, all major increases in the short term would fall to moderate short term and all moderate long term increase would fall to minor. With mitigation, it is likely that there would be no sensitive receptors with a significant effect in the long term.

10.4.37 At the same time, results show that there could be a major beneficial impact, reduction in noise levels, at six properties south of the A249 and west of the M2 Junction 5, during the short term.

10.4.38 Operational Impacts (Option 12A):

- The short term operational impacts of Option 12A in the opening year of 2021, based on variable demand modelling (Core Scenario) traffic forecasting data (version 16) and in the absence of mitigation are presented in Table 10-8.

Table 10-8 Option 12A Short-term (Opening Year 2021) Traffic Noise Reporting Table

| Impact; change in noise level | | | Daytime L _{A10,18h} (0600-0000hrs) | | Noise Important Areas |
|---|------------|-----------|---|-------------------------------------|-------------------------|
| | | | Number of Dwellings | Number of other sensitive receptors | |
| Adverse; Increase in noise level, dB | Negligible | 0.1 - 0.9 | 125 | 1 | 4574, 12242, 4576, 4577 |
| | Minor | 1 - 2.9 | 4 | 1 | |
| | Moderate | 3 - 4.9 | 5 | 0 | |
| | Major | 5 + | 0 | 0 | |
| No Change | | 0 | 25 | 0 | |
| Beneficial; Decrease in noise level, dB | Negligible | 0.1 - 0.9 | 39 | 0 | |
| | Minor | 1 - 2.9 | 8 | 0 | 4575 |
| | Moderate | 3 - 4.9 | 2 | 0 | |
| | Major | 5 + | 0 | 0 | |
| Totals | | | 208 | 2 | |

10.4.39 The long term operational impacts of Option 12A for the years 2021 to 2041, based on variable demand modelling (Core Scenario) traffic forecasting data (version 16) and in the absence of mitigation are presented in **Table 10-9**.

Table 10-9 Option 12A Long term (Years 2021 – 2041) Traffic Noise Reporting Table

| Impact; change in noise level | | | Daytime L _{A10,18h} (0600-0000hrs) | | Night-time L _{night} (2300-0700hrs) | Noise Important Areas |
|---|------------|-----------|---|-------------------------------------|--|-------------------------|
| | | | Number of Dwellings | Number of other sensitive receptors | Number of dwellings (≥55 dB only) | |
| Adverse; Increase in noise level, dB | Negligible | 0.1 - 2.9 | 190 | 2 | 58 | 4574, 12242, 4576, 4577 |
| | Minor | 3 - 4.9 | 6 | 0 | 0 | |
| | Moderate | 5 - 9.9 | 1 | 0 | 0 | |
| | Major | 10 + | 0 | 0 | 0 | |
| No Change | | 0 | 0 | 0 | 0 | |
| Beneficial; Decrease in noise level, dB | Negligible | 0.1 - 2.9 | 10 | 0 | 8 | 4575 |
| | Minor | 3 - 4.9 | 1 | 0 | 1 | |
| | Moderate | 5 - 9.9 | 0 | 0 | 0 | |
| | Major | 10 + | 0 | 0 | 0 | |
| Totals | | | 208 | 2 | 67 | |

10.4.40 For Option 12A, **Tables 10-8 and 10-9** demonstrate that most of receptors would be subject to a negligible impact and that there would be a limited number of noise sensitive receptors subject to a moderate adverse impact. This is likely to occur at properties on Maidstone Road,

east of the A249. Impacts during the long term will be mainly negligible. The installation of a noise barrier in the correct location (i.e. along the edge of the westbound A249 carriageway to the north of the M2) would typically reduce the noise levels by approximately 10 dB. Therefore, all moderate increases would fall to minor. With mitigation, it is likely that there would be no sensitive receptors with a significant effect in the short or long term.

10.4.41 At the same time, results show that there could be a moderate beneficial impact, reduction in noise levels during the short-term, at properties south of the A249 and west of the M2 Junction 5.

10.4.42 Operational Impacts (Data Comparison – Variable Demand Modelling (Alternative Scenario) Traffic Forecasting Data Set):

- A comparison was undertaken between the noise assessment results for Noise Important Areas using variable demand model (Core Scenario) traffic forecasting data (version 16) (i.e. the results presented above) and variable demand modelling (Alternative Scenario) traffic forecasting data (version 16). The results of the comparison suggest that the noise impact using the variable demand modelling (Alternative Scenario) traffic forecasting data (version 16) would be no worse than the impacts presented above.

