

## LNMS EVALUATION REPORT

# A30 Chiverton Cross Roundabout Improvement Scheme



JOB NUMBER: 5048001.			DOCUMENT REF: POPE of LNMS - A30 Chiverton Cross_FINAL.doc			
Revision	Purpose / Description	Originated	Checked	Reviewed	Authorised	Date
01	DRAFT	JA	KH	SB	PR	May 2009
02	FINAL	JA	KH	SB	PR	May 2009
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# Contents

<i>Section</i>	<i>Page</i>
<b>1. Introduction</b>	<b>1</b>
Purpose of this report	1
Background	1
Scheme Description	4
Scheme categorisation and objectives	2
Future Schemes	2
Pope methodology overview	3
Report Structure	3
<b>2. Data Collection and Stakeholder Feedback</b>	<b>4</b>
Introduction	4
Datasets used to support the pope evaluation	4
Summary of site observations	5
Consultation	8
<b>3. Traffic and Economic Impacts</b>	<b>13</b>
Introduction	13
Traffic volume changes	13
Manual Classified Count Data	15
Analysis of Journey Times	17
A30 (West)	18
A30 (East)	20
Pope Assessment	22
Interpreting the POPE Conclusions	27
Scheme costs	30
<b>4. Safety Impacts</b>	<b>32</b>
Introduction	32
Par assessment	32
Par predicted corrected assessment	33
Outturn impacts	34
<b>5. Environment, Accessibility and Integration Impacts</b>	<b>39</b>
Environmental Impacts	39

Accessibility Impacts	40
Integration Assessment	41
<b>6. Summary and Conclusions</b>	<b>43</b>
Introduction	43
Summary of key impacts	43
Conclusions	45
Summary of recommendations	46
<b>Appendix A – Original Scheme AST</b>	<b>47</b>
<b>Appendix B – Outturn EST</b>	<b>48</b>
<b>Appendix C – Turning Counts</b>	<b>49</b>
<b>Appendix D – Economy Calculations</b>	<b>50</b>
<b>Appendix E – 10 Year Appraisal</b>	<b>51</b>
<b>Appendix F – Glossary</b>	<b>52</b>

### List of Tables

Table 2.1 – AM Peak Journey Times	11
Table 2.2 – PM Peak Journey Times	11
Table 3.1 – AADT Data	14
Table 3.2 – PAR predicted economic benefits	22
Table 3.3– Summary of predicted-corrected economic benefits	24
Table 3.4 – Summary of POPE Economic Benefits	26
Table 3.5 – Annual Hours Delay A30 Approach Arms	26
Table 3.6 – Comparison of predicted and outturn scheme costs	30
Table 4.1 – Number of Personal Injury Accidents, PAR	33
Table 4.2 - Number of Personal Injury Accidents, Predicted Corrected Analysis	34
Table 4.3 – Number of Personal Injury Accidents, POPE	35
Table 4.4 – Location of Personal Injury Accidents	35
Table 4.5- Predicted and outturn monetary safety benefits	37
Table 5.1 – Summary of Predicted and Outturn Environmental Impacts	39
Table 6.1 – Summary Economic Evaluation	44

## List of Figures

Figure 1.1 – Chiverton Cross Roundabout Location	2
Figure 1.2 - Scheme Drawing (Pre September 2006 Lane Markings)	1
Figure 2.1 – Spiral type road markings to delineate traffic lanes on the circulatory carriageway, together with additional direction signing on the approaches, to assist lane discipline	5
Figure 2.2 - Subsidiary islands on the A30 and A390 entries to improve deflection on entry.	5
Figure 2.3 – Segregated left turn lane on the A390 approach with merge onto the A30 southbound.	6
Figure 2.4 - New subsidiary roundabout linking the B3277 to St Agnes and road to Blackwater and replacement link to the main roundabout to reduce number of arms.	6
Figure 2.5 - A shared use cycle path and footpath	7
Figure 2.6 - New banks and replanting on both sides of the approach from the new roundabout, and on the left hand side of the new segregated left turn lane from the A390 Truro to A30(W) Redruth.	7
Figure 3.1 – Location of Count Sites	14
Figure 3.2 – AM Peak Hour Traffic Flows	16
Figure 3.3 – PM Peak Traffic Flows	16
Figure 3.4: A30 (West) Flow and Recurrent Delay by Month, 2004 to 2008	19
Figure 3.5 – A30 (West) Flow and Recurrent Delay by Hour, 2004 to 2008	19
Figure 3.6 - A30 (East) Flow and Recurrent Delay by Month, 2004 to 2008	21
Figure 3.7 - A30 (East) Flow and Recurrent Delay by Hour, 2004 to 2008	21
Figure 3.8 – Pre and Post Scheme Layouts and A30 Approach Arms	29

# 1. Introduction

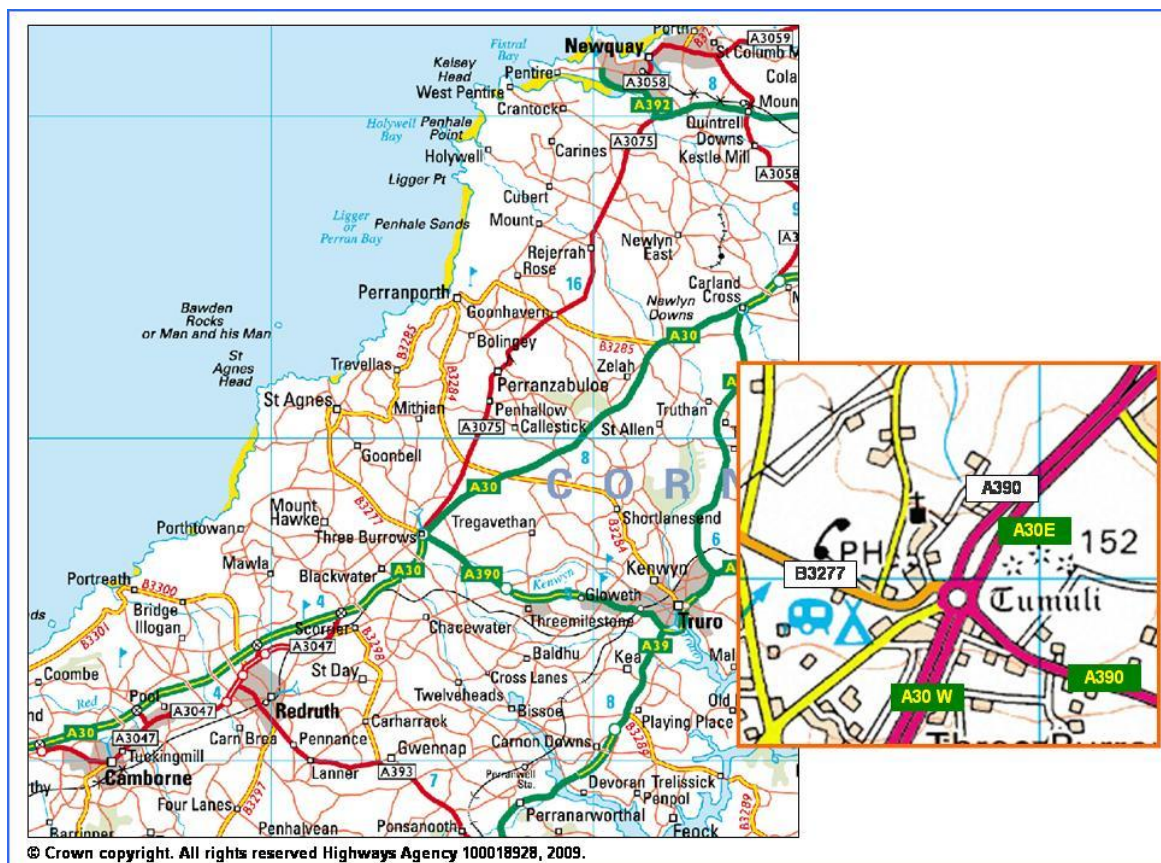
## PURPOSE OF THIS REPORT

- 1.1 As part of an ongoing requirement of the Highways Agency to evaluate the impacts of new trunk road schemes, Atkins has been commissioned to undertake post-opening evaluations of Local Network Management Schemes (LNMS) with an implementation cost of between £1m and £5m. The aim of this process is to assist the Highways Agency (HA) and their Managing Agents to:
- ◆ Quantify the outturn benefits and dis-benefits accruing from new schemes and to ascertain which schemes offer the greatest value for money;
  - ◆ Develop the pre-scheme appraisal processes (PAR Guidance) to assist in providing accurate predictions about the possible impacts of highway schemes on safety, economy, environment, accessibility and integration in the future;
- 1.2 This document specifically sets out the results of the Post-Opening Project Evaluation (POPE) of the Chiverton Cross Roundabout improvement scheme as implemented in May 2006. This report examines the economic, safety, environmental, accessibility, and integration impacts resulting from the installation of the junction improvement. The findings from this and other reports will inform the POPE of Local Network Management Schemes (LNMS) Year 6 Report in August 2009.

## BACKGROUND

- 1.3 Chiverton Cross Roundabout is located on the A30 approximately 6km northeast of Redruth and forms a junction with A390 from Truro, the A3075 from Newquay and the B3277 from St. Agnes. The location of the scheme and layout of the junction are shown overleaf in Figure 1.1.

Figure 1.1 – Chiverton Cross Roundabout Location



- 1.4 Prior to the junction improvements a high level of accidents had been identified at the junction. The junction also suffered from severe congestion and queuing traffic on some arms, particularly on the A390 during peak hours.
- 1.5 A report by Mott MacDonald in 2002 'A30 Chiverton Roundabout Scheme Investigation Study' identified the problems with the junction as follows:
- ◆ High Speed of Circulatory Traffic
    - Circulatory speeds on the roundabout were high, limiting the opportunities for traffic to enter the roundabout. This resulted in shunt type accidents, which occurred when drivers would begin to enter the roundabout but hesitate as they perceived the speed of approaching traffic. Contributory factors to high circulatory speeds were the large inscribed diameter of the roundabout, the width of the circulatory carriageway and poor entry deflection on the A30 Bodmin and A390 Truro approaches.
  - ◆ Number of approaches
    - The roundabout had six approach arms, further increasing the potential for driver hesitation and vehicle conflicts. The arms led to confusion for drivers in

selecting which lane they should be in on the approach arm and where to position their vehicle on the circulatory carriageway. Confusion in selecting the correct arm also arose on exiting the roundabout particularly on the A3075 Newquay, A30 Bodmin and A390 Truro arms.

- ◆ Capacity of A390 Truro Approach
  - Significant queues formed at this location during peak hours. Approximately 50% of the traffic on this arm was taking the first exit in a south-westerly direction towards Redruth.
- ◆ Potential cyclist/pedestrian conflicts with vehicles
  - The issues above were considered to result in safety implications for pedestrians and particularly cyclists. Although the junction was not heavily used by cyclists there were two personal injury accidents involving cyclists in the two year period leading up to 31<sup>st</sup> May 2001

## SCHEME DESCRIPTION

- 1.6 Based on the above issues, the scheme identification study recommended a package of improvements at the roundabout to reduce congestion, improve safety and encourage walking and cycling. The recommendations were reviewed and refined by Parsons Brinckerhoff and the proposals for the final scheme consisted of:
- ◆ Spiral type road-markings to delineate traffic lanes on the circulatory carriageway, together with additional direction signing on the approaches, to assist lane discipline;
  - ◆ Subsidiary islands on the A30 and A390 entries to reduce approach speed of vehicles on these approach arms;
  - ◆ A segregated left turn lane on the A390 approach, merging onto the A30 southbound; and
  - ◆ A new subsidiary roundabout linking the B3277 (to St Agnes) and the C700 (to Blackwater) prior to the main roundabout. This reduced the number of approach arms at the main roundabout.
- 1.7 The Project Appraisal Report (PAR) was produced by Parsons Brinckerhoff and issued in January 2006. Construction for the scheme began on 12th December 2005 and was fully operational by 25<sup>th</sup> May 2006.
- 1.8 Following the scheme opening it was found that traffic flows at the junction differed from that anticipated when the improvement was planned. It was found that traffic on the A30 West from Redruth experienced queuing and manoeuvring problems during peak periods.
- 1.9 As a result lane markings on the A30 West were amended with:
- ◆ Eastbound A30 traffic being reallocated from lane 2 to lane 1; and
  - ◆ Lane 2 being dedicated for right turning, Truro bound, traffic on the A390.
- 1.10 These works were carried out in September 2006. This evaluation focuses primarily on the final layout.
- 1.11 The scheme drawing is shown below in Figure 1.2 (spiral markings shown reflect the original scheme before the final changes were made).

Figure 1.2 - Scheme Drawing (Pre September 2006 Lane Markings)



Source: [http://www.highways.gov.uk/roads/documents/scheme\\_map.pdf](http://www.highways.gov.uk/roads/documents/scheme_map.pdf)

## SCHEME CATEGORISATION AND OBJECTIVES

- 1.12 Local Network Management Schemes are categorised according to which of the five assessment objectives of Safety, Economy, Environment, Accessibility and Integration is primarily addressed by the scheme.
- 1.13 As detailed in the original PAR document, the objective of the scheme was to:
- ◆ Reduce congestion on the A390;
  - ◆ Improve the overall performance of the junction; and
  - ◆ Provide safety benefits at the junction
- 1.14 As the primary objective was to reduce congestion on the A390 the scheme has been categorised as an **economy scheme**, with some safety benefits.

## FUTURE SCHEMES

### Carland Cross to Chiverton Cross

- 1.15 In evaluating this scheme it should be noted that at the time of the PAR there was a wider proposal for a TPI (Targeted Programme of Improvements) scheme, now known as Major Schemes, to improve the A30 between Carland Cross and Chiverton Cross to dual carriageway standards. As part of that scheme, the existing roundabout at Chiverton Cross would become a grade-separated junction superseding elements of this scheme. The scheme under evaluation in this report was intended to provide interim improvements prior to the construction of the Major Scheme.
- 1.16 Following the Spending Review 2004 the delivery of the TPI scheme became dependant on regional prioritisation. A Preferred Route Announcement was made at the end of March 2005, and at the time the PAR was carried out there was no delivery programme beyond this.
- 1.17 In the absence of a delivery programme the PAR assumed the construction of the Major Scheme would commence as originally programmed in 2008. As a result, this scheme was assessed over a 3-year appraisal period.
- 1.18 In July 2005 the South West region submitted their advice on transport priorities assuming indicative funding allocations for the next ten years. Their advice was that the Carland Cross to Chiverton Cross Improvement, when weighed against other priorities in the region, be placed in the category of longer-term schemes for delivery outside the first regional funding allocation period. In July 2006 the Secretary of State accepted that advice, which means that the A30 Carland Cross to Chiverton Cross Improvement is unlikely to be funded before 2016 at the earliest.
- 1.19 As a result, the effective life of the Chiverton Cross Roundabout Improvements scheme is likely to increase from the initial 3 years to 10 years. Consequently while the main body of this report assesses the improvement over its original 3 year appraisal period, the impacts of an extended scheme life are also calculated and are presented in Appendix E.

