Executive Summary

A traffic modelling exercise has been undertaken by WSP | Parsons Brinckerhoff on behalf of Plymouth City Council and the Transport Strategy Working Group (TSWG) to assess the future performance of the Plymouth highway network. The work was undertaken in support of the Plymouth and South West Devon Joint Local Plan (JLP) which will see additional homes built and jobs created.

An existing strategic model of the Plymouth road network has been used to assess the impact of traffic growth across the city for the year 2034 (the end year of the JLP). An extra 14,000 vehicle trips are forecast to be made per peak traffic period by this year and the model has been used to inform an assessment of the network’s ability to accommodate the extra demand.

Three versions of the 2034 traffic model were created to test the impact of an increased number of vehicle journeys, as shown in Table i below; these were:

Table i - 2034 traffic model versions

<table>
<thead>
<tr>
<th>Model Version</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2034 traffic growth with committed physical transport interventions only;</td>
</tr>
<tr>
<td>2</td>
<td>2034 traffic growth with committed physical transport interventions plus sustainable transport measures;</td>
</tr>
<tr>
<td>3</td>
<td>2034 traffic growth with committed physical transport interventions plus sustainable transport measures plus non-committed ‘pipeline’ transport interventions.</td>
</tr>
</tbody>
</table>

Junction capacity results were output from each of the models for analysis with the number of congested junctions in each used as the means to assess the operation of the network. Model version 1 displayed the highest number of congested junctions with the number reducing once sustainable interventions and additional transport schemes were added in versions 2 and 3.

The three versions of the model were compared against a ‘core’ scenario in which no JLP growth was applied. The aim of the exercise was to return the performance of the highway network to, or as close as possible to, the ‘core’ scenario and to verify that the ‘direction of travel’, in policy and infrastructure intervention terms, was indeed heading in the right direction (see Table ii below):

Table ii - Number of congested junctions by time period

<table>
<thead>
<tr>
<th>Period</th>
<th>Number of congested junctions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Core</td>
</tr>
<tr>
<td>AM (08:00-09:00)</td>
<td>184</td>
</tr>
<tr>
<td>PM (17:00-18:00)</td>
<td>195</td>
</tr>
</tbody>
</table>

As can be seen the number of congested junctions reduces as interventions are applied; however more investigation is necessary to explore the transport strategy to further reduce the number of congested junctions. This will be achieved through analysis of model outputs and a professional review of sites requiring additional interventions / measures.
Introduction

Background

WSP | Parsons Brinckerhoff (WSP | PB) has been working on behalf of Plymouth City Council (PCC) and the Transport Strategy Working Group (TSWG) to produce future year traffic forecast modelling in support of the Plymouth and South West Devon Joint Local Plan (JLP).

The JLP is a blueprint for growth across Plymouth and the surrounding towns and villages with the plan being jointly developed by PCC, South Hams District Council and West Devon Borough Council (SHWDC). The plan outlines future housing and employment developments, with an objectively assessed need (OAN) of 30,300 dwellings identified within the Housing Market Area covering Plymouth and SHWDC\(^1\).

An additional 14,000 vehicle trips, resulting from the forecast increased number of dwellings and employment opportunities within the Plymouth area over the plan period, were tested using an existing SATURN Highways Assignment Model (HAM). The existing Plymouth HAM 2 based on 2009 highway operation but updated to include housing and employment growth realised from 2009 – April 2016, was used to represent the likely operation of the highways network in 2034, producing future year modelled networks for assessment.\(^2\)

AM and PM peak period models were produced representing the busiest times in terms of traffic volumes for a typical weekday. The AM peak covers the hour between 08:00 – 09:00 with the PM peak covering the hour between 17:00 – 18:00.

Objective

The purpose of the modelling exercise was to identify junctions on the network which are forecast to see an increase in congestion as a result of 2034 traffic growth. In highlighting junctions which are forecast to exceed their capacity in future then proportionate and appropriate measures can be identified with the aim of minimising the overall impact on the Plymouth highway network.

Modelling Methodology

An origin / destination matrix was produced for each development scenario to calculate 2034 traffic volumes. These were then assigned through the future year Plymouth HAM. The results from each scenario were analysed to assess the implications of traffic growth and the road network’s ability to accommodate the predicted number of vehicle trips, in comparison with a ‘core’ scenario representing the 2034 Plymouth road network with committed developments only and committed physical transport interventions;

Three rounds of modelling using the Plymouth HAM have taken place. The model iterations are summarised in Table 1.

\(^1\) It is noted that the OAN housing figure has recently been revised to 27,300 dwellings, however for the purposes of the report the earlier figure is assumed as this was the best information available at the time that the future year traffic forecast modelling was undertaken.