PEOPLE AND COMMUNITIES

10.4.43 Construction Impacts:

- Effects on All Travellers – On site PRoWs³⁰⁰ are expected to be impacted by both Option 4H1 and Option 12A during construction. The impact on pedestrians, cyclists and equestrians is expected to be of minor adverse magnitude and slight adverse significance for Option 12A during construction and negligible adverse magnitude and slight adverse significance for Option 4H1.
- Effects on People and Health - Disruption is expected to impact local bus stops and services during construction which has the potential to negatively impact local people and in particular, the health and well-being of the young and elderly. However due to the current usage of the bus stops as identified by the NMU Context Report,³⁰¹ disruption is expected to be limited to small number of individuals. With appropriate mitigation in place, the significance of this impact is considered likely to be neutral.
- Effects on Communities - It is anticipated that the level of severance experienced by local communities for both Option 4H1 and Option 12A would result in a slight adverse impact during construction.

10.4.44 Operational Impacts:

- Effects on All Travellers - Overall impact on motorised travellers is expected to be of moderate beneficial magnitude and moderate significance for Option 4H1 and minor beneficial magnitude and slight beneficial significance for Option 12A during the operational phase. Maintenance or enhancement of PRoWs has been incorporated into the option designs, and overall improvements to facilities resulting in a slight operational benefit are expected.
- Effects on People and Health - Option 4H1 and Option 12A move the A249 carriageway further from dwellings to the south of the existing junction of the A249 and Oad Street. This is likely to have a positive impact on health and wellbeing. At this early stage of design, Option 4H1 is expected to move the carriageway slightly further from these properties than Option 12A, raised on an embankment. The retention and improvement of PRoWs also has the potential to have a benefit for health and wellbeing. Overall, the impacts on health and wellbeing operationally are expected to be neutral. Option 4H1 and

³⁰⁰ PRoW – Public Rights of Way.

³⁰¹ M2 Junction 5 Improvement Study Non-Motorised User Context Report, October 2016.

Revised Option 12A would not result in land take from any strategically allocated employment land. On this basis, a neutral impact on development land is expected.

- Effects on Communities – It is anticipated that the level of severance experienced by local communities for Option 4H1 and Revised Option 12A would result in a neutral impact operationally, with the potential for slight benefits due to increased local accessibility to the strategic road network for some users (for example, via the proposed Oad Street connection direct into Stockbury Roundabout) and slight adverse impacts for some users due to permanent closures or diversions of existing connections (for example, due to the closure of the junction of Honeycrook Hill with the A249). At this stage, the loss of agricultural land is considered likely to result in a slight adverse effect for Option 4H1 and Option 12A.

ROAD DRAINAGE AND THE WATER ENVIRONMENT

10.4.45 Construction and Operational Impacts (Option 4H1):

- The Road Drainage and the Water Environment impacts associated with Option 4H1 are considered the same as those anticipated for Option 4, which are summarised in **Section 8.12** of this report.

10.4.46 Construction Impacts (Option 12A):

- Risk to groundwater quality and associated potential impacts to human health – Minor Adverse effect of Slight Adverse significance (with mitigation) expected, particularly to the north of the M2 along the A249.
- Impacts on road users, people and property as a result of increased flood risk to adjacent properties associated with changes to overland flow paths – Minor Adverse effect of Neutral significance (with mitigation) expected.
- Impacts to the water quality of the ditch adjacent to Maidstone Road if diversion/realignment is required - Moderate Adverse effect of neutral significance (with mitigation) expected.
- Risk to the water quality of the pond at the Gate House adjacent to the A249 – Minor Adverse effect of Neutral significance (with mitigation) expected.

10.4.47 Operational Impacts (Option 12A):

- Risk to groundwater quality and associated potential impacts to human health – Minor Adverse effect of Slight Adverse significance (with mitigation) expected, particularly to the north of the M2 along the A249.
- Impacts on road users, people and property as a result of increased flood risk to adjacent properties associated with changes to overland flow paths – Minor Adverse effect of Neutral significance expected.
- Impacts on road users, people and property as a result of increased flood risk to adjacent properties associated with increased impermeable surface area – Negligible effect of Neutral significance expected.
- Impacts to the water quality of the ditch adjacent to Maidstone Road if diversion/realignment is required - Minor Adverse effect of neutral significance expected.
- Risk to the water quality of the pond at the Gate House adjacent to the A249 – Negligible effect of Neutral significance expected.