## POPE METHODOLOGY OVERVIEW

- 1.20 The remainder of this report presents a comparison of the predicted and outturn impacts of the scheme based upon the five assessment objectives in paragraph 1.9, and more specifically:
- ◆ A comparison of the 'before' and 'after' traffic volumes at the junction to illustrate how overall traffic conditions have changed following the scheme opening, and an evaluation of journey time savings;
  - ◆ An outline of changes in accident rates at the junction following scheme opening; and
  - ◆ A comparison of predicted and outturn impacts on the environment, accessibility and integration.
- 1.21 This is then followed by an assessment of the scheme in accordance with POPE methodology. This methodology aims to provide a means by which forecast and outturn effects of a scheme can be evaluated on a common basis. This process ultimately compares the following:
- ◆ The original PAR assessment completed by Parsons Brinckerhoff in January 2006. This represents the forecast benefits of the scheme, and is summarised in the original Appraisal Summary Table (AST); and
  - ◆ An Evaluation Summary Table based on the outturn effects of the scheme using a methodology consistent with the original PAR assessment undertaken prior to scheme opening.

## REPORT STRUCTURE

- 1.22 Following this introduction, the report has been divided into five further sections as follows:
- ◆ **Chapter 2:** Data Collection and Stakeholder Feedback;
  - ◆ **Chapter 3:** Traffic and Economic Impacts;
  - ◆ **Chapter 4:** Safety Impacts;
  - ◆ **Chapter 5:** Environmental, Accessibility and Integration Impacts; and
  - ◆ **Chapter 6:** Summary of Findings and Recommendations.

## 2. Data Collection and Stakeholder Feedback

### INTRODUCTION

- 2.1 This chapter sets out the data collection process used to support this scheme evaluation. More specifically, this chapter:
- ◆ Lists the datasets used to undertake the scheme POPE assessment;
  - ◆ Summarises the outcomes of a site visit undertaken by Atkins in October 2008; and
  - ◆ Provides a summary of the feedback from the consultation regarding the overall effectiveness of the scheme in achieving the intended objectives.

### DATASETS USED TO SUPPORT THE POPE EVALUATION

- 2.2 A number of datasets were used to inform this POPE study, these are listed as follows:

#### Pre-Scheme Opening Data

- ◆ A30 Chiverton Cross Roundabout PAR, January 2006;
- ◆ Personal Injuries Accident data (from 1st June 2000 to 31st October 2005);
- ◆ Classified turning count for all approaches. (15 minute intervals for the classification categories Car, LGV, OGV1, OGV2 and PSV, October 2002, Hyder, 08:00-09:00, 14:00-15:00, 17:00-18:00);
- ◆ Queue length survey for all approaches (October 2003); and
- ◆ ARCADY delay calculations from the original roundabout layout, (provided by Parsons Brinkerhoff).

#### Post-Scheme Opening Data

- ◆ Personal Injury Accident data (STATS19 data supplied by Enterprise Mouchel and Cornwall County Council, from 1<sup>st</sup> June 2006 – 30<sup>th</sup> June 2008);
- ◆ Classified Count Survey and Queue Length Survey, conducted on 11<sup>th</sup> October 2007. (Provided by Cornwall County Council);
- ◆ Classified Count turning count for all approaches. (15 minute intervals for the classification categories Car, LGV, OGV1, OGV2, Bus and Motorcycle, 21<sup>st</sup> & 22<sup>nd</sup> June 2006, Sky High, 07:00 – 19:00);
- ◆ The Highways Agency Journey Time Database (HATRIS JTDB);
- ◆ AADTs from TRADS derived from automatic count sites on the A30 Trunk Road; and
- ◆ Estimated AADTs from the DfT, as published on their website: <http://www.dft.gov.uk/matrix/> (Providing estimated AADT for every link of the 'A' road and motorway network in Great Britain).

### SUMMARY OF SITE OBSERVATIONS

- 2.3 A site visit was conducted in October 2008 to observe the post opening traffic conditions at the junction, and to confirm that the scheme had been implemented as stated in the PAR.
- 2.4 The site visit found that the scheme had been implemented as in the final scheme drawings. Aspects of the scheme are shown below:

**Figure 2.1 – Spiral type road markings to delineate traffic lanes on the circulatory carriageway, together with additional direction signing on the approaches, to assist lane discipline**



**Figure 2.2 - Subsidiary islands on the A30 and A390 entries to improve deflection on entry<sup>1</sup>.**



<sup>1</sup> The island shown above in Figure 2.2 is a physical subsidiary deflection island located on the A30 East approach arm, with the intention to direct, deflect and separate traffic movements onto the roundabout. The physical island also provides a pedestrian refuge. Similar islands are located on the A390 and A30 West approach arms.

**Figure 2.3 – Segregated left turn lane on the A390 approach with merge onto the A30 southbound.**



**Figure 2.4 - New subsidiary roundabout linking the B3277 to St Agnes and road to Blackwater and replacement link to the main roundabout to reduce number of arms.**



**Figure 2.5 - A shared use cycle path and footpath**



**Figure 2.6 - New banks and replanting on both sides of the approach from the new roundabout, and on the left hand side of the new segregated left turn lane from the A390 Truro to A30(W) Redruth.**



2.5 During the site visit the roundabout was driven throughout the peak periods. Key observations in relation to traffic conditions were:

*Weekday Morning Peak Period:*

2.6 Queues began to build up in the AM Peak at 08:10. By 08:30 there were queues on each approach arm with the exception of the A390. The extents of the queuing on drive-throughs' are described below, although this may not represent the worst conditions for each arm. Queues on the:

- ◆ A30W extended back approximately 300m. Although not stationary, it was taking about two minutes from the back of the queue to the stop line;
- ◆ A30E extended back approximately 100m, taking 2 minutes to travel from the back of the queue to the stop line;
- ◆ A3075 consisted of approximately 175m the queue was slow moving and resulted in delays of approximately 6 minutes;

- ◆ Queue on B3277 did not number more than 8 vehicles although resulted in delays of approximately 2 minutes, due to difficulties entering the roundabout caused by circulating traffic; and
- ◆ No queues were observed on the A390, all other arms were congestion free by 09:00.

#### *Weekday Evening Peak Period:*

- 2.7 During the peak period queues were only observed on the A30W and the B3277, with maximum delays occurring at around 17:30. The extent of queues during the drive-throughs' are described below:
- ◆ Queues on the A30W extended to approximately 300m long. Although the queue was not stationary, it was taking approximately 2 minutes to clear the stop line from the back of the queue; and
  - ◆ Traffic on the B3277 extended to the subsidiary roundabout taking approximately 90 seconds to clear the stop line.

## **CONSULTATION**

### *Pre Scheme*

- 2.8 Prior to the scheme, consultation was undertaken to inform on the options being considered, and to give local people and other interested parties the opportunity to comment on the proposed junction. This included a public consultation exhibition and the formal approach of Local authorities, Parish Councils and a number of Non-Statutory organisations. As part of the feedback:
- ◆ Cornwall County Council expressed their full support for the scheme, and indicated subsequently that they would be prepared to contribute £150,000 towards the scheme;
  - ◆ Chacewater Parish council expressed their support for the scheme in the form of a completed questionnaire;
  - ◆ St Agnes Parish Council passed a motion in support of the scheme at a meeting attended by representatives of Parsons Brinkerhoff and the Highways Agency;
  - ◆ Formal responses were not received from the other District, City or Town Councils, although a number of councillors had attended the public consultation and it was concluded to reveal no objections in principle;
  - ◆ Responses received from non-statutory organisations generally expressed support of the scheme in principle, highlighting points or concerns with relation to their specific interests; and
  - ◆ The vast majority of respondents from the public were in favour of improvements at Chiverton Cross with 93% agreeing that improvements of some form were required at the roundabout, and 78% supporting the proposed scheme.

### *Post Scheme - POPE*

2.9 Where contact details were available, organisations who formally responded as part of the initial consultation were contacted again to give feedback on how successful they felt the scheme had been in achieving its objectives. Consultation forms were sent to:

- ◆ Cornwall County Council;
- ◆ Chacewater Parish Council;
- ◆ The Devon and Cornwall Constabulary;
- ◆ The Term Maintenance Contractor (MAC);
- ◆ Road Haulage Association;
- ◆ Cyclists Touring Club;
- ◆ The National Farmers Union;
- ◆ Cornwall Wildlife Trust;
- ◆ Friends of the Earth; and
- ◆ Newquay Association of Tourism.

2.10 Responses were received from the MAC, Chacewater Parish Council, Cornwall County Council and the Highways Agency (via the MAC) responses are summarised below:

#### *Term Maintenance Contractor (MAC, Enterprise Mouchel)*

2.11 Three feedback replies were received from Enterprise Mouchel (who have taken over from Parsons Brinckerhoff as MAC since the scheme implementation) these included responses from; the Network Operations Manager, the Customer Care Manager and a LNMS Engineer (formerly a Traffic Management/Road Safety Officer with Devon and Cornwall Police covering the Chiverton Cross area).

2.12 Feedback responses included the following comments:

- ◆ Following the scheme, eastbound traffic on the A30 West approach to the roundabout regularly queues for over half a mile, and often well in excess of this;
- ◆ Lane discipline is poor on the A30 East approach as a result of some confusion by motorists. During peak times the approach to the roundabout is occupied by motorists, there is a requirement for more 'stacking space' and longer dedicated lanes on the approach;
- ◆ A lot of complaints have been received about A30 traffic for Truro rat running by Trevissome as they seek to avoid queuing at Chiverton during the morning and holiday peaks;
- ◆ From the A3075 approach, road markings and signage indicate A30 West Traffic to use lane two. When entering the roundabout the gyratory markings show the A30 West in two lanes. This encourages motorists to hesitate and change lanes with an increased risk of being involved in a collision; and
- ◆ The dedicated lane for A30 West traffic on the A390 from Truro works very well and reduces delays on that leg.

### *Chacewater Parish Council*

2.13 Feedback from a councillor at Chacewater Parish Council was that:

- ◆ The scheme has resulted in increased tailbacks on all arms, with the exception of the A390, and is not considered to represent an overall improvement;
- ◆ In order to avoid congestion on the B3277, people travelling towards Truro from St Agnes are bypassing Chiverton Cross roundabout, taking Kea Downs Road and Chacewater Hill to the Threemilestone roundabout. As a result, traffic heading eastbound on the A390 has to give way to this traffic, causing congestion on the A390 Eastbound. This can tailback as far as Chiverton Cross roundabout, adding to congestion at this point; and
- ◆ Although not much else could be done to improve facilities for cyclists crossing the A30, it is considered that this still represents a danger to cyclists due to the high traffic volumes.

### *Cornwall County Council*

2.14 Feedback was received from Cornwall County Council via a telephone conversation. It was felt that:

- ◆ Queuing had increased on the A30 from Redruth and decreased on the A390 from Truro following the scheme; and
- ◆ As a result of congestion on the A30 Eastbound vehicles are using the right hand lane for the A30 West exit which refutes the signage and road markings. Additional queuing on this arm has also resulted in rat running A30E through Blackwater entering the roundabout via the B3277.

2.15 It was also noted that Cornwall County Council are currently working on developing a further scheme for this roundabout, with the Highways Agency acting as consultees. Various options for future improvements have included:

- ◆ Signalisation at the main roundabout;
- ◆ An increased number of lanes on the roundabout approach arms; and
- ◆ Merging of the A3075 and the A30N via an additional roundabout to the north to further reduce the number of approach arms.

2.16 A preferred scheme would be submitted for Community Infrastructure Funding, with relation to development constraints in the area as a result of congestion at the roundabout. A preferred scheme would need to be submitted for funding in April 2009, at the time of writing there is no final priority scheme<sup>2</sup>.

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<sup>2</sup> On 29<sup>th</sup> March 2009 the Chiverton Cross Junction was one of 26 schemes invited to submit full business cases for consideration for a further £30m from the Community Infrastructure Fund, together with any remaining funding from the first round. The total estimated cost of these 26 bids is £72.95m with the Chiverton Cross Bid accounting for £3.85m. Decisions will be announced over the summer. During the first round £170m was allocated to 29 schemes.  
(Source: <http://www.communities.gov.uk/news/corporate/1187483>)

### Highways Agency

- 2.17 Due to a large amount of incidents recorded at the site, the Highways Agency have requested an enhanced Road Safety Audit Stage 4 (RSA) at this location.
- 2.18 Stage 4 Road Safety Audits are a monitoring process prepared using 12 months and 36 months of accident data from the time a road improvement scheme becomes operational. Post opening accident records are compared to those before the scheme opened and with control data, data is analysed in detail to:
- ◆ Identify locations at which personal injury accidents have occurred;
  - ◆ Identify personal injury accidents that appear to arise from similar causes or show common factors; and to
  - ◆ Make recommendations for remedial action.

### Journey Times

- 2.19 The post scheme consultation requested feedback as to whether journey times had been improved in the AM and PM peak on each approach arm; results are shown below in Tables 2.1 and 2.2.

**Table 2.1 – AM Peak Journey Times**

Approach Arm	Do you think there has been an improvement to AM Peak journey times or journey time reliability since the implementation of the scheme?			
	Yes	No	Same	Don't Know
A3075		2		2
A30 East	1	3		
A390	1		1*	2
A30 West		3		1
B3277		1		3

\* Improvements on the approach arm, increased queuing westbound on the A390.

**Table 2.2 – PM Peak Journey Times**

Approach Arm	Do you think there has been an improvement to PM Peak journey times or journey time reliability since the implementation of the scheme?			
	Yes	No	Same	Don't Know
A3075		2		2
A30 East	1	2	1	
A390	1		1*	2
A30 West		3		1
B3277		2		2

\* Improvements on the approach arm, increased queuing westbound on the A390.

2.20 Generally, where respondents have had a clear indication of journey time changes, responses indicated that following the scheme:

- ◆ Journey times had improved on the A390;
- ◆ Extra delay had resulted on the other approach arms; and
- ◆ The A30 East was the only arm with a split opinion as to whether the scheme has resulted in improved or increased journey times.

#### SUMMARY – SECTION 2

- ◆ A site visit undertaken in October 2008 revealed that the scheme was implemented as stated in the PAR.
- ◆ Post opening site-visits showed that during the AM Peak, queues were forming on all arms, with the exception of the A390. Queue lengths were greatest on the A30W (300m) while the longest delays were on A3075 (6 minutes per vehicle).
- ◆ Fewer delays were experienced during the PM peak, with queues largely being restricted to the A30 West.
- ◆ Consultation suggests that the segregated left turn lane has been successful in reducing delays on the A390. However it is felt that delay has increased on the A30 West, the A3075 and the B3277. Opinion was split on the impact the scheme has had on the A30 East.
- ◆ Despite the above, three of the four feedback forms indicated that as a whole the junction is operating better than before.
- ◆ The Highways Agency are undertaking a RSA Stage 4 at this junction due to the large number of incidents recorded.

## 3. Traffic and Economic Impacts

### INTRODUCTION

- 3.1 This chapter sets out the evaluation of the economic impacts derived from the scheme. Specifically this chapter will:
- ◆ Provide an appreciation of recent changes in traffic volume at the junction;
  - ◆ Provide an analysis of the outturn costs and compare them with those predicted in the original PAR assessment; and
  - ◆ Use post-opening surveys and the HATRIS JTDB to provide an outturn evaluation of the economic benefits of the scheme.

### TRAFFIC VOLUME CHANGES

- 3.2 A key aspect of scheme evaluation is to understand the extent to which traffic volumes have changed following the scheme's implementation. Such an analysis serves two main purposes:
- ◆ To ascertain whether any additional traffic has been attracted to the junction as a result of the scheme; and
  - ◆ To ensure that the benefits for additional/new users of the junction are considered in the estimation of outturn economic benefits.

