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Motorcycle manoeuvres review
Phase 2 and Phase 3 report

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Background

The current practical motorcycle test in Great Britain is modular, with the first of two modules testing candidates’ control of their motorcycle in an off-road area during a series of low and higher speed manoeuvres. Concerns about the accessibility and safety of the module 1 test led the Road Safety Minister (in June 2010) to announce a review exploring the feasibility of a single event, on-road practical motorcycle test. TRL was commissioned to carry out research to support the review.

The research proceeded in three consecutive phases; the first of these phases is described in Tong, Helman, Fowler, Delmonte and Hutchins (2013), and the second and third are described in this report:

1. Phase 1 (Tong et al., 2013) trialled the manoeuvres off-road so that the initial feasibility, safety and fairness of the manoeuvres could be assessed without exposing learner riders to potential risks on real roads. Test-ready learner riders rode through the proposed set of manoeuvres under mock-test conditions. They also completed the existing module 1 manoeuvres for direct comparison.

2. Phase 2 built on the findings from Phase 1 by piloting the revised manoeuvres on-road with experienced riders, so that a decision could be made on whether to proceed with Phase 3 (on-road trialling with learner riders).

3. Phase 3 trialled the manoeuvres on-road with learner riders.

Nine research questions were addressed by the project as a whole. The research questions are split into three categories. Questions 1–3 are concerned with test standards and the performance and feedback of learner riders. Questions 4–8 are concerned with the feasibility and safety implications of testing the revised manoeuvres on-road. Question 9 is concerned with the feasibility and safety of training the revised manoeuvres. The questions are listed below, along with the key data that were used to answer each (from Phases 2 and 3).

1. Do the revised manoeuvres assess the same competencies and to the same standard as the existing module 1 manoeuvres?

2. Can the revised exercises be conducted on-road in a fair and consistent manner for riders using motorcycles with different power outputs?

3. Do weather conditions have any implications for the examining of the revised manoeuvres and the assessment of performance?

4. What is the feasibility of using portable speed measuring equipment when trialling on-road?

5. What is the time taken to complete the revised set of manoeuvres in simulated test conditions?

6. What are the implications of the revised exercises (when being examined) for the safety of learner riders, examiners, and other road users?
7. What are the safety parameters (including criteria for space protection) required to safeguard all road users during an on-road test, and what are the other criteria for suitable on-road test locations?

8. What is the feasibility of conducting the revised manoeuvres at different types of road location (e.g. urban versus rural)?

9. What are the training requirements for the revised manoeuvres, including the measures to protect learners, instructors and other road users during training?

Phase 2

The purpose of Phase 2 was to pilot the manoeuvres on-road with experienced motorcyclists before exposing any learner riders to the risks that on-road trialling would inevitably present. Phase 2 was a small-scale pilot (with very small sample sizes) so its findings are largely qualitative, and therefore indicative rather than definitive.

Identifying on-road sites

On-road sites to trial the proposed manoeuvres were identified using online mapping tools and in-person site assessments. Sites were assessed against a set of safety criteria developed in Phase 1. Of the 95 potential sites identified as possibly suitable for trialling, 44 sites were surveyed in person. Fifteen of these were found to be suitable for trialling with experienced riders. It was not possible to find sites that met all of the safety criteria and some criteria were relaxed to make trialling feasible (but still as safe as is reasonably practicable). These included sight lines required for examiners and the range and extent of roadside furniture permitted (caused by the ever-present property or boundary line). In particular, it was established that sight lines based on distance were not appropriate due to wide variation in traffic speeds and site characteristics that determined the time taken for approaching traffic to move towards and through the manoeuvring areas. Sight lines based on times were deemed more appropriate.

On-road trials

Ten experienced riders were recruited through invites issued at DSA (Driving Standards Agency) test centres. They took part in seven trial days across four locations, in all cases using motorcycles that represented the machines on which candidates typically learn to ride. Riders took part in the manoeuvres under mock test conditions, with DSA examiners present. All sessions were video-recorded, and feedback was collected from riders and examiners on perceived confidence, workload, and feelings of risk and vulnerability.

The findings showed that:

- Traffic flows during trials ranged from 0.4 to 5.6 road users per minute. A low traffic flow was necessary but not sufficient for site suitability. The nature of flow (constant, versus busy ‘bursts’) was at least as important.
- Test duration (assuming a single attempt at each high speed manoeuvre and a pre-marked manoeuvring area) varied from 8–20 minutes. The shortest test durations were measured at the sites with the lowest traffic flow, but the longest test was also measured at a site with a flow near the bottom end of the range observed (1.7 road
users per minute). Again this illustrates that a low traffic flow does not guarantee a short test.

- The riding times for each manoeuvre were very similar to those observed in Phase 1. Per test, riders waited in the road on their motorcycles for between 6–13 minutes, during which time they are at some risk of being struck by passing traffic. It was concluded that Phase 3 trials sites would require a safe waiting area or sufficient road width to reduce this risk.

- Various and frequent examples of erratic behaviour by other road users were observed in response to the ‘pucks’ used to mark the manoeuvres, including sudden steering (often to the other lane) and braking responses. Use of the puck markers in Phase 3 would require low traffic flows.

- Rider and examiner feedback (workload ratings, ratings of risk, vulnerability and confidence) tended to agree with a priori risk assessments in identifying the most suitable sites. The two sites identified from the risk assessments as being most likely to be suitable also tended to give rise to the lowest levels of self-rated workload, risk and vulnerability, and the highest levels of confidence.

- The indicative findings suggested that with careful site selection, it would be possible to trial the manoeuvres further on-road in Phase 3 without generating high feelings of risk and vulnerability, or excessive workload.

**Implications for Phase 3 trialling**

The key implications of Phase 2 findings for Phase 3 trialling related to the safety criteria used to assess sites for suitability. Broadly, the Phase 2 findings suggested that it would be possible to find a small number of sites on which to trial the manoeuvres with test-ready learner riders. Adjustments to the existing safety criteria were suggested to help find further sites, and additional criteria were also identified. When these revised safety criteria were used to revisit the Phase 1 risk assessment (see Tong et al., 2013), some marginal increases in risk were observed for some manoeuvres. However none of these were considered to be a cause for concern, as long as the revised Phase 3 safety criteria were implemented in full. Based on the Phase 2 findings, it was decided that Phase 3 could proceed with the additional control measures identified.

**Phase 3**

Phase 3 trialled 151 learner participants, all of whom completed the proposed manoeuvres on-road, and the module 1 manoeuvres at a test centre. The trials took place at 11 different locations across the country and 13 different on-road sites were used. These sites were identified following the same process as was used in Phase 2. Data were collected from learner, examiner and trainer questionnaires, and from systematic observations of the trials made by the research staff on site. The findings comprised workload data from learners and examiners, test performance data (fault and competence ratings) from examiners, training records from trainers, supplementary questionnaire data from all groups, and risk assessment data collected by the project team. These findings are used collectively to provide answers to the research questions.
1. Do the revised manoeuvres assess the same competencies and to the same standard as the existing module 1 manoeuvres?

And

2. Can the revised exercises be conducted on-road in a fair and consistent manner for riders using motorcycles with different power outputs?

The test performance data showed that learners committed significantly more faults on-road than for module 1. Senior examiners’ ratings of learner competence were also significantly lower on-road than for module 1. The significantly higher fault rate was primarily attributed to learners committing four times as many serious faults on-road than in the equivalent module 1 test. The overall fault rates were significantly higher for the on-road versions of the ridden U-turn and hazard avoidance manoeuvres in particular. Likewise, for the on-road versions of these manoeuvres, senior examiners rated learner competence as significantly lower than for the equivalent module 1 manoeuvres. Further analysis of fault rates also showed that if a learner was going to receive at least one fault (or at least one serious fault – which can be used as a proxy for failing the test) in only one version of the test, it was significantly more likely to occur during the on-road test than on module 1; this would imply that the on-road test was more difficult than module 1.

The self-report data from learners showed that the on-road test generated significantly higher levels of subjective workload than module 1, in particular the on-road versions of the ridden U-turn, emergency brake and hazard avoidance manoeuvres. Analysis of the workload components responsible for this difference showed that learners had greater insight into their performance on-road (they were more aware of the errors they made), experienced significantly more frustration and had a tendency to feel time-pressure.

These findings indicate there was a difference in the competencies and assessment standards for the on-road test when compared with the current module 1 test. These differences were not attributed to motorcycles with different power outputs, or any other factor such as the width of the on-road site or the number of hours training that learners had received. Interpretation of the findings implies that the on-road manoeuvres are simply more difficult than the module 1 manoeuvres for learners to perform, in terms of their performance as measured by examiners against the required test standards, and in terms of the subjective workload they experienced as candidates.

If on-road testing is pursued, it can be expected that the competence required to pass the test on-road will be greater than it is currently using the module 1 set-up for riders of all machines, assuming the same standards of marking faults are used as were employed in this study.

3. Do weather conditions have any implications for the examining of the revised manoeuvres and the assessment of performance?

There were 73 trials in dry conditions and 71 in wet conditions; however, of the 71 wet trials, only 42 included higher speed manoeuvres trialled at the required speed of 30mph. These speed restrictions were imposed as a result of two incidents that occurred during the emergency brake manoeuvre on-road. It was concluded that the friction coefficient of wet road surfaces varied substantially and it could not be assumed that they would offer friction levels that were similar to the high-grade, uniform surfaces used for the module 1 test. As a consequence, an ethics decision was taken to not test the
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emergency brake and hazard avoidance manoeuvres on-road at 30mph when any surface moisture was present. This restriction was a response to the anticipated reduction in the friction coefficient of road surfaces when wet. A new safety criterion would be required for any future implementation of an on-road test; specifically, on-road sites would need to be tested to ensure that they offered a friction coefficient in all weather conditions that met a new minimum friction coefficient that does not currently exist. Regular re-testing of the friction coefficient would be required to ensure that on-road sites have stable friction levels over time.

Weather conditions did not affect learner performance overall. Fault rates remained significantly higher for the on-road test than for module 1, duplicating the findings reported for the first two research questions in both wet and dry conditions. However, the restrictions on wet weather testing did affect the analysis of weather effects on ratings of learner workload and competence. The overall pattern of data indicated that workload was higher and competence was lower for the on-road test; these findings were only significant in dry conditions, and were perhaps not replicated in wet weather because the sample of participants completing all manoeuvres in these conditions was lower. The smaller sample of participants completing all manoeuvres in wet conditions appeared to reduce the statistical power of the tests and a significant difference was not identified. Nevertheless, the overall data suggest that the on-road manoeuvres were more difficult for learners in both wet and dry conditions.

If on-road testing is pursued, it is feasible to test many of the manoeuvres in a range of weather conditions, but regular friction testing of on-road sites will be required to ensure that high-speed manoeuvres can be carried out safely in the wet.

4. What is the feasibility of using portable speed measuring equipment when trialling on-road?

Field-testing of a portable (hand-held) device for speed measurement was carried out at a small number of trial events. The outcome was a number of hazardous interactions between examiners and learners. The hand-held device for speed measurement appeared to compromise examiners’ ability to monitor their own personal safety, as well as that of the candidate. It also appeared to reduce the ability of examiners to assess candidates’ performance and, on several occasions, an accurate speed reading was not obtained. It was concluded that a portable device could not be used for speed measurement if it was hand-held and required any examiner input during a manoeuvre.

5. What is the time taken to complete the revised set of manoeuvres in simulated test conditions?

The time taken to complete each manoeuvre on-road was observed and recorded. The mean time required to complete all on-road manoeuvres was 15 minutes. The times observed ranged from 9.5 minutes to 27 minutes. If considering implementation of an on-road test in the future, there would be additional tasks which are not included in the times directly measured here. One such task is site preparation (e.g. unloading equipment, parking the examiner’s motorcycle), which was estimated at six minutes on the basis of a single walkthrough. Examiners would need to undertake other activities that were not measured in this study because they would require specific training, such as risk assessing a site prior to any trials. This was estimated at a minimum of five additional minutes. When considering the additional site preparation and minimum risk assessment activities, the timing data indicated that the average on-road test would
require at least 26 minutes, with 25% of tests requiring 28 minutes or longer, and 10% of tests requiring 31 minutes or longer. This does not include any time required for setting up any speed measuring device, if used.

6. What are the implications of the revised exercises (when being examined) for the safety of learner riders, examiners, and other road users?

Data and comments from examiners and learners indicated significantly greater feelings of risk and vulnerability when carrying out manoeuvres on-road rather than for module 1.

A wide range of incidents occurred during on-road trials, of which the vast majority were near-misses or non-injury incidents. The risk assessment identified that these incidents, which were across a range of the manoeuvres, often had the potential for more serious outcomes. Moreover, the majority could only occur on-road as they related to features only present in the on-road environment (and not in a module 1 off-road area).

Appropriate accident ratios from the Health and Safety Executive’s accident ratio model were applied to extrapolate from the types of incident captured by the on-road trials to the larger numbers of candidates tested at a national level. The estimates indicate that if the current module 1 test were replaced with the on-road manoeuvres trialled for this study, under similar conditions, between 447 and 561 ‘major’ incidents (requiring 3 days or more off work from injuries sustained) could be expected. If on-road testing is pursued, further control measures will be needed to reduce the anticipated number of incidents of this nature to a level that is deemed tolerable.

7. What are the safety parameters (including criteria for space protection) required to safeguard all road users during an on-road test, and what are the other criteria for suitable on-road test locations?

A wide range of safety criteria were set for on-road trials following the outcome of research findings from Phases 1 and 2. The safety criteria focus on establishing an on-road manoeuvring area with accompanying run-up and run-off zones, within which there are multiple requirements regarding street furniture, road dimensions, road layout and traffic flow. Surface quality was assessed visually during the trials but it became clear that the friction coefficient of any road used for testing these manoeuvres would need to be measured and monitored regularly to ensure that it provided sufficient friction levels in wet and dry conditions (during the trials, wet weather testing was suspended due to the increased uncertainty regarding the friction coefficient of the road surface). When applied correctly, these criteria were considered effective in minimising the probability of a hazardous event occurring, and reducing the severity of the possible outcomes. If on-road testing is pursued, the control measures outlined in this report will be a minimum requirement to retain the relevance of the outcomes reported in this study.

8. What is the feasibility of conducting the revised manoeuvres at different types of road location (e.g. urban versus rural)?

The pertinent issue for selecting an on-road site was not its urban or rural classification but rather whether it met all of the specified safety criteria. Those sites that did meet all of the safety criteria were most suitable for on-road testing, and they existed across a range of different locations. Although suitable on-road sites were otherwise difficult to characterise, it was more common to find them in industrial areas near business
premises. These sites often had wide roads with fewer premises and sufficient sightlines for examiners to monitor approaching traffic.

While this study has demonstrated that it is feasible to find sites suitable for on-road testing, only one in six surveyed roads was considered suitable for implementation of an on-road test in the future (i.e. meeting most or all of the safety criteria and within 5 miles of an existing test centre). Sourcing multiple on-road sites around a single test centre for future implementation of an on-road test would be challenging and, in some locations, our searches indicate that it would not be possible to achieve this.

9. What are the training requirements for the revised manoeuvres, including the measures to protect learners, instructors and other road users during training?

Trainers reported that most of the manoeuvres could be trained safely on-road if required, although many would choose to develop skills off-road initially. The consensus was that four of the five proposed manoeuvres (ridden U-turn, slalom, emergency brake and hazard avoidance) would require an increase in training time as a direct consequence of moving them on-road.

Trainers expressed substantial concern over the hazard avoidance manoeuvre, claiming it was too dangerous to train on-road. In addition, there was concern that a limited number of on-road sites would be suitable for training and testing within a specific area so competition would exist for training and testing time at these sites.

Any future implementation of an on-road test will need to be managed in partnership with the training industry to ensure that provisions for training candidates remain practicable.
Abstract
This study represented the second and third phases of research to explore whether the motorcycle manoeuvres for module 1 of the current practical motorcycle test in Great Britain could be revised and then moved from off-road sites to on-road sites. The anticipated benefit would be a single-event test that may be more accessible to candidates in areas of the country that are not within the vicinity of an existing multi-purpose test centre or other off-road test site. A change of test regime on this scale requires research to ensure that the changes are safe, feasible and do not alter the standards of rider competency required to pass the test. This study first assessed the feasibility and safety requirements of identifying and using on-road sites for trialling manoeuvres. On-road sites would remain open to other road users so it was necessary to devise a set of safety criteria that all trial sites would need to meet. Once these criteria had been agreed, on-road trials with 151 test-ready learners commenced. Each participant completed the proposed on-road manoeuvres and the existing module 1 manoeuvres under mock test conditions. Direct comparisons were made between the on-road and module 1 tests based on learner performance, and subjective workload ratings for learners and examiners. The findings indicated that the on-road manoeuvres were more difficult than module 1 for learners to perform and for examiners to assess. These findings were largely independent of other factors such as the amount of training learners received. The practical and safety implications of moving to an on-road test were also considered. These included test times (an average of 15 minutes, or 26 if including all known preparatory activities but excluding any time associated with deploying a speed measurement device), training implications (training programmes would be less practicable) and a full risk assessment. The risk assessment estimated that national implementation of an on-road test would be likely to create between 447 and 561 ‘major’ incidents (those requiring 3 or more days off work from injuries sustained) per annum. These figures are based on the current number of module 1 candidates presenting for test and assume that on-road testing is run under the same conditions as in this trial.
1 Introduction

1.1 Background and overview

The current practical motorcycle test in Great Britain is conducted in two separate modules that are undertaken by a candidate usually on two separate occasions (with successful completion of module 1 being required before progression to module 2). At present module 1 is a series of off-road manoeuvres that test candidates’ motorcycle competency at slow and higher speeds. This happens at several multi-purpose test centres (MPTCs) and a small number of casual sites operated by the Driving Standards Agency (DSA).

Concerns have been expressed about the accessibility of the module 1 test service to candidates across the country (especially those in remote areas) and also the safety of some of the current module 1 manoeuvres. In June 2010, the then Road Safety Minister announced a review of the practical motorcycle test, with the aim of devising a single-event test that is carried out on the road as far as is possible. As part of this review, TRL was asked to assess the feasibility and safety of carrying out a revised set of manoeuvres on-road rather than having to rely on off-road sites. The work also assessed the level of difficulty of the new manoeuvres in terms of test performance (faults awarded to learner riders in mock test conditions) and perceived difficulty of performing and examining the manoeuvres through self-rated workload using the NASA RTLX scale (see Hart & Staveland, 1988; Hart, 2006).

The work proceeded in three consecutive phases; the first of these phases is described in Tong, Helman, Fowler, Delmonte and Hutchins (2013), and the second and third are described in this report:

1. Phase 1 (Tong et al., 2013) trialled the manoeuvres off-road. Testing areas were made to resemble real roads by marking a centre line and carriageway edges with road marking tape. This afforded an opportunity to establish the initial feasibility, safety and fairness of the manoeuvres themselves without exposing learner riders to potential risks on real roads. Test-ready learner riders carried out the proposed set of manoeuvres under mock-test conditions. They also completed the existing module 1 manoeuvres (in the usual module 1 layout) for direct comparison. A brief overview of the findings from Phase 1 is reported in Section 1.2.

2. Phase 2 built on the findings from Phase 1 by piloting the revised manoeuvres on-road with experienced riders, so that a decision could be made on whether to proceed with Phase 3 (on-road trialling with learner riders). Phase 2 is described in Section 2.

3. Phase 3 trialled the manoeuvres on-road with learner riders, and is described (method and findings respectively) in Sections 3 and 4.

1.2 Phase 1 findings

The Phase 1 findings (Tong et al., 2013) were as follows:

- The revised manoeuvres, with the exception of the figure of 8, appeared to be feasible, practicable and sufficiently safe to proceed with trialling on real roads with experienced riders (Phase 2). It was decided not to trial the on-road figure of 8 on the basis of its difficulty and time taken for completion.
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- Examiners rated their workload as significantly greater when examining the mock-road versions of the ridden U-turn, the slalom, the figure of 8, the emergency brake and the hazard avoidance, in comparison with the module 1 versions of these manoeuvres. Higher workload was attributed to the physical and cognitive demands of marking out these manoeuvres using portable mats, and examining in a ‘mock-road’ environment.

- Learner riders were more likely to receive faults on the mock-road versions of the figure of 8, emergency brake, and hazard avoidance manoeuvres, when compared with the module 1 versions.

- The workload ratings from learners were mixed: the mock-road slalom generated higher workload ratings (i.e. rated more difficult) and the mock road versions of the hazard avoidance and emergency brake manoeuvres (only for bigger bikes in the latter) had lower workload ratings than the module 1 equivalents. This appeared to be related to learners’ over-estimates of their own performance; on other measures of workload the mock-road versions were rated as having higher workload.

- Examiners were generally inconsistent when estimating learners’ speeds. When extrapolated to a test situation, the outcome would be an unacceptable number of incorrect pass or fail decisions (13–36%). An objective method of speed measurement was considered necessary for further trials and future test implementation.

- On average, full mock-road tests took 13 minutes 34 seconds, in comparison with around 10 minutes for the current module 1 test. This included set-up of all the manoeuvres and all briefings, but not measuring out the manoeuvring area or any initial dynamic risk assessment (which would be necessary in a live test situation on a real road). Furthermore, the effect of traffic on test timings was not explored in Phase 1.

- The initial risk assessment identified that any on-road area used for trials would require 'zones' where specific control measures were implemented to mitigate some of the risks presented by the on-road environment.

- Data on the times taken to perform each manoeuvre made it possible to calculate (for given traffic speeds) the distances over which examiners would need clear line of sight to ensure that traffic would not enter the manoeuvring area while a manoeuvre was underway.

