Chris Kennett Consulting Limited
Traffic Signal Engineering

Old Tricks, New Dogs

Improving capacity using old techniques and new tech.

JCT Symposium 2026

Written and presented by Chris Kennett FIHE and Mark Underhill

chris@chriskennett.consulting
03301 336 316
Mark.underhill@cambridgeshire.gov.uk
TBA

Based on work undertaken by Chris Kennett Consulting Limited on behalf of Cambridgeshire County Council

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Introduction

In October 2023 the Department for Transport announced new funding specifically for the Traffic Signals Industry. Divided into two, the “Traffic Signal Obsolescence Grant” offered funds to pay for modernisation of the UK traffic signals asset, while the “Green Light Fund” provided means for Local Authorities to improve capacity and reduce delay on their network. In total, these provided £50 million to provide “better” and “smarter” traffic lights across England.

Cambridgeshire County Council already have a strong track record in innovation with traffic signals, through grants and central government funding such as City Deal and area growth funding. These are often targeted at specific technologies and demonstrators, and much of the funding is predicated for the “Greater Cambridge” area, not the more rural Market Towns.

The Traffic Signals Team for the County bid for Green Light Fund, and were successful, based on a distributed approach across the County. The Team devised a list of problem sites, areas and particular technology challenges where they felt there were unresolved problems. These were spread geographically across the entire County, and allocated small amounts of the available funding in principle to resolving or improving the problems – without knowing how.

Cambridgeshire County Council viewed the Green Light Fund as an opportunity to address long-standing traffic signal issues across the county that could not easily be resolved through existing maintenance or capital funding programmes. The Council's ambition was to improve journey time reliability, reduce unnecessary delay and make better use of existing highway infrastructure through targeted signal optimisation and modern traffic control technology. Whilst the funding supported schemes across Cambridge, Ely, Huntingdon, St Neots and Wisbech, particular attention was given to locations where congestion was having a noticeable effect on daily journeys and network resilience.

In total, 26 separate schemes were proposed, targeting four Market Towns, and the Cities of Ely and Cambridge.

One of the priority locations identified was the corridor linking Hinchingbrooke Hospital with the Cambridge-bound A1307 in Huntingdon. This route serves hospital traffic, residential areas, Huntingdon Railway Station and strategic movements towards Cambridge. Persistent congestion along the corridor, particularly during peak periods, had become a source of concern for both network users and the Council. The Green Light Fund therefore provided an opportunity to review the corridor as a whole and implement targeted improvements aimed at reducing delays, improving journey time reliability and enhancing the overall performance of the network.

Huntingdon Green Light Fund Schemes

The historic Market Town of Huntingdon (home of former Lord Protector and despot, Oliver Cromwell) has been subject to major changes to the road network and home to significant development and growth in recent decades. While housing has grown, the nation-wide shifts to online work and shopping have changed the nature of the high street and shopping areas, changing the timing and volumes of traffic flows. A major road building scheme

effectively bypassed the town in 2020, but also connected it to the Strategic Road Network in new ways, creating further huge and unpredictable changes to traffic flows.

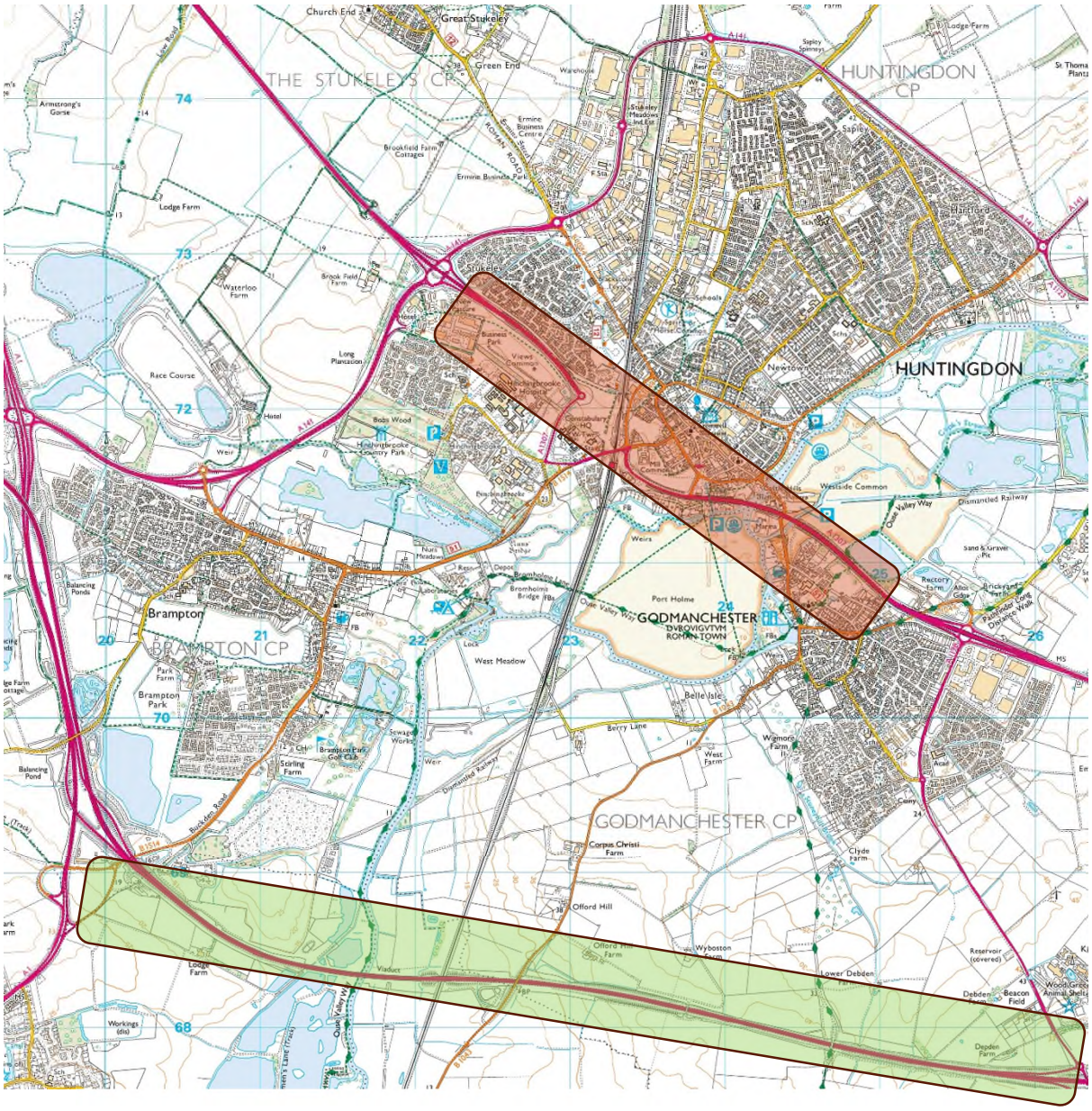


Figure 1. Huntingdon in Cambridgeshire (OS Map), route of "old A14" (now A1307) in red, new A14 in green

While these changes have been accumulating over the last 20 years, each new junction and crossing was built or refurbished without regard to the wider town or future changes. The SCOOT system in use for many years was not expanded to the new sites, and although many were on MOVA, none had linking. Older sites accumulated problems and faults. The mesh communications system installed in the early 20-teens had gaps in coverage and had become obsolete, while the DSL backhauls were also scheduled for withdrawal.