### Average Annual Daily Traffic (AADT)

- 3.3 At Chiverton Cross Roundabout AADT counts are available from TRADS for the A30 arms; in addition AADT estimates are available for the A390 and the A3075 from the Dft Matrix. The location of the sites are shown in Figure 3.1
- 3.4 Table 3.1 illustrates the changes in 24 hour AADT on the available arms for traffic entering and exiting the junction from 2003 onwards. A comparison with national road traffic forecast (NRTF) growth rates is also provided from 2004 (the last full year before scheme construction).

Figure 3.1 – Location of Count Sites



Table 3.1 – AADT Data

Year	DfT Matrix				TRADS				Combined		NRTF Central
	A390		A3075		A30W		A30E				
	AADT	Index	AADT	Index	AADT	Index	AADT	Index	AADT	Index	
2003	21000	1.123	8600	0.717	30800	0.972	-	-	-	-	0.983
2004	18700	1.000	12000	1.000	31700	1.000	17600	1.000	80000	1.000	1.000
2005	18800	1.005	10800	0.900	32100	1.013	17200	0.977	78900	0.986	1.017
2006	22000	1.176	9800	0.817	31800	1.003	17000	0.966	80600	1.008	1.034
2007	22500	1.203	10700	0.892	32300	1.019	17600	1.000	83100	1.039	1.050

3.5 From Table 3.1, the following points can be noted:

- ◆ Traffic on the A30 East reduced for two years in a row between 2004 and 2006, dropping 3.4% from 2004 levels, it should be noted that both these years may have been influenced by scheme construction. In 2007 flows returned to 2004 levels;

- ◆ Traffic on the A30 West increased by 2.9% between 2003 and 2004, an increase of 1.9% between 2004 and 2007 suggests that the scheme has not resulted in additional traffic growth on this arm;
- ◆ Prior to the scheme, traffic levels on the A390 fell by 11% between 2003 and 2004. Following on from the scheme implementation, traffic levels have increased by almost 20% on this arm;
- ◆ Traffic levels on the A3075 appear to have grown by 40% between 2003 and 2004 and to have reduced by 18% between 2004 and 2006. Traffic is shown to have continued growing between 2006 and 2007 reaching 89% of 2004 levels. It should be noted that, as with the A390, this site relies on data from the Dft Matrix and may not be as accurate as the sites where TRADS data is available; and
- ◆ Overall traffic levels appear to have grown by 3.9% between the last full year before construction and the first full year following the scheme opening, the majority of this growth comes from the A390. NRTF growth over the same period was 5.0% suggesting that there has not been a large impact on traffic growth as a result of the scheme.

#### MANUAL CLASSIFIED COUNT DATA

- 3.6 In addition to TRADS and the Dft data, classified turning counts have been undertaken at the junction. Counts were undertaken in October 2002 as part of the original PAR assessment. The most recent post opening counts were undertaken in October 2007. Comparable data is available for the AM Peak (08:00 – 09:00) and the PM Peak (17:00 – 18:00).
- 3.7 Figure 3.2 below displays the flows from the AM Peak hour for each entry arm both before and after the scheme opened. Figure 3.3 shows equivalent data for the PM peak hour<sup>3</sup>:

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<sup>3</sup> Full turning counts are shown in Appendix C.

Figure 3.2 – AM Peak Hour Traffic Flows

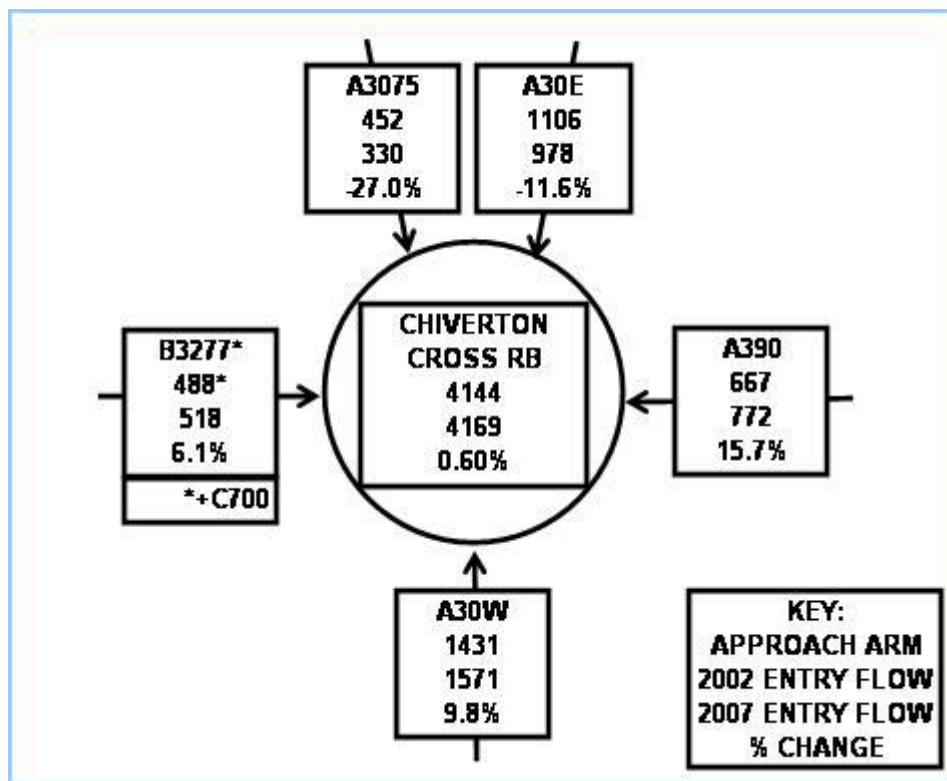
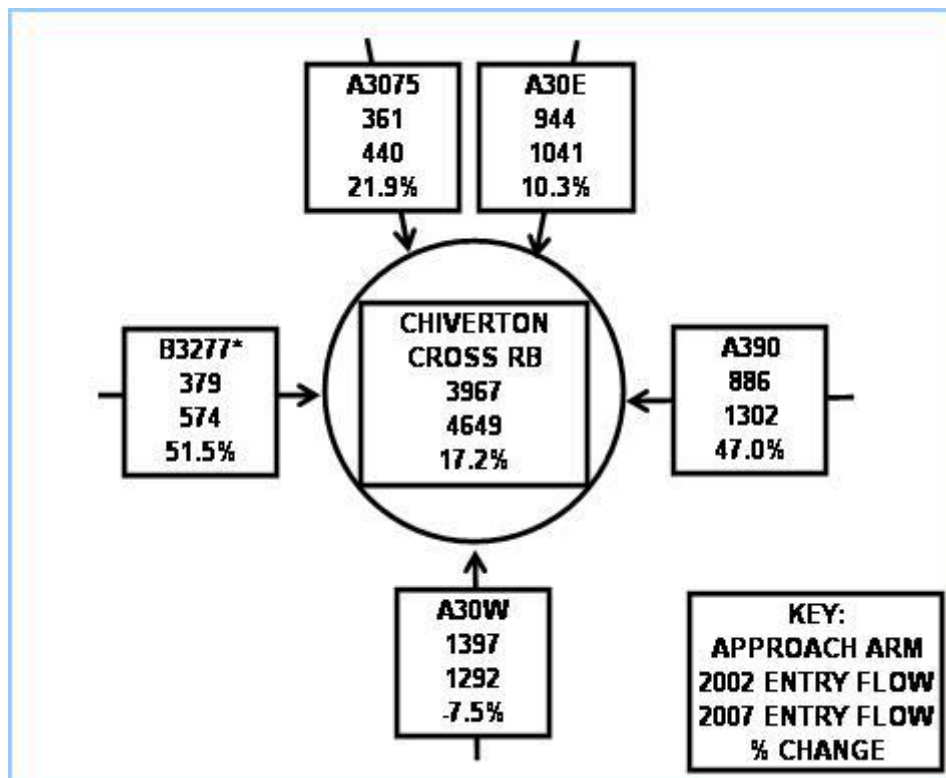


Figure 3.3 – PM Peak Traffic Flows



3.8 The key points emerging from the traffic surveys in relation to changes in traffic volumes following scheme opening are:

- ◆ Overall between the two surveys the AM peak flows were relatively unchanged while PM peak flows through the junction increased by 17.3%, accounting for an additional 682 vehicles. The overall increase between the two surveys was 16.7%;
- ◆ Traffic on the A30 Bodmin approach decreased by 11.6% in the AM Peak and increased by 10.3% in the PM Peak;
- ◆ Traffic on the A390 increased significantly in both the AM and PM peaks with increases of 15.7% and 47.0% in the AM and PM peaks respectively;
- ◆ Both the A30W and the A3075 had reduced traffic flows in the AM Peak and increased flows in the PM Peak, following the schemes implementation. The B3277 has over 50% growth in the PM peak following the schemes implementation, although was only just over 6% in the AM Peak; and
- ◆ Looking at the 12 hour traffic count prior to the scheme 2587 HGVs entered the junction compared to 2491 following the scheme, a reduction of 4%.

3.9 More detailed analysis of the turning counts reveals that following the scheme:

- ◆ Of the major movements at the junction flows between the;
  - A30W and the A390 fell by 2%;
  - A390 and the A30W increased by 17%;
  - A30W and the A30E increased by 27%;
  - A30E and the A30W increased by 54%.
- ◆ From the A390 traffic growth has been proportionally greatest to the B3277 and the A3075. This suggests these movements were being suppressed, or were rerouting, prior to the junction improvements;
- ◆ There were large proportional increases between St Agnes and Newquay; which suggests previously there may have been rat running on this route; and
- ◆ Flows between St Agnes and Redruth have decreased in both peaks; this is consistent with consultation feedback noting that there has been increased rat-running through Blackwater following the scheme.

#### ANALYSIS OF JOURNEY TIMES

3.10 The Highways Agency has developed a journey time database (JTDB) for the motorway and all-purpose trunk road network in England that it is responsible for managing. Using data from a number of sources<sup>4</sup>, this database holds data on journey times and traffic flow averaged over 15-minute intervals, for each link on the HA network.

3.11 Two links are available for each of the A30 approaches on to Chiverton Cross roundabout; these are the:

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<sup>4</sup>, Sources are the HA MIDAS system and data collected by Trafficmaster PLC and ITIS Holdings, utilising satellite data from GPS units installed in vehicles, automated number plate recognition cameras and National Traffic Control Cameras at junctions,

- ◆ A30 East (Redruth) A3047 to A390
  - ◆ A30 West (Bodmin) A39 to A3075
- 3.12 Although these represent links of 3.59km and 12.63km respectively, the A30 has priority along the length of each link until Chiverton Cross Roundabout. Chiverton Cross Roundabout represents the main source of delay and change along the length of each link. Data from the HATRIS JTDB is rated as 'high', 'medium' or 'low' quality according to the available sources of data. Data on the two A30 links above varies between the three rankings according to date and time. The vast majority of data within the 12-hour assessment period is rated as either 'high' or 'medium' quality.
- 3.13 For these approach arms, changes to recurrent delay<sup>5</sup> and traffic flow between 2004 and 2008 have been graphed. Delay and traffic flow are shown for each arm, broken down by each month, and by hour. For graphs broken down by month, the duration of the pre-scheme, construction, and post-scheme periods are annotated using vertical lines on the graphs.

### A30 (WEST)

- 3.14 Figure 3.4 overleaf shows changes to recurrent delay and traffic flow by month, and Figure 3.5 changes to recurrent delay and traffic flow by hour on the A30 West approach. In summary, these show that:
- ◆ Small peaks to pre-scheme delays on the A30 West during the summer months (associated with the heaviest traffic flows) have been significantly magnified following the scheme's implementation. Post scheme flows have reduced marginally during the same periods;
  - ◆ Following the lane alterations in September 2006, delays fell to levels comparable with the pre-scheme conditions. However, long term trend data shows this was due to reduced traffic flow during the winter months. Overall, delays on the A30 West were larger in 2007 than in 2006 suggesting that the alterations to lane marking have not been successful in reducing the delay on the A30 West;
  - ◆ Figure 3.5 shows that increased delay is largely restricted to the AM and PM peaks with little change during the other periods. There was a practically large increase in PM peak delays in 2007 following on from the alterations to lane markings on the A30 West. It also shows that traffic levels have decreased in the peak periods following the scheme implementation; and
  - ◆ Overall there were 62,206 recurrent hours delay in the year prior to the schemes construction. In the first full calendar year after construction this had increased to 124,943 hours. Therefore there were an additional 62,737 hours delay in the first year following the scheme opening; on average this is equivalent to approximately 20 seconds per vehicle.

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<sup>5</sup> An estimate of the portion of the total delay that is recurrent (due to sheer weight of traffic)

