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## Information Note

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 ct Traffic flow and delay

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### 1. Introduction

The purpose of this note is to provide a summary of traffic flow information on the Forth Road Bridge (FRB) during April 2006 and April 2007. The data collected focuses on the first weekend after Easter in both years and includes traffic delay information on the A8000 and A90 for those days in 2007 as a result of major carriageway repairs to the northbound bridge deck.

### 2. Background

Transport Scotland undertook a series of journey time surveys to monitor effects of the FRB major maintenance work on traffic congestion. Traffic delay was measured using a mobile observer method on the approach roads to the FRB and Kincardine crossing. Data was collected regularly throughout the first weekend of the 14<sup>th</sup> & 15<sup>th</sup> April 2007.

As part of the traffic monitoring programme on the trunk road network, Transport Scotland has installed a number of automatic traffic counters on the approach roads to the FRB (see Figure 1). Data was collected on the A90 northbound between the Echline Roundabout slips and on the northbound on slip at Echline Roundabout during April 2006 and the M90 north of the FRB during April 2007. Due to roadworks at the Echline junction, in connection with the upgrade of the A8000 (M9 Spur), the traffic counters on the A90 have been out of operation. Information about northbound traffic movements is, therefore, unavailable for the latter half of 2006 and all of 2007. As a result data from the northbound counter on the M90 north of the FRB in Fife was used for comparison instead.

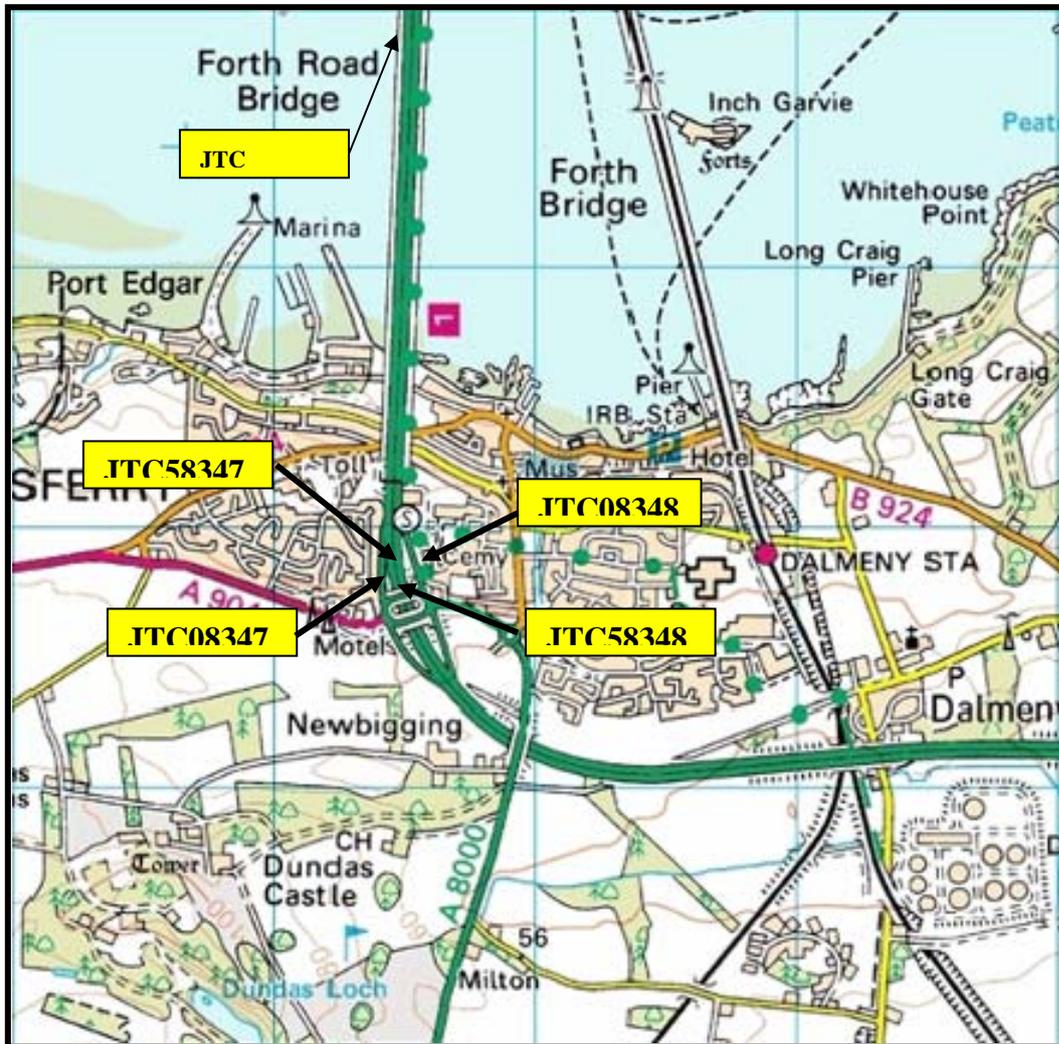
In 2006, the school Easter holidays occurred on the 15<sup>th</sup>/16<sup>th</sup> of April, whereas in 2007 they were on the 7<sup>th</sup>/8<sup>th</sup> of April. In 2007, FETA (Forth Estuary Transport Authority) took the decision to close the northbound carriageway at weekends between 14<sup>th</sup> April and 18<sup>th</sup> June and operate a contraflow system from 19.00 on Fridays until 06.00 on Mondays to allow for resurfacing on the bridge. For the duration of the roadworks the posted speed limit on the bridge and immediate approaches was reduced to 30 mph instead of the normal 50mph.

