Green Man Authority

An innovative solution to contribute to Healthy Streets in London

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Transport for London

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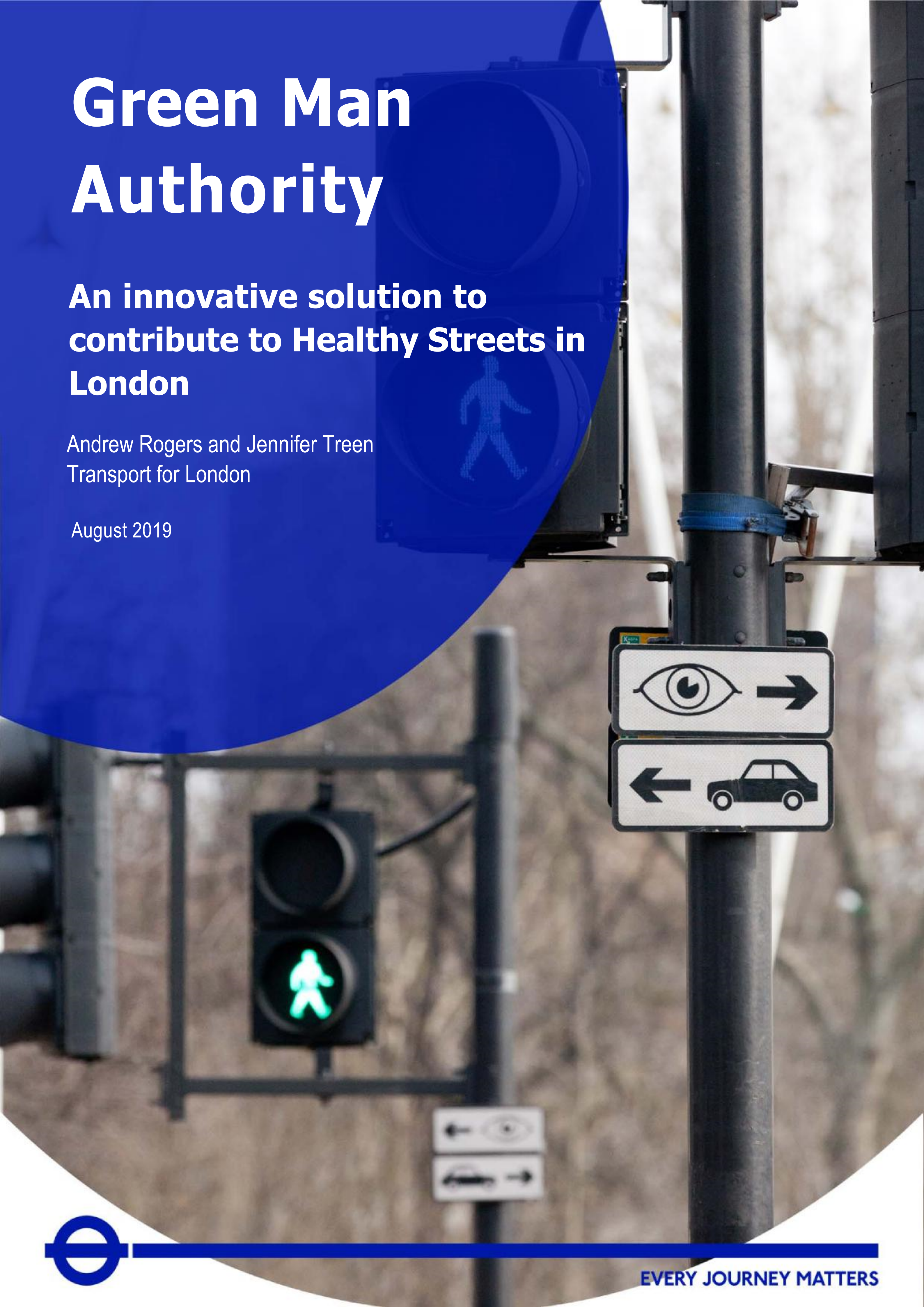

EVERY JOURNEY MATTERS

Green Man Authority

Introduction

The Mayor's Transport Strategy, March 2018[1] applies the Healthy Streets approach to the whole of London for the first time. At the heart of the strategy is walking, which is arguably the most important Healthy Streets mode. Encouraging safe and accessible walking is essential to achieving the target of 80% of trips being on foot, by cycle or bus by 2041[1]. Walking is currently the most common mode and is vital to supporting journeys by bus, another key constituent to the 80% target, but the proportion of trips made by foot has remained static at around 24% since the 1990s[2].

Access for pedestrian around London's road network is partially controlled by traffic signals. Pedestrian crossing facilities at traffic signals provide a safe opportunity where pedestrians have priority over conflicting traffic movements. Refining and optimising the timings at these crossings is essential in achieving on our mayoral objectives for sustainable travel and can contribute to making the network safer in order to deliver on the Vision Zero action plan, a Mayoral target to eliminate all deaths and serious injuries on London's transport system.

