A90, Edinburgh

Outbound Bus Priority Study

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EXECUTIVE SUMMARY

The A90 is a strategic corridor between Edinburgh and the Fife area. The section being studied is essentially the outbound direction from the City Centre/Bus Station to the Forth Road Bridge. It is predominantly wide single carriageway with a 40 mph speed limit and in an urban and suburban setting.

The key scheme objective was to identify a solution for the A90 corridor to function effectively as a strategic link for public transport, connecting Edinburgh with its north-western suburbs, commuter towns and much of the west and north of Scotland. This should be achieved while the impacts of travel on local and global environments are minimised.

In October 2007 SEStran commissioned White Young Green, in partnership with JMP consultants, to carry out a study into bus priority on the A90 Strategic Corridor in Edinburgh, specifically in the out-bound direction from Dean Bridge to Barnton junction, in particular between Blackhall and Barnton junctions.

A preferred option was identified and refined in accordance with the Scottish Transport Appraisal Guidance (STAG). It comprised the following:

- A junction modification to the A90 Blackhall junction to allow out-bound buses to completely bypass queuing traffic that currently causes operational difficulties and significant delays
- Extension of the existing PM peak bus lane on Telford Road to the exit of the Groathill Road North junction, which could also be improved to have SCOOT (Split / Cycle / Offset Optimisation Technique – a method of optimising signal timings) control to reduce delays for buses.
- A PM peak hour bus lane on Quality Street for the approach to the A90.
- Reallocation of road space to accommodate an out-bound bus lane from the exit of Quality Street junction, through and beyond the exit of Clermiston Road North.
- Minor (non-layout) improvements to Barnton and Drum Brae North junctions to allow SCOOT control to give dynamic green times and better coordination to other nearby junctions.

The scheme has been estimated to require an initial implementation budget of £708,300, and has been calculated to give a BCR of 3.5.

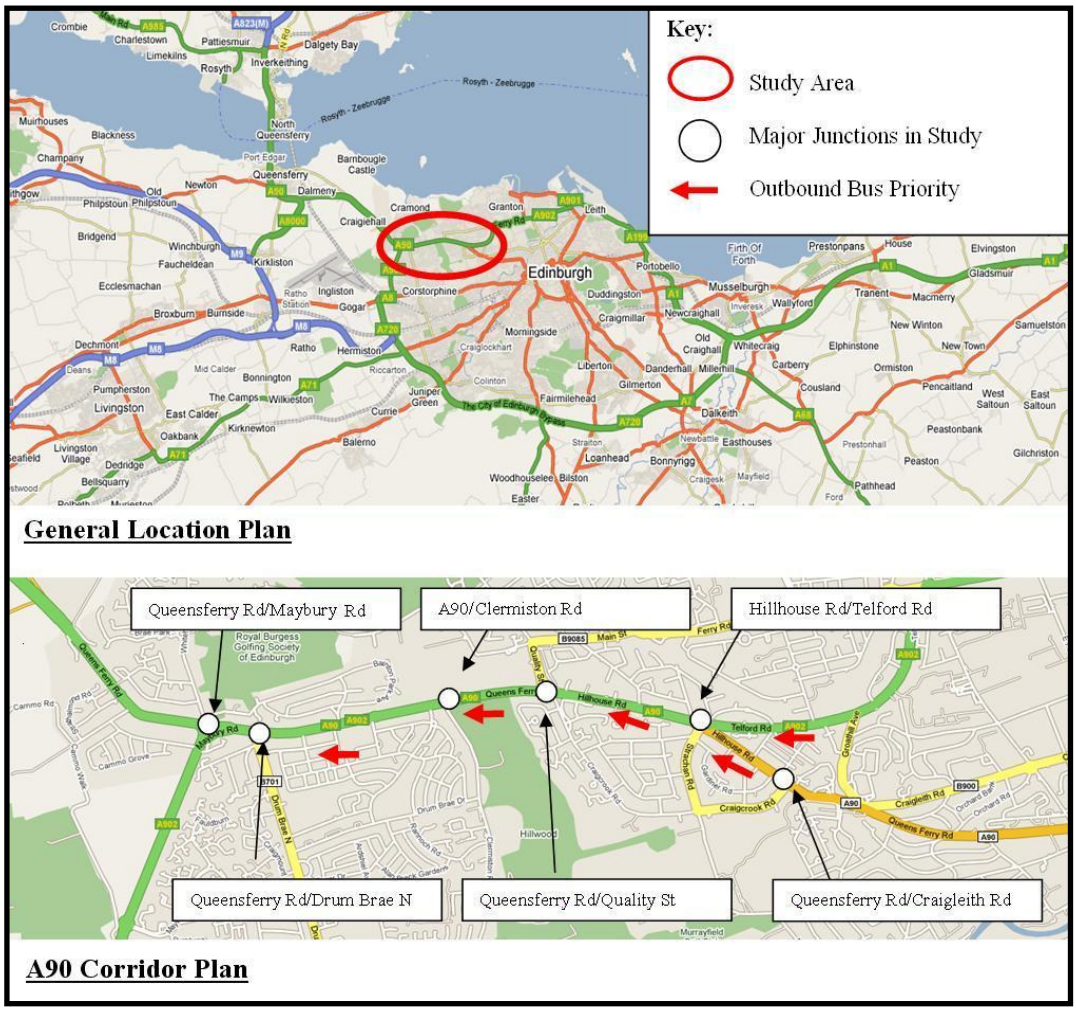
1. INTRODUCTION

1.1.1 In October 2007 SEStran commissioned White Young Green, in partnership with JMP consultants, to carry out a study into bus priority on the A90 Strategic Corridor in Edinburgh, specifically in the Outbound direction from Dean Bridge to Barnton. The key objectives of the study are:

- Problem Assessment and Review existing Bus Priority measures.
- Develop Options for Bus Priority.
- Detailed analysis of preferred option.
- STAG 1 and 2 appraisal.
- Consult with key stakeholders.

1.1.2 This report follows the STAG methodology and details the results of the study.

1.1.3 A location plan of the scheme is shown below:



2. BACKGROUND ISSUES

2.1 KEY CORRIDOR PROBLEMS & ISSUES

2.1.1 Description of Study area

2.1.1.1 The A90 is a strategic corridor between Edinburgh and the Fife area. The section being studied is essentially the outbound direction from the City Centre/Bus Station to the Forth Road Bridge. It is predominantly wide single carriageway with a 40 mph speed limit. Outside of the City limits, it becomes de-restricted dual carriageway on the approach to the Forth Road Bridge.

2.1.1.2 The A902 Ferry Road/Telford Road is a major route that joins the A90 at Blackhall junction. Significant volumes of traffic also use the Ferry Road to join the A90 at Quality Street junction.

2.1.1.3 There are signalised junctions on the A90 at the following locations:

- Queensferry Street/Randolf Crescent
- Queensferry Road/Orchard Brae
- Queensferry Road/Craigleith Road
- Hillhouse Road/Telford Road – Blackhall
- Hillhouse Road/Quality Street – Davidsons Mains
- Queensferry Road/Clermiston Road Nth
- Queensferry Road/Drum Brae Nth
- Queensferry Road/Maybury Road – Barnton

2.1.1.4 On the A902 there are signalised junctions at:

- Telford Road/Groathill Avenue
- Telford Road/Groathill Road Nth

2.1.1.5 There are also a number of signalised pedestrian crossings on the route.

2.2 BUS SERVICES

2.2.1.1 Drawing number A040878-T-11 in Appendix G shows a schematic road network with the bus frequencies. For clarity on the drawing the inbound buses are not shown, but all buses on feeder roads are shown.

2.2.1.2 Table 2 below summaries the services using the corridor in the evening peak hour

Table 1 - Bus Frequencies

Section	PM Peak Frequency (buses/hour)
Dean Bridge – Orchard Brae	28
Orchard Brae – Craigleith Road	20
Craigleith Road - Blackhall	24
Blackhall – Corbiehill Road	25
Corbiehill Road – Quality Street	21
Quality Street - Clermiston	29
Clermiston – Drum Brae	25
Drum Brae - Barnton	24

2.3 REVIEW OF CURRENT BUS PRIORITY MEASURES

2.3.1.1 The current bus priority measures on the outbound A90 consist of a queue relocation system. The key features of the system are:

- Bus lanes on the Hillhouse and Telford Road approaches to Blackhall junction
- Queue detection loops to activate automatic signal timing plan selection for Blackhall junction

2.3.1.2 The section of 4 lane single carriageway between Blackhall and Barnton junctions is key to the philosophy of the Queue Relocation system. This section becomes congested in normal peak traffic conditions. Bus lanes were not provided due to the need for capacity on this critical section. Bus lanes were provided on the approaches to Blackhall junction, where the signal timings are automatically adjusted in the PM peak to restrict the flow of traffic. In this way traffic flows between Blackhall and Barnton are maintained below the saturation level and delays are kept to a minimum. Excess traffic queues on the approaches to Blackhall where buses can get past them in the bus lanes to a position where they would expect to progress through the signals on the next green signal.

2.3.1.3 The system operates from 16:00 to 18:30 Mon – Thurs and 15:30 to 18:30 on Fridays. Two Queue detectors, an inner and an outer, are situated on the Hillhouse and Telford Road approaches. When the system starts the signal timings at Blackhall are shortened to limit traffic flows and create queues adjacent to the bus lanes. The system then tries to maintain the queues between the inner and outer limits on the approaches so that buses are not delayed on the approaches, i.e. queues do not extend beyond the bus lanes.

2.3.1.4 During the period of the study the system was not fully operational due to equipment faults that meant the queue detectors were inoperative. The system was still operating at the required times, but with an average default signal timing plan, rather than automatically adjusting timings to manage queues.

2.4 ACCIDENT DATA

2.4.1 Accident data was provided by City of Edinburgh Council and is listed in Appendix A.

2.4.1.1 There were a total of 78 accidents in the study area, which included the A90 from Craigleith Road to Barnton and the A902 from South Groathill to Blackhall junction, in the 3 year period from August 2004 to July 2007. Of these one was classed as fatal, 3 serious and the remainder slight.

2.4.1.2 5 of the accidents involved buses, 10 involved cyclists and 8 involved pedestrians.

2.4.1.3 Table 4 below summarises the accidents at each junction.

Table 2 - Junction Accidents

Location	No. of Accidents
Barnton Junction	7
Queensferry Road/Drum Brae North	1
Queensferry Road/Clermiston Road	5
Queensferry Road/Quality Street	7
Blackhall Junction	5
Queensferry Road/Craigleith Road	4
Telford Road/Groathill Road North	4
Telford Road/Groathill Avenue	2

2.5 INFORMATION FROM BRIEF

2.5.1 An initial analysis of delay to buses was undertaken and the results presented in the project brief. The table below summarises the difference between peak and off-peak journey times:

Table 3 - SEStran Survey Results

Section	**Delay (peak vs off-peak /minutes)**
West End – Orchard Brae	1:12
Orchard Brae – Craigleith	1:04
Craigleith – Blackhall	1:09
Blackhall – Quality Street (Davidsons Mains)	1:10
Quality Street (Davidsons Mains) – Barnton	4:57

2.5.1.1 The results show that the main area of concern is the section between Blackhall and Barnton.

2.5.1.2 It should be noted that these results were obtained with the existing Queue Relocation system fully operational.

2.5.1.3 Based on this data the objectives of the study as stated in the brief are:

- To assess low cost options for bus priority between Dean Bridge and Davidsons Mains
- To assess more radical options for bus priority between Davidsons Mains and Barnton

2.6 JOURNEY TIME DATA

2.6.1 Video Surveys

To supplement the data given in the brief journey time surveys have been carried out using a video camera. The videos are included in Appendix F.

2.6.2 The Existing Queue Relocation System

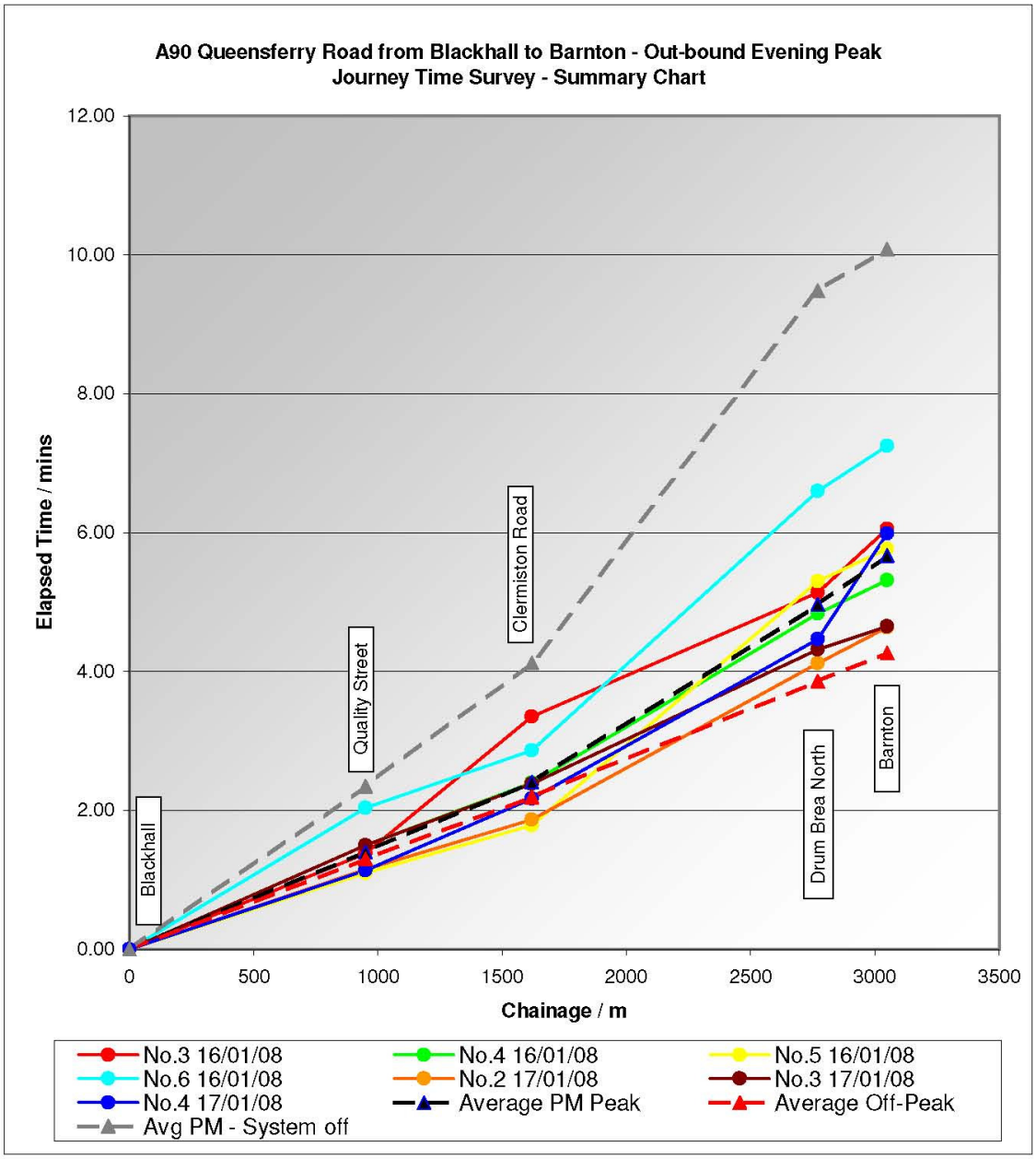
At the start of the project in October 2007 the existing Queue Relocation system was inoperative due to accident damage of site equipment. The opportunity was taken to make some measurements of journey times with the system off. Some journey times in the off peak where also recorded to use as a free flow base for comparison.

2.6.2.1 The system was largely repaired in January 2008, however, due to detector loop faults, the system was unable to automatically detect queues and change timing plans. The system was therefore working with a single averaged timing plan at Blackhall during the period of operation (this is referred to as 'Fixed Time' operation). Further video journey time surveys where carried out at this time.

2.6.3 Journey Time Survey Summary Charts

Figures 1, 2 and 3 below summarise the results of the Journey time surveys. It should be noted that the results are for general traffic. Therefore in locations where there are existing bus lanes, buses will not suffer delay indicated on the graphs, e.g. on the approaches to Blackhall junction.

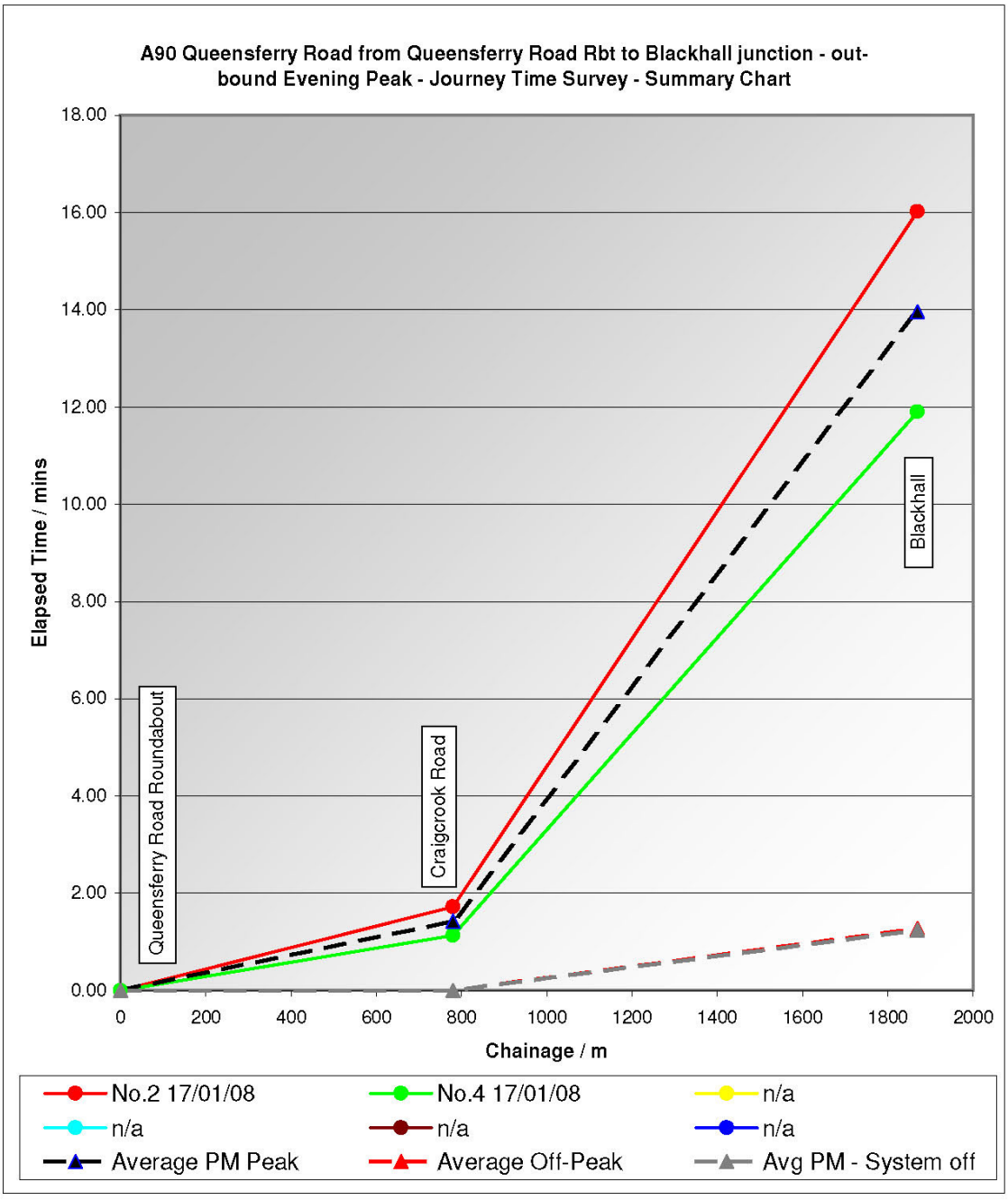
Figure 1 – Journey Time Graphs – Blackhall to Barnton



Out-bound PM Peak Journey Times

Section Start	Chainage	No.3 16/01/08	No.4 16/01/08	No.5 16/01/08	No.6 16/01/08	No.2 17/01/08	No.3 17/01/08	No.4 17/01/08	Average PM Peak	Average Off-Peak	Avg PM - System off
Blackhall	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Quality Street	950	1.38	1.50	1.10	2.03	1.15	1.50	1.13	1.40	1.30	2.34
Clermiston Road	1620	3.35	2.40	1.78	2.87	1.87	2.38	2.17	2.40	2.19	4.13
Drum Brea North	2770	5.13	4.83	5.30	6.60	4.12	4.32	4.47	4.97	3.86	9.48
Barnton Junction	3050	6.05	5.32	5.77	7.25	4.63	4.65	5.98	5.66	4.27	10.08
Journey Speed / mph		18.80	21.39	19.72	15.68	24.54	24.45	19.01	20.08	26.65	11.28

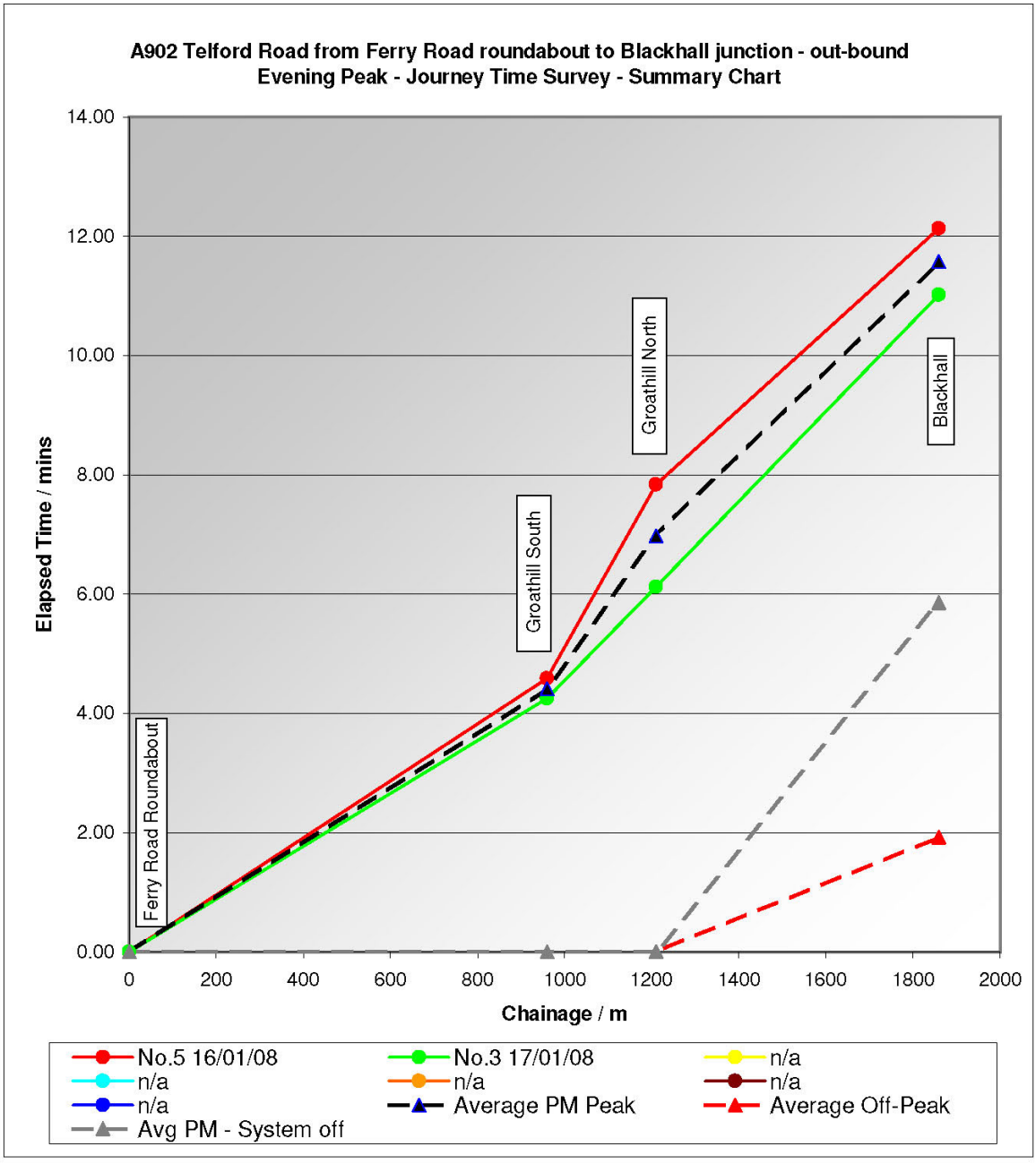
Figure 2 – Journey Time Graphs – Hillhouse Road Approach to Blackhall



Out-bound PM Peak Journey Times

Section Start	Chainage	No.2 17/01/08	No.4 17/01/08	n/a	n/a	n/a	n/a	Average PM Peak	Average Off-Peak	Avg PM - System off
Queensferryh Rd Rbt	0	0.00	0.00					0.00	0.00	0.00
Groathill South	780	1.72	1.13					1.43	0.00	0.00
Blackhall	1870	16.02	11.90					13.96	1.28	1.24
Journey Speed / mph		4.4	5.9					5.0	31.7	32.8

Figure 3 – Journey Time Graphs – Telford Road Approach to Blackhall



Out-bound PM Peak Journey Times

Section Start	Chainage	No.5 16/01/08	No.3 17/01/08	n/a	n/a	n/a	n/a	n/a	Average PM Peak	Average Off-Peak	Avg PM - System off
Ferry Road Rbt	0	0.00	0.00						0.00	0.00	0.00
Groathill South	960	4.58	4.25						4.42	0.00	0.00
Groathill North	1210	7.83	6.12						6.98	0.00	0.00
Blackhall	1860	12.13	11.02						11.58	1.92	5.85
Journey Speed / mph		5.7	6.3						6.0	12.6	4.1

2.6.4 Analysis of Journey Time Data

2.6.4.1 Table 3 below summarises the results in terms of delay to buses along each section between Blackhall and Barnton.

Table 4 - Journey Time Results

Section	PM Peak JT		PM Peak Delay	
	+ QRS	- QRS	+ QRS	- QRS
Blackhall – Quality Street	1.40	2.34	0.10	1.04
Quality Street – Clermiston Road	1.00	1.78	0.11	0.89
Clermiston Road – Drum Brae North	2.56	5.35	0.90	3.69
Drum Brae North - Barnton	0.70	0.60	0.29	0.19

Note: +/- QRS = with and without Queue Relocation System operating

2.6.4.2 Some key points to note from the video survey results are:

- With the Queue Relocation System operating in its restricted state (Fixed Time) journey times from Blackhall to Barnton are not significantly higher in the PM Peak than in the Off Peak. Delays of approximately one minute were recorded on the approach to Drum Brae North.
- Without the Queue Relocation System operating there was a total average increase in journey time between Blackhall and Barnton of 5.81 minutes. Most of this delay is on the approach to Drum Brae North junction.
- With the Queue Relocation System operating in its restricted state (Fixed Time) queues extend to the Ferry Road roundabout on the Telford Road approach to Blackhall junction. This queue extends well beyond the start of the existing bus lane. On the Hillhouse Road approach queues did not extend beyond the extent of the bus lane.
- Buses on the Hillhouse Road approach to Blackhall junction were observed taking 2-3 cycles of the signals to progress from the end of the bus lane to crossing the stop line. This problem was also observed on Telford Road.
- Long queues were observed on Quality Street, which extended back some way along Ferry Road. On all other feeder roads observed queues were within reasonable limits.

2.7 KEY TRANSPORT AND LAND USE POLICIES

2.7.1.1 A number of factors, including land-use planning policies and the recent removal of tolls from the Forth Road Bridge will potentially contribute to an increase in the demand for use of the A90 corridor to/from Edinburgh. Edinburgh's Local Transport Strategy 2007-2012 (the LTS), highlights some of these issues: "The area between the Firth of Forth and the city centre suffers from significant road capacity constraints, which will be exacerbated if the developments proposed for Leith Docks and Grantor are not focused around a high proportion of journeys being made by public transport. This will require effective management through the planning process, as well as transport measures" (LTS paragraph 8.2).

2.7.1.2 Potentially adding to the existing pressure on this route is the continued development north of the Forth, particularly of the Dunfermline Eastern Expansion, Rosyth Military Estate and Glenrothes Urban Expansion area as outlined in the Fife Structure Plan, Policies SS4-SS6.

2.7.1.3 As outlined in the 2007 Regional Transport Strategy (the RTS), the SEStran region is set to see an increase in population of around 150,000 (10%) by 2024, with Edinburgh continuing to be one of the economic drivers of the country. The city accounts for 45% of all the jobs in the region, but is home to only 31% of the population. SEStran highlights the implications of this growth as bringing an increase in the mobility of the required labour market with employees travelling further, arguably in part aggravated by the continuing tendency of areas outwith Edinburgh to become dormitory settlements for the capital's working population.

2.7.1.4 The City of Edinburgh Council recognises that it will not be possible to accommodate the increased demand for highway space on corridors entering the city. As such, and in line with aims set out in LTS, a number of policies have been adopted and actioned. These focus on encouraging private vehicle users to switch modes to more sustainable modes of transport, principally via bus and rail services. Specific to this study relevant LTS policies include:

- **Policy PT20:** "The Council will promote further bus priorities within the city where needed to maintain and improve public transport service quality and reliability; and will work with SEStran to develop bus priority schemes that will support orbital bus services linking key growth areas in and around the city, including consideration of priorities on trunk roads and motorways".

2.7.1.5 SEStran's policies are set out in the RTS. Its recommendations with respect to the main transport corridors are complementary to the LTS in as much as stating:

- **Policy 1:** "There will be a general presumption in favour of schemes that improve the efficiency and effectiveness of public transport, and make it a more attractive option for existing car users".
- **Policy 2:** "Support will be given to the improvement of all aspects of bus services (services, vehicle quality, fares, infrastructure, bus rapid transit, and integration) as a means of reducing congestion and enhancing accessibility".
- **Policy 13:** "There will be a presumption in favour of addressing problems of congestion through measures to reduce demand for car travel and promote modal shift".
- **Policy 14:** "Any additional capacity on commuter corridors that are congested, or forecast to become congested within the lifetime of the strategy, will normally be used to benefit space-efficient modes such as bus, train and high-occupancy vehicle and cycles".
- **Policy 23:** "Schemes that improve the accessibility by public transport, walking and cycling of key development areas will be afforded higher priority for implementation".
- **Policy 31:** "New transport infrastructure proposals which could have significant adverse effects on areas designated for their natural or cultural heritage and environmental quality, including air quality, will not normally be supported".

2.7.1.6 Much of the A90 corridor south of the Forth has undergone treatment to prioritise bus travel as part of the bus priority and queue management scheme linked to the development of the Ferrytoll park & ride service in Fife. Work to prioritise bus travel on the A90 corridor route to date has included some reallocation of road space where this is possible without undue detriment to general traffic, principally in the section north-west of this study area, along with amendments to signal phasing and to provide queue management.

2.7.1.7 However the options available within the part of the corridor forming this study area are severely limited by the particular geography and density of the existing urban environment. Exacerbating this are a number of major road intersections along the route which impede the free-flow of vehicles.

3. TRANSPORT PLANNING OBJECTIVES

3.1.1.1 Within this section, we have outlined transport planning objectives that any proposed enhancements on or around the A90 corridor should contribute to. These have been developed in the light of the key issues and current traffic stress that the corridor faces. The objectives are intended to contribute towards an overall aim for the study which is:

For the A90 corridor to function effectively as a strategic link connecting Edinburgh with its north-western suburbs, commuter towns and much of the west and north of Scotland whilst the impacts of travel on the local and global environments are minimised.

3.1.1.2 From this aim, the transport planning objectives are defined as:

- To maximise journey time reliability
- To minimise environmental disbenefits of transport infrastructure and its use
- To contribute to meeting local and regional sustainability goals
- To minimise average journey times
- To improve road safety
- To achieve best value for investment of public funds

3.1.1.3 The ordering of these objectives is not intended to imply priority between them.

4. OPTIONS FOR CHANGE

4.1.1 In this section, we introduce options for the A90 corridor that could potentially contribute to the transport planning objectives. The options are listed and briefly described; thereafter they are initially appraised against the objectives, in addition to financial sustainability and implementability criteria.

4.1.1.1 The options fall into a number of key categories:

- Traffic capacity enhancement through land-take on links or at junctions.
- Reallocation of some roadspace presently allocated to general traffic to sustainable and/or high-capacity modes.
- Modifications to existing traffic signals and bus priority arrangements.
- Public transport service enhancements.
- Changes to some or all of the existing junction types at the major intersections (which are presently all controlled by traffic signals) to other forms (grade separation or roundabouts, for example) or banning turns at junctions.
- Reallocation of roadspace presently given to buses to be available for all traffic.

4.1.1.2 Within these categories, the options are:

1. Traffic capacity enhancement through land-take:
   - Option 1a: increase capacity at one or more of the major intersections on the route (Craigleith, Blackhall, Davidson's Mains, Drum Brae North, Barnton) through land-take and expanded highway infrastructure (with, perhaps, new capacity being dedicated to high-capacity modes (buses)).
   - Option 1b: increase capacity on one or more links between junctions through land-take and expanded highway infrastructure (with, perhaps, new capacity being dedicated to high-capacity modes (buses)).
2. Roadspace reallocation to sustainable/high-capacity modes:
   - Option 2a: reallocate roadspace from general traffic to the most sustainable modes (walking and cycling).
   - Option 2b: reallocate roadspace from general traffic to high-capacity modes (buses).

3. Modified traffic signals and bus priority:
    - Option 3: changes to traffic signals and/or bus priority measures at one or more of the links or major intersections.
4. Public transport service enhancements:
    - Option 4a: Improve long-distance bus services (to Fife and beyond) to encourage transfer of mode.
    - Option 4b: Improve local bus services (within the Edinburgh boundary) to encourage transfer of mode.
    - Option 4c: Improve park & ride facilities to encourage transfer of mode.
5. Changes to junction types:
    - Option 5a: changes to one or more of the existing major intersections to junction types apart from traffic signals.
    - Option 5b: banning some turns at junctions to generate additional capacity for through traffic.
6. Reallocate existing bus priority roadspace to all traffic:
    - Option 6: Remove some or all existing bus priority measures from the corridor.

4.1.2 Option Sifting

4.1.2.1 An initial sift of the options has been completed. Each option has been considered for its potential to contribute to (or conflict with) the transport planning objectives, along with its cost and implementability. Findings are summarised in Table 5 overleaf.

4.1.2.2 This option sifting was undertaken in part in conjunction with key stakeholders (representatives of SEStran, City of Edinburgh Council and the main bus operators on the A90 corridor, Lothian Buses, Stagecoach and First Group). These stakeholders helped to develop and sift the options and all concurred with the findings of the initial sift.

Table 5 – Option Sifting

Option	Transport Planning Objectives						Indicative cost[1]	Implement ability	Initial sift outcome
	To maximise journey time reliability	To minimise environmental disbenefits of transport infrastructure and its use	To contribute to meeting local and regional sustainability goals	To minimise average journey times	To improve road safety	To achieve best value for investment of public funds			
1a: junction capacity enhancement through land-take	✓✓	×××	××	✓✓	✓	××	Very high	×××	Reject
1b: link capacity enhancement through land-take	✓	×××	××	✓	○	××	Very high	×××	Reject
2a: roadspace reallocation to walking and cycling	××	×	×	××	○	×	Low	××	Reject
2b: roadspace reallocation to high capacity modes	○	×	×	×	○	×	Low	××	Reject
3: modified traffic signals and bus priority	✓✓	✓	✓	✓	○	✓	Low	✓	Retain for further consideration
4a: improved long distance bus services	○	✓	✓	○	○	××	Medium	✓	Reject
4b: improved local bus services	○	✓	✓	○	○	××	Medium	✓	Reject
4c: improved park & ride services	○	✓	✓	○	○	××	High	✓	Reject
5a: changes to junction types	×	×	○	×	○	×	Medium	×	Reject
5b: banning turns at junctions	✓	×	○	✓	○	○	Low	××	Reject
6: removal of bus priority measures	××	×	××	××	○	×××	Low	×	Reject

Key:				
	✓✓✓	Significant benefit	×××	Significant disbenefit
	✓✓	Moderate benefit	××	Moderate disbenefit
	✓	Slight benefit	×	Slight disbenefit
	○	No, or negligible, impact		

[1] Intended only, at this stage, to give a broadly comparative estimate of costs incorporating both capital and revenue elements

4.1.2.3 The rationale for the rejection of some options at this initial sifting is outline below.

4.1.2.4 Option 1a: Junction capacity enhancement through land-take. This option has been rejected from detailed consideration as none of the major intersections on the route are immediately bounded by land used for residential, business or parkland. This is particularly true at the Drum Brae North junction, shown by the analysis of traffic data to be the most significant constraint on outbound traffic capacity, which is tightly constrained by non-highway land use. As such, any attempt to take any additional land for transport purposes would be highly controversial, expensive and conflict with local and regional transport policies. It would also conflict with three of the transport planning objectives for this review (minimising environmental disbenefits, contributing to sustainability goals and achieving best value). As such, this option is not considered further.

4.1.2.5 Option 1b: Link capacity enhancement through land-take. All land adjacent to both sides of the corridor throughout its length has high-value uses (for residential, business or parkland). As such, any land take would be controversial, time consuming, costly and conflict with local and regional transport policies. As such, land-take to enhance link capacity is rejected as an option for detailed consideration. However, it may be possible to provide an extra running lane (which could be used to provide a dedicated outbound bus lane) within the existing highway boundary on the A90 between Clermiston Road and Drum Brae North (Drawing No. A040878-T-08 in Appendix G). This would necessitate the complete removal of the footway and bus stops on the north side of the road and of the mid-block pedestrian crossing facilities. It is anticipated to incur substantial costs due to the need to relocate services. This scheme would not generate any junction capacity enhancements, so a new bus lane could only be used to enable buses to pass a queue on the approach to the Drum Brae North junction. Effective use (or enhancement of) existing queue relocation measures at Blackhall should enable the queue at Drum Brae North to be minimised, hence the potential benefits from the highway widening are marginal. Overall, the costs of this option are anticipated to far outweigh the benefits and it is rejected from further more detailed consideration.

4.1.2.6 Option 2a: Roadspace reallocation to walking and cycling. Although enhancement of facilities for pedestrians and cyclists would result in some increase in the use of these sustainable modes, the strategic nature of many of the journeys on this corridor precludes the potential for a substantial mode shift. A significant reduction in capacity for vehicles to cater for pedestrians and cyclists therefore conflicts with most of the transport planning objectives. This option is therefore rejected from more detailed consideration.

4.1.2.7 Option 2b: Roadspace reallocation to high capacity modes. Some roadspace on the corridor is already allocated to high-capacity modes in the form of bus lanes. It could be feasible to extend this concept to increase priority to buses through longer bus lanes (throughout most of the corridor length) and reduce bus lane setbacks at junctions by reallocating roadspace from general traffic (Drawing No. A040878-T-09 in Appendix G). Surveys undertaken for this study however show that total traffic flow on the A90 outbound between Blackhall and Barnton is approximately 1,800 pcu in the peak hour. The typical maximum capacity for a single traffic lane is around 1,350 pcu/hr (where mid-link pedestrian facilities are provided), hence significant reallocation of roadspace could result in severe congestion for general traffic. There may be specific locations at which priority for buses could be improved (these are included within option 3). However, a widespread reallocation of roadspace to buses throughout the corridor length or any substantial part of it is considered unfeasible, would conflict with objectives and therefore rejected.

4.1.2.8 Options 4a, b and c: Enhancements to bus services and/or park & ride. The A90 corridor already has a relatively high number of bus movements. In the evening peak hour there are approximately 12 buses heading for Fife or beyond, and a further 10 leaving the city centre to serve more local destinations on or adjacent to the corridor. The Ferrytoll park & ride site has been a huge success, and its recent expansion provides sufficient capacity at this time. We do not therefore foresee that improvements to bus services and/or park & ride would make substantial additional contribution to the transport planning objectives, at least not to a level where general traffic levels (and hence delays to buses) were reduced. Were bus services able to attract significantly more passengers than those presently operating, the commercial bus operators would undoubtedly step in to provide the additional capacity. As such, even if new services were required, no additional public investment in their provision can be justified at this time.

4.1.2.9 Option 5a: Changes to junction types. It could be feasible to change the junction form at one or more of the key intersections on the corridor from signals to a roundabout, grade separated junction or other type. However, at none of the intersections is a grade separated junction considered to be acceptable within the surrounding urban form (and may not be feasible without taking surrounding land; see rejected Option 1a above). Roundabouts or other priority junctions would provide significant disbenefits to pedestrians and limit the potential for the priority of particular vehicles to be controlled to meet objectives at all of the major junctions and traffic signals remain preferred at each location. At the Barnton junction, a double-roundabout layout was removed fairly recently, in part in order to enable management of traffic flow to provide inbound bus priority. Reinstatement of a roundabout at Barnton is therefore considered to conflict with objectives to improve

journey time reliability, reduce journey times and, possibly, improve road safety and is thus rejected from further consideration.

4.1.2.10 Option 5b: Banning turns at some junctions. Preventing traffic from turning at junctions can help to free capacity for through movements. This principle is already applied on the A90 corridor at the Clermiston Road and Davidson's Mains junctions. Consideration has been given to whether banning additional turns at these or other junctions could provide a capacity enhancement. Particular attention has focussed on the Drum Brae North junction, which is the most constrained junction for outbound traffic. Potentially, right turn traffic from Drum Brae North could be banned and the resulting spare capacity at least partially given to outbound traffic (banning traffic from turning right into Drum Brae North is not considered to be a viable option without reopening the right turn into Clermiston Road and, given this was prevented as part of the inbound bus priority scheme this is not considered a practicable option). However, this traffic from Drum Brae North would then need to take alternative routes. This would then load more traffic onto residential routes, particularly Drum Brae Drive. This is considered to present a road safety risk and is likely to be unacceptable to many local residents. There are therefore no banned turns that are considered to be appropriate for introduction on the corridor and this option is rejected from further consideration.

4.1.2.11 Option 6: Removal of bus priority measures. All of the existing bus priority measures on the corridor provide a contribution to the transport planning objectives of this study. Their removal would thus conflict with these objectives and this option is rejected.

4.1.3 Outcome of Option Sifting

From the above, therefore, just one potential generic option remains following the initial sift. This is Option 3; changes to traffic signals and/or bus priority measures at one or more of the major intersections. Some of the potential measures that could form part of this option are shown on Drawing No. A040878-T-10 in Appendix G. The Part 2 STAG assessment work will consider in detail measures throughout the corridor that should form part of a package of measures to make up this option.

5. CONCLUSIONS – STAG PART 1

5.1.1.1 Following the initial sift of options in section 4, just one remained for further development. This is Option 3; changes to traffic signals and/or bus priority measures at one or more of the major intersections.

6. DETAILED OPTION APPRAISAL – STAG PART 2

6.1 DESCRIPTION OF THE SCHEME

6.1.1 The elements of the scheme aim to improve bus journey times and reliability for out-bound buses, while not adversely affecting general traffic delays or in-bound bus journeys. Previously, the key areas of journey delay and variability had been outlined as:

- Quality Street to the A90 (affects 8 services);
- A90 Queensferry Road out-bound to Drum Brea North (affects 25 services);
- A90 Hillhouse Road out-bound to Blackhall (affects 24 services);
- A902 Telford Road out-bound to Blackhall (affects 5 services).

The scheme proposals target each area with highly effective and deliverable solutions.

6.1.2 Following data collection and LINSIG2 signal junction analysis, it was found the junction at Drum Brea North dictated out-bound throughput on the A90. The capacity summaries of the junctions are below. More detail can be found in Appendix B.

Table 6 – Capacity Analysis of Key A90 Junctions

Location	AM Peak PRC*	PM Peak PRC*	Cycle Time
Barnton junction	-3%	+2%	75s AM / 100s PM
Drum Brae	-11%	-10%	100s
Clermiston	+7%	+3%	112s
Quality Street	+2%	+18%	112s
Blackhall	+5%	+6%	100s

*PRC = Practical Reserve Capacity. 0% PRC = 90% ratio of flow to capacity.

