THE PAPER

The Paper I am going to present is called “Traffic Signals Innovation and Reality”
This paper explains the process of installing state of the art traffic signals at two simple t-junctions in the village of Bridge of Weir, the less than satisfactory outcome and the steps the Council took to resolve congestion problems.

The town of Bridge of Weir lies to the west of Paisley in Renfrewshire and has a population of 4,670. It is mostly affluent with high car ownership and lies on a commuting route between Inverclyde and Glasgow. An action plan for the town identified the need for pedestrian advantage which included the provision of two traffic signal installations.

Renfrewshire Councils Local Transport Strategy identifies road safety and pedestrian facilities as the key transport issues in Bridge of Weir. To help achieve the aim of enhancing the village centre an action plan was proposed for the Main Street bisecting the village involving speed reduction measures and traffic signals with pedestrian facilities.

Consultants were tasked with assisting the Council with designing and modelling work associated with two linked traffic signal installations, intended to address a particularly difficult pedestrian crossing problem and assist traffic emerging from side roads onto the main road through the village.

This paper will discuss in detail the reasons for the poor performance of the traffic signals following implementation, how the technical problems were resolved, explaining why the initial design ‘got it wrong’ and discuss the consequent reactions of the community. I would like to emphasize that it is difficult to quantify the poor performance, however the statement is based on the reaction of the local community and the number of complaints. It is also worth noting that it is unusual to receive votes of thanks for projects which have been successful and hence supporters of the scheme tend to remain silent.

DESIGN OF THE SIGNALS

A basic traffic signal layout was drafted by in house staff for two staggered T junctions:-

1. Main Street at Torr Road and Appendix 1
2. Main Street at Houston Road Appendix 2

and passed to our term Traffic Consultants to design and install. Layout drawings are included in Appendix 1 and 2 of this report. The Consultants were based in Glasgow however the signal design was carried out by an office in England then passed back to the Glasgow office for implementation.

The feedback from the Consultants was that the junctions would work based on the Transyt computer programme modelling results. That was based on measured flows obtained by a full junction count and automatic traffic counts. There were also constraints with the junction layout that made it less than ideal due to the limited road space because of the proximity of the bridge. On this basis we proceeded with the installations.

The staggered t-junctions are located as shown on the plan in Appendix 3 approximately 200m apart.

To the north is Kilmacolm Road leading to Kilmacolm and then to Port Glasgow and Greenock immediately north of junction on the west side is a bus stop and petrol filling station. Houston Road leads to Houston but also gives access to Bridge of Weir Primary School and is the vehicular route to a secondary school and another primary school.

The Houston Road junction consists of 6 signal poles with includes pedestrian aspects, tactile paving, controller and haldo pillar. All the lining was renewed with the introduction of stop lines and road studs.
All approaches and exits at this junction are single lane with the exception of Main Street which has a short two lane approach.
Additional signals were provided for the private dwellings on the northeast corner of the junction to assist safe egress from these properties.

Moving south to the other junction we have Torr Road as the side road which leads to a fairly affluent residential area. To the south is Main Street its self and to the north is the junction I have just described, which is only 200m away. This junction has a similar layout to Houston Road with 6 signal poles with includes pedestrian aspects, tactile paving, controller and haldo pillar. Again all the lining was renewed with the introduction of stop lines and road studs.

The 200m link between junctions provides access to the supermarket car park a bus stop and a school crossing patroller.

JUNCTION MODELLING

Before a computer model of a traffic signal junction can be built the traffic data must be obtained. This is usually done by carrying out a manual junction count and checking day to day flow variations through automatic classified vehicle counters. The counter uses pneumatic tubes across the road to count the number of vehicle, classify vehicle type and measure vehicle speeds over the period of a ‘typical’ week; all the data is stored in a road side recorder and download onto a desktop computer at the end of the survey.