**Figure 1: Location of Transport Scotland's Automatic Traffic Counters**

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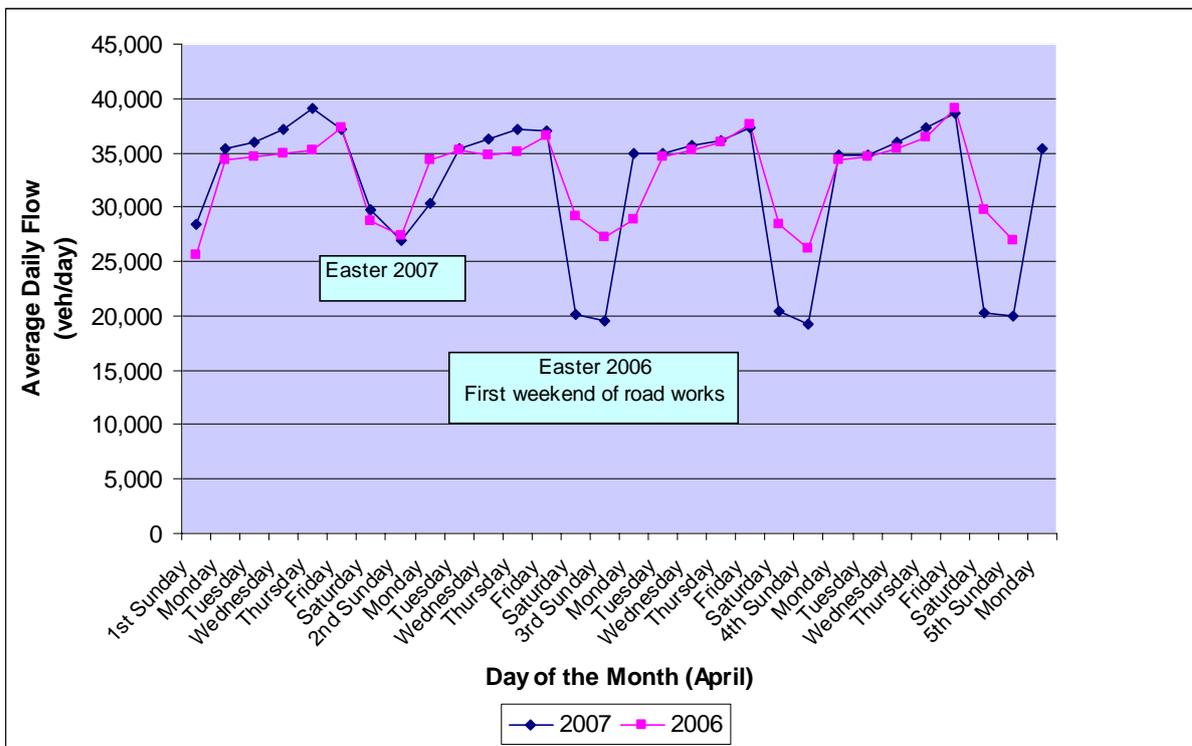
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3. Traffic / Delay Data on the Forth Road Bridge Approach Roads

Figure 2 illustrates the northbound traffic profile across the bridge for April 2006 and 2007. The profiles for the two periods are generally similar, although traffic levels are slightly higher for the first half of April 2007 than the corresponding period in 2006. However, the figure clearly shows traffic levels drop significantly over the weekends following the beginning of roadworks in 2007. The average reduction in traffic flow from that of Easter weekend 2006 to the same weekend in 2007 was approximately 8,400 vehicles per day, and 7,500 vehicles per day the following weekend. Clearly this decrease in flow is due to the reduced capacity on the FRB following closure of the northbound carriageway.