COMPLIANCE WITH SCHEME OBJECTIVES

10.4.48 The scheme objectives include consideration of the environment, specifically:

- An improved environment – To deliver a high standard of design for any M2 Junction 5 improvement that reflects the quality of the landscape and setting, and that minimises the adverse environmental impact of new construction and supports the following objectives:
- Plan for climate change;
- Work in harmony with the environment to conserve natural resources and encourage biodiversity; and
- Protect and enhance countryside and historic and archaeological environments.

10.4.49 Option 12A and Option 4H1 are considered to comply with the components of the above objective that seek to deliver a high standard of design that reflects the quality of the landscape and setting, minimise adverse environmental impacts of construction and support the objectives of planning for climate change and working in harmony with the environment to conserve natural resources and encourage biodiversity.

10.4.50 The component of the objective that seeks to achieve the protection and enhancement of historic and archaeological environments presents a possible area of non-compliance for Option 4H1 and Option 12A. This is due to potential residual adverse effects on the setting of designated heritage assets, including (but not limited to) the Chatham Land Front World War I historic landscape. Options 12A and 4H1 are expected to result in an adverse effect of moderate significance in the absence of mitigation. There may be an opportunity to reduce the level of effect with the implementation of an appropriate mitigation strategy and/or enhancement measures, which would be developed in consultation with Historic England at PCF Stage 3. However, it is possible that a slight adverse residual adverse effect will remain.

10.4.51 The potential for direct archaeological impacts presents a further possible area of non-compliance with the above objective for Option 12A and Option 4H1. Specifically, both options have the potential to result in permanent adverse impacts to the buried Chatham Land Front World War I heritage assets. At this stage, it is envisaged that avoidance of these potential impacts could be achieved through design development, or otherwise, impacts could be appropriately mitigated through preservation in situ if feasible or appropriate archaeological investigation (such as recording). However, if appropriate mitigation cannot be achieved such that the significance of the residual direct impact is reduced to neutral, there would be further non-compliance with the component of the above objective that seeks to protect archaeological environments.

10.4.52 Overall, Option 12A is considered to achieve slightly enhanced compliance with the environmental objective for the scheme than Option 4H1 at this stage. This is due to it being preferred over Option 4H1 from a landscape perspective.

COMPLIANCE WITH PLANNING POLICY

10.4.53 The PCF Stage 2 National Policy Statement for National Networks Accordance Table and Planning Statement Addendum³⁰² product provides a summary of the planning policy framework applicable to the scheme, considering compliance of Option 12A and Option 4H1 against the relevant planning policy. The key areas of potential policy that warrant particular consideration and possible areas of non-compliance for Option 12A and Option 4H1, are as follows:

- Biodiversity – the NNNPS³⁰³ and NPPF³⁰⁴ afford a strong policy direction to the protection of irreplaceable habitat, including Ancient Woodland. Option 4H1 and Option 12A have the potential to result in deterioration of Ancient Woodland habitat due to dust deposition

³⁰² M2 Junction 5 Improvements Scheme National Policy Statement for National Networks Accordance Table and Planning Statement Addendum, January 2018.

³⁰³ National Policy Statement for National Networks, Department for Transport, December 2014.

³⁰⁴ National Planning Policy Framework, Department for Communities and Local Government, March 2012.

and root compaction associated with construction activities. However, it is expected that this potential effect can be mitigated appropriately through the implementation of adequate construction environmental management measures. In light of the above, it is expected that Option 4H1 and Option 12A will be able to achieve compliance with national planning policy relating to biodiversity at this stage.

- Cultural Heritage – the NNNPS and NPPF seek to avoid substantial harm to or total loss of significance of designated heritage assets and non-designated heritage assets of equal significance to Scheduled Monuments. At this stage it has not yet been possible to determine whether any adverse impacts would constitute “substantial harm” in policy terms, as the results of the intrusive evaluation that will be used to inform a determination of asset significance and mitigation recommendations are pending. However, Option 4H1 and Option 12A have the potential to result in harm to the Chatham Land Front World War I defences and, therefore, there is potential for both options to result in non-compliance with the relevant planning policy in this respect.
- Landscape – the NNNPS and NPPF afford a strong policy direction to the protection of nationally designated landscape areas (including AONBs³⁰⁵), stating a strong presumption against any significant road widening or the building of new roads in these areas unless there are demonstrable compelling reasons for new or enhanced capacity and any benefits very significantly outweigh the costs. Option 4H1 and Option 12A involve development within the Kent Downs AONB and would, therefore, need to demonstrate compelling reasons for the planned capacity enhancements and that the benefits very significantly outweigh the costs. Given that the M2 Junction 5 is an established feature in the landscape, it is expected that a sensitive design and appropriate mitigation will enable all options to achieve policy compliance.