6.1.3 A90 Queensferry Road / A902 Maybury Road (Barnton Junction) and Drum Brae North Options.

6.1.3.1 It can be seen from the data in Table 6 that Drum Brae North junction controls traffic through-put on the A90 in both traffic peaks. Results of around -10% mean the junction is operating at its theoretical maximum capacity. It may have been the case that Barnton junction used to have similarly poor performance as Drum Brae North prior to the opening of the M9 spur. This new road reduces the in-bound right turn at Barnton junction significantly, which increases available out-bound green and improves in-bound ahead saturation flows. 2 solutions were identified at this location:

- Change of junction type to a signalised roundabout with the right turn at the adjacent junction at Drum Brae North prohibited. Buses would still be allowed to turn right from Drum Brea North.
- Improve operation of Drum Brae North and Barnton Junction, without the need for major alteration to layout.

6.1.3.2 A large-scale signalised roundabout junction improvement was ruled out as no significant increase in capacity over the existing layout could be found. Additionally, it was thought that banning the right turn from Drum Brae North would force drivers onto unsuitable alternative local residential routes.

6.1.3.3 Currently, Barnton junction signals operate as 4 separate 'streams', i.e. as 4 separate junctions to form a single compound junction. This inevitably means that rigidly fixed coordination is the only option, with either UTC fixed time or CLF control (Urban Traffic Control (a traffic management computer usually operated by the Highway Authority) or Cableless Linking Facility (a facility within the controller) dictates predetermined fixed signal timings). Currently both Barnton junction and Drum Brae North are controlled by fixed time UTC plans.

6.1.3.4 As large-scale alterations to junction layout are not viable, the alternative is to improve existing junction configurations to allow SCOOT (Split / Cycle / Offset Optimisation Technique – a method of optimising signal timings over several junctions depending on traffic demands). In the shoulders of the PM peak it was observed that some delay was experienced on the out-bound approach to Drum Brae North due to uncoordinated signals, e.g. arriving at the back of a short queue and waiting at red for some time. This is because both Quality Street and Clermiston junctions operate under SCOOT control and link very well, whereas Drum Brae North and Barnton operate under fixed time UTC on different cycle times.

6.1.3.5 Drum Brea North junction can be modified to operate under SCOOT. Combining Barnton junction into a single stream is more complex, the controller model for Barnton junction is included in Appendix C. For purposes of comparison, the LINSIG2 model of the existing layout is also included in Appendix B. It should be noted that very short intergreens of 4 seconds are present in the current configuration. Experience has shown that 4s intergreens can lead to safety issues, therefore the combined model has no intergreens less that 5s, except when Right Turn Indicative Green Arrow (early cut-off) phases are appearing.

Table 7 – PRC Analysis of Barnton Junction – SCOOT Configuration

Location	AM Peak PRC*	PM Peak PRC*	Cycle Time
Barnton Junction	-8%	-4%	100s

6.1.4 A90 Queensferry Road / Clermiston Road North

6.1.4.1 One option that was considered in the options sifting stage was to provide a bus lane on the out-bound approach to Drum Brae North junction. Significant delay was observed for this section in the Stagecoach survey (queue relocation system fully operational), but queues were only back to the petrol station (approximately 350m) with the 2008 observations when the queue relocation system was operating under fixed-time control. Nevertheless, analysis has shown that even with the lesser delays, they are still significant.

6.1.4.2 Providing an out-bound bus lane from Clermiston Road North through to Drum Brae North may well be effective for public transport, however, this has been discounted because:

- Road widening to accommodate 5 standard-width lanes requiring removal of the North footway has already been discounted.

- Reduced-width lanes could be used in this section but would require the removal of several pedestrian refuges and 2 formal dual Pelican crossings. The provision of replacement straight-over crossings is not recommended due to reduced traffic coordination, reduced traffic capacity and impaired pedestrian and driver safety (please refer to DfT LTN 2/95 The Design of Pedestrian Crossings, section 5.2, 'Where the road is more than 15m wide a staggered layout should be provided. If road width is greater than 11m a staggered layout should be considered). It is likely that Mast-arm signals would have to be used to mitigate driver and pedestrian safety. This is unlikely to be popular and they

generally have large structural bases which would be difficult to accommodate in restricted width footways in an urban area.

- The queue to Drum Brae North can effectively be relocated to Clermiston Road North junction, which is a far more suitable location to have general traffic held.

6.1.4.3 It is proposed to provide an out-bound bus lane between Quality Street junction and Clermiston Road North. Please see Drg A040878-T-13 in Appendix G. The key points to note are:

- There was an average difference of 0.9 minutes (decimal minutes) between off-peak and peak hour out-bound journey times in the Clermiston Road North to Drum Brae North. This was observed in January 2008 with the queue relocation system running 'fixed time'. There was very little difference (0.11 mins) between peak and off-peak journey times between Quality Street and Clermiston Road North. These figures relate to all traffic although they are still be relevant for buses as they mix with general traffic along this section.
- The observed out-bound PM queue on the approach to Drum Brae North was, on average, approximately 350m long. The new length of bus lane (including left-turn lane) adjacent to the relocated queue would be approximately 500m long, i.e. the existing queue can be accommodated on the approach to Clermiston Road North where a bus lane is proposed.
- It is proposed to relocate the queue currently at Drum Brae North to the new bus lane between Clermiston Road North and Quality Street. This can be achieved by manipulating SCOOT parameters within CEC's UTC system. Additional detector loops will be required along the new bus lane.
- The current queue is on a section of the A90 with residential frontages. The proposed queue relocation section has only 9 properties adjacent to it and those are towards the Quality Street end, which would fill up last, if at all.
- There are no pedestrian refuges, pelican crossings or other obstructions in the proposed queue relocation section.
- The carriageway does narrow to 14.0m in places, especially near the Clermiston Road junction (land survey has been provided). Please see drawing A040878-T-13 for a diagram showing how the carriageway width could be allocated. 2.5m lanes may be required for lane 2 traffic in both directions, i.e. generally light goods vehicles and cars, while all other lanes could be 3.0m wide. Additional signing and a review of the speed limit in this section is recommended. The use of 2.5m lanes for PLG vehicles has been used in numerous urban locations (A38 Birmingham is a reasonably high profile example), is a permitted dimension in TD50/04 (Layout of Signal Controlled

Junctions), and similar dimensions have already been used locally at Drum Brae North junction.

- The proposed queue relocation reservoir allows some scope to absorb any excess traffic (i.e. more than was intended) released from upstream junctions, i.e. keep congestion away from areas where buses and cars are mixed.
- The bus lane would continue for 150m beyond Clermiston Road North junction. This would allow the existing lay-by on the exit to remain while buses that do not stop could proceed unhindered.

6.1.5 Quality Street approach to the A90

6.1.5.1 Drawing A040878-T-14 shows the proposed PM peak bus lane on Quality Street. Currently there is severe congestion on Quality Street back to the main street mini roundabout and along Main Street. This is largely due to restricted green time at the A90 junction. These short greens cause delays for buses but do allow the A90 to remain uncongested in the area, and also deter out-bound rat-running along Ferry Road. The important points to note are:

- The out-bound bus lane could run from the Main Street roundabout to shortly before the first stop line at the A90 junction.
- There seems to be adequate road width to allow 3 lanes, although it is likely that the North-bound cycle lane would have to be removed (how much this is currently used is unknown). A wide single lane should be sufficient.
- There is existing parking in this section. It is thought there is access to the rear of adjacent properties. There is very little or no requirement for on street parking for properties on the West side of Quality Street. The acceptability to residents of removal of parking for 2 hours per day is key and will require extensive consultation and further study.
- The bus lane could be for the evening traffic peak only, allowing parking at all other times of the day.
- Likely reductions in bus journey time would be 3.47 minutes per bus during the evening traffic peak, or approximately 2 cycles of the signals.
- Traffic capacity should not be affected as the Quality Street flare length remains the same in both layouts.
- If the BusTracker system is extended to the Quality Street corridor, there may be some scope to provide additional bus priority on Quality Street. This may be done by detecting late buses and giving additional green time to get them through the junction. The new queue relocation section on the A90 would offer a facility for absorbing occasionally larger platoons of traffic.

6.1.6 A90 Hillhouse Road / A902 Telford Road – Blackhall junction.

6.1.6.1 Buses were seen to experience significant delay on the A90 out-bound approach to Blackhall. The observation vehicle could not use bus lanes and therefore could not directly measure actual bus delay. Analysis of video footage showed buses being delayed by an average of 1.67 minutes (this value has been used to calculate benefits). Anecdotal evidence is that buses are sometimes delayed by up to 3 cycles of the signals, which could be as much as 5 minutes.

6.1.6.2 2 Options have been identified. Option 1 (drawing A040878-T-12) has the following features:

- The out-bound bus lane on Hillhouse Road would continue to the junction where buses would have a separate phase. This would mean buses would no longer have to merge in with general traffic before the main stop line. Buses would receive a green signal before general traffic, but would be in conflict with them, as there is only room for 2 exit lanes (how buses demands are serviced, e.g. hurry calls, is a matter for detailed design).
- The set back of the Telford Road bus lane would be moved 45m closer to the stop line, bringing buses within 1 green of the signals.
- The plan shows the left turn from Hillhouse Road to Strachen Road being prohibited. This would remove any potential conflict between left turning traffic and out-bound buses, especially if the signals failed. The number of vehicles making the manoeuvre is very low, 19 pcu in the morning peak hour and only 8 in the PM peak. The alternative route for local traffic would be via Columba Road or Columba Avenue, while the existing service 13 could divert via Groathill Avenue and Telford Road rather than using Hillhouse Road between Craigleith Retail Park and Blackhall.
- The in-bound right turn into Strachen Road would have to be separately signalled. Currently this traffic receives a full green and traffic turns right in gaps. Separately signalling the buses and general traffic on the out-bound approach would lead to confusion if these right turners were still allowed to turn in gaps. Although the accident records do not show any treatable trends, the additional control of traffic conflicts can only serve to improve driver and pedestrian safety.
- There is an opportunity to install formal pedestrian signals over the left turn from Telford Road.

- If required, there could be a possibility of providing formal pedestrian signals over Strachen Road, although these are not shown on the plan. It would depend on whether the left turn to Strachen Road was prohibited (the Strachen Road layout shown on drg A040878-T-16 could be used).
- Traffic turning right from Hillhouse Road into Telford Road would no longer have its own lane so would have to wait in the junction, out of the way of ahead traffic (a 15m bus can do this without affecting ahead traffic). The right turn flow is extremely low with 10 pcu during the morning peak hour and only 3 pcu in the evening peak hour.

6.1.6.3 Option 2 has the following features (drawing A040878-T-16):

- As with Option 1, out-bound buses on Hillhouse Road would be able to get all the way to the stop line without having to interact with general ahead traffic. The bus lane would terminate 40m short of the stop line, where the lane changes to combine left turners and buses. Signing would allow buses to go ahead from lane 1, with a short section of bus lane on the exit.
- The bus lane on Telford Road would be moved forward to be within a green at the main signals (as option 1).
- As with option 1, it is recommended the in-bound right turn to Strachen Road be signalised to avoid right turners having to choose gaps in 3 lanes of opposing traffic.
- Although the accident records do not show any treatable trends, the additional control of traffic conflicts can only serve to improve driver and pedestrian safety.
- A separately signalled right turn to Telford Road could be provided.
- Formal pedestrian facilities could be provided over Strachen Road. A new enlarged central island would allow pedestrians to cross over the approach when it is at red and across the exit when it is at green (U-Turn prohibition TRO required).
- It is less likely that prohibitions of traffic manoeuvres would be required, making option 2 scheme more deliverable.

6.1.6.4 Either option 1 or option 2 could be adopted. Generally, there would be less delay for buses with option 2 as buses get more green time, however, this would depend on how an option 1 layout was operated, i.e. hurry calling the bus stage with option 1 could provide minimal delay for buses but could serious disruption for general traffic.

6.1.6.5 The previously installed queue relocation system (comprising several queue detection loops connected to the City of Edinburgh Urban Traffic Control system) was found not to be operational. It is recommended that once the main measures are in place the queue relocation system should be reinstated with UTC plan timings and loop positions being reviewed. Consideration should also be given to operating Blackhall junction on SCOOT control with appropriate stage maximums derived from queue detection data.

6.1.6.6 Consideration should be given to robust queue detection systems by removing any wireless communications and replacing them with cables in ducts.

Table 8 – PRC Analysis of Options at Blackhall.

Location	AM Peak PRC*	PM Peak PRC*	Cycle Time
Option 1	-4%	-1%	100s
Option 2	+1%	+7%	100s

Full LINSIG2 analysis can be found in Appendix B.

6.1.7 A90 Queensferry Road / Craigleith Road Junction (A040878-T-15)

6.1.7.1 SEStran had requested that the above junction be looked at with respect to providing an out-bound bus lane. The capacity analysis summaries are shown below:

Table 9 – PRC Analysis of Craigleith junction – existing layout.

Location	AM Peak PRC*	PM Peak PRC*	Cycle Time
Craigleith Junction	+9%	+0%	104s

6.1.7.2 The out-bound ahead lanes are at 32% and 39% degree of saturation in the AM and PM peak respectively. Although the junction is shown to be operating near capacity, the out-bound link (excluding the right turn) is not congested at all. This means buses experience no or minimal delay.

Table 10 – PRC Analysis of Craigleith junction – bus lane layout.

Location	AM Peak PRC*	PM Peak PRC*	Cycle Time
Craigleith Junction	+9%	+0%	104s

6.1.7.3 If the near-side lane was converted to a bus lane (with a small set back for left turners to the petrol station and hotel) the out-bound capacity for general traffic would inevitably be reduced. The out-bound ahead lane degree of saturation would increase to 64% and 78% in the AM and PM peak respectively. These figures are significantly below practical maximum capacity. The average maximum queue for the out-bound ahead lane would be approximately 17 pcu, or 100m. The right turn lane to the superstore, Craigleith Road and South Groathill could be extended into the existing hatched area so this traffic would not need to interact with ahead traffic, i.e. have access to the right turn lane at a point upstream of the back of the ahead queue.

6.1.7.4 Essentially, this improvement will afford little improvement in journey time for buses, and maybe none at all. If traffic flows were to increase by more than 10% there may be a situation where ahead traffic in a single lane would block access by buses to their lane. Improved operational robustness for the future of the bus lane could be achieved by extending the bus lane further, requiring alterations to the pedestrian refuge near the junction with Craigleith Drive. Saying this, there may be other reasons to implement the bus lane, such as the visual impact on drivers, promoting modal shift, etc. Please refer to drawing A040878-T-15 in Appendix A for details. As this part of the scheme is very much 'optional', the costs and benefits have been excluded from the BCR calculation.

6.1.7.5 It is estimated that the cost of implementing the minimum scheme (as shown on the drawing in Appendix G) would be relatively small at approximately £20,000.

6.1.8 A90 Queensferry Road / Orchard Brae Junction

Table 11 – PRC Analysis of Orchard Brae junction – existing layout.

Location	AM Peak PRC*	PM Peak PRC*	Cycle Time
Orchard Brae	-5%	-2%	112s

6.1.8.1 It can be seen in the table above that the junction is saturated at peak times. However, LINSIG2 analysis shows that it is the in-bound direction that dictates capacity, while the out-bound direction is operating at around 15% below practical maximum, i.e. well within acceptable limits.

6.1.9 Potential further alterations for consideration at detailed design:

- Telford Road in-bound only really need to be a single lane until Groathill Road North junction. The in-bound off-side lane between Blackhall and Groathill Road North could be hatched out to shelter right turning traffic into Drylaw Avenue, Forthview Road, Drylaw Crescent and Drylaw Grove.
- There may be an opportunity to alter the Blackhall Option 2 layout slightly to give a small advanced start for out-bound buses. Reconfiguration of the right turn to Telford Road and possible extra widening to the north of the junction could afford enough space to allow a splitter island between left turning traffic / buses and out-bound ahead traffic, although any safety implications for pedestrians should be considered. The layout would need to be studied in more detail when land survey is available.
- The internal stopline at Blackhall (in-bound exit) in Option 2 may be able to be removed.
- The layout of the end of House O'Hill Avenue might need to be revised, depending on land ownership.
- The location of queue loops on Hillhouse Road and Telford Road will need to be reviewed. It may be appropriate to extend them further to the East.
- The exact number and location of queue loops on the new A90 bus lane will need to be considered.
- A queue relocation scheme could be considered at Crewe Toll roundabout to restrict traffic along the A902 Telford Road and along Ferry Road, Main Street and Quality Street.

6.2 ECONOMY - TEE

6.2.1 The TEE (Transport Economic Efficiency) study is based upon the typical lifetime of a signal installation, i.e. 20 years.

Table 11 – Summary of time savings by location.

Location	Number of services per hour	Time saving (decimal minutes)
Blackhall junction	24	2.95
Telford Road	5	1.67
Clermiston Road/ Drum Brae North	25	0.90
Quality Street	8	3.47

Note: No increase in journey time has been identified due to proposed speed limit reductions between Quality Street and Clermiston Road North as the actual difference will be very small (approximately 10s). Additionally, any reductions would have no relative value as JT reduction would apply to buses and cars alike.

6.2.2 The identified maintenance costs are estimated to be:

- Renewal of anti-skid and road markings: £30,000 /10 years.
- Increased maintenance cost of signals: £250/annum
- Increased maintenance of bus priority hardware: £500/annum

Note: There would be an increase in cost for maintenance of the signal equipment as there would be more of it to maintain, however, this could be offset by using LED technology to reduce electricity costs.

6.2.3 The estimated construction costs are as follows:

Blackhall (civils):	£	186,000
Blackhall (signals):	£	60,000
Blackhall (stats diversions provisional sum – 10%)	£	24,600
Quality Street:	£	46,000
Clermiston Road North:	£	133,000
Groathill Road North SCOOT loops and comms	£	15,000
Drum Brae North SCOOT loops and comms	£	15,000
Barnton SCOOT loops and comms	£	20,000
Expansion of Bustracker on side roads	£	25,000
Sub Total	£	524,600
Detailed designed fees estimate @ 10%	£	52,500
Contingency @ 10%	£	52,500
Optimism Bias @ 15%	£	78,700
Total estimated construction costs	**£**	**708,300**

6.2.4 The annual benefits have been estimated below. The calculation of Net Present Value costs and benefits can be seen in Appendix F.

Road safety improvement financial benefits:	£	0
Value of time savings	£	175,800
Total annual benefits	**£**	**175,800**

6.2.5 Year-on-year costs and benefits are shown in Appendix E. The Net Present Value costs are calculated as £763,323 and the NPV benefits as £2,669,335. Assumptions have been made such as all expenditure in year 1, no maintenance costs in year 1 and no benefits in year 1. ***Therefore, the calculated Cost / Benefit Ratio for the scheme has been calculated to be 3.5.***

6.3 ECONOMY - EALI

6.3.1 The proposals will have no significant or measurable effects upon overall economic activity or its location.

6.4 ENVIRONMENT

6.4.1 Noise and Vibration

6.4.1.1 A key feature of all the proposals is that they are capacity neutral for general traffic, i.e. bus priority is achieved without creating or reducing capacity. Therefore there is no scope for generating additional traffic on the A90, which could lead to a negative impact on noise and vibration levels. Any effect from traffic displaced on to alternative routes should also be insignificant.

6.4.1.2 None of the proposals involve any significant carriageway construction that would lead to increased noise or vibration levels in nearby properties.

6.4.1.3 There is a possibility that a minor positive impact could be achieved due to the following:

- reduced speed limit on the A90 between Blackhall and Barnton junctions
- Modal shift – i.e. increased bus usage

6.4.2 Air Quality

6.4.2.1 Again, as the proposals are designed to be capacity neutral, volumes of traffic, and therefore the levels of roadside pollutants, should not significantly change from existing.

6.4.2.2 Minor positive impacts on air quality could results from the following:

- Modal shift – i.e. increased bus usage
- Relocation of queues to less sensitive areas

6.4.3 Water Quality, Drainage and Flood Defence

None of the proposals include significant alteration to existing kerblines or areas of pavement, therefore any effect in this area should be insignificant.

6.4.4 Geology

There will be no significant affect on the geology of the study area.

6.4.5 Biodiversity and Habitats

None of the proposals involve significant alteration of the current highway layout; therefore any effect in this area should be insignificant.

6.4.6 Landscape

None of the proposals involve significant alteration of the current highway layout; therefore any effect in this area should be insignificant.

6.4.7 Visual Amenity

None of the proposals involve significant alteration of the current highway layout; therefore any effect in this area should be insignificant.

The proposals do contain some areas of additional bus lanes, which would be surfaced in a green colour and may therefore have a small visual impact.

6.4.8 Agriculture and Soils

None of the proposals involve significant alteration of the current highway layout; therefore any effect in this area should be insignificant.

6.4.9 Cultural Heritage

None of the proposals involve significant alteration of the current highway layout; therefore any effect in this area should be insignificant.

The section of the A90 from the City Centre to Orchard Brae does fall within the boundary of The World Heritage Site; however there are no proposals in this area.

6.5 INTERGRATION

6.5.1 Transport Integration

The preferred scheme will provide minor benefits to transport integration. These will arise by making public transport on the A90 corridor more attractive to users, including those interchanging from other services/modes. Additionally, minor benefits will arise through improved reliability of bus services, which is particularly important for those people needing to interchange during their journeys.

Further minor benefits will arise in the integration of private and public transport modes, as the attractiveness of the already-successful park & ride site at Ferrytoll will be increased.

6.5.2 Land-use transport integration

No significant impacts on land-use transport integration will occur, though there will be a minor contribution to Structure Plan objectives by enhancing the attractiveness of sustainable transport options to some of those locations identified for recent or future housing development from Edinburgh city centre.

6.5.3 Policy integration

The proposals will provide minor benefits to national, regional and local objectives to promote sustainable transport, promote social inclusion, improve the environment and reduce carbon emissions. No part of the proposals conflicts with any established policy.

6.6 ACCESSIBILITY

6.6.1 Community accessibility

The coverage of the public transport network is not directly affected by the proposals (depends on the layout adopted at Blackhall junction), however reduced journey times and improved reliability should promote confidence in its use. These benefits will occur to all those people wishing to use public transport along the corridor; between Edinburgh city centre, the residential areas adjacent to the corridor itself and beyond in Fife and further north.

6.6.2 Comparative accessibility

The largest benefits will accrue to those people that do not have access to a car, or choose not to use it for their journey. As such, older and younger people and those on the lowest incomes will gain most benefits. Benefits will mostly accrue to those people travelling at peak times. There would be slight disbenefit for cyclists travelling North-bound on Quality Street where that cycle lane would be removed. Loading would be allowed in 24 hour bus lanes during the off-peak periods.

6.7 RISKS

6.7.1 Technical risks

All parts of the proposals comprise fully-tested and commonly-used features. No technical risks exist.

6.7.2 Operational risks

Road infrastructure components of the package will require on-going maintenance, but not at a level that is significantly different from that of existing infrastructure.

Traffic control systems require on-going assessment for their effectiveness and rapid repair in the event of damage. Assessment will be provided by the City of Edinburgh Council's existing traffic control team and no significant increase in their workload is anticipated.

Repair of damaged/faulty equipment has sometimes been delayed previously, so the proposals have been developed specifically to maximise the use of robust, commonly-available technology with maximum reliability and ease of repair.

6.7.3 Financial risks

Maintenance liabilities for road infrastructure or for traffic control systems are not anticipated to be significantly different from those already in existence on the corridor. Therefore, if capital funding for scheme implementation can be identified, no financial risks are identified.

6.7.4 Public acceptability

The principle of provision of priority for buses is well established in Edinburgh, however public acceptability risks do arise with many proposals for new/extended schemes. Experience shows these risks arise most where the proposal affect the ability to park outside a property (residential or commercial).

Particular public acceptability concerns are anticipated for:

- The proposed bus lane on the southbound approach to the Quality Street junction, where frontage access will be affected during certain times of the day.
- The proposed bus lane to the Craigleith junction, given that there is little congestion for ahead traffic at this point in any normal traffic conditions.

It is recommended that frontages affected by any part of the proposals are consulted before their introduction.

7. SUMMARY

7.1 OPTIONS SIFTING

7.1.1 Data collection was completed along the A90 route with classified traffic counts at major intersections and journey time surveys along the study routes. Some previous data was available in the form of bus journey time surveys completed by Stagecoach.

7.1.2 Following analysis of the data, 11 broad options were identified, which was distilled to 3 main options:

1 Widening of the A90 to provide an out-bound bus lane between Clermiston Road North and Drum Brae North.

2 Changing the out-bound near-side lane between Blackhall junction and Drum Brae North to PM peak bus lane. Extension of the existing bus lanes on the approach to Blackhall.

3 Junction Improvement to Barnton junction and Drum Brae North by either major improvement to improve throughput, or by minor alterations to allow better coordinated control (SCOOT).

7.1.3 Options 1 and 2 was discounted, while option 3 was taken forward for further development.

7.2 THE PREFERRED OPTION

7.2.1 The preferred option was refined and comprised the following:

- A junction modification to the A90 Blackhall junction to allow out-bound buses to completely bypass queuing traffic that currently causes operational difficulties and significant delays. There are 2 options for the layout which can considered further at detailed design.
- Extension to the existing PM peak bus lane on Telford Road to the exit of the Groathill Road North junction, which could also be improved to have SCOOT control.
- A PM peak hour bus lane on Quality Street for the approach to the A90.

- Reallocation of road space to accommodate an out-bound bus lane from the exit of Quality Street junction, through and beyond the exit of Clermiston Road North.
- Minor (not layout) improvements to Barnton and Drum Brae North junctions to allow SCOOT control which gives adaptive green times and better coordination.

7.2.2 The previously installed queue relocation system (comprising several queue detection loops connected to the City of Edinburgh Urban Traffic Control system) was found not to be operational. It is recommended that once the main measures are in place, UTC plan timings, method of operation and loop positions are reviewed.

7.2.3 The scheme has been estimated to require an initial implementation budget of £708,300, and has been calculated to give a BCR of 3.5.

7.3 APPRAISAL SUMMARY TABLE

Part 2 Appraisal Summary Table

<table>
<tr><td colspan="4">Proposal Details</td></tr>
<tr><td colspan="2">Name and address of authority or organisation promoting the proposal:

(Also provide name of any subsidiary organisations also involved in promoting the proposal)</td><td colspan="2">SESTran
First Floor
Hopetoun Gate
8b McDonald Road
Edinburgh</td></tr>
<tr><td>Proposal Name:</td><td>A90 Outbound Bus Priority</td><td>Name of Planner:</td><td>Trond Haugen</td></tr>
<tr><td rowspan="3">Proposal Description:</td><td rowspan="3">Various transportation improvement measures aimed at improving bus journey times on the outbound A90</td><td rowspan="3">Total Public Sector Funding Requirement:</td><td>Construction cost £708,300</td></tr>
<tr><td>Annual revenue support – see 6.2</td></tr>
<tr><td>Present Value of Cost to Govt - see 6.2</td></tr>
<tr><td>Funding Sought From:
(if applicable)</td><td>TBA</td><td>Amount of Application:</td><td>TBA</td></tr>
<tr><td colspan="4">Background Information</td></tr>
<tr><td>Geographic Context:</td><td colspan="3">The A90 is a major corridor into Edinburgh City Centre from the Forth road bridge. It is in the built urban area.
The proposals can be summarised as:

• Extension of bus lanes and junction modification at Hillhouse Road/Telford Road (Blackhall junction)
• Provision of Bus Lane outbound between Quality Street and Clermiston Road
• Provision of outbound bus lane on Quality Street
• Junction modifications at Drum Brae North and Barnton junction</td></tr>
<tr><td>Social Context:</td><td colspan="3">It is thought unlikely that any adjacent areas suffer from problems of deprivation or social exclusion. Is not known if the area is within a European Structural Fund area, a Priority Partnership area or a Social Inclusion Partnership area.</td></tr>
<tr><td>Economic Context:</td><td colspan="3">The scheme is unlikely to affect the economic context of the area.</td></tr>
</table>

Planning Objectives	
Objective:	Performance against planning objective:
List each of the SMART Transport Planning Objectives in summary, together with their target. The key aims of the scheme are to reduce delays for buses in the following areas: Quality Street to the A90 A90 Queensferry Road outbound to Drum Brae North A90 Hillhouse Road outbound to Blackhall A902 Telford Road outbound to Blackhall	For each objective describe to what extent the proposal is expected to meet the objective. Provide quantitative information where available. Estimated bus journey time saving: 3.47 minutes 0.9 minutes 2.95 minutes 1.67 minutes
Rationale for Selection or Rejection of Proposal:	The proposal meets the project objectives and has been selected for consideration at part 2

Implementability Appraisal	
Technical:	From a technical standpoint the scheme is reasonably straightforward to install and does not use any innovative or unusual measures, with the possible exception of some narrow lane running between Quality Street junction and Clermiston Road North.
Operational:	There are no factors that might adversely affect the ability to operate the proposal over its projected life without major additional costs.
Financial:	It is assumed the capital costs of the scheme can be funded.
Public:	The proposal has not been made public. Considerable public consultation will be required for the Quality Street part time bus lane.

Environment			
Mitigation Options Included: (Costs & Benefits)	None		
Sub-criterion	**Qualitative Information**	**Quantitative Information**	**Significance of Impact**
Noise and Vibration	Minor benefits due to increase in bus use and reduction in bus delays	N/A	Minor +ve
Global Air Quality – CO_2	Minor benefits due to increase in bus use and reduction in bus emissions	TUBA suggests a benefit of £1K in 20 years	Minor +ve
Local Air Quality – PM_{10} and NO_2	Minor benefits due to increase in bus use and reduction in bus emissions	N/A	Minor +ve
Water Quality, Drainage and Flood Defence	No Impact as there is no significant new areas of footway or carriageway proposed	N/A	Neutral
Geology	No Impact	N/A	Neutral
Biodiversity	No Impact	N/A	Neutral
Visual Amenity	Minor disbenefit due to use of coloured surfacing	N/A	Minor -ve
Agriculture and Soils	No Impact	N/A	Neutral
Cultural Heritage	No Impact	N/A	Neutral
Landscape	No Impact	N/A	Neutral
Monetised summary	**£Nil**		
Monetary Impact Ratio	N/A		

Safety			
Sub-criterion	**Item**	**Qualitative Information**	**Quantitative Information**
Accidents	Change in Annual Personal Injury Accidents	Suggested schemes increase the control of conflicting traffic, however, there are no identifiable trends to address. Narrow lane running should be mitigated by a reduction in speed limit.	N/A
	Change in Balance of Severity	No impact	N/A
	Total Discounted Savings	N/A	N/A
Security		No impact	N/A
Monetised summary		**£Nil**	
Monetary Impact Ratio		**N/A**	

Economy (Transport Economic Efficiency)			
Sub-criterion	**Item**	**Qualitative Information**	**Quantitative Information**
User Benefits	Travel Time	Net Present Value of bus journey time savings over 20 years	£2,669,335
	User Charges	None	£Nil
	Vehicle Operating Costs	Reduced VOC's due to reduced fuel consumption from journey time savings	N/A
	Quality / Reliability Benefits	None	£Nil
Private Sector Operator Impacts	Investment Costs	None	£Nil
	Operating & Maintenance Costs	None	£Nil
	Revenues	None	£Nil
	Grant/Subsidy payments	None	£Nil
Monetised summary		£2,669,335	
Monetary Impact Ratio		= 3.5	

Economy (Wider Economic Benefits)			
Sub-criterion	Item	Qualitative information	Quantitative information
Wider Economic Benefits	Agglomeration economies (WB1)	No impact	£Nil
	Increased output in perfectly competitive markets (WB3)	No Impact	£Nil
	Wider benefits arising from improved labour supply (WB4)	No impact	£Nil
Monetised summary		£Nil	
Monetary Impact Ratio		= 3.5	

Economy (Economic Activity and Location Impacts)			
Sub-criterion	**Item**	**Qualitative Information**	**Quantitative Information**
Economic Activity and Location Impacts	Local Economic Impacts	No impact	N/A
	National Economic Impacts	No impact	N/A
	Distributional Impacts	No impact	N/A

Integration			
Sub-criterion	**Item**	**Qualitative Information**	**Quantitative Information**
Transport Interchanges	Services & Ticketing	No impact	N/A
	Infrastructure & Information	No impact	N/A
Land-use Transport Integration		No impact	
Policy Integration		No impact	

Accessibility & Social Inclusion			
Sub-criterion	**Item**	**Qualitative Information**	**Quantitative Information**
Community Accessibility	Public Transport Network Coverage	No impact	N/A
	Access to Other Local Services	No impact	N/A
Comparative Accessibility	Distribution/Spatial Impacts by Social Group	No impact	N/A
	Distribution/Spatial Impacts by Area	No impact	N/A

Strategic Environmental Assessment (SEA)		
Summary of SEA outcome where appropriate		
Cost to Public Sector		
Item	**Qualitative information**	**Quantitative information**
Public Sector Investment Costs	Quote costs in current prices, undiscounted. Only applicable to directly-provided public investment, e.g. most roads projects.	£708,300
Public Sector Operating & Maintenance Costs	NPV Costs over 20 year period	£763,324
Grant/Subsidy Payments	None	£Nil
Revenues	Indirect central government tax revenues	£Nil
Taxation impacts	None	£Nil

Monetised Summary	
Present Value of Transport Benefits	£2,669,335
Present Value of Cost to Government	£763,324
Net Present Value	£1,906,011
Benefit-Cost to Government Ratio	3.5
Benefit-Cost to Government Ratio (including WEBs)	3.5
Benefit-Cost to Funding Agency Ratio	3.5

Appendix A – Accident Data

Chart Key

- Bus
- Cyclist
- M.V.N.P.
- Pedestrian
- S.V.N.P.
- T.V.N.P.

Rowanfield Service (Special School)

Neighbourhood Centre

Surgery

Telford Arms (PH)

WESTER DRYLAW ROW

GROATHILL ROAD NORTH

TELFORD ROAD

GROATHILL GDNS WEST

GROATHILL GDNS EAST

GROATHILL AVENUE

CRAIGLEITH HILL AVENUE

A90 Bus Priority

Plan 11

N

Chart Key

- Bus
- Cyclist
- M.V.N.P.
- Pedestrian
- S.V.N.P.
- T.V.N.P.

GROATHILL GDNS EAST

GROATHILL GDNS WEST

GROATHILL ROAD SOUTH

GROATHILL AVENUE

CRAIGLEITH HILL AVENUE

Craigleith Retail Park

Craigleith Retail Park

Tank

EI Sub Sta

EI Sub Sta

EI Sub Sta

Queen's Court

MAIDENCRAIG CRESCENT

MAIDENCRAIG GROVE

SOUTH GROATHILL AVENUE

A90 Bus Priority

Plan 10

N

Chart Key

- Bus
- Cyclist
- M.V.N.P.
- Pedestrian
- S.V.N.P.
- T.V.N.P.

QUEENSFERRY ROAD

SOUTH GROATHILL AVENUE

SOUTH GROATHILL AVENUE

Maidencraig Court

Maidencraig Court

Superstore

Superstore

Gas Gov

130 to 140

124 to 128

118 to 122

116

185

183

173

161

159

157

149 to 155

145

147

Subway

Hotel

Hotel

Railway

BLANKENNY GROVE WEST

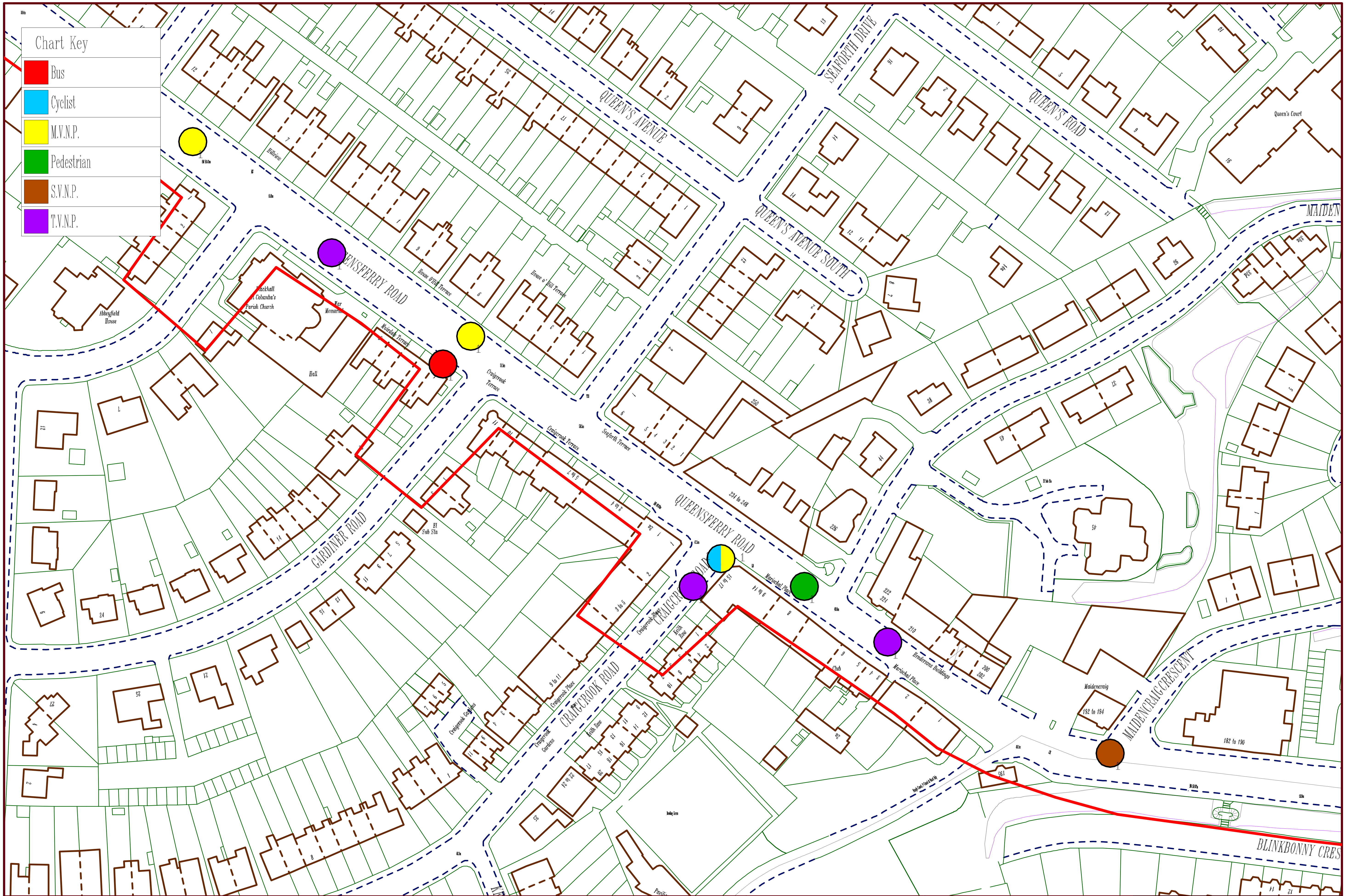
CRAIGLEITH GROVE

QUEENSFERRY

A90 Bus Priority

Plan 9

N



A90 Bus Priority

Plan 8

Chart Key

- Bus
- Cyclist
- M.V.N.P.
- Pedestrian
- S.V.N.P.
- T.V.N.P.

DRYLAW CRESCENT

DRYLAW GROVE

DRYLAW GREEN

TELFORD ROAD

Whitehall Court

Garage

HILLHOUSE ROAD

COLUMBA AVENUE

FORTHVIEW TERRACE

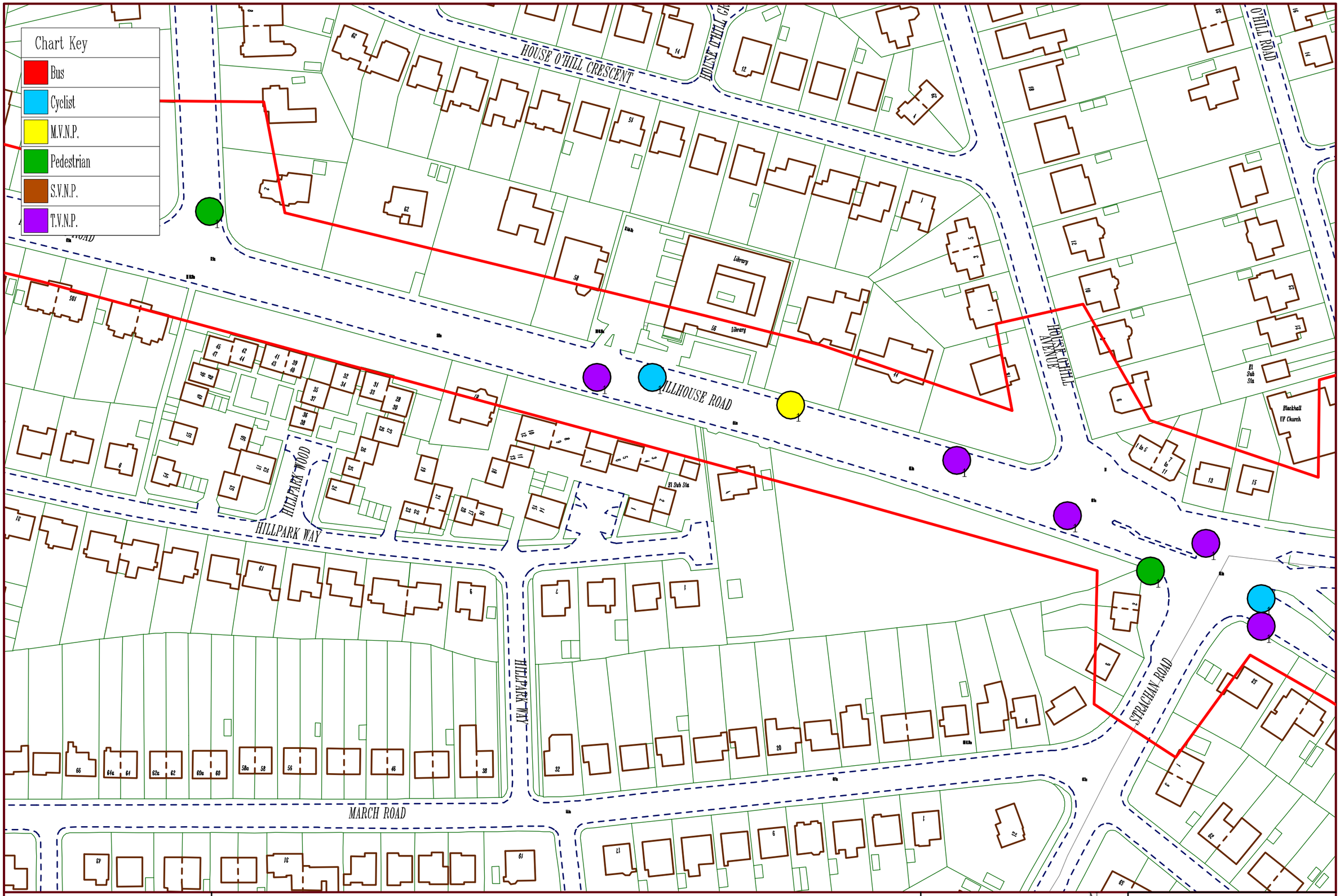
QUEEN'S AVENUE

FORTHVIEW ROAD

A90 Bus Priority

Plan 7

N



A90 Bus Priority

Plan 6

N

Chart Key

- Bus
- Cyclist
- M.V.N.P.
- Pedestrian
- S.V.N.P.
- T.V.N.P.

QUALITY STREET JUNCTION

QUEENSFERRY ROAD

MARCHFIELD PARADE

HILLHOUSE ROAD

MARCHFIELD PARK

CRAIGCROOK ROAD

HILLPARK AVENUE

HILLPARK DRIVE

HILLPARK COURT

HILLPARK CRESCENT

Davidson's Mains Parish Church

Davidson's Mains Primary School

Hall

Hall

Telephone Exchange

A90 Bus Priority

Plan 5

N

Chart Key

- Bus
- Cyclist
- M.V.N.P.
- Pedestrian
- S.V.N.P.
- T.V.N.P.

QUEENSFERRY ROAD

CLERMISTON ROAD NORTH

CLERMISTON HILL

Tanks

BT Sub Sta

Depot

Shelter

BT Sub Sta

60P

A90 Bus Priority

Plan 4

N

Chart Key

- Bus
- Cyclist
- M.V.N.P.
- Pedestrian
- S.V.N.P.
- T.V.N.P.

QUEENSFERRY ROAD

Shelter

Shelter

QUEENSFERRY ROAD

CLERMISTON AVENUE

Clermiston Primary School

Community Centre

Clermiston Primary School

PARKGROVE STREET

PARKGROVE PLACE

PO

Surgery

CLERMISTON LOAN

CLERMISTON GREEN

BT Sub Sta

A90 Bus Priority

Plan 3

N

Chart Key

- Bus
- Cyclist
- M.V.N.P.
- Pedestrian
- S.V.N.P.
- T.V.N.P.