In July 2018, Transport for London published the Walking Action Plan[3]. This document outlined 21 actions on how TfL would deliver on the Mayor's Transport Strategy, which had walking at its heart. One action was to develop and deliver "Green Man Authority" at ten locations.

What is Green Man Authority?

The Walking Action Plan establishes Green Man Authority as:

"A radical technique where traffic signals show a green signal for pedestrians continuously, until vehicular traffic is detected, at which time the pedestrians are stopped on red signal, and vehicles are given a green light to proceed." [3]

The concept was to fundamentally change the way traffic signals operate at standalone pedestrian crossings by providing priority to pedestrians, unless there is a vehicle demand.

Development of the concept

The Network Performance team within TfL Surface is responsible for delivering the road network operation. The team focuses on delivering for improvements for people choosing to walk, cycle or travel by bus and exploits the existing traffic control system using data from tools such as STUDI, which is an in-house developed tool which allows us to quickly analyse the data and operation of our Urban Traffic Control System (UTC), and individuals network knowledge to develop traffic signal improvements for these Healthy Streets modes.

The team has developed a metric to calculate the improvement to these sustainable modes, known as "Signal Timing Changes to Support Healthy Streets". This metric calculates the number of people hours saved every day for the various sustainable modes. TfL presented a paper on this new metric in 2018 titled "Saving time for bus passengers, pedestrians and cyclists in London"[4]

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[1] https://www.london.gov.uk/sites/default/files/mayors-transport-strategy-2018.pdf
[2] https://tfl.gov.uk/corporate/publications-and-reports/travel-in-london-reports
[3] http://content.tfl.gov.uk/mts-walking-action-plan.pdf
[4]

http://www.jctconsultancy.co.uk/Symposium/Symposium2018/PapersForDownload/Saving%20Time%20for%20Bus%20Passengers,%20Pedestrians%20and%20Cyclists%20in%20London%20-%20Heidi%20Smart%20and%20Wissem%20Lakache%20-%20TfL.pdf

This metric calculates the delay saving for each Healthy Street mode before and after signal timing changes have been made. The number of customers using each mode is then factored into the calculation to produce the number of pedestrian, cycle or bus passenger hours saved every day.

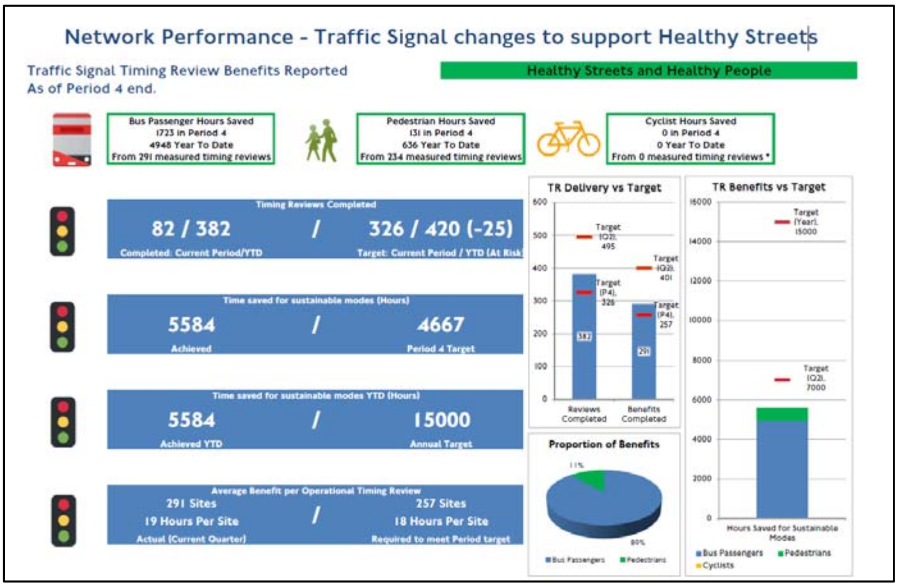


Figure 1: Traffic signal changes to support Healthy Streets Scorecard to date for 2019/20.