Few of the individual sites were truly obsolete though, as the County Council has invested in maintenance and refurbishment. Instead, the problems have accumulated in systems, and through a lack of coordination between individual projects.

Green Light Funding was seen as an ideal opportunity to target and resolve these problems, not by refurbishing whole sites, but by small, targeted interventions aimed carefully to achieve maximum impact.



Figure 2. Traffic Signal Sites

Three schemes were proposed for the western side of the Town. Two of these targeted junctions with specific capacity problems and congestion following the road building scheme in 2020. Both junctions were subject to frequent complaints and severely affected access to and from a nearby hospital, police station, fire headquarters and several schools.

The third scheme was to look at the other junctions in the area more generally, around what was described as the "Station Area". This involved the original ring-road past the Bus-Station, but included junctions on the new A1307.

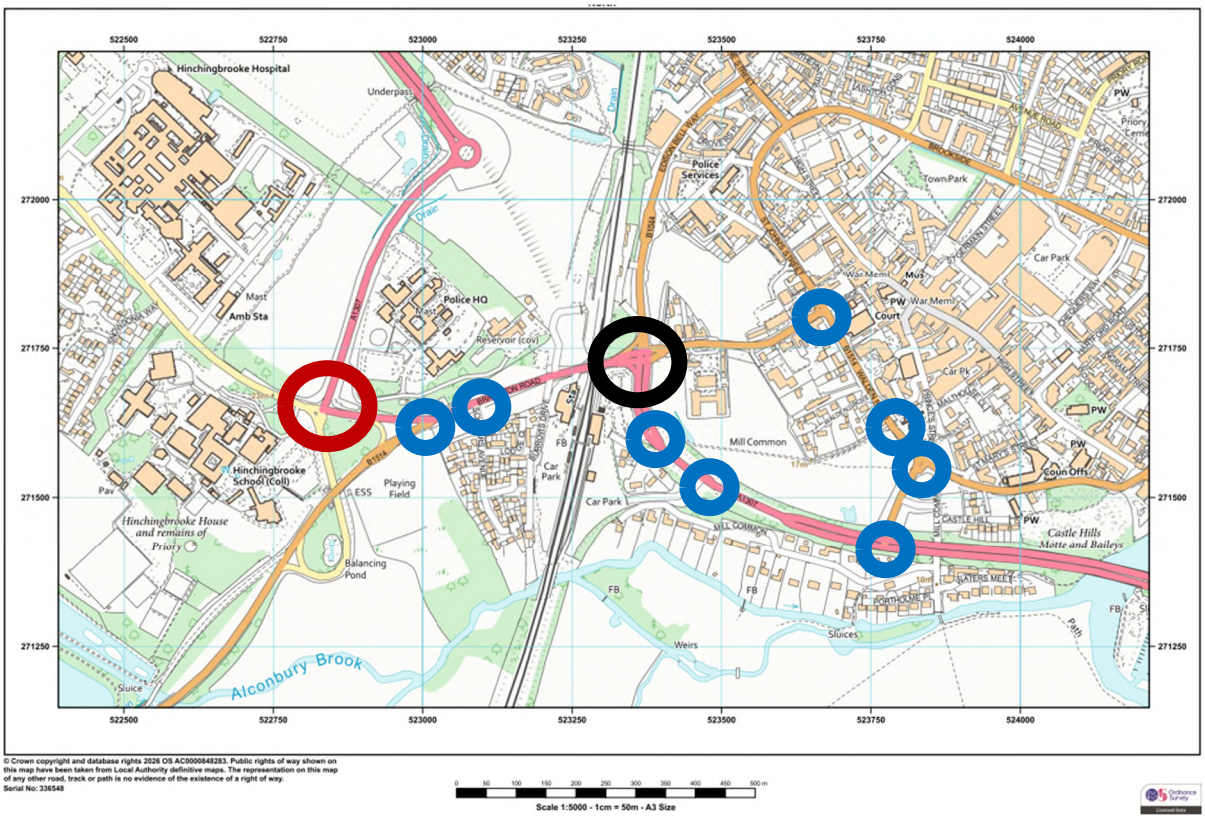


Figure 3. Western Side of Huntingdon showing Hinchingbrooke Park Road (Red), Edison Bell Way (Black) and the "Station Area" junctions (blue).

In total, the three schemes included eight junctions and two crossings, all linked in multiple ways and at different points, all with various problems and challenges.

Key complaints and known problems were:

Hinchingbrooke Park Road

The junction outside Hinchingbrooke Hospital had numerous safety problems when first opened, which resulting in changes being made that reduced total capacity. In turn, this created severe pressure and congestion leaving the hospital site, made worse by exit blocking from congestion on nearby Brampton Road.

Edison Bell Way

The junction of Edison Bell Way, Brampton Road and the new A1307 is a cross-roads. While the junction had been expanded with more lanes, each arm ran one-at-a-time, creating high cycle times, high delays and long queues – including exit blocking back at other junctions.

Station Area

Problems in this area were harder to define – apparently random and long queues could occur nearly any time of the day. The new link road connecting the A1307 to the ring road (Pathfinder Link) could block through in both directions and while the junctions would recover under MOVA, journey times were unpredictable. Leaving Edison Bell way travelling south, drivers could be stopped multiple times and the queue could exit block back.

A link cable had been provided in the design between the junctions, but never had a use. Queue detection that was put in place had to be switched off shortly after installation: by the time it was triggered, the queue had already formed but the results of the queue clearance were too disruptive. To make things worse, the original SCOOT region along the Ring Road was disrupted by the changes, resulting in control being lost on a previously working region.



Figure 4. Un-terminated link cable at site on A1307

Drivers throughout the area often complained of being stopped multiple times, and of the queues that could suddenly form.

All these junctions and crossings are modern – built or refurbished in the last eight years. All have some form of adaptive control available – mostly MOVA, but none worked as well as they should, in part due to exit blocking and lack of coordination.

In total, just £80,000 of the total £500,000 was allocated to these three scheme areas.

Old Tricks

Implicit in the scope of the schemes was the need for careful value engineering, to make the largest possible improvement within the available budget. To do this, the Engineers at Chris Kennett Consulting Limited who were tasked with finding improvements, reached for a number of old-fashioned tricks and techniques.

The very first actions taken once the project was approved was to review all of the sites, on street. This involved capturing the as-built and asset data, traffic flow data, fault records and complaints. Engineers visited all the sites, collecting further information about them, how they work and looking for potential improvements. Where traffic flow data was not already available from file, MOVA flow logs were downloaded.



Figure 5. Hinchingbrooke Park Road (prior to changes)

From this data and observing the sites, traffic models were built for only three of the junctions: only those where the Engineers felt there was a realistic chance of finding more capacity were modelled. JCT's Linsig was used to create accurate models, to be used as a design tool. These were carefully set up to match the existing sites operation as closely as possible.