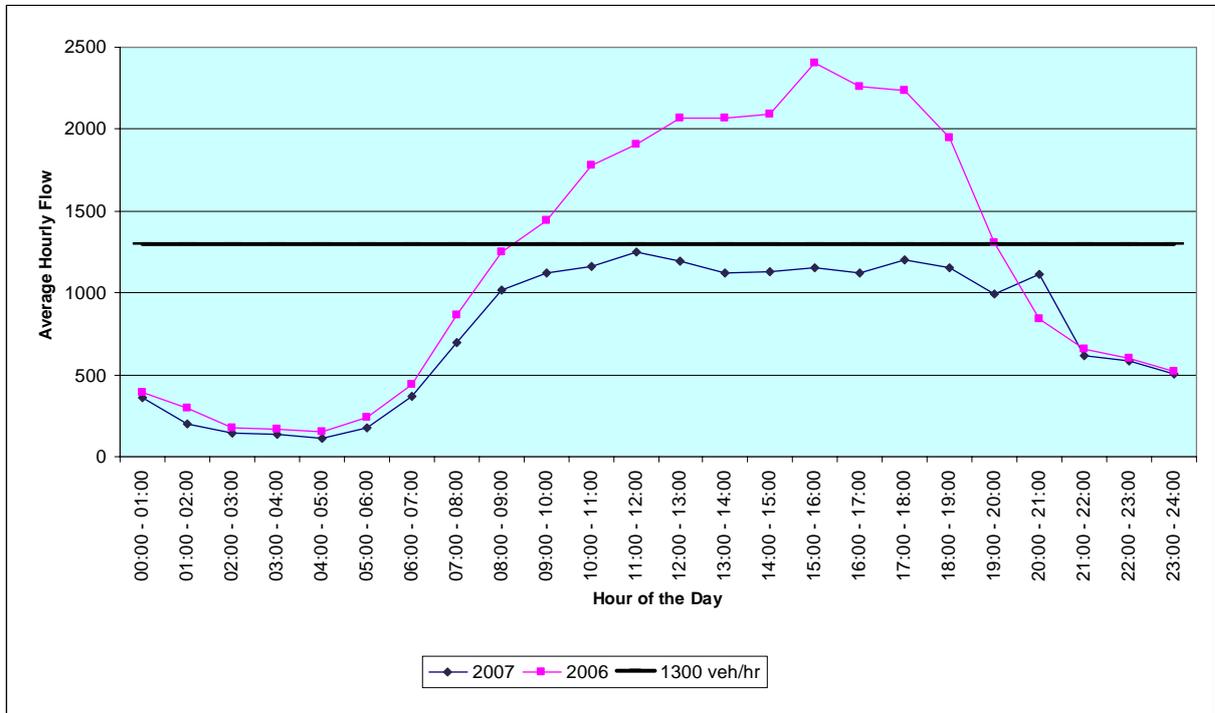
Figure 2: Average Daily Northbound Traffic Flow through April 2006 and 2007



A comparison of the daily traffic flow of Saturday 22<sup>nd</sup> April 2006 with that of 14<sup>th</sup> of April 2007 can be seen in Figure 3. The 2006 profile shows peak flow occurring between 15:00 and 16:00, whereas the flow in 2007 appears to plateau between 08:00 and 19:00 with a significant drop thereafter. For this period of the day 2007, traffic remains at approximately 1200 vehicles per hour suggesting that FRB contraflow system is near or at capacity.

A horizontal black line has been added to Figures 3, 4 and 5 to represent the maximum advisable flow on a new rural, single carriageway of 1300 vehicles per hr as set out in “Traffic Capacity of Urban Roads - Part 3 79/99, DMRB Vol. 5” where the speed limit is 30mph.

