20 mph zones and Road Safety in London

A report to the London Road Safety Unit

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Summary

Aims

This study aimed to provide robust evidence on the effects of 20 mph zones on road safety in London by:

- Describing 20 mph zones in London using Geographic Information Systems;
- Quantifying the effects of 20 mph zones on collision and casualty risk;
- Assessing whether 20 mph zones change the pattern of injuries for local residents compared with non-local travellers;
- Quantifying the cost-effectiveness of 20 mph zones in terms of the number of casualties prevented against the cost of implementation;
- Assessing the potential casualty reductions in London from future expansion of the number/size of 20 mph zones.

Background

Previous research in the UK and internationally has shown that traffic calming schemes can reduce the rates of collisions and casualties. However, the magnitude of reductions reported has varied greatly, and little of the evidence comes from studies that have adequately controlled for other factors likely to have reduced collision or casualty rates, or for the possibility of 'regression to the mean', whereby relatively high rates before implementation might be followed by more moderate rates after implementation. It is also unclear how far this evidence is transferable to London's particular transport environment.

The number of 20 mph zones in London has increased year on year since they were first introduced in 1990/91, to a total 399 zones by 2007/08, with some Boroughs far more enthusiastic about adoption than others. The introduction of 20 mph zones is not uncontroversial, and there is a need for reliable evidence on the gains in safety made already, those likely to be made by future implementation and the cost effectiveness of implementation.

Methods

This study first reviewed available evidence on traffic calming in general and 20 mph zones in particular, identifying evidence for both the casualty and collision reduction and the policy contexts in which decisions about implementation are

taken. This review was informed by discussions with key stakeholders in London, including Borough road engineers, to provide local information on the history, current debates and future intentions relating to traffic calming policy in London.

To describe and quantify the effects of 20 mph zones on collisions and casualties, we first validated a data file of every 20 mph zone in London. Using ArcGIS, we overlaid road segments onto a map of 20 mph zones and census lower super output areas (SOAs). Traffic collision and casualty data were taken from STATS19 data and assigned to completed 20 mph zones, zones under construction, adjacent zones, or outside zones for each financial year.

The main analysis used time series regression to provide a more sophisticated estimate of the effects of 20 mph zones on collisions and casualties within the zones and in adjacent areas compared with outside areas. The effects of implementing zones were examined over time, in inner and outer London, by size of zone and location relative to other zones, for different casualty user groups and severities and across different deprivation quintiles. The results from the model were used to estimate the effect of expanding 20 mph zones to other residential streets in London.

To assess cost effectiveness, the direct costs of implementing 20 mph zones were estimated from recent average costs, and the benefits measured by savings from prevented casualties were estimated using our estimates of 20 mph zone effects on casualties. Net present values and benefits per kilometre of road were estimated for low and high casualty areas.

Findings

On average, there has been a 1.7% decline in all casualties on London's roads each financial year between 1987 and 2006.

All methods used in this study confirmed previous findings that London's 20 mph zones have had an effect on reducing casualties.

The time series regression analysis estimated a 42% reduction (95% CI 36%, 48%) in all casualties within 20 mph zones compared with outside areas, adjusting for an annual background decline in casualties of 1.7% on all roads in London. The largest effects of 20 mph zones were found for all casualties aged 0 -15 killed or seriously injured (KSI) and for car occupants. A reduction was evident for all outcomes examined. In areas adjacent to 20 mph zones, reductions compared with outside areas were evident for most outcomes, except for those killed.

The effects of 20 mph declined over time, although those implemented in the most recent years (2000-2006) still had an effect of reducing all casualties by 23% (95% CI 15%, 30%) within the 20 mph zone, and 3% (95% CI -1%, 7%) in adjacent areas, compared with outside areas, adjusting for a annual background decline in casualties of 6% on all roads in London.

The cost effectiveness analysis suggested that the benefits (in terms of casualties prevented) of 20 mph zones implemented in high casualty areas are greater than the costs of implementation, whereas those in low casualty areas are not. The results show that 20 mph zones become cost effective when a road has over 0.7 casualties per km.

Those injured in 20 mph zones were more likely to be injured close to home, for all categories of casualty. There is no evidence that the effects of 20 mph zones vary between inner and outer London, in less residential and more residential areas, and in small 20 mph zones and large 20 mph zones. There is some evidence that 20 mph zones are more effective in reducing KSI casualties in less deprived areas compared to more deprived areas. There is some evidence that relative isolated 20 mph zones are more effective in reducing all casualties compared to surrounded 20 mph zones.

What are the implications for policy and practice?

This study provides robust evidence for the beneficial effects of 20 mph zones on road safety in London, with the best estimate of the overall effect being a reduction in all casualties of 42% (95% CI 36%, 48%) compared with outside areas. There were reductions for most casualty groups, and no evidence of collision migration to other areas. That a greater proportion of those injured in 20 mph zones are local residents suggests they have also had an effect on cars 'rat running'.

20 mph zones are still having an effect on road safety, but the effect appears to be smaller in more recent years. In part, this may be due to 20 mph zone implementation in higher casualty areas (with more scope for benefit) in earlier years compared to more recent years. When 20 mph zones are being implemented for road safety gain, they are most efficiently located in high casualty areas.

There is a need for more information to inform our understanding of how 20 mph zones affect exposure, in changing the travel patterns of road users, particularly cyclists.

Part A: Review of the Literature

1. Introduction

The national context

Great Britain has casualty rates among the lowest in Europe. However, this does not extend to child pedestrian casualty rates, where British rates are closer to the European average (Bly, Jones et al. 2005). Britain is often compared to Sweden and the Netherlands, countries with similar rates of collisions and casualties which have both adopted road safety "visions"—Vision Zero in Sweden and Sustainable Safety in the Netherlands. Both visions strive to eliminate all road traffic fatalities and serious injuries by creating a road system that minimises the potential outcome of collisions to result in fatal or serious injury to road users. In comparison, Britain's road safety strategy has traditionally been more pragmatic and "problem oriented" (Koornstra, Lynam et al. 2002). The focus has been to target at-risk users and high casualty areas for reform (Audit Commission 2007), rather than adopt holistic danger reduction strategies.

As in other fields of injury reduction, specific measures can be conventionally divided into the 'three E's': enforcement, education and engineering. In Great Britain, early enforcement measures focused on speed limits, driving licence tests, vehicle standards, safety helmets for motorcycles, and drink driving limits. Early education campaigns dealt with driver training, child pedestrian safety, safe driving, safe cycling, and drink driving. Early engineering measures included roundabouts (first introduced in the 1920s) and pedestrian zebra crossings (1950s). Modern road safety strategies also utilise the three E's. Enforcement has expanded to include seat belt laws and safety cameras; education campaigns have targeted speeding, seat belt wearing and drink driving. In recent years, engineering measures have included traffic calming, encompassing, for example, 20 mph zones and home zones, which attempt to physically restrict driving speeds.
Establishing measurable targets has also played a significant role in Great Britain's modern road safety strategy, with evidence that they can lead to appreciable improvements in road safety in most countries (Wong, Sze et al. 2006). In 1987, the government announced its first road safety target—a one third reduction in road casualties by the year 2000 compared to the 1981-1985 average. The target, widely publicised in the media and well received by road safety professionals and the public, helped to influence attitudes towards road safety (Crawford 2007). By 2000, Great Britain had reduced the number of fatalities by 39% and the number of

serious injuries on the roads by 45%. However, the numbers of slight injuries declined less.

The Department for Transport (DfT) set new targets in 2000. "Tomorrow's Roads, Safer for Everyone" called for significant reductions by 2010, from a baseline of the 1994-1998 average, in the following areas:

- 40% reduction in the number of people Killed or Seriously Injured (KSI);
- 50% reduction in the number of children KSI; and
- 10% reduction in the slight casualty rate, expressed as the number of people slightly injured per 100 million vehicle kilometres.

London

London is not typical of the country as a whole, with (for instance) lower levels of car ownership and higher use of public transport (Department for Transport 2006c). This makes assessing the relative safety of London's roads difficult, given that there are few measures that take exposure into account. London's pedestrian casualty rates are declining, but remain comparatively high – 74 casualties per 100,000 people, compared to the England average of 53 per 100,000 people. However, higher pedestrian casualty rates in London may, in some part, reflect higher numbers of walkers. London's casualty rates are also the highest in England in terms of vehicle miles travelled by cycles, motorcycles and cars. However, due to lower speeds in London, these higher rates may reflect more time spent on the roads. Compared to the rest of England, London's minor roads (all roads except motorways and A roads) are relatively safe, 39% of road traffic collisions in London in 2006 occurred on minor roads (Department for Transport 2007b).

The London Road Safety Plan (Transport for London 2001), set additional targets for London's vulnerable road users (pedestrians, cyclists, powered two wheeler users). Casualty reductions in London were larger than the national average and as the targets were likely to be met well before 2010, the Mayor of London set more stringent targets in 2005. The new targets aimed for the following reductions against a baseline of the 1994-1998 average by 2010 of:

- 50% reduction for all road users killed or seriously injured;
- 60% reduction in the number of children killed or seriously injured;
- 50% reduction in pedestrians and cyclists killed or seriously injured;

- 40% reduction in the number of powered 2-wheeler users killed or seriously injured; and
- 25 % reduction in the slight casualty rate (per 100 million vehicle kilometres)

Across London, some boroughs reported 'stretched' casualty reduction targets, generally resulting from local Public Service Agreements (Edwards, Green et al. 2007). To achieve these targets, Transport for London (TfL) and the boroughs aim to build partnerships with other interested stakeholders through the Pan London Road Safety Forum, manage speeds through safety cameras, home zones and 20 mph zones, improve pedestrian and cycling facilities, and examine potential powered 2-wheeler interventions (Transport for London 2001).

Engineering traffic calming measures

Traffic calming is a key intervention with the potential to make roads safer in three ways. First, slower speeds may give drivers more time to react to other road users. Secondly, reducing impact speed in road traffic collisions reduces the number and severity of injuries. Finally, traffic calming may reduce traffic in residential streets, making casualties in residential areas less likely and increase the level of walking and cycling.

The goals of traffic calming are multi-faceted. In relation to 10 themes outlined in its current road safety strategy (Department for Transport 2000b), the government sees traffic calming as particularly useful in making roads safer for children, making safer infrastructure, encouraging safer speeds, and making roads safer for pedestrians, cyclists and horse riders. In addition, the DfT notes that traffic calming can help achieve the wider objectives of improving health by encouraging walking and cycling, improving the environment by encouraging public transport and discouraging car use on inappropriate journeys, and strengthening communities by reducing community severance (Department for Transport 2007c).

Examples of traffic calming engineering measures used on roads in London include speed cushions on 30 mph roads, home zones, 20 mph limits, and 20 mph zones. These different measures vary in terms of cost, effectiveness and popularity. **Home zones**, piloted in Great Britain in 1999, are residential streets specifically designed with shared space for vehicles and other road users to slow vehicle speeds to well below 20 mph. The goal is not only to reduce casualties, but also to change perceptions of how streets are used. Home zones are based on the Dutch concept of the "woonerf" ("living yard") (Quimby and Castle 2006). The design of home zones can vary, but typically use high quality materials to convey that the street is a place for a variety of activities. While home zones have proved popular among residents, the interventions are very costly, and their use in London has been limited.