10.4.54 Based on a preliminary appraisal of the relevant policy guidance, as appropriate for PCF Stage 2, it is expected that Option 4H1 and Option 12A would be able to achieve compliance with the relevant NNNPS and NPPF policy in respect of air quality, geology and soils, materials, noise, people and communities, and road drainage and the water environment.

³⁰⁵ AONB – Area of Outstanding Natural Beauty.

11 APPRAISAL SUMMARY TABLE

11.1 INTRODUCTION

11.1.1 Please refer to **Appendix K**.

12 CONCLUSION

- 12.1.1 This section summarises the main findings of the Scheme Assessment Report comparing the options and giving a recommended route to be progressed to PCF³⁰⁶ Stage 3.
- 12.1.2 The Reference Case indicates that not going ahead with the scheme will inhibit economic growth within the local area. Congestion is forecast to worsen leading to increased journey times and potentially increasing accidents at the junction.
- 12.1.3 During PCF Stages 0 and 1 it was confirmed that given the scale of the problem identified at M2 Junction 5, there was little scope for alternative modes to play a part for providing sufficient congestion relief at the junction. Optioneering was undertaken in PCF Stage 0 to identify various methods of improving capacity at the junction such as:
- Additional capacity on the A249 approaches to the junction;
 - Free flow links for the dominant traffic movements;
 - Additional capacity at the roundabout via at-grade improvements; and
 - Additional capacity at the roundabout via grade separated improvements.
- 12.1.4 At PCF Stage 1 the options were refined and tested within a VISSIM micro-simulation model of the M2 Junction 5 as there was no strategic model available at the time. At the end of PCF Stage 1 it was recommended that Options 4, 10 and 12 were to be progressed into PCF Stage 2 as they provided an acceptable level of benefits and were within the RIS 1³⁰⁷ funding range of £50 million to £100 million. However, as Options 4 and 10 exceeded the capital funding budget allocation of £70.6 million the decision was that Option 12 was the only viable option and should be developed further in PCF Stage 2. Taking into account the uncertainties regarding the BCR³⁰⁸, resulting from the limitations of the VISSIM modelling, Options 4 and 10 in addition to Option 12 were to be modelled in the SERTM³⁰⁹.
- 12.1.5 During PCF Stage 2, the SERTM was cordoned to the scheme area, to produce the M2 Junction 5 Model, and initial forecasting results, without VDM³¹⁰, indicated that Option 12 would not cope adequately with forecast traffic flows. A potential improvement to Option 12 was therefore identified, Option 12A, based on evolving Option 12 to include an at-grade through-approach. It was considered that, whilst there are options that would better address the scheme's capacity and safety objectives, within the affordability constraint of the capital funding budget allocation (£70.6million) Option 12A would provide greater resilience for A249 traffic and as such would optimise the benefits that could be achieved with an at-grade solution.
- 12.1.6 The four options were modelled within the M2 Junction 5 Model with VDM; this confirmed again that Option 12 could not cope adequately with forecast traffic flows. Option 12A was shown at the non-statutory public consultation as the only viable option, because it was the only option within the RIS 1³¹¹ and capital baseline funding allocation that was considered to achieve the project objectives. Options 4, 10 and 12 were shown as rejected options.
- 12.1.7 Over 1,300 people attended the 5 public events held during the consultation period; and 518 responses (368 online and 150 paper ones) were logged. The feedback received from the

³⁰⁶ PCF – Project Control Framework

³⁰⁷ Road Investment Strategy: for the 2015/16 – 2019/20 Road Period, Department for Transport, March 2015

³⁰⁸ BCR - Benefit to Cost Ratio

³⁰⁹ SERTM - South East Regional Transport Model

³¹⁰ VDM – Variable Demand Modelling

³¹¹ Road Investment Strategy: for the 2015/16 – 2019/20 Road Period, Department for Transport, March 2015

public consultation was generally non-supportive of Option 12A. 68% of respondents indicated they would not support it and statutory stakeholders, such as Kent Downs Area of Outstanding Natural Beauty, Local Authorities and the Members of Parliament for Sittingbourne and Sheppey, either opposed or did not support it.