\(^2\) A description of the model and the updates is described in the Plymouth and South West Devon Joint Local Plan Strategic Modelling Methodology Note (February 2017).
Table 1 - Future model iterations

<table>
<thead>
<tr>
<th>Model iteration</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>JLP growth with committed physical transport interventions</td>
</tr>
<tr>
<td>2</td>
<td>JLP growth with committed physical transport interventions plus sustainable measures</td>
</tr>
<tr>
<td>3</td>
<td>JLP growth with committed physical transport interventions, sustainable measures plus non-committed ‘pipeline’ transport interventions</td>
</tr>
</tbody>
</table>

Specifically this report will focus upon the results from the following modelled scenarios:

- **A1** – ‘Core’ scenario, representing the 2034 Plymouth road network with committed developments only and committed physical transport interventions;
- **B1** – JLP scenario, representing the 2034 Plymouth road network with committed & JLP developments and committed physical transport interventions;
- **B2** – As B1 plus sustainable transport measures;
- **B3** – As B2 plus non-committed ‘pipeline’ interventions.\(^3\)

Physical transport interventions and sustainable transport measures were tested in the model with the objective of returning the network performance of the Scenario B highway network to that, or as close as possible to that, seen in the ‘core’ A1 scenario.

The B1 scenario displays the highest number of congested junctions across the network with this figure reduced in the B2 and B3 scenarios once sustainable transport measures and additional physical transport interventions were applied to the network respectively.

This report provides a summary of results for each time period with numbers of congested junctions in each modelled scenario providing an indication of overall network performance.

**Results**

Upon completion of the modelling, results were extracted from each scenario to assess their individual operation. Primarily, junction capacity results were analysed with the number of junctions considered congested used to assess the overall operation of the network, i.e. the fewer congested junctions the better the network is deemed to operate.

Congested junctions were defined as locations on the network displaying a Ratio of Flow to Capacity (RFC) of 75% or above. RFC is a measure of junction saturation and indicates how much traffic is passing through the junction in relation to its overall capacity. Should the volume of traffic approach the available throughput then a junction will become congested and delay will begin to occur.

**AM**

Figures 1 and 2 display the junction RFC results output from the AM modelled scenarios. The results are used to analyse the overall network operation and to assess the effectiveness of proposed interventions in reducing the overall number of junctions which appear as congested in the model.

Figure 1 displays the number of junctions which are deemed as congested per scenario:

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\(^3\) ‘Pipeline’ schemes are targeted infrastructure interventions likely to come forward during the life of the JLP.
As can be seen in the above graph the number of congested junctions increases between the ‘core’ scenario (A1) and the JLP development scenario (B1). This is the result of an increase in traffic flow once the JLP development allocations are factored into the 2034 traffic forecast.

The number of congested junctions decreases by 16 following the application of sustainable transport measures in the B2 model (B2-B1). An assumption of a 5-10% reduction in vehicle demand has been applied to the B2 scenario to reflect likely modal shift resulting from sustainable transport measures and policies outlined in the JLP.

The decrease in the number of congested junctions between the B1 and B2 modelled scenarios indicates that proposed sustainable measures will have a positive impact on the operation of the future Plymouth road network. An additional junction is removed from the overall number of congested junctions once physical ‘pipeline’ transport interventions are applied to the network in the B3 scenario.
Figure 2 - AM congested junctions once 'core' scenario congested junctions are removed

Figure 2 represents the number of junctions which are deemed as overcapacity as a result of the JLP growth, i.e. junctions which are not congested in the ‘core’ scenario but become so once JLP traffic flows are assigned to the network. Removing those junctions which are congested in the ‘core’ scenario allows us to pinpoint those areas in the network which become congested as a direct result of JLP development allocations.

The graph in Figure 2 above shows that there are 38 additional congested junctions in the B1 scenario over and above the 184 which appear as congested in the ‘core’ scenario. 22 additional junctions are congested in the B2 scenario (compared with A1) and 21 in the B3 scenario (compared with A1). By investigating those junctions which appear congested due to vehicle trips generated by JLP growth it is possible to target specific areas for improvement.

The list of junctions in the B3 model scenario which are ≥ 75% RFC, or more than as reported in scenario A1 if the junction was already greater than 75% in A1 can be found in Appendix A.
PM

As with the AM period, junction capacity results were extracted from the model for analysis and comparison. The number of junctions which appear with an RFC of 75% or above, and are therefore considered as congested, can be seen on Figure 3 below:

Figure 3 - Number of congested junctions per scenario (PM)

The graph in Figure 3 shows that in the PM peak there are 47 additional junctions that are congested in the B1 network as a result of increased traffic flow generated by the JLP development allocations.