All three models were approached with the same idea: to find the smallest changes which made the largest positive impact. Ideally changes would be to staging-only, which would minimise the cost. Any physical works required would have to be paid for from a share of the tight budget, so needed to be minimal and justifiable. The review and modelling phase could not carry on for long either, as there was pressure to find and deliver improvements.

An old technique, 'borrowed' from Project Management professionals was applied to quickly identify potential improvements – first crudely, by hand to identify where there may be opportunities – then in detail using Linsig.

Critical Phase Order

In theory, the shorter a Critical Phase Order is (for anything), the quicker and more efficient the outcome. In terms of traffic signals, we have our own phases: a Critical Phase is simply the phase which dictates the length of time that a stage needs to run for. This is often the busiest phase, but could also be a pedestrian crossing or other fixed-length phase. This is complicated where phases overlap multiple stages, but Linsig can be used to quickly re-optimise and recalculate the degree of saturation.

Shortening the Critical Phase Order could broadly be summarised as 'use the minimum number of stages' but that misses some nuance. The smallest possible number of stages may deny the opportunity to overlap the busiest Phases over multiple stages, changing the Critical Phase Order.

The Walden Road – Princess Street junction in the Station Area (Eastern most junction), was modelled with multiple different stage orders, requiring no physical changes, to look for the shortest Critical Phase Order.

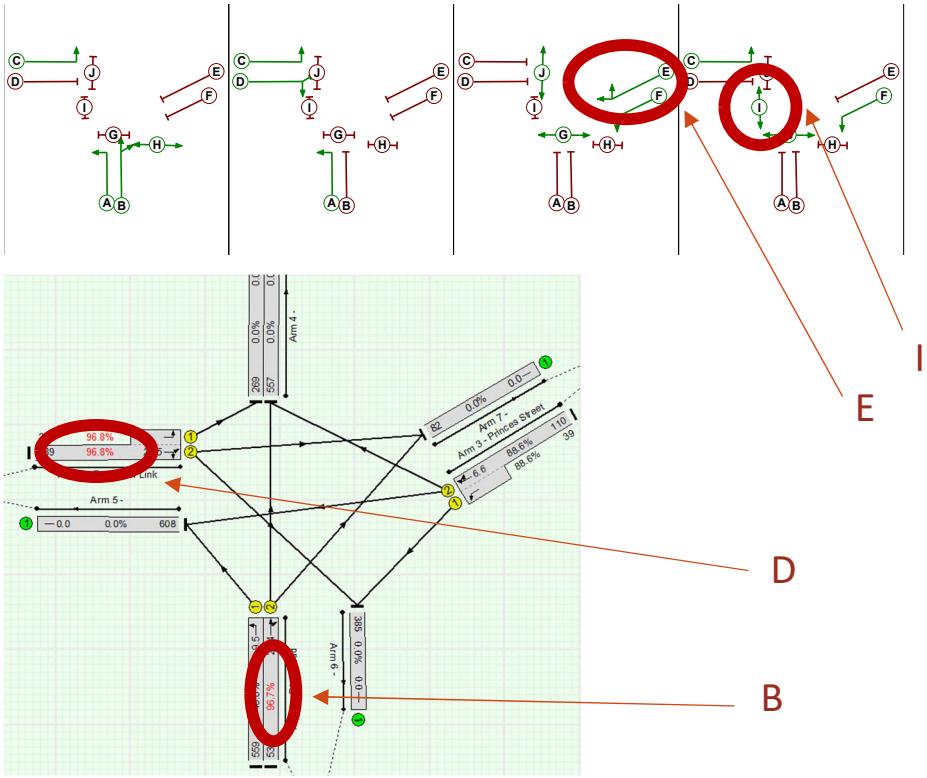


Figure 6. Walden Road Critical Phase Order (phases ringed in red)

In the PM Peak, the existing junction exceeds capacity, resulting in excess delays. The Critical Phase Order is: B, D, E, I. Of those, E and I both run for minimums, I being a pedestrian phase. These four phases dictate the cycle time of the junction.

There were immediate opportunities found to improve the junction by slight changes to the stage order.

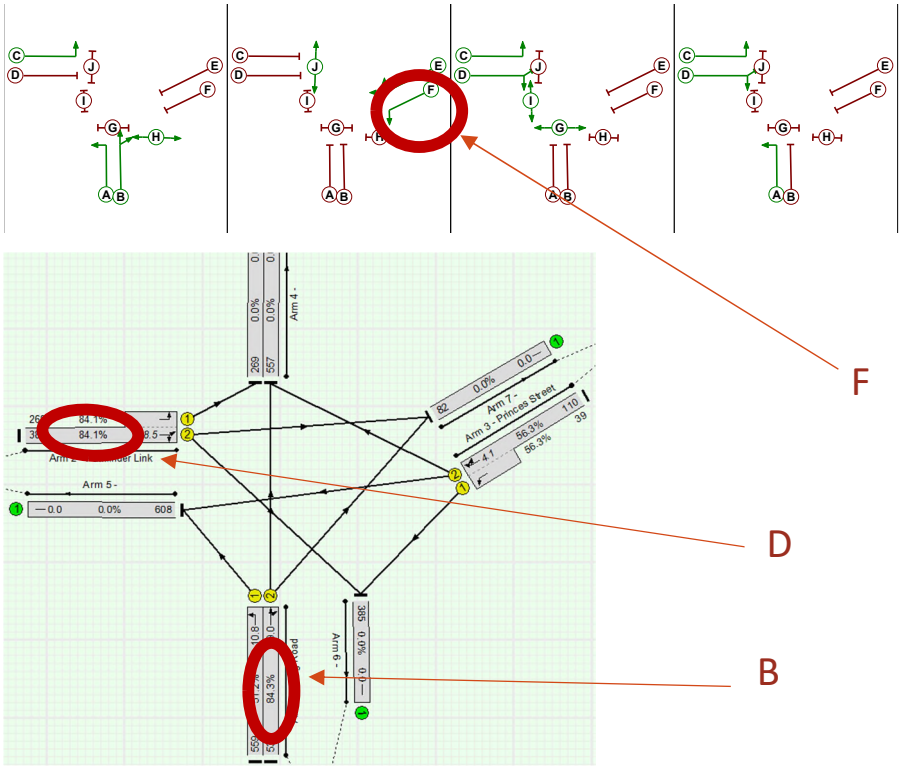


Figure 7. Walden Road Critical Phase Order using alternative stages

These changes affect the Critical Phase Order (based on Degree of Saturation), which becomes: B, F, D. Phase F runs for a minimum, despite still being below 90% saturation. Although still retaining four stages, by overlapping Phase D between Stages 3 and 4, it is busy enough to be the Critical Phase in both, effectively shortening the Critical Phase Order. This change increased capacity in the PM Peak by 14 percentage points.

In this specific case, a further improvement was found.