Figure 3.4: A30 (West) Flow and Recurrent Delay by Month, 2004 to 2008

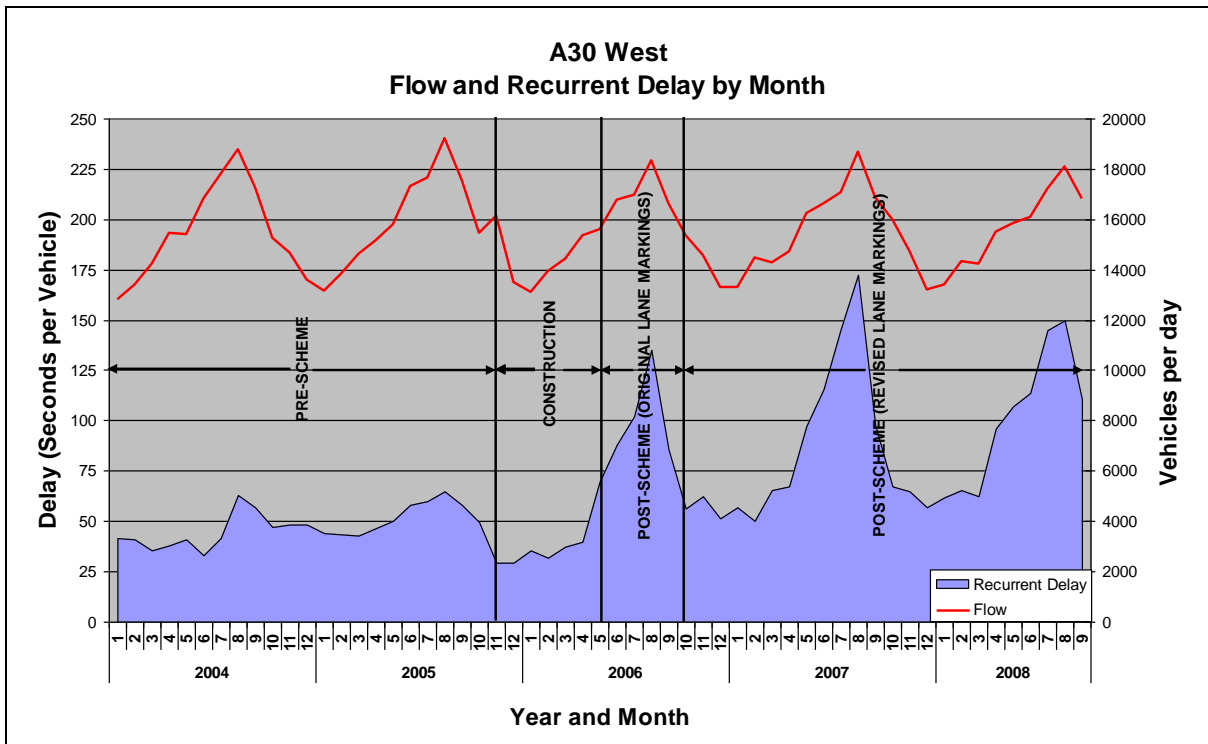
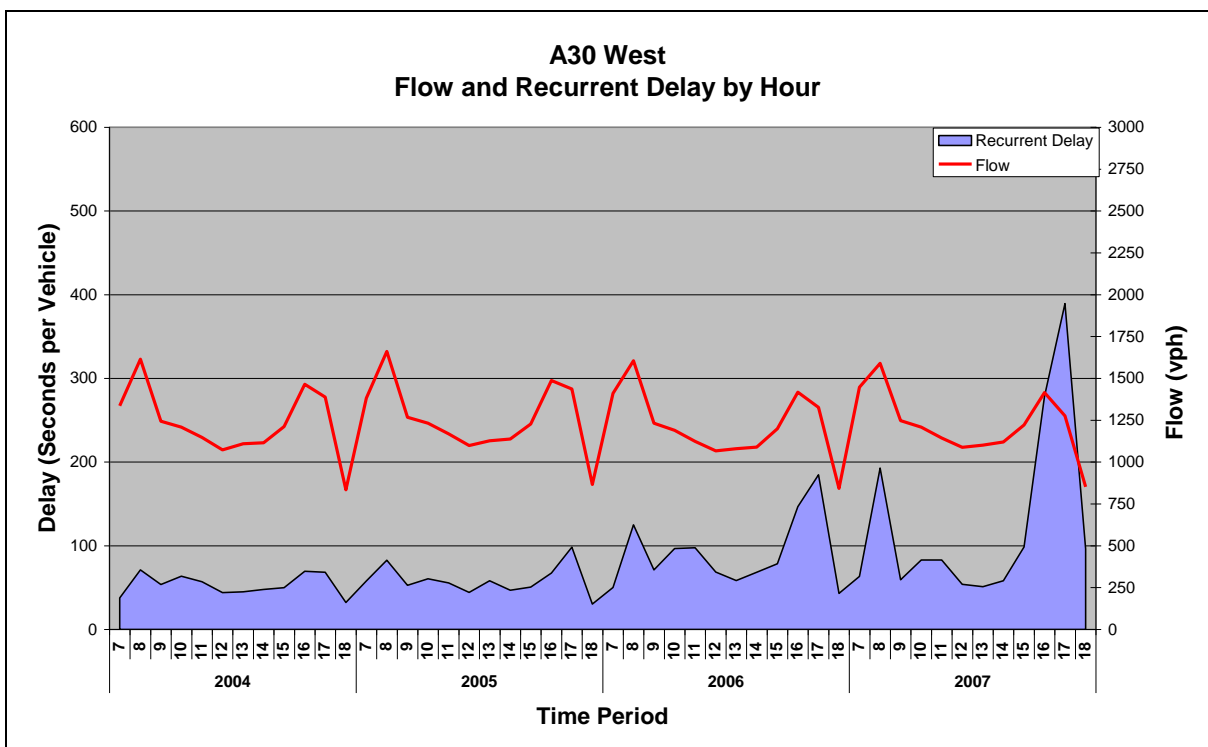


Figure 3.5 – A30 (West) Flow and Recurrent Delay by Hour, 2004 to 2008



### A30 (EAST)

3.15 Figures 3.6 and 3.7 show the same information for the A30 East approach arm. In summary, these show that:

- ◆ Following the scheme there was an increased flow in traffic and reduced delays during most months;
- ◆ The largest increases to flow were in October with 10% more traffic than before the scheme. The largest improvements to delay were between June and September with average savings of over 30 seconds per vehicle;
- ◆ Both AM and PM peak delays are reduced when compared to 2005 levels. Despite this there are still significant delays in the AM and PM peak hours following the scheme; and
- ◆ Overall there were 85,040 recurrent hours delay in the year prior to the schemes construction. In the first full calendar year after construction this had decreased to 71,147 hours.

Figure 3.6 - A30 (East) Flow and Recurrent Delay by Month, 2004 to 2008

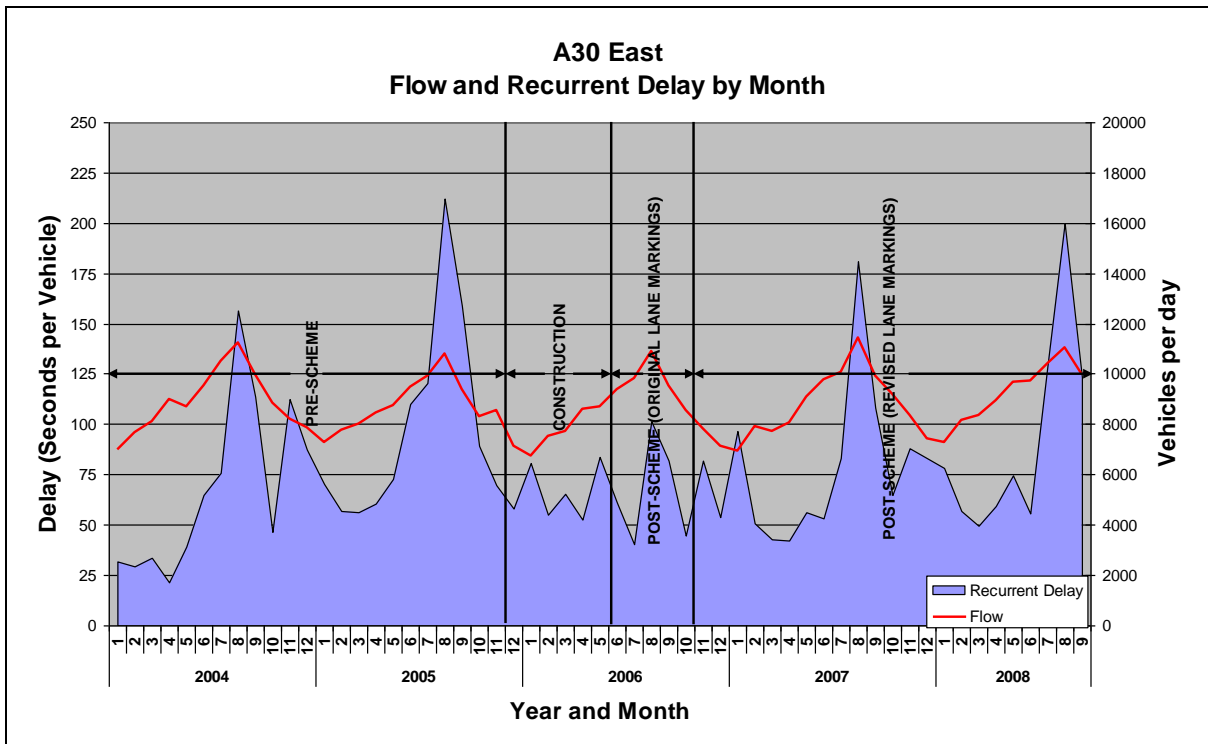
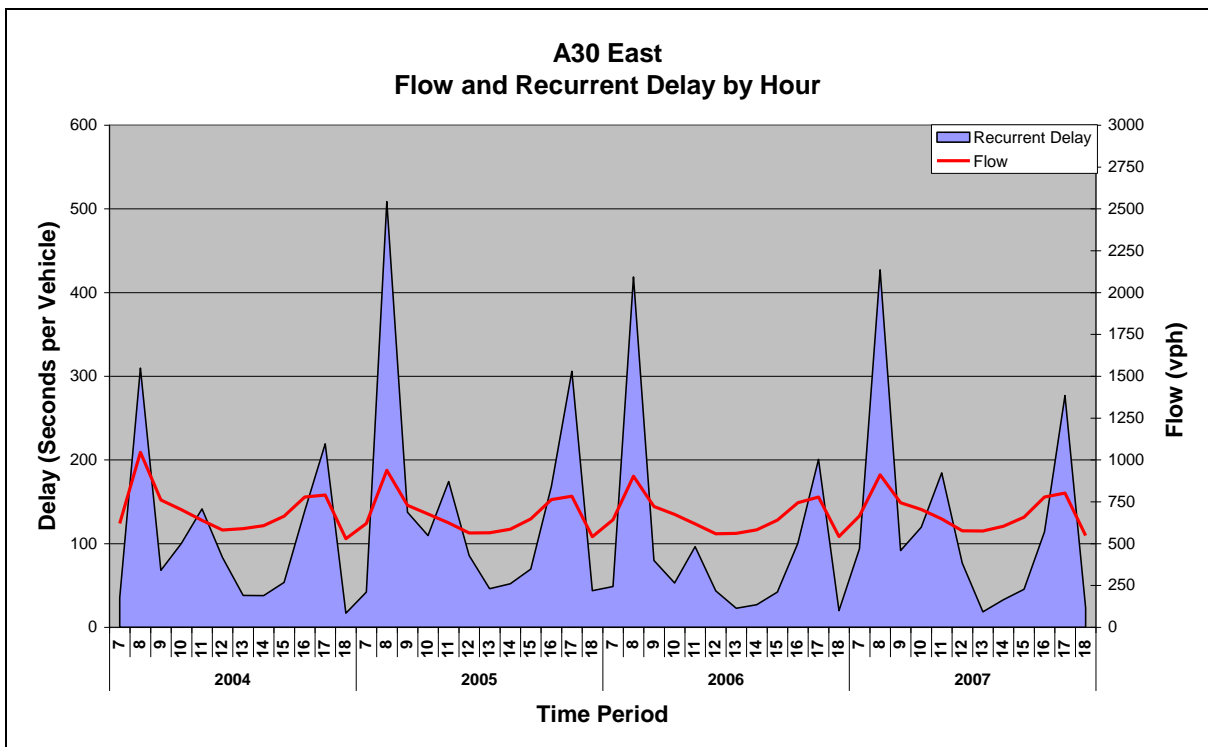


Figure 3.7 - A30 (East) Flow and Recurrent Delay by Hour, 2004 to 2008



## POPE ASSESSMENT

### The PAR Appraisal

- 3.16 The original PAR assessment for the Chiverton Cross Roundabout Improvement scheme was undertaken by Parsons Brinckerhoff. The scheme intended to provide interim capacity improvements at the roundabout in advance of the grade separation as part of the Carland Cross to Chiverton Cross Major scheme. In line with these proposals, an assessment period of 3 years was selected in the initial PAR.
- 3.17 The following methodology was used to predict the journey time benefits:
- ◆ Traffic growth from the surveys (2002) to the years 2005 and 2008 were taken from TEMPRO4 (Trip End Model Presentation Program) using growth forecasts for Cornwall;
  - ◆ AM, Inter Peak, and PM periods were modelled in ARCADY to obtain do minimum delays. Models represented the opening year 2006, and the future year 2008. The ARCADY (Assessment of Roundabout Capacity and Delay) model was calibrated to queue length surveys;
  - ◆ The Do-Something scenario (with scheme) was modelled in SIAS Paramics with, predicted delay per vehicle being taken from an ARCADY model to simulate queue lengths;
  - ◆ The JUICE spreadsheet was used to convert changes in delays to monetary values, taking into account alterations to delays on each approach arm in the AM Peak, the Inter-Peak and the PM Peak;
  - ◆ A separate COBA (Cost Benefit Analysis) model provided vehicle operating costs, indirect tax benefits and travel time costs for all links and any junctions not modelled in JUICE; and
  - ◆ The assessment did not account for delays during construction (although these were considered separately before construction).
- 3.18 The outcome of the original PAR appraisal is summarised in Table 3.2. All values are discounted to 2002 and given in 2002 prices.

**Table 3.2 – PAR predicted economic benefits**

Vehicle Hours Saved in Opening Year	Central Growth
Vehicle Hours Saved in Opening Year	83,000
VOT Savings in Opening Year discounted to 2002	£0.694m
Scheme Life Monetary Benefit (3 years)	£2.672m

- 3.19 In summary, the PAR predicted a saving of 83,000 vehicle hour in the opening year, with benefits amounting to £2.672m over the three year appraisal period.

### PAR Predicted Corrected Appraisal

- 3.20 In order to ensure that a like-for-like comparison of the predicted and outturn economic impact can be made, a PAR 'predicted corrected' appraisal of the scheme economic benefits has been undertaken. More specifically, the purpose of the PAR predicted corrected appraisal is to:
- ◆ Ensure that the predicted and outturn scheme impacts can be compared on a like-for-like basis; and
  - ◆ Account for any obvious errors in the original PAR calculations.
- 3.21 In order to account for the above the methodology used for the predicted-corrected assessment was:
- ◆ Pre-scheme delays for the A30 approach arms were taken directly from the HATRIS Journey Time Database for the last full year before construction (November 2004 – November 2005);
  - ◆ Pre-scheme delays per-vehicle were taken from the Do-Minimum 2008 ARCADY model for each period (AM-Peak, Inter-Peak, PM Peak) on the remaining approach arms;
  - ◆ Delay per vehicle was multiplied by the traffic flow in each period and the annualisation factor (taken from the PAR) to give annual number of vehicle delay hours for each approach arm;
  - ◆ Post-scheme delays per vehicle were taken from the Do-Something 2008 ARCADY forecasts and were annualised as described above; and
  - ◆ Vehicle hours saved in the opening year has been calculated by deducting the Do-Something delay forecasts from the Do-Minimum delay forecasts. These have been monetised using the 'Worksheet for Economy' from the Full PAR Guidance Version 3.3.
- 3.22 The methodology above makes the following alterations from the initial PAR assessment:
- ◆ Delays are considered on the entry arms to Chiverton Cross Roundabout, to fit data availability for the pre-scheme and post opening data, no significant delay was observed at the subsidiary roundabout; and
  - ◆ Indirect tax and vehicle operation costs are removed from the assessment. These have not been calculated in the Post Opening evaluation as changes in vehicle kilometres appear to be negligible. In the original assessment indirect tax benefits were forecast as £29,000 over 3-year appraisal period, while operating costs were forecast to fall by £2,000.
  - ◆ Traffic growth is not considered beyond the opening year to match with the outturn data available from the HATRIS JTDB.

**Table 3.3– Summary of predicted-corrected economic benefits**

Journey Time Benefits/Disbenefits			Central Growth
Vehicle Hours Saved in Opening Year <sup>6</sup>		(a)	66619
Value of Time (VOT) per average vehicle in Opening Year (p/hour)		(b)	1194
VOT Savings in Opening Year	(a) x (b) = (c)	(c)	£0.795
Capitalisation Factor			3.06
VOT Benefits	(c) x Capitalisation Factor	(d)	£2.434m
Opening Year discount factor		(e)	0.87
VOT Savings in Opening Year discounted to 2002	(c) x (e)	(f)	£0.692m
<b>Three Year VOT Benefits discounted to 2002</b>	<b>(d) x (e)</b>	<b>(g)</b>	<b>£2,118m</b>

3.23 Key points to note from the PAR predicted corrected appraisals with respect to the original PAR appraisal are:

- ◆ First year monetary benefits of £0.692m are very similar to that forecast in the PAR; and
- ◆ The benefit over the three year period is reduced slightly from £2.670m to £2.118m as traffic growth is not considered in the predicted corrected appraisal.

#### Outturn Appraisal of Economic Benefits

3.24 Outturn data available for the evaluation of the junction improvement at Chiverton Cross Roundabout includes:

- ◆ HATRIS JTDB traffic flow, journey time and delay data for the A30 trunk road approaches to the junction; and
- ◆ Three turning count surveys which have been undertaken during the post scheme period. In addition queue length surveys for the AM and PM peaks (in metres) were undertaken in October 2007 (the same month as the original surveys) and in August 2007. The queue length surveys covered all arms with the exception of the A390 which was excluded as queues had not been observed on this arm.<sup>7</sup>

3.25 Given the seasonal variation in delays at the junction this outturn assessment has been based on the above data, as the surveys are consistent with the month used

<sup>6</sup> 'Vehicle Hours Saved' calculations for the predicted-corrected assessment and the post-opening evaluation are shown in Appendix D.