Between the B1 and B2 scenarios the number of congested junctions reduces by 15 signifying that decreased traffic volumes resulting from sustainable transport measures has a positive impact on the road network.

A further 6 junctions are removed from the overall number of congested junctions in the PM B3 scenario once physical ‘pipeline’ transport interventions are also introduced to the highway network. This indicates that the pipeline physical transport interventions are easing the level of congestion experienced across Plymouth.

Figure 4 illustrates the number of congested junctions in each development scenario once those junctions which are congested in the ‘core’ scenario are removed:
The graph highlights an encouraging downward trend in the number of congested junctions seen within each scenario once sustainable transport measures and ‘pipeline’ interventions are applied. 26 additional junctions remain congested as a result of the JLP sites following that mitigation.

The list of junctions in the PM, in the B3 model scenario, which are ≥ 75% RFC, or more than as reported in scenario A1 if the junction was already greater than 75% in A1 can be found in Appendix A.

Assessing the benefits derived from the pipeline transport interventions

To further analyse the benefits of the ‘pipeline’ interventions the number of junctions which are operating at or above 85% RFC for the AM and PM peak periods has also been reviewed. The results are shown in Figure 5.
As can be seen in peak periods once the ‘pipeline’ interventions are implemented in the B3 scenario the overall number of junctions operating above 85% reduces. 22 fewer junctions are operating at or above 85% in the AM B3 scenario with 8 less in the B3 PM scenario in comparison to B1. This shows that the ‘pipeline’ interventions have a positive impact on the network.

**Conclusion**

The modelling exercise undertaken in support of the JLP has achieved the objective of identifying those locations on the network which are forecast to become congested in 2034, as a result of traffic growth associated with JLP development. The results show that, when JLP growth is applied, there is an increase during both peaks in the number of junctions which operate with an RFC of 75% or above and so are considered congested.

It is apparent that as a result of the scale of growth, which adds circa 14,000 additional vehicle trips per peak period, the Plymouth road network will experience additional congestion. The number of congested junctions can be reduced through the application of sustainable transport measures, with additional physical transport interventions (the ‘pipeline’ schemes) further improving network performance.

The PM peak period, which sees more congested junctions than the AM peak, benefits particularly from the pipeline transport interventions with the number of congested junctions across the network decreasing from 242 junctions to 221 once both sustainable transport measures and physical transport interventions are applied.

The application of further focused analysis and targeted interventions, including sustainable transport measures, will seek to deliver additional network performance improvements.
APPENDIX A – Location of congested junctions (Scenario B3)
Appendix A - Location of congested junctions (Scenario B3)

<table>
<thead>
<tr>
<th>Address</th>
<th>Node</th>
<th>AM Peak</th>
<th>PM Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>William Prance Road / Forder Valley Link Road</td>
<td>33</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>William Prance Road (East)</td>
<td>38</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>William Prance Road (South)</td>
<td>46</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Union Street / The Crescent</td>
<td>160</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Union Street / Martin Street</td>
<td>161</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Cumberland Road / George Street</td>
<td>165</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Park Avenue / Fore Street</td>
<td>166</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Park Avenue / Ferry Road</td>
<td>168</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Ferry Road / Pottery Road</td>
<td>171</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Mill Bridge / Wilton Street</td>
<td>183</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Fore Street / Kings Road</td>
<td>186</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Molesworth Road / Milehouse Road</td>
<td>194</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Albert Road / Park Road</td>
<td>197</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Keyham Road / St Levan Road</td>
<td>199</td>
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<td>✓</td>
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<tr>
<td>Ford Hill / St Levan Road</td>
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</tr>
<tr>
<td>Wolseley Road / Royal Navy Avenue</td>
<td>207</td>
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<td></td>
</tr>
<tr>
<td>Saltash Road / Wolseley Road</td>
<td>213</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Weston Mill Drive / Ferndale Road</td>
<td>214</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Saltash Road / North Road West</td>
<td>239</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