12.1.8 The general consensus from the consultation responses was that the only option that would provide long-term benefits was a flyover. Therefore, a review of Option 4 was undertaken to determine if there were any further value management measures to reduce the cost of the option within the RIS 1³¹² funding range and closer to the capital funding budget allocation, whilst maintaining an acceptable level of benefits.

12.1.9 The value management review focussed on the elements of Option 4 that were considered to have the greatest potential to reduce costs whilst minimising the reduction in the benefits. The revised version of Option 4, referred to as Option 4H1, included changes to the following elements of Option 4:

— M2 Eastbound to A249 Northbound Off line, Single Lane Slip Road:

- (1) The off-line slip road was removed from the design and replaced with an on-line improvement to the existing slip road. The existing slip road will be revised to be two lanes, as opposed to the current one lane layout, and a similar dedicated left turn lane provision will be provided at the M2 Junction 5 Roundabout. This reduced the cost of the link and reduced the impact of the link on the surrounding environment.

— Oad Street Link:

- (1) The Oad Street Link was moved to be adjacent to the existing A249 at the southern end of Oad Street. It is proposed that a speed limit be applied, between the Maidstone Road Link / Oad Street junction and the Oad Street Link / M2 Junction 5 Roundabout junction. This reduced the cost of the link, reduced the impact of the link on the surrounding environment and is considered to make the route less attractive to rat-running traffic.

— Maidstone Road Link:

- (1) The Maidstone Road Link was moved, to address safety issues at the location of the Maidstone Road Link / Oad Street junction. The alignment was moved northwards to provide improved sight lines at the junction.

12.1.10 The changes presented above represent improvements to the existing options because they contribute to some or all of the following:

- Reducing the estimated cost of the options;
- Reducing the impact of the options on the surrounding environment;
- Reducing the risk of strategic traffic rat running on the local road network;
- Improving the safety of the options.

12.1.11 The changes to Oad Street Link and Maidstone Road Link were applied to Options 4, 4H1 and 12A.

³¹² Road Investment Strategy: for the 2015/16 – 2019/20 Road Period, Department for Transport, March 2015

COSTS

12.1.12 Within the three point option estimates, the most likely cost for all three options falls within the RIS 1³¹³ budget range of £50 million to £100 million, however, only the Option 12A most likely estimate falls within the capital baseline funding allocation of £70.6 million. As such, only Option 12A is considered affordable.

Table 12-1 PCF Stage 2 Final Option Estimates Ranges (2016 Base Year)

| Option | P10 | Most Likely | P90 |
|--------|------------|-------------|-------------|
| 4 | £70million | £98million | £150million |
| 4H1 | £62million | £87million | £133million |
| 12A | £43million | £60million | £94million |

TRAFFIC AND ECONOMICS

12.1.13 Traffic forecasting was produced using a combination of TEMPro³¹⁴ growth projections, National Traffic Model forecasts and Local Plan allocations. Four scenarios were developed in accordance with WebTAG guidance, as described below. Of these the Alternative Scenario was considered to best represent current forecast growth for committed developments, as it was based on the latest local growth projections obtained from local authorities.

- The Core Scenario provided projected growth based on the national forecasting models produced by the Department for Transport – TEMPro for cars and NTM³¹⁵ for goods vehicles. This is a standard approach as outlined in WebTAG guidance³¹⁶ and provides a standard approach across all traffic forecasting.
- The Alternative Scenario forecasts growth based on the latest local growth projections obtained from local authorities, being more up to date than the national forecast models in the Core Scenario. The approach taken was as outlined in WebTAG guidance.
- The High and Low Growth Scenarios were developed from the Core Scenario in accordance with WebTAG guidance. This High and Low Growth Scenarios tested the impact of lower or higher traffic flows than the Core Scenario.

12.1.14 The traffic and economics assessments for Options 4 and 12A, with the revised Maidstone Road Link and Oad Street Link, and Option 4H1 showed that all three options provided a clear and positive benefit against the Reference Case.

12.1.15 Option 4 provided the highest overall level of benefits (£276million) followed by Option 4H1 (£237million) (refer to **Table 10-5**). However, Option 4H1 had the highest accident savings (£59million), followed closely by Option 4 (£57million). The BCR³¹⁷ for Options 4 and 4H1 were similar, at 4.246 and 4.112 respectively. As Option 4H1 was considered to be a viable option in terms of operational performance, Option 4 was discounted as it was significantly more expensive.