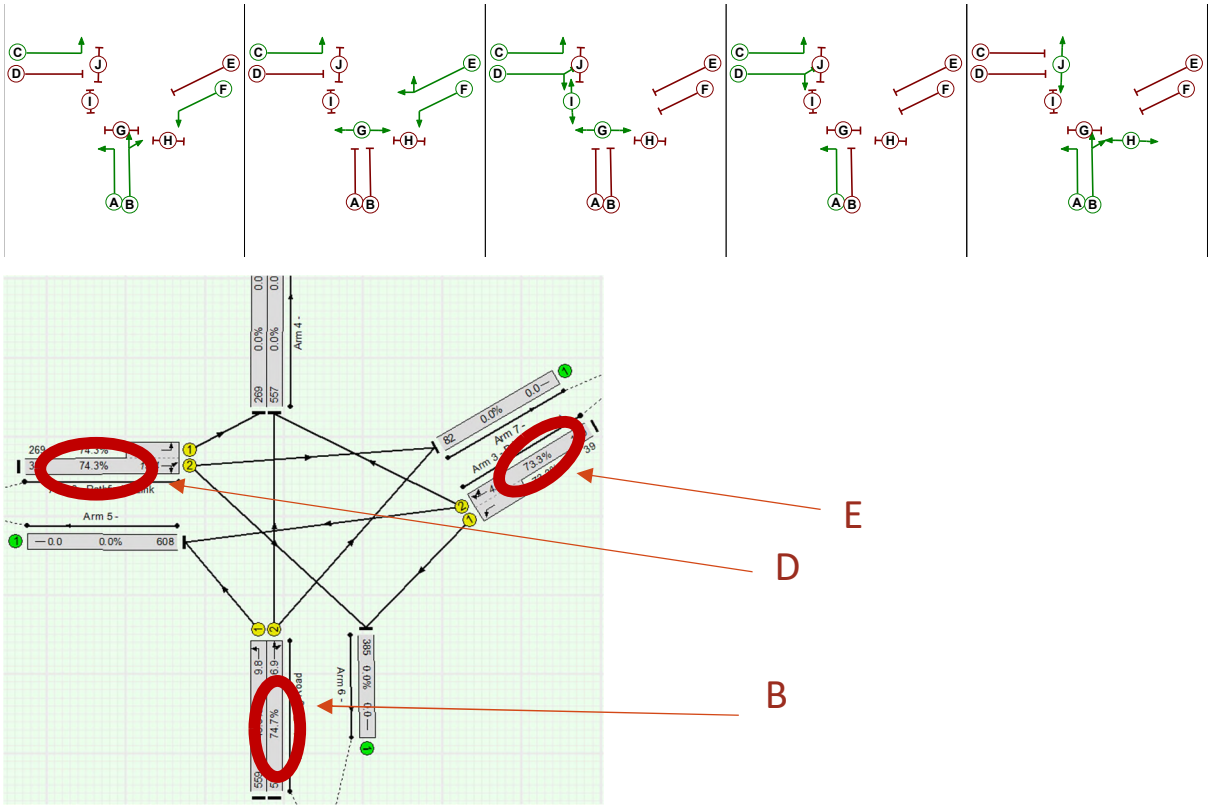


Figure 8. Walden Road Critical Phase Order, final stage sequence

Adding an additional stage, this time allowing Phase A to overlap multiple stages as well, does not shorten the Critical Phase Order, but changes it to B, E, D. There are still phases running for minimums, but they run at the same time as busier phases and so have no impact on the overall cycle time.

Although the Critical Phase Order is not shortened further, by overlapping the highest flow phases over multiple stages, the Degree of Saturation of those phases drops and less busy phases become critical at lower saturations. Overall saturation levels drop, creating Practical Reserve Capacity in the junction.

This solution increases the overall capacity by 27 percentage points in the PM Peak, compared to the original stage sequence.

The same approach was taken at both Hinchingbrooke Park Road junction, and Edison Bell Way, however in those two cases, improvements were found by changing lane designation and phasing to achieve the optimum stage order.

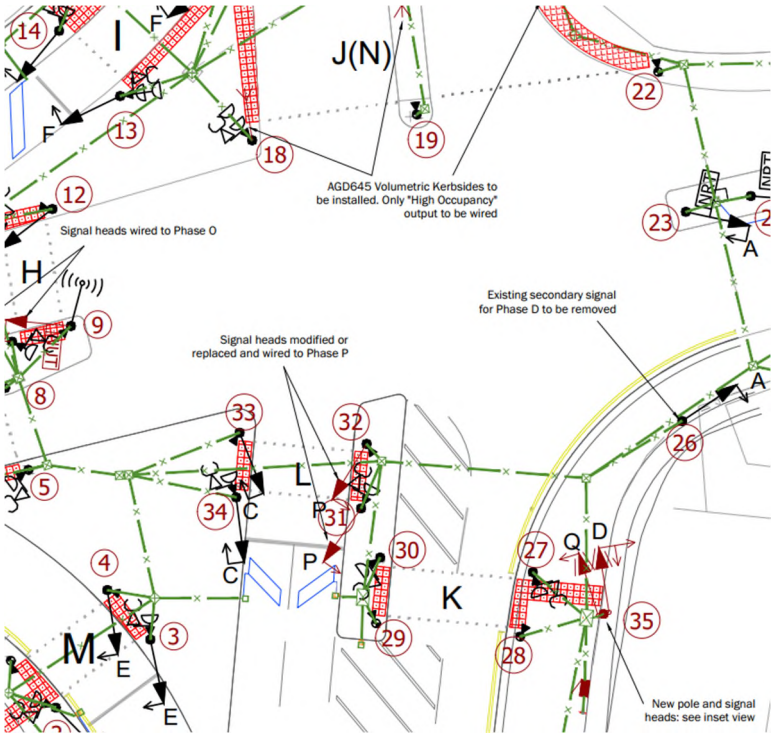
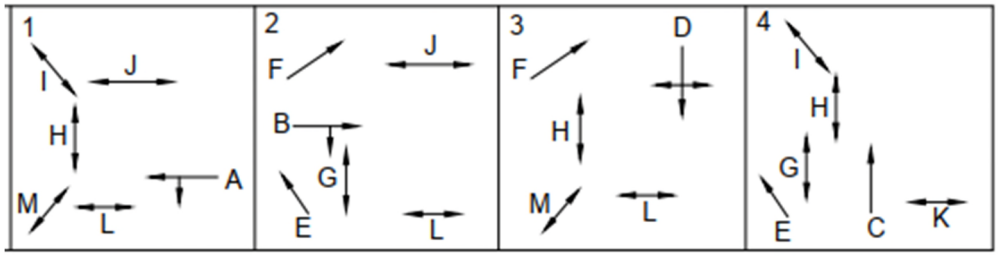


Figure 9. Edison Bell Way detailed works

Full green phases at both junctions were split on one or more approaches to allow separate signalisation of right or left turns. This splitting of phases (with necessary changes to road markings) is done to allow the heaviest non-conflicting movements to run together in the same stages, or with long fixed-length pedestrian stages.