On **20 mph limit** roads, the speed limit is lowered to calm traffic, but there are no traffic engineering measures to help enforce the slower speeds. Instead, repeater signs throughout the area announce the 20 mph limit. Guidance from the DfT states that 20 mph speed limits should only be considered for use on roads where average speeds are already below 24mph (Department for Transport 2006a).

In contrast, road engineering is used to slow traffic in **20 mph zones**. The zones are marked by terminal signs at the entrance and exit of the zone but it is not necessary to have signs for individual traffic calming measures within the zone (Department for Transport 1999). Depending on the local environment, a range of vertical and horizontal deflections, as well as other measures, may be implemented. Examples of vertical deflections include road humps, raised junctions, and speed cushions. Horizontal deflections include buildouts, chicanes, pinch points and traffic islands. Examples of other engineering measures include gateways, surfacing, and road narrowing. By definition, the design of 20 mph zones can vary, as long as the zones are self-enforcing and in compliance with Traffic Signs and General Directions 2002. Figures 1 – 12 show examples of engineering measures used in 20 mph zones.

Figure 1: Entrance to a 20 mph zones with signing

Figure 2: A gateway within a 20 mph zones with a vehicle passing through

Figure 3: Speed hump on a narrowed section of road

Figure 4: Speed cushions on a two way street

Figure 5: Speed cushions on a one way street

Figure 6: A chicane within a 20 mph zone

Figure 7: A Chicane with priority over oncoming traffic

Figure 8: A side raised entry treatment

Figure 9: A raised junction

Figure 10: A mini roundabout

Figure 11: A raised Zebra crossing being used by pedestrians

Figure 12: A raised informal crossing point and pedestrian refuge with 20 mph roundel painted on the carriageway

Each 20 mph zone is designed individually, taking into account local area characteristics, funding, cost benefit analysis, community needs and public consultation. The DfT (1999) advises that zone design should consider the needs of all road users, and the Department has established guidelines. Guidelines on the design of 20 mph zones has also been published to take into account specific user groups and to help road engineers use vertical deflections appropriately (Institute of Highway Incorporated Engineers 2008; Transport for London 2005a).

Borough policies

London's first 20 mph zone was introduced in 1991 in Kingston upon Thames. A legislative change in 1999 allowed local authorities to implement 20 mph zones without special central government approval. With fewer restrictions, the number of 20 mph zones in London grew, reaching 399 by 2007/08. Many 20 mph zones are funded through Local Implementation Plan submissions to TfL.

Individual boroughs are responsible for designing and selecting sites for 20 mph zones. Designs are expected to follow DfT guidelines and there are some concerns about likely Borough liability for injuries should they not have been met (Personal Communication 2008). When proposing 20 mph zones, local authorities are legally required to consult with relevant stakeholders such as the emergency services, local residents and organisations representing road users. Boroughs across London have differing policies regarding traffic calming and 20 mph zones. Some explicitly take a 'road danger reduction' approach (for example, Waltham Forest, Islington, Newham, Brent) and consider 20 mph zones to be an integral part of their road danger reduction plan. The borough of Southwark aims to be the first all-20 mph zone borough (Southwark Council 2005). Conversely, Barnet has a policy of reviewing and possibly removing previously installed speed humps, and Westminster uses vertical deflections only in very limited circumstances. Kensington and Chelsea will consider implementing 20 mph zones in areas with a history of speed-related casualties, but so far have found no justification for introducing a 20 mph zone anywhere in the borough.

Funding

London's 20 mph zones draw funding from four main sources. TfL finances some zones through the Local Implementation Plan process. Plans must detail how each borough will implement the Mayor's transport strategy in their area. TfL has increased the budget for 20 mph zones from £9 million in 2005/06 to £10.5 million in 2007/08. TfL funds 20 mph zones through the London Road Safety Unit (LRSU). Funding is allocated based on predicted reductions in collisions in areas with a history of reported collisions. Schemes are ranked by the First Year Rate of Return, which is calculated using cost savings from prevented collisions. When deciding between two schemes with similar rankings, TfL has recently used the Index of Multiple Deprivation (IMD) score to prioritise more deprived areas. TfL may relax collision criteria to expand an existing 20 mph zone.

Schools with School Travel Plans may also receive funding for 20 mph zones through the travel awareness process. Unlike 20 mph zones funded by The LRSU, these zones may be approved regardless of collision or casualty history. 20 mph zones located in new developments may be funded through Section 106 of the Town and Country Planning Act of 1990. Additionally boroughs may use other DfT funding or their own funds for 20 mph zones, such as revenues from parking fines.

2. Implementing traffic calming: policy and politics

Both the range of outcomes addressed by traffic calming measures and the lack of robust data on the effects on most outcomes has led to some controversy over their use. Most road safety interest groups support 20 mph zones. The Campaign for Better Transport, BRAKE, Safer Speeds Initiative and Road Peace all advocate for more 20 mph zones in Great Britain, citing benefits such as reduced collisions and casualty severity rates, increased walking and cycling, and improved local environments. However, other interest groups, particularly those representing drivers, suggest that road user mistakes (poor driver attention, unsafe walking and cycling behaviour) as well as poor road conditions account for road traffic injuries. The Association of British Drivers and Safe Speed question the assumption that inappropriate speeds cause road traffic collisions. Different perspectives also shape party political attitudes to some extent in Great Britain, with a Conservative think-tank opposing vertical deflections of any kind for road safety purposes (Heymer 2007).

Local politics also affect on policy. Research from Lyons and colleagues (2006) in two unnamed cities in Great Britain found that areas with more influential councillors (as measured by cabinet representation status) tended to have a higher density of traffic calming measures than areas with non-cabinet councillors. This is reflected in comments from across London (Personal Communications 2008) that local councillors may lobby for 20 mph zones put in their area, even if the area doesn't have a high casualty history because 20 mph zones are popular with local voters.

Within the boroughs, decisions about where to site 20 mph zones are framed by a number of national and local concerns. The government encourages local authorities to build 20 mph zones in urban areas with a high casualty potential (such as schools) and a high casualty history (Department for Transport 1999). In a survey of local authorities, the Institute for Public Policy Research (IPPR) (Grayling, Hallam et al. 2003) reports that 77% of local authorities considered a location's casualty history when planning 20 mph zones. Other common considerations included local demand (70%), Safe Routes to School (21%), Near Schools (15%), and new housing developments (7%). The IPPR report notes that one London borough, Camden, reported targeting 20 mph zones in more deprived areas in 2003. More recent road safety plans suggests other boroughs are doing the same (Southwark Council 2005). A survey of London boroughs in 2006 found that all boroughs reported taking collision history into account when prioritising engineering interventions, and all reported taking community concerns into account, at least where possible, but that half never took local deprivation levels into account (Edwards, Green et al. 2007). Many boroughs report that 20 mph zones are not implemented in locations where residents oppose them, and that they take consultations with the police, ambulance service, the fire service, and bus companies very seriously (Personal communication, Islington 2007).

Public and local concerns about 20 mph zones

While 20 mph zones have the potential to reduce collisions and casualties, encourage non-motorised road users, and improve the local environment, they also generate concerns. First, effective 20 mph zones may increase journey times. London has a target to accommodate an increase in travel of 3% within an increase in car, bus or goods vehicle journey time of no more than 1.5% (Department for Transport 2006b). 20 mph zones may hinder London's success in achieving this target. Potential increased journey times are a particular concern of the emergency services, in that if traffic calming measures increase response times, they may cause unnecessary deaths. TRL found that delays to emergency vehicles per traffic calming measure are relatively small (Boulter, Hickman et al. 2001). Yet, the London ambulance service estimates that a one minute reduction in average response time could save around 500 lives per year (London Ambulance Service 2003). However, no evidence has been presented to substantiate this estimate (London Assembly Transport Committee 2004). Traffic calming features may also increase journey times and discomfort in buses. Different types of traffic calming measures are recommended for bus routes (Transport for London 2005b).

A second potential issue is the discomfort that may be caused by vertical deflections in 20 mph zones. Research has shown that traffic calming measures are unlikely to injure people without pre-existing medical conditions (Kennedy, Oakley et al. 2004), but the measures may be uncomfortable.

Third, there are concerns relating to vibration from vehicles passing over vertical measures. Although research indicates that structural damage to residential properties is unlikely (Department for Transport 2000a) , residents may feel some vibration.

Finally, local residents may have concerns about the potential for increased noise and pollution. While slower moving traffic tends generally to be quieter, the constant braking and acceleration between measures may increase noise and disturb residents in the surrounding area. Noise surveys by TRL in Slough and York (Abbott, Taylor et al. 1997) found that traffic calming measures reduce both the overall and maximum noise levels from light vehicles, but track trials of heavier vehicles suggest that commercial vehicles may be noisier in areas with traffic calming measures (Abbott, Taylor et al. 1997). Traffic calming measures may also affect vehicle emissions, which are influenced by such factors as speed and acceleration rate (Boulter and Webster 1997). While emissions tend generally to be smaller at lower speeds, the concern is that emissions might increase in 20 mph zones as vehicles speed up between traffic calming measures and use more fuel. Research findings are mixed, with some studies finding no change in emissions after the implementation of 20 mph zones (Owen 2005), some noting marginal increases in some pollutants (Boulter, Hickman et al. 2001), and others finding large increases (Daham, Andrews et al. 2005).

Public perceptions of traffic calming measures

There is evidence that speeding is a major concern across all age and sex groups in Great Britain (Poulter and McKenna 2007). The British Social Attitudes Survey (National Centre for Social Research 2005) reported that 75% of the British public support 20 mph speed restrictions in residential areas. In a nationally representative survey of British drivers, the RAC found that 71% of drivers were concerned about others’ speeding, and 80% of drivers favour lower speed limits in built-up areas (Royal Automobile Club 2007).

Traffic calming measures also receive considerable public support. A national public opinion survey conducted in 2004 by MORI indicated that 75% of the British public favours traffic calming schemes, although some measures were more popular than others. The poll found that over half of the British public supports interactive signs, speed cameras, raised junctions, and road humps, while less than one-third supports gateways (Social Research Associates 2006). Research from case studies in Scotland found that the majority of residents supported implemented traffic calming schemes. Further, after traffic calming, residents perceived speeds as lower and driver behaviour as better (Ross Silcock Limited and Social Research Associates 1999).

Traffic calming measures are less popular among drivers. The RAC found that 57% of drivers support traffic calming measures such as speed humps (Royal Automobile Club 2007). The British Social Attitudes Survey reports that only 43% of drivers support speed humps (National Centre for Social Research 2005).