12.1.16

12.1.17 Option 4H1 provided a higher overall level of benefits compared to Option 12A (£203million), including significantly higher accident savings. Option 12A accident savings (£29million) were

³¹³ Road Investment Strategy: for the 2015/16 – 2019/20 Road Period, Department for Transport, March 2015

³¹⁴ TEMPro – Trip End Model Presentation Programme

³¹⁵ NTM – National Traffic Model

³¹⁶ WebTAG Unit M4 Forecasting and Uncertainty, Department for Transport, July 2017

³¹⁷ BCR - Benefit to Cost Ratio

broadly 50% lower than for the two grade separated options, reflecting the increased number of potential conflict points in a through-about layout. The BCR for Option 12A was better than for 4H1, at 5.079, reflecting the lower estimated cost of the option, albeit the difference in BCRs was relatively small.

ENVIRONMENT

- 12.1.18 The following information presents a summary of the key findings from the environmental assessment presented in Section 10.4 of this report.
- 12.1.19 Option 4H1 and Option 12A are not expected to result in any significant air quality impacts in terms of local and regional air quality. Neither junction option is expected to result in a risk of non-compliance with the EU limit value for annual mean Nitrogen Dioxide in 2015 (40 micrograms per cubic metre). Based on variable demand (Core Scenario) traffic modelling data (version 16) and the risk-based air quality assessment undertaken at PCF Stage 2, it has been determined that both options have the potential to result in impacts to the North Downs Woodland Special Area of Conservation (which overlaps with the Wouldham to Detling Escarpment Site of Special Scientific Interest designation). However in both cases, the predicted increases in nitrogen oxide concentration would lead to deposition of nitrogen that, when compared to reference data on the response of habitats to nitrogen deposition,³¹⁸ fall below the threshold at which the most nitrogen sensitive habitat types in the UK lose one species due to the increased nutrient load. Thus it would not be expected that North Downs Woodland Special Area of Conservation would lose any plant species due to deposition of nitrogen, and thus would not receive significant adverse effects due to the impacts of air quality change from traffic changes on the Affected Road Network.
- 12.1.20 Option 4H1 and Option 12A have the potential to result in adverse impacts to the setting of designated heritage assets and the setting of the Chatham Land Front World War I defences historic landscape. It is anticipated that a mitigation strategy and/or enhancement measures could be developed in consultation with Historic England to reduce the level of effect on setting from both junction options; however, it is possible that a slight adverse residual adverse effect will remain. Both options also have the potential to result in direct significant adverse impacts to buried Chatham Land Front World War I defences. A mitigation strategy relating to these potential impacts is currently the subject of consultation with the county archaeologist and it is anticipated that with the implementation of appropriate mitigation, these potential effects could be reduced to neutral.
- 12.1.21 Option 12A is preferred over Option 4H1 from both a landscape and visual perspective. No significant adverse landscape impacts to the Kent Downs AONB are expected. Option 4H1 and Option 12A have the potential to give rise to a moderate adverse effect from materials consumption which would be significant; however both are expected to have a significant beneficial effect from site arisings.
- 12.1.22 There is potential for Option 4H1 and Option 12A to result in significant adverse noise impacts in the absence of mitigation during both construction and operation. However it is noted that mitigation would be adopted during construction to reduce potential noise impacts as far as practicable. It is noted that construction noise impacts are temporary in nature however it is anticipated that a minor to moderate adverse effect may remain. Operationally, the installation of a noise barrier in the correct location (i.e. along the edge of the westbound A249 carriageway to the north of the M2) would be expected to result in noise level reductions of up to 10 dB. Low noise road surfacing could also be considered. For Option 4H1, all major increases in the short term would fall to moderate short term with mitigation and all moderate long term increases would fall to minor with mitigation. With mitigation, it is likely that there would be no sensitive receptors with a significant effect in the long term for Option 4H1. For Option 12A, all moderate increases would fall to minor with mitigation. With mitigation, it is likely that there would be no sensitive receptors with a significant effect in the short or long term.

³¹⁸ Ibid.

12.1.23 Based on a preliminary appraisal of the relevant policy guidance, as undertaken at PCF Stage 2, it is expected that Options 4H1 and 12A would be able to achieve compliance with the relevant Planning Policy in respect of air quality, geology and soils, materials, noise, people and communities and road drainage and the water environment.

12.1.24 Options 12A and 4H1 are considered to comply with the components of the above objective that seek to deliver a high standard of design that reflects the quality of the landscape and setting, minimise adverse environmental impacts of construction and support the objective of planning for climate change.