- Training for the mock-road manoeuvres was rated by trainers as more difficult than for module 1, with the exception of the manual handling and slalom manoeuvres, which were rated as easier. Overall, trainers said that they would continue to train learners off-road, and would only progress to training some manoeuvres on-road in accordance with safety, legality and learners' abilities.

Phase 1 results were used as the basis of planning Phases 2 and 3. These phases took the research on-road. The remainder of this document discusses the methods and findings relating to Phases 2 and 3 of the research, before answering the core research

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1 Examiners and learner riders were asked to act as if the ‘mock road’ area had the potential to contain traffic, and carry out visual checks as they would on a live road.
questions (see Section 1.4) using the most relevant findings from across all three phases.

1.3 On-road manoeuvres being assessed

Table 1-1 shows the manoeuvres in the current module 1 test, and the corresponding on-road manoeuvres trialled in Phases 2 and 3. Diagrams, dimensions and a description of the procedure for the on-road manoeuvres can be found in Appendix A.

Table 1-1: Module 1 manoeuvres and equivalent on-road manoeuvres

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<th>On-road equivalents</th>
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<td>Ridden U-turn</td>
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<td>Slalom</td>
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<td>Emergency stop after curve</td>
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<tr>
<td>Hazard avoidance after curve</td>
<td>Revised hazard avoidance after 85m straight</td>
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1.4 Research questions

Nine research questions were addressed by the project as a whole. Data from Phase 1 (Tong et al., 2013) provided initial answers to each question and outlined the case for proceeding to on-road trialling. Data from Phase 3 provided comprehensive answers to the questions, building on the Phase 1 findings and lessons learned during the piloting in Phase 2.

The research questions are split into three categories. Questions 1–3 are concerned with test standards and the performance and feedback of learner riders. Questions 4–8 are concerned with the feasibility and safety implications of testing the revised manoeuvres on-road. Question 9 is concerned with the feasibility and safety of training the revised manoeuvres.

Questions about testing standards and the performance of learner riders:

1. **Do the revised manoeuvres assess the same competencies and to the same standard as the existing module 1 manoeuvres?**
2. **Can the revised exercises be conducted on-road in a fair and consistent manner for riders using motorcycles with different power outputs?**
3. **Do weather conditions have any implications for the examining of the revised manoeuvres and the assessment of performance?**

² In order to provide flexibility regarding the proposed manual handling exercises, three different manoeuvres of this type were trialled in Phase 1—the pushed U-turn and a forward or reverse push from a bay though 90°—with approximately a third of candidates taking each. In any future version of the test, candidates would only be required to perform one of these for the manual handling section of their test. In Phases 2 and 3, it was decided that the pushed U-turn manoeuvre should be trialled with all candidates as it is this manoeuvre which is likely to be used on-road if the on-road version of the test is implemented.
To answer these questions, comparisons were made between the DL25 test report fault data, workload ratings from learners, and senior examiner competence ratings for learner riders. The same datasets were also compared according to the different sizes of motorcycle used and the road surface conditions in different weather.

**Questions about feasibility and safety of testing**

4. **What is the feasibility of using portable speed measuring equipment when trialling on-road?**

Some portable speed testing devices were sourced by DSA for the trials, and field-testing was carried out.

5. **What is the time taken to complete the revised set of manoeuvres in simulated test conditions?**

Times were measured from observations, and appropriate averages calculated.

6. **What are the implications of the revised exercises (when being examined) for the safety of learner riders, examiners, and other road users?**

Data were gathered from learner riders and examiners, and were combined with accompanying risk assessment data to answer this question.

7. **What are the safety parameters (including criteria for space protection) required to safeguard all road users during an on-road test, and what are the other criteria for suitable on-road test locations?**

Observations of learner riders and accompanying risk assessment data, along with expert feedback from examiners, were used to address this question.

8. **What is the feasibility of conducting the revised manoeuvres at different types of road location (e.g. urban versus rural)?**

During the process of answering research questions 6 and 7, attention was paid to any potential mapping between the parameters and criteria identified, and road categorisations (such as rural/urban).

**Question about feasibility and safety of training**

9. **What are the training requirements for the revised manoeuvres, including the measures to protect learners, instructors and other road users during training?**

To answer this question, trainers logged all training time for learner riders, completed questionnaires and some participated in focus groups and interviews.

**1.5 Structure of this report**

Section 2 describes Phase 2, including the reasoning for progressing with Phase 3, and the revised risk assessment. Section 3 reports the method used for the Phase 3 trialling and Section 4 describes the findings. Section 5 draws conclusions based on the findings from all three phases.
2 Phase 2

Phase 1 of the research showed that with the exception of the figure of 8, learner riders were able to perform the new manoeuvres within the confines of a road width (7.5m) without excessive difficulty. Thus the Phase 1 findings justified taking the manoeuvres (with the exception of the figure of 8) forward for on-road trialling.

The purpose of Phase 2 of the research was to pilot the manoeuvres on-road with experienced motorcyclists before exposing any learner riders to the risks that on-road trialling would present. This piloting was designed to enable identification of any changes required to the safety criteria carried forward from Phase 1 and whether, on this basis, Phase 3 could proceed.

The scale of the Phase 2 piloting (in particular the very small sample sizes) requires that its findings are presented largely in qualitative terms, and treated as indicative rather than definitive. Although in some cases we do report quantitative values (for example for the time taken to run tests at different sites) none of these should be taken as robust estimates of absolute values likely if testing was taken on-road for real\(^3\). The Phase 3 findings provide more robust quantitative data, and directly address the research questions (see Section 4).

In this section we describe the methods and initial findings related to identifying sites, and the methods and initial findings related to the feasibility and safety of running the manoeuvres on-road. In addition, we report the implications for Phase 3 from the pilot data collected in Phase 2.

2.1 Identifying on-road sites

2.1.1 Method

Four locations in England were selected to trial the on-road manoeuvres from a short-list of 11 locations. These 11 locations were all centred on Multi-Purpose Test Centres (MPTCs) with the exception of one that was included to represent a ‘gap’ area – i.e. a location where candidates can present for a Module 2 test but have to travel a greater distance to undertake a module 1 test at an MPTC. All the locations were selected on the basis of a high throughput of candidates, which would enable them to be suitable sites for Phase 3 if the research progressed to that stage. Choosing an MPTC as the centre of a location for the on-road trials would also permit easier comparisons to be made with module 1 tests for participants in Phase 3.

There were five steps to the process of identifying and selecting on-road sites that could be suitable for trialling the manoeuvres in Phase 2:

1. Online map tools were used to search systematically for suitable roads within a radius of up to 10 miles from the selected test centre locations. The search focused on roads that were straight for approximately 1km, single carriageway, approximately 7.5m wide, with a 30–40mph speed limit, with few (if any) side junctions and with little roadside furniture. Attempts were made to avoid roads that

\(^3\) The one possible exception to this is the ‘hit rate’ obtained on site surveys, reported in Section 2.1.2, which may be viewed as a reasonable estimate given the extensive survey activity that took place in Phase 2.
were believed to be heavily trafficked (e.g. major trunk routes, town centres). Google Earth was used to measure road length and width; Google Maps Street View was used to explore road layout, speed limits and roadside furniture.

2. A list of possible on-road sites was drawn up for all of the proposed locations. Contact was then made with the DSA test centre managers at each of the locations. Test centre managers were invited to provide feedback on the list of suggested sites from TRL as well as providing their own suggestions based on their local knowledge of the area. This information was used to generate a final list of on-road sites that would be assessed in person.

3. Site visits were arranged in the vicinity of four of the 11 test centre locations. The four selected locations were those with the most appropriate on-road sites according to the map search. Site visits required an initial drive of the road to identify a suitable manoeuvring area. This was followed by a detailed assessment of how well each site met the safety criteria from Phase 1. The initial aim was to identify at least four possible sites at each location (two urban and two rural).

4. Once these sites had been selected, the local highway authority (LHA) was notified so that permission could be given to erect temporary warning signs at each location. All LHAs granted permission for the signs to be used and for the trials to go ahead. The local police force for each location was also contacted to request permission to hold the trials on public roads and to log details of each event in case members of the public reported any concerns. None of the police forces that were contacted objected.

5. Further risk assessments were conducted at each site on the day of the trials. These additional risk assessments were required due to the changing nature of the on-road environment; hazards such as parked vehicles, roadworks, debris, lighting and obstacles can be subject to frequent changes so it was important to capture such risks immediately prior to trialling at a given location.

2.1.2 Findings

2.1.2.1 Summary

Contact with test centre managers was attempted at all of the locations in Table 2-1. The shaded rows indicate the four locations that were eventually used in Phase 2; trials were conducted at a total of 13 sites split across these locations, although it should be noted that not all of the sites used were deemed safe for learner riders in Phase 3.

The method followed was as described in Section 2.1.1. An initial map search was carried out for all sites to assess the general location. For all sites (except Burton on Trent, Birmingham and Leicester) the initial search was expanded to a more detailed map survey of the location to identify suitable sites. This initial search indicated that:

- Banbury yielded the biggest range of potentially suitable roads from an initial search, followed by Cambridge. It was easier to identify potentially suitable roads in these locations than it was in the other surveyed locations. Suitable sites were typically roads into and out of villages (with good sight lines and reduced speed limits towards the village centre), and industrial sites.

- Basildon, Erith, Enfield and Burgess Hill provided few potentially suitable roads. The majority of potential sites did not meet the safety criteria regarding side junctions, premises and surface irregularities. In busier urban centres it was noted that long,
...straight 30mph roads that might otherwise be suitable were often restricted by traffic calming measures.

Overall, 75 potential sites were identified using online map tools and a further 20 were suggested by test centres. Almost half of these 95 sites (44, or 46%) were surveyed in person. Of those surveyed in person, 15 (34%) were considered suitable for on-road trials after being fully risk assessed. This is an indication of the rate of conversion from surveying a site in person through to verifying that the site is suitable for trialling with experienced riders when risk assessing against the safety criteria adopted. The conversion rate for finding sites suitable for trialling with learner riders is reported in Section 4.

### Table 2-1: Phase 2 site assessments for on-road trials

<table>
<thead>
<tr>
<th>Location</th>
<th>Number of sites identified</th>
<th>From initial map search</th>
<th>From local test centres</th>
<th>To survey in person</th>
<th>To risk assess</th>
<th>To consider for trials</th>
<th>Actually trialled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farnborough</td>
<td>14</td>
<td>9</td>
<td>17</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Uxbridge</td>
<td>14</td>
<td>7</td>
<td>10</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Banbury</td>
<td>23</td>
<td>-</td>
<td>8</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Cambridgeshire</td>
<td>16</td>
<td>-</td>
<td>9</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Basildon</td>
<td>5</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Erith</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Enfield</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Burgess Hill</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Burton on Trent</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Birmingham</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Leicester</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>75</strong></td>
<td><strong>20</strong></td>
<td><strong>44</strong></td>
<td><strong>17</strong></td>
<td><strong>15</strong></td>
<td><strong>13</strong></td>
<td></td>
</tr>
</tbody>
</table>

2.1.2.2 Initial site surveys in person

When surveying in person, over half of the potential sites were quickly discounted due to a combination of factors such as speed limit (too high, at 50–60mph), gradient, width (too narrow) and visibility. This is another finding from Phase 2: many sites identified as potentially useful will not require full risk assessments to rule them out for on-road testing. Specific examples of roads that were deemed obviously not suitable after a brief personal survey are provided in this section, for illustration.

Figure 2-1 shows an unsuitable road in Farnborough. Although the road was an appropriate length, there were no sections that were sufficiently long without being intersected by at least one side junction; many hedges at the roadside were very high (thus reducing the visibility of emerging traffic). In addition, the road had frequent kerbside furniture (as shown in the image) which was not sufficiently spaced to permit a manoeuvring and run off area without increasing the risks to which riders would be exposed.
Figure 2-1: An unsuitable road in Farnborough due to junctions and road furniture

Figure 2-2 shows another unsuitable road in Farnborough. Whilst it met several of the safety criteria, the presence of a substantial ditch on one side meant it was considered unsafe. The proximity of the ditch to the roadway, coupled with the slippery grass separator and the pronounced camber, presented a heightened risk to riders. In addition, there was no footpath on which the examiner could stand during the trial.

Figure 2-2: An unsuitable road in Farnborough due to a roadside ditch
2.1.2.3 Detailed risk assessments

A total of 17 sites were risk assessed in detail. Of these, 15 sites were considered suitable for trialling, and 13 sites were actually used to trial the manoeuvres with experienced riders. The risk assessments for each site considered whether the proposed safety criteria could be implemented. Table 2-2 shows the overall frequency with which each control measure could be implemented across the sample of 17 sites. It was not possible to find any sites that met absolutely all of the proposed safety criteria. However, lessons learned during these risk assessments, and during on-road trialling with experienced riders, permitted some relaxation of the criteria (reported in Section 2.3). Notable findings from the risk assessments are as follows:

- All of the on-road sites had sufficient length for the run-up (85m), the manoeuvring area (31.5m) and the run-off (65m).
- At all sites it was possible to monitor the manoeuvring and run off areas so that no pedestrians or road users were present.
- No sites presented any difficulty for the requirement that examiners and candidates wear high-visibility clothing (for example excessively bright backgrounds against which high-visibility clothing may be less conspicuous than dark clothing).
- At all sites except one there were either no kerbs or kerbs that were no greater than 125mm high. The exception was a site where the kerb height was as high as 140mm; however, the slight increase was considered a tolerable risk on account of the good width of this road (7.4m).
- All sites except one had an acceptable road profile without excessive camber or gradient.
- At all sites except one it was possible to avoid having parked vehicles and road works in the manoeuvring and run off areas\(^4\). The exception at one site was a wide road with parking laybys on the nearside in which one vehicle was parked close to the start of the manoeuvring area and another was parked towards the end of the run off. The nearside position and the distance from the road meant that both vehicles were considered a low risk with experienced riders.
- At all but four sites, there was no obvious issue with parked vehicles in the run-up area. At four sites some parked vehicles were observed in the run up, but it was felt that this was permissible as long as they were offside and neither adjacent to the start position (this could force cars to the opposite carriageway when the rider is waiting kerbside in a vulnerable position) or in the final 20m of the run up (when the rider is starting to focus on the manoeuvre and could make a mistake during braking or fail to see an oncoming vehicle passing the parked vehicle). When riding in a straight line for the main part of the run up, parked vehicles in these positions were judged as presenting a minimal risk to riders.
- At all but two sites, lighting was adequate. In two sites however the tree canopy created inconsistent and unstable lighting conditions. In bright conditions, a

\(^4\) This statement applies to the time at which the sites were assessed with respect to road works. Regarding parked vehicles, the layout of almost all of the sites did not present an obvious issue with vehicles being in the manoeuvring or run-off areas.
stroboscopic effect occurred when riding through the area. In dull conditions, there was reduced visibility.

- At all but two sites it was possible for the examiner to stand on the nearside footway during the hazard avoidance manoeuvre. (Examiners were required to stand on the nearside footway where it is feasible to do so during trials of this manoeuvre.) However, at some trial sites such as the two exceptions encountered, the risks associated with standing on the nearside footway may be greater than the risk of standing on the offside footway (e.g. if the nearside footway is a verge with unstable footing or if the offside provides a better sight line to approaching traffic).

- At all but four sites the examiner was able to give the emergency brake signal from the offside footway. (Examiners were required to stand on the offside footway where it is feasible to do so during trials of this manoeuvre.) Primarily, this was because there was no footway on the offside and the offside verge had uneven footing, both of which could be a greater injury risk to the examiner than staying on the nearside. In addition, at some sites, there was better visibility on one side of the road which was a greater safety consideration than standing on the offside.

- Most sites had suitable surfaces. However four sites had road surface irregularities/ironwork in the manoeuvring and/or run-off areas and six sites had irregularities/ironwork in the run-up. Irregularities were defined as worn/pitted, loose, broken or slippery road surfaces, prominent cat’s eyes, and ironwork included drain and manhole covers. Whilst several sites did have such irregularities, it was frequently possible to position the manoeuvring area so that the surface irregularities were not situated where they would affect braking or turning, or the typical riding line. In the run up, it was decided that ironworks were a tolerable risk if they were not on the riding line or in the braking area. If they were in the riding line, sufficient space would be required to enable a rider to move around the ironwork and retake the riding line before the braking point. Thus a decision was made that ironworks should be excluded from the riding line in the final 20m of the run up.

- About half of the sites had what was considered a low–moderate traffic flow. Of the nine sites with higher traffic flows, it was felt that only five required additional risk control measures to be used in Phase 2. The additional measures to control the risk were typically the placement of “spotters” in one or both approaches to help the examiner identify a sufficient gap in the traffic. A further control measure was to ensure that examiners and riders were briefed to initiate an abort if traffic approached after a manoeuvre had started (riders could initiate the abort independently if they felt uncomfortable with approaching traffic). It should be noted

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5 Whilst acceptable for the trial, this would not be acceptable in a live test situation.

6 Whilst acceptable for the trial, this would not be acceptable in a live test situation.

7 Spotters were members of the research team who were positioned strategically within the on-road site to enable them to view road users who were not visible to the examiner and who were approaching the manoeuvring area. The examiner was notified of approaching vehicles by radio or hand signal. Spotters effectively increased the overall line of sight for examiners at on-road sites where direct line of sight was insufficient. It should be noted that spotters were only implemented as a control measure in Phase 2; for Phase 3, sites were selected so that spotters were not required because their use in any future implementation of an on-road test would not be cost-effective.
that traffic flow is site specific and a definitive maximum flow is difficult to define; at some sites there can be the same average traffic flow but one site may be suitable for the on-road manoeuvres because the traffic arrives in waves and creates gaps that are sufficiently long to run each manoeuvre whereas another site may have evenly distributed traffic with no obvious gaps.

- Seven sites had no side junctions along either visible approach. Those with side junctions in the run up or run off required active spotters to inform the examiner when it was clear to run the manoeuvres. Those with side junctions beyond the run up and run off areas either had spotters or had the effect of reducing the examiner’s ability to assess the clear distance to the point at which the junction was situated. Given the complexities of running the Phase 2 trials with active spotters (it is not an implementable solution and it delays safety-critical information exchange between rider and examiner), it is recommended that side junctions be avoided, although site specific assessments may enable some exceptions.

- Overall, only one site had sufficient visible road length in both directions to meet the visible clear zone requirements for Phase 2. Six sites had sufficient visible distance in the approach to the run up; however, of the 11 that did not meet the distance requirements, five required no further control measures because risk assessments on site revealed that based on prevailing traffic conditions there was actually sufficient time to run each manoeuvre without interruption from traffic as long as no traffic was present at the point of visibility.

- Just three sites had sufficient visible distance in the approach to the run off but similarly, of the 14 that did not meet the distance requirements, eight required no further control measures because there was sufficient time to run each manoeuvre in prevailing traffic conditions.\(^8\)

- Six sites had no street furniture or obstacles in the manoeuvring area. However, only one site was considered unsafe for on-road testing because of the proximity of furniture/obstacles to the kerb. The remaining sites with such furniture and obstacles were considered to present minimal additional risk for testing if prominent obstacles were excluded from the area to the offside of the third marker for the hazard avoidance and beyond, which is where riders would be most likely to travel if they lost control. The types of obstacles that were minimised in the manoeuvring area included trees, lamp posts, telegraph poles and road signs. However, there is an inherent risk associated with testing on-road that is presented by the ever-present property or boundary line that borders all roads (typically in the form of a fence, a wall or dense vegetation).

- Only five sites were free of premises in the manoeuvring, run up and run off areas. Premises present a safety risk because road users or pedestrians can emerge into the path of the rider.

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\(^8\) It became clear that a clear zone based on distance was artificial as it did not allow for changing speed limits on an approach, or the effect of road layout on approaching vehicles (e.g. a road that ends in a T-junction will have lower entering speeds than a through road). Ultimately, the manoeuvring area must be clear for the duration of the manoeuvre so a decision was made that a time-based requirement is more appropriate than a distance-based criterion. For the run up, the time requirement may be slightly less than the manoeuvre time as the rider is moving away from approaching traffic and the closing speed is thus reduced.
• None of the roads provided a run-off area that was completely free of street furniture or obstacles. Common obstacles included property fences, telegraph poles and lighting columns. In most locations, the majority of these obstacles were either towards the end of the run-off or set back from the edge of the road by at least two metres. The risk was considered to be controlled during Phase 2 by using experienced riders.
Table 2-2: Frequency with which Phase 2 safety criteria could be implemented at on-road sites subject to full risk assessments

<table>
<thead>
<tr>
<th>Safety criteria</th>
<th>Sites that meet the safety criteria (N=17)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
</tr>
<tr>
<td>Manoeuvring area of 31.5m</td>
<td>17</td>
</tr>
<tr>
<td>Run-up area of 85m</td>
<td>17</td>
</tr>
<tr>
<td>Run-off area of 65m</td>
<td>17</td>
</tr>
<tr>
<td>No pedestrians/road users in manoeuvring or run-off areas</td>
<td>17</td>
</tr>
<tr>
<td>High visibility sleeved jackets worn by all examiners and high visibility vests to be worn by all candidates</td>
<td>17</td>
</tr>
<tr>
<td>Kerb height &lt;125mm /no kerbs</td>
<td>16</td>
</tr>
<tr>
<td>No excessive gradient/camber</td>
<td>16</td>
</tr>
<tr>
<td>No roadworks, parked cars etc. in manoeuvring area</td>
<td>16</td>
</tr>
<tr>
<td>No roadworks, parked cars etc. in run-off area</td>
<td>16</td>
</tr>
<tr>
<td>Ensure weather and lighting provide suitable visibility</td>
<td>15</td>
</tr>
<tr>
<td>Examiner to stand on nearside footway during hazard avoidance as candidate likely to slide to the offside</td>
<td>15</td>
</tr>
<tr>
<td>No road surface irregularities/ironwork in manoeuvring area</td>
<td>13</td>
</tr>
<tr>
<td>No road surface irregularities/ironwork in run-off area</td>
<td>13</td>
</tr>
<tr>
<td>No roadworks, parked cars etc. in run-off area</td>
<td>13</td>
</tr>
<tr>
<td>Examiner to stand on the offside footway to give emergency brake signal</td>
<td>13</td>
</tr>
<tr>
<td>No road surface irregularities/ironwork in run-up area</td>
<td>11</td>
</tr>
<tr>
<td>Low-moderate traffic flow</td>
<td>8</td>
</tr>
<tr>
<td>No side junctions along either approach</td>
<td>7</td>
</tr>
<tr>
<td>Road length for visibility – approach 1 to run up (483m)</td>
<td>6</td>
</tr>
<tr>
<td>No street furniture or obstacles in manoeuvring area</td>
<td>6</td>
</tr>
<tr>
<td>Road width 7.5m</td>
<td>5</td>
</tr>
<tr>
<td>No premises along manoeuvring, run-up or run-off areas</td>
<td>5</td>
</tr>
<tr>
<td>Road length for visibility – approach 2 to run off (483m)</td>
<td>3</td>
</tr>
<tr>
<td>No street furniture or obstacles in run-off area</td>
<td>0</td>
</tr>
<tr>
<td><strong>Sites used for Phase 2 (from the 17 assessed)</strong></td>
<td><strong>13</strong></td>
</tr>
</tbody>
</table>
2.2 On-road trials

2.2.1 Method

Seven trial days were arranged across four locations. Table 2-3 shows the locations that were used (locations were focused on existing DSA test centres for module 1 and/or 2) and the number of urban and rural test sites at each location.