BARNTON PARK CRESCENT

BARNTON PARK DRIVE

BARNTON PARK VIEW

QUEENSFERRY ROAD

PARKGROVE DRIVE

PARKGROVE AVENUE

PARKGROVE ROAD

Shelter

Garage

EI Sub Sta

A90 Bus Priority

Plan 2

N

Chart Key

- Bus
- Cyclist
- M.V.N.P.
- Pedestrian
- S.V.N.P.
- T.V.N.P.

BARNTON GROVE

BARNTON JUNCTION

QUEENSFERRY ROAD

WESTHOUSE ROAD

MAYBURY ROAD

CAMMO GARDENS

PINEGROVE GARDENS

Cammo Crescent

Barnton Hotel

Barnton Court

Bank

Shelter

A90 Bus Priority

Plan 1

N

Appendix B – Capacity Analysis Summaries

Basic Results Summary

User and Project Details

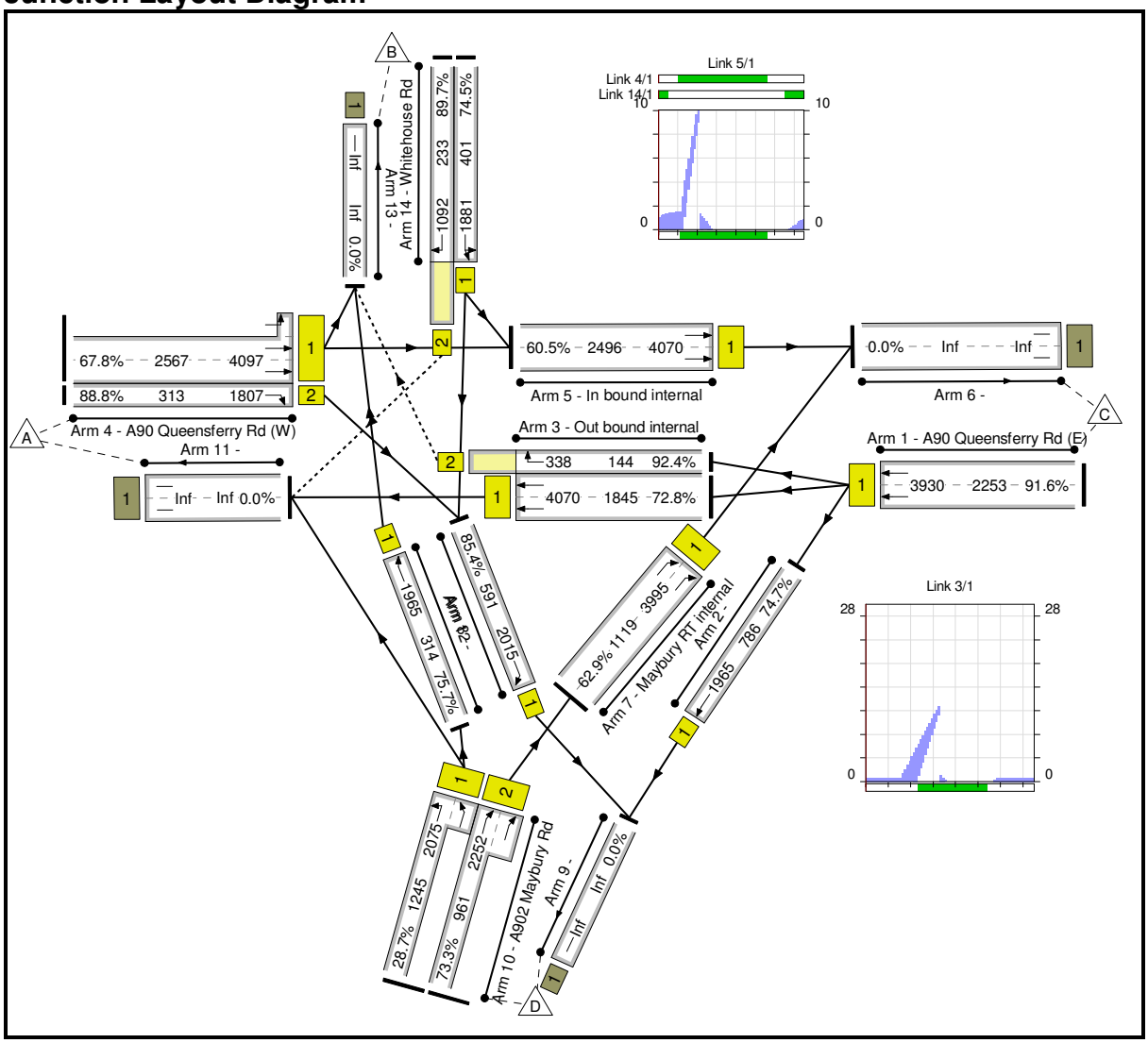
Project:	**A90 Out-bound Bus Priority Study**
Title:	**Capacity Analysis of Existing Layout**
Location:	A90 Queensferry Road / A902 Maybury Road, Edinburgh.
File name:	Barnton existing.lsgx
Author:	R Bishop
Company:	White Young Green
Address:	Avalon Way, Anstey, Leicestershire LE7 7GR
Controller:	Siemens
SCN:	446
Notes:	

Scenario 1: 'AM Peak'

Staging Plan 1: 'Staging Plan No. 1'

Flow Group 1: 'AM Peak 2008'

Junction Layout Diagram



Basic Results Summary

Link Results

Link Num	Link Desc	Link Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Max Sat Flow (pcu/Hr)	Ave Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per Veh (s/pcu)	Mean Max Queue (pcu)
1/1	A90 Queensferry Rd (E) Left Ahead	U	S		1	42	-	2063	3930	3930	2253	91.6	-	-	-	13.4	23.3	43.5
2/1	Ahead	U	N		1	29	-	587	1965	1965	786	74.7	-	-	-	2.3	14.0	10.2
3/1	Out bound internal Ahead	U	D		1	31	-	1343	4070	4070	1845	72.8	-	-	-	1.2	3.1	12.8
3/2	Out bound internal Right	O	D		1	31	-	133	1828	338	144	92.4	0	24	109	4.5	121.4	4.5
4/1	A90 Queensferry Rd (W) Ahead Left	U	A		1	46	-	1740	5771	4097	2567	67.8	-	-	-	5.2	10.8	23.8
4/2	A90 Queensferry Rd (W) Right	U	B		1	12	-	278	1807	1807	313	88.8	-	-	-	5.7	73.3	9.0
5/1	In bound internal Ahead	U	R		1	45	-	1511	4070	4070	2496	60.5	-	-	-	0.6	1.5	10.6
7/1	Maybury RT internal Right	U	Q		1	20	-	704	3995	3995	1119	62.9	-	-	-	6.2	31.6	15.5
8/1	Right	U	K		1	21	-	505	2015	2015	591	85.4	-	-	-	0.7	4.8	4.8
10/1	A902 Maybury Rd Left Ahead	U	L		1	44	-	357	3830	2075	1245	28.7	-	-	-	0.9	8.6	3.5
10/2	A902 Maybury Rd Ahead	U	M		1	31	-	704	3970	2252	961	73.3	-	-	-	4.5	22.8	12.9

Basic Results Summary

12/1	Ahead	U	H		1	11	-	238	1965	1965	314	75.7	-	-	-	3.1	46.2	6.2
14/1	Whitehouse Rd Left Ahead	U	F		1	15	-	299	1881	1881	401	74.5	-	-	-	3.7	44.7	7.2
14/2	Whitehouse Rd Right	O	F	G	1	15	5	209	1820	1092	233	89.7	47	73	89	5.4	93.1	7.2

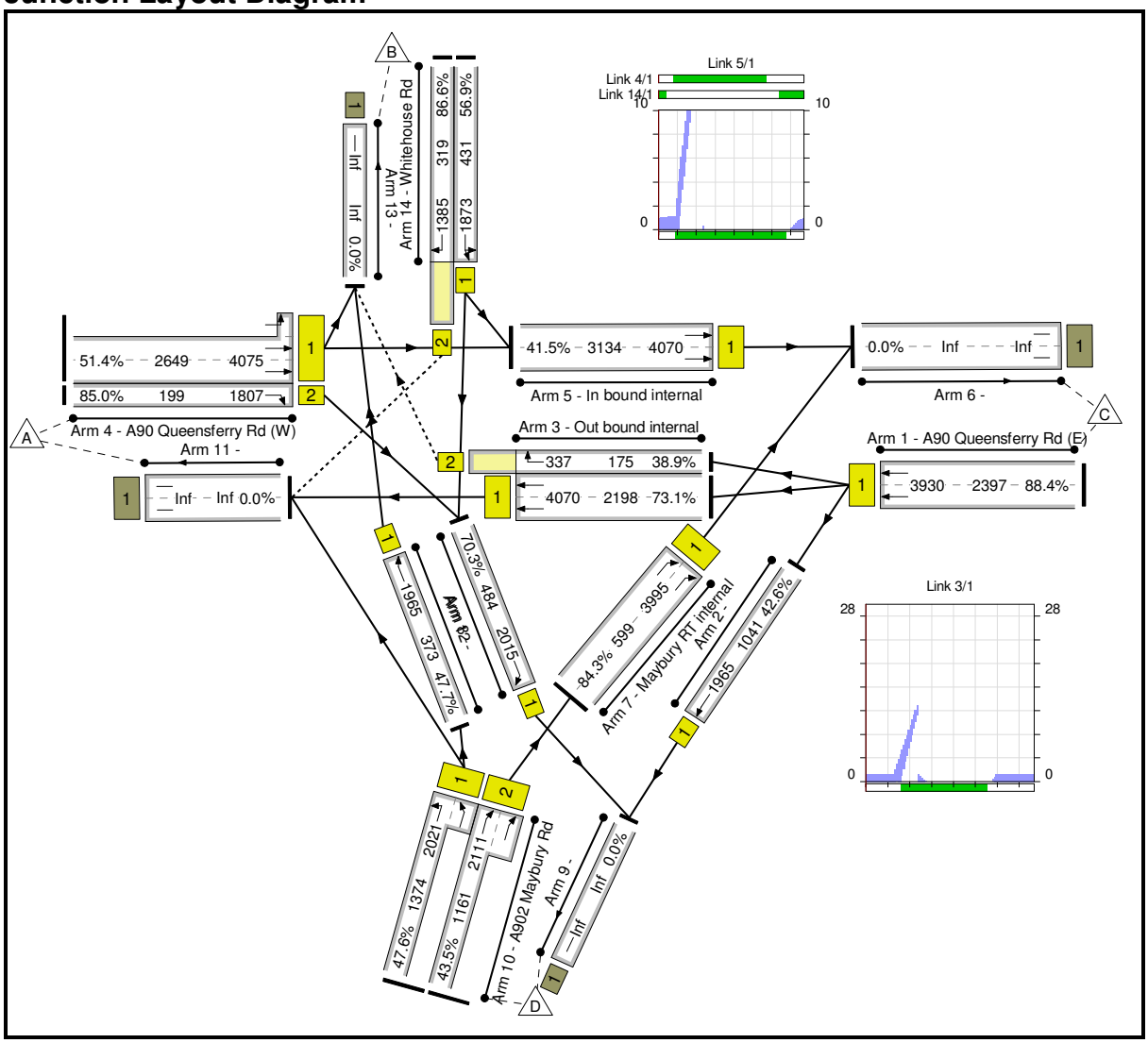
Stream: 1	PRC for Signalled Links (%):	-2.6	Total Delay for Signalled Links (pcuHr):	28.71	
Stream: 2	PRC for Signalled Links (%):	-1.7	Total Delay for Signalled Links (pcuHr):	20.19	
Stream: 3	PRC for Signalled Links (%):	5.3	Total Delay for Signalled Links (pcuHr):	8.27	
	PRC Over All Links (%):	-2.6	Total Delay Over All Links(pcuHr):	57.16	Cycle Time (s): 75

Scenario 2: 'PM Peak'

Staging Plan 1: 'Staging Plan No. 1'

Flow Group 2: 'Pm Peak 2008'

Junction Layout Diagram



Link Results

Link Num	Link Desc	Link Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Max Sat Flow (pcu/Hr)	Ave Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per Veh (s/pcu)	Mean Max Queue (pcu)
1/1	A90 Queensferry Rd (E) Left Ahead	U	S		1	60	-	2119	3930	3930	2397	88.4	-	-	-	13.4	22.8	53.2
2/1	Ahead	U	N		1	52	-	444	1965	1965	1041	42.6	-	-	-	0.6	4.5	3.9
3/1	Out bound internal Ahead	U	D		1	51	-	1607	4070	4070	2198	73.1	-	-	-	1.0	2.3	12.9
3/2	Out bound internal Right	O	D		1	51	-	68	1828	337	175	38.9	49	17	2	0.6	29.2	0.6
4/1	A90 Queensferry Rd (W) Ahead Left	U	A		1	64	-	1362	5771	4075	2649	51.4	-	-	-	3.9	10.2	19.8
4/2	A90 Queensferry Rd (W) Right	U	B		1	10	-	169	1807	1807	199	85.0	-	-	-	4.5	95.7	7.0
5/1	In bound internal Ahead	U	R		1	76	-	1301	4070	4070	3134	41.5	-	-	-	0.7	2.0	19.2
7/1	Maybury RT internal Right	U	Q		1	14	-	505	3995	3995	599	84.3	-	-	-	10.1	71.7	16.6
8/1	Right	U	K		1	23	-	340	2015	2015	484	70.3	-	-	-	0.6	6.5	4.8
10/1	A902 Maybury Rd Left Ahead	U	L		1	67	-	654	3830	2021	1374	47.6	-	-	-	1.6	9.0	8.1
10/2	A902 Maybury Rd Ahead	U	M		1	54	-	505	3970	2111	1161	43.5	-	-	-	2.0	14.4	7.8

Basic Results Summary

12/1	Ahead	U	H		1	18	-	178	1965	1965	373	47.7	-	-	-	1.9	39.3	4.9
14/1	Whitehouse Rd Left Ahead	U	F		1	22	-	245	1873	1873	431	56.9	-	-	-	3.0	43.7	6.6
14/2	Whitehouse Rd Right	O	F	G	1	22	5	276	1820	1385	319	86.6	136	55	86	6.3	81.6	10.3

Stream: 1	PRC for Signalled Links (%):	3.9	Total Delay for Signalled Links (pcuHr):	21.11	
Stream: 2	PRC for Signalled Links (%):	1.8	Total Delay for Signalled Links (pcuHr):	24.22	
Stream: 3	PRC for Signalled Links (%):	28.0	Total Delay for Signalled Links (pcuHr):	4.82	
	PRC Over All Links (%):	1.8	Total Delay Over All Links(pcuHr):	50.15	Cycle Time (s): 100

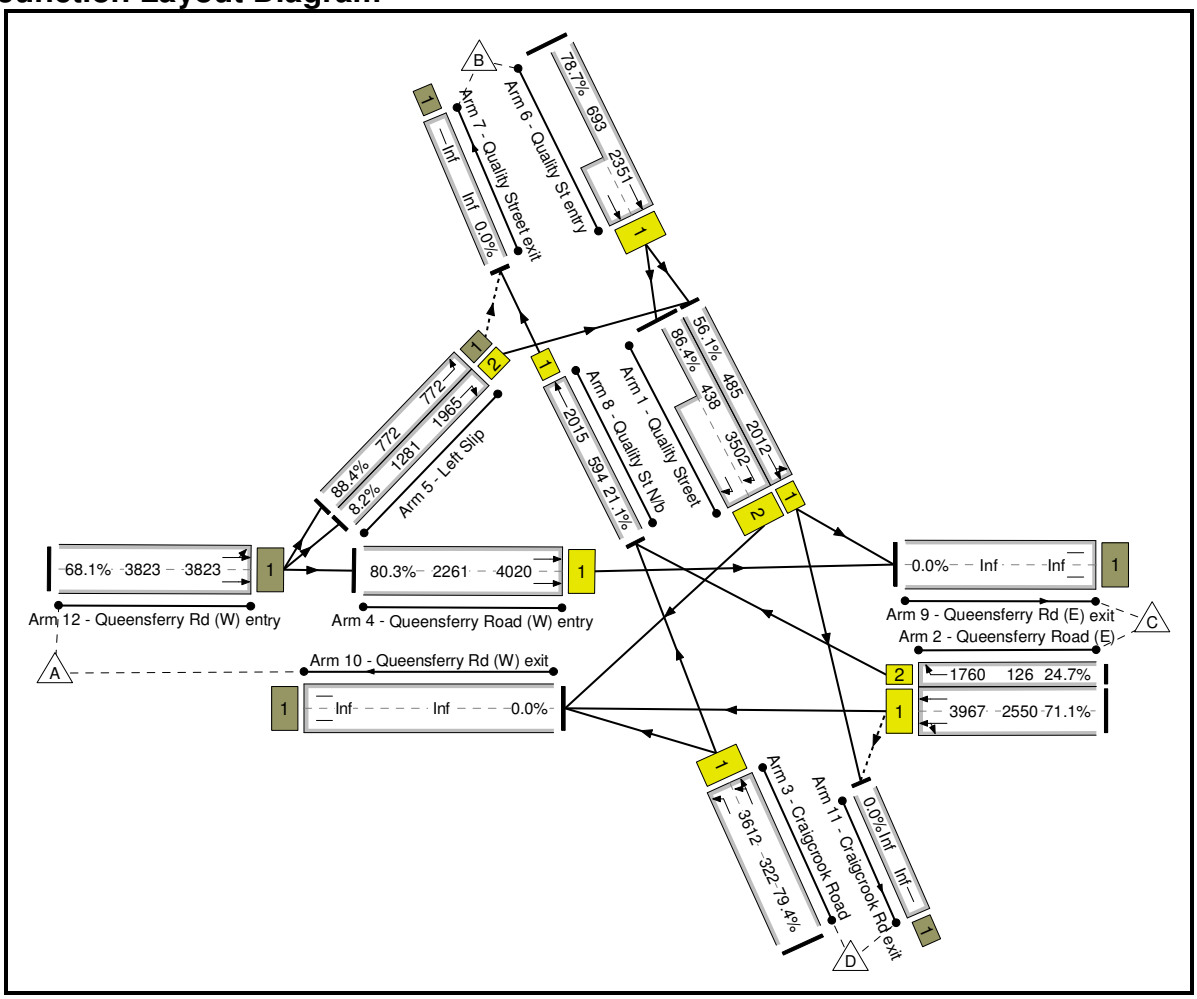
Basic Results Summary

User and Project Details

Project:	**A90 Outbound Bus Prioirity Study**
Title:	**Existing Capacity Analysis**
Location:	A90 / Quality Street
File name:	Quality Street_rb v2.lsgx
Author:	Steve Holder
Company:	White Young Green
Address:	Leicester
Controller:	Generic
SCN:	
Notes:	

Scenario 1: 'Scenario 1'
Staging Plan 1: 'Staging Plan No. 1'
Flow Group 1: 'AM Peak Count (PCU's)'

Junction Layout Diagram



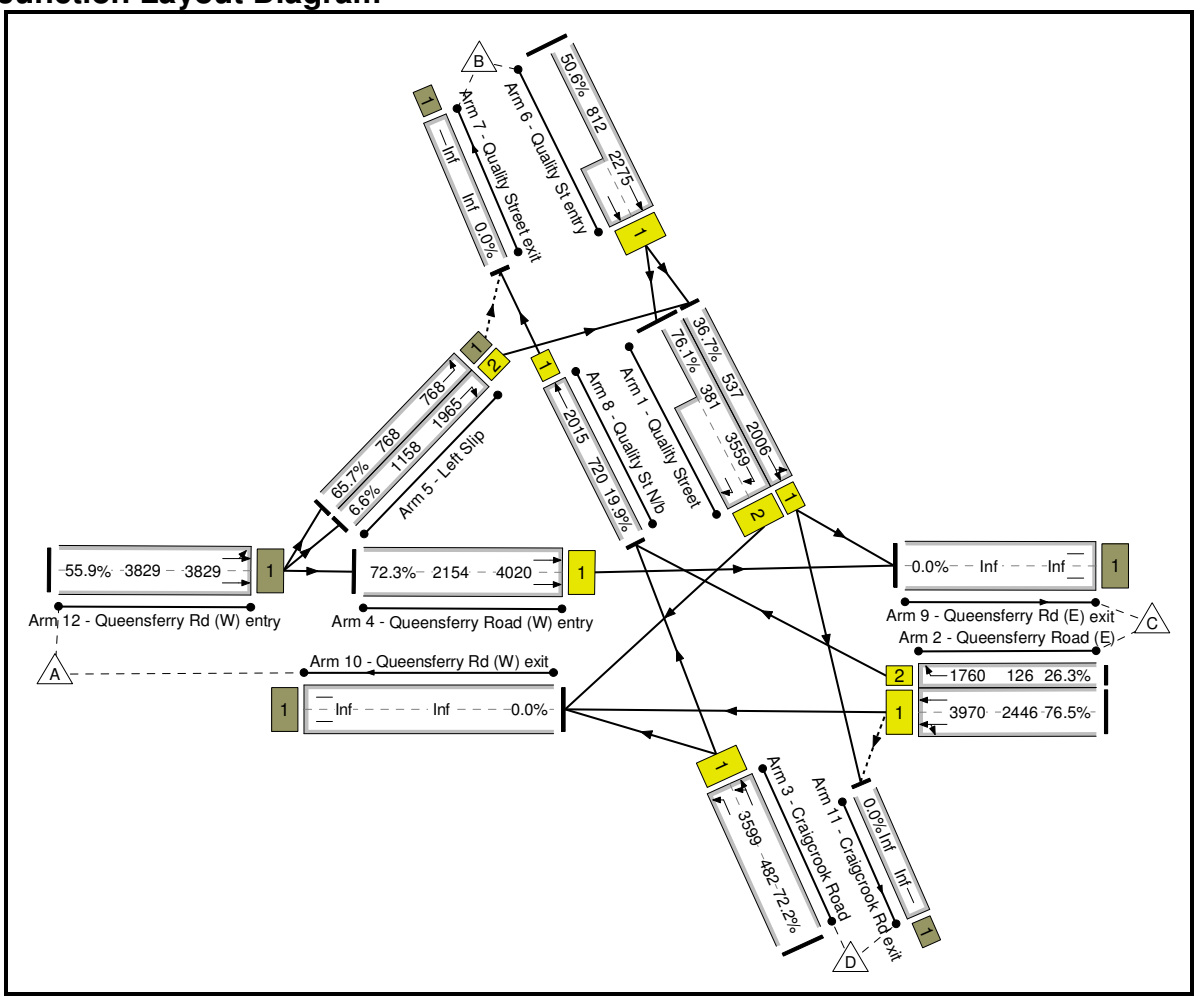
Link Results

Link Num	Link Desc	Link Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Max Sat Flow (pcu/Hr)	Ave Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per Veh (s/pcu)	Mean Max Queue (pcu)
1/1	Quality Street Left Ahead	U	E		1	26	-	272	2012	2012	485	56.1	-	-	-	1.9	24.9	6.5
1/2	Quality Street Right	U	H		1	13	-	378	3559	3502	438	86.4	-	-	-	1.5	14.3	11.4
2/1	Queensferry Road (E) Ahead Left	O	B		1	71	-	1814	3967	3967	2550	71.1	0	9	0	7.9	15.6	38.0
2/2	Queensferry Road (E) Right	U	D		1	7	-	31	1760	1760	126	24.7	-	-	-	0.6	68.1	1.1
3/1	Craigcrook Road Ahead Left	U	F		1	9	-	256	3612	3612	322	79.4	-	-	-	5.4	75.7	9.6
4/1	Queensferry Road (W) entry Ahead	U	A		1	62	-	1815	4020	4020	2261	80.3	-	-	-	11.9	23.5	46.9
5/1	Left Slip Left	O	-		-	-	-	683	1932	772	772	88.4	683	0	0	3.6	19.0	8.5
5/2	Left Slip Right	U	K		1	72	-	105	1965	1965	1281	8.2	-	-	-	0.3	8.7	1.2
6/1	Quality St entry Ahead	U	I		1	32	-	545	3830	2351	693	78.7	-	-	-	6.9	45.6	16.8
8/1	Quality St N/b Ahead	U	J		1	32	-	125	2015	2015	594	21.1	-	-	-	0.2	5.3	1.3
12/1	Queensferry Rd (W) entry Ahead Left	U	-		-	-	-	2603	3823	3823	3823	68.1	-	-	-	1.1	1.5	1.1

Stream: 1 PRC for Signalled Links (%): 4.2 Total Delay for Signalled Links (pcuHr): 29.08
Stream: 2 PRC for Signalled Links (%): 14.4 Total Delay for Signalled Links (pcuHr): 7.34
PRC Over All Links (%): 1.8 Total Delay Over All Links(pcuHr): 41.09 Cycle Time (s): 112

Scenario 2: 'Scenario 2'
Staging Plan 1: 'Staging Plan No. 1'
Flow Group 2: 'PM Peak Count (PCU's)'

Junction Layout Diagram



Link Results

Link Num	Link Desc	Link Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Max Sat Flow (pcu/Hr)	Ave Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per Veh (s/pcu)	Mean Max Queue (pcu)
1/1	Quality Street Left Ahead	U	E		1	29	-	197	2006	2006	537	36.7	-	-	-	1.3	24.5	4.5
1/2	Quality Street Right	U	H		1	11	-	290	3559	3559	381	76.1	-	-	-	1.8	22.6	8.7
2/1	Queensferry Road (E) Ahead Left	O	B		1	68	-	1870	3970	3970	2446	76.5	0	1	0	9.7	18.7	43.7
2/2	Queensferry Road (E) Right	U	D		1	7	-	33	1760	1760	126	26.3	-	-	-	0.6	68.6	1.1
3/1	Craigcrook Road Ahead Left	U	F		1	14	-	348	3599	3599	482	72.2	-	-	-	5.8	59.7	11.6
4/1	Queensferry Road (W) entry Ahead	U	A		1	59	-	1558	4020	4020	2154	72.3	-	-	-	9.8	22.7	37.7
5/1	Left Slip Left	O	-		-	-	-	505	1932	768	768	65.7	505	0	0	1.0	6.8	2.5
5/2	Left Slip Right	U	K		1	65	-	76	1965	1965	1158	6.6	-	-	-	0.2	11.5	1.0
6/1	Quality St entry Ahead	U	I		1	39	-	411	3830	2275	812	50.6	-	-	-	3.5	30.5	9.9
8/1	Quality St N/b Ahead	U	J		1	39	-	143	2015	2015	720	19.9	-	-	-	0.2	4.9	1.9
12/1	Queensferry Rd (W) entry Ahead Left	U	-		-	-	-	2139	3829	3829	3829	55.9	-	-	-	0.6	1.1	0.6

Stream: 1	PRC for Signalled Links (%):	17.7	Total Delay for Signalled Links (pcuHr):	29.12
Stream: 2	PRC for Signalled Links (%):	77.9	Total Delay for Signalled Links (pcuHr):	3.91
	PRC Over All Links (%):	17.7	Total Delay Over All Links(pcuHr):	34.62

Cycle Time (s): 112

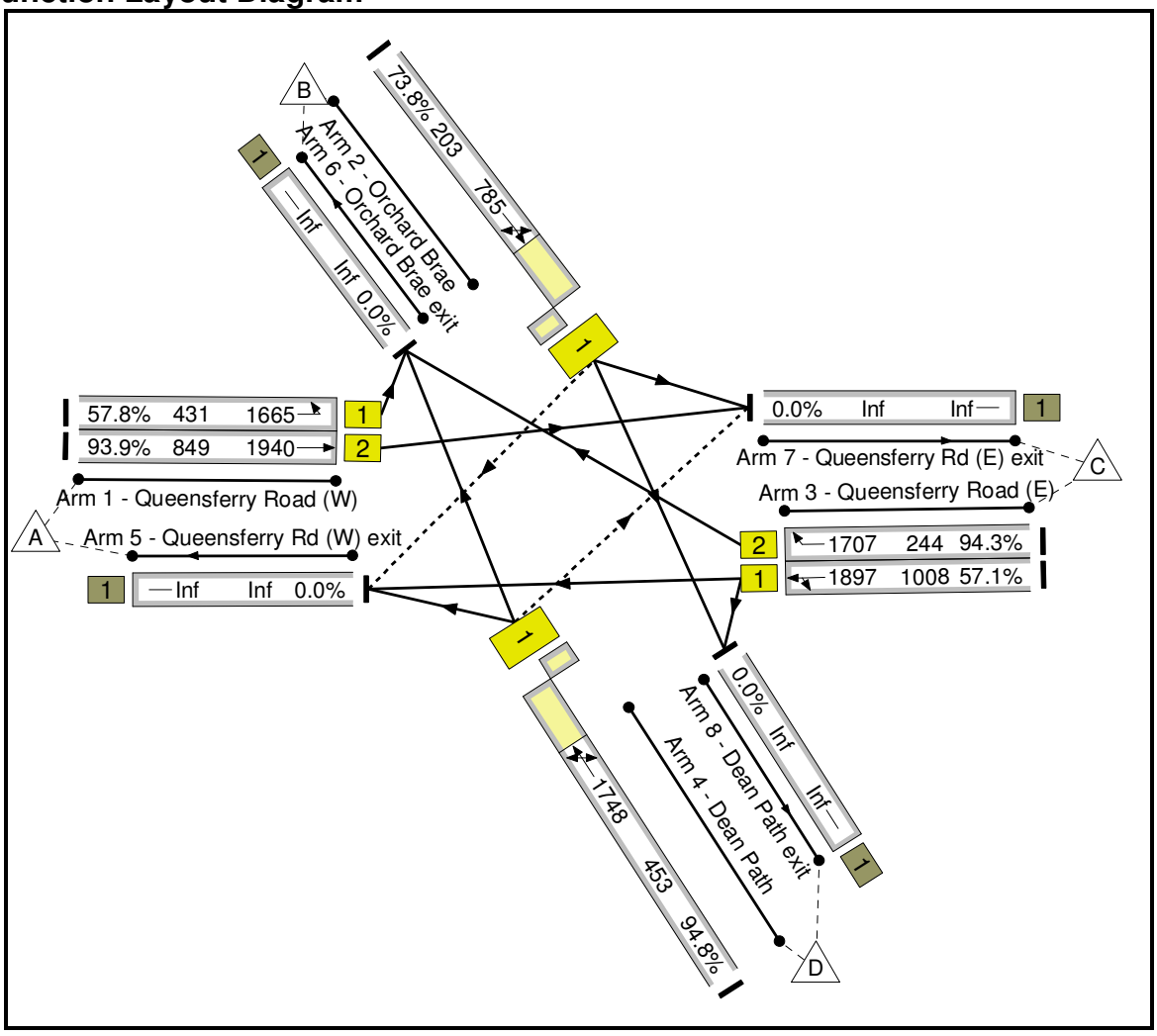
Basic Results Summary

User and Project Details

Project:	**A90 Outbound Bus Priority Study**
Title:	**Capacity analysis of existing layout**
Location:	A90 / Orchard Brae
File name:	Queensferry Rd Orchard Brae_v2_rb.lsgx
Author:	Steve Holder
Company:	White Young Green
Address:	Leicester
Controller:	Generic
SCN:	
Notes:	

Scenario 1: 'Scenario 1'
Staging Plan 1: 'Staging Plan No. 1'
Flow Group 1: 'AM Peak Count (PCU's)'

Junction Layout Diagram



Basic Results Summary

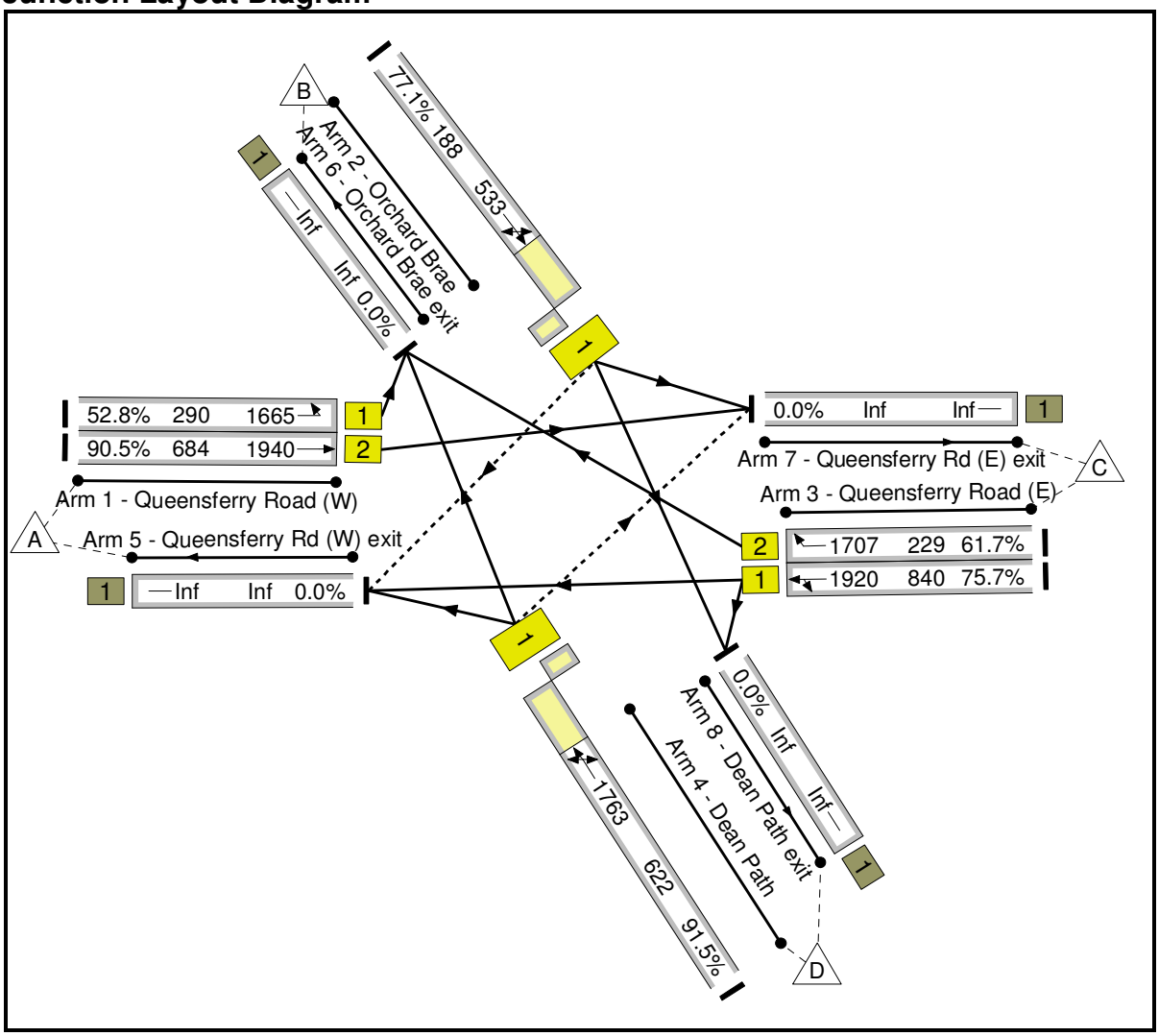
Link Results

Link Num	Link Desc	Link Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Max Sat Flow (pcu/Hr)	Ave Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per Veh (s/pcu)	Mean Max Queue (pcu)
1/1	Queensferry Road (W) Left	U	A		2	56	-	249	1665	1665	431	57.8	-	-	-	3.2	46.0	7.7
1/2	Queensferry Road (W) Ahead	U	A	L	2	96	40	797	1940	1940	849	93.9	-	-	-	12.9	58.2	31.0
2/1	Orchard Brae Right Left Ahead	O	D		2	56	-	150	1816	785	203	73.8	6	0	48	3.0	72.6	5.2
3/1	Queensferry Road (E) Ahead Left	U	B		2	117	-	575	1897	1897	1008	57.1	-	-	-	3.5	22.2	14.4
3/2	Queensferry Road (E) Right	U	C		2	30	-	230	1707	1707	244	94.3	-	-	-	7.9	123.8	11.9
4/1	Dean Path Left Ahead Right	O	E		2	56	-	429	1748	1748	453	94.8	105	0	6	10.9	91.5	19.5

Stream: 1 PRC for Signalled Links (%): -5.3 Total Delay for Signalled Links (pcuHr): 41.45
PRC Over All Links (%): -5.3 Total Delay Over All Links(pcuHr): 41.45 Cycle Time (s): 224

Scenario 2: 'Scenario 2'
Staging Plan 1: 'Staging Plan No. 1'
Flow Group 2: 'PM Peak Count (PCU's)'

Junction Layout Diagram



Basic Results Summary

Link Results

Link Num	Link Desc	Link Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Max Sat Flow (pcu/Hr)	Ave Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per Veh (s/pcu)	Mean Max Queue (pcu)
1/1	Queensferry Road (W) Left	U	A		2	37	-	153	1665	1665	290	52.8	-	-	-	2.3	55.3	5.1
1/2	Queensferry Road (W) Ahead	U	A	L	2	77	40	619	1940	1940	684	90.5	-	-	-	10.2	59.1	23.8
2/1	Orchard Brae Right Left Ahead	O	D		2	77	-	145	1808	533	188	77.1	26	0	35	3.0	75.5	4.7
3/1	Queensferry Road (E) Ahead Left	U	B		2	96	-	636	1920	1920	840	75.7	-	-	-	6.2	35.3	19.2
3/2	Queensferry Road (E) Right	U	C		2	28	-	141	1707	1707	229	61.7	-	-	-	2.6	66.1	5.1
4/1	Dean Path Left Ahead Right	O	E		2	77	-	569	1763	1763	622	91.5	122	0	7	10.1	64.0	21.8

Stream: 1 PRC for Signalled Links (%): -1.7 Total Delay for Signalled Links (pcuHr): 34.50
PRC Over All Links (%): -1.7 Total Delay Over All Links(pcuHr): 34.50 Cycle Time (s): 224

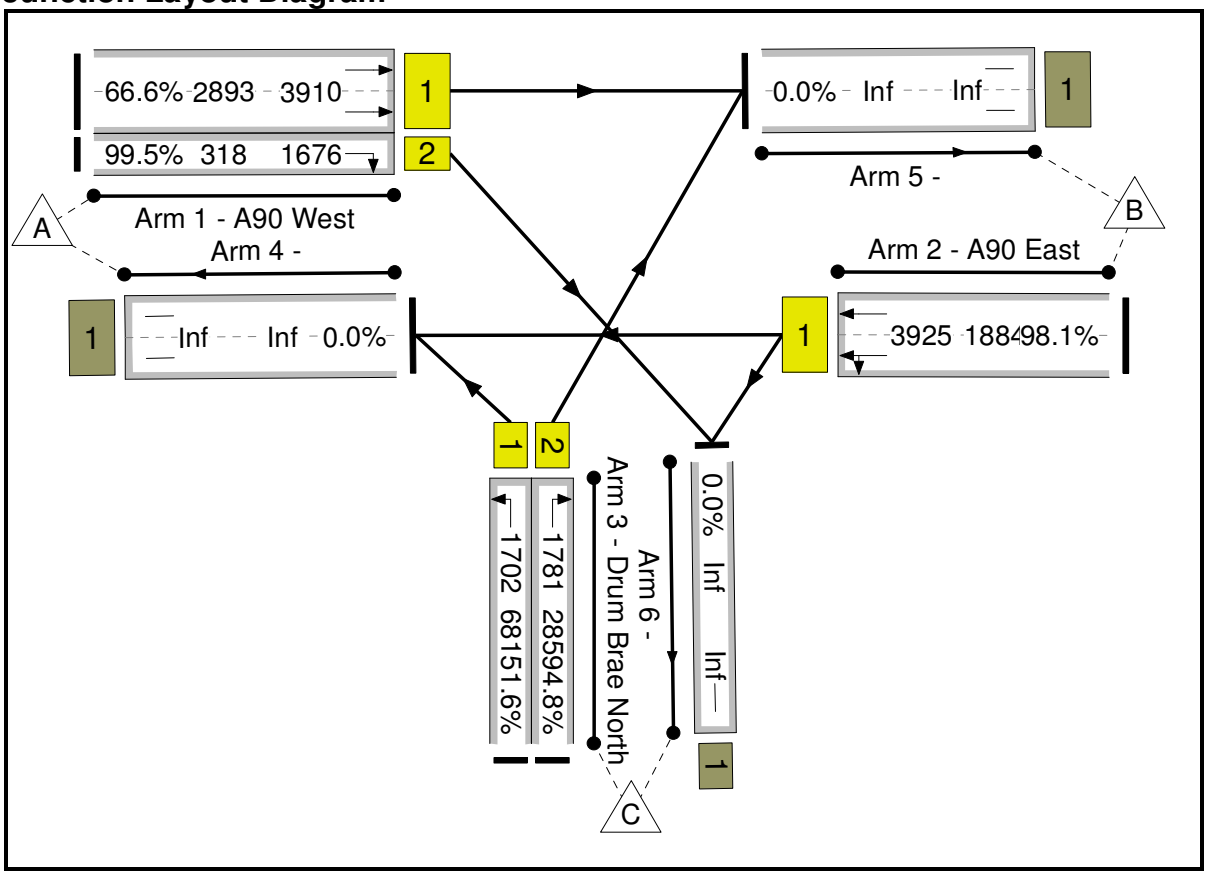
Basic Results Summary

User and Project Details

Project:	**A90 Out-bound Bus Priority Study**
Title:	**Exisying Layout**
Location:	A90 Queensferry Road / Drum Brae North, Edinburgh.
File name:	Drum Brae existing.lsgx
Author:	R Bishop
Company:	White Young Green
Address:	Avalon Way, Anstey, Leicestershire LE7 7GR
Controller:	Generic
SCN:	
Notes:	

Scenario 1: 'AM Peak'
Staging Plan 1: 'Staging Plan No. 1'
Flow Group 1: 'AM Peak 2008'

Junction Layout Diagram



Basic Results Summary

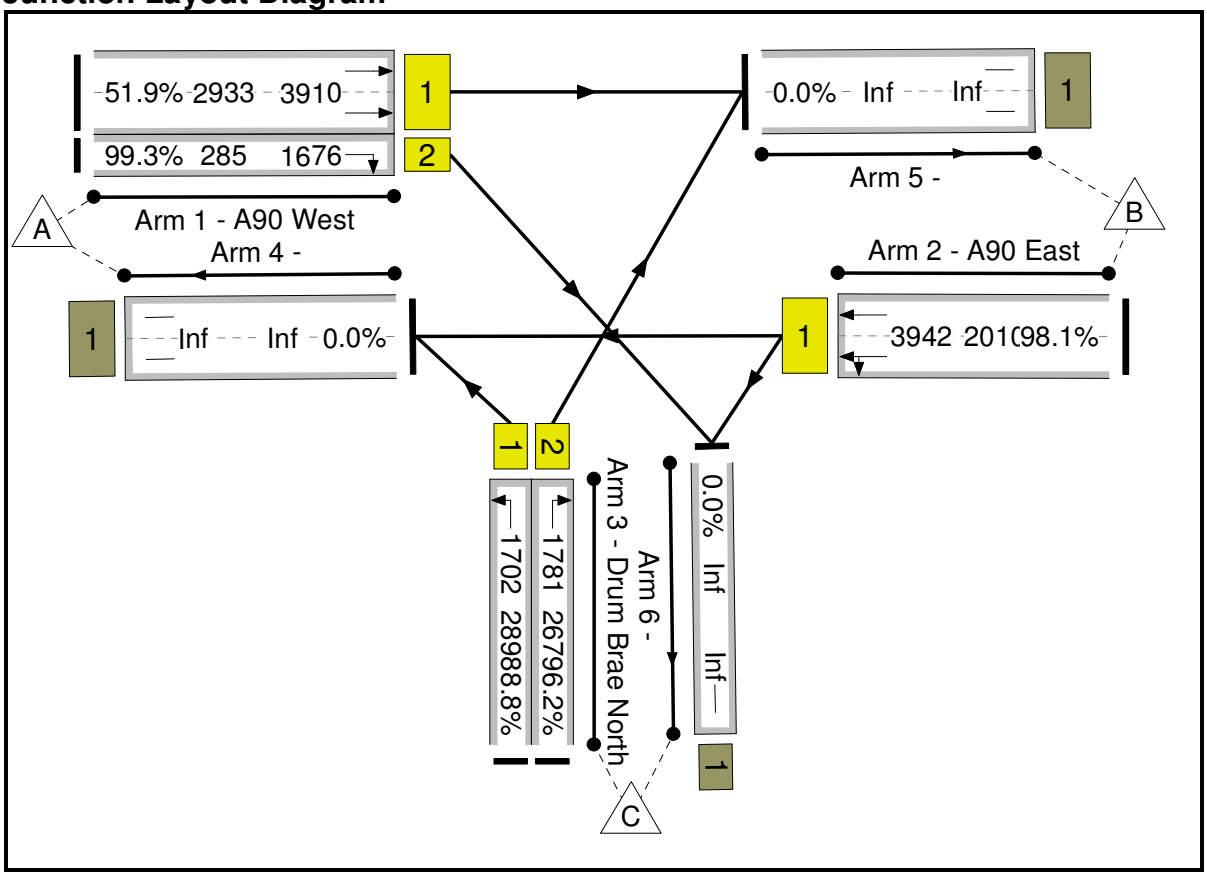
Link Results

Link Num	Link Desc	Link Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Max Sat Flow (pcu/Hr)	Ave Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per Veh (s/pcu)	Mean Max Queue (pcu)
1/1	A90 West Ahead	U	A		1	73	-	1927	3910	3910	2893	66.6	-	-	-	4.6	8.5	28.3
1/2	A90 West Right	U	B		1	18	-	317	1676	1676	318	99.5	-	-	-	12.1	137.6	17.3
2/1	A90 East Ahead Left	U	C		1	47	-	1848	3925	3925	1884	98.1	-	-	-	27.4	53.4	64.6
3/1	Drum Brae North Left	U	D		1	39	-	351	1702	1702	681	51.6	-	-	-	2.7	28.1	7.8
3/2	Drum Brae North Right	U	E		1	15	-	270	1781	1781	285	94.8	-	-	-	8.4	112.1	12.7