To determine the operational efficiency of traffic signal junctions they are modelled using a computer program in this instance Transyt , that is based on mathematical formulas for junction operation. (These mathematical formulas were first published in Technical paper no.56 “Traffic Signals” published by Webster and Cobbe (April 1966) but they are still used as the industry standard throughout the world).

The traffic flows that have been recorded at the proposed location are input into the computer model that has been customised to emulate the proposed junction configuration including lane

widths\lane usage and also an element of driver behaviour. The use of the computer program is by no means automated it requires a high degree of skill and experience to correctly encode a real life situation into mathematical formula.

A limitation with models is that the extent to which traffic flow can vary from day to day therefore it is important that a typical traffic flow is used for modelling. It should always be the case that the timings derived from the model be fine tuned on street after the junction is switched on.

CONSULTATION

Renfrewshire Council carried out extensive consultation with the Community Council and local Elected member for whom this was a very sensitive and emotive issue. It was explained that motorists would experience some delays on the Main Street which they hadn't previously experienced as we were introducing infrastructure which would include pedestrian facilities and assist side road traffic. From experience the community and others affected by proposals focus more on the advantages of the scheme and do not consider fully the possible disadvantages. When a scheme is installed the emphasis can shift to the negative effects such as congestion and the reasons for the introduction of the scheme such as pedestrian advantage are forgotten.

THE INSTALLATION

The contractural arrangements for implementing the signals involved the Council procurring the equipment and our term Consultant supervising implementation. This involved installing ducting under the footways and carriageways to link the signal poles to the controller and to the haldo pillar. Tactile paving and kerb realignments were carried out at this stage. Various road crossings were necessary to complete the ringed circuit. An additional duct was installed between the two junctions to provide a means of synchronising the two separate controllers through a hard wired link.

The haldo pillar houses the power supply which is provided by Scottish Power. This is always one of the longest tasks in any installation. To explain briefly this is to request the Street Works Information at the location identifying what utilities are located within the area ie Gas, water, electricity, Bt and Cable. Normally the haldo pillar is located as near to the power supply as practically possible, the closer it is to the power supply the cheaper the cost. The traffic signal controller is usually located beside the haldo pillar. It is also good practice to site the traffic signal controller at a location where the whole junction is visible ie unobstructed views of all approaches and exits.

Once the location has been decided a request is passed to Scottish Power asking for the provision of a low voltage power supply to our haldo pillar. A cost for the supply is sent to us to pay up front before any work commences. Thereafter we are advised of an installation date.

Even although this seems straight forward it can take many months for the power supply to be provided. It is beneficial if you know you are likely to be putting in a new set of traffic signals to request it well in advance.

When all the necessary ducting and ground works are nearing completion we arrange for the signal contractor to come on site to install the signal poles, pedestrian facilities, associated cabling and plant the controller.

Whilst this is all happening the EPROM for the controller is being blown by the signal company, this holds all the information such as stageing, phases, intergreens, plan times etc.

The EPROM contains all the data about the controllers method of operation including which approaches can run green at what time and for how long, the absolute safety timings and what set of timings run at what time of the day. This information is derived from the initial modelling but it is usually expected that it will be modified on site when the junction is switched on and driver behaviour is observed on site.

In order to complete the installation all signing, lining and road stud work must to be completed before the installation can be safely commissioned.

THE SWITCH ON

The signals were switched on before the end of the school holidays when traffic flows were low and we had no adverse comments from the community at this stage. They appeared to be operating well.

However on the 13th of August we commissioned Tarmac to resurface Bridge of Weir Road in Brookfield which is a small village lying to the east of Bridge of Weir adjacent to the A761. The works were planned to be finished in 2 weeks however works were delayed and took about 3 weeks. The consequent diversion wholly changed the traffic distribution at the new signals moving the heaviest flow to a side road. To compound the problem schools returned on the 18 August.

Further resurfacing at the Darluth junction which is just to the north of Linwood led to traffic diverting down Houston Road. This meant that the new junctions had to attempt to operate with side road flows much were greater than anticipated. This generated a large number of negative comments about the junction. Local feeling moved against the new signals which were blamed for congestion arising out of the diversions.