Table 2-3: Locations and sites used

<table>
<thead>
<tr>
<th>Location</th>
<th>No. urban test sites</th>
<th>No. rural test sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farnborough</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Uxbridge</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Banbury</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Cambridge/Peterborough</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Ten experienced riders were recruited in total. All riders were experienced motorcycle trainers from the local area. They were recruited via DSA using a self-selection process (an invitation was issued to all trainers who had registered to use the test centre at the selected location). Trainers then contacted TRL to express their interest and were sent information about the new manoeuvres by email.

Trainers who chose to participate were asked to do so on a motorcycle that represented the machines on which test candidates would learn to ride (a mixture of >500cc machines and 125cc machines). Trainers were reimbursed for their time.

Each trainer attended at least one site, with many taking part at multiple sites. At each site, trainers were asked to complete the revised manoeuvres under mock test conditions and the guidance and supervision of at least two DSA examiners. All activity was observed by TRL staff and video-recorded. At the end of each trial day, trainers and examiners were asked to complete self-rated workload questionnaires to report on their experiences. These questionnaires can be seen in Appendix B and are described in more detail in Section 3.2.

While the trials were taking place, temporary warning signs were placed at locations where traffic may enter the run up, run off and manoeuvring areas. Precise locations varied by site. An example of a sign is shown in Figure 2-3.

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9 The urban-rural distinction between sites was often blurred. Many sites were best described as semi-rural/urban and ultimately this classification was not the deciding factor in site selection. Factors such as road width, furniture, sight lines and traffic flow had a far greater effect on site suitability.
2.2.2 Findings

2.2.2.1 Traffic flows

The mean number of road users passing through all or part of the test area during the on-road trials at each site (including all vehicle types, cyclists and pedestrians) ranged from 0.4 to 5.6 per minute when trials were being run. These means were based on, at most, four tests and in many cases only two, so these traffic flows should not be assumed to be representative of the kinds of site that might be used for on-road implementation. One point illustrated clearly by the flow information, however, is that a low traffic flow is necessary, but not sufficient, for a site to be suitable for trialling. For example one site with a mean traffic flow of 3.3 road users per minute was judged by the observers to present more risk from traffic than another site with a traffic flow nearly twice as high, due to the nature in which the traffic approached the run-up and manoeuvring areas. This is one example of the general tone of the findings from Phase 2 of the project. In all cases, a holistic approach to the risk assessment (with piloting) was necessary to identify whether or not a site was suitable for trialling; the safety criteria could be used as a guide but could not be guaranteed to rule sites in or out.

2.2.2.2 Test duration

The test times were recorded for 16 test events. Times include briefing the rider for each manoeuvre, waiting for traffic to clear, laying any markers in the road (but not measuring) and then the rider riding the manoeuvres. The data showed that:
The shortest time for a complete test was 8 minutes. There were two examples of this time – at the two sites with the lowest traffic flow.

The longest complete test was 20.1 minutes. Interestingly this test was not at the site with the highest traffic flow, but at a site with a traffic flow of only 1.7 road users per minute. This illustrates the fact that a low traffic flow does not guarantee a short test.

The average time to complete a test was 14 minutes, which agrees broadly with the value from Phase 1.

These examples are based on all complete tests where there was a single attempt at each of the high speed manoeuvres. A complete test with two attempts at each of the high speed manoeuvres (based on times taken for these manoeuvres in the trialling) could be an average of 21 minutes (with a range of approximately 10 minutes through to 31 minutes). Note that these estimates are indicative only, and do not account for any time for examiners to carry out a dynamic risk assessment of the site before testing candidates (which would be required if on-road testing is implemented).

2.2.2.3 Riding time per manoeuvre

Riding times (the amount of time the candidate was actually riding their motorcycle, but not including riding to the start position) for each manoeuvre did not vary substantially between sites and were similar to those observed in Phase 1 of the research. The overall averages showed that the shortest riding time was for the ridden U-turn (14 seconds) and the longest was for the hazard avoidance (22 seconds). These riding times will be indicative of the clear distance required for each manoeuvre when using a time-based requirement for sightlines in Phase 3.

2.2.2.4 Rider waiting time per manoeuvre

The length of time riders spent waiting in the road on their motorcycles for each manoeuvre was found to vary from around six minutes to around 13 minutes. The key determinant of waiting time (which will be estimated with more precision in Phase 3) is the behaviour of traffic at the site, since examiners must wait for sufficiently large gaps in the traffic to begin the manoeuvres. Time waiting in the road for the ‘go’ signal puts riders at risk of being struck by passing traffic; this is of particular concern if the road is not sufficiently wide to allow two-way traffic to pass without conflict.

In order to minimise the risk to riders and other road users, the data collected in Phase 2 suggest that there are two key considerations for site selection: road width and traffic flow. If traffic flow is very low, narrower roads may be acceptable as few traffic conflicts are likely to be created by a rider waiting in the road. If traffic flow is moderate, the road must be sufficiently wide to permit two-way traffic when the rider is waiting kerbside. Narrower roads with moderate traffic flows may only be acceptable if the site permits the rider to wait off the road (e.g. in a layby) for briefings and when waiting to start the run up for the higher speed manoeuvres.

2.2.2.5 Behaviour of other road users

One of the key considerations for Phase 2 was how other vehicles would respond when markers were placed in the road. Two types of marker were trialled in Phase 2; these were the flat yellow rubber discs used for Phase 1 and small, deformable rubber puck-
style markers with a height of approximately five centimetres. Both types of marker are shown in Figure 2-4. Anecdotal findings from Phase 1 indicated that the flat discs were difficult to see for both riders and examiners so a more visible marker (the puck) was sought.

Figure 2-4: Markers used for on-road trials (flat yellow discs and pucks with a height of approximately 5cm)

Video analysis of the test events indicated that substantially more vehicles would move to the opposite lane if they encountered the pucks in the road than if they encountered the flat yellow discs (Table 2-4).

Table 2-4: Percentage of vehicles crossing to the opposite lane when encountering markers in the road, by type of marker

<table>
<thead>
<tr>
<th>Marker type</th>
<th>Percentage of vehicles crossing to the opposite lane for each manoeuvre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Slalom</td>
</tr>
<tr>
<td>Raised pucks</td>
<td>85.4</td>
</tr>
<tr>
<td>Flat yellow discs</td>
<td>43.5</td>
</tr>
</tbody>
</table>

The slalom configuration prompted the greatest proportion of vehicles to move to the opposite lane for both types of marker, although twice as many did when the pucks were deployed. When using the flat yellow discs for the higher speed manoeuvres, fewer than 10% of passing vehicles moved to the opposite lane. Figure 2-5 shows an example of typical response to the puck markers in the slalom configuration.

Figure 2-5: An example of erratic road-user behaviour in response to the puck markers
Based on these observations, it quickly became apparent that the pucks could not be used safely on a road with moderate traffic flows as the movement of vehicles to the opposite lane created a conflict with oncoming traffic. In some instances, unsafe behaviour was observed, such as late braking with a vehicle following close behind and sudden, sharp steering to avoid the pucks. It was therefore decided that pucks would only be used during the remaining Phase 2 trial days at quiet sites where the rate of passing road users was low enough to make traffic conflicts of this nature very rare. It was decided that this safety criterion would remain for Phase 3, with yellow disc markers being used at any sites where it was felt that the pucks would present unnecessary risks.

2.2.2.6 Rider and examiner feedback

The riders and examiners who took part in Phase 2 provided feedback on the manoeuvres using a similar questionnaire to that administered during Phase 1. The question items calculate task workload and are based on the NASA Raw Task Load Index (RTLX) (Hart & Staveland, 1988). This is a multi-dimensional scale designed to obtain subjective estimates of workload from people immediately after they have performed a task. In addition, respondents rated the confidence, and the feelings of risk and vulnerability they experienced when taking part. The data gathered in Phase 2 cannot be used for formal analysis due to the very small sample sizes involved. Nonetheless it is possible to use the data to give initial, indicative answers to the following questions:

- What can we learn about the suitability of the sites that were selected for Phase 2? How does feedback from examiners and riders compare with the risk assessments of each site?
- What can we learn about the difficulty of riding and examining the manoeuvres on roads?
- What level of risk do examiners and riders perceive when riding the manoeuvres on roads?
- How does the feedback affect Phase 3 (on-road trials using test-ready novices)?

With regard to the suitability of sites, the overall measures of workload, vulnerability, risk and confidence from both examiners and riders indicate collectively that two sites were the most suited to the trialling of the new manoeuvres. Specifically these two sites generated the lowest workload rating for examiners when setting up and examining the manoeuvres, and for riders when riding the manoeuvres. In general, they also generated the lowest ratings of risk and vulnerability, and the highest ratings of confidence. Interestingly, site risk assessments conducted in advance of the trials concluded that these two roads would be most suitable for on-road trials. The subsequent analysis of examiner and rider feedback supports these a priori site assessments.

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10 It should be noted that there are also drawbacks associated with using the flat yellow disc markers. For example they very occasionally move from wind created by large vehicles passing. In addition, they are unlikely to be suitable for implementation in a live test environment given the difficulties in seeing them reported by examiners and riders during Phase 1.
With regard to the difficulty of riding and examining the manoeuvres on roads, the most striking finding was the variability in workload by site; at some sites workload was universally at the lower end of the scale (overall and for individual manoeuvres) whereas at other sites workload ranged from moderate to high overall (and was very high for some manoeuvres). Phase 3 will provide a much more robust estimate of how workload varies by site, and by manoeuvre.

With regard to the perceived risk of riding and examining the manoeuvres on roads, the data present similar findings to those based on the workload scores.

Examiners typically reported high levels of confidence when testing the manoeuvres on real roads. There were a small number of sites that were exceptions; often these sites had frequent passing traffic or other characteristics that might be expected to affect confidence, such as narrow road width, street furniture, and poor sight lines.

With careful site selection, there are indications from all these data that the manoeuvres could be trialled further on-road without generating high feelings of risk and vulnerability, or excessive workload. Whether this remains true for learner riders is a matter for Phase 3 to determine.

### 2.3 Implications for Phase 3

Phase 2 was designed to assess the safety and feasibility of progressing to on-road trials with test-ready learners across a wide range of locations (Phase 3). The implications arising from Phase 2 for the feasibility and safety of Phase 3 are presented in Sections 2.3.1, 2.3.2, and 2.3.3.

#### 2.3.1 Identifying and selecting on-road sites

Phase 2 demonstrated that it was feasible to combine online map tools and the local knowledge of DSA test centre managers to good effect when searching for on-road sites that would be suitable for carrying out the revised manoeuvres. From the small sample of locations that were surveyed during Phase 2, a greater number of potential sites were identified using online map tools than from the knowledge of test centre staff. However, a much wider area was surveyed online around each test centre (up to a 10 mile radius) than was typically considered by test centre staff, who often identified sites that were along existing test routes (and therefore within a smaller radius from the test centre). For implementation, it would be important to consider first those on-road sites that are within the current network of test routes. It should also be noted that test centre staff were briefed to identify on-road sites that met the safety criteria for Phase 2; this contrasted with the online map searches that applied the safety criteria with greater flexibility when it became clear that some specific criteria (e.g. length of road) were difficult to satisfy, and could be relaxed under certain conditions.

Using the safety criteria set for Phase 2, a total of 44 sites were surveyed in person; 34% of these were approved for trials—a conversion rate of approximately one in three from the point at which sites are surveyed in person, when searching for sites suitable for trialling with experienced riders. It is likely that this conversion rate would be lower if attempting to find sites suitable for use with learner riders. Phase 3 will provide more data on this.
2.3.2 Revised safety criteria

Consideration was given to which criteria could be adjusted or relaxed in order to identify further sites for Phase 3. The assessment was guided by a consideration of what was feasible (during the site selection work) as well as the findings of the on-road trials at sites where some of the proposed safety criteria were not met.

In summary, the proposed adjustments are as below. A more detailed description of the changes can be seen in Appendix C.

1. Road widths below 7.5m (but above 5.5m) are acceptable for all manoeuvres except the ridden U-turn. Further on-road testing with novices is recommended to assess the suitability of road widths of 6–7.5m for the ridden U-turn. Narrower roads can be tolerated if the ridden U-turn is tested at another site and if traffic flow is low (or there is a place for riders to wait off-road) so that waiting riders do not create conflicts between passing two-way traffic. However, narrower roads still need to provide sufficient width for riders to be able to turn in the road when positioning for the two higher-speed manoeuvres (space for a pushed U-turn is the minimum requirement for this).

2. A run-off area of 55m from the point of a controlled stop on-road (i.e. the end of the manoeuvring area, indicated by the fourth marker) is sufficient. For comparison, a typical motorcycle manoeuvring area (MMA) has a run-off area that is approximately a quarter of this distance (13m) from the controlled stopping box to the perimeter fence of an MMA (and 57m from the point at which the speed is measured). See also criterion 6 below.

3. Visible clear zone requirements should be based on time (to complete the longest manoeuvre before traffic arrives) rather than distance. A site specific assessment is required and consideration given to the apparent effects of the temporary warning signs. In addition, because the examiner can observe motorcyclists during the run-up for the higher speed manoeuvres, the time requirement in this direction can be relaxed; the rider is moving away from any following traffic so the closing speed is reduced and the chance of the manoeuvre being completed before any road users come into view can be judged by the examiner.

4. Tree canopies covering the on-road area should be avoided as the reduced light can affect visibility for riders and examiners, or create a confusing stroboscopic effect for the rider when sunlight penetrates the canopy.

5. A traffic flow with sufficient gaps to run the manoeuvres is required, rather than any specific average traffic flow.

6. There should be no road surface irregularities/ironwork in the final 20m of the run-up (thus allowing some irregularities in the other part of the run-up). Individual site assessments will be required for any irregularities in the manoeuvring or run off areas.

7. Street furniture and obstacles in the manoeuvring and run-off areas should be avoided where possible. However, it needs to be accepted that the road environment carries an inherent risk associated with the property or boundary line to the road (often a hedge, fence or wall) and that some obstacles are almost always present. Risks can be controlled to a level that is as low as reasonably practicable (ALARP) by ensuring that furniture is set back from the road as far as possible. A minimum distance from marker 3 (where the hazard avoidance manoeuvre is taking place)
may need to be considered during Phase 3, and learners' skills and abilities will also need to be monitored by senior examiners to ensure that those without the required competencies are not exposed to any residual risk presented by obstacles.

8. There should be no roadworks or parked cars in the run-up, manoeuvring and run-off areas but parked cars can be accepted in the offside run-up if they are not adjacent to the rider's start position or in the final 20m.

9. There should be no side junctions in the run up, manoeuvring area and run off areas. Side junctions are permitted outside these areas in line with the time-based clear zone requirements for visibility.

10. There should be no premises along manoeuvring, run-up or run-off areas where it is not possible to see or anticipate emerging road users or pedestrians. Experience from the on-road risk assessments (and trials in Phase 2 - see Section 2.2) suggested that premises along the test area can be tolerated if they are set back from the road and/or provide the examiner with a good line of sight to monitor vehicle and pedestrian movements. Premises with restricted visibility (e.g. high hedges) that are set close to the road present a level of risk that cannot be controlled by an examiner working alone.

11. The examiner should exercise discretion regarding where to stand during the higher speed manoeuvres. If the 'correct' place to stand is on a verge with uneven footing or a footway with poor visibility to approaching traffic then these risks should be considered as part of the site assessment. Examiners could generally stand offside for the emergency stop (at 82% of sites) and nearside for the hazard avoidance manoeuvre (at 88% of sites), which are the correct positions for their safety (according to current DSA practice).

Further new measures have emerged during Phase 2. These are recommended for assessing Phase 3 sites. They include the following:

12. Selected sites require a safe area for the rider to wait. If the road is too narrow for traffic to pass the rider without straying into the opposite carriageway and affecting oncoming vehicles then the site should enable the rider to wait off the road slightly, particularly at the start of the run-up. The exception is on very quiet roads where traffic in both directions is extremely rare.

13. Pedestrians in the run-up can be tolerated if moving away from the manoeuvring area. They must not be within the final 20m of the run-up area during the high speed manoeuvres.

14. Examiners should wear high visibility sleeved jackets that are clean, fastened and feature contrasting yellow and orange colours. However, if the abort and go signals for the high speed manoeuvres are issued using flags then high visibility vests are sufficient (sleeved high visibility jackets are required for arm signals).

15. The ‘puck’ markers, while more suitable for riders in terms of visibility, are not suitable for use on busier sites with two-way traffic due to the avoiding behaviour of approaching vehicles, the frequent erratic reactions of drivers and the conflict they create between two-way traffic. While there are also drawbacks associated with using the flat yellow disc markers (for example they very occasionally move from wind created by passing large vehicles), these markers may be preferable in some
situations, although the traffic flow at each site can be considered when deciding on whether pucks are suitable.

16. An abort protocol is required, with both examiners and riders having the power to abort if they believe there is a safety risk to continuing a manoeuvre. The protocol should be based on radio communication between examiners and riders, and supported by clear visual signals.

17. Open drains in the kerb are to be avoided in the manoeuvring and run-off areas as they present a limb entanglement hazard.

18. Deep ditches close to the edge of the road are to be avoided as the risk of injury for riders that veer off the road is believed to be substantially greater than for roads without ditches.

2.3.3 Revising the risk assessment for Phase 3

The Phase 1 risk assessment was revisited to assess the effect of compiling a revised set of safety criteria. For each manoeuvre, several top level hazardous events were identified in Phase 1 and the risk was reduced for some by the stricter safety criteria implemented for Phase 2. For all manoeuvres, one of the most effective risk control measures for Phase 2 was the use of experienced riders. For Phase 3 this criterion must necessarily be relaxed to enable test-ready learner riders to participate. Whilst this does increase the risk, examiners will be briefed to use their discretion and will not test motorcyclists who are considered unprepared for the manoeuvres. Discussions with trainers will ensure that an acceptable amount of pre-trial training has been conducted.

The effect of relaxing this and other safety criteria was therefore assessed for each manoeuvre. A detailed description of the risk assessments (including all Phases of the research) can be seen in Appendix D. In summary, the changes in risk from Phase 2 to Phase 3 were assessed as:

- A marginal increase for the pushed U-turn, due to changing controls on kerb heights and street furniture. The revised risk level was not substantial enough to be considered a concern.
- A marginal increase for two of the three hazardous events for the ridden U-turn, due to changing controls on the run-off area, the clear zone requirements, the kerb heights, the street furniture, and the presence of premises in the test area. The revised risk level was not substantial enough to be considered a concern.
- A marginal increase for four of the six hazardous events for the emergency brake, and a marginal increase for three of the four hazardous events for the hazard avoidance, both of which were due to changing controls on the run-off area, the clear zone requirements, and the presence of parked vehicles in the run-up. The revised risk level was not substantial enough to be considered a concern.

In summary, none of the adjustments to the risk assessment going into Phase 3 were either substantial or a cause for concern providing that the Phase 3 safety criteria are implemented in full.

2.4 Broad conclusions from Phase 2

Based on the findings from Phase 2, the following broad conclusions are drawn:
• Phase 3 (with some additional control measures) seems plausible and ethically acceptable, but only on roads that meet the revised safety criteria. Phase 3 will provide robust data on timing, workload ratings, and learner performance.

• From the site searches carried out for Phase 2, it would seem that some locations do not have suitable roads within a reasonable distance of the test route network around the test centre. Suitable roads were more easily found in the one ‘gap’ area as well as outside of the busy South East area of England. This may be indicative of where Phase 3 locations should be sought, and could affect decisions regarding the feasibility of on-road testing nationwide.

• Further work will need to be done to establish whether such roads can be found in gap areas and in areas with MPTCs; as a national exercise, this will be more fruitful post-Phase 3, when a final list of road criteria will be available.
3 Phase 3 – background and method

Phase 3 is the culmination of the project in that it trials the manoeuvres with test-ready learners on real roads. The aim of Phase 3 was to address the research questions in detail, and to output a clear set of criteria and outcomes that would be expected should the DSA and DfT pursue testing of the revised on-road manoeuvres as an alternative to the current module 1 test. The basic design of Phase 3 was a direct comparison of the on-road manoeuvres and the current module 1 manoeuvres. The principle variables of interest were workload (for learners and examiners) and performance (for learners).