PRC for Signalled Links (%): -10.6 Total Delay for Signalled Links (pcuHr): 55.24
PRC Over All Links (%): -10.6 Total Delay Over All Links(pcuHr): 55.24 Cycle Time (s): 100

Scenario 2: 'PM Peak'
Staging Plan 2: 'Staging Plan No. 2'
Flow Group 2: 'PM Peak 2008'

Junction Layout Diagram



Basic Results Summary

Link Results

Link Num	Link Desc	Link Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Max Sat Flow (pcu/Hr)	Ave Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per Veh (s/pcu)	Mean Max Queue (pcu)
1/1	A90 West Ahead	U	A		1	74	-	1521	3910	3910	2933	51.9	-	-	-	2.7	6.4	17.4
1/2	A90 West Right	U	B		1	16	-	283	1676	1676	285	99.3	-	-	-	11.2	142.5	15.7
2/1	A90 East Ahead Left	U	C		1	50	-	1972	3942	3942	2010	98.1	-	-	-	27.7	50.7	68.3
3/1	Drum Brae North Left	U	D		1	16	-	257	1702	1702	289	88.8	-	-	-	6.2	86.8	10.2
3/2	Drum Brae North Right	U	E		1	14	-	257	1781	1781	267	96.2	-	-	-	8.9	124.5	12.9

PRC for Signalled Links (%): -10.4 Total Delay for Signalled Links (pcuHr): 56.73

PRC Over All Links (%): -10.4 Total Delay Over All Links(pcuHr): 56.73 Cycle Time (s): 100

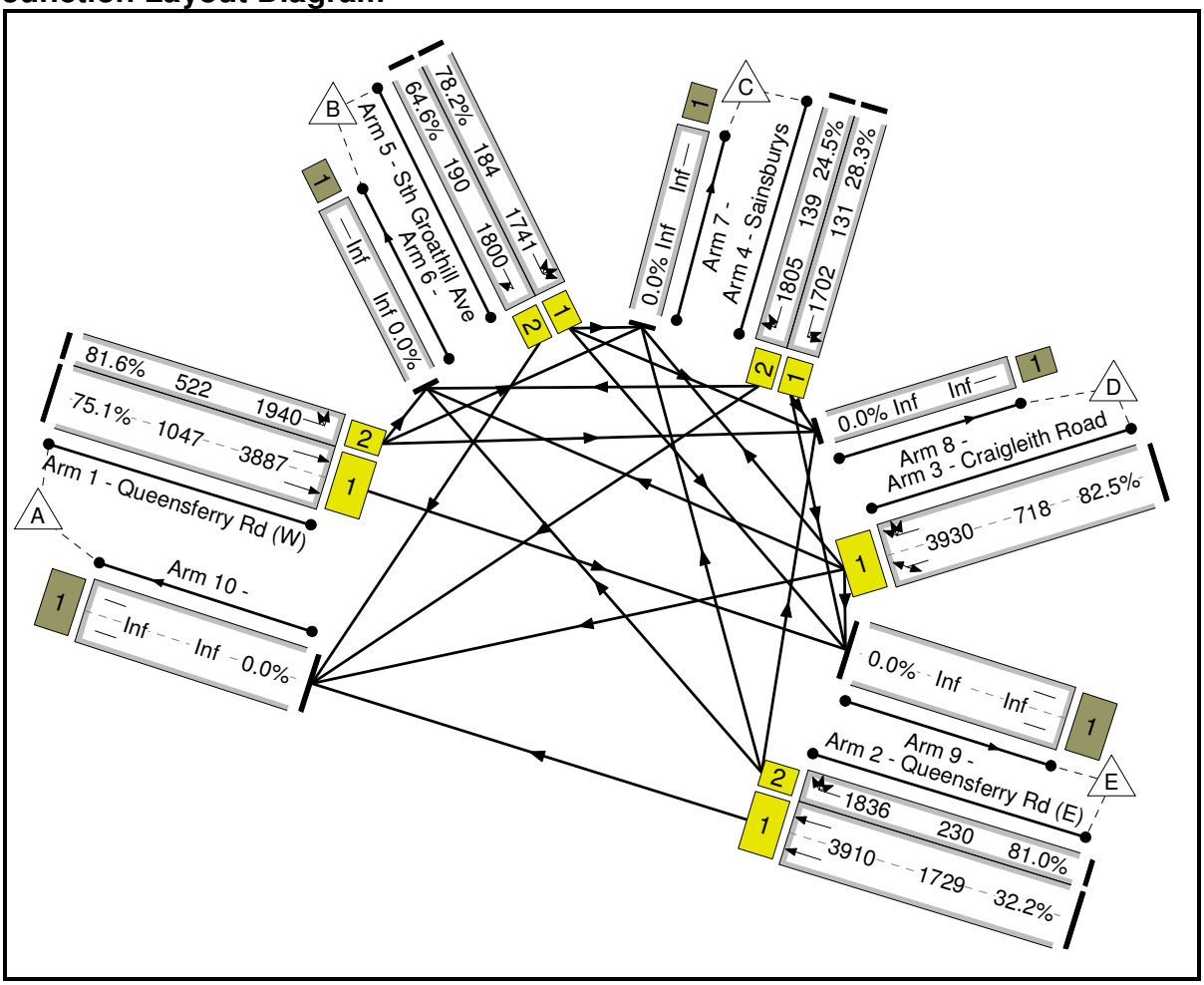
Basic Results Summary

User and Project Details

Project:	**A90 Out-bound Bus Priority Study**
Title:	**Existing Layout**
Location:	A90 Queensferry Road / Craigleith Road, Edinburgh.
File name:	Craigleith Existing.lsgx
Author:	R Bishop
Company:	White Young Green
Address:	Avalon Way, Anstey, Leicestershire LE7 7GR
Controller:	Generic
SCN:	122
Notes:	

Scenario 1: 'AM Existing'
Staging Plan 1: 'Staging Plan No. 1'
Flow Group 1: 'AM Peak'

Junction Layout Diagram



Link Results

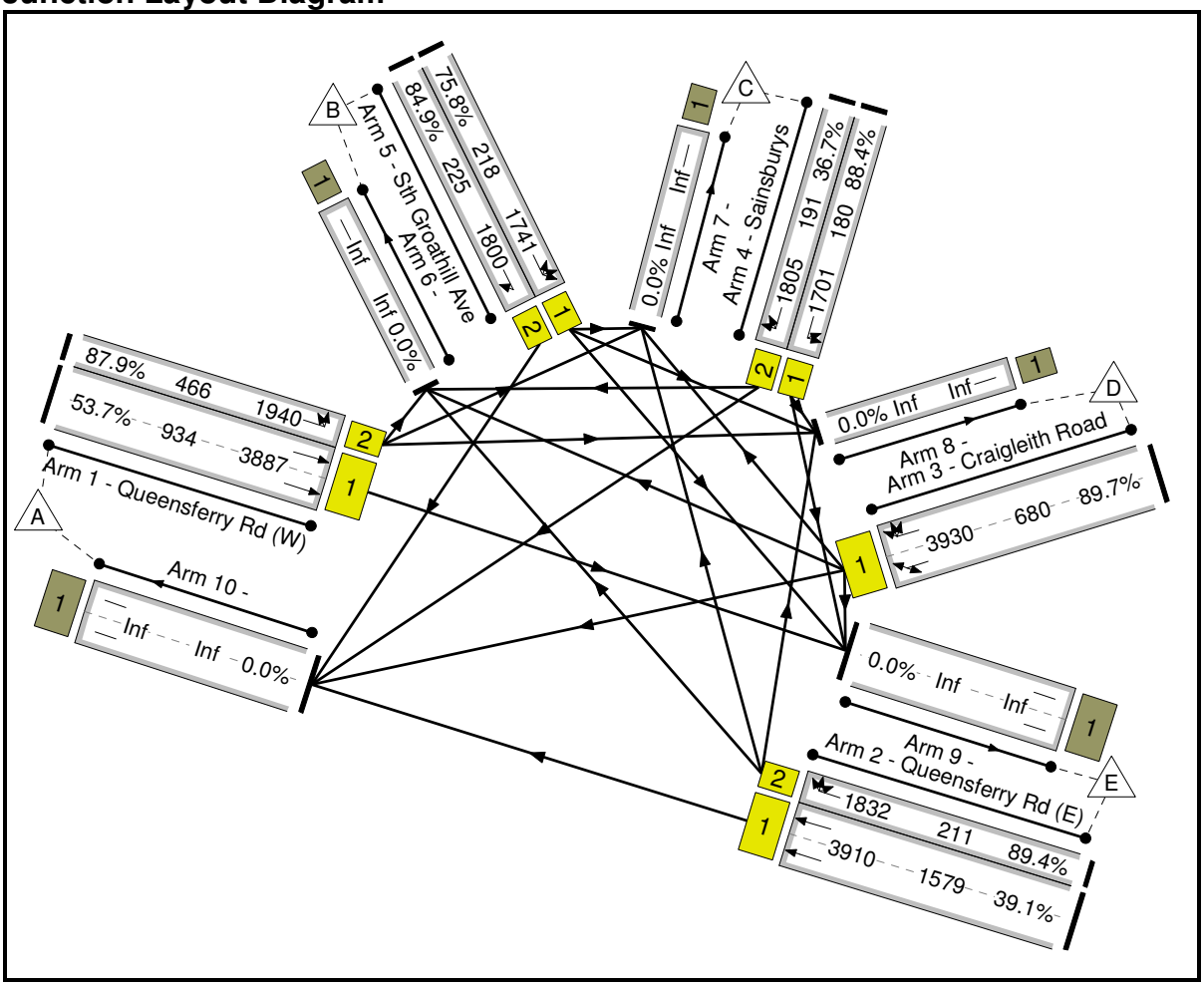
Link Num	Link Desc	Link Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Max Sat Flow (pcu/Hr)	Ave Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per Veh (s/pcu)	Mean Max Queue (pcu)
1/1	Queensferry Rd (W) Ahead	U	A		1	27	-	786	3887	3887	1047	75.1	-	-	-	9.1	41.6	22.2
1/2	Queensferry Rd (W) Left Left2 Ahead	U	A		1	27	-	426	1940	1940	522	81.6	-	-	-	6.3	53.5	13.6
2/1	Queensferry Rd (E) Ahead	U	B		1	45	-	557	3910	3910	1729	32.2	-	-	-	3.2	20.4	10.6
2/2	Queensferry Rd (E) Right Right2 U-Turn	U	C		1	12	-	186	1836	1836	230	81.0	-	-	-	4.3	82.3	7.2
3/1	Craigleith Road Right Right2 U-Turn Ahead	U	D		1	18	-	592	3930	3930	718	82.5	-	-	-	9.0	54.7	18.7
4/1	Sainsburys Left Left2	U	E		1	7	-	37	1702	1702	131	28.3	-	-	-	0.7	64.4	1.2
4/2	Sainsburys U-Turn Right	U	E		1	7	-	34	1805	1805	139	24.5	-	-	-	0.6	62.3	1.1
5/1	Sth Groathill Ave U-Turn Left Left2	U	F		1	10	-	144	1741	1741	184	78.2	-	-	-	3.5	86.8	5.7
5/2	Sth Groathill Ave Right	U	F		1	10	-	123	1800	1800	190	64.6	-	-	-	2.4	70.7	4.3

PRC for Signalled Links (%): 9.2 Total Delay for Signalled Links (pcuHr): 38.96

PRC Over All Links (%): 9.2 Total Delay Over All Links(pcuHr): 38.96 Cycle Time (s): 104

Scenario 2: 'PM Existing'
Staging Plan 1: 'Staging Plan No. 1'
Flow Group 2: 'PM Peak'

Junction Layout Diagram



Link Results

Link Num	Link Desc	Link Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Max Sat Flow (pcu/Hr)	Ave Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per Veh (s/pcu)	Mean Max Queue (pcu)
1/1	Queensferry Rd (W) Ahead	U	A		1	24	-	502	3887	3887	934	53.7	-	-	-	5.4	38.6	13.1
1/2	Queensferry Rd (W) Left Left2 Ahead	U	A		1	24	-	410	1940	1940	466	87.9	-	-	-	7.6	66.7	14.6
2/1	Queensferry Rd (E) Ahead	U	B		1	41	-	617	3910	3910	1579	39.1	-	-	-	4.1	23.8	12.8
2/2	Queensferry Rd (E) Right Right2 U-Turn	U	C		1	11	-	189	1832	1832	211	89.4	-	-	-	5.7	107.6	8.6
3/1	Craigleith Road Right Right2 U-Turn Ahead	U	D		1	17	-	610	3930	3930	680	89.7	-	-	-	11.0	65.2	21.0
4/1	Sainsburys Left Left2	U	E		1	10	-	159	1701	1701	180	88.4	-	-	-	5.0	112.9	7.5
4/2	Sainsburys U-Turn Right	U	E		1	10	-	70	1805	1805	191	36.7	-	-	-	1.1	58.1	2.2
5/1	Sth Groathill Ave U-Turn Left Left2	U	F		1	12	-	165	1741	1741	218	75.8	-	-	-	3.5	76.4	6.1
5/2	Sth Groathill Ave Right	U	F		1	12	-	191	1800	1800	225	84.9	-	-	-	4.8	90.8	7.8

PRC for Signalled Links (%): 0.4 Total Delay for Signalled Links (pcuHr): 48.19
PRC Over All Links (%): 0.4 Total Delay Over All Links(pcuHr): 48.19 Cycle Time (s): 104

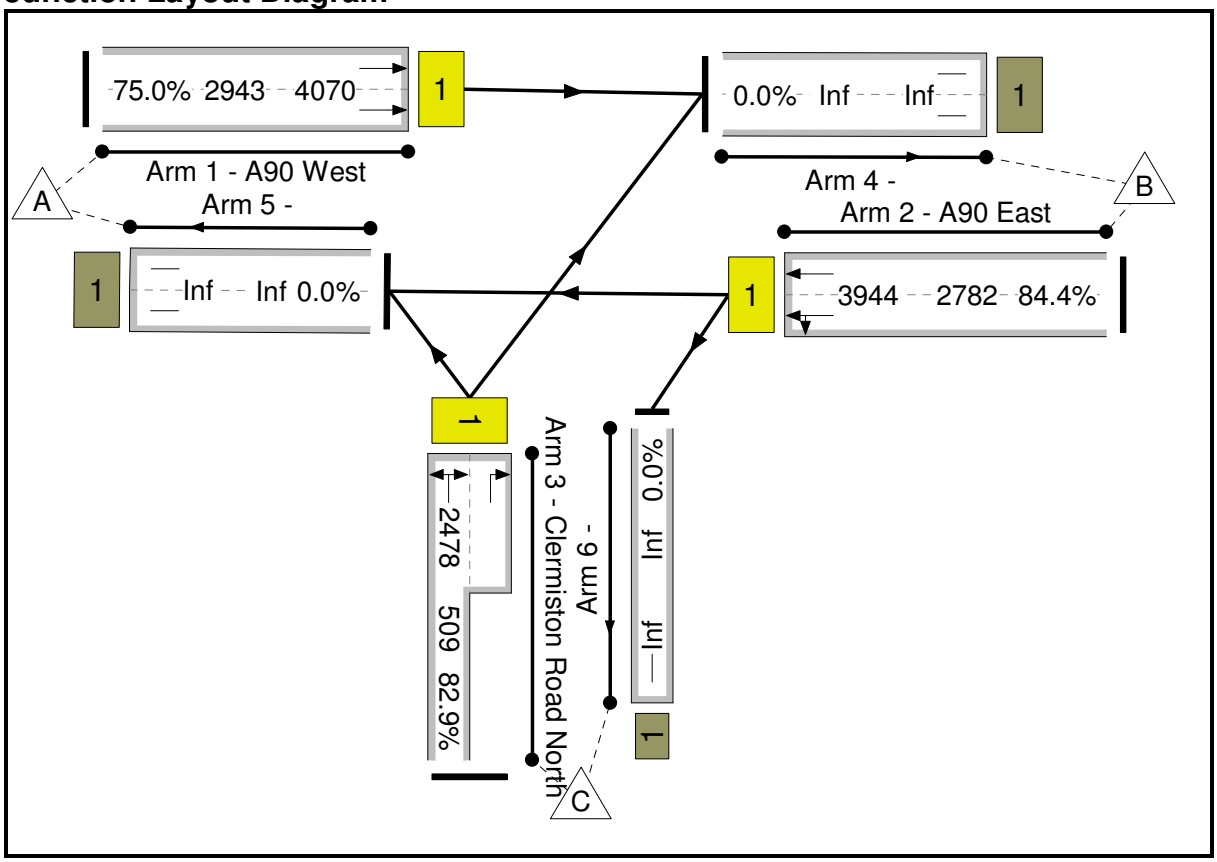
Basic Results Summary

User and Project Details

Project:	**A90 Out-bound Bus Priority Study**
Title:	**Existing Layout**
Location:	A90 Queensferry Road / Clermiston Road North, Edinburgh.
File name:	Clermiston existing.lsgx
Author:	R Bishop
Company:	White Young Green
Address:	Avalon Way, Anstey, Leicestershire LE7 7GR
Controller:	Generic
SCN:	90
Notes:	

Scenario 1: 'AM Peak'
Staging Plan 1: 'Staging Plan No. 1'
Flow Group 1: 'AM Existing'

Junction Layout Diagram



Link Results

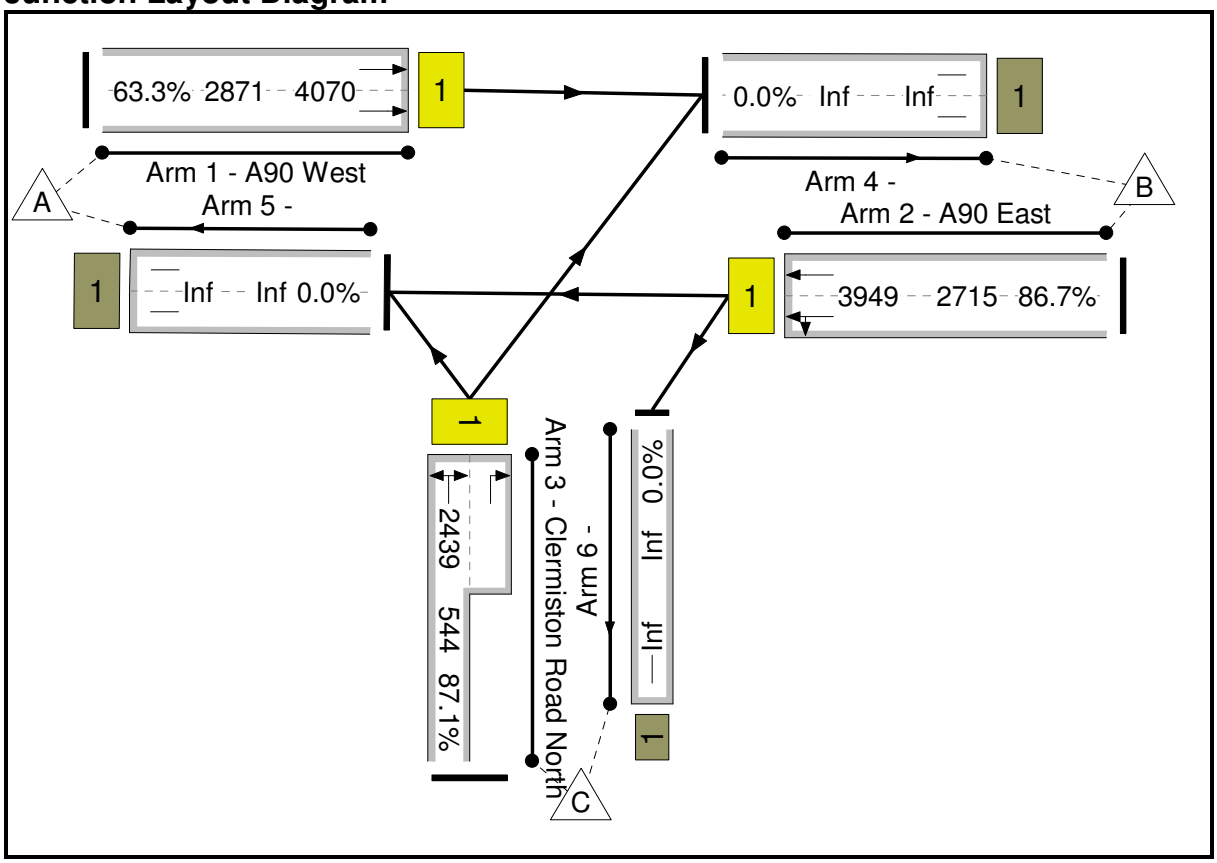
Link Num	Link Desc	Link Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Max Sat Flow (pcu/Hr)	Ave Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per Veh (s/pcu)	Mean Max Queue (pcu)
1/1	A90 West Ahead	U	A		1	80	-	2207	4070	4070	2943	75.0	-	-	-	7.2	11.8	42.6
2/1	A90 East Ahead Left	U	B		1	78	-	2348	3944	3944	2782	84.4	-	-	-	10.5	16.1	55.5
3/1	Clermiston Road North Right Left	U	C		1	22	-	422	3503	2478	509	82.9	-	-	-	7.0	60.1	14.5

PRC for Signalled Links (%): 6.6 Total Delay for Signalled Links (pcuHr): 24.80

PRC Over All Links (%): 6.6 Total Delay Over All Links(pcuHr): 24.80 Cycle Time (s): 112

Scenario 2: 'PM Peak'
Staging Plan 1: 'Staging Plan No. 1'
Flow Group 2: 'PM Existing'

Junction Layout Diagram



Link Results

Link Num	Link Desc	Link Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Max Sat Flow (pcu/Hr)	Ave Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per Veh (s/pcu)	Mean Max Queue (pcu)
1/1	A90 West Ahead	U	A		1	78	-	1816	4070	4070	2871	63.3	-	-	-	5.3	10.5	30.6
2/1	A90 East Ahead Left	U	B		1	76	-	2355	3949	3949	2715	86.7	-	-	-	12.1	18.5	59.5
3/1	Clermiston Road North Right Left	U	C		1	24	-	474	3527	2439	544	87.1	-	-	-	8.3	63.1	16.9

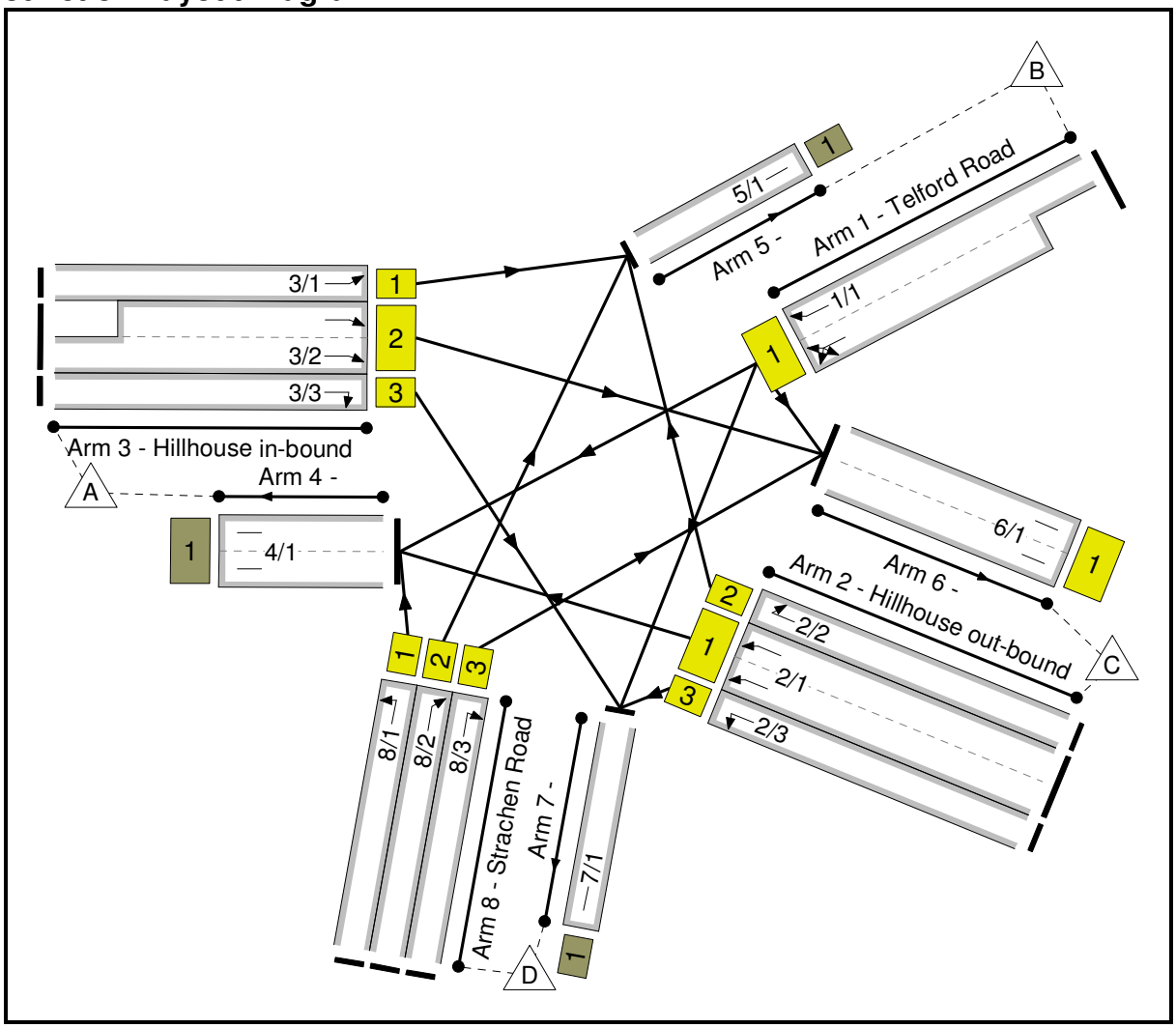
PRC for Signalled Links (%): 3.4 Total Delay for Signalled Links (pcuHr): 25.67
PRC Over All Links (%): 3.4 Total Delay Over All Links(pcuHr): 25.67 Cycle Time (s): 112

Full Input Data And Results

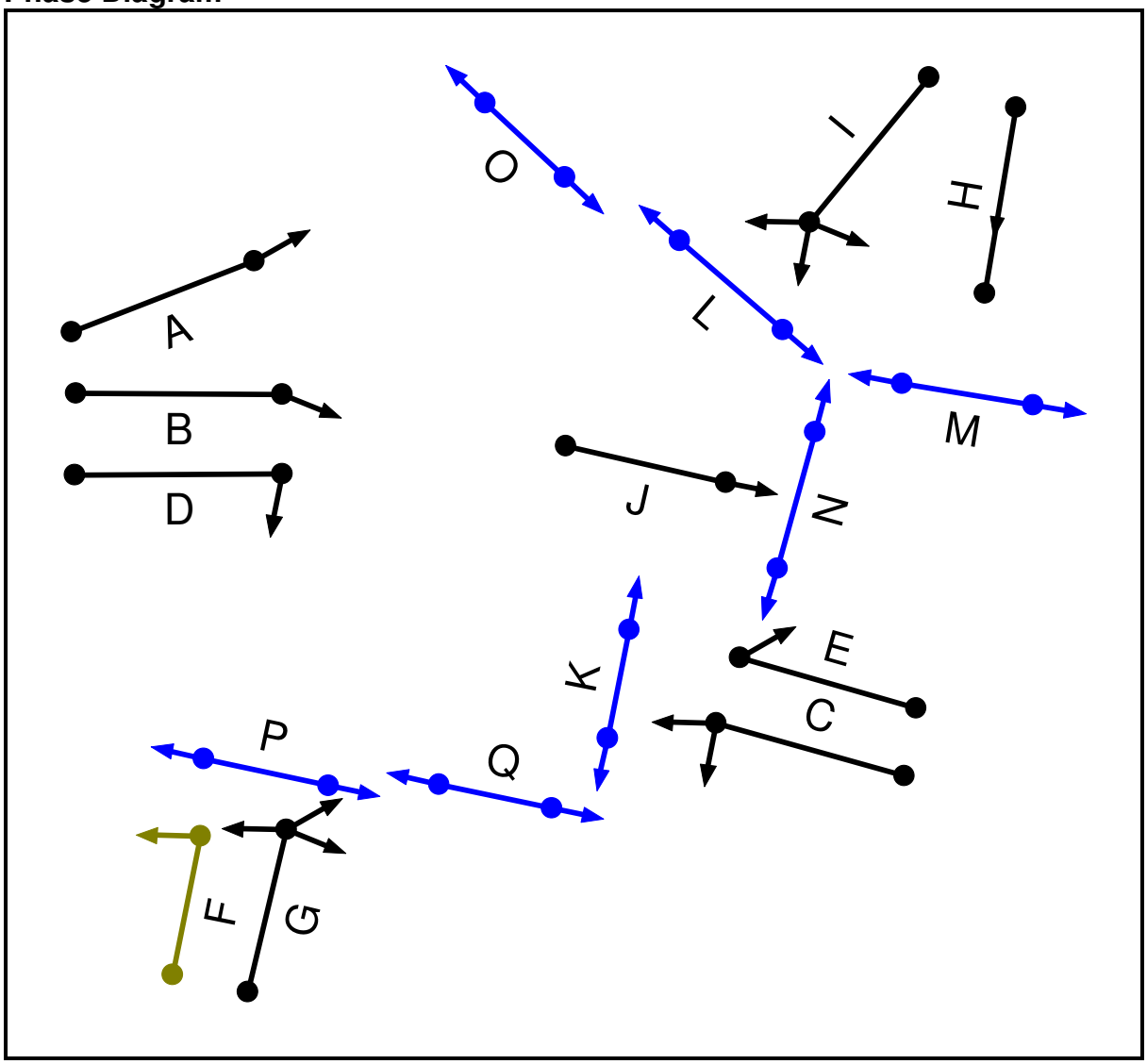
User and Project Details

Project:	**A90 Out-bound Bus Priority Study**
Title:	**Option 2 Layout**
Location:	A90 Hillhouse Road / A902 Telford Road
File name:	Blackhall proposed option 2.lsgx
Author:	R Bishop
Company:	White Young Green
Address:	Avalon Way, Anstey, Leicestershire LE7 7GR
Controller:	Generic
SCN:	115
Notes:	

Junction Layout Diagram



Phase Diagram



Phase Input Data

Phase Name	Phase type	Assoc Phase	Street Min	Cont Min
A	Traffic		-9999	7
B	Traffic		-9999	6
C	Traffic		-9999	4
D	Traffic		-9999	5
E	Traffic		-9999	7
F	Filter	G	-9999	4
G	Traffic		-9999	4
H	Traffic		-9999	7
I	Traffic		-9999	7
J	Traffic		-9999	7
K	Pedestrian		-9999	7
L	Pedestrian		-9999	5
M	Pedestrian		-9999	5
N	Pedestrian		-9999	5
O	Pedestrian		-9999	5
P	Pedestrian		-9999	6
Q	Pedestrian		-9999	4

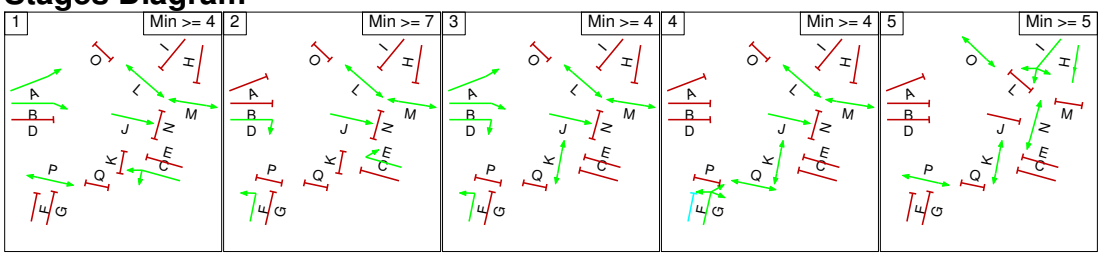
Phase Intergreens Matrix

		Starting Phase															
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Terminating Phase	A		-	-	-	5	-	5	-	-	-	-	-	-	-	8	-	-
	B	-		-	-	5	-	5	-	6	-	-	-	-	-	-	-	-
	C	-	-		6	-	7	7	-	5	-	5	-	-	-	-	-	8
	D	-	-	5		-	-	5	-	5	-	-	-	-	-	-	-	8
	E	6	6	-	-		-	5	-	5	-	5	-	-	-	10	-	-
	F	-	-	5	-	-		-	-	5	-	-	-	-	-	-	5	-
	G	8	8	5	7	7	-		-	8	-	-	-	-	-	11	5	-
	H	-	-	-	-	-	-	-		-	5	-	-	5	-	-	-	-
	I	-	5	7	8	6	9	9	-		-	-	5	-	-	-	-	10
	J	-	-	-	-	-	-	-	5	-		-	-	-	5	-	-	-
	K	-	-	14	-	14	-	-	-	-	-		-	-	-	-	-	-
	L	-	-	-	-	-	-	-	-	7	-	-		-	-	-	-	-
	M	-	-	-	-	-	-	-	7	-	-	-	-		-	-	-	-
	N	-	-	-	-	-	-	-	-	-	7	-	-	-		-	-	-
	O	8	-	-	-	8	-	8	-	-	-	-	-	-	-		-	-
	P	-	-	-	-	-	10	10	-	-	-	-	-	-	-	-		-
	Q	-	-	7	7	-	-	-	-	7	-	-	-	-	-	-	-	

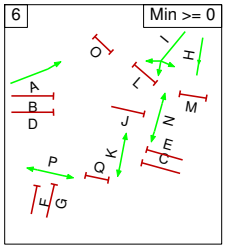
Phases in Stage

Stage No.	Phases in Stage
1	A B C J L M P
2	D E F J L M
3	A B D F J K L M
4	G J K L M Q
5	H I K N O P
6	A H I K N P

Stages Diagram



Full Input Data And Results



Phase Delays

Term. Stage	Start Stage	Phase	Type	Value	Cont value
1	2	A	Losing	5	5
1	2	B	Losing	5	5
1	2	C	Losing	3	3
1	3	C	Losing	3	3
1	4	A	Losing	5	5
1	4	B	Losing	5	5
1	4	C	Losing	2	2
1	5	A	Losing	2	2
1	5	B	Losing	2	2
1	5	C	Losing	3	3
1	5	J	Losing	5	5
1	5	L	Losing	1	1
1	5	M	Losing	3	3
1	6	B	Losing	1	1
1	6	C	Losing	2	2
1	6	J	Losing	5	5
1	6	M	Losing	3	3
4	5	J	Losing	3	3
4	5	L	Losing	1	1
4	5	M	Losing	1	1
4	5	Q	Losing	1	1
4	6	J	Losing	6	6
4	6	L	Losing	1	1
4	6	M	Losing	4	4
4	6	Q	Losing	1	1
5	1	H	Losing	7	7
5	1	I	Losing	7	7
5	1	N	Losing	5	5
5	1	O	Losing	4	4
5	3	H	Losing	1	1
5	3	I	Losing	1	1
6	1	H	Losing	7	7
6	1	I	Losing	7	7
6	1	N	Losing	5	5

6	3	H	Losing	1	1
6	3	I	Losing	1	1

Prohibited Stage Changes

		To Stage					
		1	2	3	4	5	6
From Stage	1		10	10	10	10	10
	2	X		X	8	X	X
	3	X	X		8	X	X
	4	X	X	X		11	11
	5	14	X	10	X		8
	6	14	X	10	X	8	

Link Input Data

Arm/ Link	Link Name	Link Type	Num Lanes	Phases	Start Disp.	End Disp.
1/1	Telford Road Ahead Left Left2	U	2	I	2	3
2/1	Hillhouse out-bound Ahead	U	2	C	2	3
2/2	Hillhouse out-bound Right	U	1	E	2	3
2/3	Hillhouse out-bound Left	U	1	C	2	3
3/1	Hillhouse in-bound Ahead	U	1	A	2	3
3/2	Hillhouse in-bound Ahead	U	2	B	2	3
3/3	Hillhouse in-bound Right	U	1	D	2	3
4/1		U	2		2	3
5/1		U	1		2	3
6/1		U	2	J	2	3
7/1		U	1		2	3
8/1	Strachen Road Left	U	1	G F	2	3
8/2	Strachen Road Right	U	1	G	2	3
8/3	Strachen Road Right	U	1	G	2	3

Lane Input Data

Arm/ Lane	Link Num	Physical Length (PCU)	Expected Usage (PCU)	Sat Flow Type	User Saturation Flow (PCU/Hr)	Lane Width (m)	Gradient	Nearside Lane	Allowed Turns	Turning Radius (m)
1/1 (Telford Road Lane 1)	Link 1 (Telford Road Ahead Left Left2)	14.0	14.0	Geom	1800	3.30	0.00	Y	Arm 4 Ahead	60.00
									Arm 6 Left	15.00
									Arm 7 Left	25.00
1/2 (Telford Road Lane 2)	Link 1 (Telford Road Ahead Left Left2)	Inf	Inf	Geom	1800	3.30	0.00	N	Arm 4 Ahead	60.00
2/1 (Hillhouse out-bound Lane 1)	Link 3 (Hillhouse out-bound Left)	Inf	Inf	Geom	1800	3.00	0.00	Y	Arm 7 Left	12.00
2/2 (Hillhouse out-bound Lane 2)	Link 1 (Hillhouse out-bound Ahead)	Inf	Inf	Geom	1800	3.00	0.00	Y	Arm 4 Ahead	Inf
2/3 (Hillhouse out-bound Lane 3)	Link 1 (Hillhouse out-bound Ahead)	Inf	Inf	Geom	1800	3.00	0.00	N	Arm 4 Ahead	Inf
2/4 (Hillhouse out-bound Lane 4)	Link 2 (Hillhouse out-bound Right)	Inf	Inf	User	1800	3.25	0.00	Y	Arm 5 Right	Inf
3/1 (Hillhouse in-bound Lane 1)	Link 1 (Hillhouse in-bound Ahead)	Inf	Inf	Geom	1800	3.00	0.00	Y	Arm 5 Ahead	Inf
3/2 (Hillhouse in-bound Lane 2)	Link 2 (Hillhouse in-bound Ahead)	18.0	18.0	Geom	1800	3.00	0.00	Y	Arm 6 Ahead	Inf
3/3 (Hillhouse in-bound Lane 3)	Link 2 (Hillhouse in-bound Ahead)	Inf	Inf	Geom	1800	3.00	0.00	Y	Arm 6 Ahead	Inf
3/4 (Hillhouse in-bound Lane 4)	Link 3 (Hillhouse in-bound Right)	Inf	Inf	Geom	1800	3.00	0.00	Y	Arm 7 Right	10.00
4/1	Link 1	Inf	Inf	Inf (Exit)	1800	3.25	0.00	Y		

4/2	Link 1	Inf	Inf	Inf (Exit)	1800	3.25	0.00	Y		
5/1	Link 1	Inf	Inf	Inf (Exit)	1800	3.25	0.00	Y		
6/1	Link 1	Inf	Inf	Geom	1800	3.00	0.00	Y		
6/2	Link 1	Inf	Inf	Geom	1800	3.00	0.00	N		
7/1	Link 1	Inf	Inf	Inf (Exit)	1800	3.25	0.00	Y		
8/1 (Strachen Road Lane 1)	Link 1 (Strachen Road Left)	Inf	Inf	User	1800	3.25	0.00	Y	Arm 4 Left	Inf
8/2 (Strachen Road Lane 2)	Link 2 (Strachen Road Right)	Inf	Inf	User	1800	3.25	0.00	Y	Arm 5 Right	Inf
8/3 (Strachen Road Lane 3)	Link 3 (Strachen Road Right)	Inf	Inf	User	1800	3.25	0.00	Y	Arm 6 Right	Inf

Traffic Flow Groups

Flow Group	Start Time	End Time	Duration	Formula
1: 'AM 2008 CTC'	07:45	08:45	01:00	
2: 'PM 2008 CTC'	17:00	18:00	01:00	

Flow Group 1: 'AM 2008 CTC'
Traffic Flow Matrix
Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	881	1139	86	2106
	B	929	0	4	89	1022
	C	994	10	0	19	1023
	D	34	171	63	0	268
	Tot.	1957	1062	1206	194	4419

Link Traffic Flows

Arm/Link	Flow Group 1: AM 2008 CTC
1/1	1022
2/1	994
2/2	10
2/3	19
3/1	881
3/2	1139
3/3	86
4/1	1957
5/1	1062
6/1	1206
7/1	194
8/1	34
8/2	171
8/3	63

Lane Saturation Flows

Arm/ Lane	Lane Width (m)	Gradient	Nearside Lane	Allowed Turns	Turning Radius (m)	Turning Prop.	Sat flow (PCU/Hr)
1/1 (Telford Road Lane 1)	3.30	0.00	Y	Arm 4 Ahead	60.00	81.8 %	1885
				Arm 6 Left	15.00	0.8 %	
				Arm 7 Left	25.00	17.4 %	
1/2 (Telford Road Lane 2)	3.30	0.00	N	Arm 4 Ahead	60.00	100.0 %	2034
2/1 (Hillhouse out-bound Lane 1)	3.00	0.00	Y	Arm 7 Left	12.00	100.0 %	1702
2/2 (Hillhouse out-bound Lane 2)	3.00	0.00	Y	Arm 4 Ahead	Inf	100.0 %	1915
2/3 (Hillhouse out-bound Lane 3)	3.00	0.00	N	Arm 4 Ahead	Inf	100.0 %	2055
2/4 (Hillhouse out-bound Lane 4)	This lane uses a directly entered Saturation Flow						1800
3/1 (Hillhouse in-bound Lane 1)	3.00	0.00	Y	Arm 5 Ahead	Inf	100.0 %	1915
3/2 (Hillhouse in-bound Lane 2)	3.00	0.00	Y	Arm 6 Ahead	Inf	100.0 %	1915
3/3 (Hillhouse in-bound Lane 3)	3.00	0.00	Y	Arm 6 Ahead	Inf	100.0 %	1915
3/4 (Hillhouse in-bound Lane 4)	3.00	0.00	Y	Arm 7 Right	10.00	100.0 %	1665
4/1	Infinite Saturation Flow (on Exit Link)						Inf
4/2	Infinite Saturation Flow (on Exit Link)						Inf
5/1	Infinite Saturation Flow (on Exit Link)						Inf
6/1	3.00	0.00	Y				1915
6/2	3.00	0.00	N				2055
7/1	Infinite Saturation Flow (on Exit Link)						Inf
8/1 (Strachen Road Lane 1)	This lane uses a directly entered Saturation Flow						1800
8/2 (Strachen Road Lane 2)	This lane uses a directly entered Saturation Flow						1800
8/3 (Strachen Road Lane 3)	This lane uses a directly entered Saturation Flow						1800

Flow Group 2: 'PM 2008 CTC'

Traffic Flow Matrix

Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	809	857	102	1768
	B	1032	0	15	64	1111
	C	704	3	0	8	715
	D	188	139	48	0	375
	Tot.	1924	951	920	174	3969

Link Traffic Flows

Arm/Link	Flow Group 2: PM 2008 CTC
1/1	1111
2/1	704
2/2	3
2/3	8
3/1	809
3/2	857
3/3	102
4/1	1924
5/1	951
6/1	920
7/1	174
8/1	188
8/2	139
8/3	48