<sup>7</sup> Cornwall County Council will be undertaking surveys at this junction annually as part of the monitoring process for the Truro park and ride which opened on the A390 arm in 2008.

in the PAR assessment. The following methodology has been used in assessing delays in the post opening period:

- ◆ Recurrent delays on the A30 approach arms have been taken directly from the HATRIS Journey Time Database for the last full year before construction (November 2004 – November 2005) and for the first full calendar year after the scheme's construction;
- ◆ Queue length surveys were not undertaken on the A390 during October 2007 as prior to the surveys it had been observed that queues were not building up on the approach arm. This is consistent with observations from the October 2008 site visit. Consequently delays for the A390 as forecast in the Do-Something scheme from the PAR have been used (amounting to 5 seconds per vehicle in the AM and Inter-Peaks and 7 seconds in the PM Peak.); and
- ◆ Queue length surveys have been used to estimate delays on the A3075 and the B3277. A queuing distance of 6 metres has been allocated for each vehicle while delay per queuing vehicle has been taken from the ARCADY for the original assessment. Resulting delays are of the same magnitude as those observed on site in October 2008.

3.26 Journey time benefits were then calculated using the Full PAR – Worksheet for Economy: Transport Economic Efficiency – Journey Time Benefits/Dis-benefits. The following assumptions were made:

- ◆ The appraisal period is over 3-years (10 years in Appendix E);
- ◆ Benefits are derived for the AM, Inter-Peak and PM peak periods;
- ◆ Do-Minimum Delays are taken from the PAR forecasts for 2008, when forecast growth gave traffic levels comparable to those observed in 2007 surveys;
- ◆ Do-Something Delays are derived as stated above;
- ◆ The 'rule of half' has been applied to new traffic on approaches where traffic had increased by more than 10%. This involves the principal that full benefits can be assigned to existing traffic and half benefits assigned to additional traffic; and
- ◆ As with the JUICE spreadsheet, the COBA default maximum delay of 5minutes per vehicle has been allocated to each arm.

3.27 Table 3.4 below displays the journey time benefits of the scheme over the 3-year assessment period:

**Table 3.4 – Summary of POPE Economic Benefits**

Journey Time Benefits/Disbenefits			Central Growth
Vehicle Hours Saved in Opening Year		(a)	4684
Value of Time (VOT) per average vehicle in Opening Year (p/hour)		(b)	1194
VOT Savings in Opening Year	(a) x (b) = (c)	(c)	£0.056
Capitalisation Factor			3.06
VOT Benefits	(c) x Capitalisation Factor	(d)	£0.171
Opening Year discount factor		(e)	0.87
VOT Savings in Opening Year discounted to 2002	(c) x (e)	(f)	£0.049
<b>VOT Benefits discounted to 2002</b>	<b>(d) x (e)</b>	<b>(g)</b>	<b>£0.149</b>

3.28 The table above shows that first year time savings of 4,684 were much lower than the 66,619 forecast in the predicted-corrected appraisal. As a result, first year savings are £0.049 compared to the £0.692m forecast. Benefits over the three year appraisal period total £0.149m; only 7% of the £2.118m predicted.

3.29 Table 3.5 below shows the total hours delay experienced on each approach arm prior to, and following the scheme:

**Table 3.5 – Annual Hours Delay A30 Approach Arms**

Approach	PC* Do – Minimum Delay (Hours in Opening Year)	PC* Do-Something Delay (Hours in Opening Year)	Forecast Change in Delay	Outturn – Do Something Delay (Hour in Opening Year)	Outturn Change in Delay
A30E	85040	90522	<b>+6%</b>	71147	<b>-16%</b>
A390	61683	1971	<b>-97%</b>	3981	<b>-94%</b>
A30W	62206	56567	<b>-9%</b>	124943	<b>+101%</b>
C700	4663	0	<b>-100%</b>	0	<b>-100%</b>
B3277	5300	4030	<b>-24%</b>	15731	<b>+197%</b>
A3075	20457	19640	<b>-4%</b>	18865	<b>-8%</b>
<b>All Arms</b>	<b>239349</b>	<b>172730</b>	<b>-28%</b>	<b>234666</b>	<b>-2%</b>

\* PC = Predicted - Corrected

3.30 Table 3.5 above reveals that:

- ◆ The project has been successful in achieving its primary aim of reducing peak-time delays on the A390, with opening year delay savings of 57,700 hours on this approach arm, a reduction of 94%;
- ◆ However, the scheme has resulted in a doubling of delay on the A30 West which were not forecast, and cancel out economic benefits from the journey time savings above. In the opening year there were an additional 62,700 delay hours on this approach arm;
- ◆ There is a reduction in delay of 16% on the A30 East approach arm (13,900 delay hours). A 6% increase in delays had been forecast on this approach arm;
- ◆ The scheme resulted in an overall increase in delays on the B3277 (10,400 delay hours), however a net journey time saving had been forecast for this arm; and
- ◆ The overall impact on the A3075 is slightly beneficial, a 4% decrease in delays were predicted for this arm, with an outturn reduction of 8%.

#### INTERPRETING THE POPE CONCLUSIONS

3.31 The segregated left-turn lane appears to have been successful in reducing delay on the A390. However, following the scheme, delays have increased significantly on the A30 West approach arm from Redruth. Reasons for this are suggested below, (issues described can be seen in Figure 3.8).

- ◆ Prior to the improvement scheme there were no dedicated lane markings on the A30 West approach arm. Two lanes on the circulatory carriageway and a wide exiting lane onto the A30 East resulted in vehicles being able to use either approach lane when travelling from the A30 West to the A30 East (See Figure 3.8 A1 & A2). As a result traffic was evenly distributed between lanes on the A30 West approach arm;
- ◆ Following the scheme dedicated lane markings assigned only one lane to traffic heading from the A30 West to the A30 East (Figure 3.8, B1 & B2);
- ◆ Although using two lanes for this movement had been raised as a safety concern by the Stage 1 RSA (due to the short length of the two lanes available at the exit); restricting traffic to using one lane for this movement has resulted in an uneven distribution of traffic in the lanes on the A30 West approach arm;
- ◆ At present, lane markings requiring traffic for the B3277 (St Agnes), the A3075 (Newquay) and the A30 East (Bodmin) requires 64% (1009 vehicles) of traffic on the approach arm to use the left hand lane in the AM. In the PM peak 69% (888 vehicles) of traffic is required to use the left hand lane;
- ◆ Original markings following the schemes implementation assigned A30 eastbound traffic to the left hand lane along with the A390, this resulted in a similar imbalance of traffic on the A30 West 89% (1303 vehicles) of traffic being required to use the right-hand lane during the AM Peak and 78% (1001 vehicles) in the PM Peak;
- ◆ Queuing on the A30 West may have been magnified by the filter lane which has removed left turning traffic from the preceding arm. This may have resulted in a decreased number of opportunities to enter the roundabout from the A30

West, with left turning traffic from the A390 previously providing this opportunity; and

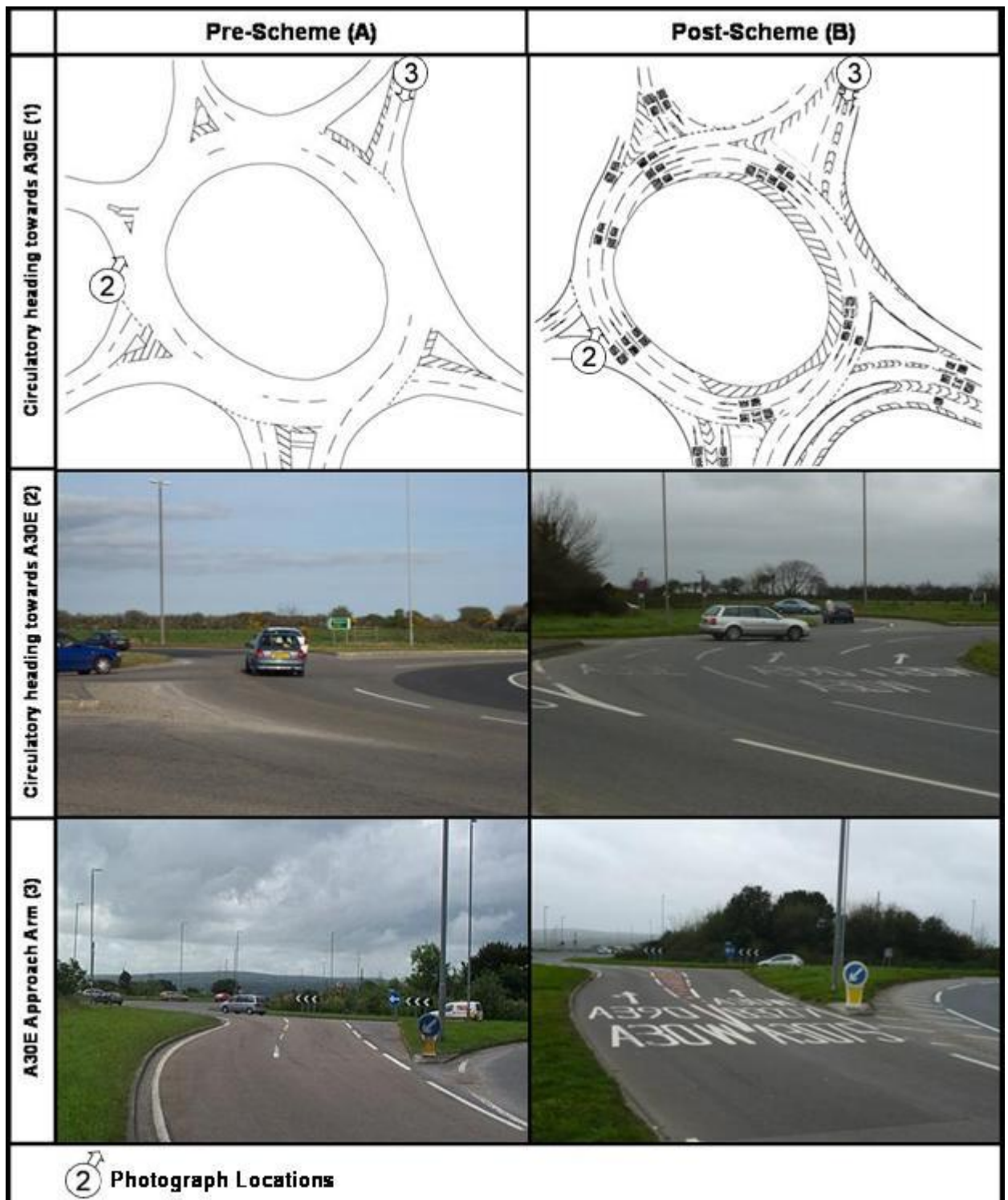
- ◆ Reallocating two lanes to traffic continuing on the A30 West would potentially reduce delays on this approach arm, and could allow benefits as a result of the left hand filter lane and the reduced number of arms to be realised. However, options testing would be required to confirm this and to assess the impact on the other approach arms.

3.32 Original proposals for the scheme also saw a single lane on the circulatory carriageway being allocated from the A30 East to the A30 West. During options testing, increased queuing was identified on the A30 East approach arm, and as a result, amendments were made to provide two lanes for the A30 Westbound (Picture 3B, Figure 3.8). Following these amendments, there has been a reduction in delays on the A30 East approach arm.

3.33 Figure 3.6 overleaf shows:

- ◆ The junction layout before and after the improvement scheme;
- ◆ The circulatory on carriageway towards the A30 East; and
- ◆ The A30 East approach arm.

Figure 3.8 – Pre and Post Scheme Layouts and A30 Approach Arms



## SCHEME COSTS

- 3.34 Predicted and outturn costs for the scheme are shown below in Table 3.6. Outturn costs of £2.179m (2008 Q2) are equivalent to £1.785m in 2002 prices. The outturn costs of £1.785m were 35% above forecasts due to increased spending on construction, preparation and supervision. A contribution of £150,000 from Cornwall County Council is included in both the predicted and outturn assessment. In converting prices to Present Value Costs at 2002 values and prices, costs have been discounted by 3.5% per annum and multiplied by the general taxation factor of 1.209.

**Table 3.6 – Comparison of predicted and outturn scheme costs**

Sub Cost	PAR Cost Estimate (2002 Prices)	Outturn Costs (2002 Prices)
Preparation	£0.023m	£0.207m
Supervision	£0.059m	£0.127m
Main works	£1.040m	£1.299m
Ancillary works	£0.000m	£0.039m
Statutory Undertakers works	£0.096m	£0.088m
Land costs - Acquisition	£0.014m	£0.016m
Land costs - Part 1 claims	£0.024m	£0.009m
Risk Cost	£0.066m	£0.000m
<b>Total Cost</b>	<b>£1.323m</b>	<b>£1.785m</b>
<b>PVC (2002 market prices, discounted to 2002)</b>	<b>£1.391m</b>	<b>£1.877m</b>

### SUMMARY – SECTION 3

- ◆ In the first full year following the scheme, the combined AADT on the four main arms was almost 4% higher than in the last full year before construction. The NRTF growth over the same period was 5%;
- ◆ Manual classified traffic counts from 2002 and 2007 suggest that in this period growth has been constrained in the AM Peak, increasing by less than 1%. During the same period inter-peak and PM Peak flows increased by 17%, significantly greater than NRTF forecasts of 8.6%;
- ◆ An analysis of before and after HGV flows revealed that 4% fewer HGVs were travelling through the junction following the scheme. 2491 HGVs passed through the junction in the October 2007 surveys; this is 5.7% of the total flow.
- ◆ Following the scheme, the objective to reduce delays on the A390 has been achieved; however this has been to the detriment of delays on the A30 West and the B3277.
- ◆ Overall, the net delay at the junction is very similar to the pre-scheme conditions.
- ◆ Outturn opening year and scheme life economic benefits are equivalent to £0.049m and £0.149m respectively. This is only equivalent to 7% of the predicted scheme life benefits of £2.118m
- ◆ The outturn cost for the scheme was 35% more than predicted due to overrunning on preparation, site supervision and works costs.

## 4. Safety Impacts

### INTRODUCTION

- 4.1 This section examines the changes in 'before' and 'after' accident data to quantify the scheme safety benefit<sup>8</sup>.
- 4.2 The objectives of this section are to:
- ◆ Provide an appreciation of the changes in the number, distribution and causation of accidents emerging as a result of this scheme; and
  - ◆ Ascertain the overall monetary safety benefit derived from improvements at the Chiverton Cross Roundabout.
- 4.3 The accident data referred to in this report has not necessarily been derived from the national validated accident statistics produced by DfT. As such, the data may subsequently be found to be incomplete or contain inaccuracies. The requirement for up-to-date information and site specific data was a consideration in the decision to use unvalidated data and, as it is sourced from Local Processing Units through the HA's Managing Agent Contractors, it is sufficiently robust for use in this context.
- 4.4 The scheme took approximately 6 months to construct (December 2005 – May 2006). Accidents occurring during this period have been excluded from this accident analysis. The outturn evaluation is based on 25 months (June 2006 – July 2008) of post opening accident data and hence is only intended to provide an indication of outturn safety impacts.