Figure 3: Average Hourly Northbound Traffic Flow on Saturdays 22nd of April 2006 and 14th of April 2007



Similar traffic behaviour was recorded on Sunday 23<sup>rd</sup> April 2006 and 15<sup>th</sup> April 2007, which can be seen in Figure 4. The daily peak flow on the Sunday in 2006 occurred between 16:00 and 17:00, whereas on the corresponding Sunday of 2007, much like on the Saturday, traffic flow seems to plateau between 10:00 and 20:00 at approximately 1100 vehicles per hour.

**Figure 4: Average Hourly Northbound Traffic Flow on Sunday 23rd of April 2006 and 15th of April 2007**

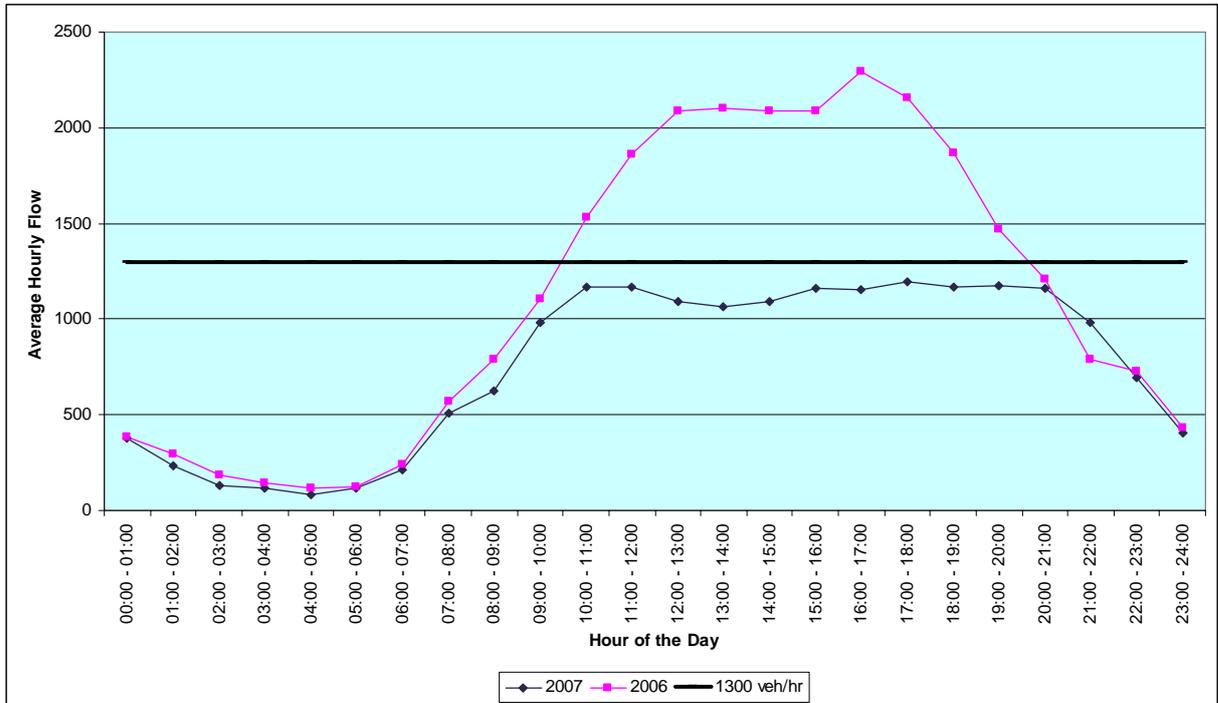


Figure 5 shows the traffic behaviour of the Saturday and Sunday on the same chart.

**Figure 5: Average Hourly Northbound Traffic Flow during first weekends after Easter 2006 and 2007 (showing Saturday and Sunday together)**