Lane Saturation Flows

Arm/ Lane	Lane Width (m)	Gradient	Nearside Lane	Allowed Turns	Turning Radius (m)	Turning Prop.	Sat flow (PCU/Hr)
1/1 (Telford Road Lane 1)	3.30	0.00	Y	Arm 4 Ahead	60.00	85.8 %	1886
				Arm 6 Left	15.00	2.7 %	
				Arm 7 Left	25.00	11.5 %	
1/2 (Telford Road Lane 2)	3.30	0.00	N	Arm 4 Ahead	60.00	100.0 %	2034
2/1 (Hillhouse out-bound Lane 1)	3.00	0.00	Y	Arm 7 Left	12.00	100.0 %	1702
2/2 (Hillhouse out-bound Lane 2)	3.00	0.00	Y	Arm 4 Ahead	Inf	100.0 %	1915
2/3 (Hillhouse out-bound Lane 3)	3.00	0.00	N	Arm 4 Ahead	Inf	100.0 %	2055
2/4 (Hillhouse out-bound Lane 4)	This lane uses a directly entered Saturation Flow						1800
3/1 (Hillhouse in-bound Lane 1)	3.00	0.00	Y	Arm 5 Ahead	Inf	100.0 %	1915
3/2 (Hillhouse in-bound Lane 2)	3.00	0.00	Y	Arm 6 Ahead	Inf	100.0 %	1915
3/3 (Hillhouse in-bound Lane 3)	3.00	0.00	Y	Arm 6 Ahead	Inf	100.0 %	1915
3/4 (Hillhouse in-bound Lane 4)	3.00	0.00	Y	Arm 7 Right	10.00	100.0 %	1665
4/1	Infinite Saturation Flow (on Exit Link)						Inf
4/2	Infinite Saturation Flow (on Exit Link)						Inf
5/1	Infinite Saturation Flow (on Exit Link)						Inf
6/1	3.00	0.00	Y				1915
6/2	3.00	0.00	N				2055
7/1	Infinite Saturation Flow (on Exit Link)						Inf
8/1 (Strachen Road Lane 1)	This lane uses a directly entered Saturation Flow						1800
8/2 (Strachen Road Lane 2)	This lane uses a directly entered Saturation Flow						1800
8/3 (Strachen Road Lane 3)	This lane uses a directly entered Saturation Flow						1800

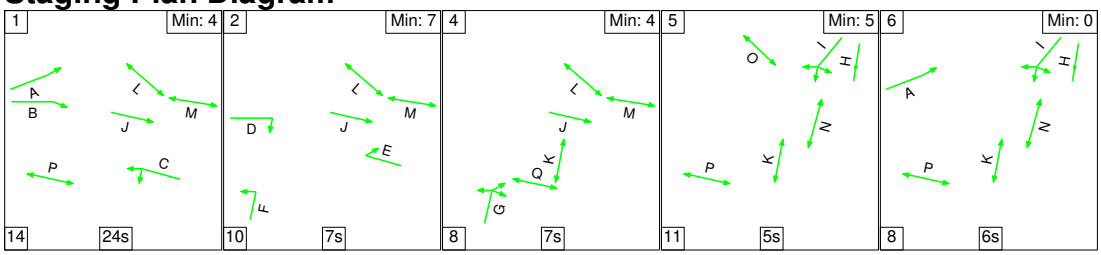
Full Input Data And Results

Scenario 1: 'AM Worst Case'

Staging Plan 1: 'Staging Plan No. 1'

Flow Group 1: 'AM 2008 CTC'

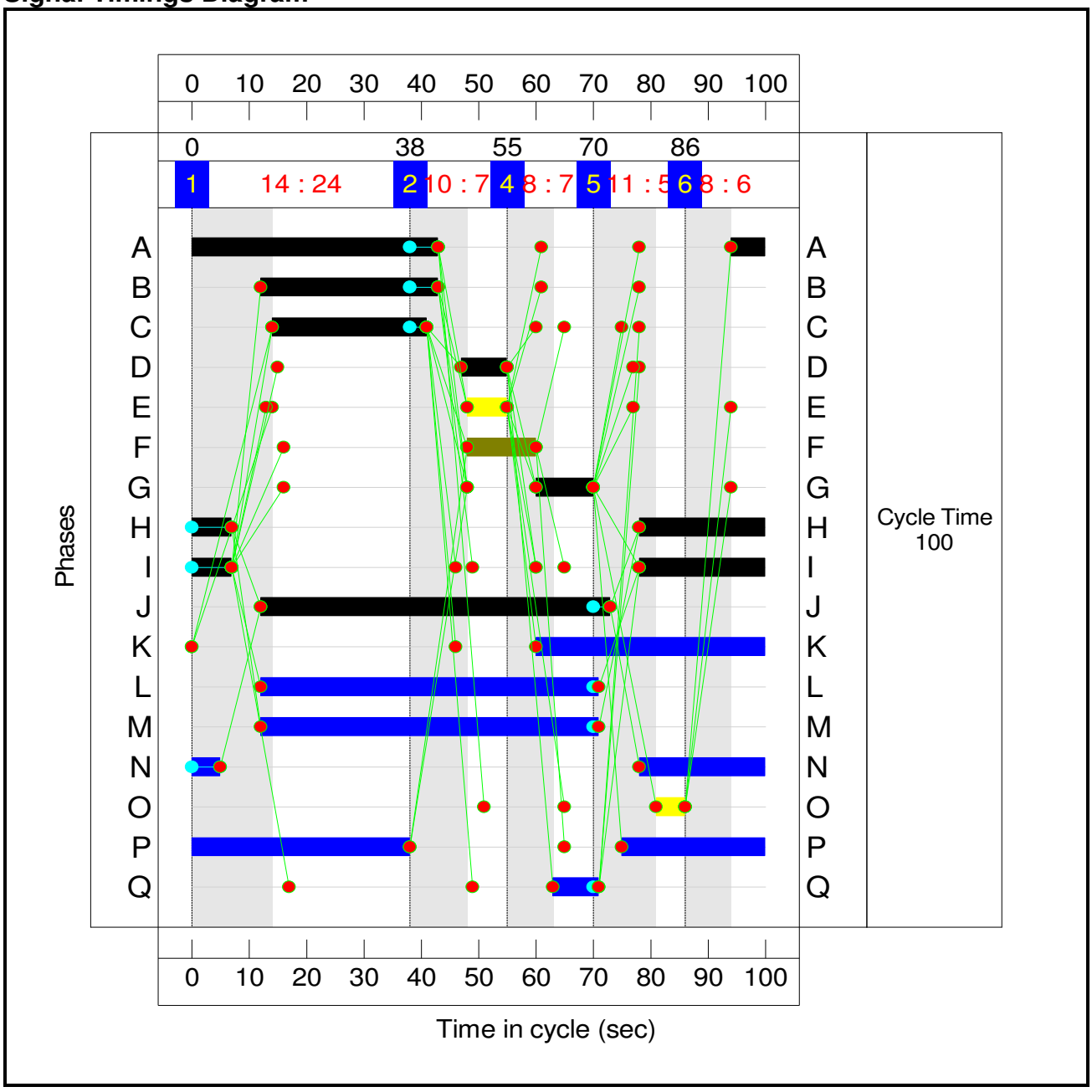
Staging Plan Diagram



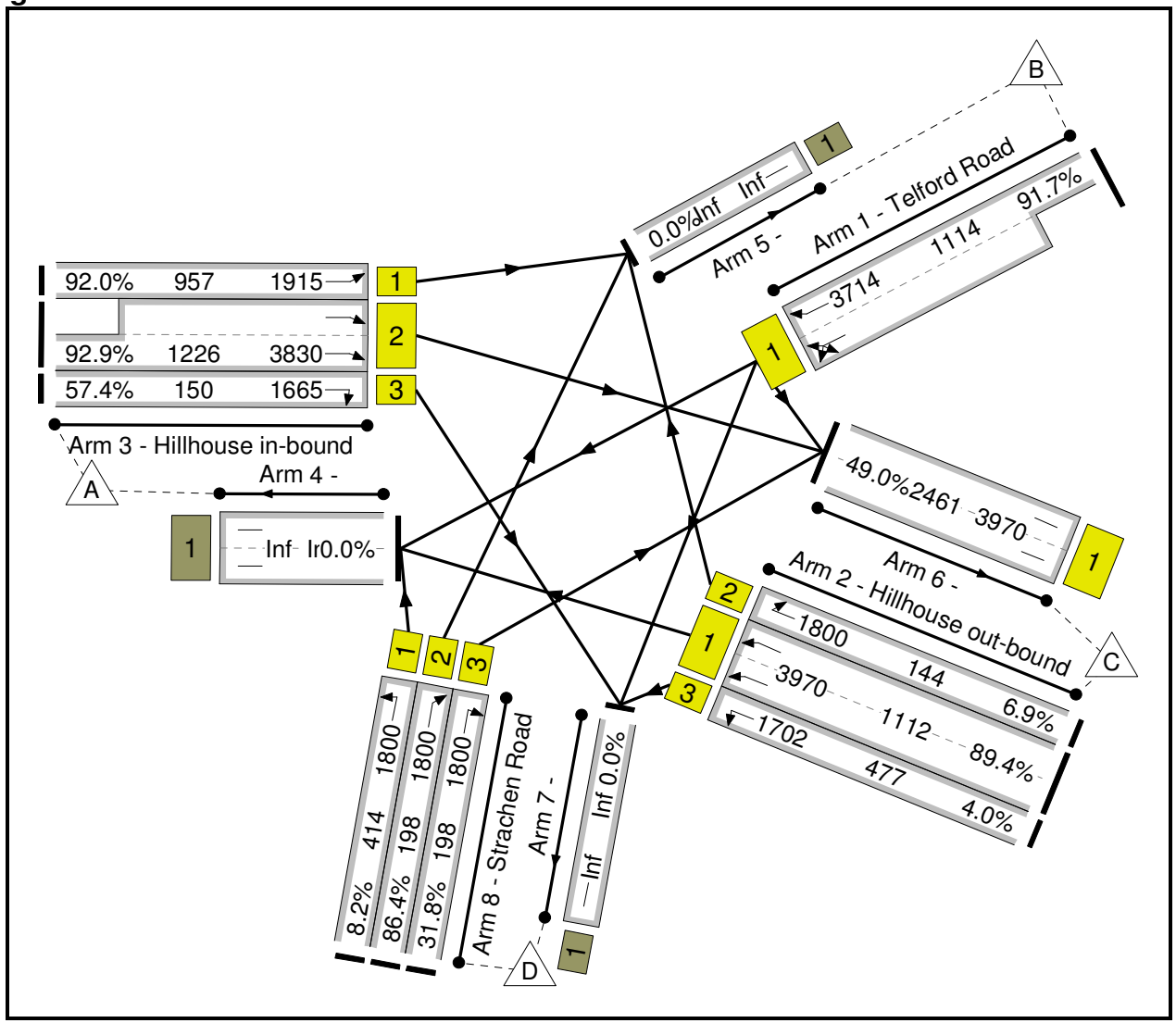
Stage Timings

Stage	1	2	4	5	6
Duration	24	7	7	5	6
Change Point	0	38	55	70	86

Signal Timings Diagram



Junction Layout Diagram



Link Results

Link Num	Link Desc	Link Type	Stage Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Max Sat Flow (pcu/Hr)	Ave Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
1/1	Telford Road Ahead Left Left2	U	N/A	N/A	I		1	29	-	1022	3919	3714	1114	91.7
2/1	Hillhouse out-bound Ahead	U	N/A	N/A	C		1	27	-	994	3970	3970	1112	89.4
2/2	Hillhouse out-bound Right	U	N/A	N/A	E		1	7	-	10	1800	1800	144	6.9
2/3	Hillhouse out-bound Left	U	N/A	N/A	C		1	27	-	19	1702	1702	477	4.0
3/1	Hillhouse in-bound Ahead	U	N/A	N/A	A		1	49	-	881	1915	1915	957	92.0
3/2	Hillhouse in-bound Ahead	U	N/A	N/A	B		1	31	-	1139	3830	3830	1226	92.9
3/3	Hillhouse in-bound Right	U	N/A	N/A	D		1	8	-	86	1665	1665	150	57.4
4/1		U	N/A	N/A	-		-	-	-	1957	Inf	Inf	Inf	0.0
5/1		U	N/A	N/A	-		-	-	-	1062	Inf	Inf	Inf	0.0
6/1		U	N/A	N/A	J		1	61	-	1206	3970	3970	2461	49.0
7/1		U	N/A	N/A	-		-	-	-	194	Inf	Inf	Inf	0.0
8/1	Strachen Road Left	U	N/A	N/A	G	F	1	22	12	34	1800	1800	414	8.2
8/2	Strachen Road Right	U	N/A	N/A	G		1	10	-	171	1800	1800	198	86.4

Full Input Data And Results

8/3	Strachen Road Right	U	N/A	N/A	G		1	10	-	63	1800	1800	198	31.8
Link Num	**Entering (pcu)**	**Leaving (pcu)**	**Turners In Gaps (pcu)**	**Turners When Unopposed (pcu)**	**Turners In Intergreen (pcu)**	**Uniform Delay (pcuHr)**	**Rand + Oversat Delay (pcuHr)**	**Storage Area Uniform Delay (pcuHr)**	**Total Delay (pcuHr)**	**Av. Delay Per Veh (s/pcu)**	**Max. Back of Uniform Queue (pcu)**	**Rand + Oversat Queue (pcu)**	**Mean Max Queue (pcu)**	
1/1	1022	1022	-	-	-	9.4	5.0	-	14.4	50.8	26.7	5.0	31.7	
2/1	994	994	-	-	-	9.5	4.0	-	13.5	48.9	26.5	4.0	30.5	
2/2	10	10	-	-	-	0.1	0.0	-	0.2	56.2	0.3	0.0	0.3	
2/3	19	19	-	-	-	0.1	0.0	-	0.2	30.2	0.4	0.0	0.4	
3/1	881	881	-	-	-	5.7	5.1	-	10.7	43.9	22.5	5.1	27.6	
3/2	1139	1139	-	-	-	10.4	5.8	-	16.2	51.2	30.4	5.8	36.2	
3/3	86	86	-	-	-	1.0	0.7	-	1.7	71.3	2.3	0.7	2.9	
4/1	1957	1957	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
5/1	1062	1062	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
6/1	1206	1206	-	-	-	0.1	0.0	-	0.1	0.2	0.2	0.0	0.2	
7/1	194	194	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
8/1	34	34	-	-	-	0.3	0.0	-	0.3	35.0	0.7	0.0	0.8	
8/2	171	171	-	-	-	2.1	2.6	-	4.7	99.5	4.7	2.6	7.3	
8/3	63	63	-	-	-	0.7	0.2	-	1.0	54.4	1.6	0.2	1.8	

PRC for Signalled Links (%): -3.3 Total Delay for Signalled Links (pcuHr): 62.96
PRC Over All Links (%): -3.3 Total Delay Over All Links(pcuHr): 62.96 Cycle Time (s): 100

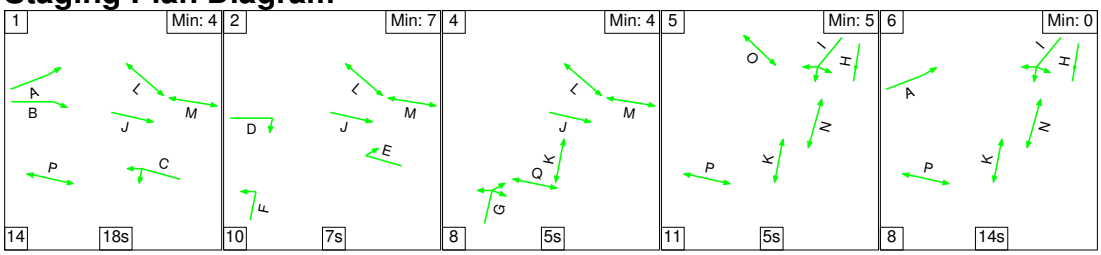
Full Input Data And Results

Scenario 2: 'PM Worst Case'

Staging Plan 1: 'Staging Plan No. 1'

Flow Group 2: 'PM 2008 CTC'

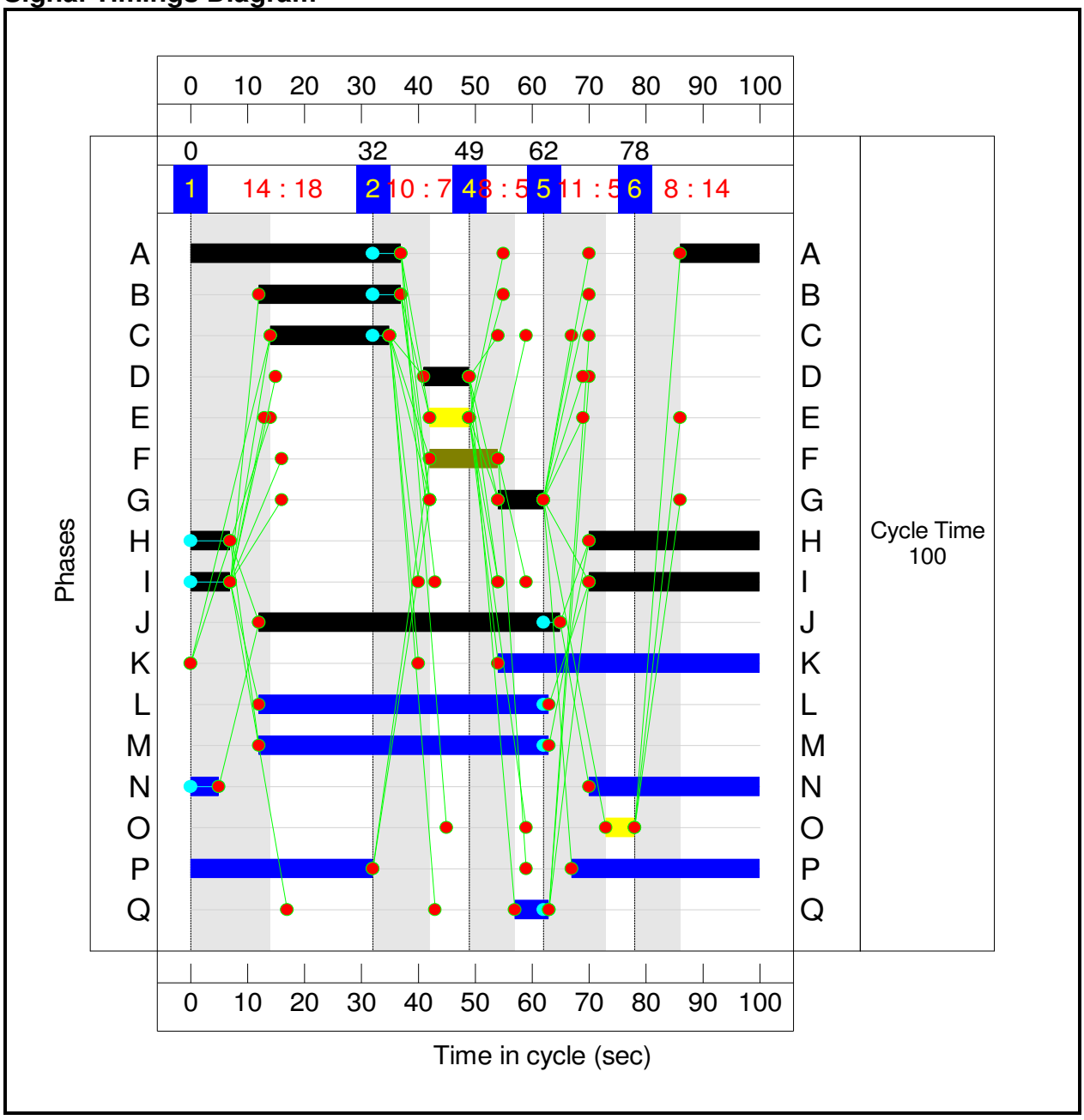
Staging Plan Diagram



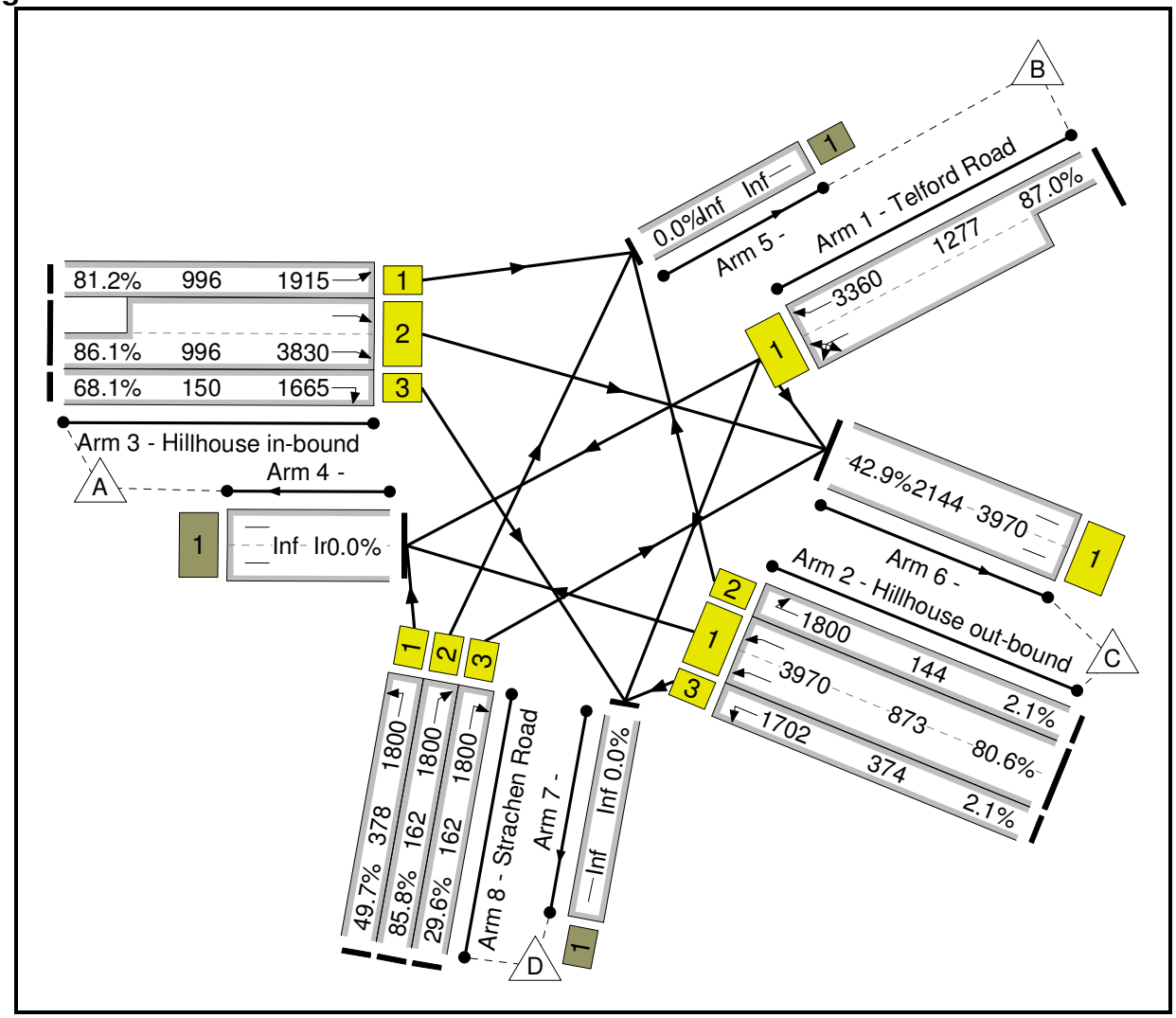
Stage Timings

Stage	1	2	4	5	6
Duration	18	7	5	5	14
Change Point	0	32	49	62	78

Signal Timings Diagram



Junction Layout Diagram



Link Results

Link Num	Link Desc	Link Type	Stage Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Max Sat Flow (pcu/Hr)	Ave Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
1/1	Telford Road Ahead Left Left2	U	N/A	N/A	I		1	37	-	1111	3920	3360	1277	87.0
2/1	Hillhouse out-bound Ahead	U	N/A	N/A	C		1	21	-	704	3970	3970	873	80.6
2/2	Hillhouse out-bound Right	U	N/A	N/A	E		1	7	-	3	1800	1800	144	2.1
2/3	Hillhouse out-bound Left	U	N/A	N/A	C		1	21	-	8	1702	1702	374	2.1
3/1	Hillhouse in-bound Ahead	U	N/A	N/A	A		1	51	-	809	1915	1915	996	81.2
3/2	Hillhouse in-bound Ahead	U	N/A	N/A	B		1	25	-	857	3830	3830	996	86.1
3/3	Hillhouse in-bound Right	U	N/A	N/A	D		1	8	-	102	1665	1665	150	68.1
4/1		U	N/A	N/A	-		-	-	-	1924	Inf	Inf	Inf	0.0
5/1		U	N/A	N/A	-		-	-	-	951	Inf	Inf	Inf	0.0
6/1		U	N/A	N/A	J		1	53	-	920	3970	3970	2144	42.9
7/1		U	N/A	N/A	-		-	-	-	174	Inf	Inf	Inf	0.0
8/1	Strachen Road Left	U	N/A	N/A	G	F	1	20	12	188	1800	1800	378	49.7
8/2	Strachen Road Right	U	N/A	N/A	G		1	8	-	139	1800	1800	162	85.8

Full Input Data And Results

8/3	Strachen Road Right	U	N/A	N/A	G		1	8	-	48	1800	1800	162	29.6
Link Num	**Entering (pcu)**	**Leaving (pcu)**	**Turners In Gaps (pcu)**	**Turners When Unopposed (pcu)**	**Turners In Intergreen (pcu)**	**Uniform Delay (pcuHr)**	**Rand + Oversat Delay (pcuHr)**	**Storage Area Uniform Delay (pcuHr)**	**Total Delay (pcuHr)**	**Av. Delay Per Veh (s/pcu)**	**Max. Back of Uniform Queue (pcu)**	**Rand + Oversat Queue (pcu)**	**Mean Max Queue (pcu)**	
1/1	1111	1111	-	-	-	8.3	3.2	-	11.5	37.3	26.5	3.2	29.8	
2/1	704	704	-	-	-	7.2	2.0	-	9.3	47.4	18.4	2.0	20.4	
2/2	3	3	-	-	-	0.0	0.0	-	0.0	55.5	0.1	0.0	0.1	
2/3	8	8	-	-	-	0.1	0.0	-	0.1	35.7	0.2	0.0	0.2	
3/1	809	809	-	-	-	4.5	2.1	-	6.6	29.4	18.7	2.1	20.8	
3/2	857	857	-	-	-	8.4	3.0	-	11.4	47.7	22.6	3.0	25.6	
3/3	102	102	-	-	-	1.2	1.0	-	2.3	80.2	2.7	1.0	3.7	
4/1	1924	1924	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
5/1	951	951	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
6/1	920	920	-	-	-	0.2	0.0	-	0.2	0.6	0.5	0.0	0.5	
7/1	174	174	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
8/1	188	188	-	-	-	1.8	0.5	-	2.3	44.3	4.6	0.5	5.1	
8/2	139	139	-	-	-	1.7	2.5	-	4.2	109.2	3.8	2.5	6.3	
8/3	48	48	-	-	-	0.6	0.2	-	0.8	58.3	1.2	0.2	1.4	

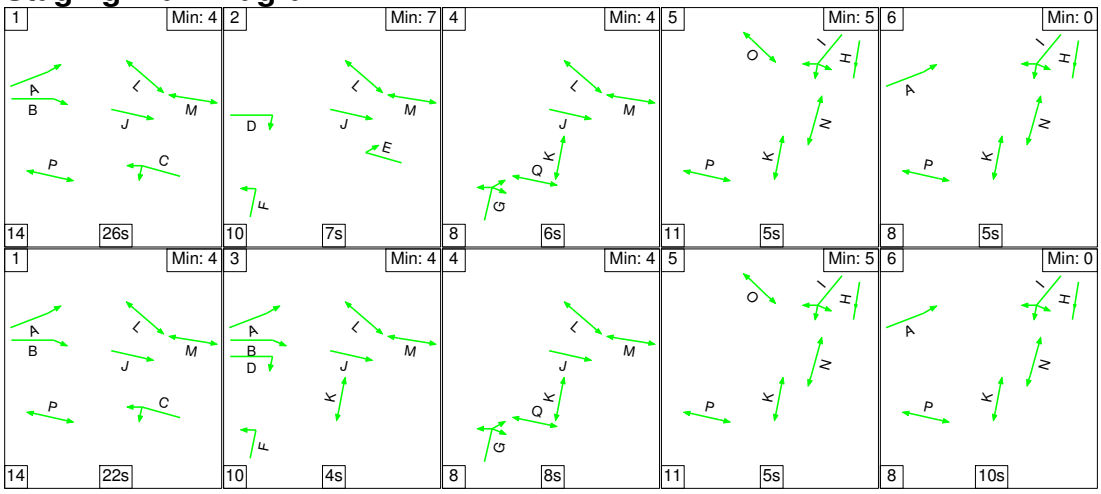
PRC for Signalled Links (%): 3.4 Total Delay for Signalled Links (pcuHr): 48.58
PRC Over All Links (%): 3.4 Total Delay Over All Links(pcuHr): 48.58 Cycle Time (s): 100

Scenario 3: 'AM Alternative Stage Sequence'

Staging Plan 2: 'Staging Plan No. 2'

Flow Group 1: 'AM 2008 CTC'

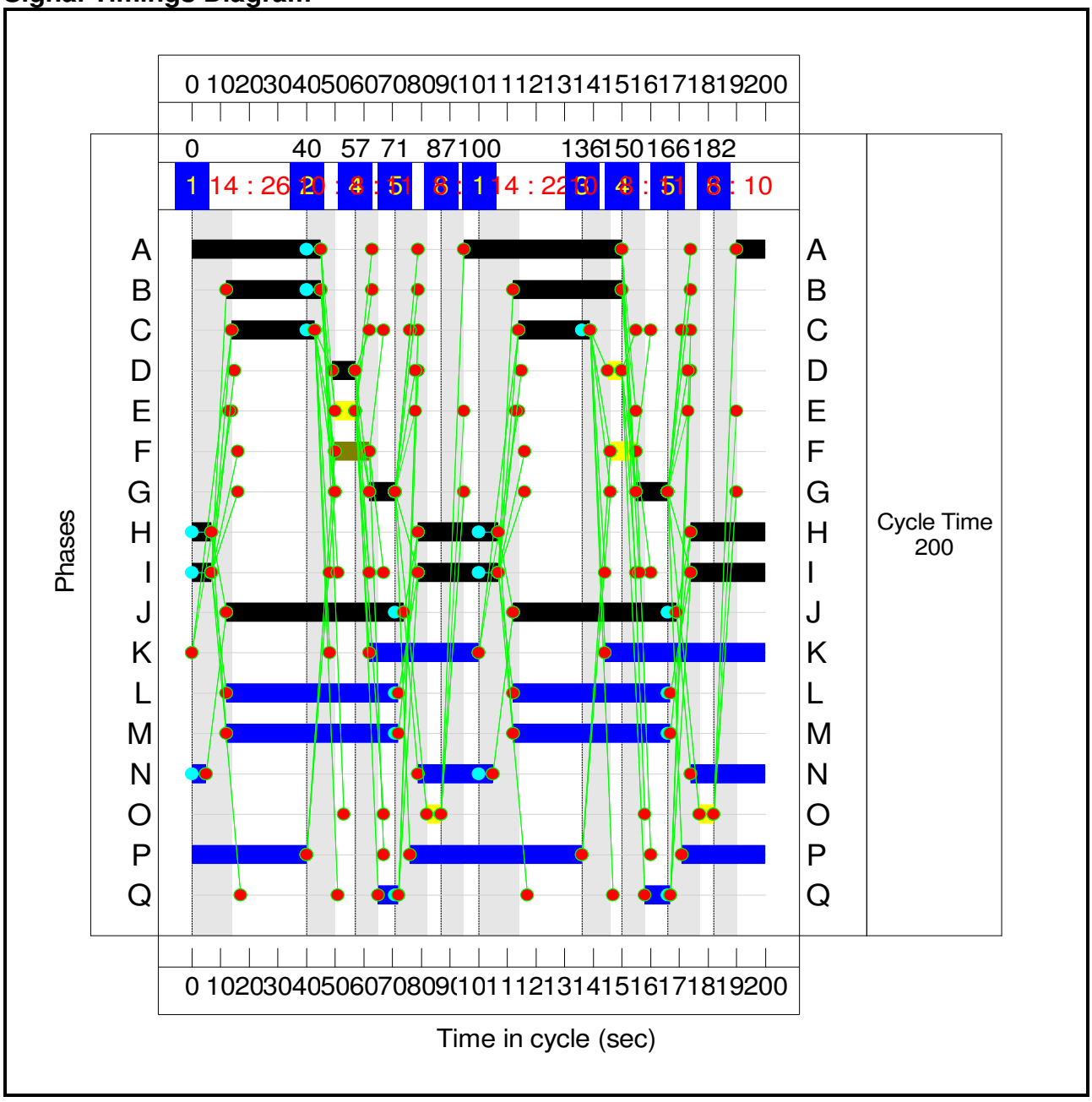
Staging Plan Diagram



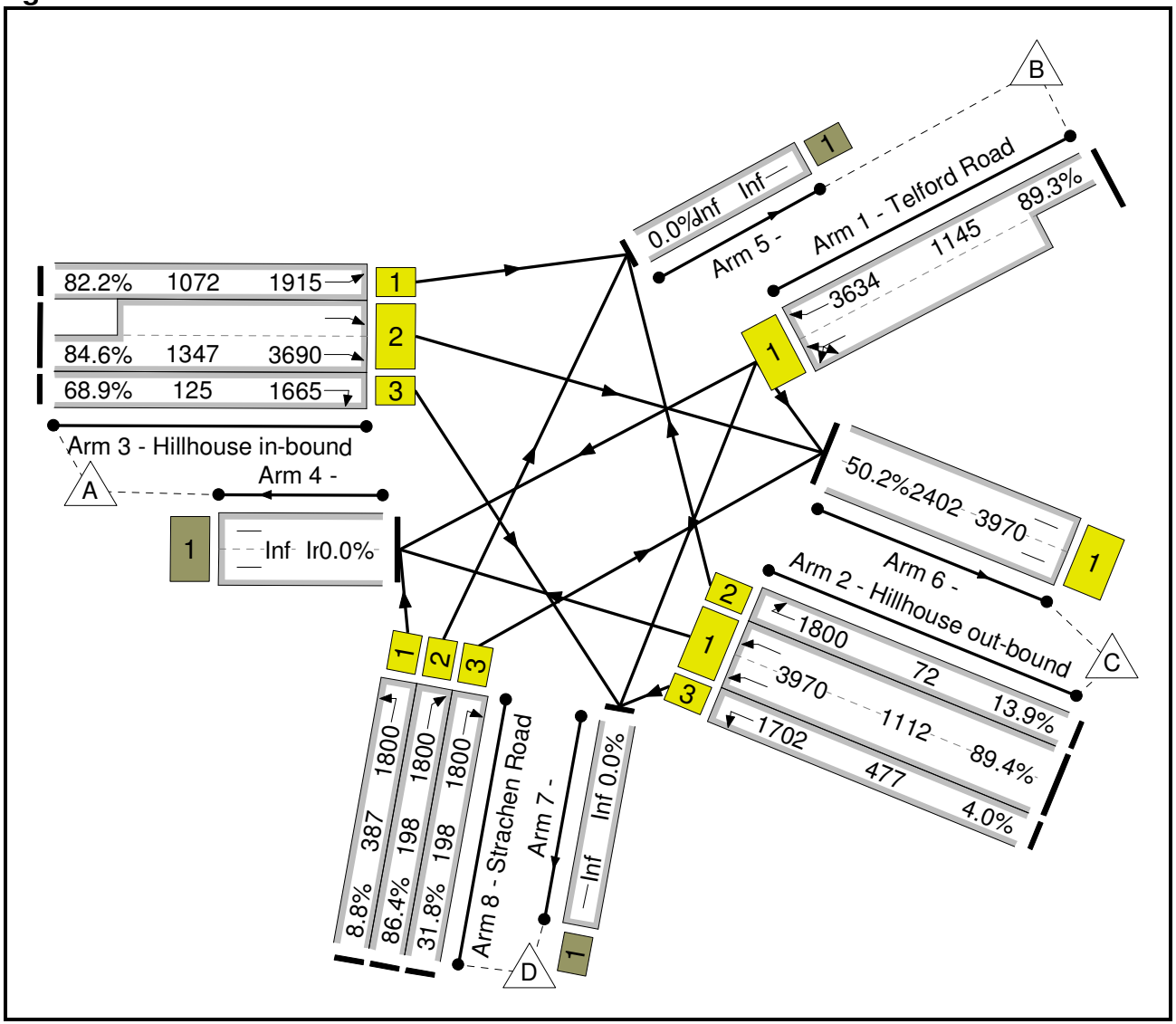
Stage Timings

Stage	1	2	4	5	6	1	3	4	5	6
Duration	26	7	6	5	5	22	4	8	5	10
Change Point	0	40	57	71	87	100	136	150	166	182

Signal Timings Diagram



Junction Layout Diagram



Link Results

Link Num	Link Desc	Link Type	Stage Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Max Sat Flow (pcu/Hr)	Ave Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
1/1	Telford Road Ahead Left Left2	U	N/A	N/A	I		2	61	-	1022	3919	3634	1145	89.3
2/1	Hillhouse out-bound Ahead	U	N/A	N/A	C		2	54	-	994	3970	3970	1112	89.4
2/2	Hillhouse out-bound Right	U	N/A	N/A	E		1	7	-	10	1800	1800	72	13.9
2/3	Hillhouse out-bound Left	U	N/A	N/A	C		2	54	-	19	1702	1702	477	4.0
3/1	Hillhouse in-bound Ahead	U	N/A	N/A	A		2	110	-	881	1915	1915	1072	82.2
3/2	Hillhouse in-bound Ahead	U	N/A	N/A	B		2	71	-	1139	3830	3690	1347	84.6
3/3	Hillhouse in-bound Right	U	N/A	N/A	D		2	13	-	86	1665	1665	125	68.9
4/1		U	N/A	N/A	-		-	-	-	1957	Inf	Inf	Inf	0.0
5/1		U	N/A	N/A	-		-	-	-	1062	Inf	Inf	Inf	0.0
6/1		U	N/A	N/A	J		2	119	-	1206	3970	3970	2402	50.2
7/1		U	N/A	N/A	-		-	-	-	194	Inf	Inf	Inf	0.0
8/1	Strachen Road Left	U	N/A	N/A	G	F	2	41	21	34	1800	1800	387	8.8
8/2	Strachen Road Right	U	N/A	N/A	G		2	20	-	171	1800	1800	198	86.4

Full Input Data And Results

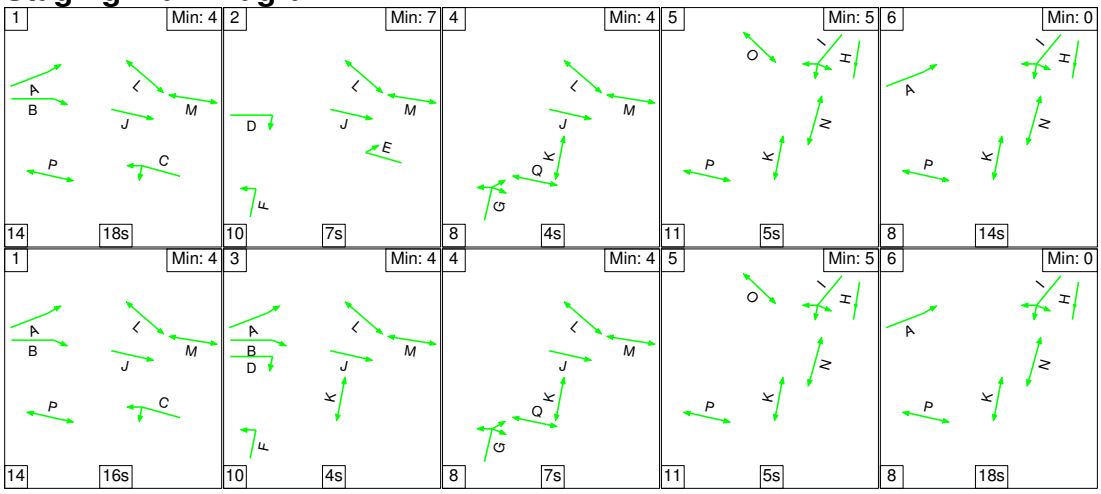
8/3	Strachen Road Right	U	N/A	N/A	G		2	20	-	63	1800	1800	198	31.8
Link Num	**Entering (pcu)**	**Leaving (pcu)**	**Turners In Gaps (pcu)**	**Turners When Unopposed (pcu)**	**Turners In Intergreen (pcu)**	**Uniform Delay (pcuHr)**	**Rand + Oversat Delay (pcuHr)**	**Storage Area Uniform Delay (pcuHr)**	**Total Delay (pcuHr)**	**Av. Delay Per Veh (s/pcu)**	**Max. Back of Uniform Queue (pcu)**	**Rand + Oversat Queue (pcu)**	**Mean Max Queue (pcu)**	
1/1	1022	1022	-	-	-	9.0	3.9	-	12.9	45.6	27.3	3.9	31.2	
2/1	994	994	-	-	-	9.6	4.0	-	13.5	48.9	27.1	4.0	31.0	
2/2	10	10	-	-	-	0.3	0.1	-	0.3	121.7	0.5	0.1	0.6	
2/3	19	19	-	-	-	0.1	0.0	-	0.2	30.2	0.4	0.0	0.4	
3/1	881	881	-	-	-	4.4	2.2	-	6.7	27.3	22.0	2.2	24.3	
3/2	1139	1139	-	-	-	9.1	2.7	-	11.8	37.2	29.4	2.7	32.1	
3/3	86	86	-	-	-	1.1	1.0	-	2.1	89.2	2.5	1.0	3.5	
4/1	1957	1957	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
5/1	1062	1062	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
6/1	1206	1206	-	-	-	0.1	0.0	-	0.1	0.2	0.3	0.0	0.3	
7/1	194	194	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
8/1	34	34	-	-	-	0.3	0.0	-	0.3	36.7	0.8	0.0	0.8	
8/2	171	171	-	-	-	2.1	2.6	-	4.7	99.7	4.9	2.6	7.6	
8/3	63	63	-	-	-	0.7	0.2	-	1.0	54.5	1.7	0.2	1.9	

PRC for Signalled Links (%): 0.6 Total Delay for Signalled Links (pcuHr): 53.64
PRC Over All Links (%): 0.6 Total Delay Over All Links(pcuHr): 53.64 Cycle Time (s): 200

Scenario 4: 'PM Alternative Stage Sequence'

Staging Plan 2: 'Staging Plan No. 2'
Flow Group 2: 'PM 2008 CTC'