While lower speeds and traffic calming receive considerable support in Great Britain, there is a mismatch between what the general public and British drivers say they want, and actual driver behaviour. In a nationally representative sample, half of drivers surveyed admitted to driving significantly over the speed limit in built up areas, and 16% of respondents reported a speeding offence conviction in the last 5 years (Royal Automobile Club 2007). International evidence suggests that drivers may be underestimating their speeds. A study from New Zealand (Harre 2003) reports large differences between drivers' estimated speeds and actual speeds when children are present on the streets. TfL are currently researching the public attitudes and understanding of speeding and speed management measures in London, including public attitudes to traffic calming in 20 mph zones.

Before implementing a 20 mph zone in London, local authorities are required to consult local residents. Local authorities such as Enfield and Richmond upon Thames have reported overwhelming support for their proposed traffic calming schemes (London Assembly Transport Committee 2004). In a case study in one London borough, a report by Social Research Associates (2006) found that the media was a major contributor to the consultation process, mainly supporting traffic calming opposition groups. In the case study, opposition groups succeeded in producing substantial modifications to original traffic calming plans. Even after modifications, 22% of questionnaire respondents gave the scheme a negative approval rating, while 30% of respondents gave a neutral rating and 48% of respondents gave the scheme a positive rating. Evidence suggests that programmes with good community consultation processes tend to have higher community satisfaction ratings (Ross Silcock Limited and Social Research Associates 1999). Taylor and Tight (1997) reviewed traffic calming schemes in

Brighton, Leicester, Sheffield and York and found the support of the local community depends on the openness of the consultation process.

3. Research on the effects of traffic calming

Methods

To obtain information on the effects of traffic calming, we searched the following databases: MEDLINE, EMBASE, Transport, IBSS, CENTRAL, and the National Research Register. We searched the databases with terms such as 20 mph zone, 30 kph zone, traffic restraint, traffic calming, traffic engineering, road design, road layout, area traffic control, traffic distribution, speed hump, and speed cushion. We also hand searched the Department for Transport (DfT) website as well as Transport Research Laboratory's (TRL) publications lists.

Speed and collisions

There is good British and international evidence that speed is a major contributory factor in both the frequency of road traffic collisions and the severity of injuries (Aarts and van Schagen 2006; Finch, Kompfner et al. 1994; Kloeden, McLean et al. 1997; Moore, Dolinis et al. 1995). In Great Britain research by Taylor and colleagues (2000) found that higher average speeds are associated with higher collision frequency on urban roads. Their research predicts that a 1 mph reduction in average speed can lead to a 7% reduction in collisions on 'slower' urban roads (average speed 20 mph) and a 2% reduction in collisions for 'faster' urban roads (average speed of 34 mph). Further, the report concludes that the larger the spread of speeds around the average speed, the higher the collision frequency. Therefore, reducing not only average speeds, but also the highest vehicle speeds may help Great Britain and London to reduce casualties.

Speed also affects the severity of injuries, particularly for vulnerable road users such as pedestrians and cyclists. The European Transport Safety Council (European Transport Safety Council 1995) reports that in a vehicle-pedestrian collision, the probability of pedestrian death is 5% if the vehicle is travelling at 20 mph, but increases to 45% at 30 mph, and reaches 85% at 40 mph.

Researching the impact of traffic calming: methodological challenges

There are substantial methodological challenges in researching relationships between traffic speed and road traffic collisions, including difficulties in measuring speed averages and ranges, and adjusting for exposure differences that result from speed changes (Shinar 2005). Evaluating 20 mph zones presents particular challenges. Area-wide traffic calming schemes can introduce a variety of traffic-calming measures simultaneously, making evaluations of particular measures difficult (Department for Transport 2007c). Additionally, because the goals of 20 mph zones are multifaceted, there are many potential outcomes of interest, such as speeds, road traffic collisions, road traffic injuries, neighbourhood cohesion, or walking and cycling patterns. Some outcomes, such as speeds, collisions, and casualties, are relatively easy to measure, while measures such as walking and cycling patterns, traffic volume and neighbourhood cohesion are more elusive. This means that 20 mph zones are often judged on their success in casualty reduction, rather than in road danger reduction as a whole. Further, casualties and collisions are subject to under-reporting (Ward, Robertson et al. 2005). Finally, all 20 mph zones are located within complex social, political, and road environments. The design of each 20 mph zone is likely to vary by location, as do travel patterns and practices. Therefore, care must be taken when generalising results from particular schemes.

To investigate changes in casualties, speeds, and traffic flows, most research studies on traffic calming in general, and 20 mph zones in particular, use before and after study designs. Outcomes of interest are measured before implementing traffic calming measures and then compared to the results after implementation. The more rigorous studies compare the before-after changes in outcome measures in the traffic calmed area to before-after changes in a control area (an area with similar characteristics which did not receive traffic calming) to ensure that any findings are not the result of other concurrent changes in the outcome of interest. Since traffic calming and 20 mph zones are often introduced in areas with relatively high numbers of casualties, before and after evaluations may be subject to the 'regression-to-the-mean' phenomenon – i.e. which, on average, high numbers of casualties would tend to be followed by more moderate rates. This could overestimate the effect of traffic calming on injuries. To mitigate this bias, studies often use the average number of outcomes across a several year period when measuring before and after effects.

The non-casualty effects of traffic calming and 20 mph zones are relatively under-researched. The limited studies on this topic have used a variety of research tools, including postal questionnaires, individual interviews and pedestrian counts.

Findings from the international literature

There is a large international literature on traffic calming, including studies from Germany (Blanke 1993), Switzerland (Lindenmann 2005), Australia (Farlie and Taylor 1990), Denmark (Engel and Thomsen 1992), the Netherlands (Agustsson 2001; Vis and Dijkstra 1992), USA (Cottrell, Kim et al. 2006; Day, Anderson et al. 2007), Japan (Yamanaka, Yamaguchi et al. 1998) and Canada (Zein, Geddes et al. 1997). Two international systematic reviews have looked at the effects of traffic calming on injuries. Elivk (2001) conducted a meta analysis on the effects of urban-wide traffic calming schemes on personal injury collisions, including all relevant before and after studies regardless of whether the study design included a control group. He found that on average traffic calming schemes reduced road traffic collisions by 15% (95% CI -17%, -12%). Using subsets and meta-analysis for studies using matched comparison groups, Elvik found that traffic calming reduced collisions by 12% (-21%, -1%). Using data from Great Britain only, the meta analysis reported that traffic calming reduced collisions resulting in casualties by 9% (-15%, -3%).

A Cochrane Injuries group review (Bunn, Collier et al. 2003) performed an international meta-analysis of the impact of area-wide traffic calming schemes on injury collisions using only controlled before and after studies. The review found that traffic calmed areas had an 11% (-20%, 0%) lower risk of traffic collisions compared to control areas.

Findings from literature in Great Britain

Studies from Great Britain in general, and London in particular, reflect international findings that traffic calming schemes can reduce traffic volume, speed and injuries, but that there are mixed findings in relation to impacts on perceptions of road danger and on pedestrian activity.

Traffic calming

Traffic calming was developed as a iterative and measured programme that sought to reduce vehicle speeds using methods first developed in Europe (Lines and Castelijn 1991). A number of studies have investigated the safety effects of area wide traffic calming and 20 mph zones in Great Britain. One of the first was The Urban Safety Project conducted in the 1980s (Mackie 1990). This project installed a variety of traffic calming measures (including mini-roundabouts, banned right turns, selective closures, sheltered parking, right turn bays, and central refuges) in five British towns and used a controlled before-and-after design, with 5 years' road collision data before the measures were installed and 2 years of data after. The study found that relative to the matched control areas, traffic calming schemes slightly reduced average speeds, decreased the total number of collisions by 12%, and significantly reduced cycling collisions. Pedestrian collisions also fell, but the change was not statistically significant.

An ecological study by Jones and colleagues (2005) examined child pedestrian casualty rates by deprivation in two British cities (Cities A and B) before and after traffic calming. They found that in City A, which had a greater density of traffic calming measures, child pedestrian injury rates significantly declined by more than 2% overall, and that the inequalities gap between the most affluent and most deprived child pedestrians also fell significantly. This is an interesting suggestion that traffic calming both reduces overall injuries, and the inequalities gap, although the authors note the limitations of a small ecological study, and the lack of installation dates for traffic calming (Jones, Lyons et al. 2005).

Studies have also examined the impact of traffic calming on residents' attitudes to road danger and on pedestrian activity. In Scotland, Ross Silcock Limited and Social Research Associates (1999) examined 10 traffic calming schemes on trunk and non-trunk (urban) roads by conducting attitude surveys of 150 residents in each area and 50 driver interviews in four of the study areas. The researchers found that after 1-2 years of implementation, the percentage of respondents who felt that speeds had been reduced ranged from 21%-75% (drivers ranged from 48%-66%) and the percentage of respondents who felt that traffic flows had been reduced ranged from 0%-46% (drivers from 4%-22%). The percentage of respondents who felt that pedestrian safety was improved ranged from 5%-69% (drivers from 8%-50%).

A more recent study by Morrison and colleagues (2004) used postal questionnaire surveys of randomly selected residents and pedestrian counts near traffic calming schemes on the outskirts of Glasgow six months before and six months after 20 mph zone implementation. According to the returned questionnaires, 20% of respondents claimed to walk more as a result of the traffic calming scheme. The pedestrian counts indicated substantial increases in the number of pedestrians (of most age groups) at most sites. The survey also reported that most respondents felt that road safety had improved. Road safety for cyclists and motorists, traffic nuisance, pedestrian facilities and traffic smells and fumes were reported to be significantly less of a problem after implementation of traffic calming measures.

20 mph zones

The Babtie group (formerly Allot & Lomax now part of the Babtie group) (Department for Transport 2001) investigated the environmental and behavioural changes resulting from six 20 mph zones implemented in or near Manchester and Liverpool. The uncontrolled study used vehicle and traffic noise surveys, manual and automated traffic counts, pedestrian counts, video surveys, and household surveys to examine outcomes before and after implementation. The study found that average mean vehicle speeds fell by 5.5 mph between traffic calming measures and by 8.7 mph at traffic calming measures across the six zones. However, in some zones 85 percentile speeds remained above 20 mph. Using on average three to five years of collision data before zone implementation, and nearly three years of collision data after zone implementation, the study found that collisions in the 20 mph zones were significantly reduced from 30%-100%. Traffic flows in the zones fell by an average of 17% and traffic and noise levels were also reduced. Despite these findings, local residents did not perceive changes in speeds or noise. The study found that 20 mph zones had virtually no impact on walking and cycling patterns or street activity. However, local residents were overwhelmingly in favour of the 20 mph zones.

Kingston upon Hull has more 20 mph zones than anywhere else in Great Britain, and 20 mph zones covered 25% of its roads in 2003. An uncontrolled before and after study found remarkable declines in casualties. Overall, Hull's road casualties have decreased 14% from 1994-2001. Comparatively, road traffic casualties increased 1.5% over the same time period in the nearby areas of Yorkshire and Humberside. In the 20 mph zones, total collisions decreased 56%, KSI casualties decreased 90%, pedestrian casualties decreased 54%, child casualties decreased 64% and child pedestrian casualties decreased 74%. (Brightwell 2003). Assuming that without the 20 mph zones, casualties in Hull would follow national trends, The Institute for Public Policy Research estimated that 20 mph zones in Hull have prevented over 1000 minor injuries and 200 KSI (Grayling, Hallam et al. 2003).