Edison Bell Way Original Staging



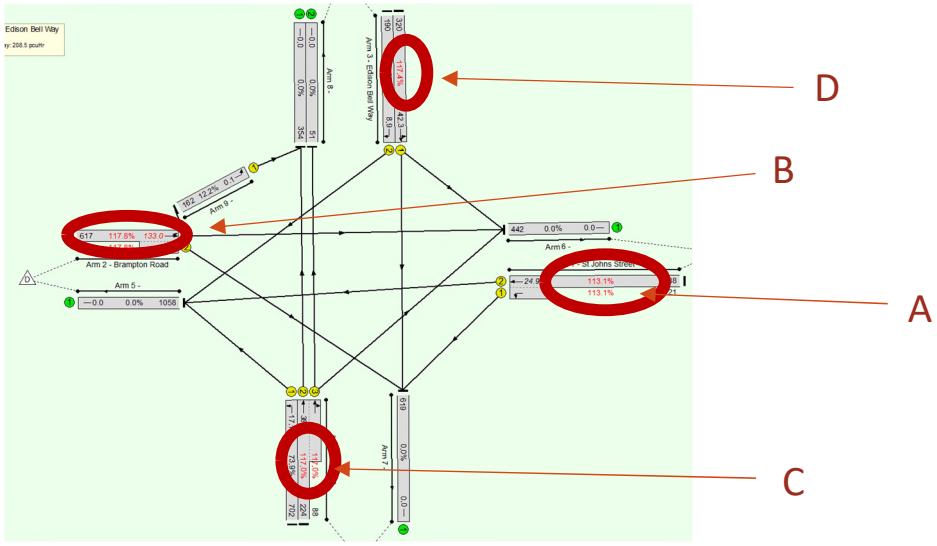
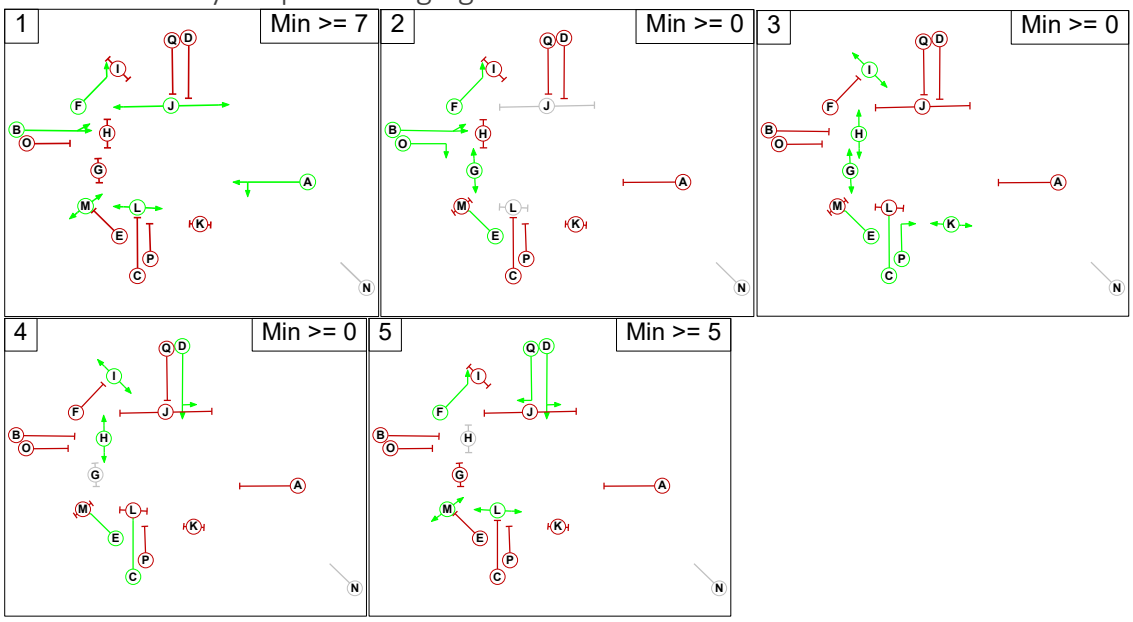


Figure 10. Edison Bell Way Critical Phase Order, original stage sequence

Previously, the long Toucan crossing Phase J was also a major factor, as it could require a very long intergreen between Stages 2 and 3. Removing it from Stage 2 ensures the intergreen can have not impact, but would have a slight negative impact on walking and cycling.

Edison Bell Way Proposed Staging



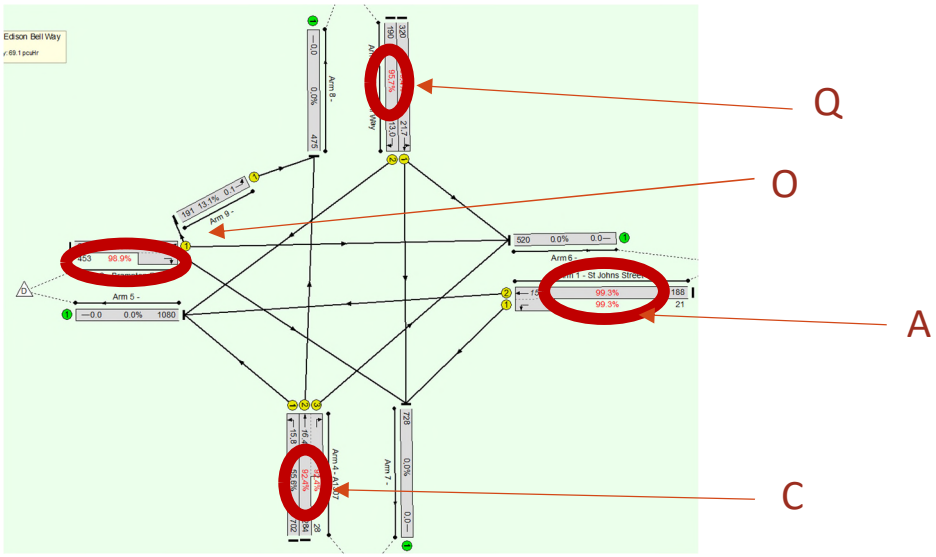


Figure 11. Edison Bell Way Critical Phase Order, proposed stage sequence

Again, despite the increased number of stages, the Critical Phase Order remains the same length but the busiest phases run in more than one stage, making the lighter-trafficked and shorter phases the Critical Phase Order. It changes from A,B,D,C to A,O,C,Q (P is so light, it does not run in most cycles). Two of the heaviest trafficked phases – B and D are no longer critical as they now get much more green time by running in multiple stages.

At Edison Bell Way, the modelling indicates a 20% increase in capacity in the PM Peak, and 15% in the AM.

A similar approach at Hinchingbrooke Park Road indicated a capacity increase of 25% in the PM peak, and 12% in the AM Peak. This however required ahead traffic on one of the busiest approaches to be moved to an offside lane. Rather than a fully signalled right turn,

the left turn became fully signalled to allow it to run with a side road, but end early using a hold-the-left sequence, and run a Toucan crossing with the busy ahead-and-right turn lane. Doing this removed the Toucan from the Critical Phase Order.