### PAR ASSESSMENT

- 4.5 The PAR used accident data for the period 1<sup>st</sup> January 2000 to 31 December 2004. Key pre-scheme accident trends that can be identified from the PAR include:
- ◆ Accident severity (ratio of KSI's to all accidents) was 7.9%; and
  - ◆ There were an average of 7.6 accidents per year before the scheme; this was calculated as twice the comparable national average accident rate of 3.8 per year for the given flows and a junction of this type<sup>9</sup>.
- 4.6 Accident savings were forecast in the PAR by analysing each accident over the preceding five years and assessing the likelihood that it would have been prevented with the scheme in place. For example collisions making a left hand turn from the A390 were assumed to be removed following the scheme's implementation as they would have used the segregated left hand turn lane.

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<sup>9</sup> Using traffic flow data and COBA manual Volume 13, Chapter 5, Table 5.1.

- 4.7 The PAR predicted that the scheme would result in an opening year accident saving of 1.2 PIA's. Safety benefits over the three year appraisal period were equivalent to £378,023 (2002 prices discounted to 2002)
- 4.8 Table 4.1 provides a summary of accident data used in the PAR.

**Table 4.1 – Number of Personal Injury Accidents, PAR**

Year	Number of Personal Injury Accidents (NOT casualties)			
	Slight	Serious	Fatal	Total
2000	6	0	-	6
2001	5	-	-	5
2002	8	3	-	11
2003	9	-	-	9
2004	7	-	-	7
<b>TOTAL</b>	<b>35</b>	<b>3</b>	<b>0</b>	<b>38</b>
<b>Severity Index (Fatal + Serious /All Accidents as percentage)</b>				<b>7.9%</b>
<b>Provide observed accident rate, and state units</b>				<b>7.6 PIA/year</b>

**PAR PREDICTED CORRECTED ASSESSMENT**

- 4.9 The PAR appraisal considered accidents within 100m from each approach stop-line and on the circulatory carriageway. Given that significant queuing had been observed prior to the scheme, and to enable a like-for-like comparison of predicted and outturn accidents, a predicted-corrected accident saving was forecast in order to:
- ◆ include an analysis of all accidents within 1km of the junction, to account for queuing on the approach arms; and to
  - ◆ Update the period of pre-scheme accident analysis (November 2000-October 2005).
- 4.10 As in the PAR, all accidents in the study area have been included in the analysis. For the purpose of the PAR predicted corrected analysis the same percentage applied in the PAR has been applied to the PAR predicted corrected accidents.

4.11 Table 4.2 below provides a summary of the pre-opening predicted corrected accident data.

**Table 4.2 - Number of Personal Injury Accidents, Predicted Corrected Analysis**

Year	Number of Personal Injury Accidents (NOT casualties)			
	Slight	Serious	Fatal	Total
Nov 2000 – Oct 2001	13	1	1	15
Nov 2001 – Oct 2002	10	4		14
Nov 2002 – Oct 2003	19	1		20
Nov 2003 – Oct 2004	18	2		20
Nov 2004 – Oct 2005	15	1		16
<b>TOTAL</b>	<b>75</b>	<b>9</b>	<b>1</b>	<b>85</b>
Severity Index (Fatal + Serious /All Accidents as percentage)				11.8%
Provide observed accident rate, and state units				17 PIA/year

- 4.12 Key accident trends identified as part of the predicted corrected appraisal include:
- ◆ In the 5 year pre-scheme period (November 2000 – October 2005) there were a total of 85 accidents (an average of 17.0 per year); and
  - ◆ A pre-scheme KSI rate of 11.8%.
- 4.13 Upon re-calculating the PAR predicted safety benefit using the updated accident data set, the first year accident saving is predicted to be 1.5. The revised opening year safety benefits therefore equates to £0.170, giving benefits of £0.470m over the 3 year appraisal period.

#### OUTTURN IMPACTS

- 4.14 During the 25 month period following the scheme’s implementation, there were a total of 48 accidents at the junction, an average of 23.0 per year.
- 4.15 Table 4.3 summarises the outturn assessment of the scheme safety impacts.

**Table 4.3 – Number of Personal Injury Accidents, POPE**

Year	Number of Personal Injury Accidents (NOT casualties)			
	Slight	Serious	Fatal	Total
June 2006 – May 2007	22	1	1	24
June 2007 – May 2008	20	2	-	22
June 2008 – July 2008	2	-	-	2
<b>TOTAL</b>	<b>44</b>	<b>3</b>	<b>1</b>	<b>48</b>
<b>Severity Index (Fatal + Serious /All Accidents as percentage)</b>				<b>8.3%</b>
<b>Provide observed accident rate, and state units</b>				<b>23 PIA/year</b>

4.16 Table 4.3 shows that:

- ◆ On average there have been 23 accidents a year following the schemes opening, this is equivalent to an increase of 6 accidents each year; and
- ◆ The accident severity (ratio of KSI's to all accidents) has fallen from 11.8% to 8.3%.

4.17 Table 4.4 shows the number of accidents both at the Chiverton Cross Roundabout itself (within 20m of each stop-line) and up to 1km back on each approach arm.

**Table 4.4 – Location of Personal Injury Accidents**

Location	Before Accidents per year	After Accidents per year	Difference
At Junction (<20m to Chiverton Cross)	8.4	10.6	2.2
A 390	1.6	2.4	0.8
A390 Filter	0.0	1.0	1.0
A30W	1.8	2.4	0.6
C 700	0.8	1.0	0.2
B 3277	1.4	1.9	0.5
A 3075	1.6	1.4	-0.2
A30E	1.4	2.4	1.0
<b>Total</b>	<b>17.0</b>	<b>22.6</b>	<b>6.0</b>

4.18 Key points emerging from the Post Opening analysis include:

- ◆ Following the scheme's implementation there have been an additional 2.2 accidents per year within 20m of Chiverton Cross Roundabout. Most accidents at the junction are a result of either rear-ends shunts or collisions while entering the roundabout. The major increase, within the area defined above,

appears to be at the A30E entry to the roundabout, although there has also been an increase on the B3277 entry;

- ◆ Overall, on the extended approach to the junction there has been an additional 3.9 accidents each year. Although the numbers of accidents are likely to be too small to draw meaningful conclusions; the main increases appear to have been on the A390, the A30W and the A30E. The reasons for the increased accident rate on these approach arms are unclear although they may be a result of:
  - Increased traffic flow on individual arms following the scheme's implementation, although proportional increases in the accident numbers are greater than increases in traffic flow.
  - An increased amount of congestion following the schemes implementation; or
  - An increased use of the minor junctions on the approach arms, caused by rat-running to avoid the roundabout, resulting in an increased number of conflicts on these approach arms. The only location where this is apparent is where the unclassified road by Roscarnick Farm meets the A30 East. In the five years prior to the scheme there were two accidents at this location, while there had already been three accidents in the 25 months following the scheme; an increase of over one accident per year. All accidents in this location had occurred on weekdays between 15:00 and 17:05 suggesting they are occurring during periods of heavy traffic.

4.19 Accident analysis has included 5 years of pre-scheme data; analysis of the Dft Matrix data prior to 2003 suggests that there was significant traffic growth at the junction between 2000 and 2003. Data from the available roads suggests that traffic levels were only 91% of 2007 values in 2001, and 92% of 2007 values in 2002. From 2003, traffic levels at the junction have been relatively consistent. If post opening accidents are compared to the 3-years prior to the improvements, the increase in the number of accidents at the junction falls from 2.2 per year to 1.2 and the increase within 1km falls from 3.9 to 3.1 additional accidents a year. This would represent a total increase of 4.4 accidents a year (rather than 6.0 when considering 5 years of pre-scheme accident data).

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### Monetised Accident Savings

4.20 In both the PAR and outturn assessments, an accident valuation has been derived for an all-purpose road with a 50-70mph speed limit. This gives an accident valuation of £132,290 for the opening year of 2006, in 2002 market prices.

4.21

Table 4.5 provides a summary of the predicted, predicted corrected and outturn safety impacts.

**Table 4.5- Predicted and outturn monetary safety benefits**

	PAR Predicted	PAR Predicted-Corrected	Outturn
Evaluation Period	3 years	3 years	3 years
Number of Personal Injury Accidents saved in opening year	1.2	1.5	-6.0
Number of accidents saved in assessment period	3.4	4.1	-17.6
Average cost of accident in the opening year (at 2002 market prices)	£0.134m	£0.132m	£0.132m
Annual accident benefit in opening year (2002 prices)	£0.161m	£0.196m	-£0.794m
Annual accident benefit in opening year (discounted to 2002)	£0.135m	£0.170m	-£0.691m
Accident benefits over assessment period, (discounted to 2002)	£0.378m	£0.470	-£1,934m

- 4.22 The PAR predicted that 1.2 accidents would be saved in the opening year. However this figure was corrected to 1.5 based upon a more appropriate area. The outturn safety impact was an increase of 6.0 accidents in the opening year. This is equivalent to a monetary cost of £0.691m for first year, and £1.934m over the initial 3 year appraisal period.
- 4.23 A Chi-squared test has been undertaken to determine whether the outturn savings between the PAR Predicted Corrected and Outturn analysis occurred by chance or is a direct impact of the scheme. From this test we cannot be 95% confident that the change in accident rate could not have occurred by chance alone. Therefore the increase in accident rates is not necessarily a direct impact of the scheme.
- 4.24 The Highways Agency has requested a RSA Stage 4 at the site due to the large number of incidents recorded.

#### SUMMARY – SECTION 4

- ◆ The outturn accident analysis includes 1km on each approach arm to the Chiverton Cross Roundabout to account for changes to queuing at the junction following the roundabout improvements;
- ◆ Following the scheme, the number of accidents each year has increased from 17.0 to 23.0 and hence the scheme has resulted in a first year accident disbenefit of 6.0;
- ◆ Accident disbenefits of 6.0 additional accidents per year contrasts to a predicted-corrected accident saving of 1.5 accidents each year;
- ◆ Of the additional 6.0 accidents a year; 2.2 occur at or within Chiverton Cross Roundabout with an additional 3.9 on the approach arms;
- ◆ In monetary terms the opening year accident benefit is equivalent to a loss of £0.691m compared to a predicted corrected saving of £0.170m;
- ◆ The accident severity index has fallen from 11.8% to 8.3%. However the annual number of severe and fatal accidents is almost identical due to the increased total following the schemes implementation.
- ◆ When only considering the last 3-years accident data before the scheme, the accident rate has only increased by 4.4 accidents per year. An increase of 1.2 accidents per year was observed within 20m of the junction.
- ◆ A chi squared test has demonstrated that we cannot be 95% confident that the change in accident rate could not have occurred by chance alone
- ◆ The Highways Agency has requested a RSA Stage 4 at the site due to the high number of incidents recorded.

## 5. Environment, Accessibility and Integration Impacts

### Introduction

- 5.1 This section reviews the impact of the roundabout improvement scheme on the local environment, accessibility and integration.
- 5.2 The forecast impacts of the scheme have been derived from the main body of the PAR document and the AST (Appraisal Summary Table). The outturn assessments have been completed through information gathered on site, and through a desk-top research exercise in line with POPE guidance.

### ENVIRONMENTAL IMPACTS

- 5.3 The majority of outturn environmental impacts for the scheme were as forecast in the PAR. A summary of the predicted and outturn impacts is shown in Table 5.1.

**Table 5.1 – Summary of Predicted and Outturn Environmental Impacts**

Environmental Sub-Objective	PAR Predicted Impact	Outturn Impact	Qualitative/Quantitative Evidence for Outturn Assessment
Noise	Neutral	Neutral	Traffic flows on all arms have increased by less than 25% (Max 20% A390) and HGV flows have increased by less than 20% (3.7% Reduction).
Local Air Quality	Slightly Beneficial	Neutral	Changes to AADT have been minor between 2004 and 2007 (approx. 200 vehicles on the four main arms). Overall delay at the junction is relatively unchanged by the scheme, although the impact varies by approach arm.
Greenhouse Gases	Slightly Beneficial	Neutral	The change in the total distance travelled on the roads affected by the project is less than 10%
Landscape	Slightly Adverse	Slightly Adverse	As noted in the PAR the project required limited land take and resulted in the loss of 50m <sup>2</sup> of scrubby copse and 12 semi-mature trees. Mitigation measures in the form of tree and shrub planting were carried out as in the PAR.
Townscape	Neutral	Neutral	The scheme is not located in a built up area.
Heritage of Resources	Slightly Adverse	Slightly Adverse	The scheme required a limited land take on an area already affected by modern road improvements.
Biodiversity	Slightly	Slightly	As noted in the PAR loss of scrub and semi-

Environmental Sub-Objective	PAR Predicted Impact	Outturn Impact	Qualitative/Quantitative Evidence for Outturn Assessment
	Adverse	Adverse	mature trees were mitigated by plantings of native species. A reptile mitigation strategy involving the creation of artificial hibernacula was conducted in partnership with English Nature.
Water Environment	Neutral	Neutral	The scheme is considered to have had negligible impacts on the volume and quality of water discharge.
Physical Fitness	Slightly Beneficial	Slightly Beneficial	No formal pedestrian or cycle counts have been undertaken post scheme implementation (non motorised user counts on a weekday and weekend in May 2005 showed 9 pedestrian users on both days and no cyclists). The numbers of pedestrians and cyclists at the junction remain low, although both should be encouraged by the introduction of a dedicated shared route for cyclists and pedestrians.
Journey Ambience	Large Beneficial	Slightly Adverse	Overall considering all approach arms journey times are similar to the pre-scheme conditions with additional delays on the A30West and the B3277 and savings on the A390. There has been an increased accident rate following the schemes implementation.

5.4 The remainder of this section describes the forecast and outturn implications of the roundabout improvement on the accessibility and integration sub-objectives.

#### ACCESSIBILITY IMPACTS

##### Option Values

##### *PAR*

5.5 The PAR forecast that the scheme would have no impact upon option values

##### *Outturn Assessment*

5.6 The scheme provides no new public transport services. The outturn assessment was in agreement that there would be **no impact** on option values.

## Severance

### PAR

- 5.7 The PAR predicted that the scheme would have a slightly beneficial impact upon severance, as improved and new sections of footway\cycle way would be likely to encourage greater use, particularly by pedestrians in the local area.

### Outturn Assessment

- 5.8 While no formal pedestrian count has been undertaken post-scheme implementation, it has been observed that pedestrian movements at the junction remain low. However, the scheme has improved the quality of routes used by pedestrians and cyclists throughout the junction. Therefore, as in the PAR, the outturn assessment is that the scheme has had a **slightly beneficial** impact on severance.

## Access to the Transport System

### PAR

- 5.9 The PAR predicted that the scheme would have no considered effect on access to the public transport system.

### Outturn Assessment

- 5.10 The scheme had **no impact** upon the public transport system.

## INTEGRATION ASSESSMENT

### Transport Interchange

#### PAR

- 5.11 The PAR stated that the scheme would have no considered effect on Public Transport Interchange.

#### Outturn Assessment

- 5.12 The scheme did not make any changes to interchange facilities in connection with the transport system, and there were no Park and Ride sites or rail stations in the vicinity of the junction. Therefore the outturn assessment is that the scheme had **no impact** on transport interchange.

### Land-Use Policy

#### PAR

- 5.13 The PAR predicted that there would be **no impact** on Land-Use Policy.

### *Outturn Assessment*

- 5.14 The scheme is not mentioned in either the Local Transport Plans or the Regional Transport. The scheme did not have any implications for local transport or planning policies and is considered to have had **no impact** upon land use policy.