In 1996, TRL reviewed 20 mph zones in Great Britain (Webster and Mackie 1996). The uncontrolled study included 72 20 mph schemes and used 5 years of before data and at least 1 year of after data (the average was 30 months). The researchers found that overall collision rates decreased 61%, pedestrian collision rates decreased 63%, child pedestrian collision rates decreased 70% and overall child casualty rates decreased 67%. The ratio of KSI to all collisions fell from 0.21 to 0.16.

The evidence from London

International and national evidence may not be transferable to a London context. To understand how 20 mph zones work in London the LRSU commissioned TRL to undertake a research project investigating 20 mph zones in London in 2002 (Webster and Layfield 2007). The study evaluated 78 zones in an uncontrolled before and after study design with 5 years of before data and at least 1 year of after data (average was 3 years). Though the study did not have a formal comparison group, the authors were able to adjust estimates of casualty reductions to account for background trends on unclassified roads and found substantial casualty reductions in London's 20 mph zones.

Table 1: Reduction in casualty frequency in 20 mph zones (adjusted)

User group	All Casualties	KSI
All road users	45%	54%
Children	42%	45%
Pedestrians	36%	39%
Pedal cyclists	21%	30%
Powered 2 wheelers	58%	79%

Using data from 38 20 mph zones, the researchers found little collision migration taking place. The study did not explicitly adjust for regression to the mean, but did compare the numbers of collisions, and the proportion of KSI collisions in 20 mph zones and non 20 mph zones to account for background changes.

4. Future developments

Psychological traffic calming

Psychological traffic calming aims to slow speeds by increasing the cognitive load of the driver, making the road environment feel more complex and less safe. Measures such as enclosing a distant view, breaking up linearity, creating uncertainty, increasing roadside activity, and emphasising boundaries increase perceived risk (as opposed to actual risk), which causes drivers to slow down (York, Bradbury et al. 2007). A scheme using a number of psychological traffic calming measures was trialled in Latton in 2003. The scheme had success in slowing traffic speeds, resulting in an 8 mph reduction in mean speeds and a 10 mph reduction in 85^{th} percentile speeds in the village. Three quarters of residents were in favour of the scheme and half felt that the scheme had improved safety (Kennedy, Gorell et al. 2005).

Schemes designed under the idea of 'shared-space', where the entire road is available to all road user types, often use forms of psychological traffic calming. In addition to home zones where physical measures are often present as well, psychological traffic calming aspects are employed in 'Quiet Lanes', and 'Naked streets'. 'Quiet lanes' are minor rural roads which have low traffic flows and low speeds. Increased uncertainty due to the possibility of other road users helps to ensure that vehicle speeds remain low. 'Naked Streets' are schemes where road signs, traffic lights, footways, white lines and/or kerbs are removed to encourage road user interaction. Pioneered in the Netherlands, Naked Street schemes have been embraced in a number of European countries. Schemes in the Netherlands, Denmark and Sweden have reported reduced casualty figures after implementation (Hamilton-Baillie 2004). In London, this concept has been trialled on Kensington High Street where traffic signs and street furniture has been kept to a minimum. Initially, collisions on Kensington High Street have declined (Webster 2007), but it is not clear yet whether drivers will become familiar with the new layout, and the borough of Kensington and Chelsea closely monitors this new scheme.

There is little evidence or published research on the safety implications of psychological traffic calming or simplified streetscape schemes. Schemes that have been monitored and reported on were identified by a literature review commissioned by the LRSU. The review found that some simplified streetscape schemes had safety benefits but that each scheme should be considered on a case by case basis (Quimby and Castle 2006).

Time over distance cameras

Currently, the DfT mandates that 20 mph zones use vertical or horizontal deflections or other physical measures to self-enforce the speed limit. However, TfL is currently trialling time over distance speed cameras to enforce a 20 mph speed limit along sections of road. In London, Tower Bridge (permanently) and Upper Thames Street (temporarily during road works) have had 20 mph speed limits enforced by time over distance cameras. These fixed systems rely on cabling underneath the carriageway, which makes them expensive, however, a new generation of time over distance cameras are currently awaiting Home Office type approval.

The new generation of time over distance cameras will be wireless, which will allow for cheaper installation and use in areas with multiple entries or exits. A series of time over distance cameras will use Automatic Number Plate Recognition (ANPR) cameras to record when a vehicle enters and exits a zone. A calculation is then made of the average speed of the vehicle. If approved to regulate 20 mph zones, time over distance cameras may potentially lessen some of the concerns about noise, emissions, discomfort, and delays to emergency vehicles.

Intelligent Speed Adaptation

Intelligent Speed Adaptation (ISA) refers to in-vehicle systems that help drivers regulate their speed. Through a combination of a Global Positioning System and a digital road map of all speed limits, vehicles could be located and informed of the prevailing speed limit. Three variations of ISA have been considered: Advisory ISA notifies the driver of the speed limit; Voluntary ISA limits the speed of travel but may be overridden by the driver; and mandatory ISA limits the speed of the vehicle at all times (Carsten, Fowkes et al. 2008). London has currently ruled out using mandatory ISA in the system currently under development. However, the potential casualty savings are substantial. Jamson and colleagues (Jamson, Carsten et al. 2006) estimate that equipping all cars in Great Britain with advisory ISA would reduce collisions 10% and KSI collisions 14%. For voluntary ISA, the estimates for reductions in all collisions and KSI collisions are 10% and 15% respectively.

5. Conclusion

There is international, national and London level evidence that reducing the speed of traffic through interventions such as 20 mph zones can reduce the number and severity of collisions and injuries, although the gains reported are variable. Evidence on how 20 mph zones contribute to other social goals such as increasing community cohesion and increasing levels of active transport is less conclusive. There are also suggestions from the literature that traffic calming can reduce the well-documented risk gradient between affluent and deprived areas. However, because of the challenges of researching the impact of traffic calming, there have been few well conducted studies in this area, and the evidence is neither robust nor necessarily generalisable to London. Given the increasing popularity of 20 mph zones as a method of reducing speed, there is a real need for good evidence on their impact on collision and casualty rates. With the persisting challenge of addressing injury inequalities on London’s roads, there is also a need to evaluate the impact they have had on relative risks across London’s population.

Part B: Evaluation of the effects of 20 mph zones

1. Introduction

The review of the literature on traffic calming has provided background on the available evidence on the effect of 20 mph zones on road casualties across the UK. As we have noted though, much of this evidence is neither robust nor necessarily generalisable to London. The one study of 20 mph zones in London conducted by the Transport Research Laboratory (TRL) (Webster and Layfield, 2007) was only able to analyse data from 78 zones, just over half of zones implemented at the time. The TRL study did not analyse whether effects of 20 mph zones changed over time or across area types. Further, more than 250 zones have been implemented since the TRL study period. In 2008, Transport for London (TfL) commissioned the London School of Hygiene and Tropical Medicine (LSHTM) to conduct an analysis of the effects of 20 mph zones on casualty reductions, in order to provide an up-to-date evidence base for recommendations that are applicable specifically to London. In this part of the report we examine the effect of 20 mph zones on casualties among children and adults injured on London’s roads as pedestrians, pedal cyclists, powered 2-wheeler riders and as car occupants. Using 20 years of geographically referenced road collisions and resulting casualties in London, we aim to provide an assessment of the effectiveness and cost effectiveness of 20 mph zones on casualty reduction and identify implications for road safety policy in London.

It is important to note that casualty reduction is only one of many aims of 20 mph zones. However, it is often the primary aim, and it is essential that policy decisions are based on robust evidence on the likely gains made in collision and casualty reduction.

Aims

Specifically, the aims of this part of the project were to:

- Describe 20 mph zones in London using Geographic Information Systems;
- Quantify the effects of 20 mph zones on collision and casualty risk;
- Quantify the cost-effectiveness of 20 mph zones in terms of the number of casualties prevented against the cost of implementation;
- Assess the potential casualty reductions in London from future expansion of the number/size of 20 mph zones; and
- Assess whether 20 mph zones change the pattern of injuries for local residents compared with non-local travellers.

As noted in part A of this report, evaluating the effects of 20 mph zones on casualty reduction presents a number of challenges. First, as 20 mph zones are only one of a number of casualty reduction measures that have been implemented across London over the last 20 years, any analysis of casualty reduction effects must take into account underlying temporal trends that may be increasing or decreasing road casualties more generally. Second, because 20 mph zones have the potential to displace traffic to surrounding areas, analyses must investigate whether any collision migration has taken place. Finally, analyses must address the regression to the mean phenomenon. Because 20 mph zones are often introduced where casualty rates are observed to be high, casualty rates in these areas may tend to be followed by more moderate rates in subsequent years even without an intervention. These three issues will be addressed in our analyses.

2. Methods

20 mph zones

The London Road Safety Unit (LRSU) provided a dataset of every 20 mph zone in London containing the location, residency status, costs, dates of construction, and implementation date of every 20 mph zone in London among other variables. The data had to be checked and cleaned so it could be used. A full description of the data cleaning is provided in Appendix A.

Road network

Ordnance Surveys Integrated Transport Network (ITN) was used to provide the location of every road segment in London. The analysis required road segments which did not cross 20 mph zone or census lower super output area (SOA) boundaries. ArcGIS was used to overlay 20 mph zone and SOA boundaries onto the road network. Any road segments that crossed either 20 mph zone or SOA boundaries were split at those boundaries to form separate road segments. Each road segment was then assigned to an SOA and those road segments which fell within 20 mph zone boundaries were assigned to that 20 mph zone.

Next, to examine whether implementation of 20 mph zones resulted in any collision migration on neighbouring roads, each road segment was assigned an adjacency status. Using ArcGIS all road junctions within 150 meters of each 20 mph zone were assigned as being adjacent to that zone. All road segments that connect to these road junctions were assigned as being adjacent. Where a road segment was adjacent to several zones, it was assigned to the zone that was implemented at the earliest date.

Residential status

While a residential status variable was included in the 20 mph zone data provided by LRSU, it was not complete and also did not exist for other areas of London. To provide complete coverage of London a variable on the proportion of postcodes in an SOA that are characterized as ‘business’, was generated using information from the All Field Postcode Directory (AFPD). Each SOA was then assigned a residential status: residential (≤ 10% business), Mixed (11 - 25 %) or Commercial (> 25%). Road segments were assigned the residential status of the SOA they were linked to.

Each 20 mph zone was assigned a residency status by creating an average proportion of business score from road segments weighted by length in each zone. This generated residential status was compared to information on residency status obtained on the 20 mph zone file supplied by the LSRU. The majority of zones had the same residency status in our calculations and the LRSU data file (see Appendix A for details on data cleaning).