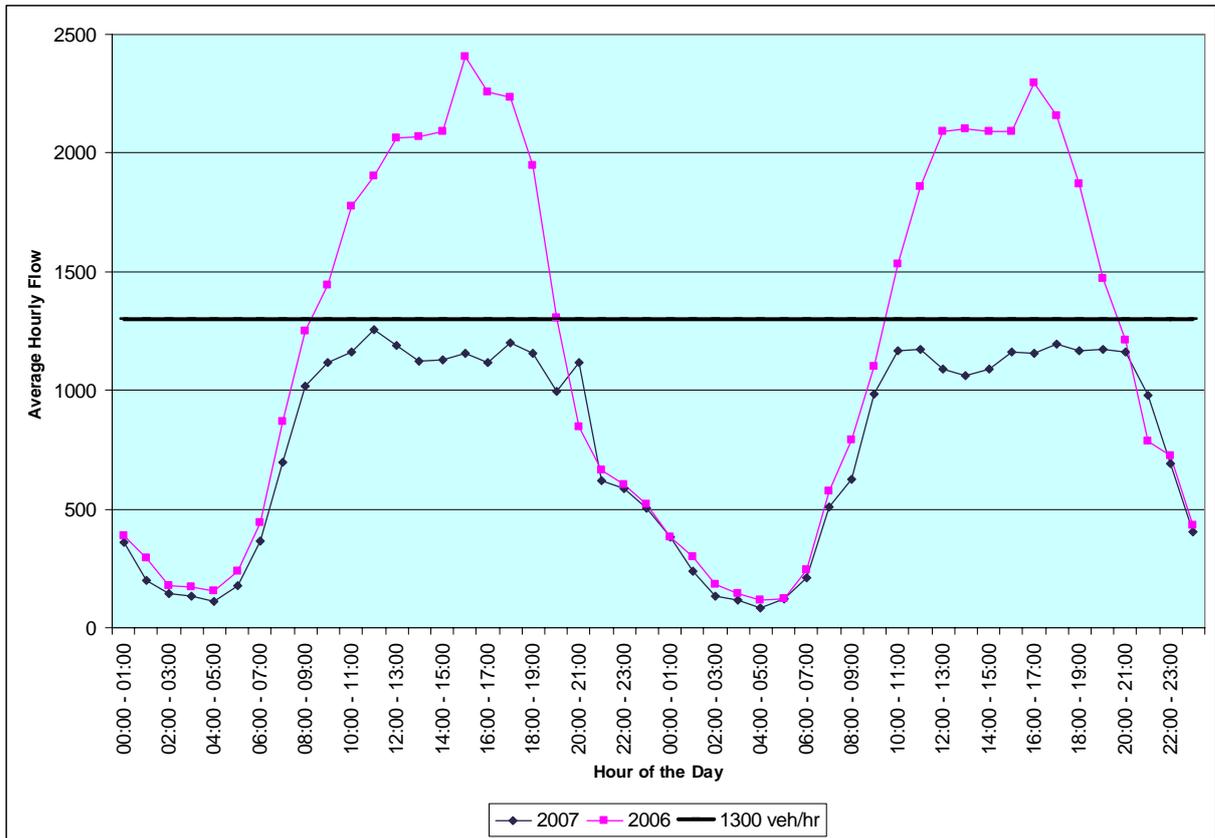


Figure 5 demonstrates that over the period of the first weekend of road closures as a result of carriageway repairs, traffic flow northbound on the FRB never exceeded 1300 vehicles per hour. Compare this with the similar weekend in 2006 when flow reached 2400 vehicles per hour on the Saturday afternoon and slightly less on Sunday.

As a consequence of the weekend roadworks on the FRB, severe congestion problems have been caused on the local roads leading to the FRB during weekends when the northbound carriageway is closed. It is known that the reduction in flow over the FRB over the dates previously compared is caused by the reduction in capacity of the bridge. Following on from analysis of traffic flow, it has been possible to compare the delays on the first weekend closure of the FRB with the results of traffic flow. These results are reported below.

Figure 6 shows the relationship between traffic flows on the FRB and delays on the two northbound approach roads, the A8000 and the A90. Between 10:00 and 21:00, during which traffic flows remain relatively constant at around 1300 vehicles per hour, significant delays occur on both roads. Delay on the A8000 is around 90 minutes between 14:00 and 20:00, with a peak delay of almost 2 hours between 15:00 and 16:00. This peak delay coincides with the peak traffic flow across the FRB for the similar weekend in 2006 (see Figure 5 above). There are no delays until 11:00, but over the next five hours delays increase to a maximum of 115 minutes on the A8000 (15:00-16:00) and 70 minutes on the A90 (13:00-14:00). Traffic delays on the A8000 remain constant at 90 minutes from after the peak flow until 21:00.

This comparison demonstrates that although northbound flow remains relatively constant the continual demand in traffic between 14:00-21:00 to cross the Forth results in a significant delay to drivers, even after the usual Saturday peak traffic flow has declined.