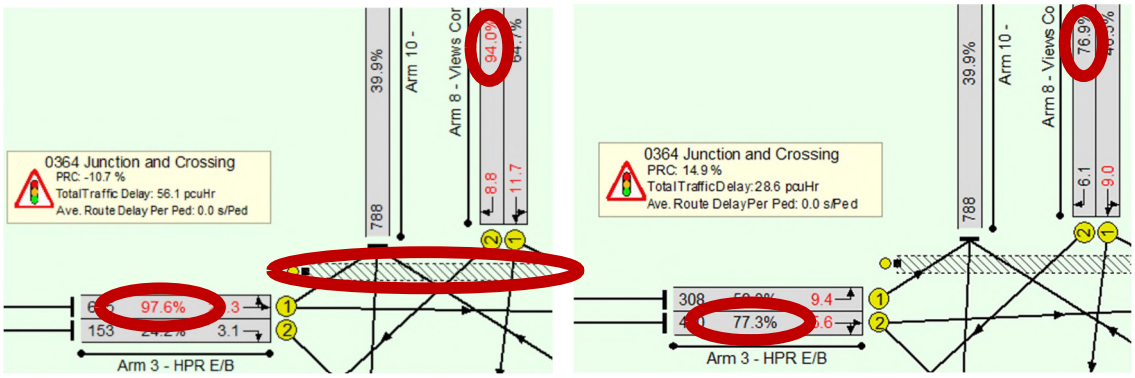


Figure 12. Changes to lanes and phases change Critical Phases



Figure 13. Hinchingbrooke Park Road new lane markings and phases

None of this is new – these techniques have been known about for decades, but while basic truisms (few stages = good) have been passed on between generations of engineers, some of the detailed knowledge has been forgotten. Software modelling (and in the future probably AI) help us rapidly build and test models, and can provide insight, but are not capable of the creativity and understanding needed to find the best solutions, at least not yet.

Connecting the Network

As well as capacity improvements at the three major junctions, it was clear that other work was needed to maximise capacity in the area and solve as many problems as possible. Improvements to be made were:

- Restore SCOOT on the ring-road and use it elsewhere if it improves the network
- Provide MOVA linking from Edison Bell Way southwards, to reduce exit blocking and repeat stops

These are not easy to achieve though, as SCOOT infrastructure is traditionally expensive. With the existing communications patchy and now obsolete, reliability would be difficult to achieve within the budget.

New Dogs

It was clear from the outset that conventional methods of providing SCOOT and linking infrastructure – inductive loops, ducting and copper communications – could not achieve the results needed within budget. Instead, latest technologies were deployed to create the infrastructure with as little equipment as possible.

New SCOOT Region

Where inductive loops were already in use as MOVA IN detectors on two junctions these were simply passed through to the existing outstations as SCOOT detectors, by reconfiguring the outstations or minor changes to the controller configuration. An existing but disused loop was brought back into use at Edison Bell Way, again with a minor configuration change and new feeder cable installed. This covered a lot of the requirements for SCOOT, but four above ground stop-line detectors were also installed as SCOOT detectors, filling the missing gaps between the new junctions and existing.

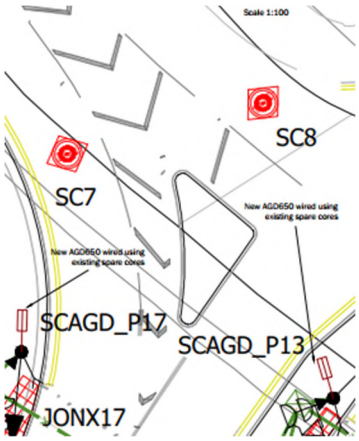


Figure 4. New SCOOT loops created using above ground detection

Many of the sites were already communicating by 4G routers, however the older sites using a mixture of mesh-wireless and local linked communications had stopped working due to gaps in coverage. The remaining – now unmonitored – sites were converted to 4G, but all sites on SCOOT or hosting SCOOT detection were fitted with 'M2M' sim cards, prioritising the data connectivity.

A new SCOOT Region created for the west side of the ring road runs for only a few hours of the day, when the coordination is critical, particularly on the short distance between junctions on Pathfinder Link. Existing sites previously on SCOOT were rebuilt within the database to move them into the new region, while the new sites were added.

While under SCOOT the overall capacity is noticeably limited and queues on the A1307 approaches are longer, but the internal links are no longer exit blocked and the town Ring Road is now much more free-flowing. The combination of MOVA Loops and above-ground detection works well, providing a close approximation of conventional SCOOT detection and allowing SCOOT to model the network with reasonable accuracy.

Linking MOVA

The previously unused multicore link cable was brought into use by connecting media converters at each controller. These provided a local IP network, but it would be incompatible with the existing 4G networks. Rather than change the existing 4G networks and rely on the local network for monitoring, by combining them on one network a different and simpler approach was taken. The existing controllers had a secondary IP network available via the same Ethernet connection on which a separate, local network was configured. The controllers had minor configuration changes made to accept inputs from the MOVA outstations, which they pass between themselves over the local IP network.

This has created a completely flexible linking infrastructure, separate to the monitoring network, for coordinating the sites using MOVA Special Conditioning. Outputs were written at the roadside, during validation. These has been used to trigger holds (under MOVA) on the main road at the two railway station sites when Edison Bell Way discharges traffic towards them – minimising or avoiding exit blocking. This also helps to hold the main roads in advance, allowing more traffic to reach Edison Bell Way northbound during green, without being disrupted.

With the two networks sharing physical infrastructure, but technically isolated, either can work independently in the absence of the other, but they can also be used in combination – MOVA Outputs can be generated from any of the sites and passed via UTC to the sites on Pathfinder Link, which are not connected by the local network. Those sites can therefore use this for linking when running under MOVA control (most of the day). Further changes can be made through the instation and outstation configurations, without needing to reconfigure the controllers further.

Active Travel

While the overall project is aimed at increasing capacity and reducing delay, Cambridgeshire County Council's policies and priorities relating to Active Travel still apply and were considered throughout. Routes through the Edison Bell Way and Hinchingbrooke Park Road sites are known to have very high pedestrian and cycle flows, particularly children attending the local schools. While making the changes, volumetric detection was added to the key crossing routes, and passed into MOVA to provide extensions.

The combination of stage changes and addition of volumetric detection increases green periods when pedestrian and cycle volumes are high, while substantially reducing the impact of the crossings on drivers.

Physical Changes

Throughout the design of the modifications, the Designers were very aware of the need to change as little hardware as possible, while ensuring safety.

At Edison Bell Way, a single new pole was installed with double secondary heads, as it was quicker and easier to be able to construct this in advance, than to have the signals off under temporary control for longer.

Recent changes to controller firmware were utilised to reduce the number of phase-drive-outputs needed, minimising the need for additional lamp-drive cards and backplanes to be installed into the existing controllers to just one. Using IP communications and MOVA

Special Conditions also reduced the amount of Physical IO cards needed, again reducing the cost and complexity of installation.

Total Hardware and Physical Works

- 8 x Reconfigurations
- 6 x MOVA Upgrades
- 8 x Modified or new signal heads
- 1 x New pole
- 11 x Signal heads rewired
- 1 x Additional Lamp Drive Card and backplane
- 3 x Media converters
- 4 x Above ground stop-line detector (as SCOOT Loops)
- 4 x Pedestrian volumetric detectors
- 2 x 4G Routers
- 4 x 4G M2M Sim card
- 3 x White arrow road markings changed
- 8 x Sites validated on SCOOT and/or MOVA

Impact and Public Reception

The changes made have had a marked visible impact on congestion and queues in the local area. Queues are noticeably shorter, cycle times are reduced and congestion occurs later and ends earlier. Key through-routes and the Ring Road are noticeably improved.