12.1.25 Overall, Option 12A would achieve slightly enhanced compliance with the environmental objective for the scheme over Option 4H1 for landscape reasons.

12.1.26 As the design progresses and mitigation proposals are developed in later PCF³¹⁹ Stages there will be opportunities to enhance compliance with the environmental objective for the scheme with both junction options. At this stage, compliance with the environmental objective is not considered a clear differentiator between the options and will need to be re-evaluated in PCF Stage 3 once the full environmental assessment for the preferred option is available.

12.1.27 Both Options 4H1 and 12A have been screened as requiring statutory Environmental Impact Assessment as both are considered likely to result in significant adverse effects on the environment at this stage in the assessment. These anticipated significant impacts are associated with landscape and visual effects during construction and in the short term (at year one), materials consumption, potential construction noise impacts associated with both junction options, and potential short term noise impacts (Opening Year 2021) at two sensitive receptors for Option 4H1.

SCHEME OBJECTIVES/ AFFORDABILITY

12.1.28 A comparison of how Options 4H1 and 12A compare, in terms of the metrics identified for determining whether the scheme objectives have been achieved, is given in **Table 12-2**. Within this table the two options have been ranked in order as to which option achieves each metric more effectively, with 1 being better than 2. The table also includes whether the options fall within the affordability metrics for the scheme.

Table 12-2 Options 4H1 and 12A Comparative Performance Regarding Scheme Objectives

| Scheme Objective / Affordability | Option 4H1 | Option 12A |
|--|------------|------------|
| Most Likely Options Estimate | | |
| Within RIS 1 ³²⁰ funding range of £50 million to £100 million | Yes | Yes |
| Within capital baseline funding allocation of £70.6 million | No | Yes |
| Supporting economic growth: | | |
| Enhanced capacity, connectivity and resilience at Junction 5 | 1 | 2 |
| Strengthen the local and regional economic base | 1 | 2 |
| Delivery of housing allocations from the Swale Local Plan | 1 | 2 |
| Promotion of economic growth across the region | 1 | 2 |
| A safe and serviceable network: | | |

³¹⁹ PCF: Project Control Framework

³²⁰ Road Investment Strategy: for the 2015/16 – 2019/20 Road Period, Department for Transport, March 2015

| Scheme Objective / Affordability | Option 4H1 | Option 12A |
|---|------------|------------|
| Improved safety and security for all road users | 1 | 2 |
| Reduction in the number of KSI ³²¹ collisions and slight collisions | 1 | 2 |
| A more free flowing network: | | |
| Improved journey quality, journey time and reliability for all routes through Junction 5 | 1 | 2 |
| An improved environment: | | |
| High standard of design reflecting the landscape and setting | 2 | 1 |
| Supports climate change, conserves natural resources, encourages bio-diversity and protects historic environments | Equal | Equal |
| A more accessible and integrated network: | | |
| Make changes at the junction that could benefit the community and provide a legacy, where reasonable and proportionate. | Equal | Equal |

12.2 RECOMMENDED OPTION

- 12.2.1 Option 12A is considered a viable option as it is both within the current capital funding budget allocation and operationally achieves the scheme objectives. The feedback received from the non-statutory public consultation was that 68% would not support Option 12A, which included Kent Area of Outstanding Natural Beauty, Local Authorities and the Members of Parliament for Sittingbourne and Sheppey, who either opposed or did not support Option 12A.
- 12.2.2 Whilst Option 4H1 delivers the scheme objectives more effectively there is currently insufficient funding available for this more expensive option. For Option 4H1 to be considered a viable option additional funding would need to be sourced and secured. The general consensus from the non-statutory public consultation responses was that only a flyover option would provide long-term benefits at the junction.
- 12.2.3 Whether additional funding could be identified and secured is currently being investigated and until that process has completed a final decision regarding the preferred option for the scheme will not be made.