3.1 Design

A repeated measures design was used for most of the comparisons of questionnaire scale measures. Questionnaire responses from each learner rider, examiner or trainer were used to draw comparisons between the relevant module 1 and on-road manoeuvres. The key independent variable was ‘test type’ (related samples, two levels: ‘on-road’ and ‘module 1’). For learner riders, ‘bike type’ and ‘weather conditions’ were also used as between-participants variables. When sample size permitted, appropriate statistical tests were used to test for the statistical significance of any differences observed. To assess the overall effects of specific variables, repeated measures ANOVA (analysis of variance) tests were conducted; to explore differences between module 1 and on-road data for the same variable, paired samples t-tests were conducted. For fault data, McNemar tests were used to assess whether the on-road or module 1 test manoeuvres were more likely to result in faults being awarded.

The order in which participants completed the module 1 and on-road tests was balanced as closely as possible, with 73 participants completing the module 1 manoeuvres first and 78 completing the on-road manoeuvres first. This was done in an effort to control possible order effects.

Ethics clearance for the study was granted by an Ethics Panel associated with the TRL Ethics Committee.

3.2 Materials

The questionnaire materials used in Phase 3 can be found in Appendix B. All of the questionnaire measures were bespoke, with the exception of the NASA Raw Task Load Index (RTLX) (Hart & Staveland, 1988). This is a multi-dimensional scale designed to obtain subjective estimates of workload from people immediately after they have performed a task. It has been used in a variety of domains (including the operation of automobiles) since its original development in the aviation context and has been shown to be a reliable and valid measure of workload (for a review see Hart, 2006).

In addition to the above data, interviews and focus groups were held with trainers (the topic guide used can be seen in Appendix E) and general feedback was invited from local and senior examiners. These qualitative data were used to address the research questions when appropriate.

3.3 On-road trial sites

The method used to identify sites for on-road trials in Phase 3 was broadly the same as Phase 2 but applying the revised safety criteria described in Section 2.3.2. More
information on the site selection process is provided in Section 4.7. Table 3-1 lists the 11 sites used for on-road trials in Phase 3, and the number of participants at each. Darlington was the most used trial site, followed by Walton and Basildon; collectively, 70% of participants were trialled at one of these locations.

**Table 3-1: Trial locations for on-road trials**

<table>
<thead>
<tr>
<th>Trial area</th>
<th>Trial site</th>
<th>Nearest MPTC(s)</th>
<th>No. of trial events</th>
<th>No. of learner riders</th>
<th>% of sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Yorkshire (N)</td>
<td>Darlington</td>
<td>Darlington MPTC</td>
<td>9</td>
<td>67</td>
<td>44</td>
</tr>
<tr>
<td>North Yorkshire (S)</td>
<td>Walton</td>
<td>Walton LGV**</td>
<td>6</td>
<td>20</td>
<td>13</td>
</tr>
<tr>
<td>Essex</td>
<td>Basildon</td>
<td>Basildon MPTC</td>
<td>4</td>
<td>20</td>
<td>13</td>
</tr>
<tr>
<td>Cambridgeshire</td>
<td>Peterborough</td>
<td>Peterborough MPTC</td>
<td>4</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>West Midlands</td>
<td>Wolverhampton</td>
<td>Wolverhampton MPTC</td>
<td>2</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Kent (N)</td>
<td>Sittingbourne</td>
<td>Herne Bay; Gillingham</td>
<td>2</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Somerset</td>
<td>Bristol</td>
<td>Bristol MPTC</td>
<td>1</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Dorset</td>
<td>Poole</td>
<td>Poole LGV**</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Lincolnshire</td>
<td>Lincoln</td>
<td>Lincoln MPTC</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>West Midlands</td>
<td>Shrewsbury</td>
<td>Shrewsbury MPTC</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Oxfordshire</td>
<td>Banbury</td>
<td>Oxford Kassam (casual)</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>32</td>
<td>151</td>
<td>98*</td>
</tr>
</tbody>
</table>

*Total is not 100% due to rounding

**LGV** is ‘Large Goods Vehicle’ and refers to sites used by the Vehicle and Operator Services Agency (VOSA) to test vehicles of this type

### 3.4 Procedure

#### 3.4.1 Participant recruitment

Learner riders were recruited for the study via DSA-approved motorcycle training providers. Training schools were invited to provide learners to take part in the study. The three methods of advertising the study to trainers were as follows:

- DSA sent emails direct to trainers to provide them with information about the study and to request that they register their interest.
- DSA test centres in the vicinity of trial locations displayed posters to advertise the study.
TRL made direct telephone calls to approved trainers in the vicinity of trial locations.

All trainers were asked to provide learner riders that they considered to be ‘test-ready’. The amount of training that was given to participants was left to the discretion of the trainers, with the exception of the revised hazard avoidance manoeuvre for which it was a requirement of the study that learners be taught the skills required to complete this manoeuvre (specifically braking followed immediately by steering).

3.4.2 On-road and module 1 trialling

On arriving at a trial site, learner riders were given an opportunity to ask questions about the study and were then invited to complete a consent form. Each rider was then asked to complete mock examinations of the module 1 manoeuvres (conducted off-road at the nearest MPTC or casual test site) and of the on-road manoeuvres. Both mock tests were examined by local DSA examiners and were supervised by senior DSA examiners.

On a given test day, generally all participants were tested at one site (on-road or module 1) and then again at the other site later during the same day. At the end of each set of manoeuvres, learner riders answered a series of questions to rate the workload associated with the activity they had just completed. After completing both sets of manoeuvres, riders answered a final set of more general questions before finally being thanked and paid for their participation.

The local examiners who delivered the mock tests completed modified DL25 test forms for each learner rider (to record any faults on each manoeuvre), and then at the end of the session answered an examiner questionnaire that enabled them to rate the workload they experienced, and their feelings of risk, vulnerability and confidence when administering mock tests at the on-road site and at the module 1 site. Usually, the senior DSA examiner present at the trial day observed the event and completed a senior examiner questionnaire as each test progressed (to provide a secondary measure of learner rider competence). Occasionally, senior DSA examiners took the test administration role (for example to cover breaks) but when this happened it was ensured that a given learner rider was always assessed by the same examiner in the on-road and module 1 versions of the test.

3.4.3 Data collection from trainers

All trainers completed a training log for each of the learner riders they supplied. This provided an indication of the time spent training for module 1 and the additional time spent training specifically for the revised on-road manoeuvres.

Face-to-face focus groups were organised with some groups of trainers at a few trial sites. In addition, telephone interviews were conducted with several trainers after trial days were complete. The focus groups and interviews were designed to investigate trainers’ views on specific training-related issues for each of the proposed on-road manoeuvres. The specific items discussed were:

- How learners were trained to undertake each on-road manoeuvre for this trial, including:
  - What trainers did
  - Where training was provided (on-road or off-road)
• How easy or difficult it was to train learners for each manoeuvre

• How trainers would approach the training task if they had to train all learners for the proposed on-road manoeuvres, including:
  o How training would differ from current approaches to training learners for this trial
  o Where learners would be trained (on-road or off-road)
  o How easy or difficult it would be to train all students like this

• What could be done to protect the safety of the following groups when training:
  o Learners
  o Trainers
  o Other road users (if training on-road)

3.5 Participant characteristics

In total, 151 learner riders took part in the trials\textsuperscript{11}. References to riders undertaking ‘tests’ in this report refer to the trials of the two sets of manoeuvres. However, neither the module 1 manoeuvres, nor the proposed revised set of manoeuvres, constituted a real test. No candidate was issued a test pass as an outcome from these trials, even though the trials were conducted as far as possible under the same conditions as real tests and, for the purposes of evaluating the outcome, candidates may have been deemed to have ‘passed’ the test.

Sample characteristics for the learner riders are shown in Table 3-2. Participants had a mean age of 30 years and the majority (92%) were male. More than three-quarters (77%) were training on motorcycles with larger engines and no restrictions on power outputs, and were therefore seeking to acquire an unrestricted motorcycle licence. The remainder were using motorcycles with smaller engines and restricted power outputs of up to 35 kW. Learners had received a mean of 13 hours of motorcycle training overall; a mean of 4.75 hours was specifically for the module 1 trial and a mean of 3.75 hours was specifically for the revised on-road manoeuvres.

\textsuperscript{11} Data presented throughout this report use the maximum available sample size for a given variable. It should be noted that data were not always provided by all 151 participants as this depended on how many manoeuvres they attempted and whether all survey materials were completed. The majority of learner data are for a maximum sample of 143 participants, as one was involved in an incident during the trial and did not complete the questionnaires afterwards, and seven others did not complete any on-road manoeuvres.
Across the 11 trial sites, 23 different training schools took part in the study by providing at least one learner rider. Of these, 29 individual instructors provided data on the training of the manoeuvres through completing questionnaires, and 13 took part in interviews or focus groups.

Trainers and learner riders were compensated for their time. Trainers were paid £125 for every learner rider they provided to the study, to cover their costs of providing bikes, training learners for the revised on-road manoeuvres and attending the trial days. All learners gave informed consent and were paid £55 in cash for their participation.

A group of three senior DSA examiners were responsible for overseeing the examination of participants during the module 1 manoeuvres and the revised on-road manoeuvres. In particular, their role was to brief and supervise the local DSA examiners who were given the task of delivering the mock examinations to learners participating in the study. Local DSA examiners were recruited from nearby test centres by senior DSA examiners. The purpose of using local examiners to deliver the two mock examinations was to collect feedback from the relevant workforce on the workload associated with delivery of the revised on-road manoeuvres when compared directly with the current module 1 manoeuvres. In total, 16 local examiners participated and provided feedback. In a small number of cases, when local examiners were not available to take part in a trial, a senior examiner from the central team served in this role.

### 3.6 Higher-speed on-road manoeuvres

Not all participants completed the higher-speed manoeuvres (the emergency brake and the hazard avoidance manoeuvres from 30mph) during the on-road trials. Due to intolerable risks to participant safety when the surface of the road was wet, 40 participants did not complete these manoeuvres at the required speed. Specifically:

- 20 participants completed the emergency brake and the hazard avoidance at a maximum speed of 20mph on-road (often riding through the manoeuvring area in a straight line).
- 13 participants completed no version of the high-speed manoeuvres on-road.
- 7 participants completed no on-road manoeuvres whatsoever.
When an on-road site was wet, the emergency brake and hazard avoidance manoeuvres were sometimes run at a slower speed to enable the continued collection of timing and risk assessment data. However, some participants did not complete some or all of the on-road manoeuvres due to adverse trial conditions.

Overall, 111 participants attempted the emergency brake and hazard avoidance manoeuvres on-road at a target speed of 30mph. Data from these participants are used throughout this report wherever there is analysis of the complete on-road test, or the higher-speed manoeuvres. Wherever the analysis can separate the slow-speed on-road manoeuvres (the pushed U-turn, the ridden U-turn and the slalom), data are used from a maximum of 144 participants who completed these manoeuvres.
4  Phase 3 – findings

The findings are organised into sub-sections for each research question.

4.1  Do the revised manoeuvres assess the same competencies and to the same standard as the existing module 1 manoeuvres?

The data used to answer this question are DL25 fault reports (i.e. the number, category and severity of riding faults committed by learners in the study), workload data from the learner riders, and competence ratings from senior examiners (i.e. subjective ratings of the level of competence displayed by each rider on each component manoeuvre of each mock test). In all cases, comparisons are drawn between the on-road and module 1 versions of the test and the comparable individual manoeuvres in each test.

4.1.1  DL25 test report fault data

4.1.1.1  Faults by category

Figure 4-1 shows fault data broken down by fault type (not worthy, riding, serious, dangerous) and by test type (module 1 and on-road).

![Figure 4-1: Number of faults by category and test type]

The fault data are divided into four categories. These are ‘not worthy’ (faults that an examiner would ordinarily not deem worthy of recording during a test as they do not meet the definition of a rider fault – these were captured in this study to enable further comparisons), ‘rider’ (minor faults worthy of reporting that can lead to a test fail should a candidate accumulate five or more for module 1), ‘serious’ (a fault that presents a serious risk to safety and could develop into a dangerous situation), and ‘dangerous’ (a fault that places a candidate or other user in immediate danger). The overall pattern of data shows that there were more faults recorded during the on-road manoeuvres (234 in total) than for the full set of module 1 manoeuvres (150 in total) and the equivalent set
of module 1 manoeuvres (124 in total), which excluded faults recorded for the figure of 8 and controlled stop.

A paired samples t-test\(^\text{12}\) showed that the mean number of faults on-road (at 2.1 faults per participant) was significantly\(^\text{13}\) greater (p<.001) than that for the full module 1 test (at 1.4 faults per participant). The full module 1 test included additional manoeuvres (the figure of 8 and controlled stop) with no comparable on-road manoeuvres, and thus provided further opportunities for faults to be recorded during module 1. A further paired samples t-test showed that the mean number of faults on-road was still significantly greater (p<.001) than for the module 1 test (at 1.1 faults per participant) even when only the equivalent manoeuvres (manual handling/pushed U, ridden U, slalom, emergency stop, hazard avoidance) were included in the analysis.

Analysis of the mean number of faults within each fault category (using paired samples t-tests) showed that:

- There was no significant difference in the number of rider faults generated on-road when compared with either the full module 1 test or the equivalent module 1 manoeuvres. However, the higher number of rider faults on-road when compared with the number of rider faults on the equivalent module 1 manoeuvres approached significance.

- The number of serious faults on-road was significantly greater than both the full module 1 test (three times as many faults overall; p<.001) and the equivalent module 1 manoeuvres (four times as many faults overall; p<.001).

- There were only two dangerous faults (both on-road), and very few ‘not worthy’ faults, so statistical comparisons were not possible between the test environments for these two fault types.

4.1.1.2 Faults by manoeuvre

Figure 4-2 shows (all) fault data for each manoeuvre of the on-road test and the comparable manoeuvres of the module 1 test. For all manoeuvres, there were more faults recorded during the on-road test than during the comparable manoeuvres of the module 1 test, with the exception of the on-road pushed U-turn (and the comparable module 1 manual handling exercise). The mean number of faults for each manoeuvre was compared across the two test types using paired samples t-tests. The findings showed that:

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\(^{12}\) The fault data were not always entirely appropriate for the use of parametric statistical tests such as t-tests as there was a suggestion that sometimes the assumptions underlying such tests may have been violated. However all analyses were repeated using an appropriate non-parametric test (Wilcoxon) and in all cases the findings were confirmed. Therefore we only report the t-tests here for simplicity.

\(^{13}\) Throughout this report, we use the word ‘significant’ in the conventional way it is used in the behavioural sciences; that is, when we say that a measure in one condition (e.g. mock road) differs ‘significantly’ from that measure in another condition (e.g. module 1) we mean that the probability of the difference observed having arisen purely due to random variability in the data is lower than the generally-used level of 5% (i.e. p<0.05). Actual probability levels are given in the text.
- More than three times as many faults were recorded during the on-road ridden U-turn than during the comparable module 1 manoeuvre—the difference in the mean values was significant (p<.001).

- More faults were recorded during the on-road hazard avoidance than during the comparable module 1 manoeuvre—the difference in the mean values was significant (p<.001).

- More faults were also recorded during the on-road versions of the slalom and emergency brake manoeuvres than during their module 1 counterparts—the differences in the mean values approached significance.

- Fewer faults were recorded for the on-road pushed U-turn than during the module 1 manual handling exercise—the difference in the mean values approached significance. This finding was expected given that the manual handling exercise for module 1 requires candidates to conduct more complex manoeuvring of the motorcycle than a pushed U-turn.

![Figure 4-2: Number of faults by manoeuvre and test type](image)

**4.1.1.3 Faults by category and manoeuvre**

In this subsection, the numbers of faults per manoeuvre are compared within each category (not worthy, rider, serious, dangerous) for the on-road and module 1 tests. Statistical comparisons of the mean number of faults per category for each manoeuvre were conducted to identify significant differences between the on-road and module 1 tests. Only manoeuvres with significant differences in mean fault rates (or approaching significant differences), and with sufficient distribution of faults across the categories, are presented here (the pushed U-turn/manual handling manoeuvres are not presented because the frequency of faults was low for these manoeuvres).

Figure 4-3 shows that the number of faults in each category for the on-road ridden U-turn was generally equal to, or higher than the number of faults for the same manoeuvre in module 1. More than six times as many serious faults were recorded during the on-
road ridden U-turn than during the comparable module 1 manoeuvre—the difference in the mean values was significant (p<.001).

Figure 4-3: Number of ridden U-turn faults by category and test type

Figure 4-4 shows that the numbers of rider and serious faults for the on-road slalom were higher than the number of faults in the same categories for the same manoeuvre in module 1, although the small numbers of faults involved meant that statistical comparison was not possible.

Figure 4-5 shows that the number of faults in each category for the on-road emergency brake was approximately equal to, or higher than the number of faults for the same
manoeuvre in module 1. Almost three times as many serious faults were recorded during the on-road emergency brake than during the comparable module 1 manoeuvre—the difference in the mean values was significant \( (p=0.038) \).

Figure 4-5: Number of emergency brake faults by category and test type

Figure 4-6 shows that the number of faults in each category for the on-road hazard avoidance was approximately equal to, or higher than the number of faults for the same manoeuvre in module 1. More than three times as many serious faults were recorded during the on-road hazard avoidance than during the comparable module 1 manoeuvre—the difference in the mean values was significant \( (p<0.001) \).

Figure 4-6: Number of hazard avoidance faults by category and test type
4.1.2 **Participants with at least one fault**

Another way of analysing the fault data is to consider the relative test outcomes for candidates in terms of thresholds of faults in each of the test types. When considering whether or not candidates received any faults at all for example, we can identify four types of candidate:

- Those who get no faults on either test
- Those who get at least one fault on both tests
- Those who get at least one fault on module 1 but none on-road
- Those who get at least one fault on-road but none on module 1

A comparison of the final two categories (those with a fault on one test but not the other) can provide an indication of which set of manoeuvres is more difficult. The initial two categories are less interesting since they can be thought of as representing riders who are clearly competent enough to ride fault-free in both tests and riders who are not competent enough to ride fault-free in either, respectively. However even competent riders will occasionally ‘get unlucky’ or experience a lapse in concentration, and will pick up a fault in one test but not the other. A comparison of the final two categories is therefore useful as if the tests are equally difficult then this should be just as likely to happen on one test as on the other.

For the purpose of comparing the two test types all the fault data were pooled, to ensure that the maximum number of data points could be used for each comparison (overall, and for the individual manoeuvres). To compare the test types, McNemar tests were run on the data. McNemar tests use data from those participants who had at least one fault in one test type, but not in the other; these data were used to check whether this happens significantly more for one or the other test type.

When comparing the on-road manoeuvres with the full set of module 1 manoeuvres, the data showed that:

- 8 learners had no faults on either test
- 75 learners had faults on both tests
- 6 learners had faults ONLY on module 1
- 21 learners had faults ONLY on-road

Almost four times as many learners received their only fault(s) during the on-road test than during the whole module 1 test (21 learners compared with 6 learners). This difference was significant (p=.006). When comparing the on-road manoeuvres with the equivalent set of module 1 manoeuvres the difference was even greater: more than four times as many learners received their only fault during the on-road manoeuvres (27 learners compared with 6 learners). These findings indicate that that if a learner is going to receive at least one fault, it is significantly more likely to occur during the on-road manoeuvres than the module 1 manoeuvres; this would imply that the on-road manoeuvres are more difficult than the module 1 manoeuvres.

A similar analysis was conducted for learners who received at least one serious or dangerous fault on either of the two tests. This analysis provided an indication of theoretical pass and fail rate for the two types of test, since one of either type of this
fault constitutes a test fail. When comparing the on-road manoeuvres with the full set of module 1 manoeuvres, the data showed that:

- 38 learners had no serious/dangerous faults on either test
- 23 learners had serious/dangerous faults on both tests
- 6 learners had serious/dangerous faults ONLY on module 1
- 43 learners had serious/dangerous faults ONLY on-road

Approximately seven times as many learners received their only serious/dangerous fault(s) during the on-road test than during the module 1 test (43 learners compared with 6 learners). This difference was significant (p<.001). When comparing the on-road manoeuvres with the equivalent set of module 1 manoeuvres the difference was even greater: more than nine times as many learners received their only serious/dangerous fault during the on-road manoeuvres (47 learners compared with 5 learners). These findings indicate that if a learner is going to receive at least one serious/dangerous fault, it is significantly more likely to occur during the on-road manoeuvres than the module 1 manoeuvres; thus, not only are learners more likely to fail the on-road test than fail the module 1 test, they are also far more likely to commit a fault that could lead to a hazardous event occurring.

Further analysis enables us to explore on which manoeuvres the serious and dangerous faults were issued. Figure 4-7 shows the number of learners who received at least one serious or dangerous fault for three of the specific manoeuvres conducted on-road and during module 1—the ridden U-turn, the emergency brake and the hazard avoidance. For all three manoeuvres there were significantly more learners committing at least one serious or dangerous fault only on the on-road version than only during module 1 (ridden U-turn, p<.001; emergency brake, p=.049; hazard avoidance, p<.001).

![Figure 4-7: Number of learners receiving at least one serious or dangerous fault by manoeuvre and by test type](image-url)
4.1.3 Learners’ workload ratings

Workload is defined as the human cost of completing a task (Hart, 2006). In this study, the NASA (raw) task load index (RTLX) was used to provide workload scores (Hart & Staveland, 1988). All the workload scores are on a scale of 1–21, with higher numbers representing higher levels of workload. Overall workload is taken here as the average of individual ratings of the six subscales (mental demand, physical demand, temporal demand, performance, effort, and frustration).

These individual subscale ratings have also been analysed separately to identify the reasons for differences in workload between manoeuvres where appropriate.