### **Other Government Policies**

#### *PAR*

- 5.15 The PAR predicted that there would be **no impact** on other government policies.

### *Outturn Assessment*

- 5.16 The outturn assessment is in agreement that the scheme does not have any recognisable effects on other government policies.

## **SUMMARY – SECTION 5**

### **Environment**

- ◆ Impacts upon the environment are generally as forecast in the PAR. Outturn impacts reduced from 'Slightly Beneficial' to 'Neutral' for the Local Air Quality and Greenhouse Gases objectives, as reductions in delay were less than forecast in the PAR.
- ◆ The outturn assessment was that the scheme had had a Slightly-Adverse impact upon journey ambience due to an increased accident rate. This had been forecast as Large-Beneficial in the PAR.

### **Accessibility**

- ◆ All sub-objectives relating to accessibility and integration were as forecast in the PAR these were all classified as being neutral with the exception of severance which a 'slightly beneficial' impact is observed due to improvements to routes for pedestrians and cyclists.

## 6. Summary and Conclusions

### INTRODUCTION

- 6.1 The improvement scheme at Chiverton Cross Roundabout had the primary purpose of reducing peak hour congestion in order to reduce delays, particularly on the A390, and to reduce the number of personal injury accidents at the junction.
- 6.2 The improvements comprised of spiral type lane demarcation of the circulatory carriageway and associated advance direction signs, deflection improvements and a segregated left turn lane with merge taper onto the A30 southbound. A subsidiary roundabout and associated link road was also constructed to reduce the number of arms on the main roundabout.
- 6.3 The POPE assessment of Chiverton Cross Roundabout has utilised the data available to examine the outturn impacts of the scheme compared to those forecast in the PAR. The purpose of this section is to:
- ◆ Summarise the key lessons emerging from this evaluation; and
  - ◆ Suggest recommendations that will facilitate and increase the accuracy of future PAR appraisals for similar schemes.

### SUMMARY OF KEY IMPACTS

- 6.4 Table 6.1 provides a summary of the monetised benefits of the improvements at Chiverton Cross Roundabout based on a comparison of a 3-year appraisal period. The AST and EST are included in Appendix A and B, respectively.
- 6.5 Key points to note include:
- ◆ The total first year benefits of the scheme were -£0.642m, predicted-corrected benefits of £0.862m had been forecast.
  - ◆ The re-forecast benefits of the scheme were £-1.785m over the 3-year appraisal period, compared to a predicted corrected forecast of £2.588m.
  - ◆ Although the scheme was successful in reducing delays on the A390, the impact of this was counteracted by increased delays on the A30 West approach arm.
  - ◆ Following the scheme there has been an increased number of accidents at the site, with an additional 2.2 accidents per year at the junction and an additional 3.9 accidents per year on the extended approach to the junction.
  - ◆ The outturn BCR of the scheme over 3-years is -0.95 compared to a predicted corrected forecast BCR of 1.86.
  - ◆ An evaluation over the extended 10 year appraisal period would have resulted in outturn BCR of -2.76 compared to a predicted-corrected BCR of 6.10. This can be seen in greater detail in Appendix E.
- 6.6 Table 6.1 provides a summary economic evaluation for the scheme:

**Table 6.1 – Summary Economic Evaluation**

	PAR Predicted	PAR Predicted-Corrected	Outturn
PAR Version	PAR 3.3	PAR 3.3	PAR 3.3
Method of Calculation	Economy: Juice	Economy: Manual Calculation	Economy: Manual Calculation
	Accidents: Manual Calculation	Accidents: Manual Calculation	Accidents: Manual Calculation
Present Value Year	2002	2002	2002
Discount Rate	3.50%	3.50%	3.50%
Scheme Opening Year	2006	2006	2006
Evaluation Period	3 Years	3 Years	3 Years
Economy Benefits	£2.672m	£2.118m	£0.149m
Accident Benefits	£0.378m	£0.470m	-£1.934m
<b>Total Scheme Life Benefits (PVB)</b>	<b>£3.050*m</b>	<b>£2.588m</b>	<b>-£1.785m</b>
<b>Total Cost (PVC)</b>	<b>£1.439*m</b>	<b>£1.391m</b>	<b>£1.877m</b>
<b>Benefit Cost Ratio (BCR)</b>	<b>2.12</b>	<b>1.86</b>	<b>-0.95</b>
First Year Economy Benefits	£0.694m	£0.692m	£0.049m
First Year Accident Benefits	£0.135m	£0.170m	-£0.691m
First Year Total Benefits (PVB)	£0.829m	£0.862m	-£0.642m
First Year Rate of Return (FYRR)	58.40*%	61.99%	-34.20%

\*Includes changes to Indirect Tax and Vehicle Operating Costs

6.7 The main outturn economy, safety, environment, accessibility and integration impacts of the scheme are listed below:

### Economy Impacts

- ◆ In the first full year following the scheme, the combined AADT on the four main arms was 3.9% higher than in the last full year before construction. During the same period national traffic forecast growth was 5.0%.
- ◆ Variation in AADT on individual arms was more significant with a 20% increase to flow on the A390 and a 9% increase on the A30 E. Flows reduced by 11% on both the A30 W and the A3075 following the schemes implementation.
- ◆ Following the scheme the objective to reduce delays on the A390 has been achieved; however this has been to the detriment of delays on the A30 West and the B3277.
- ◆ Overall the net delay at the junction is very similar to the pre-scheme conditions.

- ◆ Outturn opening year and scheme life economic benefits are equivalent to £0.049m and £0.149m respectively. This is equivalent to 7% of the predicted scheme life benefits of £2.118m
- ◆ The outturn cost for the scheme was 35% more than predicted due to overrunning on preparation, site supervision and works costs.

### Safety Impacts

- ◆ The outturn accident analysis includes 1km on each approach arm to the Chiverton Cross Roundabout to account for changes to queuing at the junction following the roundabout improvements.
- ◆ Following the scheme the number of accidents each year has increased from 17.0 to 23.0 and hence the scheme has resulted in a first year accident dis-benefit of 6.0.
- ◆ Accident dis-benefits of 6.0 contrasts to a predicted-corrected accident saving of 1.5 accidents each year.
- ◆ Of the additional 6.0 accidents a year; 2.2 occur at or within Chiverton Cross Roundabout with an additional 3.9 on the approach arms.
- ◆ In monetary terms the opening year accident benefit is equivalent to -£0.691m compared to a predicted figure of £0.170m.
- ◆ When only considering the last 3-years accident data before the scheme, the accident rate has only increased by 4.4 accidents per year.
- ◆ The Highways Agency has requested a RSA Stage 4 at the site due to the high number of incidents recorded.

### Environmental, Accessibility and Integration Impacts

- ◆ Impacts upon the environment are generally as forecast in the PAR. Outturn impacts reduced from 'Slightly Beneficial' to 'Neutral' for the Local Air Quality and Greenhouse Gases objectives as reductions in delay were less than forecast in the PAR.
- ◆ The outturn assessment was that the scheme had had a Slightly-Adverse impact upon journey ambiance due to an increased accident rate. This had been forecast as Large-Beneficial in the PAR.
- ◆ All sub-objectives relating to accessibility and integration were as forecast in the PAR these were all classified as being unchanged with the exception of severance which a 'slightly beneficial' impact is observed due to improvements to routes for pedestrians and cyclists.

### CONCLUSIONS

- ◆ The scheme was intended to act as an interim measure before the Carland Cross to Chiverton Cross improvements, which would see a grade separated junction being constructed at the junction;
- ◆ The scheme has achieved its primary objective of reducing delays on the A390, however it has not recovered its costs, largely due to an increased accident rate and increased delays on the A30 West;
- ◆ Although this evaluation has illustrated that the scheme has not had the desired impact upon the overall efficiency of the roundabout, it should be noted that the

improvements were an interim scheme and it was not intended, or considered possible, to solve all problems at the roundabout;

- ◆ The relationship between the geometry\roundabout layout and the total number of accidents is complex. The spiral markings\lane designation on the roundabout may not have been successful in aiding entry to the roundabout; and
- ◆ Predicting queue lengths can be complex on a large roundabout with many arms such as Chiverton. Numerous factors come into play, such as angle of approach and available lane widths at entry, together with anticipated driver behaviour. Small changes at one entry can, particularly at times when traffic is heavy, seriously affect adjacent arms.

#### SUMMARY OF RECOMMENDATIONS

- ◆ Cornwall County Council is currently investigating further improvements at the junction as a Community Infrastructure scheme. This is recommended along with HA involvement;
- ◆ Reinstating two lanes from the A30 West to the A30 East would offer potential to reduce increased queuing on this arm. Options testing would need to be conducted to assess the wider impacts at the junction; and
- ◆ Where feasible, forecasting should use recent traffic data, TEMPRO growth forecasts from the 2002 survey to the opening year of 2006 may have been conservative given the suggested increases in traffic volume from the DfT count data.
- ◆ Accidents should be considered to the maximum extent of the before opening queues, particularly in scheme with a high proportion of shunt type congestion related accidents;

## Appendix A – Original Scheme AST

### Pre-Implementation Predicted Impacts: APPRAISAL SUMMARY TABLE (AST) 2006

Objectives	Sub-Groups	QUALITATIVE IMPACTS	QUANTITATIVE MEASURE	ASSESSMENT
ENVIRONMENT	Noise	There is a scattered community of residential homes a service area, commercial business and public houses in the vicinity of the improvement. It is not expected that they will experience a significant increase in noise above ambient values generated by the A30, A390 and other side roads.	Approximately 30 residential and 7 commercial/recreational properties within 200m of the scheme	Neutral
	Local Air Quality	No significant change in air quality is expected, although emissions may reduce slightly because of congestion reduction on A390 at peak times, which would have a beneficial effect for 8 properties within 200m of the scheme.		Slight beneficial
	Greenhouse Gases	Although there is no significant change in the total vehicle kms travelled as a result of the scheme, it is expected that there would be a minor reduction in greenhouse gases from congestion reduction on the A390 approach.	N/A	Slight beneficial
	Landscape	Local landscape quality is already diminished by the A30. The scheme would result in the loss of approx 50m <sup>2</sup> of scrubby copse and 12 semi-mature trees, but this could partly be mitigated by tree and shrub planting outside of visibility splays. Overall the landscape fit of the scheme appears to be good, but it would nevertheless result in further encroachment into the semi-rural landscape character to the west of the present junction.	N/A	Slight adverse
	Townscape	The junction improvements would have negligible townscape implications due to the existing dominance of the A30 and associated commercial development, and the lack of a distinct settlement core in the vicinity. The Listed Buildings in Three Burrows are outside of the visual envelope of the scheme.	N/A	Neutral
	Heritage of Historic Resources	The scale of the scheme involves only a very limited land-take in an area already affected by modern road improvement. The only identifiable elements of the historic environment to be affected will be short portions of the Kenwyn/Perranzabulow/St. Agnes parish boundaries that survive variably as earthworks on land on the west side of the current roundabout.; There is very limited potential for the discovery of further heritage assets within the scheme area. The presence of scheduled monuments in the vicinity means that great care will be needed in the siting of any temporary construction sites.	N/A	Slight adverse
	Biodiversity	Overall the habitat types to be directly affected, comprising improved grassland with scrub and scattered woodland plantings are of local importance and low ecological value. Loss of scrub and semi-mature trees within the HA soft estate will be mitigated by proposed plantings of native species. Common lizard have been recorded on site in vicinity of the stone wall (alongside the A30 southbound carriageway) therefore a reptile mitigation strategy has been implemented, in accordance with English Nature guidelines, to ensure vegetation clearance and stone wall dismantling does not cause any harm to this or other reptile species. Artificial hibernacula will also be constructed as part of the works.	N/A	Slight adverse
	Water Environment	Water features are typical of the locality. Potential impacts include increased surface run-off, spillages from the road surface and increased likelihood and extent of localised flooding. However, mitigation measures are to be included into the scheme design to reduce the significance of potential impacts. Overall, the scheme is unlikely to have any significant impacts, either positive or negative, upon the water environment.	N/A	Neutral
	Physical Fitness	The scheme incorporates a dedicated shared use route for pedal cyclists and pedestrians which would give these users an opportunity to safely bypass the roundabout, and therefore encourage walking or cycling to local amenities. However, experienced cyclists may continue to use the main carriageway as it would be quicker.	No. of cyclists and pedestrians are very low. It is hoped that more cyclists and pedestrians will make journeys than they do at present. Due to the rural location of the scheme most journey times are likely to be over 30 minutes in total.	Slight beneficial
	Journey Ambience	Implementation of the segregated left turn lane on the A390 approach would greatly reduce queue lengths on this arm of the roundabout and hence reduce driver frustration. The segregated left turn lane would also remove a movement from the roundabout itself, and hence limit the fear of potential accidents. The demarcation of lanes around the roundabout is expected to give drivers more certainty about their chosen route and reduce side-to-side collisions, together with conflicts between entering and circulating vehicles. Improved advance signing to get vehicles in the correct lane on approach would also improve driver confidence regarding the correct path through the roundabout.	N/A	Large beneficial
SAFETY	Accidents	Accident benefits gained by the improvement are predicted to be approximately £378,000 over the expected three year life of the scheme.	Accident Reductions Central Growth Casualty Reductions	PVB Central Growth TOTAL £0.378m
	Security	N/A	N/A	Neutral
ECONOMY	Public Accounts	Funded by Central Government £150,000 contribution from Cornwall County Council confirmed	Central Govt PVC, Central Growth £1.261m	Central Govt PVC, Central Growth £1.261m, NPV - £1.611m, FYRR = 58.4%
	Business Users & Providers	Vehicle travel for traffic on the A390 will reduce significantly due to the provision of segregated left turn lane, producing scheme benefits of £1.28m over the three year life of the scheme.	Business User Benefits, Central Growth £1.271m Private Sector Impacts, Central Growth £0.002m	
	Consumer Users	Vehicle travel for traffic on the A390 will reduce significantly due to the provision of segregated left turn lane, producing scheme benefits of £1.41m over the three year life of the scheme.	Consumer User Benefits, Central Growth £1.399m	PVB £1.399m
	Reliability	Not Applicable for a junction assessment	Not Applicable for a junction assessment	Neutral
	Wider Economic Impacts	Not Applicable for a junction assessment	N/A	Neutral
ACCESSIBILITY	Option Values	There is no considered effect	N/A	Neutral
	Severance	Number of pedestrian/cyclists using the roundabout at present are very low. However safer improved and new sections of footway/cycleway across the south of Chiverton Roundabout, and around the new subsidiary roundabout, are likely to encourage greater use, particularly by pedestrians in the local area to access the service area, Chiverton Arms, the Church and the existing public footpaths. The improved facilities are intended also to encourage safer use of the roundabout by cyclists, possibly from further afield.	N/A	Slight beneficial
	Access to the Transport System	There is no considered effect	N/A	Neutral
INTEGRATION	Transport Interchange	There is no considered effect	N/A	Neutral
	Land-Use Policy	No land outside existing highway boundaries is required for the scheme	None	Neutral
	Other Government Policies	N/A	N/A	Neutral