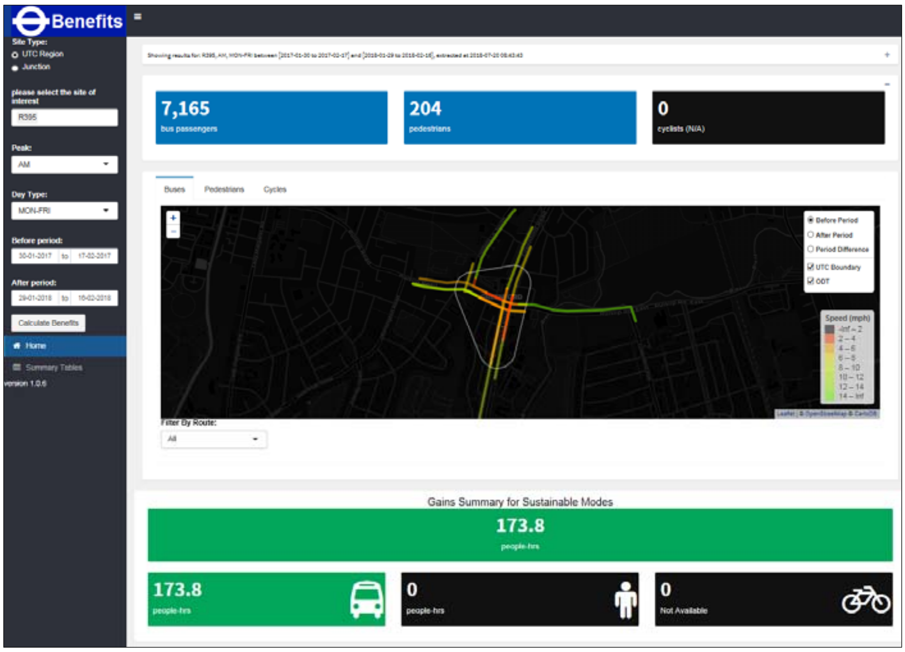


Figure 2: Traffic signal changes to support Healthy Streets calculator.

Traffic signals are a key tool which assists pedestrian movement, providing a safe opportunity to cross a busy, and sometimes congested, road network. However, a previous study has shown that pedestrians are often reluctant to wait and will cross in gaps in traffic with approximately 85% crossing within the first 30 seconds of arriving at a set of traffic signals.[5]

[5] http://content.tfl.gov.uk/PCaTS-Note-3-PCaTS-Trial-Results-Report.pdf

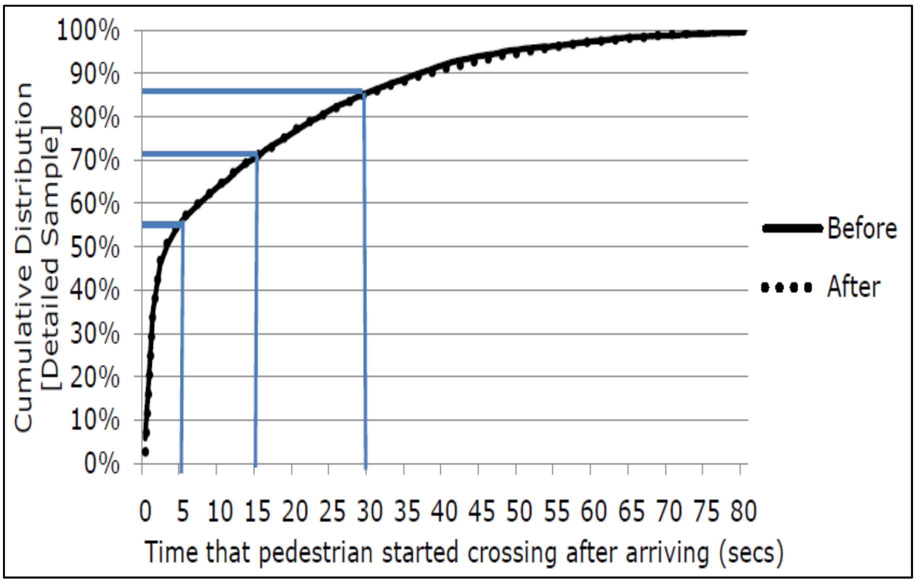


Figure 3: Graph showing time before pedestrians begun crossing, conducted as part of the Pedestrian Countdown at Traffic Signal Junctions (PCaTS) - Road Trial[6]

The result is something that is frequently observed by the Network Performance team when visiting traffic signals to setup the operation of London's road network. There are locations such as Westfield Avenue by Endeavour Square which have a large pedestrian flow and relatively low traffic volumes, resulting in pedestrians choosing to cross in an unsafe manner.

Figure 4: A photograph of Westfield Avenue by Endeavour Square in Stratford, London, showing pedestrians crossing without right of way at a pedestrian crossing.

The team have also undertaken more recent studies with London Living Streets to understand how the pedestrian experience changes when wait times are reduced. The study concluded that, as wait times are reduced, the subjective user experience is improved. This trend was particularly significant when the reduction in wait times exceeded 30 seconds.[7] It can be concluded from the previous studies that reducing wait times for pedestrians will improve their experience and encourage higher compliance.