Measures of casualties

The LSRU provided STATS19 data for all road traffic collisions, resulting casualties, and vehicles involved in collisions in London between 1986 and 2006. Data on collisions included an x and y coordinate of the location of collision as well as the type of road (A road, B road, minor road, motorway, etc.) on which the collision occurred.

Using the x and y coordinate and information on the type of road on which the collision occurred, each collision was assigned to the nearest road segment of the appropriate type. We investigated collisions in which the x and y coordinate was greater than 50 metres from a road of the appropriate type. Collisions which were over 100 metres away from a road segment (such as those in parks) were excluded from the analysis, and all other collisions were assigned to their nearest road segment, regardless of type. See Appendix B for more information on the assignment of collisions to road segments.

For collisions which fell on road segments that were either inside or adjacent to 20 mph zones, we compared the financial year (April to March) of the collision to the building and implementation dates of the 20 mph zone to assign a zone and adjacency status.

From 1999, the police have collected information on the postcode of residence of each casualty and vehicle involved in road collisions in the STATS19 data. Of all casualties, 61% were found to have a valid postcode. Using this information, we calculated the distance from site of collision to postcode of residence for each casualty and vehicle with valid postcode of residence information.

Data construction

A data file was generated for each financial year (April to March) of every road segment in London. Road segments were assigned an intervention status. At any given time road segments could fall into one of five categories:

1) outside a 20 mph zone;

2) inside a completed 20 mph zone;
3) inside a 20 mph zone under construction;
4) adjacent to a completed 20 mph zone;
5) adjacent to a 20 mph zone under construction.

The file also contained the number of collisions and casualties that occurred on each road segment by financial year, by user mode and casualties by age, severity and user mode.

Statistical analysis

Time series regression analysis

Multivariable methods were based on analysis of the change in annual *counts* of casualties (and collisions) within each road segment using conditional fixed effects Poisson models (implemented in the Stata software package using the xtpoisson command). Each road segment was therefore treated as its own unit of analysis. The underlying trend over time in number of casualties was modelled as a (log)-linear function of year (i.e. assuming a constant percentage decline per year across all road segments), and the effect of 20 mph zones in the 20 mph zones themselves and in adjacent roads was modelled as step changes (percentage reductions) occurring from the first year of operation of each 20 mph zone. Results are presented as point estimate percentage reduction in casualties and 95% confidence intervals. Standard errors were obtained by a jackknife procedure, clustering on borough to allow for the similarity of outcomes within borough.

Because the analyses use 20 years of data, the results provide reasonably robust estimates of effects. To allow for potential bias from ‘regression to the mean’, key analyses were repeated dropping data for three, four or five years prior to the implementation of the 20 mph zones. This ensures that the observation of high casualty numbers over these periods, which may have affected the decision to implement some 20 mph zones, did not influence the estimates of casualty reduction attributable to them.

Choice of analytical methods

The analyses used in this report were based on computationally intensive models of change in annual counts within each road segment in London (fixed effects population Poisson models). These methods were used because the lack of denominators necessitated focus on within-segment changes. They represent a state-of-the-art approach.

Traditionally, the effect of 20 mph zones on casualties has been assessed using a before and after analysis. We investigate whether a before and after analysis can be used to monitor the relationship between 20 mph zones and casualties in section 4.3. Alternative methodological approaches, including Empirical Bayes methods, were not considered appropriate or feasible for the data structure and questions in hand.

3. Results

3.1 Where are 20 mph zones in London located?

A total of 399 20 mph zones were implemented across London between 1991 and 2008. Figure 13 shows the location of 20 mph zones in each borough. A full list of 20 mph zones can be found in Appendix F, table F1.

Figure 13: Map of 20 mph zones in London

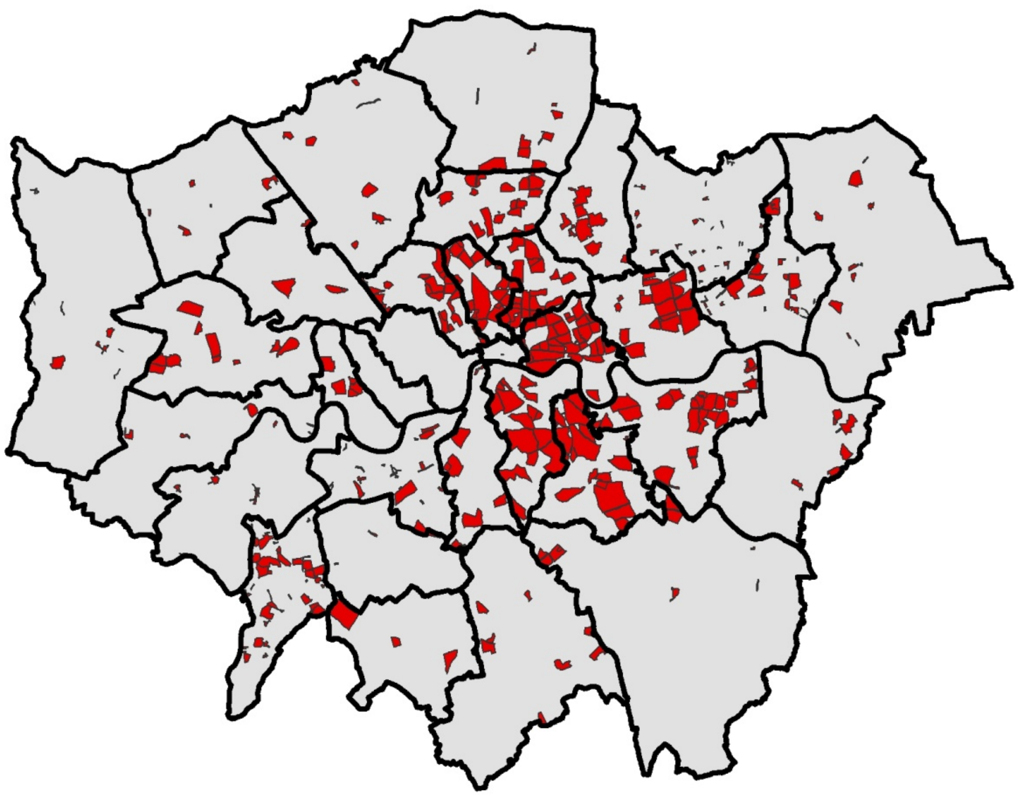


Table 2 shows the length of roads in new 20 mph zones, by road type and financial year. The size of 20 mph zones (measured by length of road) varies greatly, from a single stretch of road 0.07 km long, to an area covering 37 km of roads. The majority of roads included in 20 mph zones are minor roads. Further details of how zones were derived, and the descriptions of the zones can be found in Appendix A. Table 3 shows the length of roads in areas that are adjacent to 20 mph zones, by road type. The majority of roads in adjacent areas are minor roads (68%) with A roads being the second largest group (26%).

Table 2: Length of roads (km) in 20 mph zones by road type and financial year of implementation

Year	New Zones	Length of roads (km)			
		All roads	A	B	Minor
90/91	1	3.34	0.00	0.00	3.34
91/92	0	0.00	0.00	0.00	0.00
92/93	1	21.45	0.00	0.00	21.45
93/94	0	0.00	0.00	0.00	0.00
94/95	7	28.35	0.00	0.60	27.75
95/96	3	18.79	0.00	0.00	18.79
96/97	4	12.71	0.00	0.00	12.71
97/98	7	24.13	0.00	0.00	24.13
98/99	11	54.42	0.00	0.87	53.55
99/00	10	37.49	0.00	0.00	37.49
00/01	24	99.49	1.83	1.15	96.52
01/02	41	163.26	0.19	0.50	162.57
02/03	44	186.99	2.19	5.72	179.08
03/04	80	400.95	4.20	11.68	385.07
04/05	49	257.05	0.92	4.82	251.31
05/06	70	407.16	1.42	10.02	395.72
06/07	29	218.31	3.12	3.46	211.73
07/08	4	19.86	0.30	0.41	19.15
Not Known	14	52.48	0.00	0.00	52.48
Total	399	2,006.23	14.18	39.22	1,952.84

Table 3: Length of roads (km) adjacent to 20 mph zones by road type (2008)

Road type	Road length (km)
All Roads	2,216
Motorways	3
A Roads	584
B Roads	111
Minor Roads	1,518

Distribution of 20 mph zones by deprivation quintile

The location of 20 mph zones by deprivation quintile has changed over time. Table 4 shows the length of roads (kilometres) and percentage of roads in each deprivation quintile by financial year. In the early years, 20 mph zones were located on roads in more affluent areas (Quintile 1). In later years, 20 mph zones were located in more deprived areas. By 2008, 36% of roads in 20 mph zones were located in the most deprived areas of London (Quintile 5), and only 6% of roads in 20 mph zones were located in the most affluent areas of London.

Table 4: Length of roads (km, %) in 20 mph zones by IMD quintile and financial year of implementation

Year	New Zones	IMD Quintile 1 km	1 %	2 km	2 %	3 km	3 %	4 km	4 %	5 km	5 %
90/91	1	3.34	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%
91/92	0	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-
92/93	1	18.43	86%	3.02	14%	0.00	0%	0.00	0%	0.00	0%
93/94	0	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-
94/95	7	3.58	13%	6.21	22%	1.49	5%	13.09	46%	3.99	14%
95/96	3	0.00	0%	2.23	12%	11.60	62%	4.96	26%	0.00	0%
96/97	4	0.00	0%	0.22	2%	1.61	13%	4.27	34%	6.61	52%
97/98	7	4.27	18%	11.59	48%	1.58	7%	2.51	10%	4.18	17%
98/99	11	1.84	3%	7.04	13%	11.54	21%	12.62	23%	21.38	39%
99/00	10	2.93	8%	1.39	4%	10.70	29%	16.11	43%	6.36	17%
00/01	24	10.53	11%	15.76	16%	25.19	25%	23.38	23%	24.63	25%
01/02	41	16.09	10%	30.99	19%	23.72	15%	49.84	31%	42.62	26%
02/03	44	5.12	3%	24.02	13%	22.88	12%	52.96	28%	82.02	44%
03/04	80	12.83	3%	26.81	7%	65.04	16%	101.51	25%	194.75	49%
04/05	49	13.81	5%	38.46	15%	43.42	17%	56.42	22%	104.95	41%
05/06	70	20.21	5%	44.77	11%	92.70	23%	148.27	36%	101.20	25%
06/07	29	1.01	0%	22.19	10%	41.36	19%	63.58	29%	90.17	41%
07/08	4	0.00	0%	0.00	0%	1.76	9%	5.44	27%	12.65	64%
Not Known	14	0.65	1%	3.00	6%	7.28	14%	6.51	12%	35.04	67%
Total	399	114.64	6%	237.70	12%	361.88	18%	561.46	28%	730.55	36%