Whilst these necessary roadworks were unavoidable it masked underlying problems with the two traffic signal installations. For the duration of the road works traffic patterns changed on a daily basis. However the road works were due to end and the community would experience

the real implications of the two traffic signal installations in the town centre. This is what happened!!!!!

Monday morning early September, all diversions removed and another telephone call to do with Bridge of Weir, 5 minute journeys taking 30 minutes, children late for school, school buses late, people late for work. All morning, calls from members of the public asking what are we going to do about it. Initially, there is a settling down period whilst motorists get used to having to wait at signals, allow side road traffic out and getting pedestrians across the road safely. Hopefully the telephone complaints would tail off towards the end of the week. Maybe motorists would take another route albeit limited or change their travel times. We intended not being pressurised into making any changes at this stage.

The following week more complaints including the local Councillor for the area. Can we come out and have a look at whats happening. Next morning we were on site for 8am. The traffic was moving with some queing as a result of the signals which is acceptable. As we got further into the peak period queues were developing and by 8.35am we had a very congested village centre. This situation lasted till about 8.55am after that the traffic all cleared and we had free following traffic throughout the village.

What happened between 8.35am and 8.55am?

The school run happened parents take their children to school by car resulting in journeys going through the sets of traffic signals dropping the children off at school then coming back through the traffic signals. Houston Road is used to access all the schools in the area therefore you can imagine the congestion caused by this alone

In between the two sets of traffic signals are two bus stops and obviously if one stops this holds up through traffic, furthermore we have the access to a car park which was causing blocking as vehicles turning right into the car park are held up because of the through traffic. There is also a school crossing patroller operating here. Remember this is over a 200 metre length of road.

Traffic wanting to turn right from Main Street into Houston Road was not able to complete the manoeuvre because of the heavy flow of traffic through Bridge of Weir was blocking back through the junction from Torr Road and the school crossing patroller.

Back at the office we held a meeting with our Consultants who had modelled the junctions when some important information came to light. If the pedestrian phase is demanded every cycle then the junctions would be over capacity and result in heavy congestion. There was not a high demand by pedestrians but it was constant every cycle between 8.35am and 8.55am.

Very significantly however, the modelling of the junction had not identified the unusual flow profile and 15 minute peak within a peak. Additionally, the scale of the peak changed on a daily basis. Bridge of Weir has very high car ownership and parents can readily choose to run

kids to school if it is wet for example. In consequence, on certain days the village centre grid locked

What we did

First request was for us to give more green time for the right turning traffic into Houston Road from the Main Street our reaction to this was to call out the traffic signal contractor to monitor what was happening and to make any minor tweaks to the signal timings. Generally any adjustment to one phase has detrimental effects on the other phases this is why any change at this time is minimal. Two seconds was added to the signal timings/intergreens to assist the right turners which did not make much of a difference so a further two seconds was added. This enabled an extra three vehicles to make the turn. Again this was not a significant improvement.

A new request was made to install a right turn arrow for the above manoeuvre. This was possible because the consultant had carried out additional work to ensure the facility was available for the expected demand in the future. Pressure from the community forced this to be put in place. An initial figure of fifteen seconds had been programmed into the controller which let about eight extra vehicles through each cycle. This helped to clear the right turning traffic however at the expense of the traffic from Kilmacolm Road which is a combination of through commuting traffic and School run.

We now receive calls from the motorists from Kilmacolm Road complaining about the delays they were experiencing. Next action was to reduce the right turners time from fifteen seconds back to about eight seconds. As expected this assisted Kilmacolm Road but resulted in the right turn movement becoming a problem again. The situation now was a balancing act and what was considered to be an acceptable compromise.

It had been observed from day one that incorrect vehicle positioning was being adopted by the right turning traffic, these vehicles were not entering the junction when the signal went green, therefore they would not activate the right turning detection loop. I agreed that a second loop be cut in the carriageway immediately behind the stop line.