Analysis (using an ANOVA) of workload ratings showed that the type of test (on-road or module 1) had a significant effect on the workload scores overall (p=.029). The interaction between test type and manoeuvre type was also significant (p=.047), showing that workload differences only existed for some manoeuvres. The difference was subject to further analysis to identify which manoeuvres were responsible for this difference in workload. Figure 4-8 shows the mean overall workload reported by learners for each of the on-road manoeuvres was approximately equal to, or higher than the workload for the comparable module 1 manoeuvres. Statistical comparison of the mean workload within each manoeuvre across the two test types was conducted using paired samples t-tests. The results showed that mean overall workload was significantly greater for the on-road versions of the ridden U-turn, emergency brake and hazard avoidance manoeuvres (p=.013, p=.013 and p=.016, respectively). This indicates that learners found these manoeuvres significantly harder to complete in the on-road test.

Figure 4-8: Mean overall workload ratings by manoeuvre and test type (with standard error)

To understand why the ridden U-turn, emergency brake and hazard avoidance manoeuvres were all generating significantly greater workload in the on-road setting, the differences in the means for the individual workload components were compared using
paired samples t-tests. This would identify which from the seven workload components (mental, physical, temporal, performance, effort, frustration) were driving the difference, and would help explain why these specific manoeuvres were rated by learners as more difficult.

Figure 4-9 shows the mean ratings for each of the seven components of the TLX workload measure for the on-road and module 1 versions of the ridden U-turn. Overall, learners rated the workload for the ridden U-turn as significantly greater on-road, and the data here show that this is because the temporal, performance and frustration components of workload were all significantly greater on-road (p=.028, p=.003 and p<.001, respectively). This means that learners:

- Experienced greater time-pressure on-road, and felt hurried and/or rushed.
- Had greater insight into their performance on-road and were more aware of their errors.
- Experienced greater frustration on-road, including feelings of stress and insecurity.

![Figure 4-9: Mean ratings for each workload component for the ridden U-turn, by test type (with standard error)](image)

Figure 4-10 shows the mean ratings for the seven components of workload for the on-road and module 1 versions of the emergency brake manœuvre. Learners rated the overall workload for the emergency brake as significantly greater on-road, and the data here show that this is because the performance and frustration components of workload were both significantly greater on-road (p=.036 and p<.001, respectively). In addition, the temporal component of workload was greater on-road although this difference only approached significance. This means that learners:

- Had greater insight into their performance on-road and were more aware of their errors.
- Experienced greater frustration on-road.
- Tended to feel greater time-pressure on-road.
Figure 4-10: Mean ratings for each workload component for the emergency brake, by test type (with standard error)

Figure 4-11 shows the mean ratings for the seven components of workload for the on-road and module 1 versions of the hazard avoidance manoeuvre. Learners rated the overall workload for the hazard avoidance as significantly greater on-road, and the data here show that this is because the performance and frustration components of workload were both significantly greater on-road (p=.008 and p<.001, respectively). The mental and temporal components of workload were also greater on-road although these differences only approached significance. This means that learners:

- Had greater insight into their performance on-road and were more aware of their errors.
- Experienced greater frustration on-road.
- Tended to find the on-road hazard avoidance was mentally more demanding.
- Tended to feel greater time-pressure on-road.

Figure 4-11: Mean ratings for each workload component for the hazard avoidance, by test type (with standard error)
4.1.4 What senior examiners said about learner competence

A secondary measure of learner competence was provided by senior examiners, who rated competence on each manoeuvre of the on-road and module 1 tests using scores on a scale of 1 (total lack of competence) to 10 (total competence).

Analysis of the difference (using paired samples t-tests) between the mean competence ratings awarded to learners on-road and for module 1 showed that learner competence was rated as significantly lower for the on-road test than for the module 1 test (mean competence ratings of 7.9 and 8.5, respectively; p<.001). The difference was the same when comparing on-road competence ratings with ratings for the full module 1 test as well as for the equivalent module 1 manoeuvres only.

To understand which manoeuvres were driving this difference in overall competence between the two tests, further analysis was conducted to compare the mean competence ratings for comparable manoeuvres across the two test types. Figure 4-12 shows how senior examiners rated the competence of each learner on each manoeuvre for both on-road and module 1 trials. The only significant differences in competence levels were reported for the ridden U-turn and the hazard avoidance; learners displayed significantly lower levels of competence during the on-road versions of both manoeuvres (p<.001 for both). These findings support the data on fault rates and workload: for both manoeuvres, learners received a significantly greater number of serious faults than for module 1 and reported significantly greater workload levels.

Figure 4-12: Senior examiner ratings of learner competence for module 1 and on-road manoeuvres (with standard error)

4.1.5 Road width

Some variation existed in the width of roads used for on-road trials. This was a necessary concession in order to source roads that otherwise met all of the other safety criteria necessary to enable on-road trialling to take place. The width of the roads used
ranged from 6.8 metres to 7.4 metres (with the exception of one site that was sub-6m but was only used by two participants—and not for the U-turn manoeuvres).

In light of the significant number of faults occurring during the on-road versions of the ridden U-turn and the two higher-speed manoeuvres (both of which required multiple turns in the road), it was considered necessary to explore whether road width may have contributed to these findings. Overall, there were 84 participants who completed the manoeuvres on roads that were at least 7m wide and 67 participants who completed the manoeuvres on roads that were narrower than this (the narrowest road used for U-turn manoeuvres was 6.8m). The difference between the 7.5m allowed for the U-turn in module 1 and roads at least 7m wide was considered negligible and unlikely to lead to a difference in performance. Roads narrower than 7m were of greater concern.

Fault rates were re-analysed for participants who carried out the manoeuvres on a road width of 7m or more, and for those who carried out the manoeuvres on roads less than 7m wide. The pattern of findings remained the same as it was for the analysis of the sample as a whole. For participants using both wide and narrower roads, significantly more serious faults were still committed during the on-road test (p<.001 for both groups), and when exploring fault rates for the ridden U-turn as an individual manoeuvre, again there were significantly more faults on-road in both groups (p<.001 for both). This indicates that the width of on-road sites used in the study was not a key driver of the differences seen between the on-road and module versions of the test. It should be noted that this does not mean that road width is not important at all; it just means that within the range of widths used, other features of the on-road environment were more important in revealing differences between the two test types.

### 4.1.6 Learner preparedness

One approach to assessing whether learner preparedness affected performance and workload levels during the trial was to explore the effect of training time on faults and workload ratings. Analysis indicated that the number of hours of module 1 training, and the number of hours of additional time spent training for the revised on-road manoeuvres, had no effect on fault rates or workload levels.

Figure 4-13 shows that subjectively learners reported feeling slightly, but significantly, less prepared for each of the on-road manoeuvres than for the comparable module 1 manoeuvres (p<.001 for all manoeuvres). This may partly account for the significantly higher fault and workload ratings for the on-road manoeuvres than for module 1. However, this conclusion should be treated with caution for two reasons:

- Firstly, the analysis of training time showed that there was no effect on faults and workload ratings for different amounts of training. This indicates that the higher fault and workload rates were independent of the amount of training participants received, which is the best measure we have of their preparedness for the trial.

- Secondly, the participants’ rated their preparedness after they had completed both tests. The workload data show that participants were significantly more aware of their performance for the on-road test (which was generally poorer) so, on reflection, they may have considered this to be an indication that they were less well-prepared.

In summary, this finding may indicate a lack of preparation for the ‘experience’ of riding the manoeuvres, rather than a lack of training in the skills required. The learner
workload and risk ratings certainly support this interpretation given that significantly higher levels of frustration, stress, insecurity and risk were reported by learners on-road.

![Figure 4-13: Learners’ ratings of preparedness for each manoeuvre](image)

### 4.1.7 Summary

From a performance perspective, the on-road manoeuvres appear more difficult than the comparable module 1 manoeuvres. There are three streams of data that support this conclusion. The first stream of data is based on a series of significant findings following analysis of the fault data for each test:

- Overall, more faults were recorded during the on-road manoeuvres than during the module 1 manoeuvres, especially those faults in the ‘serious’ category.
- Specifically, more serious faults occurred during the on-road versions of the ridden U-turn and hazard avoidance manoeuvres.
- If learners were going to be marked for at least one fault on only one of the two tests, it was more likely to be the on-road test.
- If learners were going to be marked for at least one serious or dangerous fault on only one of the two tests, it was more likely to be the on-road test—and particularly during the ridden U-turn, emergency brake and hazard avoidance manoeuvres.

The second stream of data is based on a series of significant findings following analysis of the learner workload data for each test:

- Overall, learners experienced greater workload during the on-road manoeuvres than during the module 1 manoeuvres, particularly during the ridden U-turn, emergency brake and hazard avoidance manoeuvres.
- Learners had greater insight into their performance on-road (and were more aware of the errors they made) for the three manoeuvres where there were significant workload differences. Learners also experienced significant frustration.
during these manoeuvres. In addition, there was a tendency for learners to experience time-pressure during these manoeuvres.

The third stream of data is based on a series of significant findings following analysis of the competence ratings awarded to learners for each test by senior examiners:

- Overall, learner competence was rated as lower on-road.
- Learner competence was significantly lower for the on-road versions of the ridden U-turn and hazard avoidance manoeuvres.

The greater difficulty associated with the on-road test was driven primarily by the two higher-speed manoeuvres and the ridden U-turn. It would seem that the on-road environment may be responsible for the higher level of faults and workload for these manoeuvres (and the lower level of competence displayed): frustration and time pressure were two specific workload components that accounted for much of the difference in workload. Collectively, they indicate that learners experienced stress, insecurity, irritation and annoyance on-road and felt hurried—a feeling that is likely to be attributed to the traffic conditions. Learners also appeared more aware of how well they performed on-road and were able to recognise the greater number of faults they generally committed during certain on-road manoeuvres.

### 4.2 Can the revised exercises be conducted on-road in a fair and consistent manner for riders using motorcycles with different power outputs?

The sample of learners was not split equally between those who participated on larger, unrestricted motorcycles and those who participated on smaller motorcycles with restricted power outputs (117 and 34 participants, respectively). However, this ratio broadly reflects the rate at which candidates appear for test on bikes of both sizes. Unfortunately, the small sample of those on restricted motorcycles limits the scope of analysis, particularly when looking at sub-groups within the data. This section therefore analyses the main effects for large and small bikes for fault data, workload data and competence ratings to establish if the overall pattern of findings was the same or if it differed for the two groups.

#### 4.2.1 Fault data

The fault data for both tests were divided into two groups (large and small bikes) to compare, using a repeated measures ANOVA, the pattern of fault data for learners using bigger bikes and those using smaller, restricted motorcycles. The patterns of data were remarkably similar and the findings showed that:

- Overall, the higher rate of faults for the on-road manoeuvres than for the module 1 manoeuvres remained a significant finding for both categories of motorcycle ($p<.001$ for larger motorcycles and $p=.042$ for smaller motorcycles).
- Even when splitting the sample by size of motorcycle, both groups still had a significantly greater number of faults in the ‘serious’ category during the on-road test ($p<.001$ for larger motorcycles and $p=.002$ for smaller motorcycles).

When exploring the difference in fault rate by manoeuvre for the two categories of motorcycle, the findings did vary slightly by bike size. Specifically:
• The mean number of faults for the on-road version of the ridden U-turn remained significantly greater than on the module 1 test for both categories of motorcycle, indicating that this manoeuvre was more difficult to complete on-road irrespective of bike size.

• For the hazard avoidance manoeuvre, the mean rate of faults remained significantly higher in the on-road test for larger motorcycles (p<.001); however, for smaller motorcycles the difference was less pronounced and only approached significance. The data indicate that the hazard avoidance manoeuvre was still more difficult on-road for learners riding both sizes of motorcycle—the much smaller sample of riders on restricted motorcycles reduces the statistical power of the analysis, and in our judgement this explains the less robust finding for smaller motorcycles.

• For the slalom manoeuvre, the mean rate of faults was significantly higher in the on-road test for larger motorcycles (p=.017) and not significantly different for smaller motorcycles. When the fault rate for the slalom was analysed for all motorcycles together, it was greater on-road but this difference only approached significance. In our judgement, these findings are likely to be attributable to the low statistical power for the sample of smaller motorcycles, and possibly indicative also of the greater manoeuvrability of smaller motorcycles.

• For the emergency brake manoeuvre, the higher rate of faults for the on-road version only approached significance for riders on smaller motorcycles. The difference in faults between the two tests was not significant for larger motorcycles. This indicates that errors on the emergency brake were more likely on-road when riding a smaller machine. It is possible that these smaller motorcycles were more susceptible to any reduction in friction levels on-road, which may be due to the generally lower braking capabilities, the almost universal absence of anti-lock braking systems and the narrower tyres of these motorcycles.

Repeated analysis of the proportions of riders on the two categories of motorcycle that received at least one fault on one test only showed that:

• If learners were going to be marked for at least one fault on only one of the two tests, it was still more likely to be the on-road test, irrespective of bike size.

• If learners were going to be marked for at least one serious or dangerous fault on only one of the two tests, it was still more likely to be the on-road test, irrespective of bike size—and particularly during the ridden U-turn, emergency brake and hazard avoidance manoeuvres.

When analysing the numbers of learners on different bike sizes who received at least one fault (and at least one serious/dangerous fault) across either of the tests as a whole, the findings remained significant. This suggests that bike size did not affect the likelihood of committing a fault on either test. Analysis of those committing at least one serious/dangerous fault on specific manoeuvres again showed the same pattern of findings although the small sample of learners on smaller bikes did mean that many of the differences were not significant, except for the ridden U-turn (where learners were significantly more likely to only commit a serious/dangerous fault on-road, irrespective of bike size).
In summary, there was evidence that the on-road test—and specific manoeuvres within it—generated significantly greater faults for riders of all bike sizes when compared with the module 1 test.

### 4.2.2 Learner workload data

Overall, the patterns of data for learner workload were similar, with generally higher workload ratings for the on-road manoeuvres than for the module 1 manoeuvres for participants on both large and small bikes. However, the differences in workload between the two tests were only significant for larger motorcycles. This may be due to the lower statistical power due to the small sample size of riders on smaller machines.

### 4.2.3 Competence ratings

Overall, the patterns of data for competence ratings awarded to learners by senior examiners were similar, with generally lower competence ratings for the on-road manoeuvres when compared with the module 1 manoeuvres for those on both large and small bikes. However, as with the workload comparisons, the differences in competence between the two tests were only significant for larger motorcycles. Again, this may be an artefact of low statistical power due to the small sample of smaller bikes.

### 4.2.4 Summary

Motorcycle size appears to have very little effect on the rate and type of faults that learners commit across the two test types and it is clear that fault rates were still significantly higher in the on-road test, irrespective of bike size.

The effect of bike size on workload and competence ratings was less clear. Whilst the same pattern of results as found in the overall analysis still existed for big bikes—i.e. workload ratings were significantly higher, and competence ratings were significantly lower on-road—this was not replicated for smaller bikes. Although there are concerns about the conclusions that can be drawn from this small sample (due to low statistical power), one possible explanation is that the on-road manoeuvres posed a similar level of demand for learners on smaller bikes as the module 1 manoeuvres. Nevertheless, a significantly higher rate of faults on-road for riders on smaller bikes would indicate that, in spite of this possible parity between the two tests in the minds of learners on smaller bikes and senior examiners observing them, it does not manifest in absolute performance terms.

### 4.3 Do weather conditions have any implications for the examining of the revised manoeuvres and the assessment of performance?

Weather and surface conditions were noted on the trial days so that any obvious implications could be considered. There were 73 trials in dry conditions and 71 in wet conditions; however, of the 71 wet trials, only 42 included all manoeuvres without any speed restrictions. Speed restrictions were introduced after two incidents occurred in wet weather that were at least partly attributable to wet road surfaces (specifically, a suspected reduction in the friction coefficient of the surface contributing to a loss of grip for riders). Both incidents are described in Appendix F (see individual site assessments for Bristol and Basildon). In some extreme wet weather conditions, high-speed manoeuvres were not tested on-road at all because of safety concerns for participants. Learners managed to complete the module 1 and on-road tests in some very challenging
weather conditions (rain, wind) and surface conditions (wet and damp conditions existed on a number of the test days). This section presents findings from analyses of the main effects in wet and dry conditions for fault data, workload data and competence ratings to establish if the overall pattern of findings was the same or if it differed for the two groups.

4.3.1 Fault data

The patterns of overall DL25 test report fault data were broadly the same for different surface conditions. Specifically:

- Overall, the higher rate of faults for the on-road manoeuvres than the module 1 manoeuvres remained a significant finding in both wet and dry conditions (p=.004 for wet conditions and p<.001 for dry conditions).
- When comparing the rate of faults in each category across the two test types, there was still a significantly greater number of faults in the ‘serious’ category during the on-road test in both wet and dry conditions (p<.001 for both groups).

When exploring the difference in fault rate by manoeuvre in wet and dry conditions, the findings did not vary from those reported for the analysis of the full sample. Specifically:

- The mean number of faults for the on-road version of the ridden U-turn remained significantly greater than on the module 1 test in both wet and dry conditions (p<.001 for both), indicating that this manoeuvre was more difficult to complete on-road, irrespective of surface moisture.
- For the hazard avoidance manoeuvre, the mean rate of faults remained significantly higher in the on-road test irrespective of whether it was wet or dry (p=.004 in the wet, p<.001 in the dry).

4.3.2 Learner workload data

The learner workload data for both tests were divided into two groups (wet and dry conditions) to analyse whether the same pattern of workload data emerged for learners in different weather conditions. Overall, the patterns of data were similar, with generally higher workload ratings for the on-road manoeuvres when compared with the module 1 manoeuvres. However, the differences in workload between the two tests were only significant in dry conditions (p=.043). This may be an effect of low statistical power affecting the analysis of workload data from learners in wet conditions, due to the smaller sample of learners completing all manoeuvres in that group (as already stated, some manoeuvres were not carried out in wet weather because of safety concerns).

4.3.3 Competence ratings

The competence ratings awarded to learners by senior examiners in both tests were divided into two groups (wet and dry conditions) to analyse whether the same pattern of competence data emerged for learners in different weather conditions. Overall, the patterns of data were similar, with generally lower competence ratings for the on-road manoeuvres. However, as with the workload comparisons, the differences in competence between the two tests were only significant in dry conditions (p<.001). It should be noted that the lower competence ratings for the on-road manoeuvres in wet conditions
only approached significance, so again this may be an artefact of low statistical power due to the small sample of learners completing all manoeuvres in the wet.

4.3.4 Summary

Wet and dry surface conditions do not seem to have a marked effect on the main findings related to faults, learner workload and learner competence ratings. Fault rates were significantly higher for the on-road manoeuvres, irrespective of whether the road surface was wet or dry. Workload and competence ratings remained significantly lower during the on-road test when the surface of the road was dry but the difference was not significant in the wet (although the general pattern of findings was for both measures to be lower on-road than for module 1). However, this should not be interpreted as an indication that the on-road manoeuvres were easier in the wet. Firstly, the low statistical power generated by the smaller sample of riders in wet conditions may be responsible for the absence of a statistically significant finding with regard to workload and competence ratings in these conditions. Secondly, there were two incidents (one minor, one major) that occurred on-road when it was wet that were attributed to the wet road surface (and after the second incident, trials of the higher-speed manoeuvres were curtailed when the road surface was wet). Overall, the data suggest that the on-road manoeuvres were more difficult for learners in both wet and dry conditions, and also that there are some features of wet conditions that have implications for the assessed safety criteria of future on-road sites.

4.4 What is the feasibility of using portable speed measuring equipment when trialling on-road?

Phase 1 indicated that subjective speed measurements by examiners when conducting tests were accurate when considered collectively, but not reliably so. It was therefore concluded that any on-road test would require the speed for the emergency brake and hazard avoidance manoeuvres to be measured objectively by a speed measurement device. All Phase 3 trials used the existing ‘speedoscope’ device (as used currently for module 1) to record the speed of learners at the prescribed point for both of the higher speed manoeuvres. However, the current speedscope design is not portable so a different, more portable device was tested in Phase 3 to establish whether it might be suitable for on-road implementation. (While the current speedscope was suitable for use in the research trials, it is clearly not suitable for implementation.)

The selected device for the trials was a hand-held ‘speed gun’: a Unipar SL700 laser speed meter, as used by some police forces for monitoring the speed of vehicles. It was trialled at a small number of on-road sites in Phase 3. The trials led to a small number of hazardous interactions between examiners and riders, and highlighted the excessive task demand of operating the speed gun in addition to other examiner duties.

Figure 4-14 shows an examiner using the portable speed gun during the emergency brake manoeuvre. In the first image the examiner can be seen signalling to the candidate to begin the manoeuvre. In the second image, the examiner steps into the road to obtain a more direct line of sight to the candidate so that the speed can be recorded. In the third image he gives a signal to stop, but does so with the hand that is holding the speed gun, thus losing the ability to take an accurate reading.
Figure 4-15 shows the examiner issuing an emergency stop signal during the hazard avoidance manoeuvre. This was a potentially hazardous action given that the signal was issued as the candidate was about to conduct the steering element of the hazard avoidance manoeuvre, at which point any braking could destabilise the motorcycle and cause an accident. The inappropriate signal was a product of confusion. The examiner attributed this to excessive task demand; data on examiner workload (see Section 4.6.1) shows that even without the additional task of using the speed gun, workload is significantly higher for the on-road test than it is for the module 1 test—the addition of the speed measurement task was therefore considered likely to lead to task overload.
As shown in Figure 4-15, the examiner was standing on the offside of the candidate’s approach; the safety criteria for the hazard avoidance manoeuvre require the examiner to be standing on the nearside as the candidate approaches to protect them should the candidate lose control during the steering element and slide towards the offside of the carriageway. Figure 4-16 shows that during the next attempt at the hazard avoidance manoeuvre, the examiner realises he is positioned incorrectly but when he crosses the road to take up a safer position, he does so in front of the candidate as he is about to begin the manoeuvre. This was partly attributed to the road layout at this particular location; the slightly curved approach meant it was necessary for the examiner to stand offside to signal the start of the manoeuvre and then obtain a speed reading. However, this does highlight the inflexibility of using a hand-held speed gun.
The trials depicted in these images draw attention to some of the problems with using a hand-held speed gun while examining the on-road test, such as:

- The examiner may have to compromise their safe positioning to obtain a clear line of sight (which the DSA has stated would not be acceptable in a live test environment).
- It is difficult to obtain a speed reading at the exact point required—and sometimes it is not possible to obtain any reading.
- The examiner has to compromise their ability to give hand signals and carry out other tasks as a consequence of having to hold the speed gun.
- The examiner is less able to make sufficient observations for other road users prior to the manoeuvre starting because they are focused on obtaining a speed reading.
- The examiner is less able to assess candidates’ riding ability because their attention is diverted to the task of speed measurement.