The overall network is still over capacity for periods of the day, so the increase in capacity has not removed the problems entirely, and there are indications that additional traffic is now passing through the junctions. While this lessons the noticeable improvements, it hopefully takes traffic and relieves congestion on other local roads which were being used as alternatives or rat runs.

In other places downstream though, longer queues have been observed – this is believed to be the result of more traffic now reaching these junctions, where normally it was effectively gated upstream.

Following the works, data has been taken from the sites running MOVA 8 to assess performance.

Edison Bell Way

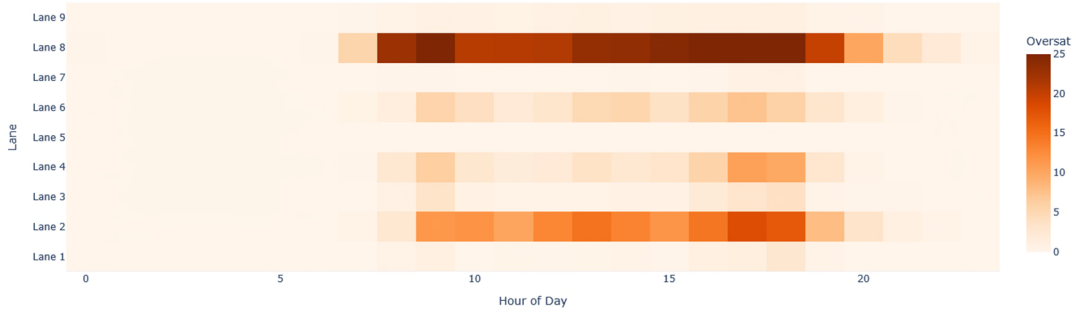


Figure 15. Congestion still occurs, mostly on Lane 2 and 8



Figure 16. All stages follow expected patterns, indicating the data (and therefore MOVA) is accurate

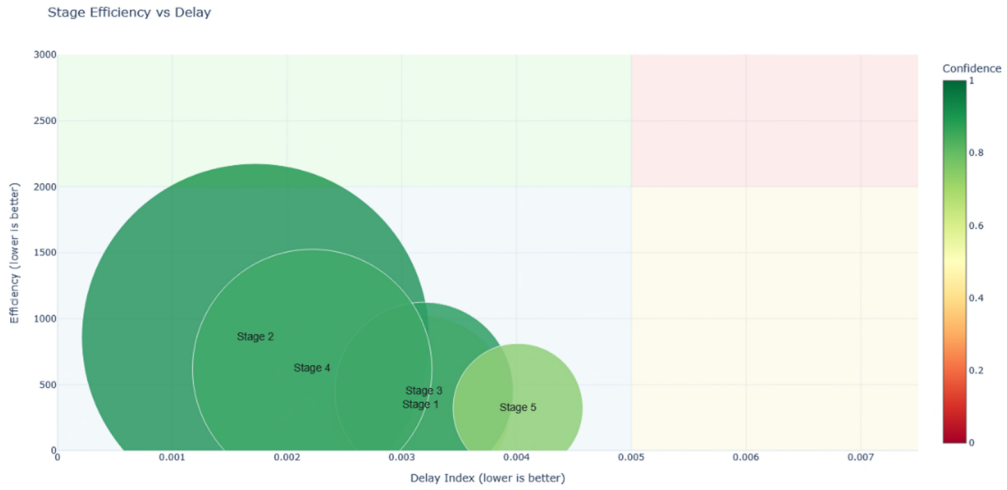


Figure 17. Data shows all stages are highly efficient at discharging traffic, but not free-flowing

Hinchingbrooke Park Road

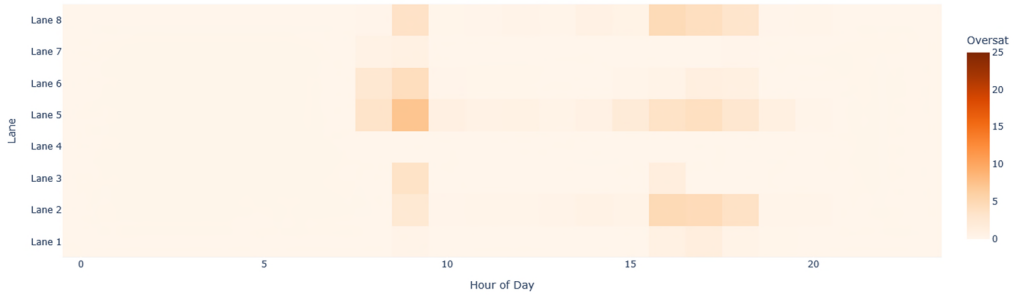


Figure 18. Low levels of congestion now seen



Figure 19. Data is consistent

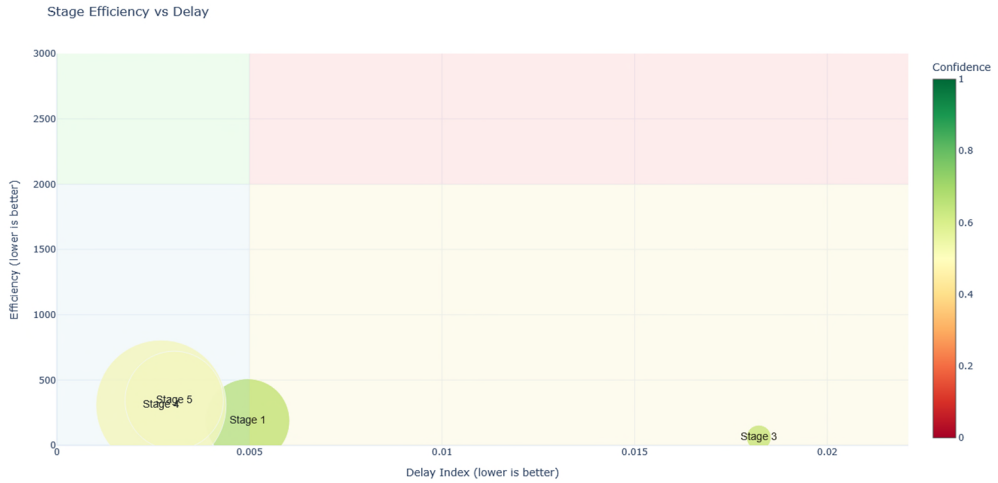


Figure 19. Data shows stages are efficient. One minor stage incurs much greater delay than the others