[6] http://content.tfl.gov.uk/PCaTS-Note-3-PCaTS-Trial-Results-Report.pdf
[7] https://londonlivingstreets.files.wordpress.com/2018/12/pedestrian-crossing-wait-time-survey-briefing-note.pdf

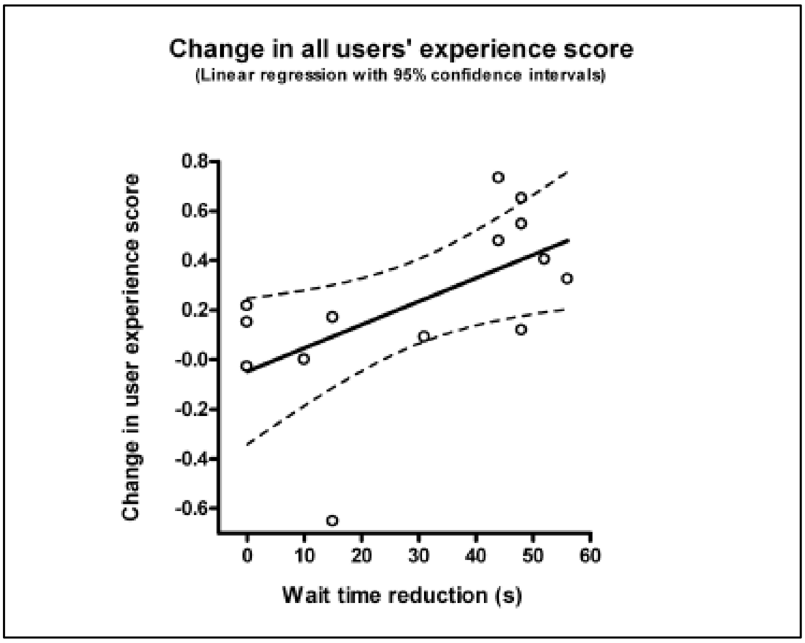


Figure 5: Graph showing the linear regression and 95% confidence intervals of change in user experience score against wait time reduction.

The team have used their knowledge to develop a toolbox of techniques to benefit pedestrians, whether through signal timing changes using our UTC system or new technologies such as pedestrian countdown or ped SCOOT. These techniques have been developed and implemented by interpreting the Mayor's Transport Strategy ambitions and applying our data and knowledge to drive forward improvements.

Green Man Authority is the latest step in this drive to deliver improvements for people walking. The team has proofed the concept of "Green Man Authority" using the UTC system to hold the crossing on pedestrian green stage at two locations in Morden and Hounslow. Both locations are on the exit of a "Bus Only" section of the network and have high pedestrian footfall, particularly outside Morden Station.

These changes provided significant benefits for pedestrians, allowing the green time to continue until a bus approaches the stop line. The bus is then detected and, at the appropriate point in the traffic signal cycle, the signals change to allow the bus to continue its journey. At this location, this has been able to provide over one minute of continuous green time for pedestrians during certain parts of the day.

The team has furthered the development of the concept of Green Man Authority, determining six requirements on how TfL would like sites to operate in order to maximise the benefits of this technique. These requirements are:

1. Default to the pedestrian stage when there is no traffic.
    - In essence, the opposite to a traditional pedestrian crossing, where traffic is the default stage
2. Have the capability of operating as such 24/7.
3. When a vehicle arrives, the crossing will move to the traffic stage (assuming all minimum timers including intergreens have been satisfied).
4. If there are larger flows of traffic, the site will operate like a traditional pedestrian crossing.
5. A user, be it on the road or crossing the road, would not be able to notice a difference between UTC or VA or GMA.
6. Be beneficial to pedestrians and of only marginal impact to road users.

These requirements formed the basis of our customer request to TfL Engineering for new traffic infrastructure technology to able us to implement our planned strategy.

Trail Site Selection

A range of sites were selected from across London to identify different characteristics, particularly in terms of pedestrian and vehicle flows, and the percentage mix of these user types.
The locations were also chosen from across London to ensure different types of user and demographic.

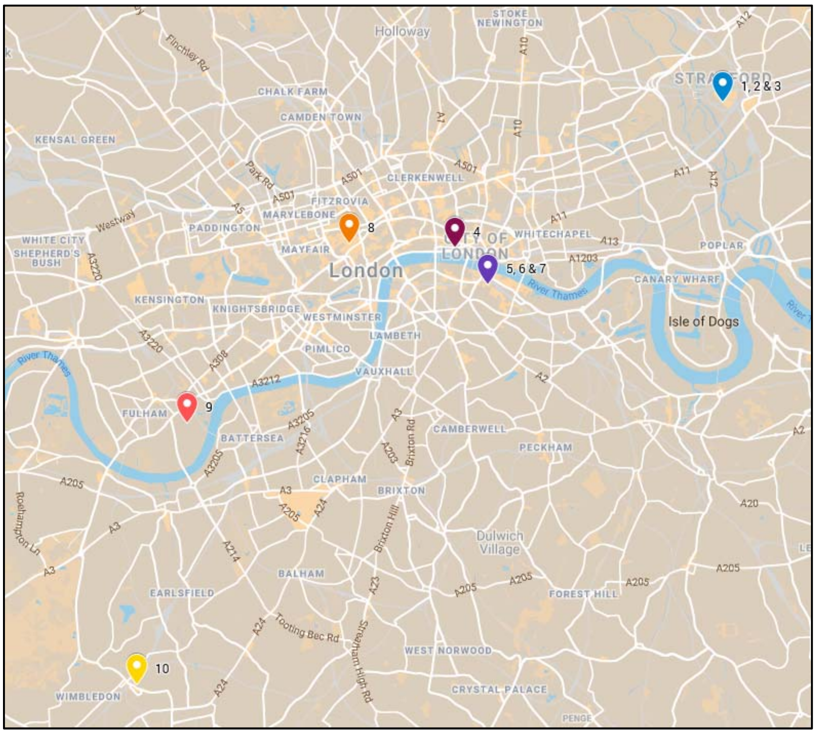


Figure 6: Map showing trial site locations.