Note that by this definition, if a node is above 75% in both scenarios but the RFC decreases from Core to B3, it is not included in this table.
<table>
<thead>
<tr>
<th>Road Crossing</th>
<th>Number</th>
<th>Right</th>
<th>Left</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alma Road / Outland Road</td>
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<td>✓</td>
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</tr>
<tr>
<td>Outland Road / Milehouse Road</td>
<td>248</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Outland Road / Seagrave Road</td>
<td>252</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Outland Road / Peverell Park Road</td>
<td>253</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Seagrave Road / North Prospect Road</td>
<td>258</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Beacon Park Road / North Prospect Road</td>
<td>263</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Western Approach / Mayflower Street</td>
<td>275</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Ford Park Road / College View</td>
<td>284</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Hyde Park Road / Gifford Terrace Road</td>
<td>285</td>
<td>✓</td>
<td></td>
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<tr>
<td>Hyde Park Road / Weston Park Road</td>
<td>286</td>
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<td></td>
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<td>Weston Park Road / Burleigh Park Road</td>
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<tr>
<td>Ham Drive / Pennycross Park Road</td>
<td>293</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Crownhill Road / Budshead Road</td>
<td>314</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Crownhill Road / St Peters Road</td>
<td>318</td>
<td>✓</td>
<td>✓</td>
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<td>Crownhill Road / Meavy Way</td>
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<td>✓</td>
</tr>
<tr>
<td>Budshead Road / Tamerton Foliot Road</td>
<td>322</td>
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<td>✓</td>
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<td>Milford Lane / Fore Street</td>
<td>326</td>
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<td></td>
</tr>
<tr>
<td>Tamerton Foliot Road / Southway Drive</td>
<td>337</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>North Hill / Clifton Place</td>
<td>349</td>
<td>✓</td>
<td></td>
</tr>
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</tr>
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<td>Mannamead Road / Seymour Road</td>
<td>362</td>
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<tr>
<td>Road Junctions</td>
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<td>367</td>
</tr>
<tr>
<td>--------------------------------------------</td>
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<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>Mannamead Road / Eggbuckland Road</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Mannamead Road / Thornhill Road</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Mannamead Road / Torr Lane</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>A386 Tavistock Rd north of Manadon Roundabout</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tavistock Road / Meavy Way</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Tavistock Road / Plumer Road</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tavistock Road / Charlton Road (S/B)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Tavistock Road / Sendall's Way</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Derriford Roundabout / Tavistock Road (North)</td>
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<td></td>
</tr>
<tr>
<td>Tavistock Road / Powisland Drive</td>
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<tr>
<td>Mannamead Road / Compton Park Road</td>
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<td>Tavistock Road / Morgan Road</td>
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<td>Mannamead Road / Hartley Road</td>
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<tr>
<td>Tavistock Road / Derriford Road</td>
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<td></td>
<td></td>
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<tr>
<td>Derriford Roundabout / Brest Road</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Derriford Roundabout / Tavistock Road (South)</td>
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<tr>
<td>Derriford Roundabout / Looseleigh Lane</td>
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<td></td>
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<tr>
<td>Lipson Road / Mount Gould Road</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alexandra Road / Southern Terrace</td>
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<td>Alexandra Road / Ashford Hill</td>
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<td>Lipson Road / Mostyn Road</td>
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</tr>
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<td>Old Laira Road / Efford Lane</td>
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<tr>
<td>Eggbuckland Road / Efford Road</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Intersection / On-Slip</td>
<td>Code</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>------</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Egguckland Road / Shallowford Road</td>
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<td>✓</td>
</tr>
<tr>
<td>Fort Austin Road / Widey Lane</td>
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<td>Fort Austin Road / Church Hill</td>
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<td>✓</td>
</tr>
<tr>
<td>Barnstaple Close / Longbridge Road</td>
<td>437</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Forder Valley Road / Novorossiysk Road</td>
<td>439</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Novorossiysk Road / Miller Way</td>
<td>440</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Novorossiysk Road / Sheepstor Road</td>
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<td>✓</td>
<td></td>
</tr>
<tr>
<td>Glenn Road / Hillcrest Drive</td>
<td>460</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Deep Lane E/B off-slip / Deep Lane</td>
<td>462</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>A38 / Deep Lane E/B off-slip</td>
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<td>✓</td>
<td></td>
</tr>
<tr>
<td>A38 / Deep Lane W/B off-slip</td>
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<td>Deep Lane / A38 W/B off-slip</td>
<td>466</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Deep Lane / W/B on-slip</td>
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<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Sherford Road / Stamps Hill</td>
<td>469</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Notte Street / Princess Street Ope</td>
<td>484</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Exeter Street / Bretonsise</td>
<td>489</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>A38 E/B off-slip / Marsh Mills Roundabout</td>
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<td>✓</td>
<td></td>
</tr>
<tr>
<td>Ridgeway / Moorland Road</td>
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</tr>
<tr>
<td>Merafield Road / Ridge Road</td>
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<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Stamps Hill / Deep Lane</td>
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<td>✓</td>
<td></td>
</tr>
<tr>
<td>Springfield Road / Reservoir Road</td>
<td>551</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Laira Bridge Road / Hele's Terrace</td>
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