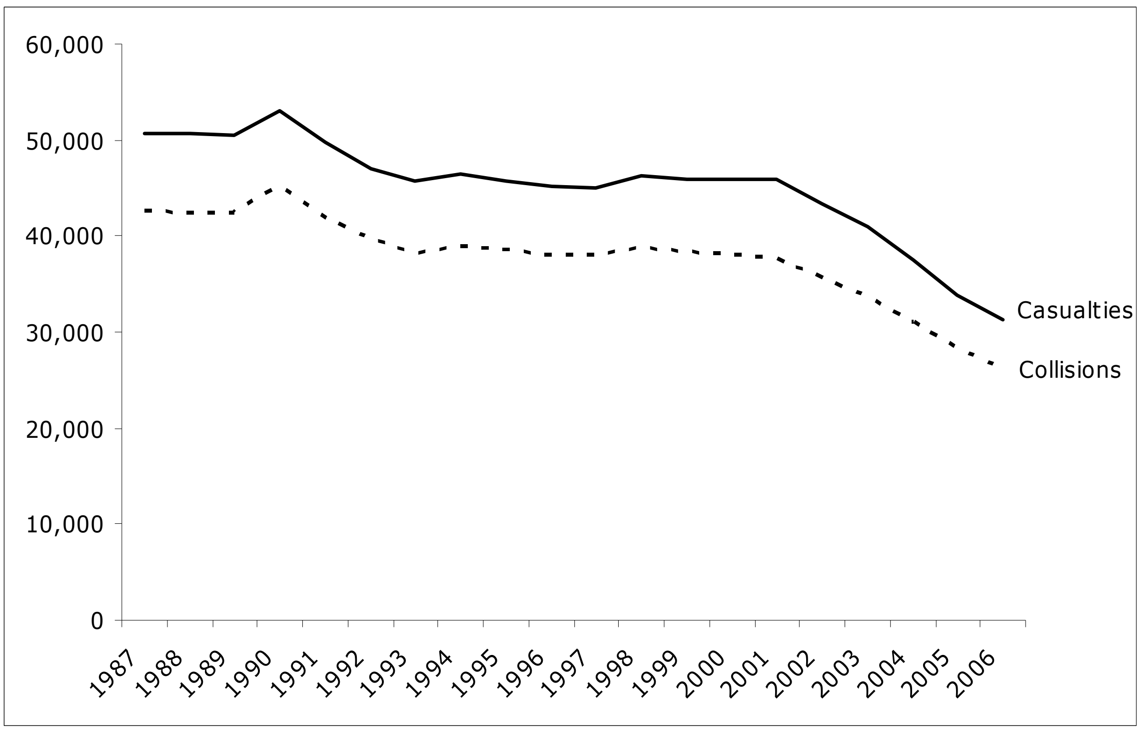
Further information on the relationship between area deprivation and 20 mph zones can be found in the companion report: *The Effect of 20 mph Zones on Inequalities in Road Casualties in London*.

3.2 What has happened to collisions and casualties in London by road type and in 20 mph zones?

Between April 1986 and March 2006, 753,975 collisions resulting in 908,004 casualties occurred on London's roads.

Across London, collisions and casualties decreased steadily between 1990 and 1993 and between 2001 and 2006. Between 1993 and 2001, however, collisions and casualties experienced small declines and some increases (Figure 14).

Figure 14: Trends in casualties and collisions in London



Collisions and casualties by types of road

The proportions of each type of road covered by 20 mph zones, adjacent areas and outside areas vary (section 3.1), resulting in different patterns of collisions in each type of area. Table 5 shows the number of collisions per kilometre of road, by road type, and status (in 20 mph zones, adjacent areas and outside areas). Results for 20 mph zones and adjacent areas are shown before and after 20 mph zone implementation. Results by year can be found in Appendix D, tables D1a – D1e.

20 mph zones are predominantly located on minor roads (table 2), and consequently most collisions within 20 mph zones occur on minor roads (79% before completion; 81% after). Adjacent areas tend to cover more major roads (table 3), and the majority of collisions in adjacent areas occurred on A roads (77% before, 73% after). Outside areas are more mixed, with a more equal spread of road types. The majority of collisions on outside roads occurred on A roads (59%) and a substantial proportion of collisions (30%) occurred on minor roads.

Table 5: Collisions per km by road type and status, 1986 – 2006

Road Type		20 mph zone		Adjacent area		Outside
		Before	After	Before	After	
Motorways	Collisions / Km	0.00	0.00	2.18	0.04	2.55
	%	0.00%	0.00%	0.02%	0.13%	1.30%
A Roads	Collisions / Km	10.12	5.07	13.90	10.66	8.69
	%	6.91%	8.94%	76.91%	73.54%	59.13%
B Roads	Collisions / Km	6.46	1.62	8.31	5.82	5.45
	%	12.20%	7.90%	8.56%	8.26%	8.25%
Minor Roads	Collisions / Km	1.01	0.32	1.15	1.01	0.81
	%	79.36%	81.29%	14.51%	17.76%	30.48%
Other Roads	Collisions / Km	0.16	0.06	0.16	0.10	0.10
	%	1.54%	1.87%	0.31%	0.31%	0.84%
All Roads	Collisions / Km	1.10	0.34	4.73	3.45	1.85
	%	100%	100%	100%	100%	100%

In tables 5 – 7 we have split the category of minor roads into two groups, "minor roads" which are local or residential roads, and "other roads" which are private and pedestrian roads.

The pattern for casualties is similar to that for collisions. The majority of casualties within 20 mph zones occurred on minor roads, the majority of casualties in adjacent areas occurred on A roads, and the majority of casualties in outside areas occurred on A roads. Table 6 shows all casualties by road type. Table 7 shows KSI casualties by road type.

Table 6: All casualties by km by road type and status, 1986-2006

Road Type		20 mph zone Before	20 mph zone After	Adjacent area Before	Adjacent area After	Outside
Motorways	Casualties/ Km	0.00	0.00	3.08	5.56	3.69
	%	0.00%	0.00%	0.02%	0.15%	1.56%
A Roads	Casualties / Km	11.90	5.69	16.35	12.69	10.52
	%	7.03%	9.00%	76.79%	74.11%	59.35%
B Roads	Casualties / Km	7.43	1.87	9.73	6.77	6.48
	%	12.13%	8.22%	8.51%	8.13%	8.14%
Minor Roads	Casualties / Km	1.17	0.35	1.35	1.16	0.97
	%	79.35%	80.98%	14.39%	17.31%	30.14%
Other Roads	Casualties / Km	0.18	0.06	0.17	0.12	0.12
	%	1.49%	1.79%	0.29%	0.29%	0.81%
All Roads	Casualties / Km	1.27	0.38	5.57	4.08	2.21
	%	100%	100%	100%	100%	100%

Table 7: KSI casualties per km by road type and status, 1986-2006

Road Type		20 mph zone Before	20 mph zone After	Adjacent area before	Adjacent area After	Outside
Motorways	Casualties / Km	0.00	0.00	0.68	1.05	0.47
	%	0.00%	0.00%	0.03%	0.23%	1.31%
A Roads	Casualties / Km	1.84	0.49	2.47	1.60	1.62
	%	6.89%	6.87%	76.21%	73.97%	59.91%
B Roads	Casualties / Km	1.11	0.19	1.53	0.90	1.01
	%	11.45%	7.22%	8.76%	8.61%	8.32%
Minor Roads	Casualties / Km	0.19	0.04	0.21	0.14	0.15
	%	80.12%	84.88%	14.71%	16.86%	29.66%
Other Roads	Casualties / Km	0.03	0.00	0.02	0.02	0.02
	%	1.54%	1.03%	0.28%	0.33%	0.80%
All Roads	Casualties / Km	0.20	0.04	0.85	0.51	0.34
	%	100%	100%	100%	100%	100%

Deprivation and collisions

The majority of roads in 20 mph zones are in the more deprived IMD quintiles (table 4), so it is to be expected that the majority of collisions in 20 mph zones will occur on roads in more deprived quintiles. Looking at the number of collisions per year per km of road, in 20 mph zones, adjacent areas and other roads in London, the collisions per km are highest in the more deprived IMD quintiles (table 8).

Table 8: Collisions per km by deprivation quintile and status, 1986-2006

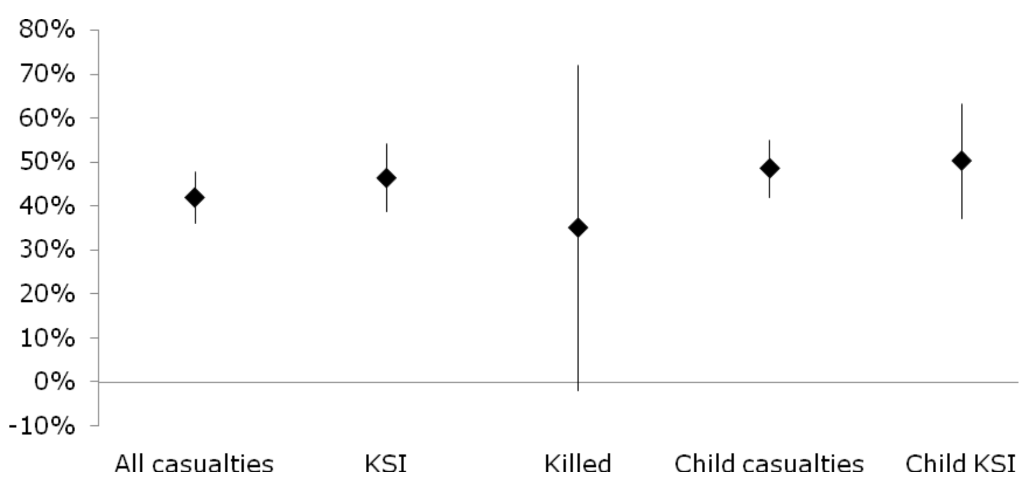
IMD Quintile		20 mph zone		Adjacent area		Outside
		Before	After	Before	After	
Quintile 1	Collisions / km	0.90	0.32	1.84	1.82	1.06
	%	4%	8%	4%	8%	17%
Quintile 2	Collisions / km	0.94	0.38	2.56	2.27	1.89
	%	10%	11%	9%	12%	26%
Quintile 3	Collisions / km	0.86	0.42	3.87	3.11	2.04
	%	15%	15%	16%	19%	24%
Quintile 4	Collisions / km	1.14	0.52	4.97	5.41	2.45
	%	30%	27%	28%	36%	20%
Quintile 5	Collisions / km	1.17	0.64	6.37	3.76	2.75
	%	41%	39%	44%	26%	14%
Total	Collisions / km	1.07	0.50	4.54	3.45	1.83
	%	100%	100%	100%	100%	100%

3.3 What is the effect of 20 mph zones on casualties and collisions?

In the figures shown below, each black diamond represents the point estimate of the percentage ***reduction*** in casualties following 20 mph zone implementation. The vertical lines through each diamond show the 95% confidence interval (CI) for the percentage reduction based on statistical 'jackknife' procedures, which allow for the clustering of effects by borough. For example, there was an estimated 42% reduction in all casualties (figure 15a) following implementation of 20 mph zones, and we can be confident that the true reduction was somewhere between 36% and 48% (the 95% CI). Negative estimates of reductions in casualties represent a relative *increase* in casualties. The models used to derive these estimates allow for the (generally) downward trend over time in the annual number of casualties in London. The models assume that the background trend in casualties declines at a constant rate. Full results of the models can be found in Appendix C (table C1).