Map No.	Location	Number of pedestrians (1 day)	Number of vehicles (1 day)	Pedestrians crossing on pedestrian red (%)
1	Endeavour Square (Westfield Avenue by Southern Boulevard)	25,125	8,727	70%
2	Endeavour Square (Westfield Avenue by Middle Crossing)	1,950	8,731	83%
3	Endeavour square (Westfield Avenue by International Way)	1,189	8,734	78%
4	Millennium Bridge (Queen Victoria Street by Distaff Lane)	26,023	14,234	27%
5	Guy's Hospital (St Thomas Street by Weston Street west side)	5,507	410	100%
6	Guy's Hospital (St Thomas Street by Weston Street eastside)	10,161	531	98%
7	The Shard / Guy's Hospital (St Thomas Street by Joiner Street)	38,716	3,093	88%
8	Wardour Street (Wardour Street by Brewer Street)	6,005	7,034	64%
9	Imperial Wharf Station (Imperial Road by Fulmead Street)	491	12,976	60%
10	Wimbledon Shopping Centre (Queens Road by South Park Road)	2,481	5,884	88%

Table 1: Data collected from our before behavioural surveys showing the number of users and pedestrian compliance.

This range of sites was chosen to establish the site suitability criteria for future deployment of Green Man Authority. It is already understood from sites with low flows and high pedestrian volumes, like at Morden Station, that Green Man Authority will have substantial benefits. However, one aim the trial was to push the boundaries of the new technique to understand the limits of traffic flow and pedestrian volume where this could be implemented and still deliver benefits.

Introduction to Engineering

In the beginning of 2019, TfL Surface approached TfL Engineering with the initial customer requirements for the Green Man Authority Project, including suggested "ideal" trial locations. TfL Engineering was set the challenge of both developing the new "GMA" strategy and determining the most suitable way to implement that strategy, both at the trial sites and with an eye for the further wider roll-out and implementation should the trial be successful.

The New Strategy

The initial customer requirements were fleshed out into a traffic control strategy. The strategy would be actuated by site conditions, with a sequence as shown in the tables.

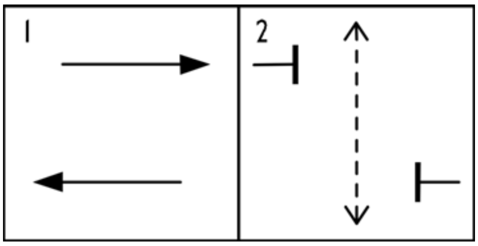


Figure 7: Staging diagram.

Current Stage	Minimum Stage 1 Time Reached	Maximum Stage 1 Time Reached	Pedestrian Presence	Road Traffic Presence	Action
Stage 1	No	-	-	-	Remain on Stage 1
	Yes	No	No	No	Move to Stage 2
	Yes	No	No	Yes	Remain on Stage 1
	Yes	No	Yes	No	Move to Stage 2
	Yes	No	Yes	Yes	Remain on Stage 1
	Yes	Yes	No	No	Move to Stage 2
	Yes	Yes	No	Yes	Remain on Stage 1
	Yes	Yes	Yes	No	Move to Stage 2
	Yes	Yes	Yes	Yes	Move to Stage 2

Table 2: Proposed GMA stage movements from Stage 1.

Current Stage	Minimum Stage 2 Time Reached	Road Traffic Presence	Action
Stage 2	No	-	Remain on Stage 2
	Yes	No	Remain on Stage 2
	Yes	Yes	Move to Stage 1

Table 3: Proposed GMA stage movements from Stage 2.

At this point the strategy was named "GMA-conditioned VA", as it was acknowledged that in its infancy this strategy of operation would not be a discreet "mode" in the controller (such as Part Time, Vehicle Actuated (VA), Light Rail Transit (LRT) etc.), but take the form of conditioned statements whilst the controller was within VA mode.

Designing GMA Generically

The preferred crossing type in London is known as "Ped X with PCaTS", which operates a signal sequence as described in the table.

Period	Non-Road	Road	Stage / Interstage	Minimum Duration (s)
1	Red	Green	Stage 1	7
2	Red	Amber	1 -> 2 Interstage	3
3	Red	Red		2/3
4	Green	Red	Stage 2	6
5	Blackout	Red	2 -> 1 Interstage	Dependant on Road Width
6	Red	Red		3
7	Red	Red/Amber		2

Table 4: Signal sequence of "Ped X with PCaTS".