**Figure 6: Comparison of Hourly Traffic Delay and Traffic Flow on Saturday 14<sup>th</sup> April 2007**

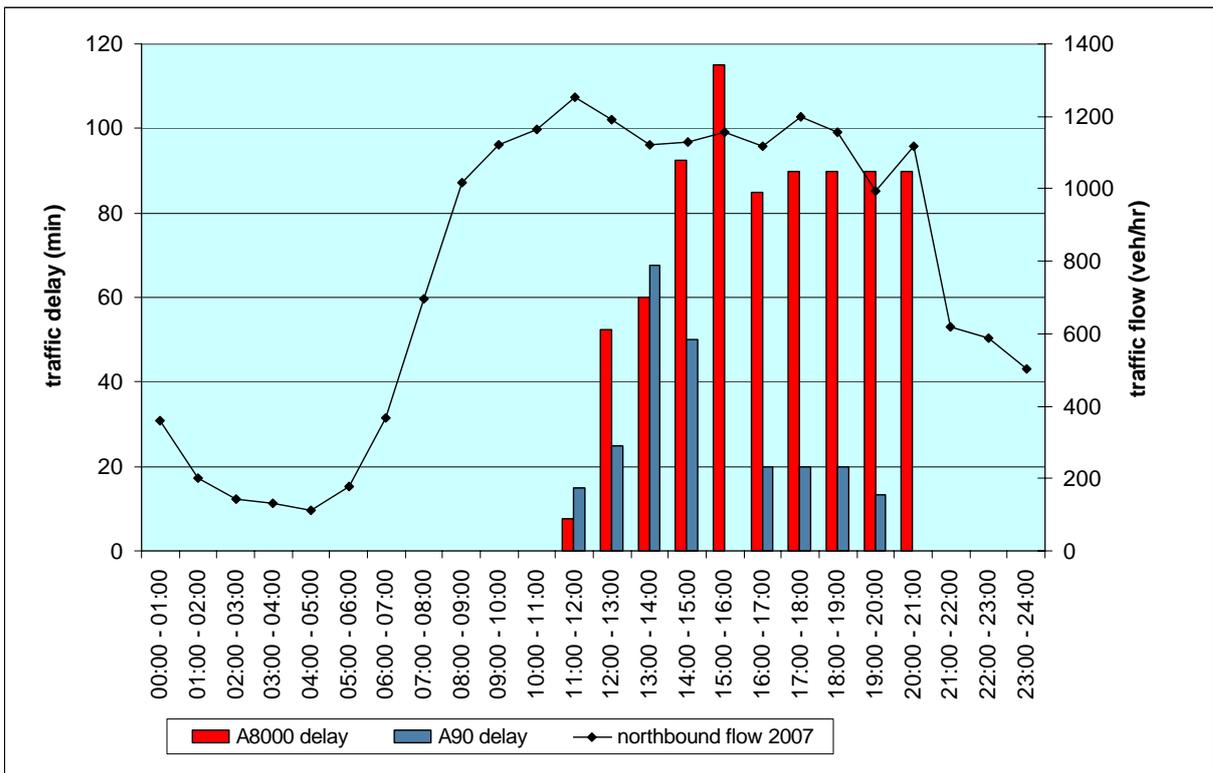
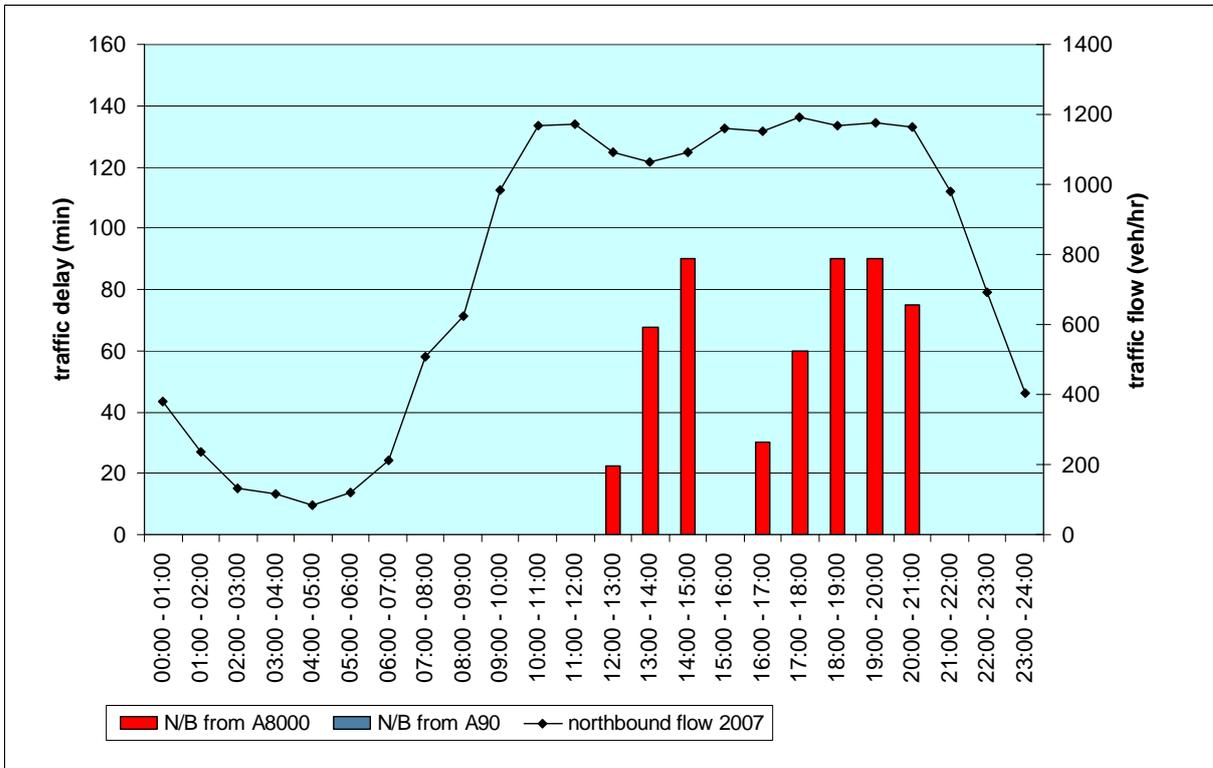