Figure 15 presents the percentage reductions in casualties on roads inside 20 mph zones after 20 mph zone implementation. Overall, figure 15a suggests that the introduction of the 20 mph zones has led to a reduction in casualties of around 40%.

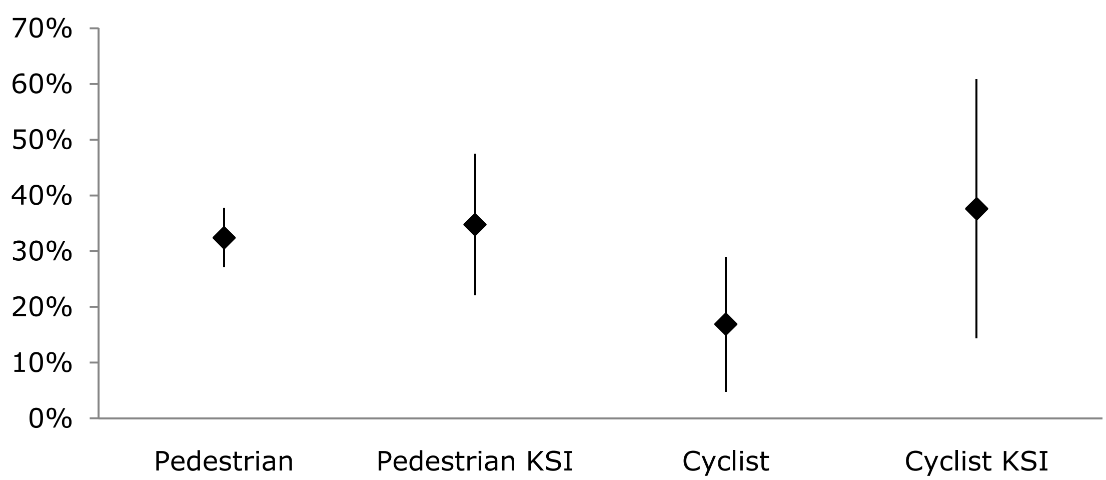
Figure 15a: Percentage reduction in all casualties, KSI casualties, killed casualties, child casualties, child KSI casualties, in 20 mph zones, 1986-2006



The figure suggests that overall casualties reduced by 42% (95% CI 36%, 48%), with slightly larger estimated reductions in all child (0-15 years) casualties of 49% (95% CI 42%, 55%), and in the KSI casualties of 46% (95% CI 39%, 54%). Child KSI casualties were reduced by 50% (95% CI 37%, 63%). The point estimate of the overall number of people killed was slightly smaller at 36% but confidence intervals for this estimate were wide (95% CI -0.3%, 72%).

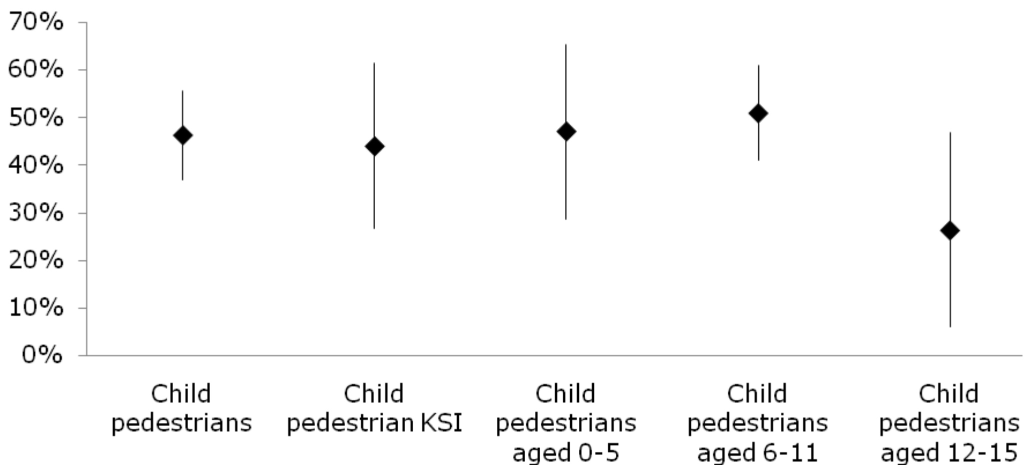
Pedestrian casualties as a whole were reduced by 32% (95% CI 27%, 38%), pedestrian KSI were reduced by 35% (95% CI 22%, 47%). Reduction in cycling casualties was more modest, 17% (95% CI 5%, 29%). Cyclist KSI casualties were reduced by 38% (95% CI 14%, 61%) (figure 15b).

Figure 15b: Percentage reduction in pedestrian casualties, pedestrian KSI casualties, cyclist casualties, cyclist KSI casualties, in 20 mph zones, 1986-2006



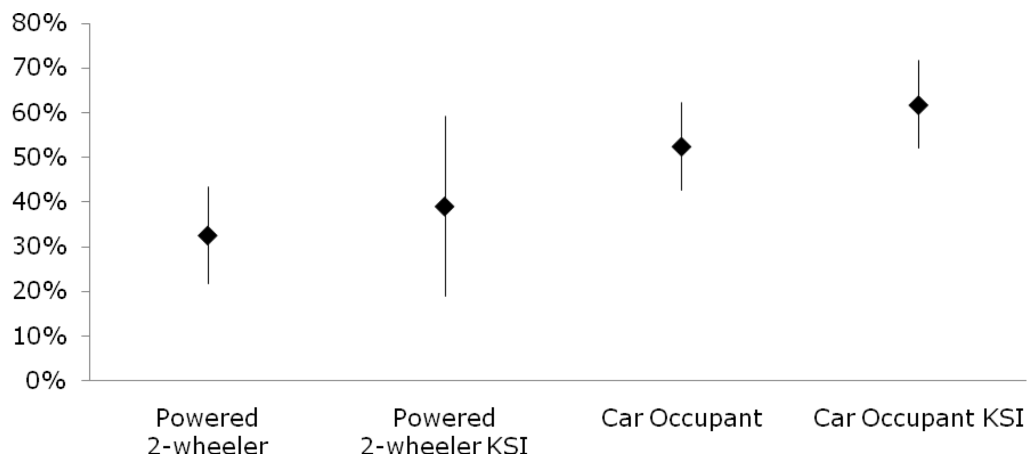
Child pedestrian casualties in 20 mph zones declined by 46% (95% CI 37%, 56%) after implementation with similar estimates for child pedestrian KSI casualties. Point estimates were larger for the youngest children (0-5 and 6-11 years) (figure 15c). Casualties declined by 47% for 0-5 year olds (95% CI 29%, 65%) and by 51% for 6-11 year olds (95% CI 41%, 61%). Casualties for 12-15 years olds declined by 26% (95% CI 6%, 47%).

Figure 15c: Percentage reduction in child pedestrian casualties, child pedestrian KSI casualties, and child pedestrian casualties by age group, in 20 mph zones, 1986-2006



Casualties involving riders of powered two-wheeled vehicles declined by 33% (95% CI 19%, 59%), and those of car occupants fell by 53% (95% CI 43%, 63%). In both cases, the estimates for the effect on KSI casualties was slightly greater than for casualties overall (figure 15d). Powered two-wheeler KSI casualties reduced by 39% (95% CI 19%, 59%) and car occupant KSI by 62% (95% CI 52%, 72%).

Figure 15d: Percentage reduction on powered 2-wheeler casualties, powered 2-wheeler KSI casualties, car occupant casualties, car occupant KSI casualties, in 20 mph zones, 1986-2006



The number of *collisions* (figure 15e) showed a broadly similar reduction (37%, 95% CI 31%, 43%) to that observed with casualties both overall and for particular user groups.

Figure 15e: The percentage reduction in all collisions, KSI collisions, collisions involving at least one pedestrian, cyclist, and powered 2-wheeler, in 20 mph zones, 1986-2006

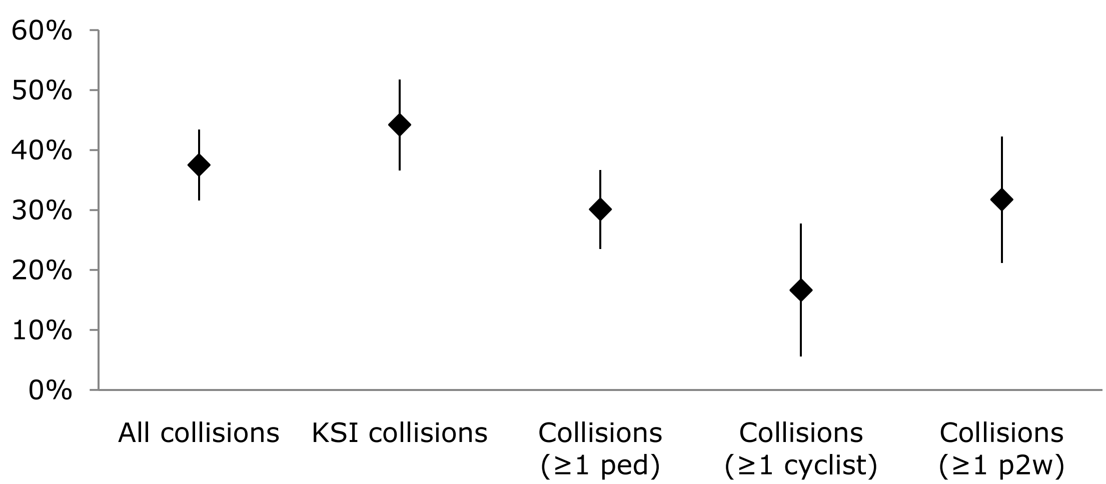
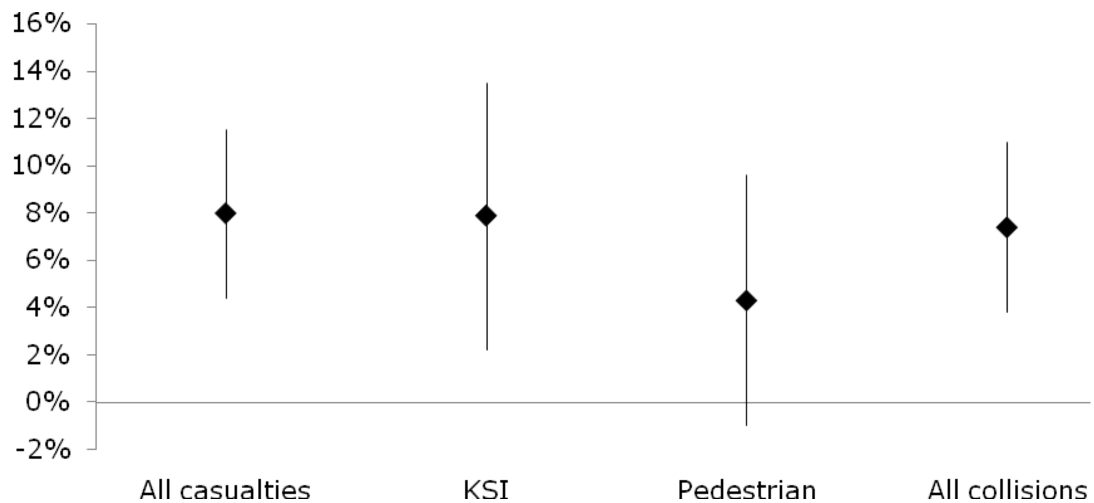


Figure 16 shows the percentage reductions in casualties in adjacent areas after 20 mph zone implementation for key outcomes. Results for all outcomes can be found in Appendix C (table C1). Results show that some reduction in casualties and collisions was also seen in the areas adjacent to 20 mph zones, with generally single percentage reductions in risk. This suggests that casualties inside 20 mph zones are not being displaced to nearby roads.