³²¹ KSI – Killed or Seriously Injured

APPENDIX

A EXISTING CONDITIONS APPENDIX

APPENDIX

A-1 CLIENT SCHEME REQUIREMENTS

APPENDIX

A-2 *ENVIRONMENTAL CONSTRAINTS MAP*

APPENDIX

B PLANNING FACTORS APPENDIX

APPENDIX

B-1 *OPTIONS LOG*

APPENDIX

B-2 *VDM METHODOLOGY* *TECHNICAL NOTE*

***B-3 PCF STAGE 2
INTERIM NO. 1
OPTIONS ESTIMATES
(APRIL 2017)***

APPENDIX

B-4 *OPTIONEERING LOG* *(STAGES 0 TO 2)*

B-5 *PCF STAGE 1 FINAL
OPTION ESTIMATES*

APPENDIX

C NOT USED



APPENDIX

D SUMMARY OF ALTERNATIVE SCHEME APPENDIX

APPENDIX

D-1 GENERAL ARRANGEMENTS (SEPTEMBER 2017)

***D-2 C3 BUDGET
ESTIMATES***

APPENDIX

| AFFECTED UTILITY | OPTION 4 COST | OPTION 10 COST | OPTION 12 COST |
|--|---------------|----------------|----------------|
| GENYSIS (EX. VAT) | £405,116 | £405,116 | £405,116 |
| GENYSIS (INC VAT) | £486,139 | £486,139 | £486,139 |
| OPENREACH (EX VAT) | £990,097 | £1,032,129 | £843,581 |
| OPENREACH (INC VAT) | £1,188,117 | £1,238,555 | £1,012,298 |
| POWERNET (EX VAT) | £96,000 | £82,000 | £96,000 |
| POWERNET (INC VAT) | £115,200 | £98,400 | £115,200 |
| SOUTHERN WATER (INC VAT) | £1,139,653 | £1,183,633 | £858,498 |
| SOUTHERN WATER (EX VAT) | £1,367,584 | £1,420,360 | £1,030,199 |
| ESTIMATED TOTAL UTILITY COSTS / PER OPTION (EX. VAT) | £2, 630, 867 | £2, 702, 878 | £2, 203, 196 |
| ESTIMATED TOTAL UTILITY COSTS / PER OPTION (INC VAT) | £3, 157, 040 | £3, 243, 454 | £2, 643, 836 |

APPENDIX

E SUMMARY TABLES TRAFFIC , COSTS AND ECONOMICS APPENDIX

***E-1 INTERIM NO. 2
OPTIONS ESTIMATES
(OCTOBER 2017)***

E-2 CONVERGENCE
TABLES (CORE)

E-3 *VOLUME TO
CAPACITY RATIO*

E-4 *QUEUE LENGTHS*
(CORE)

E-5 *JOURNEY TIME
RESULTS (CORE)*

E-6 *MODEL*
CONVERGENCE
(ALTERNATIVE)

E-7 VOLUME TO
CAPACITY RATIO
(ALTERNATIVE)

E-8 *QUEUE LENGTHS*
(ALTERNATIVE)

***E-9 JOURNEY TIMES
(ALTERNATIVE)***

APPENDIX

E-11 PROFILE BENEFITS SPLIT BY TIME PERIOD AND TRIP TYPE

APPENDIX

F MAINTENANCE AREA MAP



APPENDIX

G NOT USED



APPENDIX

H NOT USED



APPENDIX

I

NOT USED



APPENDIX

J POST- CONSULTATION ASSESSMENT APPENDIX

***J-1 GENERAL
ARRANGEMENTS
(REVISED LOCAL
ROADS – NOVEMBER
2017)***

J-2 *FINAL OPTIONS
ESTIMATES
(DECEMBER 2017)*

APPENDIX

K APPRAISAL SUMMARY TABLES

If you need help accessing this or any other Highways England information, please call **0300 123 5000** and we will help you.

© Crown copyright and database rights 2018 OS 100030649.
You are permitted to use this data solely to enable you to respond to, or interact with, the organisation that provided you with the data. You are not permitted to copy, sub-licence, distribute or sell any of this data to third parties in any form.

You may re-use this information (not including logos) free of charge in any format or medium, under the terms of the Open Government Licence. To view this licence: visit www.nationalarchives.gov.uk/doc/open-government-licence/ write to the **Information Policy Team, The National Archives, Kew, London TW9 4DU**, or email psi@nationalarchives.gsi.gov.uk.

This document is also available on our website at www.highwaysengland.co.uk

If you have any enquiries about this publication email info@highwaysengland.co.uk or call **0300 123 5000***

Highways England Creative GFD18_0103

*Calls to 03 numbers cost no more than a national rate call to an 01 or 02 number and must count towards any inclusive minutes in the same way as 01 and 02 calls. These rules apply to calls from any type of line including mobile, BT, other fixed line or payphone. Calls may be recorded or monitored.

Printed on paper from well-managed forests and other controlled sources.

Registered office Bridge House, 1 Walnut Tree Close, Guildford GU1 4LZ
Highways England Company Limited registered in England and Wales number 09346363