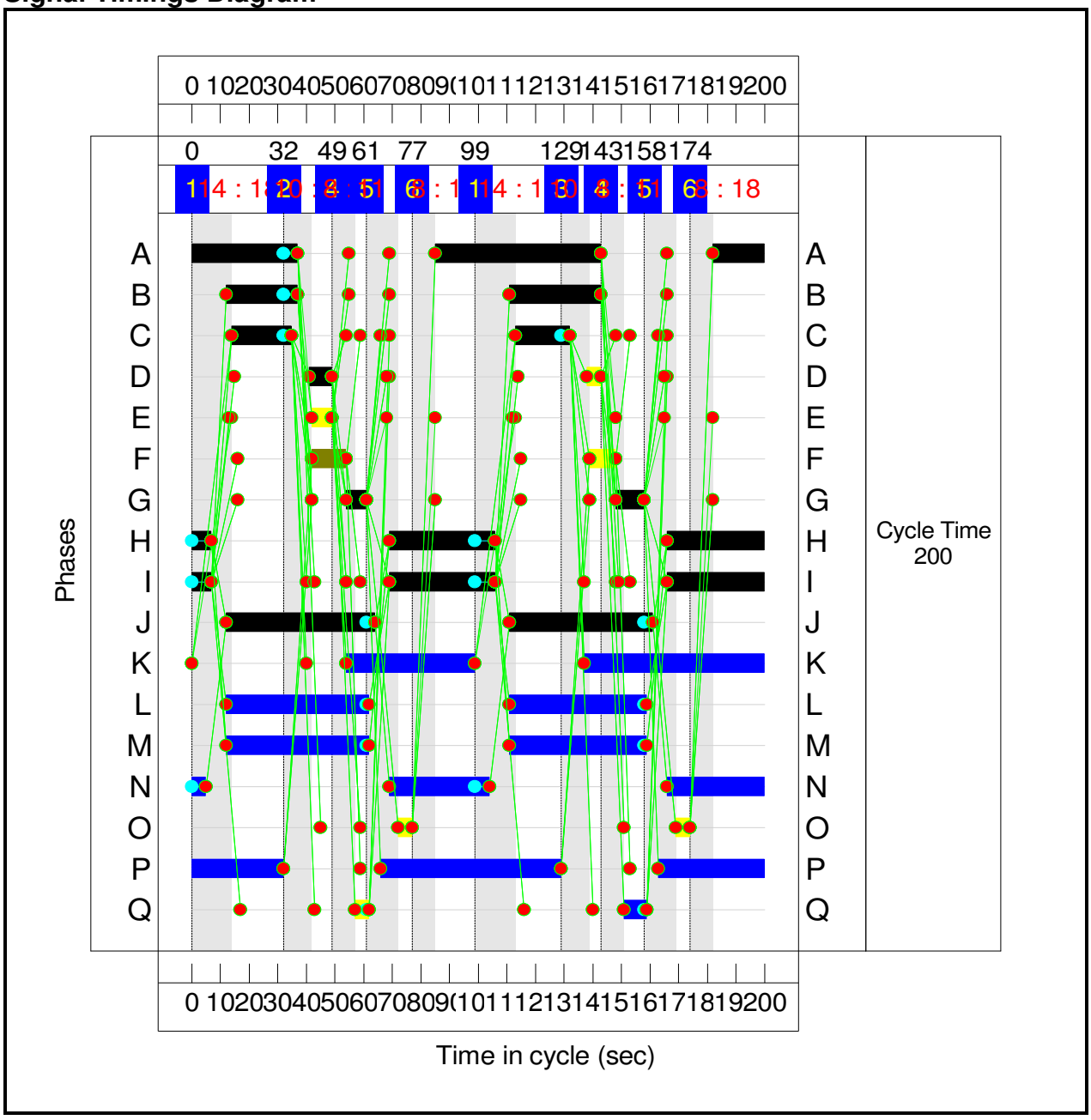
Staging Plan Diagram



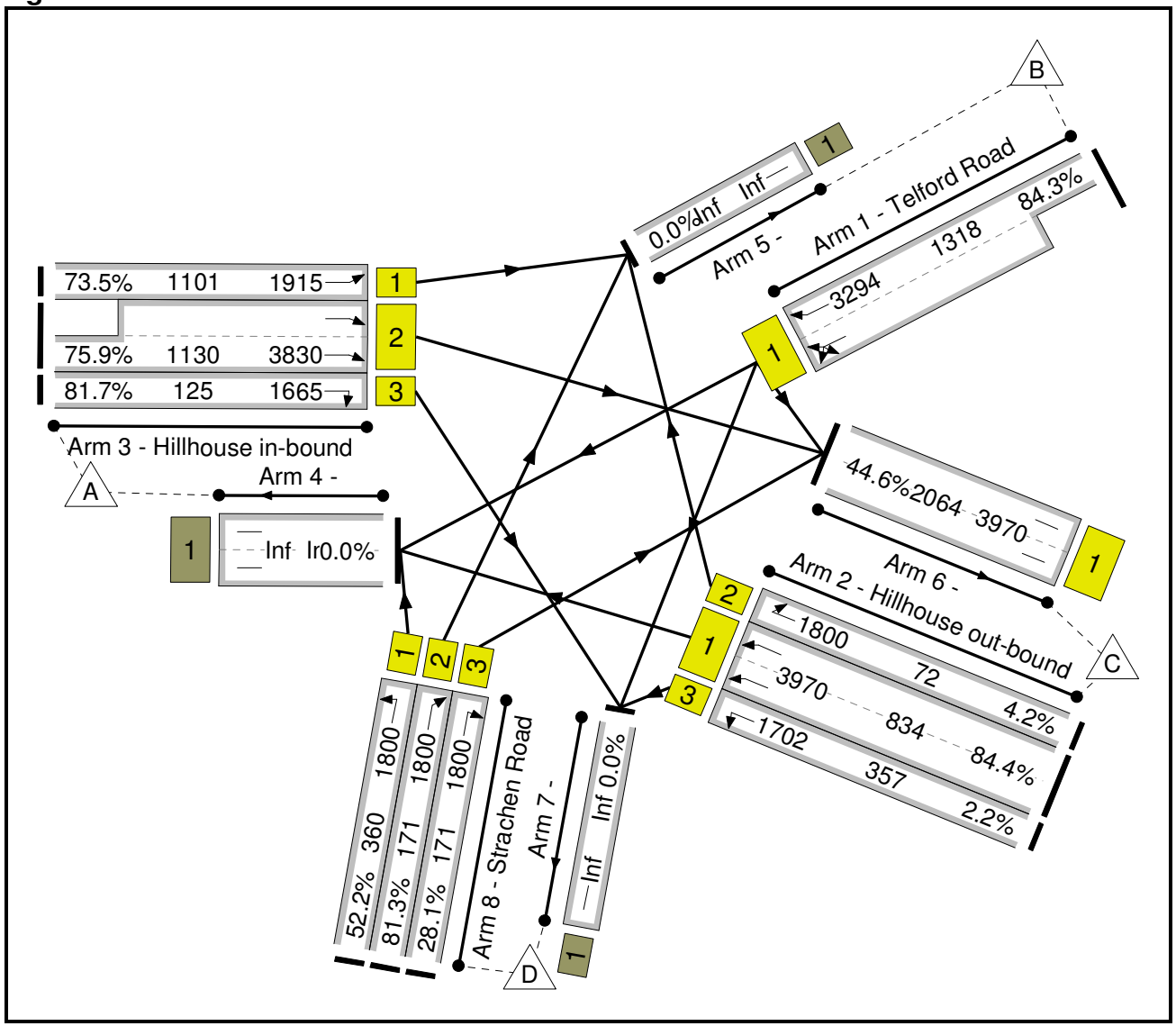
Stage Timings

Stage	1	2	4	5	6	1	3	4	5	6
Duration	18	7	4	5	14	16	4	7	5	18
Change Point	0	32	49	61	77	99	129	143	158	174

Signal Timings Diagram



Junction Layout Diagram



Link Results

Link Num	Link Desc	Link Type	Stage Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Max Sat Flow (pcu/Hr)	Ave Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
1/1	Telford Road Ahead Left Left2	U	N/A	N/A	I		2	78	-	1111	3920	3294	1318	84.3
2/1	Hillhouse out-bound Ahead	U	N/A	N/A	C		2	40	-	704	3970	3970	834	84.4
2/2	Hillhouse out-bound Right	U	N/A	N/A	E		1	7	-	3	1800	1800	72	4.2
2/3	Hillhouse out-bound Left	U	N/A	N/A	C		2	40	-	8	1702	1702	357	2.2
3/1	Hillhouse in-bound Ahead	U	N/A	N/A	A		2	113	-	809	1915	1915	1101	73.5
3/2	Hillhouse in-bound Ahead	U	N/A	N/A	B		2	57	-	857	3830	3830	1130	75.9
3/3	Hillhouse in-bound Right	U	N/A	N/A	D		2	13	-	102	1665	1665	125	81.7
4/1		U	N/A	N/A	-		-	-	-	1924	Inf	Inf	Inf	0.0
5/1		U	N/A	N/A	-		-	-	-	951	Inf	Inf	Inf	0.0
6/1		U	N/A	N/A	J		2	102	-	920	3970	3970	2064	44.6
7/1		U	N/A	N/A	-		-	-	-	174	Inf	Inf	Inf	0.0
8/1	Strachen Road Left	U	N/A	N/A	G	F	2	38	21	188	1800	1800	360	52.2
8/2	Strachen Road Right	U	N/A	N/A	G		2	17	-	139	1800	1800	171	81.3

Full Input Data And Results

8/3	Strachen Road Right	U	N/A	N/A	G		2	17	-	48	1800	1800	171	28.1
Link Num	**Entering (pcu)**	**Leaving (pcu)**	**Turners In Gaps (pcu)**	**Turners When Unopposed (pcu)**	**Turners In Intergreen (pcu)**	**Uniform Delay (pcuHr)**	**Rand + Oversat Delay (pcuHr)**	**Storage Area Uniform Delay (pcuHr)**	**Total Delay (pcuHr)**	**Av. Delay Per Veh (s/pcu)**	**Max. Back of Uniform Queue (pcu)**	**Rand + Oversat Queue (pcu)**	**Mean Max Queue (pcu)**	
1/1	1111	1111	-	-	-	7.8	2.6	-	10.4	33.6	26.2	2.6	28.9	
2/1	704	704	-	-	-	7.4	2.6	-	10.0	51.3	19.2	2.6	21.8	
2/2	3	3	-	-	-	0.1	0.0	-	0.1	118.7	0.2	0.0	0.2	
2/3	8	8	-	-	-	0.1	0.0	-	0.1	36.8	0.2	0.0	0.2	
3/1	809	809	-	-	-	3.6	1.4	-	4.9	21.9	18.2	1.4	19.6	
3/2	857	857	-	-	-	7.6	1.6	-	9.2	38.6	22.4	1.6	23.9	
3/3	102	102	-	-	-	1.3	1.9	-	3.2	113.1	2.9	1.9	4.8	
4/1	1924	1924	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
5/1	951	951	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
6/1	920	920	-	-	-	0.2	0.0	-	0.2	0.6	0.6	0.0	0.6	
7/1	174	174	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
8/1	188	188	-	-	-	1.9	0.5	-	2.4	46.2	4.8	0.5	5.3	
8/2	139	139	-	-	-	1.7	1.9	-	3.7	94.7	3.9	1.9	5.9	
8/3	48	48	-	-	-	0.6	0.2	-	0.8	56.8	1.3	0.2	1.5	

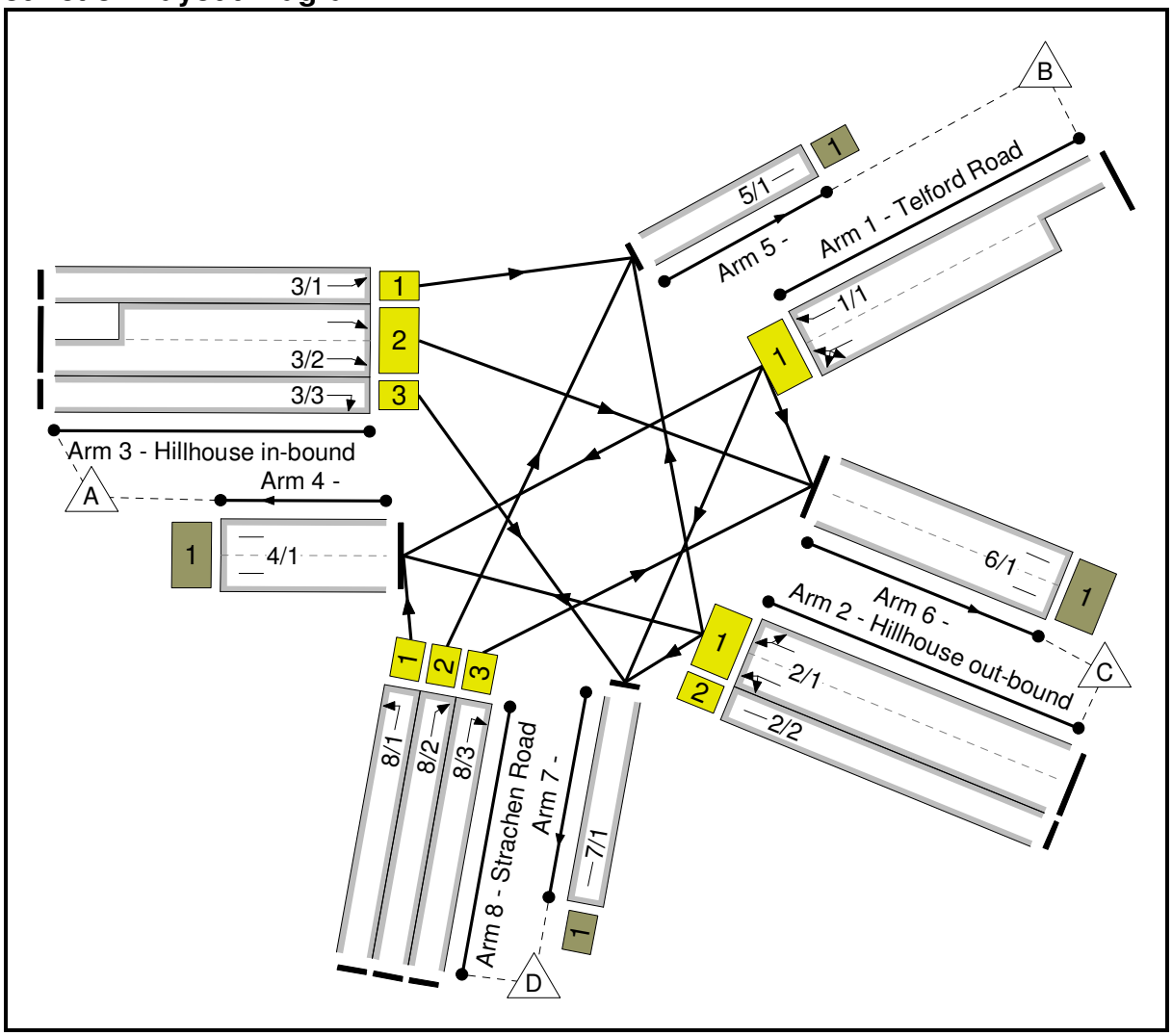
PRC for Signalled Links (%): 6.6 Total Delay for Signalled Links (pcuHr): 44.89
PRC Over All Links (%): 6.6 Total Delay Over All Links(pcuHr): 44.89 Cycle Time (s): 200

Full Input Data And Results

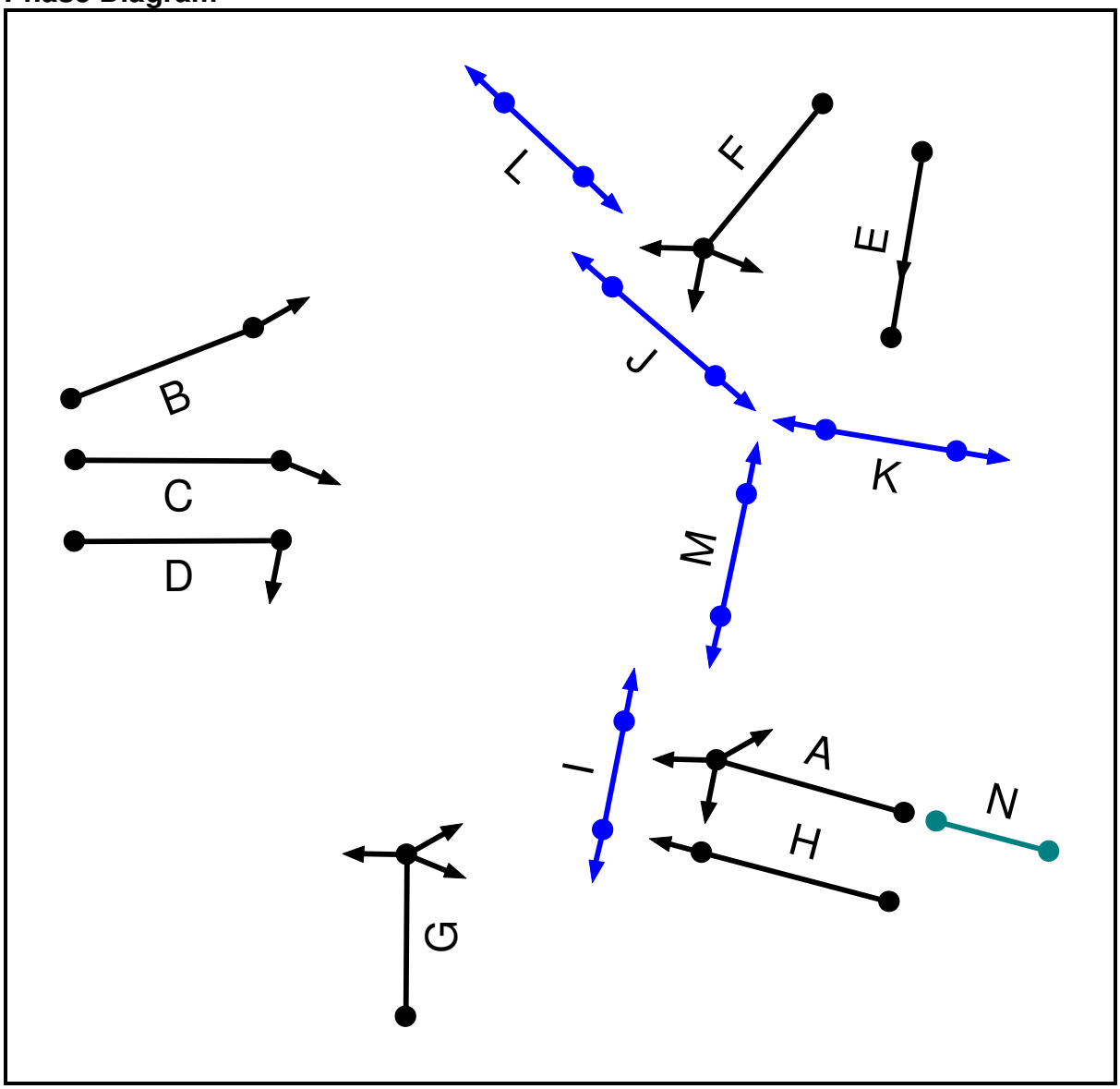
User and Project Details

Project:	**A90 Out-bound Bus Priority Study**
Title:	**Option 1 Model**
Location:	A90 Hillhouse Road / A902 Telford Road, Edinburgh.
File name:	Blackhall proposed option 1.lsgx
Author:	R Bishop
Company:	White Young Green
Address:	Avalon Way, Anstey, Leicestershire LE7 7GR
Controller:	Generic
SCN:	115
Notes:	

Junction Layout Diagram



Phase Diagram



Phase Input Data

Phase Name	Phase type	Assoc Phase	Street Min	Cont Min
A	Traffic		-9999	7
B	Traffic		-9999	7
C	Traffic		-9999	7
D	Traffic		-9999	5
E	Traffic		-9999	7
F	Traffic		-9999	7
G	Traffic		-9999	4
H	Traffic		-9999	5
I	Pedestrian		-9999	10
J	Pedestrian		-9999	5
K	Pedestrian		-9999	5
L	Pedestrian		-9999	6
M	Pedestrian		-9999	5
N	Dummy		-9999	10

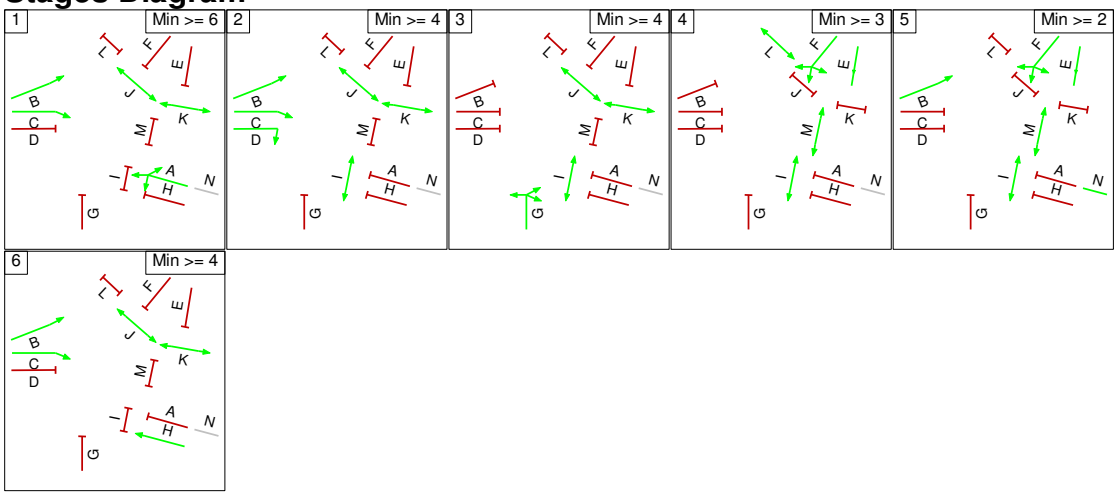
Phase Intergreens Matrix

		Starting Phase													
		A	B	C	D	E	F	G	H	I	J	K	L	M	N
Terminating Phase	A		-	-	7	-	5	6	4	5	-	-	10	-	-
	B	-		-	-	-	-	5	-	-	-	-	8	-	-
	C	-	-		-	9	6	5	-	-	-	-	-	9	-
	D	5	-	-		-	5	5	5	-	-	-	-	-	-
	E	-	-	5	-		-	5	-	-	-	5	-	-	-
	F	7	-	5	8	-		8	7	-	5	-	-	-	-
	G	5	6	6	5	11	5		5	-	-	-	9	10	-
	H	4	-	-	5	-	5	7		5	-	-	-	-	-
	I	7	-	-	-	-	-	-	7		-	-	-	-	-
	J	-	-	-	-	-	8	-	-	-		-	-	-	-
	K	-	-	-	-	8	-	-	-	-	-		-	-	-
	L	6	8	-	-	-	-	8	-	-	-	-		-	-
	M	-	-	8	-	-	-	6	-	-	-	-	-		-
	N	-	-	-	-	-	-	-	-	-	-	-	-	-	

Phases in Stage

Stage No.	Phases in Stage
1	A B C J K
2	B C D I J K
3	G I J K
4	E F I L M
5	B E F I M N
6	B C H J K

Stages Diagram



Phase Delays

Term. Stage	Start Stage	Phase	Type	Value	Cont value
1	3	B	Losing	1	1
1	3	C	Losing	1	1
1	4	A	Losing	2	2
1	4	B	Losing	2	2
1	4	C	Losing	2	2
1	4	K	Losing	3	3
1	5	A	Losing	2	2
1	5	C	Losing	2	2
1	5	K	Losing	3	3
2	3	B	Losing	2	2
2	3	C	Losing	2	2
2	3	D	Losing	2	2
2	4	C	Losing	2	2
2	4	D	Losing	2	2
2	4	K	Losing	3	3
2	5	C	Losing	2	2
2	5	D	Losing	2	2
2	5	K	Losing	3	3
2	6	D	Losing	2	2
3	1	G	Losing	3	3
3	1	I	Losing	1	1
3	2	G	Losing	3	3
3	4	G	Losing	3	3
3	4	K	Losing	6	6
3	5	G	Losing	3	3
3	5	K	Losing	6	6
3	6	G	Losing	3	3
3	6	I	Losing	1	1
4	1	E	Losing	1	1
4	1	F	Losing	1	1
4	1	I	Losing	1	1
4	2	E	Losing	1	1
4	3	E	Losing	3	3
4	3	M	Losing	2	2

Full Input Data And Results

4	6	E	Losing	1	1
4	6	F	Losing	1	1
4	6	I	Losing	1	1
5	1	E	Losing	3	3
5	1	F	Losing	3	3
5	1	I	Losing	3	3
5	2	E	Losing	2	2
5	2	F	Losing	2	2
5	3	B	Losing	5	5
5	3	E	Losing	2	2
5	3	F	Losing	2	2
5	3	M	Losing	4	4
5	6	E	Losing	3	3
5	6	F	Losing	3	3
5	6	I	Losing	3	3

Prohibited Stage Changes

		To Stage					
		1	2	3	4	5	6
From Stage	1		7	6	12	11	4
	2	X		7	11	11	7
	3	9	9		14	14	9
	4	8	8	8		8	8
	5	10	10	10	X		10
	6	4	X	X	X	X	

Link Input Data

Arm/ Link	Link Name	Link Type	Num Lanes	Phases	Start Disp.	End Disp.
1/1	Telford Road Ahead Left Left2	U	2	F	2	3
2/1	Hillhouse out-bound Ahead Right Left	U	2	A	2	3
2/2	Hillhouse out-bound	U	1	H	2	3
3/1	Hillhouse in-bound Ahead	U	1	B	2	3
3/2	Hillhouse in-bound Ahead	U	2	C	2	3
3/3	Hillhouse in-bound Right	U	1	D	2	3
4/1		U	2		2	3
5/1		U	1		2	3
6/1		U	2		2	3
7/1		U	1		2	3
8/1	Strachen Road Left	U	1	G	2	3
8/2	Strachen Road Right	U	1	G	2	3
8/3	Strachen Road Right	U	1	G	2	3

Lane Input Data

Arm/ Lane	Link Num	Physical Length (PCU)	Expected Usage (PCU)	Sat Flow Type	User Saturation Flow (PCU/Hr)	Lane Width (m)	Gradient	Nearside Lane	Allowed Turns	Turning Radius (m)
1/1 (Telford Road Lane 1)	Link 1 (Telford Road Ahead Left Left2)	14.0	14.0	Geom	1800	3.30	0.00	Y	Arm 4 Ahead	60.00
									Arm 6 Left	15.00
									Arm 7 Left	25.00
1/2 (Telford Road Lane 2)	Link 1 (Telford Road Ahead Left Left2)	Inf	Inf	Geom	1800	3.30	0.00	N	Arm 4 Ahead	60.00
2/1 (Hillhouse out-bound Lane 1)	Link 2 (Hillhouse out-bound)	Inf	Inf	User	1800	3.25	0.00	Y		
2/2 (Hillhouse out-bound Lane 2)	Link 1 (Hillhouse out-bound Ahead Right Left)	Inf	Inf	Geom	1800	3.00	0.00	Y	Arm 4 Ahead	Inf
									Arm 7 Left	Inf
2/3 (Hillhouse out-bound Lane 3)	Link 1 (Hillhouse out-bound Ahead Right Left)	Inf	Inf	Geom	1800	3.00	0.00	N	Arm 4 Ahead	Inf
									Arm 5 Right	Inf
3/1 (Hillhouse in-bound Lane 1)	Link 1 (Hillhouse in-bound Ahead)	Inf	Inf	Geom	1800	3.00	0.00	Y	Arm 5 Ahead	Inf
3/2 (Hillhouse in-bound Lane 2)	Link 2 (Hillhouse in-bound Ahead)	18.0	18.0	Geom	1800	3.00	0.00	Y	Arm 6 Ahead	Inf
3/3 (Hillhouse in-bound Lane 3)	Link 2 (Hillhouse in-bound Ahead)	Inf	Inf	Geom	1800	3.00	0.00	Y	Arm 6 Ahead	Inf
3/4 (Hillhouse in-bound Lane 4)	Link 3 (Hillhouse in-bound Right)	Inf	Inf	Geom	1800	3.00	0.00	Y	Arm 7 Right	10.00
4/1	Link 1	Inf	Inf	Inf (Exit)	1800	3.25	0.00	Y		
4/2	Link 1	Inf	Inf	Inf (Exit)	1800	3.25	0.00	Y		

5/1	Link 1	Inf	Inf	Inf (Exit)	1800	3.25	0.00	Y		
6/1	Link 1	Inf	Inf	Inf (Exit)	1800	3.25	0.00	Y		
6/2	Link 1	Inf	Inf	Inf (Exit)	1800	3.25	0.00	Y		
7/1	Link 1	Inf	Inf	Inf (Exit)	1800	3.25	0.00	Y		
8/1 (Strachen Road Lane 1)	Link 1 (Strachen Road Left)	Inf	Inf	User	1800	3.25	0.00	Y	Arm 4 Left	Inf
8/2 (Strachen Road Lane 2)	Link 2 (Strachen Road Right)	Inf	Inf	User	1800	3.25	0.00	Y	Arm 5 Right	Inf
8/3 (Strachen Road Lane 3)	Link 3 (Strachen Road Right)	Inf	Inf	User	1800	3.25	0.00	Y	Arm 6 Right	Inf

Traffic Flow Groups

Flow Group	Start Time	End Time	Duration	Formula
1: 'AM 2008 CTC'	07:45	08:45	01:00	
2: 'PM 2008 CTC'	17:00	18:00	01:00	

Flow Group 1: 'AM 2008 CTC'

Traffic Flow Matrix

Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	881	1139	86	2106
	B	929	0	4	89	1022
	C	994	10	0	19	1023
	D	34	171	63	0	268
	Tot.	1957	1062	1206	194	4419

Link Traffic Flows

Arm/Link	Flow Group 1: AM 2008 CTC
1/1	1022
2/1	1023
2/2	0
3/1	881
3/2	1139
3/3	86
4/1	1957
5/1	1062
6/1	1206
7/1	194
8/1	34
8/2	171
8/3	63

Lane Saturation Flows

Arm/ Lane	Lane Width (m)	Gradient	Nearside Lane	Allowed Turns	Turning Radius (m)	Turning Prop.	Sat flow (PCU/Hr)
1/1 (Telford Road Lane 1)	3.30	0.00	Y	Arm 4 Ahead	60.00	81.8 %	1885
				Arm 6 Left	15.00	0.8 %	
				Arm 7 Left	25.00	17.4 %	
1/2 (Telford Road Lane 2)	3.30	0.00	N	Arm 4 Ahead	60.00	100.0 %	2034
2/1 (Hillhouse out-bound Lane 1)	This lane uses a directly entered Saturation Flow						1800
2/2 (Hillhouse out-bound Lane 2)	3.00	0.00	Y	Arm 4 Ahead	Inf	96.3 %	1915
				Arm 7 Left	Inf	3.7 %	
2/3 (Hillhouse out-bound Lane 3)	3.00	0.00	N	Arm 4 Ahead	Inf	98.0 %	2055
				Arm 5 Right	Inf	2.0 %	
3/1 (Hillhouse in-bound Lane 1)	3.00	0.00	Y	Arm 5 Ahead	Inf	100.0 %	1915
3/2 (Hillhouse in-bound Lane 2)	3.00	0.00	Y	Arm 6 Ahead	Inf	100.0 %	1915
3/3 (Hillhouse in-bound Lane 3)	3.00	0.00	Y	Arm 6 Ahead	Inf	100.0 %	1915
3/4 (Hillhouse in-bound Lane 4)	3.00	0.00	Y	Arm 7 Right	10.00	100.0 %	1665
4/1	Infinite Saturation Flow (on Exit Link)						Inf
4/2	Infinite Saturation Flow (on Exit Link)						Inf
5/1	Infinite Saturation Flow (on Exit Link)						Inf
6/1	Infinite Saturation Flow (on Exit Link)						Inf
6/2	Infinite Saturation Flow (on Exit Link)						Inf
7/1	Infinite Saturation Flow (on Exit Link)						Inf
8/1 (Strachen Road Lane 1)	This lane uses a directly entered Saturation Flow						1800
8/2 (Strachen Road Lane 2)	This lane uses a directly entered Saturation Flow						1800
8/3 (Strachen Road Lane 3)	This lane uses a directly entered Saturation Flow						1800

Flow Group 2: 'PM 2008 CTC'

Traffic Flow Matrix

Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	809	857	102	1768
	B	1032	0	15	64	1111
	C	704	3	0	8	715
	D	188	139	48	0	375
	Tot.	1924	951	920	174	3969

Link Traffic Flows

Arm/Link	Flow Group 2: PM 2008 CTC
1/1	1111
2/1	715
2/2	0
3/1	809
3/2	857
3/3	102
4/1	1924
5/1	951
6/1	920
7/1	174
8/1	188
8/2	139
8/3	48

Lane Saturation Flows

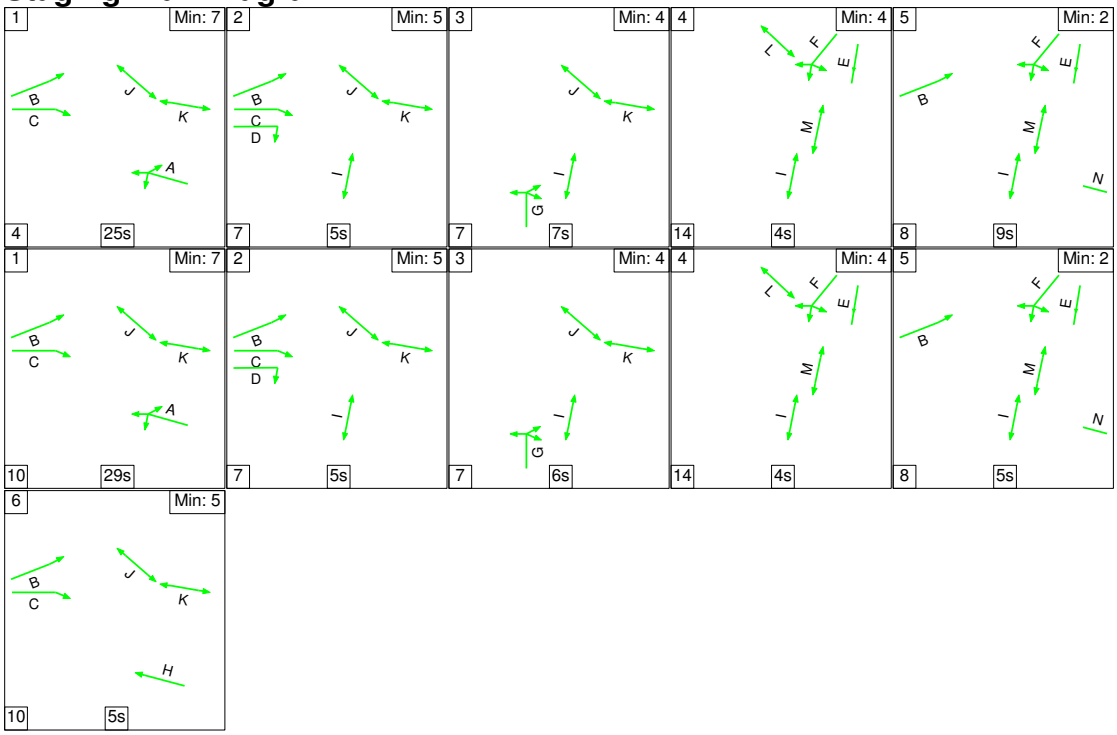
Arm/ Lane	Lane Width (m)	Gradient	Nearside Lane	Allowed Turns	Turning Radius (m)	Turning Prop.	Sat flow (PCU/Hr)
1/1 (Telford Road Lane 1)	3.30	0.00	Y	Arm 4 Ahead	60.00	85.8 %	1886
				Arm 6 Left	15.00	2.7 %	
				Arm 7 Left	25.00	11.5 %	
1/2 (Telford Road Lane 2)	3.30	0.00	N	Arm 4 Ahead	60.00	100.0 %	2034
2/1 (Hillhouse out-bound Lane 1)	This lane uses a directly entered Saturation Flow						1800
2/2 (Hillhouse out-bound Lane 2)	3.00	0.00	Y	Arm 4 Ahead	Inf	97.8 %	1915
				Arm 7 Left	Inf	2.2 %	
2/3 (Hillhouse out-bound Lane 3)	3.00	0.00	N	Arm 4 Ahead	Inf	99.2 %	2055
				Arm 5 Right	Inf	0.8 %	
3/1 (Hillhouse in-bound Lane 1)	3.00	0.00	Y	Arm 5 Ahead	Inf	100.0 %	1915
3/2 (Hillhouse in-bound Lane 2)	3.00	0.00	Y	Arm 6 Ahead	Inf	100.0 %	1915
3/3 (Hillhouse in-bound Lane 3)	3.00	0.00	Y	Arm 6 Ahead	Inf	100.0 %	1915
3/4 (Hillhouse in-bound Lane 4)	3.00	0.00	Y	Arm 7 Right	10.00	100.0 %	1665
4/1	Infinite Saturation Flow (on Exit Link)						Inf
4/2	Infinite Saturation Flow (on Exit Link)						Inf
5/1	Infinite Saturation Flow (on Exit Link)						Inf
6/1	Infinite Saturation Flow (on Exit Link)						Inf
6/2	Infinite Saturation Flow (on Exit Link)						Inf
7/1	Infinite Saturation Flow (on Exit Link)						Inf
8/1 (Strachen Road Lane 1)	This lane uses a directly entered Saturation Flow						1800
8/2 (Strachen Road Lane 2)	This lane uses a directly entered Saturation Flow						1800
8/3 (Strachen Road Lane 3)	This lane uses a directly entered Saturation Flow						1800

Scenario 1: 'AM Peak'

Staging Plan 1: 'Staging Plan No. 1'

Flow Group 1: 'AM 2008 CTC'

Staging Plan Diagram

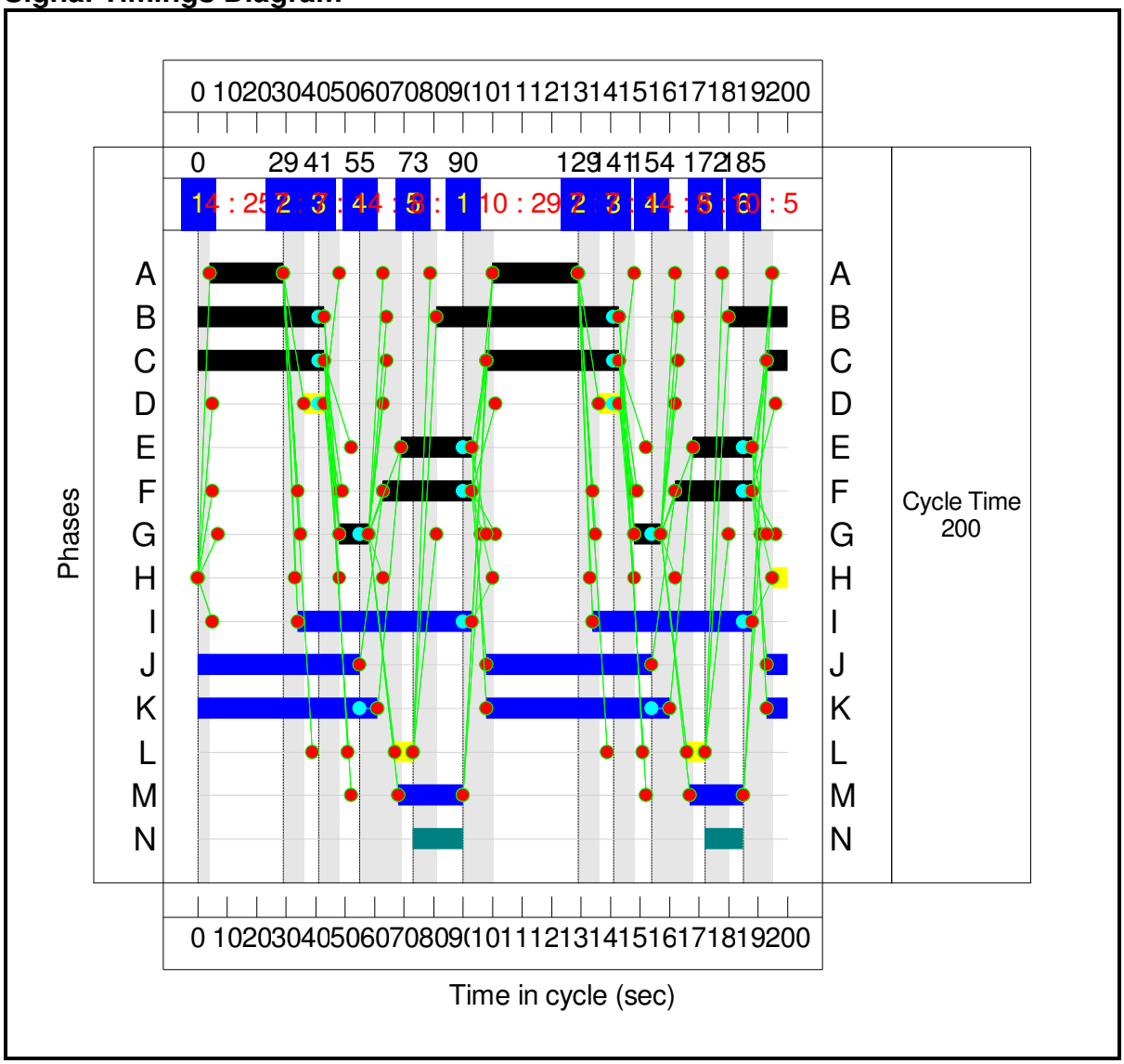


Stage Timings

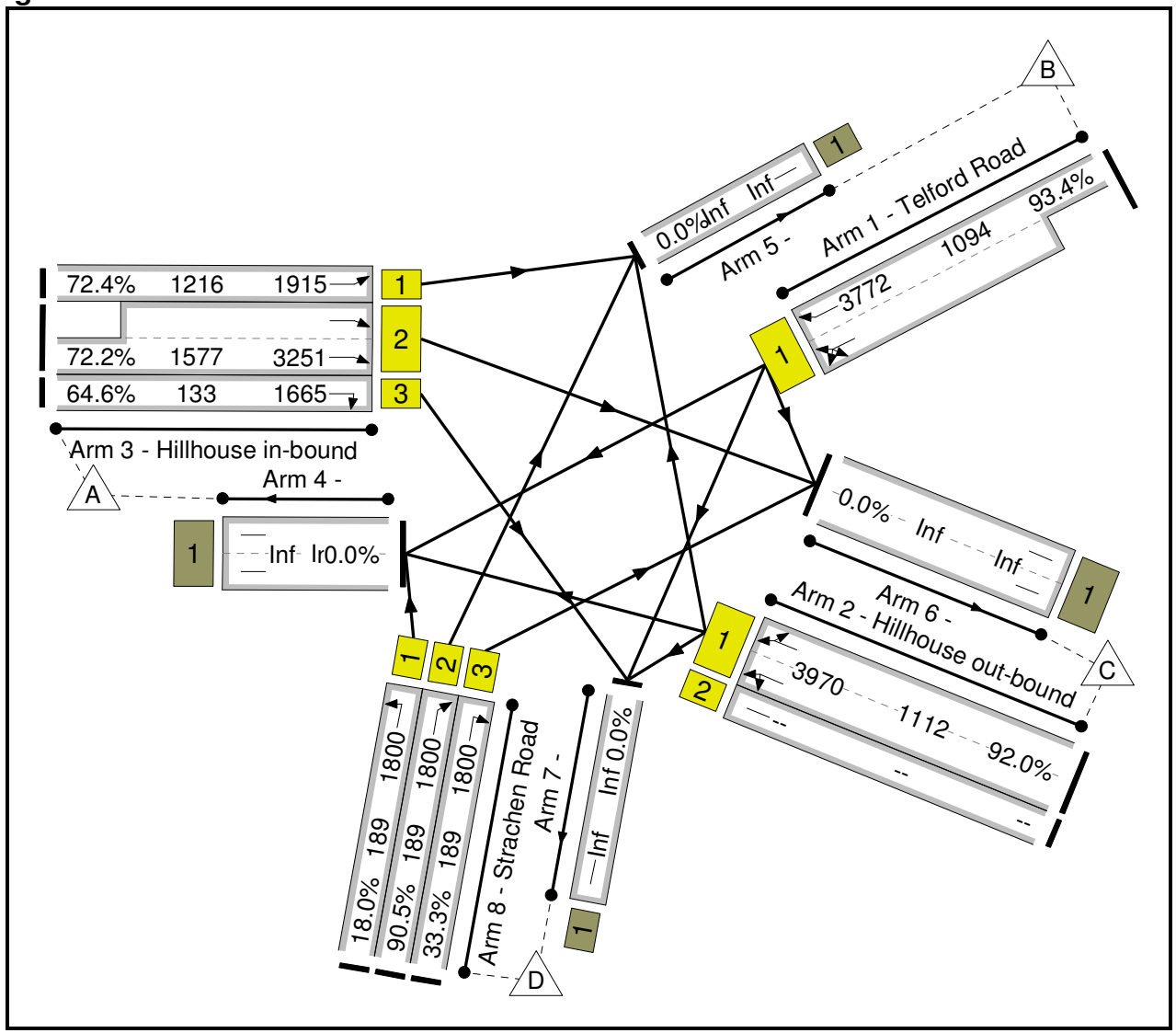
Stage	1	2	3	4	5	1	2	3	4	5
Duration	25	5	7	4	9	29	5	6	4	5
Change Point	0	29	41	55	73	90	129	141	154	172

Stage	6									
Duration	5									
Change Point	185									

Signal Timings Diagram



Junction Layout Diagram



Link Results

Link Num	Link Desc	Link Type	Stage Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Max Sat Flow (pcu/Hr)	Ave Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
1/1	Telford Road Ahead Left Left2	U	N/A	N/A	F		2	56	-	1022	3919	3772	1094	93.4
2/1	Hillhouse out-bound Ahead Right Left	U	N/A	N/A	A		2	54	-	1023	3970	3970	1112	92.0
2/2	Hillhouse out-bound	U	N/A	N/A	H		1	5	-	0	1800	-	-	-
3/1	Hillhouse in-bound Ahead	U	N/A	N/A	B		2	125	-	881	1915	1915	1216	72.4
3/2	Hillhouse in-bound Ahead	U	N/A	N/A	C		2	95	-	1139	3830	3251	1577	72.2
3/3	Hillhouse in-bound Right	U	N/A	N/A	D		2	14	-	86	1665	1665	133	64.6
4/1		U	N/A	N/A	-		-	-	-	1957	Inf	Inf	Inf	0.0
5/1		U	N/A	N/A	-		-	-	-	1062	Inf	Inf	Inf	0.0
6/1		U	N/A	N/A	-		-	-	-	1206	Inf	Inf	Inf	0.0
7/1		U	N/A	N/A	-		-	-	-	194	Inf	Inf	Inf	0.0
8/1	Strachen Road Left	U	N/A	N/A	G		2	19	-	34	1800	1800	189	18.0
8/2	Strachen Road Right	U	N/A	N/A	G		2	19	-	171	1800	1800	189	90.5
8/3	Strachen Road Right	U	N/A	N/A	G		2	19	-	63	1800	1800	189	33.3