The gridlock through the town centre could be eased by synchronising both sets of traffic signals albeit a number of factors would still affect this on a random basis that is the bus stops, school crossing patroller and vehicles accessing the supermarket car park..

A further interesting problem was that the vehicle detection systems on the side roads did not operate during grid lock because there was no movement. This compounded the problem. Various elements of the signals failed at different stages making it very difficult to identify the effects of changes we were making.

Continuing complaints were coming from pedestrians advising that they would cross on the green man whilst vehicles were still moving. This was found to be frustrated drivers still coming through on red illegally. Again we were pressurised by bad driving to restage the junction.

The signals are now operating as

Houston Road
Between 07:30 and 08:30 there is set of timings that will only call the right turn arrow if there are vehicles waiting on the detection loop this was extended to include the time period between 08:30 and 09:00 to assist the school traffic turning into Houston Road.
After 09:30 the junction changes to a demand responsive method of control (Vehicle Actuated) this is to ensure that delays to all vehicles should be reduced
During the evening school run there is additional time available to Houston Road.

Torr Road

The stage order has been modified between 07:00 and 07:30 to remove the change between right turning Traffic on Main Street and pedestrians across Torr Road.
The timings only give 10 seconds of green to Torr Road, this is all that can be spared without causing additional delay on Main Street but it may require a few additional seconds for Torr road if queues are unduly increased.

At other times of day the safety period between Main Street and the pedestrian has been increased to allow for drivers that are failing to stop during the amber period.
At all other times of day the junction runs a demand responsive method of control (Vehicle Actuated) this is to ensure that delays to all vehicles should be reduced.

The demand responsive method of control does not allow coordination between the junctions but this does not seem to be required after on street observations because traffic flow is very light outside of the peak periods.

As all of these changes were made, daily contact was maintained with the local Elected Member who was distributing newsletters. As a community however, Bridge of Weir was turning against the Council. Whilst we sought to manage this through customer responses and press releases, the only genuine solution was to remove congestion to a level that locals could consider as acceptable. In a modern local authority that is responsive to customer needs there is a real pressure to get projects like this “right”. It is quite feasible that political concern fuelled by local views could lead to the signals being removed.

CONCLUSIONS

A computer model is only as good as the data that is put into it!! In this instance closer attention to the flow profiles would have identified a problem. Micro simulation modelling may also have assisted with a grid lock situation. It is essential that any new traffic signal installation is monitored post-commissioning by an experienced traffic signal engineer and the necessary adjusts are made to the timings to ensure optimum junction operation BEFORE the public lose confidence in the junction and the complaints start. It may also be wise to make some pessimistic assumptions in the modelling process to ensure that the projected performance has a degree of tolerance.