## Appendix B – Outturn EST

### Post-Implementation Actual Impacts: EVALUATION SUMMARY TABLE (EST) 2009

Objectives	Sub-Groups	QUALITATIVE IMPACTS	QUANTITATIVE MEASURE	ASSESSMENT
<b>ENVIRONMENT</b>	Noise	The scheme has had a neutral impact on noise levels. Traffic flows on all arms have increased by less than 25% (Max 20% A390) and HGV flows have increased by less than 20% (3.7% Reduction).	-	Neutral
	Local Air Quality	No significant changes to Local Air Quality. Congestion is reduced on the A390 where 8 properties were identified within 200m of the scheme. Although overall delay and AADT at the junction is similar to the initial conditions.	-	Neutral
	Greenhouse Gases	The change in the total distance travelled on the roads affected by the project is less than 10%, the scheme is considered to have had no impact on Greenhouse Gases.	-	Neutral
	Landscape	As noted in the PAR the project required limited land take and resulted in the loss of 50m2 of scrubby copse and 12 semi-mature trees. Mitigation measures in the form of tree and shrub planting were carried out as in the PAR.	-	Slightly Adverse
	Townscape	The scheme is not located in a built up area.	-	Neutral
	Heritage of Historic Resources	The scheme required a limited land take on an area already affected by modern road improvements.	-	Slightly Adverse
	Biodiversity	As noted in the PAR loss of scrub and semi-mature trees were mitigated by plantings of native species. A reptile mitigation strategy involving the creation of artificial hibernacula was conducted in partnership with English Nature.	-	Slightly Adverse
	Water Environment	The scheme was implemented as in the PAR and is considered to have had negligible impacts on the volume and quality of water discharge.	-	Neutral
	Physical Fitness	No formal pedestrian or cycle counts have been undertaken post scheme implementation. The numbers of pedestrians and cyclists at the junction remain low, although both should be encouraged by the introduction of a dedicated shared route for cyclists and pedestrians.	-	Slightly Beneficial
	Journey Ambience	Overall journey times are similar to the pre-scheme conditions although there is an increased accident rate following the schemes implementation.	-	Slightly Adverse
<b>SAFETY</b>	Accidents	An additional 6.0 accidents per year have occurred within 1km of the junction since the schemes implementation. These are valued at -£1.934 over the three year appraisal period.	Increased Accident rate of 6.0 accidents in opening year	PVB Central Growth TOTAL - £1.934m
	Security	N/A	N/A	Neutral
<b>ECONOMY</b>	b	Funded by Central Government with a £150,000 contribution from Cornwall County Council	Central Government PVC, £1.877	Central Government PVC, £1.877
	Business Users & Providers	The scheme has resulted in benefits on the A390 although has resulted in increased delay on the A30West during the AM and PM peak periods. Scheme benefits over the three year assessment period are £0.149	Central Growth, £0.149m	Central Growth, £0.149m
	Consumer Users			
	Reliability	N/A	-	Neutral
	Wider Economic Impacts	N/A	-	Neutral
<b>ACCESSIBILITY</b>	Option Values	No considered effect on the public transport system	-	Neutral
	Severance	The scheme has improved the quality of routes for pedestrians and cyclists throughout the junction	-	Slightly Beneficial
	Access to the Transport System	The scheme has not resulted in any changes to the public transport system	-	Neutral
<b>INTEGRATION</b>	Transport Interchange	No considered effect on public transport interchange	-	Neutral
	Land-Use Policy	The scheme is considered to have had no impact on Land-Use policy	-	Neutral
	Other Government Policies	The scheme has not had any recognisable effects on other government policies	-	Neutral

## Appendix C – Turning Counts

	A30 East	A390 Truro	A30 West	A3075 Newquay	B3277 St Agnes	Unclassified	Total
<b>3rd October 2002</b>							
<b>AM (08:00-09:00)</b>							
A30 East	0	94	832	103	15	62	<b>1106</b>
A390 Truro	214	0	364	51	8	30	<b>667</b>
A30 West	759	450	0	166	24	32	<b>1431</b>
A3075 Newquay	1	144	269	0	8	30	<b>452</b>
Unclassified	75	50	88	15	8	0	<b>236</b>
B3277 St Agnes	82	55	96	9	0	10	<b>252</b>
<b>Total</b>	<b>1131</b>	<b>793</b>	<b>1649</b>	<b>344</b>	<b>63</b>	<b>164</b>	<b>4144</b>
<b>PM (17:00-18:00)</b>							
A30 East	0	31	576	194	59	84	<b>944</b>
A390 Truro	198	0	506	101	29	52	<b>886</b>
A30 West	555	462	0	280	76	24	<b>1397</b>
A3075 Newquay	2	112	193	0	20	34	<b>361</b>
Unclassified	37	26	74	17	9	0	<b>163</b>
B3277 St Agnes	52	44	97	10	0	13	<b>216</b>
<b>Total</b>	<b>844</b>	<b>675</b>	<b>1446</b>	<b>602</b>	<b>193</b>	<b>207</b>	<b>3967</b>
<b>12 Hour</b>							
A30 East	0	620	4617	862	216	573	<b>6888</b>
A390 Truro	2132	0	4610	933	223	691	<b>8589</b>
A30 West	5192	5498	0	1985	442	419	<b>13536</b>
A3075 Newquay	37	1066	2199	0	81	275	<b>3658</b>
Unclassified	413	396	971	138	167	0	<b>2085</b>
B3277 St Agnes	498	539	1207	177	0	125	<b>2546</b>
<b>Total</b>	<b>8272</b>	<b>8119</b>	<b>13604</b>	<b>4095</b>	<b>1129</b>	<b>2083</b>	<b>37302</b>
<b>11th October 2007</b>							
<b>AM (08:00-09:00)</b>							
A30 Bodmin	0	54	849	6	69		<b>978</b>
A390	134	0	<b>401</b>	119	118		<b>772</b>
A30 Redruth	831	555	7	142	36		<b>1571</b>
A3075	0	88	194	0	48		<b>330</b>
B3277	213	107	123	75	0		<b>518</b>
<b>Total</b>	<b>1178</b>	<b>804</b>	<b>1574</b>	<b>342</b>	<b>271</b>		<b>4169</b>
<b>PM (17:00 -18:00)</b>							
A30 Bodmin	0	38	822	16	165		<b>1041</b>
A390	167	0	708	225	202		<b>1302</b>
A30 Redruth	603	403	1	228	57		<b>1292</b>
A3075	2	112	258	0	68		<b>440</b>
B3277	170	153	78	173	0		<b>574</b>
<b>Total</b>	<b>942</b>	<b>706</b>	<b>1867</b>	<b>642</b>	<b>492</b>		<b>4649</b>
<b>12 Hour</b>							
A30 Bodmin	2	672	7132	163	1020		<b>8989</b>
A390	1375	0	5404	1626	1795		<b>10200</b>
A30 Redruth	6619	5373	55	1916	659		<b>14622</b>
A3075	38	1330	2222	0	783		<b>4373</b>
B3277	1552	1648	1133	1009	0		<b>5342</b>
<b>Total</b>	<b>9586</b>	<b>9023</b>	<b>15946</b>	<b>4714</b>	<b>4257</b>		<b>43526</b>

## Appendix D – Economy Calculations

Hours Delay	Period	Approach Arm						All Approach Arms
		A390	B3277	A3075	A30 East	A30 West	C Road	
PAR Do-Min Delay (Minutes per Vehicle 2008)	AM	1.74	1	5	0.7	0.18	0.89	
	IP	0.58	0.25	0.26	0.1	0.11	0.25	
	PM	5	0.52	0.4	0.3	0.4	0.85	
PAR Do-Some Delay (Minutes per Vehicle 2008)	AM	0.09	0.31	5	1.49	0.09		
	IP	0.08	0.13	0.21	0.12	0.07		
	PM	0.12	0.21	0.42	0.18	0.14		
POPE Do-Some Delay (Minutes per Vehicle 2008)	AM	0.09	2.29	5	HATRIS	HATRIS		
	IP	0.08	0.25	0.26	HATRIS	HATRIS		
	PM	0.12	1.23	0.95	HATRIS	HATRIS		
PAR Do-Min Flow (2008)	AM	652	251	465	1085	1406	234	
	IP	767	227	326	615	1208	186	
	PM	960	212	360	925	1363	161	
PAR Do-Some Flow (2008)	AM	296	467	465	1085	1406	0	
	IP	355	386	326	614	1208	0	
	PM	411	351	360	925	1364	0	
Actual 2008 Flow	AM	337	471	365	889	1428	0	
	IP	850	445	364	749	1219	0	
	PM	540	522	400	946	1175	0	
Annualisation Factor	AM	390	390	390	390	390	390	
	IP	3120	3120	3120	3120	3120	3120	
	PM	390	390	390	390	390	390	
PC Do-Min Delay (hours/year)	AM	7378	1629	15106	29995	13910	1357	69375
	IP	23120	2954	4414	27870	30936	2419	91713
	PM	31186	717	936	27175	17361	887	78262
	<b>Total</b>	<b>61683</b>	<b>5300</b>	<b>20457</b>	<b>85040</b>	<b>62206</b>	<b>4663</b>	<b>239349</b>
PC Opening Year Delay (hours/year)	AM	173	942	15098	35564	13088	0	64864
	IP	1477	2609	3560	28505	28423	0	64574
	PM	321	479	983	26454	15057	0	43293
	<b>Total</b>	<b>1971</b>	<b>4030</b>	<b>19640</b>	<b>90522</b>	<b>56567</b>	<b>0</b>	<b>172730</b>
Opening Year Delay (hours/year)	AM	197	7009	11848	27427	25622		72104
	IP	3362	5787	4670	22802	43347		79970
	PM	421	2934	2347	20917	55973		82593
	<b>Total</b>	<b>3981</b>	<b>15731</b>	<b>18865</b>	<b>71147</b>	<b>124943</b>	<b>0</b>	<b>234666</b>
PC Opening Year Saving (hours/year)	AM	7204	688	9	-5569	822	1357	4511
	IP	21643	345	854	-635	2513	2419	27139
	PM	30865	238	-47	721	2304	887	34969
	<b>Total</b>	<b>59712</b>	<b>1271</b>	<b>816</b>	<b>-5482</b>	<b>5639</b>	<b>4663</b>	<b>66619</b>
POPE Opening Year Saving (hours/year)	AM	7180	-5380	3259	2568	-11712	1357	-2729
	IP	19757	-2833	-256	5068	-12412	2419	11743
	PM	30764	-2217	-1411	6258	-38613	887	-4331
	<b>Total</b>	<b>57702</b>	<b>-10430</b>	<b>1592</b>	<b>13893</b>	<b>-62736</b>	<b>4663</b>	<b>4684</b>

## Appendix E – 10 Year Appraisal

### Summary Economic Evaluation (10 Year Appraisal Period)

	PAR Predicted	PAR Predicted-Corrected	Outturn
PAR Version	PAR 3.3	PAR 3.3	PAR 3.3
Method of Calculation	Economy: Juice Accidents: Manual Calculation	Economy: Manual Calculation Accidents: Manual Calculation	Economy: Manual Calculation Accidents: Manual Calculation
Present Value Year	2002	2002	2002
Discount Rate	3.50%	3.50%	3.50%
Scheme Opening Year	2006	2006	2006
Evaluation Period	3 Years	10 Years	10 Years
Economy Benefits	£2.672m	£6.989m	£0.492m
Accident Benefits	£0.378m	£1.500m	-£5.677m
<b>Total Scheme Life Benefits (PVB)</b>	<b>£3.050m</b>	<b>£8.490m</b>	<b>-£5.185m</b>
<b>Total Cost (PVC)</b>	<b>£1.439m</b>	<b>£1.391m</b>	<b>£1.877m</b>
<b>Benefit Cost Ratio (BCR)</b>	<b>2.12</b>	<b>6.10</b>	<b>-2.76</b>
First Year Economy Benefits	£0.694m	£0.692m	£0.049m
First Year Accident Benefits	£0.135m	£0.170m	-£0.691m
First Year Total Benefits (PVB)	£0.829m	£0.862m	-£0.642m
First Year Rate of Return (FYRR)	58.40%	61.99%	-34.20%

## Appendix F – Glossary

The following table details the acronyms and specialist terms used within the context of this report.

Term	Definition
AADT	<b>Annual Average Daily Traffic.</b> Average of 24 hour flows, seven days a week, for all days within the year.
ARCADY	<b>Assessment of Roundabout Capacity and Delay:</b> A computer program used in the design of roundabouts.
AST	<b>Appraisal Summary Table.</b> This records the impacts of the scheme according to the Government's five key objectives for transport, as defined in DfT guidance contained on its Transport Analysis Guidance web pages, WebTAG
BCR	<b>Benefit Cost Ratio</b> A ratio identifying the relationship between cost and benefits of a proposed project.
COBA	<b>COst Benefit Analysis</b> – a computer program which compares the costs of providing road schemes with the benefits derived by road users (in terms of time, vehicle operating costs and accidents), and expresses the results in terms of a monetary valuation. The COBA model uses the fixed trip matrix unless it is being used in Accident-only mode.
DFT	<b>Department for Transport</b>
DMRB	<b>Design Manual for Roads and Bridges</b>
EST	<b>Evaluation Summary Table.</b> In POPE studies, this is a summary of the evaluations of the TAG objectives using a similar format to the forecasts in the AST.
FYRR	<b>First Year Rate of Return</b>
GPS	<b>Global Positioning System</b>
HA	<b>Highways Agency.</b> An Executive Agency of the Department for Transport, responsible for operating, maintaining and improving the strategic road network in England.
HATRIS	<b>Highways Agency Traffic Information System</b> The Highways Agency (HA) currently maintains, operates and develops three traffic databases and associated applications. The Traffic Flow Data System (TRADS) holds information on traffic flows at sites on the network. The Journey Time Database (JTDB) system holds information on journey times and traffic flows for links of the network. These two databases are known collectively as the HA Traffic Information System (HATRIS).
HGV	<b>Heavy Goods Vehicle</b>
JTDB	<b>Journey Time Database</b>

JUICE	Spreadsheet model calculating value of time benefits
KSI	<b>Killed or Seriously Injured</b>
LGV	<b>Light Goods Vehicle</b>
LNMS	<b>Local Network Management Scheme</b> A contribution to bringing about the changes required by the integrated transport white paper and 10 year plan.
MAC	A <b>Managing Agent Contractor</b> is responsible for the operation, maintenance, and improvement of the motorway and trunk road network of a Highways Agency area.
MIDAS	<b>Motorway Incident Detection and Automatic Signalling</b>
NRTF	<b>National Road Traffic Forecast.</b> This document defines the latest forecasts produced by the Department of the Environment, Transport and the Regions of the growth in the volume of motor traffic. The most recent one is NRTF97 and the one previous was NRTF89.
OGV	<b>Other Goods Vehicle</b>
Outturn	Evaluation based on data following a schemes implementation
PAR	<b>Project Appraisal Report</b>
POPE	<b>Post Opening Project Evaluation</b> , before & after monitoring of all major highway schemes in England.
PIA	<b>Personal Injury Accident</b>
Predicted Corrected	An adjustment of the schemes original appraisal to ensure that before and after results can be meaningfully compared
PSV	<b>Public Service Vehicles</b>
PVB	<b>Present Value Benefits</b> Value of a stream of Benefits accruing over the appraisal period of a scheme expressed in the value of a single 'present' year. For this scheme this is 2002.
PVC	<b>Present Value Cost</b> As for PVB but for a stream of costs
Recurrent Delay	Delay as a result of recurrent congestion
RSA	<b>Road Safety Audit</b>
TEMPRO	<b>Trip End Model Program</b> This is a PC program which provides access to the Department for Transport's national Trip End Model projections of growth in travel demand, and the underlying car ownership and planning data projections.
VOT	<b>Value of Time</b>