Ped X with PCaTS can also be provided with a green cycle aspect, to allow both pedestrians and cyclists to cross. The preferred controller type is determined by TfL's TCMS2 contract, where TCMS2 contractors select and supply standalone crossing controllers. At the time of the trial, the TCMS2 contractors deployed the Siemens ST750ELV, Siemens ST750LV and Telent Optima-P controllers.

It was determined that three generic GMA configurations would be generated, one for each currently deployed controller type and all running the Ped X with PCaTS sequence. As the TfL estate consists of approximately 2300 standalone pedestrian controllers, TfL has historically generated generic pedestrian configurations for each controller and sequence type with site-specific timing parameters adjusted on installation. This removes the costs associated with provided bespoke configurations on such a large scale.

Design of a Generic Layout

A generic traffic signal layout for GMA methodology was developed which would implement three forms of detection:

- Stop line detection, for detection of road traffic at the stop line;
- Distant detection, for detection of road traffic at a distance approaching the stop line; and
- Push buttons, for detection of non-road traffic.

The inclusion of distant detection arose from the requirement to reduce road traffic waiting time as much as safely practicable, which would bring about two benefits. Firstly, without distant detection, road traffic would have to wait at the stop line for the duration of the 2 -> 1 inter-stage period, a duration which could be significant, depending on the length of the crossing. By putting in distant detection, demands could be inserted earlier and some of this lost time would be taken up in travel time for the road traffic approaching the stop line. Secondly, using two types of vehicle detection reduces the changes of "no right of way" for vehicles, both under normal and fault conditions. This was done to reduce the risk of vehicle non-compliance.

The optimum distance (OD) back from the stop line which this detection would have to be placed is defined as "*the distance from the stop line where a detector must be placed in order for road traffic to demand and then reach the stop line during Period 7 (assuming that the minimum for Period 4 was met prior to the road vehicle demand).*"

OD depended on the following variables:

- Speed of approaching road traffic (20mph / 30mph); and
- Duration of Period 5 (“P_5”), which is dependent on crossing width.

This was translated into the formulas:

For 20mph:

$OD = 8.94(P_5 + 3)$

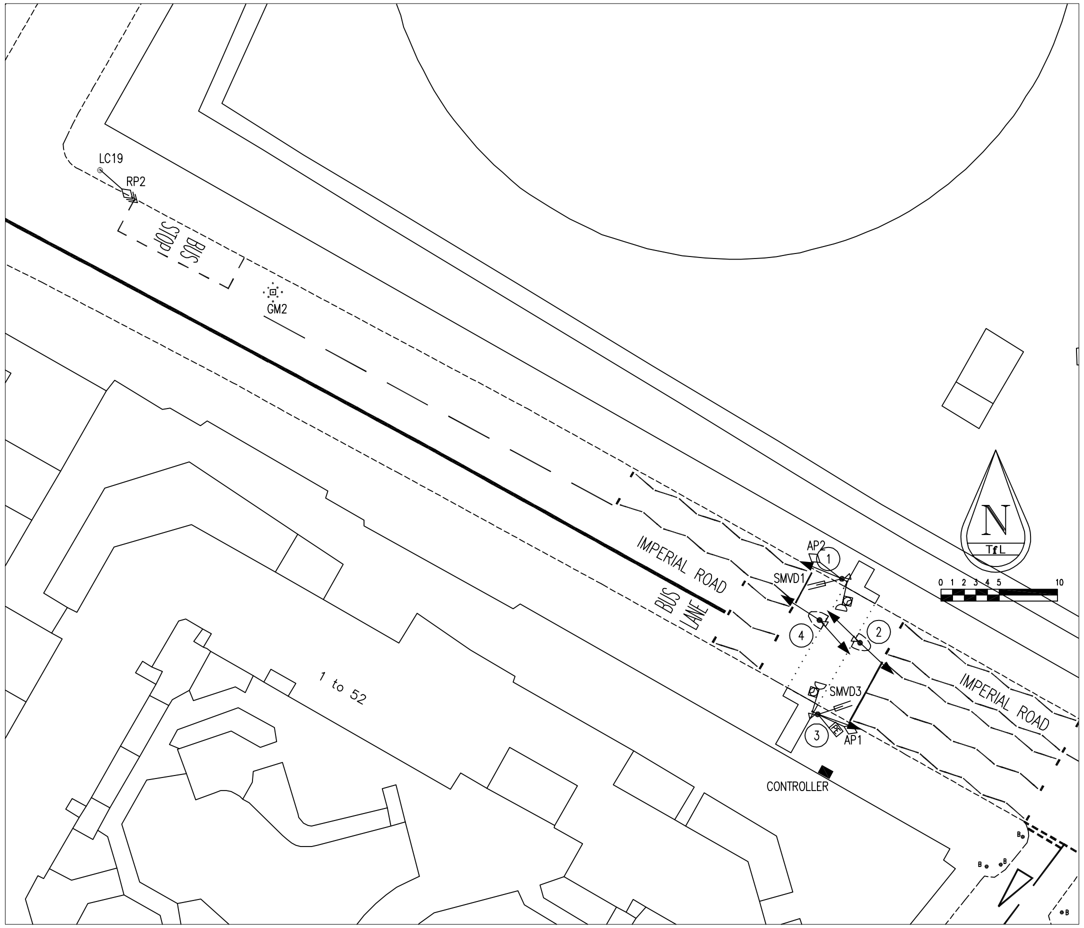
For 30mph:

$OD = 13.41(P_5 + 3)$

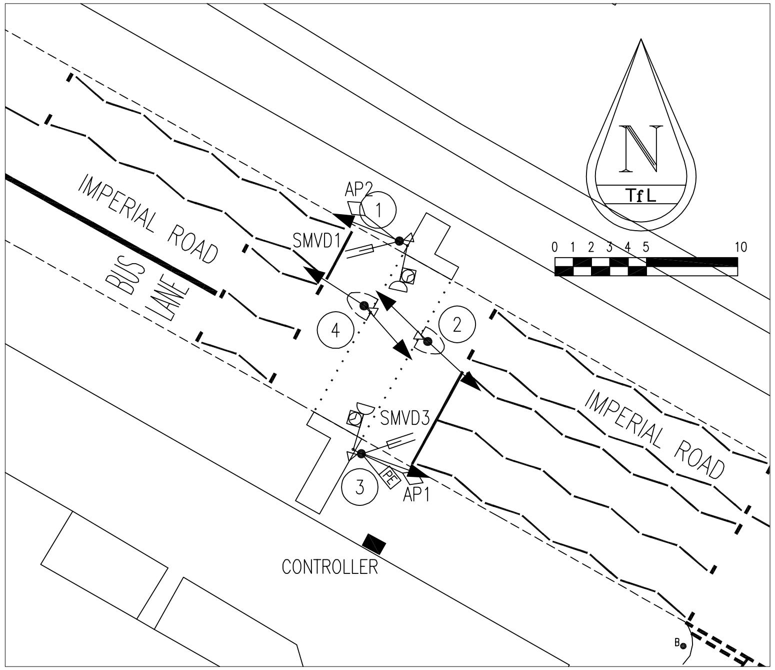
As Period 5 duration is calculated within bands of road width, tables could be generated which correlated road width (m) with the optimum distance for both 20mph and 30mph. This would allow for site-specific design.

Road Width (m)	Optimum Distance (m) 20mph	Optimum Distance (m) 30mph
Up to 7.2	53.6	80.5
7.2 - 8.4	62.6	93.9
8.4 - 9.6	71.5	107.3
9.6 - 10.8	80.5	120.7
10.8 - 12.0	89.4	134.1
12.0 - 13.2	98.3	147.5
13.2 - 14.4	107.3	160.9
14.4 - 15.6	116.2	174.3
15.6 - 16.8	125.2	187.7
16.8 - 18.0	134.1	201.2
18.0 - 19.2	143.0	214.6
19.2 - 20.4	152.0	228.0
20.4 - 21.6	160.9	241.4
21.6 - 22.8	169.9	254.8
22.8 - 24.0	178.8	268.2

Table 5: Optimum distance against road width in consideration of road speed.



SCHEME PLAN
SCALE 1:500



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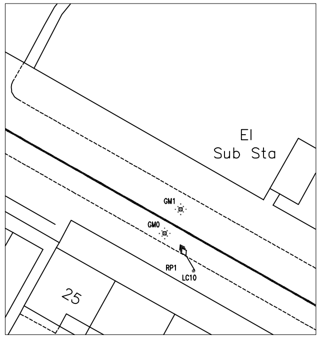


SCHEME PLAN
SCALE 1:500

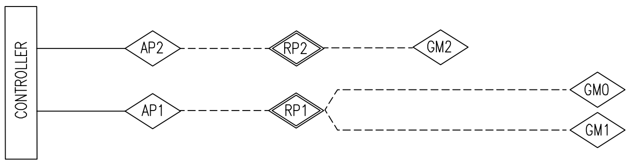
MAGNETOMETERS

NUMBER	DISTANCE FROM N/S KERB	DISTANCE TO STOPLINE (METRES)	REFERENCE POINT	PROPOSED OR EXISTING
GM0	C of L	15.9	6M BACK FROM LAMP COLUMN 16	Proposed
GM1	C of L	15.8	7.5M BACK FROM LAMP COLUMN 10	Proposed
GM2	C of L	45.8	JUST AFTER BUS STOP P BUS CAGE	Proposed

ACCESS POINT/ REPEATER	SIGNAL POLE/ LAMP COLUMN	LOCATION
AP1	SIGNAL POLE	SIGNAL POLE 3
AP2	SIGNAL POLE	SIGNAL POLE 1
RP1	LC19	IN LINE WITH PARTY WALL OF BUILDING NMRs 26 & 27
RP2	LC10	4m EAST OF EMDEN ST