4.4.1 Summary

The trials of speed measurement using a hand-held device were stopped following the hazardous interactions between examiners and candidates. The poor rates of speed detection were likely to require repeated attempts by candidates in order to simply
register a speed, which would then be open to challenges if it was not sufficient. It was therefore concluded that the use of a speed gun compromised an examiner’s ability to conduct a test fairly and safely.

To enable testing on-road, it is recommended that speed measurement is via a remote device that requires no examiner interaction during the manoeuvre, and that can reliably record the speed at the prescribed point. The current speedoscope is suited to this task and, at the time of trialling, the manufacturer did report that design proposals existed for a smaller, portable version of the speedoscope that could be transported to a roadside environment. This could be a feasible solution to the problem of measuring speed on-road; however, it should be noted that a speedoscope based on the same design principles would probably be equally sensitive to the environment in which it is used. During Phase 3, substantial difficulties were encountered when trying to align the two parts of the speedoscope across the width of a road. This can take time (up to 15 minutes in some cases), often requires two people, and the impact on projected test times will need to be considered if such a solution is taken forward.

4.5 What is the time taken to complete the revised set of manoeuvres in simulated test conditions?

The time taken to complete each manoeuvre on-road was observed and recorded. This section presents the average (mean) times for total test, by manoeuvre, and also the time that riders and examiners spent carrying out specific activities (such as waiting in the road, or laying markers). The on-road test area was always pre-marked so examiners were able to lay markers in the road without any measurements being required. It is assumed that if the test were to be implemented on-road, sites would be pre-marked in this way.

4.5.1 Total manoeuvre and test time

Figure 4-17 shows the mean time required for each component of the on-road test. The data used to calculate the mean times are based on the largest sample of participants that completed each manoeuvre in representative test conditions (e.g. timing data from participants that completed the emergency brake and hazard avoidance manoeuvres at a reduced speed were excluded). The specific components are as follows:

- ‘Site prep’ refers to the preparations that examiners would need to undertake prior to starting an on-road test. The timing data here represent arriving at the site with a candidate, travelling to each end of the manoeuvring area to display the warning signs (which we assume would be already on-site and would require simply opening), unloading and positioning—but not aligning—the speedoscope, unloading the markers, parking the examiner’s motorcycle outside of the manoeuvring area, and returning to the centre of the manoeuvring area to begin briefing the candidate. This required six minutes, based on a single walkthrough at a single site by one of the DSA senior examiners. This time can be taken as an indication of the minimum time required for this activity, given that the walkthrough was carried out at a very quiet site with ample parking close to the manoeuvring area.

- ‘Preamble’ refers to the time it took to introduce the candidate to the test area and get them in position to begin the first manoeuvre. This required just over a minute.
• The pushed U-turn, ridden U-turn, slalom set-up and slalom then followed. Each part took between 35 and 75 seconds, approximately. The slalom set-up refers to the time taken for the examiner to lay the five markers in the road for the slalom manoeuvre.

• The emergency brake set-up comprised clearing the markers from the slalom and laying them for the emergency brake manoeuvre. This took an average of 1.6 minutes. The hazard avoidance set-up required adding further markers to those laid for the emergency brake. This took a little longer, with a mean time of 1.8 minutes.

• The two higher speed manoeuvres (emergency brake and hazard avoidance) required about 3–4 minutes each (the mean time comprised participants who made only one attempt at each and those who made multiple attempts either because they did not achieve the speed or because of aborted attempts due to traffic).

The mean time to complete all the manoeuvres (from preamble through to clearing markers at the end of the hazard avoidance, but excluding the site preparation) was 15 minutes. Figure 4-18 presents a histogram of the total test times. The shortest time to complete all the manoeuvres was 9.5 minutes, with the longest attempt taking 27 minutes; within this range the data are positively skewed. When considering future implementation of an on-road test, it is necessary to consider the proportion of tests that may take longer than the average. shows the mean time taken for the 5th to the 95th percentiles. Data for the 75th percentile show that 25% of all tests will take 17 minutes or longer (or at least 23 minutes if including site preparation). Data for the 90th percentile show that 10% of all tests will take 20 minutes or longer (or at least 26 minutes if including site preparation).
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Figure 4-18: Histogram of total on-road test time (excluding site preparation)

Table 4-1: Mean on-road test time (excluding site prep) for 5th–95th percentiles

<table>
<thead>
<tr>
<th>Percentile</th>
<th>5th</th>
<th>10th</th>
<th>25th</th>
<th>50th</th>
<th>75th</th>
<th>90th</th>
<th>95th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minutes (without site prep)</td>
<td>10</td>
<td>11</td>
<td>13</td>
<td>15</td>
<td>17</td>
<td>20</td>
<td>22</td>
</tr>
<tr>
<td>Minutes (with site prep)</td>
<td>16</td>
<td>17</td>
<td>19</td>
<td>21</td>
<td>23</td>
<td>26</td>
<td>28</td>
</tr>
</tbody>
</table>

The timing data presented in this section may not represent fully the time requirements of an on-road test. The ever-changing hazards present in an on-road environment necessitate a dynamic reassessment of the risks prior to examining any manoeuvres on-road. This was completed by TRL staff during Phase 3 as local DSA examiners would need to be trained to carry out this activity. It typically required about five minutes (although this was often with two staff assisting) and some of the assessment could be incorporated with site preparation activities (e.g. the road surface could be checked when walking along the manoeuvring area whilst preparing the site). In addition, examiners may need to position and align a speed measuring device, which in Phase 3 required just a couple of minutes at some sites but up to 15 minutes at others (depending on the alignment of the opposing kerbs on which the two parts of the device were positioned). In our judgement, an additional five minutes at least is likely to be
added to each individual on-road test for risk assessment purposes, meaning the average time could be approximately 26 minutes (with 25% of tests taking 28 minutes, and 10% of tests taking 31 minutes). These estimates do not allow for any time to set up a device for speed measurement which, if it is a speedoscope, could be considerable.

4.6 What are the implications of the revised exercises (when being examined) for the safety of learner riders, examiners, and other road users?

This section presents findings from a number of sources to answer the question of whether the on-road manoeuvres have implications for the safety of learners, examiners and other road users and, if they do, what those risk implications may be. The sources of data reported in this section are examiner workload and risk ratings, examiner exposure to traffic, examiner feedback, learner risk ratings, learner exposure to traffic and learner feedback; and risk analysis findings from the observations made during the trial process.

4.6.1 Examiner workload

Figure 4-19 shows the workload associated with setting up and examining the on-road manoeuvres, compared with examining the module 1 manoeuvres. Workload for examiners was measured using the NASA RTLX scale in the same way that it was for learners. A higher score indicates a higher workload.

Examiners reported significantly higher workload for the on-road test when compared with the module 1 test (p<.001). Workload for the on-road manoeuvres increased with each manoeuvre—the on-road pushed U-turn generated the lowest workload levels, rising progressively to the hazard avoidance manoeuvre, with almost double the workload rate of the pushed U-turn.

When analysing the difference in workload for individual manoeuvres, again, workload was significantly greater for the on-road version of each manoeuvre (p<.001 for all manoeuvres). Although the module 1 manoeuvres require no setting up during the test itself, the workload associated with setting up the three on-road manoeuvres with markers was compared with the respective module 1 manoeuvres: the workload for the on-road set-up was significantly greater (p<.001 for all manoeuvres).

Further analysis showed that the higher workload levels for each of the on-road manoeuvres were a product of significantly higher ratings across all six components of the workload scale. All manoeuvres were significantly more demanding from a physical, mental and temporal perspective, all required more effort, all enabled examiners to gain insight into their (subjectively poorer) performance, and all left examiners feeling frustrated, insecure and stressed.
4.6.2 Examiners’ exposure to traffic

One measure of examiners’ exposure to risk was provided by the mean time spent in the road either examining or setting out and clearing up the markers (Figure 4-20). All mean times were calculated from video analysis of a random sample of 52 trials. The data show that:

- Examiners spent an average of between 5 and 47 seconds in the road examining each of the manoeuvres. This comprised the cumulative time that the examiner was in the road and not on the footway whilst the manoeuvre was taking place (e.g. when crossing the road, when standing in the road to brief the candidate).
- Examiners spent an average of between 42 and 68 seconds in the road setting out markers and clearing them away for the three manoeuvres that required markers.

In summary, the higher speed manoeuvres presented the most risk to examiners based on the amount of time spent in the road (and therefore at risk from traffic). The hazard avoidance manoeuvre required almost two minutes in the road overall for a single attempt.

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14 This represented analysis of approximately a third of all trial events. A random sample of videos were analysed with the requirement that at least one video was analysed from each site and, where appropriate, a random sample of approximately a third of all trials from each site were analysed.
4.6.3 Examiner risk ratings

Examiners rated three risk-related factors associated with examining the manoeuvres on-road. Figure 4-21 shows the overall perceived risk of examining each manoeuvre on a real road, as rated by examiners. The overall rating is the average of aggregated subscale scores to define examiners’ feeling of:

- Vulnerability when examining each manoeuvre on-road. A higher score indicates greater feelings of vulnerability.
- Confidence when examining each manoeuvre on-road. A higher score indicates a lack of confidence.
- Risk when examining each manoeuvre on-road. A higher score indicates greater feelings of risk.

It shows that, for each manoeuvre, the on-road versions generated significantly greater feelings of vulnerability, risk and low confidence in examiners than the module 1 versions of the same manoeuvres (p=.001 for the pushed U-turn, p<.001 for all other manoeuvres).
The individual components were analysed separately for each manoeuvre and paired samples t-tests used to compare the on-road and module 1 ratings. Figure 4-22 shows that the same pattern of findings as for the overall risk ratings is evident: ratings were consistently lowest for the pushed U-turn, rising for the ridden U-turn and the slalom, and then peaking for the high speed manoeuvres. All on-road ratings were significantly greater than the module 1 counterparts (p=.005 or less for all comparisons). Examiners felt significantly more vulnerable, less confident and more at risk when examining each manoeuvre on-road than they did examining the same manoeuvre for module 1.
Conversely, the ratings for each module 1 manoeuvre were shown to be consistently low, except for a slight increase in feelings of risk during the emergency brake and hazard avoidance manoeuvres. This appears to suggest that the off-road environment enables examiners to feel more in control of their personal safety, whereas on-road there are interactions between the examining task and the road environment that give rise to substantial concerns about personal safety.

4.6.4 Examiner feedback on set-up and examining of on-road manoeuvres

Examiners were asked to provide any comments that they had regarding the set-up or examination of the on-road manoeuvres; twelve of the nineteen respondents provided comments.

One of the key concerns raised by examiners related to the nature of setting up and examining in a live traffic environment. Examiners used phrases like “stressful” and “very dangerous”. Some examiners described feeling particularly vulnerable when they were setting up the manoeuvres. Some examiners described the trials as being physically tiring, particularly with regard to setting up for the manoeuvres. The following quote from one of the examiners illustrates this well:

"By the end of the tests, I had an aching across my back, shoulders and hamstrings. I found it overall tiring."

Examiners also reported feeling that the on-road element required more concentration than the current module 1 test. They described needing to attend to multiple elements during the on-road test including looking out for hazards, monitoring evolving traffic conditions, and examining the candidates. Several examiners suggested that the need to carry out safety checks during the test reduced the attention they could pay to the candidate, as illustrated by the following quote:

"It seemed as if making sure things were safe was time taken off of watching the candidates."

Overall, the comments mirror the workload and risk ratings provided by examiners and highlighted the increased workload that they experienced during the on-road parts of the trial.

4.6.5 Learners’ exposure to traffic

One measure of learners’ exposure to risk was provided by the mean time spent in the road either riding the manoeuvres or waiting on their bikes kerbside (Figure 4-23). All mean times were calculated from video analysis of a random sample of 52 trials. The data show that:

- Learners spent an average of between 14 and 20 seconds in the road riding each of the manoeuvres. These figures are an indication of the amount of time required to run each manoeuvre before traffic enters the manoeuvring area.

- Learners spent an average of between 25 and 171 seconds in the road waiting on their motorcycles kerbside. The time spent waiting was substantially longer for those manoeuvres that required the examiner to set out and clear up markers.

In total, riders spent almost 11 minutes per test on average simply waiting on the road kerbside on their motorcycles. During this period they were at risk from passing vehicles, particularly on roads with frequent two-way traffic.
4.6.6 Learners’ risk ratings

Learner riders rated risk on the same three scales that examiners used (described in Section 4.6.3). Figure 4-24 shows that the aggregated risk rating for each of the on-road manoeuvres was greater than the rating for the comparable module 1 manoeuvres. A series of paired samples t-tests showed that risk ratings for all the on-road manoeuvres were significantly greater than for module 1 (p<.001).
The individual components were analysed separately for each manoeuvre and paired samples t-tests used to compare the on-road and module 1 ratings from learners. Figure 4-25 shows that broadly the same pattern of findings emerged from this further analysis, at least for the individual ratings of vulnerability and risk. Specifically:

- Of the three slow manoeuvres, ratings of vulnerability and risk were highest for the ridden U-turn.
- Ratings of vulnerability and risk were highest overall for the emergency brake and hazard avoidance manoeuvres, with the hazard avoidance manoeuvre carrying the highest mean ratings for both measures.
- All on-road manoeuvres made learners feel significantly more vulnerable and at risk than the module 1 counterparts (p<.001 for all).

Figure 4-25 shows that for feelings of confidence, there was little to differentiate between the ratings for the three slow-speed on-road and module 1 manoeuvres. Indeed, it was only the on-road versions of the emergency brake and hazard avoidance manoeuvres that gave rise to a significant lack of confidence when compared with the comparable module 1 manoeuvres (p=.014 and p<.001, respectively).

Overall, the findings suggest that, when compared with module 1, learners may feel reasonably confident carrying out the slower-speed manoeuvres on-road but their confidence wanes significantly during the higher speed manoeuvres, and for all on-road manoeuvres they have significant concerns about their personal safety.

4.6.7 Learner feedback on their experience of the on-road manoeuvres

Learners were asked to provide any comments that they had regarding their experience of completing the on-road manoeuvres; comments were provided by 86 of the 143 respondents who had completed the rider questionnaire and attempted at least some of the manoeuvres on-road.
These comments were analysed and several key themes were identified:

- **Safety-specific concerns**, relating to:
  - Presence of traffic/other road users
  - Road surface quality and defects
  - Performing high-speed manoeuvres in adverse weather conditions

- **Workload concerns**, relating to:
  - Time taken to complete manoeuvres
  - Personal performance
  - Levels of frustration

There was a general sense that riders found the process of completing on-road manoeuvres to be dangerous, with many riders commenting that they would feel safer completing them off-road. One of the main reasons suggested for this unease was the presence of other road users. A selection of views is illustrated in the following quotes:

"It seems very dangerous with live traffic."

"I feel it is much safer to carry out the mod 1 manoeuvres on the test pad at the test centre."

"It was awful. Someone got hurt, cars were constantly around and school kids. This needs to be kept in a secure enclosure with a decent surface."

Some manoeuvres were deemed to be more dangerous than others, namely the hazard avoidance and emergency brake manoeuvres. Issues reported by participants related to the hazard avoidance manoeuvre included the level of difficulty associated with the manoeuvre itself, undertaking it in a live traffic environment and worries about completing it in adverse weather conditions. Some of the comments received are presented below:

"Doing the emergency stop and avoidance manoeuvres on the roads whilst doing the test was very dangerous as more people will come off and injure themselves."

"The new hazard avoidance is far too compact, leaving not enough time or space to hit the required speed – then brake – then swerve. To make matters worse, it’s on the road. If this was a real life situation, there would be a crash. Changing the current mod 1 to this seems a very bad idea."

"The hazard avoidance test seemed like a large step up in comparison with other manoeuvres in the test in terms of safety and difficulty."

"The hazard avoidance controlled stop made me feel unsafe due to the wet road surfaces and the likelihood of coming off the bike and being hit by other traffic."

However, participants also commented that the presence of kerbs on the U-turn manoeuvres was challenging. A sample of the comments received are presented below—

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15 A thematic content analysis was undertaken. Comments were grouped according to whether they mentioned specific manoeuvres or general conditions and were then filtered for common themes (i.e. multiple participants mentioning similar items). Selected comments are representative of opinions shared by multiple participants.
these reflect the concerns that trainers expressed regarding kerb fixation (see Section 4.9):

"The only problem I had is the ridden U-turn because I was looking at the kerb."

"I had trouble doing U-turns going towards the large kerb and trees."

Riders also raised concerns over the suitability of the road surfaces on the roads that were (or could be) selected for the on-road trials. Such concerns included features such as utility access covers and drains, as well as seasonal factors such as the presence of leaves near to the kerbs. It should be noted here that the safety criteria ensured that such features were not present in parts of the manoeuvring area where they could be safety critical but may have been encountered by participants when riding the length of a site for the higher-speed manoeuvres, and when turning in the road at either end of a site for these manoeuvres.

"The road surface was uneven; it had drain holes and leaves and was not clean."

"I feel that these manoeuvres are very dangerous to be practised on-road given the low quality of UK roads."

"Manhole covers and potholes add to risk on manoeuvres."

Performing high speed manoeuvres in adverse weather was a concern for riders. Several riders explained that they had been asked to do their hazard avoidance at lower speeds because of wet surface conditions, which they felt was appropriate.

"I felt that the weather [made the manoeuvres] very unsafe and distracting."

"I found the hazard avoidance and controlled stop very difficult in the weather conditions and I cannot see it being a smart manoeuvre to use on public roads."

"I would not like to do [the on-road manoeuvres] in poor/wet conditions – especially the avoidance."

In terms of workload, participants commented on the amount of time that completion of the manoeuvres took as a result of riders waiting for appropriate gaps in the traffic. It was felt that this time waiting increased their nerves and caused them stress and may have affected their performance. It was also felt that they had to concentrate more for the on-road manoeuvres than the off-road manoeuvres.

"You’re trying to complete the test, but you’re always looking around for hidden dangers i.e. cars/oil on the road, etc. I wasn’t very confident at all during the test and felt rushed in case cars/wagons went past."

"It was not comfortable all round; it took longer [because of traffic] which built pressure and nerves."

"The constant worry of traffic caused one to stress on the U-turn and the pushed U-turn."

"The stream of traffic worried me somewhat and seemed to make the test longer, which made me slightly more nervous."

Concerns were also raised about the potential consequences of the presence of traffic if on-road tests were required in the future, for example:
“If you have had a day off work to do the test and there is too much traffic to complete the manoeuvres and you’re told you will have to come back another time, that would be very unfair.”

4.6.8 The effect of markers on traffic

Phase 2 provided evidence that some drivers behaved erratically when they encountered markers in the road. This appeared to be more likely when the markers used were of the ‘puck’ style rather than the flat yellow discs used in Phase 1. It also appeared to be more likely on busy roads with a steady flow of two-way traffic.

It was decided that pucks should be used to mark the manoeuvres in Phase 3 as they had been reported to be more visible to both examiners and riders. To help mitigate the effects of these markers on traffic, care was taken to ensure on-road sites had lower traffic flows than those used in Phase 2, and examiners were encouraged to clear markers from the road as soon as possible after a manoeuvre had completed.

Video analysis of a random sample of 52 trial events recorded the behaviour of road users in response to the markers. Figure 4-26 shows the number of vehicles that, upon encountering markers in the road, chose to either stay in their lane and drive over the markers or move to the opposite lane and drive around the markers. The data suggest that when there are more than two pucks in the road (i.e. the slalom and hazard avoidance manoeuvres), vehicles are more likely to move to the opposite lane. There was also some evidence of erratic driving in Phase 3 trials, with vehicles occasionally driving very close to riders when they were waiting kerbside as a consequence of trying not to drive over the markers.

These findings suggest that some drivers are concerned about driving over the pucks. This is attributed to their vertical profile, which makes them appear to be more of an obstacle. As a consequence, they are more likely to move to the opposite lane when
faced with multiple pucks in the road, which can cause conflict with other traffic and with test participants. All specific incidents related to the markers are reflected in the full risk assessment that follows this section.

4.6.9    Risk assessment data

The overall aims of the Phase 3 risk assessment were to:

1. Understand the implications of the test manoeuvres regarding the safety of learner riders, examiners and other road users, if rolled out as a replacement for the current module 1 test.
2. Understand the safety parameters or necessary interventions required to safeguard all road users (i.e. to reduce risks to a level that is as low as reasonably practicable) during such an on-road test.

The risk assessment in Phase 3 comprised four tasks. First, site safety assessments were undertaken and reviewed throughout the trial period. Second, all incidents throughout the trial period (injury incidents, non-injury incidents, and near misses) were recorded and reviewed. Third, the incident data were used as the basis of an estimate of the likely incident rates that might be expected if the module 1 test was replaced with the on-road manoeuvres trialled in this project, using the Health and Safety Executive (HSE) accident ratio model as the main tool to calculate this. Fourth, the semi-quantitative risk assessments carried out at the end of Phase 2 (regarding the probability of specific top-level hazardous events occurring—see Appendix D.1 for the full list of hazardous events) were reviewed in light of the experience gained during Phase 3 trialling.