Figure 7 shows that similar, although slightly reduced, delays occurred on Sunday 15<sup>th</sup> April on the A8000, but that there were no delays on the A90 for the whole day. It would appear that no delays were recorded between 15:00 and 16:00 and that peak delays occurred and were sustained for quite some time directly after the peak flow on the FRB. This follows a similar trend to the traffic delay data for the previous day shown in Figure 6.

**Figure 7: Comparison of Hourly Traffic Delay and Traffic Flow on Sunday 15<sup>th</sup> April 2007**



**4. Discussions & Conclusion**

It is clear from the above results that the northbound carriageway works had a significant effect on levels of traffic flow on the FRB, with a corresponding impact on delay to drivers approaching the bridge from the south.

The question is can any conclusions be drawn from these results to indicate the likely effect that a semi-permanent / permanent restriction like those for the roadworks, would have on average weekday traffic flows and patterns. There are a number of factors that need to be considered:

1. Despite the works being temporary in nature and well publicised in advance, there were still significant delay to drivers.
2. The imposed speed limit on the bridge for the duration of the works was 30 mph. The reduction in speed is very much a safety issue. The normal speed limit is 50 mph.
3. It is likely that regular drivers, or those with advance knowledge, either re-routed their journey, did not undertake their journey, or changed mode for their journey.

It is hard to draw any conclusions from the analysis regarding the impact on weekday traffic patterns. There are numerous variables that need to be considered, such as:

1. If the speed limit was increased to 50 mph, it would be expected that there would be a marginal increase in hourly traffic able to cross the bridge, maybe of the order of 1400-1500 vehicles per hour.

2. If any restriction were to take place over a long term period, drivers would undoubtedly seek to transfer to other modes of transport (train, bus etc.)
3. Commuting journeys would make up a much higher proportion of traffic in weekday peak periods. These journeys have much less flexibility from the shopping/leisure trips typical of weekend traffic. They are not able to significantly re-time their journeys. Nor can they change their destination.

It would seem likely that cross-Forth demand would remain high and, as a result, delays would be extremely long in the peaks, spreading across the whole peak period and even into the current inter-peak periods (i.e. before 06:00 and between 10:00 - 15:00 and after 19:00).

Journey time reliability would be also be finely balanced with such high demand and reduced capacity. Any incident, however small, could have a significant impact on journey times and increase potential delays still further.