Full Input Data And Results

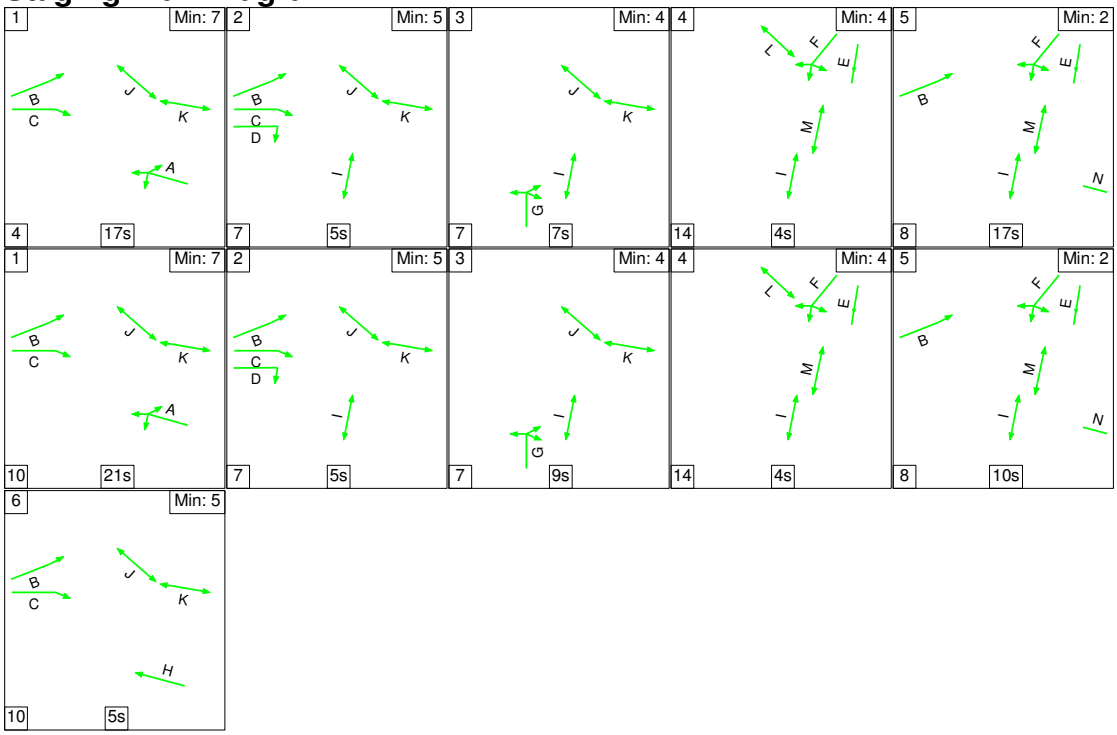
Link Num	Entering (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per Veh (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)	
1/1	1022	1022	-	-	-	9.7	6.1	-	15.8	55.6	28.4	6.1	34.5	
2/1	1023	1023	-	-	-	9.9	5.2	-	15.1	53.1	28.1	5.2	33.3	
2/2	-	-	-	-	-	-	-	-	-	-	-	-	-	
3/1	881	881	-	-	-	3.0	1.3	-	4.3	17.7	16.6	1.3	17.9	
3/2	1139	1139	-	-	-	6.0	1.3	-	7.3	23.0	24.0	1.3	25.3	
3/3	86	86	-	-	-	1.1	0.9	-	1.9	81.4	2.3	0.9	3.2	
4/1	1957	1957	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
5/1	1062	1062	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
6/1	1206	1206	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
7/1	194	194	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
8/1	34	34	-	-	-	0.4	0.1	-	0.5	52.5	0.9	0.1	1.0	
8/2	171	171	-	-	-	2.1	3.4	-	5.5	116.6	4.7	3.4	8.1	
8/3	63	63	-	-	-	0.7	0.2	-	1.0	55.8	1.6	0.2	1.9	

PRC for Signalled Links (%): -3.8 Total Delay for Signalled Links (pcuHr): 51.44

PRC Over All Links (%): -3.8 Total Delay Over All Links(pcuHr): 51.44 Cycle Time (s): 200

Scenario 2: 'PM Peak'
Staging Plan 1: 'Staging Plan No. 1'
Flow Group 2: 'PM 2008 CTC'

Staging Plan Diagram

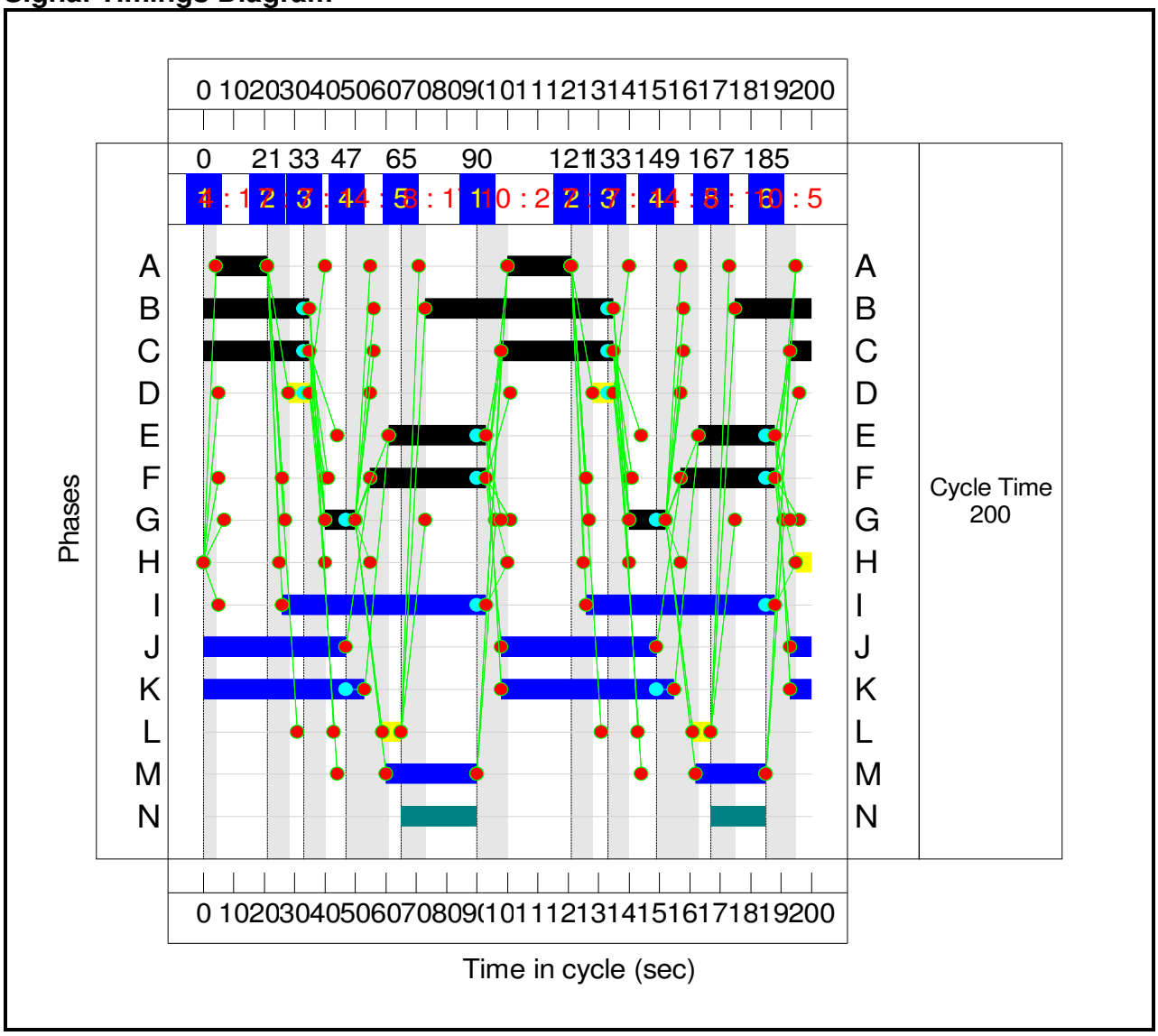


Stage Timings

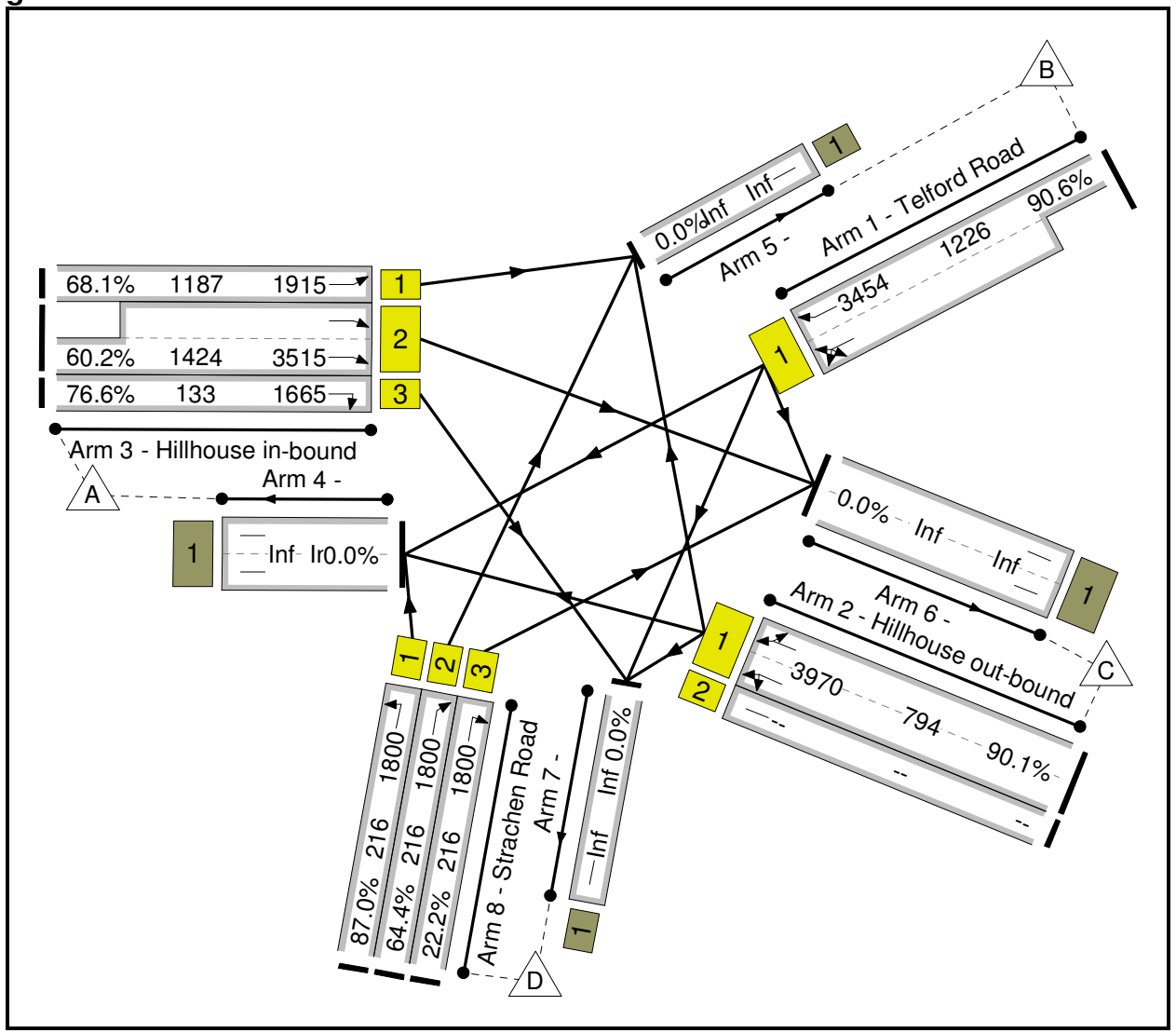
Stage	1	2	3	4	5	1	2	3	4	5
Duration	17	5	7	4	17	21	5	9	4	10
Change Point	0	21	33	47	65	90	121	133	149	167

Stage	6									
Duration	5									
Change Point	185									

Signal Timings Diagram



Junction Layout Diagram



Link Results

Link Num	Link Desc	Link Type	Stage Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Max Sat Flow (pcu/Hr)	Ave Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
1/1	Telford Road Ahead Left Left2	U	N/A	N/A	F		2	69	-	1111	3920	3454	1226	90.6
2/1	Hillhouse out-bound Ahead Right Left	U	N/A	N/A	A		2	38	-	715	3970	3970	794	90.1
2/2	Hillhouse out-bound	U	N/A	N/A	H		1	5	-	0	1800	-	-	-
3/1	Hillhouse in-bound Ahead	U	N/A	N/A	B		2	122	-	809	1915	1915	1187	68.1
3/2	Hillhouse in-bound Ahead	U	N/A	N/A	C		2	79	-	857	3830	3515	1424	60.2
3/3	Hillhouse in-bound Right	U	N/A	N/A	D		2	14	-	102	1665	1665	133	76.6
4/1		U	N/A	N/A	-		-	-	-	1924	Inf	Inf	Inf	0.0
5/1		U	N/A	N/A	-		-	-	-	951	Inf	Inf	Inf	0.0
6/1		U	N/A	N/A	-		-	-	-	920	Inf	Inf	Inf	0.0
7/1		U	N/A	N/A	-		-	-	-	174	Inf	Inf	Inf	0.0
8/1	Strachen Road Left	U	N/A	N/A	G		2	22	-	188	1800	1800	216	87.0
8/2	Strachen Road Right	U	N/A	N/A	G		2	22	-	139	1800	1800	216	64.4
8/3	Strachen Road Right	U	N/A	N/A	G		2	22	-	48	1800	1800	216	22.2

Full Input Data And Results

Link Num	Entering (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per Veh (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)	
1/1	1111	1111	-	-	-	9.0	4.5	-	13.4	43.6	28.4	4.5	32.9	
2/1	715	715	-	-	-	7.8	4.1	-	11.9	59.7	19.9	4.1	24.0	
2/2	-	-	-	-	-	-	-	-	-	-	-	-	-	
3/1	809	809	-	-	-	2.8	1.1	-	3.9	17.2	15.1	1.1	16.1	
3/2	857	857	-	-	-	5.4	0.8	-	6.2	26.0	18.8	0.8	19.6	
3/3	102	102	-	-	-	1.3	1.5	-	2.8	97.7	2.8	1.5	4.3	
4/1	1924	1924	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
5/1	951	951	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
6/1	920	920	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
7/1	174	174	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
8/1	188	188	-	-	-	2.3	2.8	-	5.1	96.8	5.2	2.8	8.0	
8/2	139	139	-	-	-	1.6	0.9	-	2.5	64.8	3.7	0.9	4.6	
8/3	48	48	-	-	-	0.5	0.1	-	0.7	50.5	1.2	0.1	1.4	

PRC for Signalled Links (%): -0.7 Total Delay for Signalled Links (pcuHr): 46.37

PRC Over All Links (%): -0.7 Total Delay Over All Links(pcuHr): 46.37 Cycle Time (s): 200

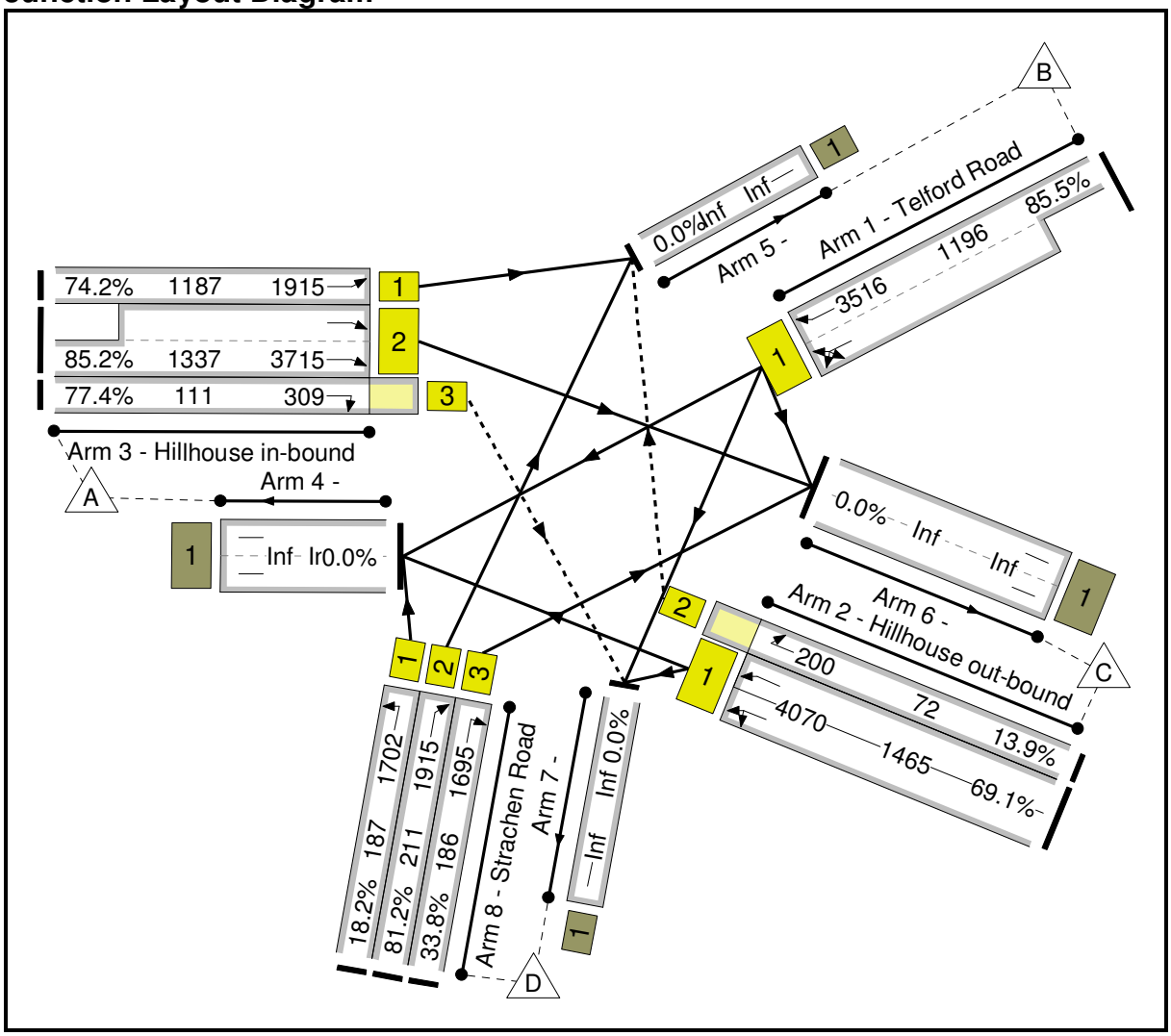
Basic Results Summary

User and Project Details

Project:	**A90 Out-bound Bus Priority Study**
Title:	**Existing Layout**
Location:	A90 Hillhouse Road / A902 Telford Road
File name:	Blackhall existing.lsgx
Author:	R Bishop
Company:	White Young Green
Address:	Avalon Way, Anstey, Leicestershire LE7 7GR
Controller:	Generic
SCN:	115
Notes:	

Scenario 1: 'AM'
Staging Plan 1: 'AM Peak Plan'
Flow Group 1: 'AM 2008 CTC'

Junction Layout Diagram



Basic Results Summary

Link Results

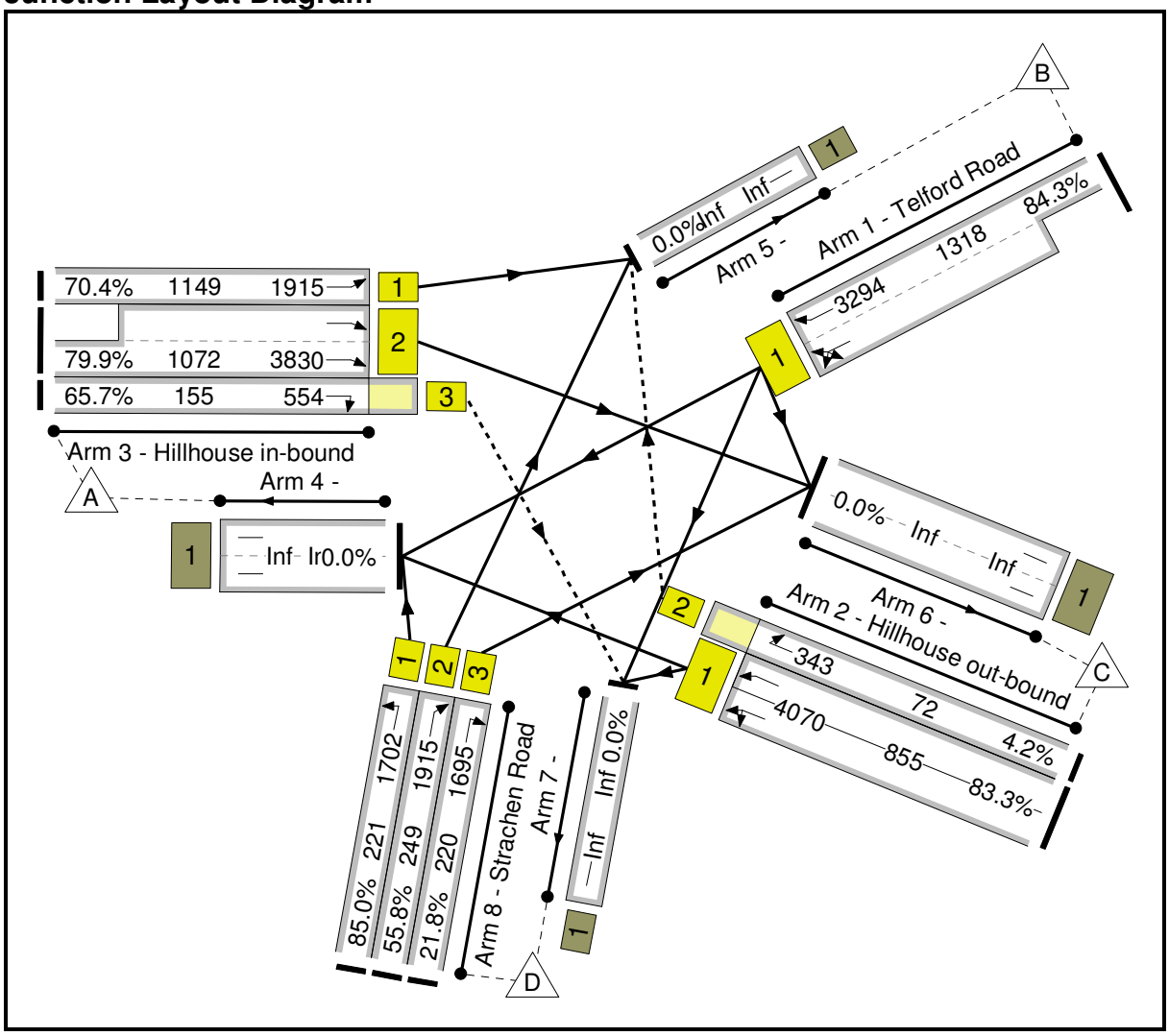
Link Num	Link Desc	Link Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Max Sat Flow (pcu/Hr)	Ave Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per Veh (s/pcu)	Mean Max Queue (pcu)
1/1	Telford Road Ahead Left Left2	U	C		1	33	-	1022	3919	3516	1196	85.5	-	-	-	11.2	39.5	28.1
2/1	Hillhouse out-bound Ahead Left	U	I		1	35	-	1013	4070	4070	1465	69.1	-	-	-	8.8	31.2	25.0
2/2	Hillhouse out-bound Right	O	I		1	35	-	10	1800	200	72	13.9	0	0	10	0.2	79.5	0.3
3/1	Hillhouse in-bound Ahead	U	A	H	1	61	26	881	1915	1915	1187	74.2	-	-	-	4.7	19.2	18.6
3/2	Hillhouse in-bound Ahead	U	A		1	35	-	1139	3830	3715	1337	85.2	-	-	-	12.0	38.0	31.6
3/3	Hillhouse in-bound Right	O	A		1	35	-	86	1665	309	111	77.4	46	0	40	2.6	110.8	3.1
8/1	Strachen Road Left	U	B		1	10	-	34	1702	1702	187	18.2	-	-	-	0.5	52.2	1.0
8/2	Strachen Road Right	U	B		1	10	-	171	1915	1915	211	81.2	-	-	-	4.0	84.8	6.6
8/3	Strachen Road Right	U	B		1	10	-	63	1695	1695	186	33.8	-	-	-	1.0	55.7	1.9

PRC for Signalled Links (%): 5.3 Total Delay for Signalled Links (pcuHr): 45.08

PRC Over All Links (%): 5.3 Total Delay Over All Links(pcuHr): 45.08 Cycle Time (s): 100

Scenario 2: 'PM'
Staging Plan 2: 'PM Peak Plan'
Flow Group 2: 'PM 2008 CTC'

Junction Layout Diagram



Link Results

Link Num	Link Desc	Link Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Max Sat Flow (pcu/Hr)	Ave Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per Veh (s/pcu)	Mean Max Queue (pcu)
1/1	Telford Road Ahead Left Left2	U	C		1	39	-	1111	3920	3294	1318	84.3	-	-	-	10.4	33.6	28.2
2/1	Hillhouse out-bound Ahead Left	U	I		1	20	-	712	4070	4070	855	83.3	-	-	-	9.9	50.0	21.2
2/2	Hillhouse out-bound Right	O	I		1	20	-	3	1800	343	72	4.2	0	0	3	0.1	76.6	0.1
3/1	Hillhouse in-bound Ahead	U	A	H	1	59	32	809	1915	1915	1149	70.4	-	-	-	4.3	19.1	16.7
3/2	Hillhouse in-bound Ahead	U	A		1	27	-	857	3830	3830	1072	79.9	-	-	-	9.9	41.6	23.9
3/3	Hillhouse in-bound Right	O	A		1	27	-	102	1665	554	155	65.7	23	79	0	1.8	62.4	3.1
8/1	Strachen Road Left	U	B		1	12	-	188	1702	1702	221	85.0	-	-	-	4.7	89.7	7.5
8/2	Strachen Road Right	U	B		1	12	-	139	1915	1915	249	55.8	-	-	-	2.2	57.0	4.2
8/3	Strachen Road Right	U	B		1	12	-	48	1695	1695	220	21.8	-	-	-	0.7	49.4	1.3

PRC for Signalled Links (%): 5.9 Total Delay for Signalled Links (pcuHr): 43.84

PRC Over All Links (%): 5.9 Total Delay Over All Links(pcuHr): 43.84 Cycle Time (s): 100

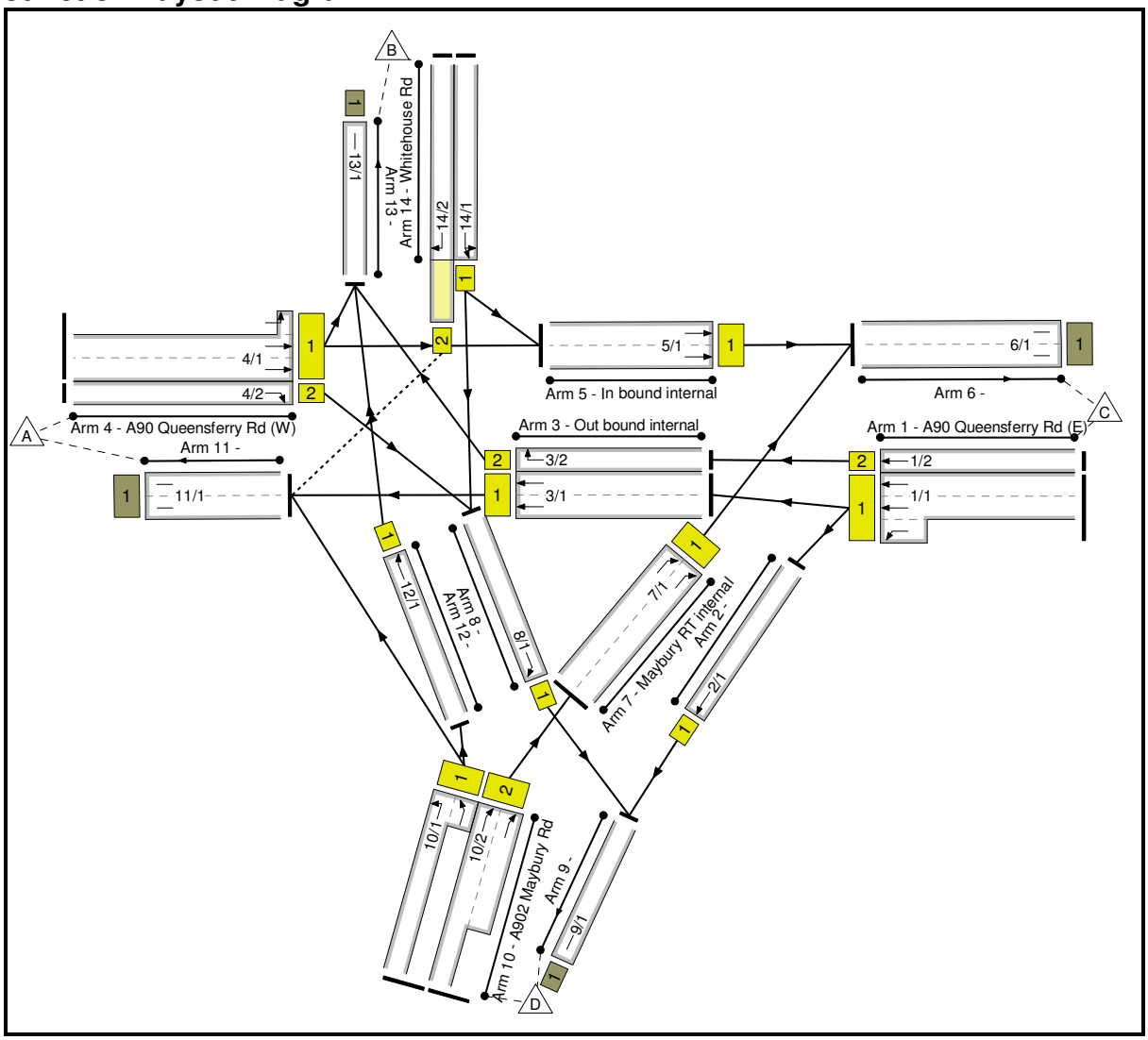
Appendix C – A90 Barnton Junction LINSIG2 Controller Model & Capacity Analysis

Full Input Data And Results

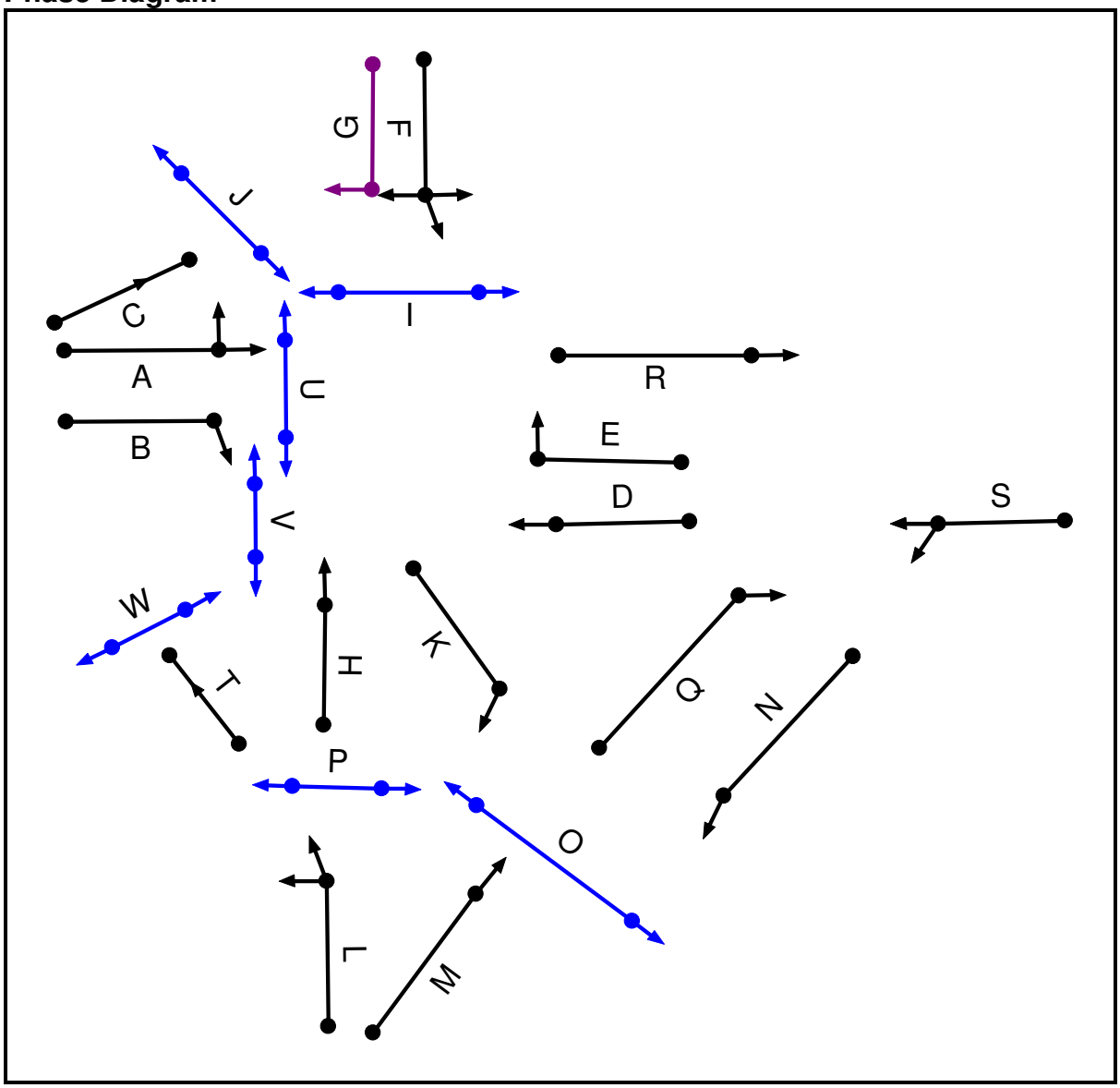
User and Project Details

Project:	**A90 Out-bound Bus Priority Study**
Title:	**Proposed Single-Stream Configuration**
Location:	A90 Queensferry Road / A902 Maybury Road
File name:	Barnton Proposed Final.lsgx
Author:	R Bishop
Company:	White Young Green
Address:	Avalon Way, Anstey, Leicestershire LE7 7GR
Controller:	Siemens
SCN:	
Notes:	

Junction Layout Diagram



Phase Diagram



Phase Input Data

Phase Name	Phase type	Stage Stream	Assoc Phase	Street Min	Cont Min
A	Traffic	1		-9999	7
B	Traffic	1		-9999	5
C	Traffic	1		-9999	6
D	Traffic	1		-9999	7
E	Traffic	1		-9999	4
F	Traffic	1		-9999	5
G	Ind. Arrow	1	F	-9999	3
H	Traffic	1		-9999	3
I	Pedestrian	1		-9999	7
J	Pedestrian	1		-9999	5
K	Traffic	1		-9999	6
L	Traffic	1		-9999	7
M	Traffic	1		-9999	7
N	Traffic	1		-9999	7
O	Pedestrian	1		-9999	7
P	Pedestrian	1		-9999	5
Q	Traffic	1		-9999	4
R	Traffic	1		-9999	7
S	Traffic	1		-9999	7
T	Traffic	1		-9999	7
U	Pedestrian	1		-9999	5
V	Pedestrian	1		-9999	3
W	Pedestrian	1		-9999	5

Phase Intergreens Matrix

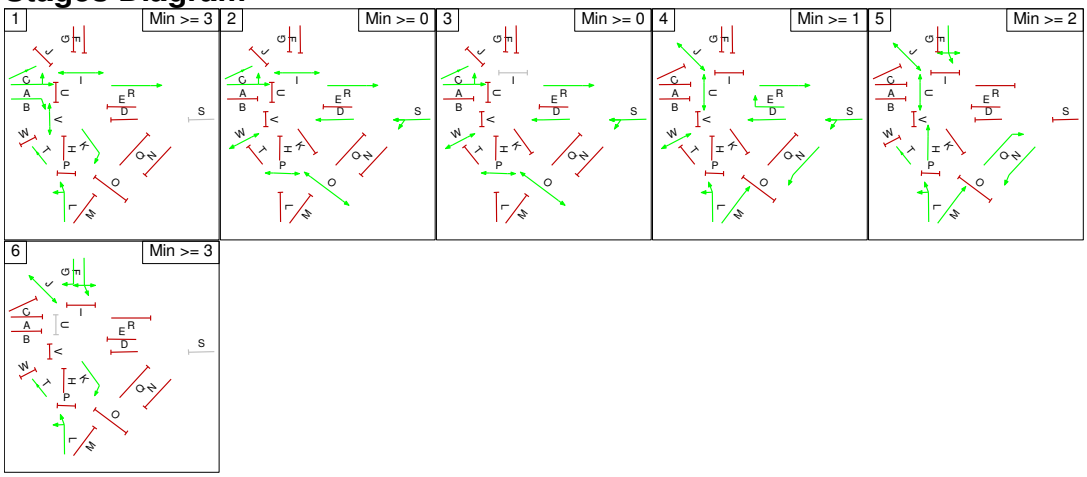
		Starting Phase																					
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
Terminating Phase	A		-	-	-	5	6	5	5	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-
	B	-		-	7	-	5	5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	C	-	-		-	5	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-
	D	-	5	-		-	5	5	6	-	-	-	-	-	-	-	-	-	-	-	7	-	7	-
	E	6	-	9	-		5	5	5	9	-	-	-	-	-	-	-	-	-	-	-	-	10	-
	F	5	5	-	7	6		-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	10	-
	G	5	5	-	6	6	-		5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	H	6	6	-	5	5	-	4		8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	I	-	-	-	-	10	12	12	11		-	-	-	-	-	-	-	-	-	-	-	-	-	-
	J	-	-	6	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-
	K	-	-	-	-	-	-	-	-	-	-		-	5	5	7	-	-	-	-	-	-	-	-
	L	-	-	-	-	-	-	-	-	-	-	-		-	-	-	5	-	-	-	-	-	-	-
	M	-	-	-	-	-	-	-	-	-	-	5	-		-	5	-	-	-	-	-	-	-	-
	N	-	-	-	-	-	-	-	-	-	-	5	-	-		8	-	-	-	-	-	-	-	-
	O	-	-	-	-	-	-	-	-	-	-	10	-	12	10		-	-	-	-	-	-	-	-
	P	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-		-	-	-	-	-	-	-
	Q	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		7	6	-	-	-	-
	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5		-	-	-	-	-
	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-		-	-	-	-
	T	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	5
	U	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-
	V	-	-	-	6	6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-	-	

Phases in Stage

Stream	Stage No.	Phases in Stage
1	1	A B C I K L R T V
1	2	A C D I O P R S W
1	3	A C D O P R S W
1	4	D E J L M N R S U W
1	5	F H J L M N Q T U
1	6	F G J K L T

Stage Stream 1

Stages Diagram



Phase Delays

Term. Stage	Start Stage	Phase	Type	Value	Cont value
1	2	K	Losing	5	5
1	2	V	Losing	1	1
2	4	A	Losing	5	5
2	4	C	Losing	5	5
3	4	A	Losing	4	4
3	4	C	Losing	4	4
3	4	N	Gaining absolute	12	10
4	5	D	Losing	3	3
4	5	E	Losing	3	3
4	5	F	Gaining absolute	9	7
4	5	H	Gaining absolute	6	4
4	5	W	Losing	3	3
5	6	H	Losing	4	4
5	6	Q	Losing	5	5
6	1	R	Gaining absolute	5	3

Prohibited Stage Changes

		To Stage					
		1	2	3	4	5	6
From Stage	1		12	X	X	X	X
	2	X		0	12	X	X
	3	X	X		12	X	X
	4	X	X	X		10	X
	5	10	8	X	X		8
	6	10	7	X	X	X	

Link Input Data

Arm/ Link	Link Name	Link Type	Num Lanes	Phases	Start Disp.	End Disp.
1/1	A90 Queensferry Rd (E) Left Ahead	U	3	S	2	3
1/2	A90 Queensferry Rd (E) Ahead	U	1	S	2	3
2/1	Ahead	U	1	N	2	3
3/1	Out bound internal Ahead	U	2	D	0	3
3/2	Out bound internal Right	U	1	E	2	3
4/1	A90 Queensferry Rd (W) Ahead Left	U	3	A	2	3
4/2	A90 Queensferry Rd (W) Right	U	1	B	2	3
5/1	In bound internal Ahead	U	2	R	2	3
6/1		U	2		2	3
7/1	Maybury RT internal Right	U	2	Q	2	3
8/1	Right	U	1	K	2	3
9/1		U	1		2	3
10/1	A902 Maybury Rd Left Ahead	U	2	L	2	3
10/2	A902 Maybury Rd Ahead	U	2	M	2	3
11/1		U	2		2	3
12/1	Ahead	U	1	H	2	3
13/1		U	1		2	3
14/1	Whitehouse Rd Left Ahead	U	1	F	2	3
14/2	Whitehouse Rd Right	O	1	F G	2	3

Give-Way Link Input Data

Arm/ Link	Link Name	Movement	Max Flow when Giving Way (PCU/Hr)	Opposing Link	Opp. Link Coeff.	Opp. Mvmnts.	Right Turn Storage (PCU)	RTF	Right Turn Move up time (s)	Max Turns in Intergreen (PCU)
14/2	Whitehouse Rd Right	14/2 to 11/1	1439	12/1	1.09	12/1	4.00	0.50	2	4.00

Lane Input Data

Arm/ Lane	Link Num	Physical Length (PCU)	Expected Usage (PCU)	Sat Flow Type	User Saturation Flow (PCU/Hr)	Lane Width (m)	Gradient	Nearside Lane	Allowed Turns	Turning Radius (m)
1/1 (A90 Queensferry Rd (E) Lane 1)	Link 1 (A90 Queensferry Rd (E) Left Ahead)	3.0	3.0	Geom	1800	3.25	0.00	Y	Arm 2 Left	Inf
1/2 (A90 Queensferry Rd (E) Lane 2)	Link 1 (A90 Queensferry Rd (E) Left Ahead)	Inf	Inf	Geom	1800	3.50	0.00	Y	Arm 3 Ahead (Out bound internal)	Inf
1/3 (A90 Queensferry Rd (E) Lane 3)	Link 1 (A90 Queensferry Rd (E) Left Ahead)	Inf	Inf	Geom	1800	3.50	0.00	Y	Arm 3 Ahead (Out bound internal)	Inf
1/4 (A90 Queensferry Rd (E) Lane 4)	Link 2 (A90 Queensferry Rd (E) Ahead)	Inf	Inf	User	1800	3.25	0.00	Y	Arm 3 Ahead (Out bound internal)	Inf
2/1	Link 1 (Ahead)	Inf	Inf	Geom	1800	3.50	0.00	Y	Arm 9 Ahead	Inf
3/1 (Out bound internal Lane 1)	Link 1 (Out bound internal Ahead)	Inf	Inf	Geom	1800	3.50	0.00	Y	Arm 11 Ahead	Inf
3/2 (Out bound internal Lane 2)	Link 1 (Out bound internal Ahead)	Inf	Inf	Geom	1800	3.50	0.00	N	Arm 11 Ahead	Inf
3/3 (Out bound internal Lane 3)	Link 2 (Out bound internal Right)	Inf	Inf	Geom	1800	3.50	0.00	Y	Arm 13 Right	20.00
4/1 (A90 Queensferry Rd (W) Lane 1)	Link 1 (A90 Queensferry Rd (W) Ahead Left)	1.0	1.0	Geom	1800	3.00	0.00	Y	Arm 13 Left	16.00
4/2 (A90 Queensferry Rd (W) Lane 2)	Link 1 (A90 Queensferry Rd (W) Ahead Left)	Inf	Inf	Geom	1800	3.25	0.00	Y	Arm 5 Ahead (In bound internal)	Inf
4/3 (A90 Queensferry Rd (W) Lane 3)	Link 1 (A90 Queensferry Rd (W) Ahead Left)	Inf	Inf	Geom	1800	3.25	0.00	N	Arm 5 Ahead (In bound internal)	Inf