NOTES
1. PUSHBUTTONS MOUNTED AT 45° TO KERB ON POLES 1 & 3
2. PUSHBUTTONS MOUNTED AT 90° TO KERB ON POLES 2 & 4
3. TACTILE ROTATING CONES FITTED TO PUSHBUTTONS ON POLES 1 & 3
4. AUDIBLES FITTED TO PUSHBUTTONS ON POLES 1 & 3
5. MAGNETOMETER ACCESS POINT (FOR MAGNETOMETER SYSTEM)
6. MAGNETOMETER REPEATER (FOR MAGNETOMETER SYSTEM)
7. MAGNETOMETER
8. COUNTDOWN UNIT
9. TRAFFIC SIGNAL (RAG)
10. PEDESTRIAN FAR-SIDE SIGNAL WITH PCaTS
11. PUSH BUTTON UNIT ON POLE
12. CONTROLLER
13. SLOW-MOVING VEHICLE DETECTOR (SMVD)

MAGNETOMETER CONNECTION DIAGRAM



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IMPERIAL ROAD BY
FULMEAD STREET
CROSSING LAYOUT

FOR GREEN MAN AUTHORITY

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TfL
Engineering
Windsor House
42-50 Victoria Street
LONDON SW1H 0TL
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Additional Considerations - Tactile/Audible Functionality

With the proposed operation and generic layout now determined, the implications on the lifecycle of the proposed new asset and the effect on road traffic and non-road traffic were reviewed.

It was identified that, although there would be no change to the signs or sequencing, there would be a necessary change to the audible/bleeper and tactile rotating cone ("tactile") units. As the Stage 2 duration could now be indefinite, if audible and tactile units were to retain their usual operation of sounding/rotating during the duration of the green figure then the consequences would be potential intolerable noise pollution (audibles) and shortened life span of the units (tactiles).

Proposed changes to the operation were done in consultation with TfL's Independent Disability Advice Group (IDAG), which represents the interests of disabled people including those with visual impairments, and with engagement to the wider disabled community through TfL's Access All Areas event. It was imperative that audible/tactile behaviour did not change from what was well understood and it was not acceptable to lose the functionality of these facilities.

An adjusted functionality was proposed which would function as follows:

- When the pedestrian phase gains right of way, the audible/tactile will run for the duration the Period 4 minimum (6 seconds).
- The audible/tactile will then terminate.
- If any push button is pressed after the Period 4 minimum has been met <u>and</u> whilst Period 4 is still active, the audible/tactile will restart and run for a duration of time which matches the Period 4 minimum (6 seconds). During this time, Period 4 will not be allowed to expire.
- The audible/tactile will then terminate.

This functionality would reoccur for as long as Period 4 is active.

Engineering Challenges in Trial Installation

Through the TCMS2 contract, Siemens and Telent collectively delivered 3 generic standalone crossing configurations to the TfL specification generated by Engineering. These were approved through Factory Acceptance Test (FAT), Local Acceptance Test (LAT) and System Acceptance Test (SAT), the latter onto TfL's UTC system, to validate both that the TfL specification was met and that the functionality requested in the TfL specification matched what was needed.

These were implemented at the 10 trial locations, from which we gathered a better understanding of the site-specific considerations to undertake when implementing GMA-conditioned VA crossings, such as:

- At the Wardour Street by Brewer Street location, road traffic approached at a speed too slow to be detected by the slow moving microwave vehicle detector, causing no right of way for vehicles on that approach. It was decided to implement an additional infra-red detector on this approach.
- At the Queens Road by South Park Road location, bus stops were located on the approaches within the optimum distance. If the distant detection was implemented at the optimum distance, buses would call the crossing before stopping at the stop, thereby unnecessarily losing green time to non-road users. It was decided to implement the distant

detection just in front of the bus stop, under the understanding that the increased delay to road traffic was preferable to the unnecessary lost time to non-road traffic.

Further Trial Works - Behavioural Study

During the trials at these locations, the team will undertake a behavioural study. The study will look at user compliance to determine whether there is a change in pedestrian behaviour and an increase in pedestrian compliance. As wait times will be reduced and pedestrians will arrive more frequently at the signals when the pedestrian signal is at green, it is expected there will be an improvement in pedestrian compliance. This study will also determine that there is not a detrimental impact on vehicle compliance.

The before surveys were undertaken in February 2019. The after data will be collected in autumn 2019.

Summary

Green Man Authority or "GMA" is a technique which has been developed by TfL in response to the Healthy Streets walking challenges laid out in the Mayor's Transport Strategy and the Walking Action Plan. The concept builds on previous traffic signal strategies implemented at Morden Station and Hounslow Town Centre. The collaborative approach by TfL Surface and TfL Engineering has developed a solution with safety and improvements for walking at its heart.

The solution is being rolled out at 10 locations across London. The programme is conducting behavioural studies to assess any impacts on compliance. The pedestrian benefits at each location will be calculated to determine where this technology can be implemented to deliver walking and safety improvements in line with the mayoral ambitions on sustainable travel and Vision Zero.

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