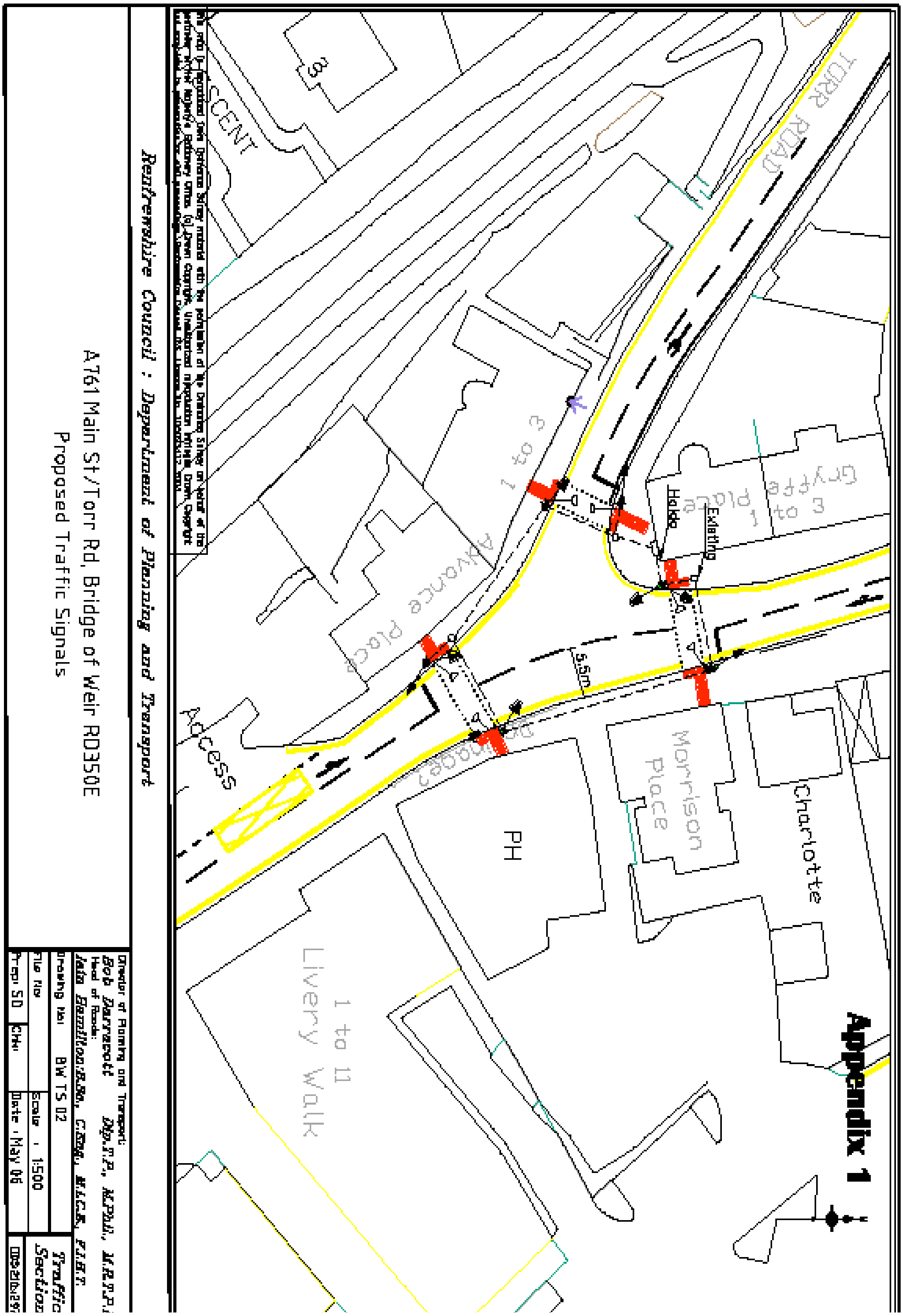
A very important stage of the project was the Consultation where extensive communication took place with the community, businesses and the usual consultee bodies such as the police, bus companies, emergency services, local members. It is vitally important that every one is aware of the disadvantages as well as the advantages and that the disadvantages are not forgotten about during the installation and operational stages. People tend to focus on the positive improvements prior to implementation and do disregard the identified disadvantages. Therefore it is important that this is not lost.

It is also extremely important that communication is good between everyone involved. It should be clear that the Council is working with the community.

The timing of the switch on for signals should be well planned and take place at the most appropriate time with good publicity well in advance. In retrospect we should have delayed implementation until all local resurfacing work involving diversions was complete.

At present the signals are generally working satisfactorily. Volatility remains however during the morning school run, when depending on circumstances significant congestion can still occur. The community view at present could be described as neutral. Our last hope is for the children to want to walk to school on the wet days and not just on the dry ones!

Andrew McNab
Senior Transportation Officer
Renfrewshire Council
Renfrewshire House
Cotton Street
Paisley
.tele 0141 842 5983
Mob 07717478262
Email drew.mcnab@renfrewshire.gov.uk



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