A1307 – Station Car Park

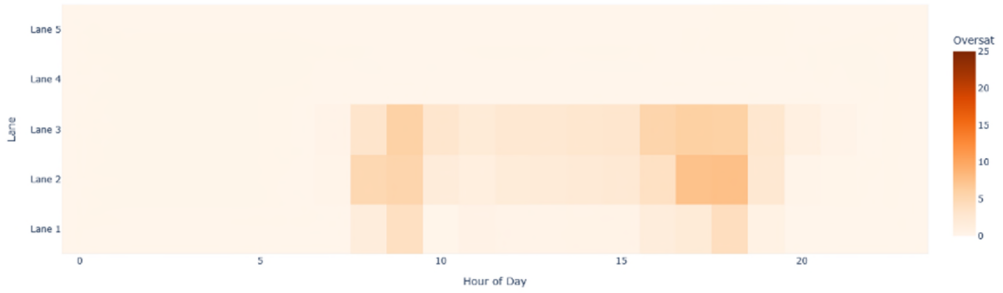


Figure 20. Low levels of congestion

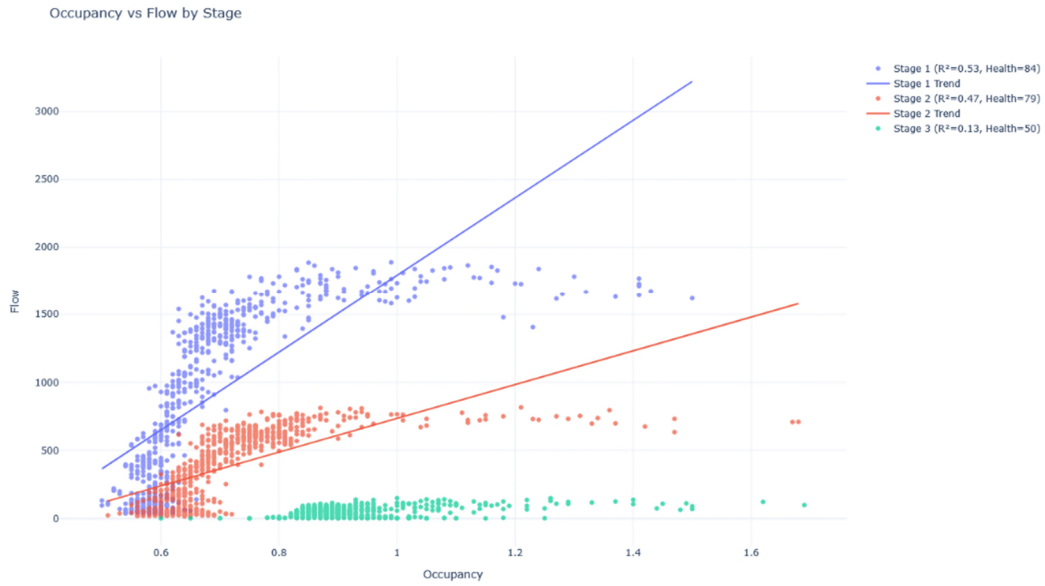


Figure 21. Very low levels of delay

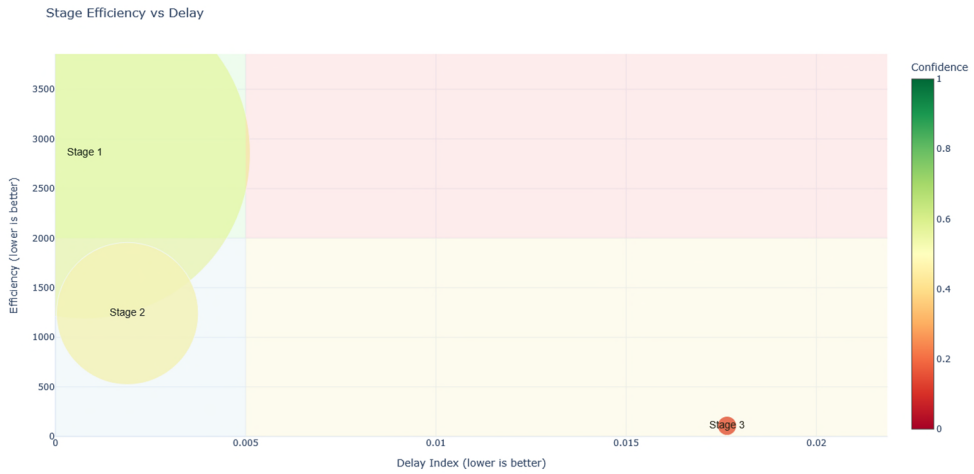


Figure 22. Data shows main road stage is free-flowing as the linking minimises the number of stopped vehicles

Public Comments

Feedback from local people has been generally good and acknowledged the reduced queues and quicker journeys, but few have been willing to speak publicly. This is in part because of (demand for and fear of) local development growth in the area. There have already been suggestions made that the improvements could be used to "unlock growth" (i.e. build more houses), without needing to add capacity to the highway network. This would be to effectively to return the area back to the previous levels of congestion, which most residents felt were unacceptable.

The changes at the Hinchingbrooke Park Road junction did cause immediate trouble when the lane changes were implemented. With risk assessments in place, signage was put up in advance to warn of the changes and some additional road markings were laid to emphasise the changes. Engineers were on site in full high-vis by the stop line.

With the signals switched back on, a number of drivers (including busses and taxis) simply drove the lanes as they had before, angry and irritated when they cut-up another driver to push over at or after the stop line.

One driver, incensed by the changes, stopped after passing through a red and going ahead from a (now) left turn lane. Approaching the Engineers on site, and after having the multiple arrows and numerous large red temporary signs pointed out to her said:

"Yes, but when I'm driving on autopilot and not paying attention…"

The problems resolved themselves with a little time.

Bottom Line

The final cost of the project was £81,803, within 2% of the original budget. There was also some overlap between these schemes and a wider 4G roll-out, with the Huntingdon schemes absorbing some of those costs. Although originally planned to be one of the first projects that would be delivered by CCC under the GLF programme, it became one of the last due to sensitivity over the streetworks permit required – ironically because of the congestion.

Conclusion

The overall project has come in on time and at budget, although it took longer than first imagined. The modest spend has unlocked an additional 20% of additional capacity through several junctions and over several routes, showing how targeted funding can be highly effective. In particular congestion has been reduced, delays reduced, vehicles stopped (and therefore carbon emitted) has reduced, and active travel has still been considered and even improved. As well as schools and the hospital, the scheme has improved access too and from the railway and bus station for walking and cycling, while cutting delay to drivers.

From Cambridgeshire County Council's perspective, the scheme has successfully delivered improvements to traffic flow with relatively modest investment. Feedback received from both local residents and Hinchingbrooke Hospital has been positive, with stakeholders reporting improved traffic conditions and fewer occurrences of severe delays than were experienced prior to the scheme. Whilst congestion remains during periods of exceptional demand, particularly when incidents on the A14 result in traffic diverting onto the local road network, the scheme has improved the day-to-day operation of this important corridor and delivered the intended benefits for network users.

This has all been achieved by the use of old techniques, sometimes dismissed as being “car-centric”, or just forgotten about. The delivery of this project at low cost and (fairly) quickly has been made possible by the use of modern technology. Ultimately, it is this combination of solid, old-fashioned value engineering and the options provided by cutting edge equipment, which delivers the best results for all road users, whether walking, cycling, driving, taking the bus or train, or just living nearby.