4/4 (A90 Queensferry Rd (W) Lane 4)	Link 2 (A90 Queensferry Rd (W) Right)	Inf	Inf	Geom	1800	3.00	0.00	Y	Arm 8 Right	25.00
5/1 (In bound internal Lane 1)	Link 1 (In bound internal Ahead)	Inf	Inf	Geom	1800	3.50	0.00	Y	Arm 6 Ahead	Inf
5/2 (In bound internal Lane 2)	Link 1 (In bound internal Ahead)	Inf	Inf	Geom	1800	3.50	0.00	N	Arm 6 Ahead	Inf
6/1	Link 1	Inf	Inf	Inf (Exit)	1800	3.25	0.00	Y		
6/2	Link 1	Inf	Inf	Inf (Exit)	1800	3.25	0.00	Y		
7/1 (Maybury RT internal Lane 1)	Link 1 (Maybury RT internal Right)	Inf	Inf	Geom	1800	3.50	0.00	Y	Arm 6 Right	80.00
7/2 (Maybury RT internal Lane 2)	Link 1 (Maybury RT internal Right)	Inf	Inf	Geom	1800	3.50	0.00	N	Arm 6 Right	80.00
8/1	Link 1 (Right)	Inf	Inf	Geom	1800	4.00	0.00	Y	Arm 9 Right	Inf
9/1	Link 1	Inf	Inf	Inf (Exit)	1800	3.25	0.00	Y		
10/1 (A902 Maybury Rd Lane 1)	Link 1 (A902 Maybury Rd Left Ahead)	Inf	Inf	Geom	1800	3.00	0.00	Y	Arm 11 Left	Inf
10/2 (A902 Maybury Rd Lane 2)	Link 1 (A902 Maybury Rd Left Ahead)	1.0	2.0	Geom	1800	3.00	0.00	Y	Arm 12 Ahead	Inf
10/3 (A902 Maybury Rd Lane 3)	Link 2 (A902 Maybury Rd Ahead)	Inf	Inf	Geom	1800	3.00	0.00	Y	Arm 7 Ahead (Maybury RT internal)	Inf
10/4 (A902 Maybury Rd Lane 4)	Link 2 (A902 Maybury Rd Ahead)	8.0	8.0	Geom	1800	3.00	0.00	N	Arm 7 Ahead (Maybury RT internal)	Inf
11/1	Link 1	Inf	Inf	Inf (Exit)	1800	3.25	0.00	Y		
11/2	Link 1	Inf	Inf	Inf (Exit)	1800	3.25	0.00	Y		
12/1	Link 1 (Ahead)	Inf	Inf	Geom	1800	3.50	0.00	Y	Arm 13 Ahead	Inf

13/1	Link 1	Inf	Inf	Inf (Exit)	1800	3.25	0.00	Y		
14/1 (Whitehouse Rd Lane 1)	Link 1 (Whitehouse Rd Left Ahead)	Inf	Inf	Geom	1800	3.00	0.00	Y	Arm 5 Left (In bound internal)	20.00
									Arm 8 Ahead	Inf
14/2 (Whitehouse Rd Lane 2)	Link 2 (Whitehouse Rd Right)	Inf	Inf	User	1820	3.00	0.00	Y	Arm 11 Right	12.00

Traffic Flow Groups

Flow Group	Start Time	End Time	Duration	Formula
1: 'AM Peak 2008'	07:45	08:45	01:00	
2: 'PM Peak 2008'	17:00	18:00	01:00	

Flow Group 1: 'AM Peak 2008'

Traffic Flow Matrix

Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	301	1439	278	2018
	B	209	0	72	227	508
	C	1343	133	0	587	2063
	D	119	238	704	0	1061
	Tot.	1671	672	2215	1092	5650

Link Traffic Flows

Arm/Link	Flow Group 1: AM Peak 2008
1/1	1930
1/2	133
2/1	587
3/1	1343
3/2	133
4/1	1740
4/2	278
5/1	1511
6/1	2215
7/1	704
8/1	505
9/1	1092
10/1	357
10/2	704
11/1	1671
12/1	238
13/1	672
14/1	299
14/2	209

Lane Saturation Flows

Arm/ Lane	Lane Width (m)	Gradient	Nearside Lane	Allowed Turns	Turning Radius (m)	Turning Prop.	Sat flow (PCU/Hr)
1/1 (A90 Queensferry Rd (E) Lane 1)	3.25	0.00	Y	Arm 2 Left	Inf	100.0 %	1940
1/2 (A90 Queensferry Rd (E) Lane 2)	3.50	0.00	Y	Arm 3 Ahead (Out bound internal)	Inf	100.0 %	1965
1/3 (A90 Queensferry Rd (E) Lane 3)	3.50	0.00	Y	Arm 3 Ahead (Out bound internal)	Inf	100.0 %	1965
1/4 (A90 Queensferry Rd (E) Lane 4)	This lane uses a directly entered Saturation Flow						1800
2/1	3.50	0.00	Y	Arm 9 Ahead	Inf	100.0 %	1965
3/1 (Out bound internal Lane 1)	3.50	0.00	Y	Arm 11 Ahead	Inf	100.0 %	1965
3/2 (Out bound internal Lane 2)	3.50	0.00	N	Arm 11 Ahead	Inf	100.0 %	2105
3/3 (Out bound internal Lane 3)	3.50	0.00	Y	Arm 13 Right	20.00	100.0 %	1828
4/1 (A90 Queensferry Rd (W) Lane 1)	3.00	0.00	Y	Arm 13 Left	16.00	100.0 %	1751
4/2 (A90 Queensferry Rd (W) Lane 2)	3.25	0.00	Y	Arm 5 Ahead (In bound internal)	Inf	100.0 %	1940
4/3 (A90 Queensferry Rd (W) Lane 3)	3.25	0.00	N	Arm 5 Ahead (In bound internal)	Inf	100.0 %	2080
4/4 (A90 Queensferry Rd (W) Lane 4)	3.00	0.00	Y	Arm 8 Right	25.00	100.0 %	1807
5/1 (In bound internal Lane 1)	3.50	0.00	Y	Arm 6 Ahead	Inf	100.0 %	1965
5/2 (In bound internal Lane 2)	3.50	0.00	N	Arm 6 Ahead	Inf	100.0 %	2105
6/1	Infinite Saturation Flow (on Exit Link)						Inf
6/2	Infinite Saturation Flow (on Exit Link)						Inf
7/1 (Maybury RT internal Lane 1)	3.50	0.00	Y	Arm 6 Right	80.00	100.0 %	1929
7/2 (Maybury RT internal Lane 2)	3.50	0.00	N	Arm 6 Right	80.00	100.0 %	2066

8/1	4.00	0.00	Y	Arm 9 Right	Inf	100.0 %	2015
9/1	Infinite Saturation Flow (on Exit Link)						Inf
10/1 (A902 Maybury Rd Lane 1)	3.00	0.00	Y	Arm 11 Left	Inf	100.0 %	1915
10/2 (A902 Maybury Rd Lane 2)	3.00	0.00	Y	Arm 12 Ahead	Inf	100.0 %	1915
10/3 (A902 Maybury Rd Lane 3)	3.00	0.00	Y	Arm 7 Ahead (Maybury RT internal)	Inf	100.0 %	1915
10/4 (A902 Maybury Rd Lane 4)	3.00	0.00	N	Arm 7 Ahead (Maybury RT internal)	Inf	100.0 %	2055
11/1	Infinite Saturation Flow (on Exit Link)						Inf
11/2	Infinite Saturation Flow (on Exit Link)						Inf
12/1	3.50	0.00	Y	Arm 13 Ahead	Inf	100.0 %	1965
13/1	Infinite Saturation Flow (on Exit Link)						Inf
14/1 (Whitehouse Rd Lane 1)	3.00	0.00	Y	Arm 5 Left (In bound internal)	20.00	24.1 %	1881
				Arm 8 Ahead	Inf	75.9 %	
14/2 (Whitehouse Rd Lane 2)	This lane uses a directly entered Saturation Flow						1820

Flow Group 2: 'PM Peak 2008'

Traffic Flow Matrix

Desired Flow :

		Destination				
		A	B	C	D	Tot.
Origin	A	0	135	1227	169	1531
	B	276	0	74	171	521
	C	1607	68	0	444	2119
	D	476	178	505	0	1159
	Tot.	2359	381	1806	784	5330

Link Traffic Flows

Arm/Link	Flow Group 2: PM Peak 2008
1/1	2051
1/2	68
2/1	444
3/1	1607
3/2	68
4/1	1362
4/2	169
5/1	1301
6/1	1806
7/1	505
8/1	340
9/1	784
10/1	654
10/2	505
11/1	2359
12/1	178
13/1	381
14/1	245
14/2	276

Lane Saturation Flows

Arm/ Lane	Lane Width (m)	Gradient	Nearside Lane	Allowed Turns	Turning Radius (m)	Turning Prop.	Sat flow (PCU/Hr)
1/1 (A90 Queensferry Rd (E) Lane 1)	3.25	0.00	Y	Arm 2 Left	Inf	100.0 %	1940
1/2 (A90 Queensferry Rd (E) Lane 2)	3.50	0.00	Y	Arm 3 Ahead (Out bound internal)	Inf	100.0 %	1965
1/3 (A90 Queensferry Rd (E) Lane 3)	3.50	0.00	Y	Arm 3 Ahead (Out bound internal)	Inf	100.0 %	1965
1/4 (A90 Queensferry Rd (E) Lane 4)	This lane uses a directly entered Saturation Flow						1800
2/1	3.50	0.00	Y	Arm 9 Ahead	Inf	100.0 %	1965
3/1 (Out bound internal Lane 1)	3.50	0.00	Y	Arm 11 Ahead	Inf	100.0 %	1965
3/2 (Out bound internal Lane 2)	3.50	0.00	N	Arm 11 Ahead	Inf	100.0 %	2105
3/3 (Out bound internal Lane 3)	3.50	0.00	Y	Arm 13 Right	20.00	100.0 %	1828
4/1 (A90 Queensferry Rd (W) Lane 1)	3.00	0.00	Y	Arm 13 Left	16.00	100.0 %	1751
4/2 (A90 Queensferry Rd (W) Lane 2)	3.25	0.00	Y	Arm 5 Ahead (In bound internal)	Inf	100.0 %	1940
4/3 (A90 Queensferry Rd (W) Lane 3)	3.25	0.00	N	Arm 5 Ahead (In bound internal)	Inf	100.0 %	2080
4/4 (A90 Queensferry Rd (W) Lane 4)	3.00	0.00	Y	Arm 8 Right	25.00	100.0 %	1807
5/1 (In bound internal Lane 1)	3.50	0.00	Y	Arm 6 Ahead	Inf	100.0 %	1965
5/2 (In bound internal Lane 2)	3.50	0.00	N	Arm 6 Ahead	Inf	100.0 %	2105
6/1	Infinite Saturation Flow (on Exit Link)						Inf
6/2	Infinite Saturation Flow (on Exit Link)						Inf
7/1 (Maybury RT internal Lane 1)	3.50	0.00	Y	Arm 6 Right	80.00	100.0 %	1929
7/2 (Maybury RT internal Lane 2)	3.50	0.00	N	Arm 6 Right	80.00	100.0 %	2066

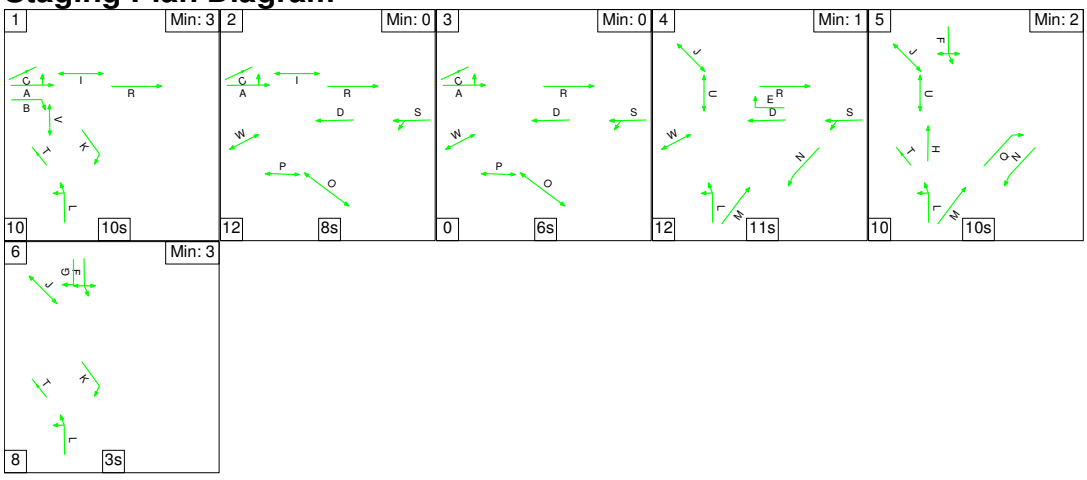
8/1	4.00	0.00	Y	Arm 9 Right	Inf	100.0 %	2015
9/1	Infinite Saturation Flow (on Exit Link)						Inf
10/1 (A902 Maybury Rd Lane 1)	3.00	0.00	Y	Arm 11 Left	Inf	100.0 %	1915
10/2 (A902 Maybury Rd Lane 2)	3.00	0.00	Y	Arm 12 Ahead	Inf	100.0 %	1915
10/3 (A902 Maybury Rd Lane 3)	3.00	0.00	Y	Arm 7 Ahead (Maybury RT internal)	Inf	100.0 %	1915
10/4 (A902 Maybury Rd Lane 4)	3.00	0.00	N	Arm 7 Ahead (Maybury RT internal)	Inf	100.0 %	2055
11/1	Infinite Saturation Flow (on Exit Link)						Inf
11/2	Infinite Saturation Flow (on Exit Link)						Inf
12/1	3.50	0.00	Y	Arm 13 Ahead	Inf	100.0 %	1965
13/1	Infinite Saturation Flow (on Exit Link)						Inf
14/1 (Whitehouse Rd Lane 1)	3.00	0.00	Y	Arm 5 Left (In bound internal)	20.00	30.2 %	1873
				Arm 8 Ahead	Inf	69.8 %	
14/2 (Whitehouse Rd Lane 2)	This lane uses a directly entered Saturation Flow						1820

Scenario 1: 'AM Peak'

Staging Plan 1: 'Staging Plan No. 1'
Flow Group 1: 'AM Peak 2008'

Stage Stream 1

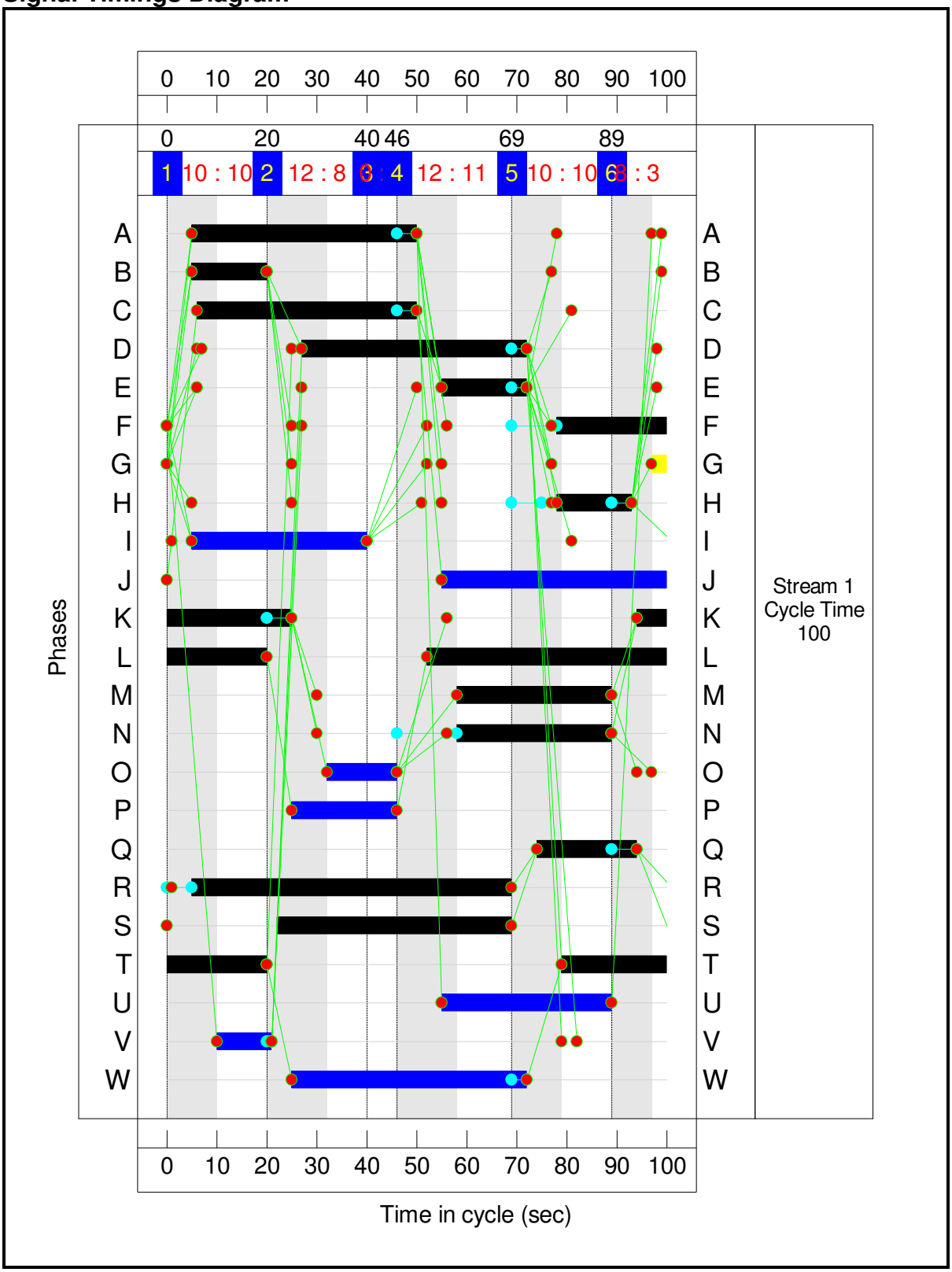
Staging Plan Diagram



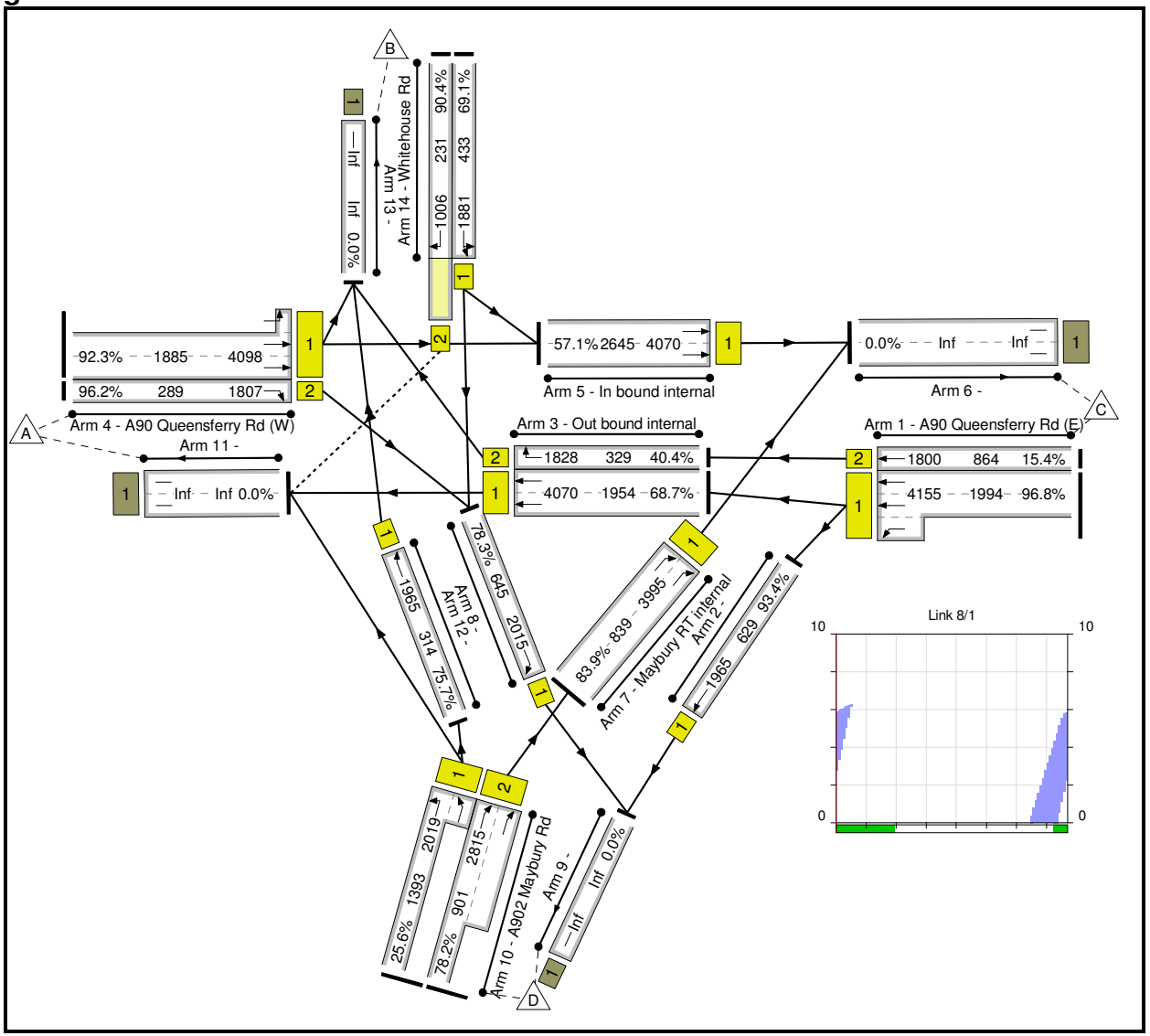
Stage Timings

Stage	1	2	3	4	5	6
Duration	10	8	6	11	10	3
Change Point	0	20	40	46	69	89

Signal Timings Diagram



Junction Layout Diagram



Link Results

Link Num	Link Desc	Link Type	Stage Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Max Sat Flow (pcu/Hr)	Ave Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
1/1	A90 Queensferry Rd (E) Left Ahead	U	1	N/A	S		1	47	-	1930	5870	4155	1994	96.8
1/2	A90 Queensferry Rd (E) Ahead	U	1	N/A	S		1	47	-	133	1800	1800	864	15.4
2/1	Ahead	U	1	N/A	N		1	31	-	587	1965	1965	629	93.4
3/1	Out bound internal Ahead	U	1	N/A	D		1	45	-	1343	4070	4070	1954	68.7
3/2	Out bound internal Right	U	1	N/A	E		1	17	-	133	1828	1828	329	40.4
4/1	A90 Queensferry Rd (W) Ahead Left	U	1	N/A	A		1	45	-	1740	5771	4098	1885	92.3
4/2	A90 Queensferry Rd (W) Right	U	1	N/A	B		1	15	-	278	1807	1807	289	96.2
5/1	In bound internal Ahead	U	1	N/A	R		1	64	-	1511	4070	4070	2645	57.1
6/1		U	-	N/A	-		-	-	-	2215	Inf	Inf	Inf	0.0
7/1	Maybury RT internal Right	U	1	N/A	Q		1	20	-	704	3995	3995	839	83.9
8/1	Right	U	1	N/A	K		1	31	-	505	2015	2015	645	78.3
9/1		U	-	N/A	-		-	-	-	1092	Inf	Inf	Inf	0.0
10/1	A902 Maybury Rd Left Ahead	U	1	N/A	L		1	68	-	357	3830	2019	1393	25.6
10/2	A902 Maybury Rd Ahead	U	1	N/A	M		1	31	-	704	3970	2815	901	78.2

Full Input Data And Results

11/1		U	-	N/A	-		-	-	-	1671	Inf	Inf	Inf	0.0
12/1	Ahead	U	1	N/A	H		1	15	-	238	1965	1965	314	75.7
13/1		U	-	N/A	-		-	-	-	672	Inf	Inf	Inf	0.0
14/1	Whitehouse Rd Left Ahead	U	1	N/A	F		1	22	-	299	1881	1881	433	69.1
14/2	Whitehouse Rd Right	O	1	N/A	F	G	1	22	3	209	1820	1006	231	90.4

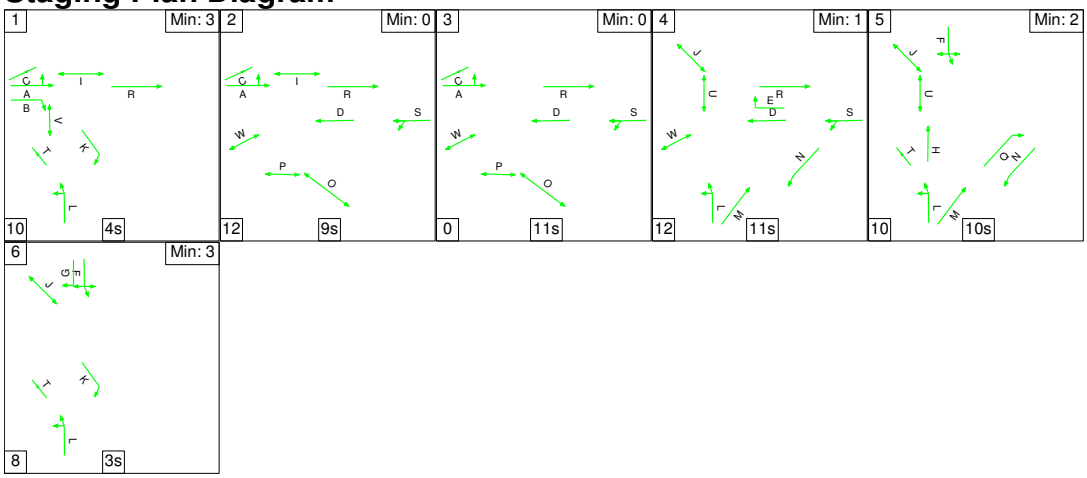
Full Input Data And Results

Link Num	Entering (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per Veh (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)	
1/1	1930	1930	-	-	-	12.9	11.1	-	24.0	44.8	51.5	11.1	62.6	
1/2	133	133	-	-	-	0.5	0.1	-	0.6	17.1	2.1	0.1	2.2	
2/1	587	587	-	-	-	4.3	5.5	-	9.8	60.2	16.3	5.5	21.9	
3/1	1343	1343	-	-	-	0.1	0.0	-	0.1	0.2	0.8	0.0	0.8	
3/2	133	133	-	-	-	0.8	0.3	-	1.2	31.3	3.3	0.3	3.6	
4/1	1740	1740	-	-	-	12.0	5.6	-	17.6	36.4	45.0	5.6	50.5	
4/2	278	278	-	-	-	3.2	6.0	-	9.2	119.5	7.6	6.0	13.7	
5/1	1511	1511	-	-	-	0.3	0.0	-	0.3	0.7	2.0	0.0	2.0	
6/1	2215	2215	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
7/1	704	704	-	-	-	2.1	2.5	-	4.7	23.8	19.0	2.5	21.5	
8/1	505	505	-	-	-	0.6	0.0	-	0.6	4.2	6.3	0.0	6.3	
9/1	1092	1092	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
10/1	357	357	-	-	-	0.5	0.2	-	0.7	7.0	3.4	0.2	3.5	
10/2	704	704	-	-	-	5.5	1.8	-	7.3	37.1	16.2	1.8	18.0	
11/1	1671	1671	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
12/1	238	238	-	-	-	2.3	1.5	-	3.8	57.5	6.3	1.5	7.8	
13/1	672	672	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
14/1	299	299	-	-	-	2.9	1.1	-	4.0	48.5	7.6	1.1	8.7	
14/2	209	209	48	91	70	2.1	3.6	0.6	6.2	107.2	5.7	3.6	9.2	

Stream: 1 PRC for Signalled Links (%): -7.5 Total Delay for Signalled Links (pcuHr): 90.10
PRC Over All Links (%): -7.5 Total Delay Over All Links(pcuHr): 90.10 Cycle Time (s): 100

Scenario 2: 'PM Peak'
Staging Plan 1: 'Staging Plan No. 1'
Flow Group 2: 'PM Peak 2008'
Stage Stream 1

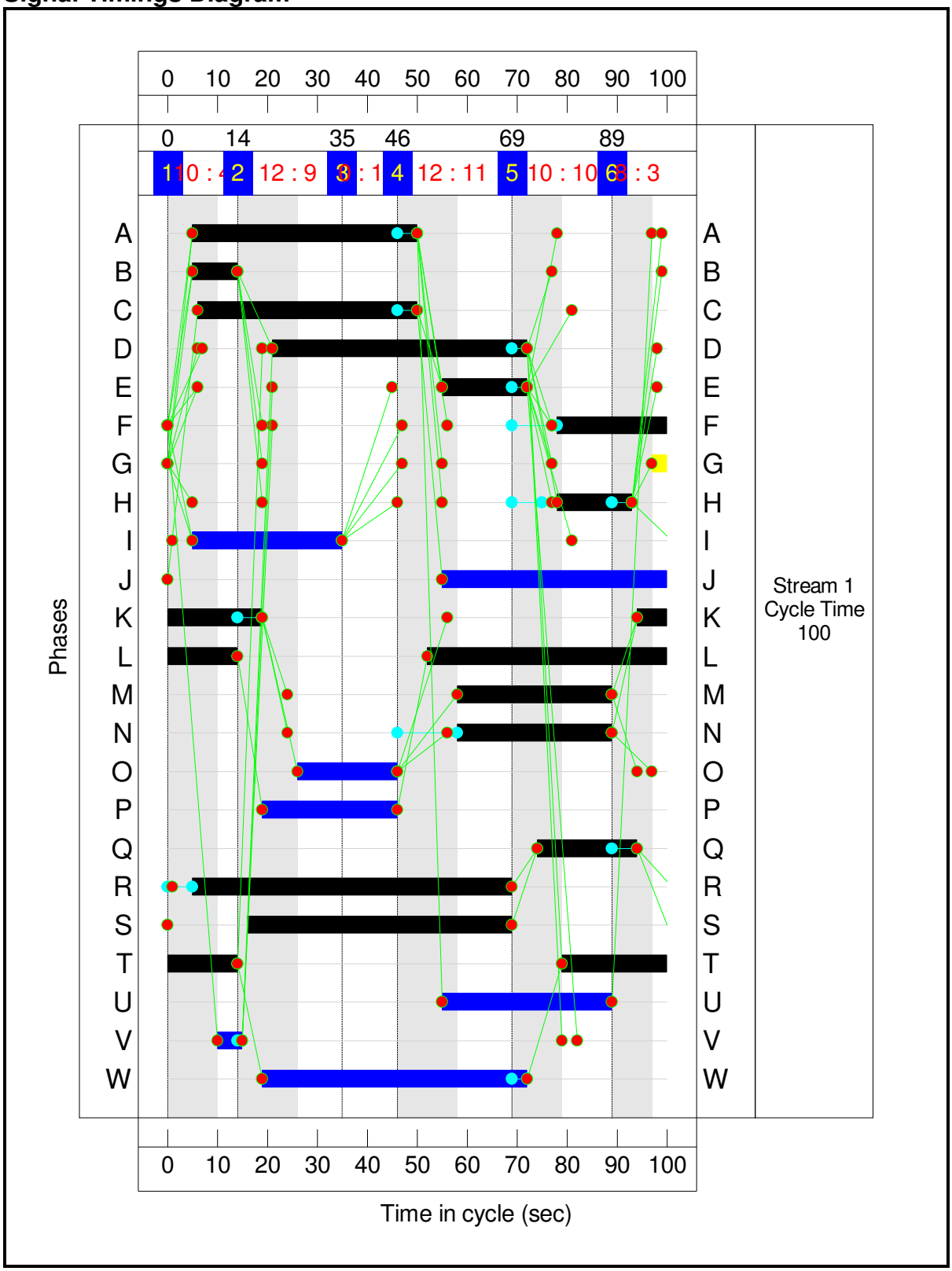
Staging Plan Diagram



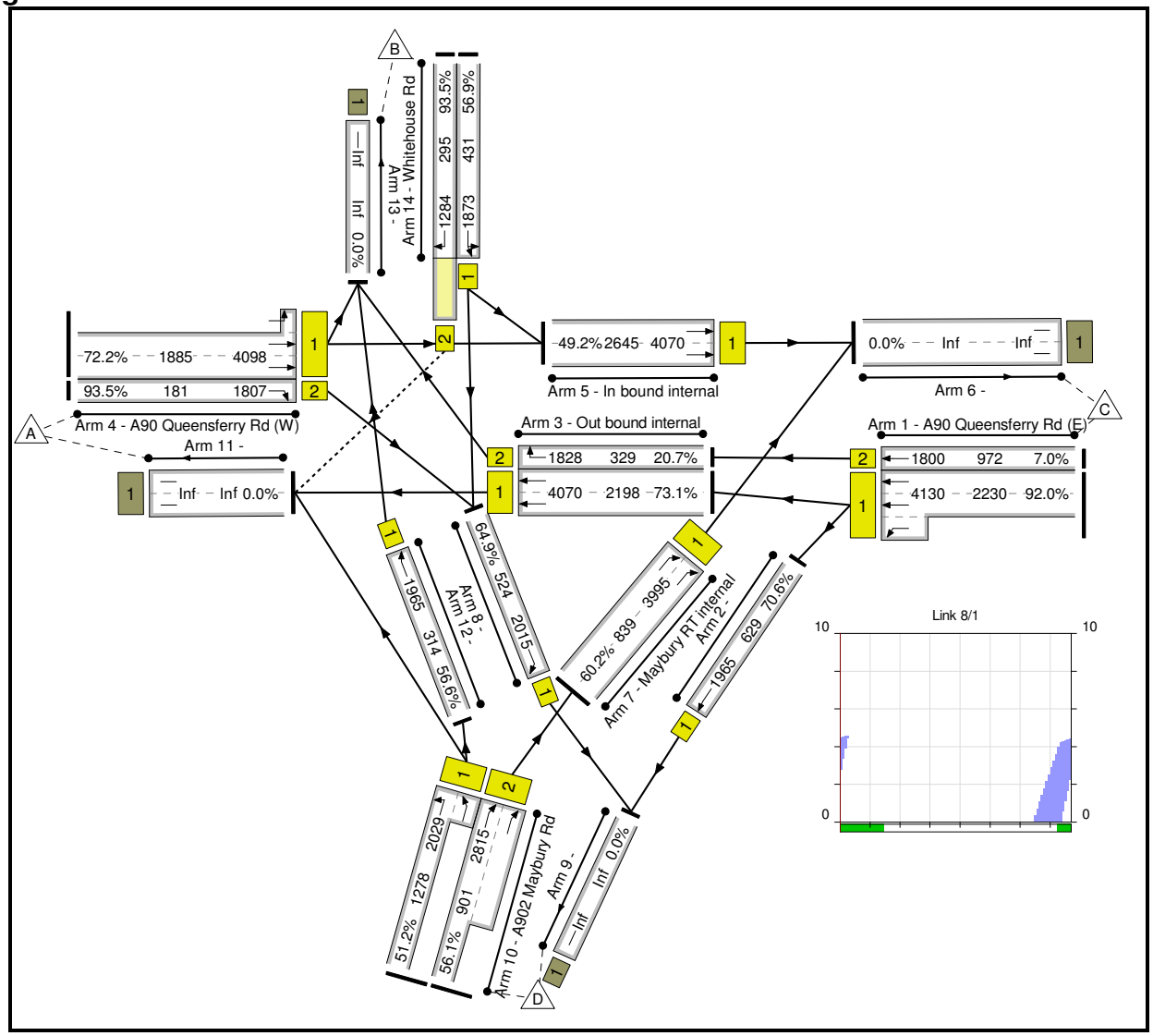
Stage Timings

Stage	1	2	3	4	5	6
Duration	4	9	11	11	10	3
Change Point	0	14	35	46	69	89

Signal Timings Diagram



Junction Layout Diagram



Link Results

Link Num	Link Desc	Link Type	Stage Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Max Sat Flow (pcu/Hr)	Ave Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
1/1	A90 Queensferry Rd (E) Left Ahead	U	1	N/A	S		1	53	-	2051	5870	4130	2230	92.0
1/2	A90 Queensferry Rd (E) Ahead	U	1	N/A	S		1	53	-	68	1800	1800	972	7.0
2/1	Ahead	U	1	N/A	N		1	31	-	444	1965	1965	629	70.6
3/1	Out bound internal Ahead	U	1	N/A	D		1	51	-	1607	4070	4070	2198	73.1
3/2	Out bound internal Right	U	1	N/A	E		1	17	-	68	1828	1828	329	20.7
4/1	A90 Queensferry Rd (W) Ahead Left	U	1	N/A	A		1	45	-	1362	5771	4098	1885	72.2
4/2	A90 Queensferry Rd (W) Right	U	1	N/A	B		1	9	-	169	1807	1807	181	93.5
5/1	In bound internal Ahead	U	1	N/A	R		1	64	-	1301	4070	4070	2645	49.2
6/1		U	-	N/A	-		-	-	-	1806	Inf	Inf	Inf	0.0
7/1	Maybury RT internal Right	U	1	N/A	Q		1	20	-	505	3995	3995	839	60.2
8/1	Right	U	1	N/A	K		1	25	-	340	2015	2015	524	64.9
9/1		U	-	N/A	-		-	-	-	784	Inf	Inf	Inf	0.0
10/1	A902 Maybury Rd Left Ahead	U	1	N/A	L		1	62	-	654	3830	2029	1278	51.2
10/2	A902 Maybury Rd Ahead	U	1	N/A	M		1	31	-	505	3970	2815	901	56.1

Full Input Data And Results

11/1		U	-	N/A	-		-	-	-	2359	Inf	Inf	Inf	0.0
12/1	Ahead	U	1	N/A	H		1	15	-	178	1965	1965	314	56.6
13/1		U	-	N/A	-		-	-	-	381	Inf	Inf	Inf	0.0
14/1	Whitehouse Rd Left Ahead	U	1	N/A	F		1	22	-	245	1873	1873	431	56.9
14/2	Whitehouse Rd Right	O	1	N/A	F	G	1	22	3	276	1820	1284	295	93.5

Full Input Data And Results

Link Num	Entering (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per Veh (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)	
1/1	2051	2051	-	-	-	11.3	5.4	-	16.7	29.3	51.3	5.4	56.7	
1/2	68	68	-	-	-	0.2	0.0	-	0.2	13.0	0.9	0.0	0.9	
2/1	444	444	-	-	-	3.3	1.2	-	4.5	36.4	12.3	1.2	13.5	
3/1	1607	1607	-	-	-	0.1	0.0	-	0.1	0.3	1.1	0.0	1.1	
3/2	68	68	-	-	-	0.5	0.1	-	0.6	31.3	1.6	0.1	1.7	
4/1	1362	1362	-	-	-	8.1	1.3	-	9.4	24.8	30.3	1.3	31.6	
4/2	169	169	-	-	-	2.1	4.2	-	6.3	134.2	4.6	4.2	8.9	
5/1	1301	1301	-	-	-	0.3	0.0	-	0.3	0.9	2.0	0.0	2.0	
6/1	1806	1806	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
7/1	505	505	-	-	-	1.5	0.8	-	2.2	15.7	12.8	0.8	13.5	
8/1	340	340	-	-	-	0.4	0.0	-	0.4	4.6	4.6	0.0	4.6	
9/1	784	784	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
10/1	654	654	-	-	-	1.6	0.5	-	2.1	11.7	9.1	0.5	9.6	
10/2	505	505	-	-	-	3.7	0.6	-	4.4	31.0	10.8	0.6	11.4	
11/1	2359	2359	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
12/1	178	178	-	-	-	1.5	0.6	-	2.1	43.1	4.5	0.6	5.2	
13/1	381	381	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	
14/1	245	245	-	-	-	2.3	0.7	-	3.0	43.7	6.0	0.7	6.6	
14/2	276	276	92	91	93	2.9	4.8	0.6	8.2	107.6	7.5	4.8	12.3	

Stream: 1 PRC for Signalled Links (%): -3.9 Total Delay for Signalled Links (pcuHr): 60.61
PRC Over All Links (%): -3.9 Total Delay Over All Links(pcuHr): 60.61 Cycle Time (s): 100

Appendix D – Value of Time Spreadsheet

Estimated Journey Time Savings

	A90 Out-bound @ Blackhall	Telford out-bound @ Blackhall	Out-bound to Drum Brea North	Quality Street PM Peak bus lane	TOTAL
Peak Hour Buses	24	5	25	8	
Capacity Per Vehicle	50	50	50	50	
Assumed Occupancy %	75.00%	75.00%	75.00%	75.00%	
Total Peak Hour Passengers	900	187.5	937.5	300	
Predicted AM Journey Time Saving (mins/trip)	0.00	0.00	0.00	0.00	
Predicted PM Journey Time Saving (mins/trip)	2.95	1.67	0.90	3.47	
Total Journey Time Saving (mins/trip)	2.85	1.67	0.90	3.47	
Value of Time (£/Hr)					
Passengers	£5.37	£5.37	£5.37	£5.37	
Driver	£11.55	£11.55	£11.55	£11.55	
Daily benefit for Drivers	£13.17	£1.61	£4.33	£5.34	
Daily benefit for Passengers	£229.57	£28.02	£75.52	£93.17	
Total daily benefit	£242.73	£29.63	£79.85	£98.51	
Total daily benefit *1.5	£364.10	£44.45	£119.77	£147.77	
Total Annual Benefit	**£94,666.46**	**£11,556.50**	**£31,140.28**	**£38,420.19**	**£175,783.43**

Appendix E – Calculation of Net Present Values

Appendix E - Calculation of Net Present Value Costs and Benefits

Total Annual Costs			**£750.00**
Bank of England base rate			4.75%
Current annual Inflation			2.40%
Year	Annual Maintenance (2008 Prices)	Capital Costs (2008 Prices)	Discounted Costs
1	£0.00	£708,300.00	£708,300.00
2	£750.00	£0.00	£732.78
3	£750.00	£0.00	£715.95
4	£750.00	£0.00	£699.52
5	£750.00	£0.00	£683.45
6	£750.00	£0.00	£667.76
7	£750.00	£0.00	£652.43
8	£750.00	£0.00	£637.45
9	£750.00	£0.00	£622.81
10	£30,750.00	£0.00	£24,949.08
11	£750.00	£0.00	£594.54
12	£750.00	£0.00	£580.89
13	£750.00	£0.00	£567.55
14	£750.00	£0.00	£554.52
15	£750.00	£0.00	£541.79
16	£750.00	£0.00	£529.35
17	£750.00	£0.00	£517.20
18	£750.00	£0.00	£505.32
19	£750.00	£0.00	£493.72
20	£30,750.00	£0.00	£19,777.71
Net Present Value of Costs			**£763,323.84**

Benefit / Cost Ratio	**3.5**

Total Annual Benefits			**£175,800.00**
Bank of England base rate			4.75%
Current annual Inflation			2.40%
Year	Annual Benefits (2008 Prices)	Additional Benefits (2008 Prices)	Discounted Benefits
1	£0.00	£0.00	£0.00
2	£175,800.00	£0.00	£171,763.56
3	£175,800.00	£0.00	£167,819.79
4	£175,800.00	£0.00	£163,966.58
5	£175,800.00	£0.00	£160,201.83
6	£175,800.00	£0.00	£156,523.53
7	£175,800.00	£0.00	£152,929.68
8	£175,800.00	£0.00	£149,418.35
9	£175,800.00	£0.00	£145,987.64
10	£175,800.00	£0.00	£142,635.70
11	£175,800.00	£0.00	£139,360.73
12	£175,800.00	£0.00	£136,160.94
13	£175,800.00	£0.00	£133,034.63
14	£175,800.00	£0.00	£129,980.10
15	£175,800.00	£0.00	£126,995.70
16	£175,800.00	£0.00	£124,079.82
17	£175,800.00	£0.00	£121,230.90
18	£175,800.00	£0.00	£118,447.38
19	£175,800.00	£0.00	£115,727.78
20	£175,800.00	£0.00	£113,070.62
Net Present Value of Benefits			**£2,669,335.27**

Appendix F – Video Survey

Appendix G – Drawings