Appendix D provides a detailed description of the risk assessment methods and findings carried out in Phase 3, as well as a summary of the work that predated it in Phases 1 and 2. In this section, we focus on the key findings, which largely relate to the incidents that occurred and what these tell us regarding the potential future implementation of the manoeuvres on-road.

Table 4-2 (reproduced from Table D12 in Appendix D) shows the incidents broken down by severity and manoeuvre. From this table, it is apparent that 50% of the injury incidents occurred during the emergency brake, although it should be noted that this is likely to have been partly due to the fact that the hazard avoidance always came after the emergency brake in the test order.
### Table 4-2: Incidents by severity and manoeuvre

<table>
<thead>
<tr>
<th>Consequence severity and manoeuvre</th>
<th>Number of incidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major</td>
<td>1</td>
</tr>
<tr>
<td>Emergency Brake</td>
<td>1</td>
</tr>
<tr>
<td>Minor</td>
<td>3</td>
</tr>
<tr>
<td>Emergency Brake</td>
<td>1</td>
</tr>
<tr>
<td>Slalom</td>
<td>1</td>
</tr>
<tr>
<td>Ridden U turn</td>
<td>1</td>
</tr>
<tr>
<td>Negligible</td>
<td>243</td>
</tr>
<tr>
<td>Hazard Avoidance</td>
<td>60</td>
</tr>
<tr>
<td>Emergency Brake</td>
<td>55</td>
</tr>
<tr>
<td>Ridden U turn</td>
<td>48</td>
</tr>
<tr>
<td>Slalom</td>
<td>27</td>
</tr>
<tr>
<td>Emergency brake set up</td>
<td>15</td>
</tr>
<tr>
<td>Slalom set up</td>
<td>15</td>
</tr>
<tr>
<td>Pushed U Turn</td>
<td>12</td>
</tr>
<tr>
<td>Hazard avoidance set up</td>
<td>7</td>
</tr>
<tr>
<td>Preamble</td>
<td>3</td>
</tr>
<tr>
<td>All manoeuvres (i.e. attributed to whole test)</td>
<td>1</td>
</tr>
</tbody>
</table>

Because almost all of the incidents are negligible in terms of their outcome (i.e. they were effectively all near-misses) it is useful to apply a subjective assessment of the level of concern and potential outcome of each so that a judgement can be made as to the kinds of risks that riders might be exposed to in live on-road testing. The first part of this analysis was a subjective rating of the ‘level of concern’ for each incident, which was undertaken using a five-category scale as described in Appendix D. Broadly, the levels 1 to 5 of this scale corresponded to:

- Very minor incidents with no further potential for more severe consequences (level 1)
- Minor incidents with little potential for more severe consequences (level 2)
- Minor incidents where there is some concern over the potential for more severe consequences (level 3)
- Close calls where there is some real concern that a more severe consequence could easily have resulted (level 4)
- Incidents which did actually result in some kind of injury (level 5)

Table D13 (in Appendix D) shows the mean ratings for levels of concern for incidents of each category identified during the risk assessment. The key concerns are the incidents that occur most frequently and have a higher level of concern. From this table (highlighted yellow and in bold) it can be seen that the key concerns are:

- Motorcyclist at risk of conflict with a vehicle
- Examiner observation failure when setting out markers
- Vehicle approaching during manoeuvre

It is important to note that none of these incidents could occur off-road.
The next step in the risk assessment work was to consider the likely numbers of incidents (of varying severities) that might take place if the manoeuvres trialled in this study were taken on-road as a replacement of the current module 1 test. For this analysis, we utilised the HSE accident ratio model. Appendix D provides some information on the origin of this model; it represents the most appropriate model to apply to the current dataset as, in order to extrapolate from near-miss and inconsequential incidents, we need to understand how these relate to more serious incidents in larger datasets. The model (shown in Figure 4-27 which is reproduced from Figure D1 in Appendix D) illustrates how serious injuries are ‘built’ on numerous unsafe acts and conditions, near misses, accidents and minor injuries.

In 1997, the HSE’s Accident Prevention Advisory Unit confirmed the general validity of these ratios through the analysis of accident reports within oil, food, construction, health and transport industries. Ratios of similar orders of magnitude are seen in road traffic accident data (see Appendix D).

![Figure 4-27: HSE accident triangle](image)

The HSE ratios of ‘non-injury: minor: major incidents’ according to the model are 189:7:1. The Phase 3 data has resulted in a ratio of 243:3:1, which broadly reflects the pattern expected by the HSE in terms of the orders of magnitude involved. In order to use these ratios to extrapolate to live on-road testing, we need to know the number of candidates that would be exposed to on-road testing. In 2012, DSA tested 67,564 candidates, so we can take this as the most recent available estimate of the number of people who would be exposed to the risks involved in on-road testing if the module 1 test were replaced with on-road testing of the manoeuvres trialled in this study. 151 candidates were tested during Phase 3, resulting in the 247 incidents observed. Utilising these numbers, and the model we can calculate the corresponding number of near-miss incidents that might be expected within the larger dataset. Table 4-3 (reproduced from Table D18 in Appendix D) provides an indication of the number of major, minor and non-injury incidents that could occur annually during on-road testing based on an extrapolation of the HSE model ratios. In addition, the table provides estimates based on the ratios observed in Phase 3.
Table 4-3: Estimated number of annual incidents extrapolated from Phase 3 data

<table>
<thead>
<tr>
<th></th>
<th>HSE accident ratio</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of candidates</td>
<td>Number of incidents</td>
<td>Major</td>
<td>Minor</td>
</tr>
<tr>
<td>Phase 3</td>
<td>151</td>
<td>247</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Annually</td>
<td>67564</td>
<td>110519</td>
<td>561</td>
<td>3927</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Phase 3 accident ratio</th>
<th>Number of candidates</th>
<th>Number of incidents</th>
<th>Major</th>
<th>Minor</th>
<th>Non-injury</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Number of candidates</td>
<td>Number of incidents</td>
<td>Major</td>
<td>Minor</td>
<td>Non-injury</td>
</tr>
<tr>
<td>Phase 3</td>
<td>151</td>
<td>247</td>
<td>1</td>
<td>3</td>
<td>235</td>
<td></td>
</tr>
<tr>
<td>Annually</td>
<td>67564</td>
<td>110519</td>
<td>447</td>
<td>1342</td>
<td>108729</td>
<td></td>
</tr>
</tbody>
</table>

The assumption underlying this assessment is that all of those candidates currently being tested at module 1 sites would instead be tested on-road, under the conditions seen in the Phase 3 trialling. It can be seen that by using the available data as the basis of our best estimate, we would predict between 447 and 561 major incidents annually (where the definition here of ‘major’ is requiring 3 days off of work from the injuries sustained) from on-road motorcycle testing, up to 3,927 minor incidents and over 100,000 near misses, if all tests were run on-road under the kinds of conditions utilised in the Phase 3 trialling.

It is outside of the scope of this project to consider in these estimates different sets of control measures than the ones used in Phase 3. In addition, the estimated incident numbers given here should not be used as a firm prediction; rather they should be taken as an indication (based on the most directly-relevant risk assessment work on this topic) of the order of magnitude of risk that will need to be managed, should implementation of the on-road test proceed.

Table D17 in Appendix D outlines several categories of intervention that might be applied to reduce the likelihood of the incidents reoccurring. In our judgement, 178 of the incidents were amenable to some kind of intervention (the other 69 would have happened anyway). The majority of the interventions identified rely on the application of controls rather than the removal of risk, and this falls into the lower levels of the usual hierarchy used by the HSE (HSE recommends that risk management strategies seek to first eliminate a hazard, or substitute materials and processes so that the hazard is reduced; the application of engineering and administrative controls are considered less desirable). The extent to which they are applied will vary considerably depending on the location, examiner, rider and the overarching priority that is given to safety.

The final part of the risk assessment work was a review of the semi-quantitative risk assessments for the top level adverse events identified in the earlier analysis. Some changes were observed in these which will be useful for future risk assessment work; details can be found in Appendix D.
**4.6.10 Summary**

Data and comments from examiners provide a strong indication that the on-road manoeuvres gave rise to significantly greater feelings of risk and vulnerability than for module 1, and left examiners feeling significantly less confident when examining these manoeuvres on-road. In part, this helps to explain the greater workload they reported on-road—but these concerns about personal safety may be a product of this high level of workload because examiners reported that it left them feeling unable to carry out all of the necessary safety checks.

Data and comments from riders indicated that the on-road manoeuvres carried increased feelings of risk and vulnerability that were openly reported to impair performance. The risk ratings and feedback from learners may explain the performance deficit identified in Section 4.1.1, and provides some context to the higher levels of workload reported for the on-road manoeuvres (see Section 4.1.3).

The risk assessment work showed that a wide range of different incidents occurred, the vast majority of which were near-miss or non-injury incidents, across a range of the manoeuvres. Consideration of the potential for these to have been more serious in terms of outcomes or potential loss suggested that many of the most concerning ones could only occur on-road, as they related to features only present on-road (for example, other road users). Application of the HSE accident ratios to extrapolate from the near-miss incidents in this trial to the larger numbers of candidates being tested at a national level suggested that if the current module 1 test were replaced with the on-road manoeuvres trialled in the current study, under similar conditions, between 447 and 561 incidents requiring 3 days or more off work could be expected without further control measures put in place.

Some interventions are suggested that would have had an impact on the reoccurrence of some of the incidents, although the effectiveness of these in live testing is unknown.

**4.7 What are the safety parameters (including criteria for space protection) required to safeguard all road users during an on-road test, and what are the other criteria for suitable on-road test locations?**

Phase 1 proposed a set of safety criteria for on-road trials in Phases 2 and 3 (see Table C1 in Appendix C). The safety criteria for Phase 2 were stricter to provide an additional level of protection while the actual risks and practicalities of on-road trials were assessed with experienced riders. These stricter safety criteria were not considered necessary for Phase 3 when it became clear that measures such as extending the run-off areas by 10m were not required.

The proposed safety criteria for Phase 3 are summarised graphically in Figure 4-28. The criteria match those described for Phase 3 in Table C1 of Appendix C, and can be summarised as follows:

- A target road width of 7.5m (>6.8m appears to not affect performance).
- A manoeuvring area of 31.5m.
- A run-up area of 85m.
- A run-off area of 55m.
• A time-based requirement for visibility of approaching traffic in both directions (learner riding times for manoeuvres in Phase 3 suggest a maximum of 20 seconds of traffic-free time is required for the longest manoeuvre to run without interruption). Examiners should be confident that the traffic will not enter the manoeuvring area from any of the approaching roads/junctions during the time period required to run the manoeuvre. A visible distance is not specified as this would depend on the approach speed of traffic—junctions and corners were found to slow traffic speed substantially so it was not representative to calculate distances based on a continuous approach speed.

• No pedestrians or other road users in the manoeuvring area for slow-speed manoeuvres, or in the manoeuvring and run-up/run-off areas for higher-speed manoeuvres. The exception is if road users are leaving the manoeuvring area via the run-up area and can be expected to be clear once the manoeuvring begins.

• Low-moderate traffic flows with sufficient gaps to run the manoeuvres uninterrupted.

• No excessive gradient or camber.

• No surface irregularities/ironwork in the manoeuvring area.

• No surface irregularities/ironwork in the final 20m of the run-up area.

• No surface irregularities/ironwork in the run-off area subject to individual site assessments. Exceptions can be made if irregularity is not anticipated to interrupt braking or cause injury should the rider come off in the run-off area.

• Kerb height of 125mm or less—or no kerbs.

• Avoid street furniture and obstacles in the manoeuvring area. Kerbs are permitted, as is some furniture as long as it is set back from the kerbside (e.g. close to the property/boundary line of the road) and is not prominent on the offside of marker 3 (where the rider is most at risk if they come off during the hazard avoidance manoeuvre).

• Avoid street furniture and obstacles in the run-off area. Kerbs are permitted, as is some furniture set back from the kerbside.

• No roadworks, parked vehicles or other obstacles in the road on the nearside of the run-up. Some obstacles may be in the road on the nearside but not in the final 20m of the run-up or adjacent to the start position. Obstacles must not impair sightlines for examiners, or for riders when turning in the road at the start of the run-up.

• No roadworks, parked vehicles or other obstacles in the road in the manoeuvring and run-off areas.

• No side junctions in the run-up, manoeuvring and run-off areas.

• No premises along manoeuvring, run-up or run-off areas where it is not possible to see or anticipate emerging road users or pedestrians.

• High visibility vests to be worn by all examiners and candidates.

• Ensure weather and lighting provides suitable visibility, including stable and consistent lighting through any tree canopy.
• Examiner must stand on the offside footway to give emergency brake signal.
• Examiner must stand on nearside footway during hazard avoidance manoeuvre.
• Rider must have sufficient space when waiting kerbside (road width) or a safe place to wait off the road.
• Open drains in the kerb to be avoided in the manoeuvring and run-off areas.
• Deep ditches close to the edge of the road are to be avoided.
• Examiners must have somewhere safe to stand on both sides of the road that is away from the traffic and has even footing.

There were two additions to the safety criteria specified above, based on procedures for Phase 3 and outcomes from the trials:

• Reflective warning signs must be displayed to all road users approaching the manoeuvring area (e.g. Figure 2-3).
• Road surfaces must be friction tested to ensure they provide a suitable minimum coefficient of friction, especially when the surface is wet (the desired coefficient of friction is not specified but should be comparable to the level required for module 1 sites).

![Figure 4-28: Diagram of proposed safety criteria for on-road trials (as used for Phase 3)](image)

4.8 What is the feasibility of conducting the revised manoeuvres at different types of road location (e.g. urban versus rural)?

One of the research questions required the trials in Phase 3 to determine whether different types of road (e.g. urban and rural) affected the feasibility of conducting the revised manoeuvres on-road. This section explores the sites that were assessed and used in Phase 3, and discusses the characteristics of a suitable site for on-road trials.

4.8.1 On-road site surveys and selection

Sites were surveyed in two types of location. One type of location used for Phase 3 trials involved sites in ‘gap areas’. These are areas across Great Britain where there is a demand for module 1 motorcycle tests but there is not a permanent MPTC to cater for this demand. In some of these areas, temporary solutions are in use, such as part-time operation of VOSA sites as Module 1 test centres. Gap areas are potentially most
relevant for trialling in terms of any future implementation of examining manoeuvres on-road; however, they are typically areas where demand is not high and so potential provision of participants for the trials would be low. To ensure a sufficient sample size could be achieved within the project timescales of this study, the other type of location surveyed involved sites served by a moderately busy MPTC. This would provide access to a larger pool of potential participants for trialling. The intention was also to balance the sample so that it included trainers with and without a vested interest in the future implementation of a single event test conducted on-road.

Table 4-4 lists the areas that were surveyed for potential trial sites but were never used for any on-road trials in Phase 3. Table 4-5 lists the areas that were surveyed for potential trial sites and then eventually used for on-road trials in Phase 3.

Overall, 18 new locations were surveyed in Phase 3 to supplement two locations that were used in Phase 2 and were already considered suitable for Phase 3 (Banbury and Peterborough). Across the 18 new locations that were surveyed:

- 159 potential on-road sites were identified using online mapping tools (79 of which were in locations that were used for on-road trials).
- Almost three-quarters of the roads (114) that were initially identified across all locations were surveyed in person. The outcome of these risk assessments—and a re-appraisal of all the sites identified initially—resulted in 57 sites being assessed as potentially suitable for on-road trials (31 of which were in locations that were used for on-road trials), excluding the two sites already identified in Phase 2 and selected for Phase 3.
- Eleven new on-road sites were trialled in Phase 3, making a total of 13 sites when the two carried over from Phase 2 were included (Table 4-5).

The suitability of sites for on-road trials at each location was re-assessed following the completion of Phase 3 to reflect our improved understanding of how the safety criteria must be implemented at each site.

The colour-coding of Table 4-4 summarises the suitability of these locations for on-road trials. Locations shaded green are those where there were sites that would have been suitable for on-road trials had there been sufficient participation from the local training community. The four locations shaded green were all somewhat different although the proposed trial areas could be loosely characterised as rural areas around urban centres. Locations shaded yellow indicate sites where there were thought to be moderate opportunities to trial. One of these two locations was a gap area and more rural, the other was not a gap area and was urbanised. The locations shaded orange indicate areas where it was extremely difficult to find any suitable roads for trials. Three of these locations were rural gap areas and the fourth was a large city. A decision was made to not attempt to trial at these locations as there was an insufficient pool of suitable on-road sites should any proposed site suddenly become unavailable (e.g. due to roadworks or parked vehicles).
The colour coding of Table 4-5 provides a similar summary in that locations shaded green were far more suited to on-road trials than locations shaded orange, except with these examples the knowledge was borne of experience. Those locations shaded orange were found to require compromises to the safety criteria when trialling began and, in the majority of cases, only one trial day was run at each. Two of these locations were gap areas but were otherwise a mix of different levels of urbanisation. Of the sites that did prove to be most suited to on-road trials, only one was in a gap area. Again, all provided a mix of sites that were urban and rural to varying extents.
Table 4-5: Summary of assessments for sites that were used for on-road trials

<table>
<thead>
<tr>
<th>Location/area</th>
<th>Nearest MPTC(s) or VOSA sites</th>
<th>Gap area? (nearest Mod 2 site)</th>
<th>Number of sites</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Identified from initial map search</td>
<td>Surveyed and risk assessed in person</td>
<td>Suitable for on-road trials</td>
<td>Within 5-mile radius of a DTC</td>
<td>Used for on-road trials</td>
</tr>
<tr>
<td><strong>North Yorkshire (S)</strong></td>
<td>Walton</td>
<td>Yes (York)</td>
<td>9</td>
<td>9</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>North Yorkshire (N)</strong></td>
<td>Darlington</td>
<td>No</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Kent (N)</strong></td>
<td>Herne Bay; Gillingham</td>
<td>No</td>
<td>6</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>West Midlands</strong></td>
<td>Wolverhampton; Shrewsbury</td>
<td>No</td>
<td>16</td>
<td>15</td>
<td>6</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>Cambridgeshire</strong></td>
<td>Peterborough</td>
<td>No</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Dorset</strong></td>
<td>Poole LGV</td>
<td>Yes (Poole)</td>
<td>11</td>
<td>11</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td><strong>Lincolnshire</strong></td>
<td>Lincoln</td>
<td>No</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Essex</strong></td>
<td>Basildon</td>
<td>No</td>
<td>14</td>
<td>10</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Somerset</strong></td>
<td>Bristol</td>
<td>No</td>
<td>15</td>
<td>15</td>
<td>4</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td><strong>Oxfordshire</strong></td>
<td>Oxford Kassam (casual)</td>
<td>Yes (Banbury)</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td></td>
<td></td>
<td>79</td>
<td>74</td>
<td>31</td>
<td>10</td>
<td>13</td>
</tr>
</tbody>
</table>

*Locations identified and risk assessed during Phase 2

4.8.2 Projections for implementation of an on-road test

Projections can be made regarding the feasibility of sourcing sites for on-road testing in the future (although this was not a specific part of the study remit). The process of site selection enables estimates to be made regarding the ‘conversion rate’ of sites, from the initial search process through to finding a suitable site that was within a five-mile radius of an existing Driving Test Centre (DTC), and therefore within the likely test route network—see Table 4-4 and Table 4-5 for the number of sites meeting this criterion in each location. The search process revealed that:

- Of 114 roads surveyed in person, less than half (48%) were suitable for on-road trials.
- Of 55 suitable on-road sites, just a third (31%) were within a five-mile radius of an existing test centre.
- It was necessary to survey six roads for every one suitable road found within a five-mile radius of a test centre.

The only other guidance that emerged with regard to site selection was that roads that met all the safety criteria were typically most suited to on-road trials, and those roads were perhaps more often to be found in industrial estates. However, the site survey process for Phase 3 did not identify any other distinguishing characteristics that may assist with finding suitable locations for on-road trialling or testing in the future.
4.8.3 Individual site assessments

The individual site assessments for each location surveyed during Phase 3 are presented in Appendix F.

4.8.4 Summary

A wide range of locations were surveyed for on-road sites for Phase 3 trials. These locations represented gap areas and locations served by the existing network of MPTCs. The survey process was not efficient; although a large sample of possible on-road sites was identified using online mapping tools, once the sites were assessed in person slightly more than half were discounted for various reasons that were not evident during the online search. Furthermore, barely a third of the sites that were suitable were within a five-mile radius of the nearest test centre (and therefore close enough to be incorporated into the test route network). This equated to just one in six surveyed roads being suitable for implementation of an on-road test in the future. This would indicate that sourcing multiple on-road sites around a single test centre for possible future implementation of an on-road test would be challenging.

Two other findings emerged from the process of surveying sites. Firstly, the most suitable sites were those that met all of the safety criteria. This superseded all prior suggestions that suitable roads may be characterised by other features such as whether they were urban or rural. These characteristics were mostly redundant if the safety criteria were met. However, the second finding offers some further guidance in site selection as it did become clear throughout Phase 3 that the most appropriate sites were often located in industrial areas near business premises. Such locations tended to have wider roads, fewer premises (and those that did exist often had entrances and exits that were easier to monitor) and better sightlines than roads that were found elsewhere.

4.9 What are the training requirements for the revised manoeuvres, including the measures to protect learners, instructors and other road users during training?

To understand the training approaches used to prepare candidates for on-road trials of the revised manoeuvres, structured interviews and focus groups were conducted with a subset of the trainers that took part in the study. Where possible, multiple trainers from a single training school were invited to form a focus group (so that they could all share their views at the same time); where this was not possible—or for independent trainers—separate telephone interviews were conducted. In total, 13 trainers from six different training schools participated in the discussions.

The interviews followed a structured topic guide (see Appendix E) and focused on asking trainers to describe:

- How their riders were trained to undertake each of the manoeuvres.
- What could be done to protect the safety of learners, trainers and other road users during training.
- How easy or difficult it would be to follow all of the safety parameters required for on-road testing.
4.9.1 How were learner riders trained for the on-road manoeuvres?

Trainers were invited to provide feedback on how they prepared learners for the on-road manoeuvres by completing their questionnaires, and through the discussion groups and interviews. Many of the trainers had been working as motorcycle instructors before the current off-road, module 1 manoeuvres were introduced in 2009. Trainers frequently commented that some of the proposed on-road manoeuvres, such as the pushed U-turn and emergency stop, were similar or identical to the manoeuvres that were tested prior to the introduction of the module 1 test, and that they already had experience of training learners to complete these manoeuvres on-road.

The following subsections summarise their feedback.

4.9.1.1 Pushed U-turn

Trainers were already familiar with how to train their learners to perform the pushed U-turn manoeuvre on-road from the version of the motorcycle test that preceded module 1. As a result, they generally did not feel that this manoeuvre presented them with any challenges from a training perspective. Trainers reported that they typically structured their training for the on-road trial so that candidates prepared for the manoeuvre off-road first and then, when they had mastered the required techniques, practised it on-road. This was a common approach across all manoeuvres.

It was felt that if trainers had to train all of their learners for the on-road test, the pushed U-turn would not require a change to what they were already doing. There was however a fear that training for this manoeuvre on-road may have implications for lessons, such as additional time taken to travel to a suitable on-road location and the fact that a trainer can only take two learners with them at a time.

4.9.1.2 Ridden U-turn

Again, trainers reported that the vast majority of training for the on-road ridden U-turn took place in an off-road environment (typically with the road width being marked out with tape or cones); on-road training only took place once the trainer felt the learner was competent. Trainers described kerb fixation (and the associated loss of confidence if a kerb was struck) as being a concern associated with on-road training of this manoeuvre. This was one of the principle reasons that they were keen for their trainees to master the manoeuvre off-road before introducing real on-road obstacles such as kerbs.

The trainers involved in the interviews and focus groups felt that the on-road ridden U-turn was not difficult to train—but it would take longer than the current module 1 version. When it was completed on-road, it presented certain training challenges for learners, such as kerb fixation, road features (camber and varying surface conditions), as well as monitoring for other road users. This was supported by the trainer questionnaire data which also suggested that learners were more nervous practicing this manoeuvre on-road than off-road. Trainers suggested that if they had to train all of their learners for the on-road test, the time they spent training learners for this manoeuvre would probably increase, due to these extra challenges presented by the on-road environment.
4.9.1.3  **Slalom**

Trainers stated that they preferred to train their learners for the slalom off-road before practicing on-road, and that this would continue to be the case if the on-road manoeuvres became part of the formal motorcycle test.

Trainers across the different participating training schools offered mixed opinions about the slalom being trained on-road. Some schools described that they had actually found training candidates for the on-road slalom to be easier than training them for the current module 1 slalom owing to the puck-style markers used in the trial not presenting the same challenges as the module 1 cones (the reduced radius and vertical profile means a tighter line can be ridden between the on-road markers). Other respondents felt that it was more challenging to train the slalom on-road with the pucks as they were harder for candidates to see.

The trainer questionnaire data suggest that the presence of traffic increased the difficulty of training this manoeuvre and reduced learner safety. Two of the trainers described a situation in which their learners were overtaken by other vehicles while practising the slalom which left the learners feeling vulnerable and unsafe.

4.9.1.4  **Emergency stop**

As with some of the slow manoeuvres, the emergency brake manoeuvre was one that was previously undertaken on-road as part of the test before module 1 was introduced and, as such, trainers felt that it did not present any particular challenge to the way that they trained their candidates for the trial, or would train in the future if required. However, it should be noted here that when the emergency brake manoeuvre was examined on-road as part of the official test, it was not at a measured speed and the guidance was to ride at approximately 20mph rather than 30mph.

Some variations were reported in the way the manoeuvre was trained. For example, some training schools reported focusing on the technique rather than the speed, with learners completing the manoeuvre at lower speeds than those required in the trial and then gradually increasing the speed. A mixture of on-road and off-road training was used in preparation for the trial and it was felt that this would continue if the test went on-road. Trainers described that learners were only permitted to graduate to on-road training when they were considered to be sufficiently skilled and experienced. For the emergency stop (and the hazard avoidance manoeuvre), the specific on-road location was considered a particularly important aspect of the training—oil spills, utility access covers, potholes and other surface irregularities all needed to be avoided, as did any road with entrances or exits along the training area.

4.9.1.5  **Hazard avoidance**

This manoeuvre was the most controversial of all manoeuvres when it was discussed with trainers, and the manoeuvre most frequently commented on in the trainer questionnaire. Trainers expressed several concerns related to the manoeuvre itself and to the training their candidates required to perform it correctly.

In terms of the manoeuvre itself, it was felt that it the physical requirements (achieving a certain speed, then braking, avoiding and braking again to come to a controlled stop) were dangerous and not appropriate for learner riders. Trainers also described it as an unusual manoeuvre to complete, given that in real-world riding conditions, they would
never encourage riders to accelerate towards a hazard. It was considered to be difficult, ‘unintuitive’ and dangerous. It is acknowledged here that the period of acceleration is incorporated only so that riders can accelerate to a 30mph riding speed and then maintain this speed for the start of the manoeuvre; however, trainers clearly had a different perception of this component of the manoeuvre. It is notable that when getting up to speed for the module 1 hazard avoidance, candidates ride a cornering exercise so this may explain why trainers did not perceive the straight line acceleration for the on-road hazard avoidance manoeuvre as equivalent.

With regard to training for the on-road hazard avoidance, trainers reported that they did not feel confident or safe training their learners to do this manoeuvre on-road. Instead they tended to do all of the training at their typical off-road training facilities. One trainer reported that he attempted to train his candidates to perform the manoeuvre on-road and, after a couple of attempts, did not feel secure or in control so stopped practising on-road. Another school described the way in which its instructors focused on breaking the hazard avoidance down into sections and worked through the various requirements of the manoeuvre at a pace learners were comfortable with (for example, getting the riders to begin riding in a straight line for 85m, reach a speed of 28-30 mph and then slow down to an almost complete stop before steering around the marker). Many trainers suggested that even as experienced riders, they found it a difficult manoeuvre to demonstrate.

4.9.2 How can the safety of the learners, instructors and other road users be protected during such training?

Feedback from trainers was used to address this question. For many of the trial manoeuvres, trainers suggested that the only way to ensure learners, instructors and other road users were protected during the training would be to avoid doing it on public roads, or to close the road completely. The second option was thought to be unfeasible as it contravenes the law. Trainers acknowledged that practicing manoeuvres on-road was required for this trial and suggested the following ideas in relation to the safety of learners, instructors and other road users.

4.9.2.1 Communication

Maintaining radio contact between the learner and trainer was beneficial to the safety of both parties (and often a legal requirement, depending on the type of motorcycle and the learner’s licence status). For example, it gave trainers an opportunity to abort an exercise without relying on potentially confusing hand signals. Trainers perceived themselves to be ultimately responsible for ensuring the safety of the learner, which presented a challenge in terms of observing the trainee and the road environment at all times (although this could potentially be addressed by having an additional ‘look-out’).

Instructors suggested that the safety of all parties could be improved by the use of signs on the road to make people aware that training was in progress (similar to those used for Phase 3 trials, but instead warning road users of ‘motorcycle training’ rather than testing). Another option was to use a second trainer as a ‘look-out’. Trainers indicated that the use of ‘look-outs’ would have an impact on the cost of lessons as two instructors would be required for each lesson, and for small training schools and independent trainers, there were concerns that this would not be possible.
4.9.2.2 When and where to carry out on-road manoeuvres

Trainers stressed that it was very important to ensure that their learners were competent at completing the manoeuvres before practicing them on-road.

In terms of selecting appropriate roads, trainers felt that it was important to choose on-road sites away from people or property. They tended to opt for industrial estates to practice the on-road manoeuvres as quieter stretches of road could be found in such areas. The physical hazards presented by the road environment were of concern to trainers due to the potential for injury to trainees and/or damage to bikes. Trainers reported it was critical to find roads with a consistent surface for any on-road training. Trainers also needed to be competent in terms of anticipating other road users’ actions and selecting appropriate roads.

4.9.2.3 Weather

Concerns were expressed regarding carrying out some of the manoeuvres during periods of cold, icy or wet weather. It was felt that the high-speed manoeuvres (emergency stop, and in particular, the hazard avoidance manoeuvre) would be particularly dangerous in adverse weather conditions. Trainers felt that these issues would almost certainly affect rider safety as well as their own willingness to carry out on-road training in such conditions.

4.9.2.4 Kerb fixation

The issue of kerb fixation for on-road manoeuvres was raised by a number of trainers, particularly in relation to the ridden U-turn. This process occurs when riders become so focused on the kerb (or another object) that their awareness of other hazards or obstacles is reduced. In some situations, this may result in the rider becoming fixated on the kerb to such an extent that they will forget to take any actions required to avoid it, resulting in a collision. From a training context, it was felt if the on-road training for this manoeuvre was undertaken before the learner was competent, it might have an impact on their confidence if they were to make a serious error. A trainer from one training school suggested that one way of reducing the issues associated with kerb fixation for on-road training might be to use roads with dropped kerbs so that learners could practice the manoeuvre in an on-road environment.

4.9.2.5 Other safety considerations

It was felt that the safety of some manoeuvres may be dependent on the size of bike being used. For example, one of the training schools which had participated in a focus group explained that carrying out a pushed U-turn on a large bike may be more dangerous for learners as they might find that the weight of the bike makes it difficult to move, therefore there was a risk of them not completing the manoeuvre safely.

When setting up manoeuvres on the road, trainers described how they would be required to walk in the road to lay down the markers, which increased their exposure to traffic and subsequently their risk. The importance of learners and trainers wearing high-visibility clothing (i.e. vests or jackets) was also emphasised as an essential safety mechanism, particularly given the increased amount of time spent in a live carriageway.
4.9.3 What were trainers’ perceptions of the ease or difficulty of following the safety criteria for on-road testing?

All of the trainers consulted with for this part of the study were presented with the safety criteria specified for Phase 3 (and described in Section 4.7). They were asked to consider each parameter and specify how easy or difficult it would be for them to follow if they had to train all their learners for the on-road manoeuvres in future. Table 4-6 shows the outcome of these discussions. Trainers’ responses to the feasibility of applying these parameters to the on-road training varied, but there was general agreement that it would not be easy (or in many cases possible) to apply all of the safety criteria.

Some parameters were reported as being easier to apply than others and these tended to be those over which trainers and/or learners had some control. Examples included finding somewhere safe for the trainer to stand during manoeuvres and for both parties to wear high visibility sleeved jackets that were clean and fastened.

Parameters that presented difficulties for trainers to apply typically involved other road users (e.g. pedestrians) and features outside of their control (for example, no roadworks, parked cars, side junctions or premises in the run-up, manoeuvring and run off areas). Trainers felt that some of these issues could be overcome by using locations such as industrial estates. However, they did acknowledge that factors like business start and finish times and shift changes would lead to increased traffic flow at certain times, which would need to be factored into their training schedules and might ultimately make their businesses less flexible.

Table 4-6: Safety criteria for on-road training sites that trainers would find easy and difficult to implement

<table>
<thead>
<tr>
<th>Easy to implement</th>
<th>Difficult to implement</th>
</tr>
</thead>
<tbody>
<tr>
<td>A road width greater than 7m for the ridden U-turn</td>
<td>85m run-up</td>
</tr>
<tr>
<td>(At weekends) a traffic flow with sufficient gaps to run the manoeuvres</td>
<td>A clear run-off area of 55m after the manoeuvring area</td>
</tr>
<tr>
<td>No street furniture and obstacles in the manoeuvring and run-off areas</td>
<td>Sightlines to permit at least 20 seconds’ warning of oncoming traffic</td>
</tr>
<tr>
<td>Somewhere safe for the trainer to stand during manoeuvres</td>
<td>No road surface irregularities/ironwork in the final 20m of the run-up</td>
</tr>
<tr>
<td>No pedestrians in the run-up unless moving away from the manoeuvring area</td>
<td>Individual site assessments (not easy and time consuming)</td>
</tr>
<tr>
<td>Trainers and candidates must wear high visibility sleeved jackets that are clean and fastened</td>
<td>No roadworks or parked cars in the run-up, manoeuvring and run-off areas</td>
</tr>
<tr>
<td>No open drains in the kerb in the manoeuvring and run-off areas</td>
<td>No side junctions in the run-up, manoeuvring and run-off areas</td>
</tr>
<tr>
<td>No deep ditches close to the edge of the road in the manoeuvring area</td>
<td>No premises along the run-up, manoeuvring and run-off areas</td>
</tr>
<tr>
<td></td>
<td>A safe area for the rider to wait</td>
</tr>
</tbody>
</table>
A related concern was that the number of suitable on-road locations in a given area was likely to be small and therefore the availability of such areas would be in demand if the on-road manoeuvres were implemented. At the very least, most trainers in the area would be competing to use the suitable on-road locations and it would be likely that such areas would be designated as test locations so examiners and candidates would also be competing for the space. If fixed road signs and markings were implemented at on-road test areas, trainers reported that they would prefer to use those areas for training purposes. The expected outcome would be disruption to testing schedules and/or training programmes.

4.9.4 Summary

A broad range of trainers who had provided participants for the Phase 3 trials provided feedback, either by means of questionnaires, focus groups or telephone interviews.

In general, trainers felt that most of the manoeuvres could be trained safely on-road if required. However, they acknowledged that on-road training would result in certain modifications to their training being required (e.g. the potential for a ‘lookout’ to monitor traffic or longer lesson times to allow for traffic flow and finding suitable on-road locations if necessary). Indeed, the consensus was that four of the five manoeuvres (ridden U-turn, slalom, emergency brake and hazard avoidance) would require an increase in training time as a direct consequence of moving them on-road. Some of this increase was attributed to the time required to travel to suitable on-road locations for training purposes, whilst some increases were attributed to the increased demands of the proposed manoeuvres in comparison to what is required for module 1.

The only manoeuvre that caused substantial concern with regard to training on-road was the hazard avoidance; trainers generally reported that it was too dangerous to train on-road, even with competent learners.

In order to protect the safety of learners, instructors and other road users during on-road training, a number of suggestions were made which related to communication, on-road locations, weather, kerb fixation and other safety considerations.

In terms of the ease of applying the safety criteria to sites selected for on-road training, nobody who participated in the interviews and focus groups felt that they could easily apply the whole list. Particular concerns were raised over the impact of other road users and environmental features outside of their control. Related to this were concerns that the few on-road sites that may prove suitable in a particular area would then face competing demands from all trainers and potentially from examiners and test candidates, too.
5 Conclusions

This document reports Phases 2 and 3 of the Motorcycle Manoeuvre Review project, which sought to establish the safety and feasibility of replacing the current module 1 motorcycle test with a series of similar (in some cases identical) manoeuvres carried out on-road.

An earlier phase of the project (Phase 1, see Tong et al., 2013) had involved preparatory research that underpinned Phase 2, which itself underpinned Phase 3. Phase 1 trialled the manoeuvres at off-road locations using learner riders, and Phase 2 took the manoeuvres on-road but with experienced motorcyclists. Phase 3 itself trialled the manoeuvres fully on-road with test-ready learner riders. A consideration of the findings from Phase 3 (supported by Phases 1 and 2) allow us to draw firm conclusions as to the safety and feasibility of taking the manoeuvres on-road; although the trialling can never be expected to match perfectly the conditions of on-road live testing (due to the research-nature of the work and additional presence at the roadside that this entails) it is as close as it is possible to get to live testing within an ethical research approach.

Nine research questions were addressed. The questions are listed below, with the key conclusions related to each.

1. Do the revised manoeuvres assess the same competencies and to the same standard as the existing module 1 manoeuvres?

The revised set of manoeuvres was objectively more challenging that the current module 1 test. More faults were recorded during the on-road manoeuvres than during the module 1 manoeuvres, especially those faults in the ‘serious’ category, and especially for the on-road versions of the ridden U-turn, emergency brake, and hazard avoidance manoeuvres. Additional competence ratings from senior examiners agreed with objective fault data assigned by local examiners.

Subjectively, learner riders experienced greater workload in the on-road test, largely because they felt frustrated and insecure, felt rushed, and had insight into their poorer performance. Again these differences appeared largely in the ridden U-turn, emergency brake, and hazard avoidance manoeuvres.

If on-road testing is pursued, it can be expected that the competence required to pass the test on-road will be greater than it is currently using the module 1 set-up, assuming the same standards of marking faults are used as were employed in this study.

2. Can the revised exercises be conducted on-road in a fair and consistent manner for riders using motorcycles with different power outputs?

Comparisons were made between the two tests based on rider performance using test fault data and workload ratings for riders on different sizes of bike. Broadly the pattern of findings was the same for each group. Thus the increased difficulty of the on-road test appeared to be present for larger and smaller machines.

If on-road testing is pursued, it can be expected that on the whole, riders of different sized machines will not be differentially affected.
3. Do weather conditions have any implications for the examining of the revised manoeuvres and the assessment of performance?

Weather and surface conditions did not appear to substantially affect the general pattern of data in that overall the on-road test was more difficult, regardless of weather and surface conditions. However, testing the high-speed manoeuvres in the wet did have an impact on safety; it became apparent after a number of incidents that when the road surface is wet this can have a serious impact on surface friction.

If on-road testing is pursued, it is feasible to test many of the manoeuvres in a range of weather conditions, but regular friction testing of on-road sites will be required to ensure that high-speed manoeuvres can be carried out in the wet.

4. What is the feasibility of using portable speed measuring equipment when trialling on-road?

Field-testing of one portable speed gun was carried out, and it became quickly apparent that examiners were unable to use the device and examine the candidate safely.

If on-road testing is pursued, any kind of speed measurement device employed will need to be properly user-tested and will need to be usable without any interruption to the examining of the actual riding during manoeuvres.

5. What is the time taken to complete the revised set of manoeuvres in simulated test conditions?

Based on measurements taken for the tests carried out as part of Phase 3, we estimate that the average time for an on-road test (including time to prepare and dynamically risk-assess the site\(^\text{16}\) on arrival, time to set-up and examine all manoeuvres, and all candidate briefings) is likely to be approximately 26 minutes (with 25% of tests taking 28 minutes, and 10% of tests taking 31 minutes). This does not include any time for aligning a speedoscope, if such a technology solution for speed measurements is pursued.

6. What are the implications of the revised exercises (when being examined) for the safety of learner riders, examiners, and other road users?

Data and comments from examiners and learners provide a strong indication that the on-road manoeuvres gave rise to significantly greater feelings of risk and vulnerability than for module 1, and lower confidence.

The risk assessment work showed that a wide range of different incidents occurred, the vast majority of which were near-miss or non-injury incidents, across a range of the manoeuvres. Many of these had the potential for more serious outcomes, and the majority of these could only occur on-road as they related to features only present in the on-road environment.

Application of the HSE accident ratios to extrapolate from the near-miss incidents in this trial to the larger numbers of candidates being tested at a national level suggested that

\(^{16}\) This assumes that the site has already been risk assessed in full and the required control measures identified and implemented accordingly. The examiner will therefore be aware of the potential hazards at the site and will re-assess the risks on the day using the original risk assessment as a basis.
if the current module 1 test were replaced with the on-road manoeuvres trialled in the current study, under similar conditions, between 447 and 561 incidents requiring 3 days or more off work could be expected without further control measures put in place.

If on-road testing is pursued, control measures will need to be sought to reduce the anticipated number of incidents of this nature to a level that is deemed tolerable. Some interventions are suggested in this report (see Table D17 in Appendix D).

7. What are the safety parameters (including criteria for space protection) required to safeguard all road users during an on-road test, and what are the other criteria for suitable on-road test locations?

A wide range of safety criteria are given in Section 4.7 of this report, partly summarised by the following diagram:

If on-road testing is pursued, it will be necessary to use at least the control measures outlined in this report to retain the relevance of the findings in this report to the likely effects on candidates and examiners.

8. What is the feasibility of conducting the revised manoeuvres at different types of road location (e.g. urban versus rural)?

The most suitable sites were those that met all of the safety criteria. This superseded other features such as whether the roads in question were urban or rural. The most appropriate sites were often located in industrial areas near business premises, although this was not always the case. Such locations tended to have wider roads, fewer premises (and those that did exist often had entrances and exits that were easier to monitor) and better sightlines than roads that were found elsewhere.

One in six surveyed roads was suitable for implementation of an on-road test in the future (meeting most or all of the safety criteria and within 5 miles of an existing test centre). This would indicate that sourcing multiple on-road sites around a single test centre for possible future implementation of an on-road test would be challenging.

If on-road testing is pursued, considerable efforts will need to be focused on the issue of finding suitable roads.

9. What are the training requirements for the revised manoeuvres, including the measures to protect learners, instructors and other road users during training?

In general, trainers felt that most of the manoeuvres could be trained safely on-road if required, with some modifications to current practice. The consensus was that four of
the five manoeuvres (ridden U-turn, slalom, emergency brake and hazard avoidance) would require an increase in training time as a direct consequence of moving them on-road.

The only manoeuvre that caused substantial concern with regard to training on-road was the hazard avoidance; trainers generally reported that it was too dangerous to train on-road, even with competent learners.

Concern was expressed over the competition that would exist for training locations (some of which would likely also be testing locations).

If on-road testing is pursued, the training industry will need to be heavily involved in the transition from the module 1 test to an on-road test, to ensure that concerns and practical issues around training are taken in to account.
References