Figure 16: Percentage reduction in casualties in adjacent areas



There was also a general downward trend in casualties and collisions on all roads in London (including road segments other than those in 20 mph zones and adjacent areas). The annual decline in all casualties was 1.7%, equivalent to a 15.8% reduction over ten years, or 29.0% reduction over twenty years.

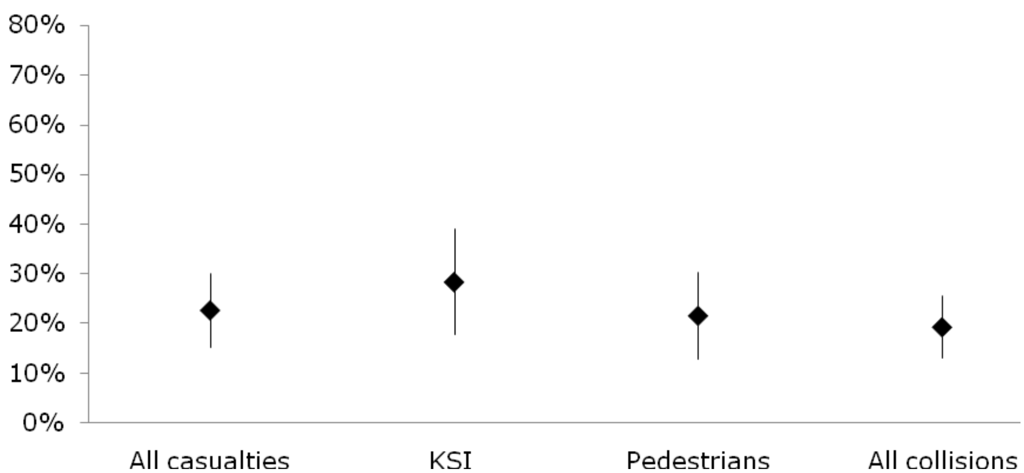
One of the concerns with assessing the effect of 20 mph zones is the issue of 'regression to the mean'. This is the name given to the fact that high rates of casualties in one period will, *on average*, be followed by lower rates in subsequent years if there is no change in underlying risk. This means that if 20 mph zones are put in place *because* casualties are observed to be high, there is anyway a natural statistical tendency for casualties in subsequent years to be lower. To address this, we repeated models of the effect of 20 mph zones removing data for 3, 4 and 5 years before the introduction of the zones. The results for the three main categories of casualty outcomes (Appendix C table C3) suggest that regression to the mean is *not* the explanation for the observed 20 mph zone effects; in each case, the point estimates were larger than in the corresponding models based on data for all years.

3.4 Have the effects of 20 mph zones changed over time?

The analyses in section 3.3 covered a 20 year time period. To explore whether the effects of 20 mph zones have changed over time, we repeated the analyses restricting the data to the years 2000-2006.

Results from the 2000-2006 time period showed generally smaller percentage reductions than results from the entire 1987-2006 period. However, results on 20 mph zones from 2000-2006 still show a substantial reduction in casualties and collisions after implementation, a 22% reduction in all casualties (95% CI 15%, 30%), (figure 17). Full results can be found in Appendix C (table C2).

Figure 17: Percentage reduction in casualties in 20 mph zones (2000-2006)



3.5 Are the effects of 20 mph zones modified by other factors?

The model was extended to assess evidence for whether the effects of 20 mph zones are modified by other factors. Full results can be found in Appendix C (table C4). Each model shows the relative effects on casualties and collisions of zones in:

- Inner vs. Outer London
- Less residential vs. More residential areas
- Less deprived vs. More deprived areas
- Small 20 mph zones vs. Large 20 mph zones
- Surrounded 20 mph zones vs. Isolated 20 mph zones

Road segments were categorised as being 'more residential' if the SOAs in which they were located contained fewer than 10% business postcodes. Road segments were classified as 'more deprived' if the SOA in which they were located had an IMD score higher than 21.90 (the median IMD score in London). 20 mph zones were classified as 'large' if the number of kilometres in the 20 mph zone exceeded 3.6 km (the median size of 20 mph zones in London). 20 mph zones were classified as 'isolated' if less than 28% of roads in the 500 meters surrounding the 20 mph zone boundaries were in a 20 mph zone.

Figures 18-22 show the point estimates and 95% confidence intervals of the estimated percentage reduction in casualties following implementation of 20 mph zones.
The full results of these models that estimate differential effects of 20 mph zones on casualties and collisions are presented in Appendix C Table 4.

Inner vs. Outer London

There was some suggestion from the point estimates that the percentage reduction in casualties was greater in outer London compared to inner London. However, a formal statistical test (not shown) provided no evidence that the effect of 20 mph zones differed between inner and outer London for all casualties (p=0.167) or KSI casualties (p=0.270) (figure 18).

Figure 18: Percentage reductions in casualties in 20 mph zones in inner and outer London

Figure 18a: All casualties

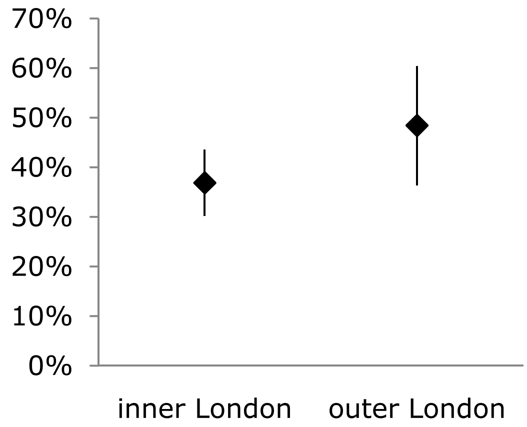
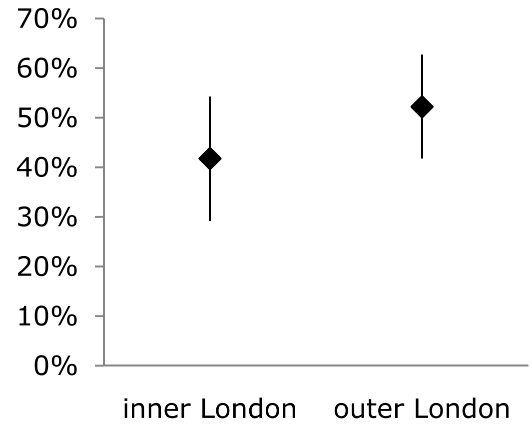


Figure 18b: KSI casualties



Less residential vs. More residential areas

There was no evidence that the effect of 20 mph zones on casualties and KSI casualties differed in less residential and more residential areas (figure 19).

Figure 19: Percentage reductions in casualties in 20 mph zones in less residential and more residential areas

Figure 19a: All casualties

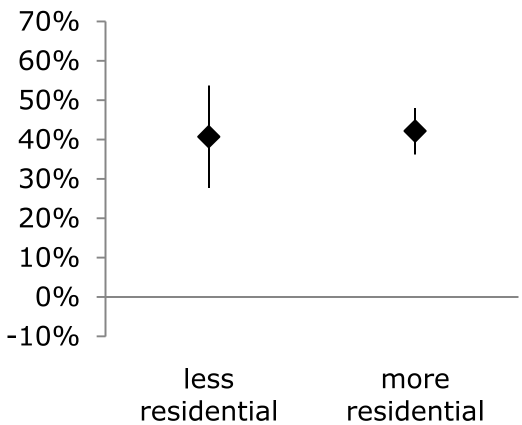
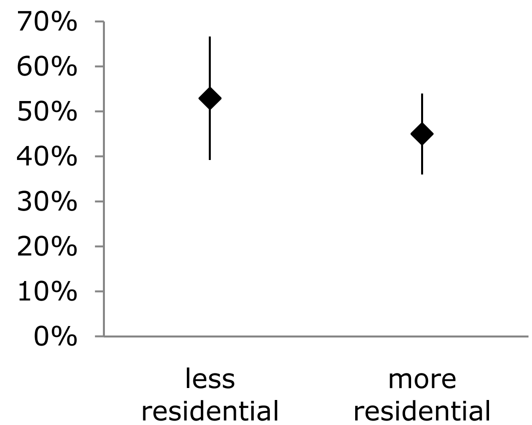


Figure 19b: KSI casualties



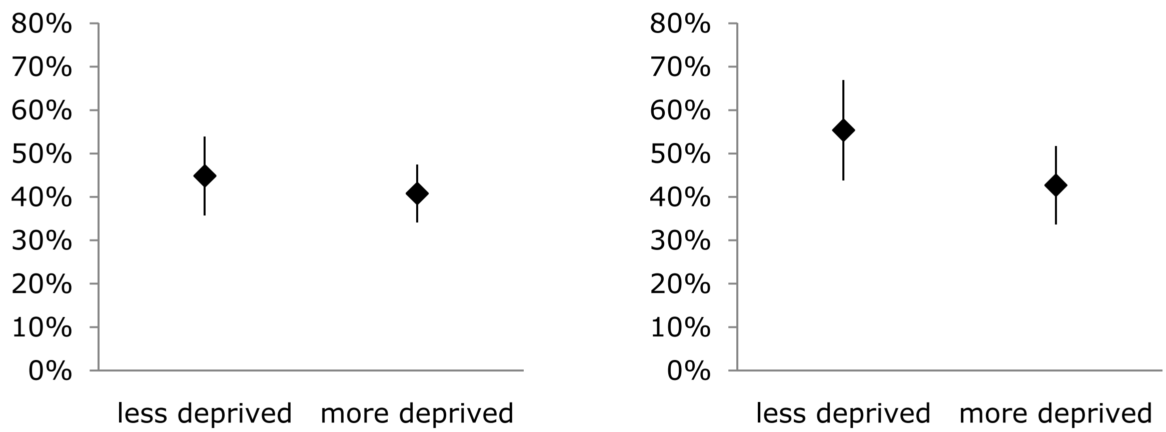
More deprived vs. Least deprived areas

The was no evidence that the effect of 20 mph zones on all casualties differed in less deprived compared areas to more deprived areas. The point estimates suggested the effect of 20 mph on KSI casualties was lower in more deprived areas. A formal statistical test provided some evidence that the effect of 20 mph zones on KSI casualties differed by area deprivation (p=0.046) (figure 20).

A more detailed analysis of differential effects of zones on socio-economic and ethnic inequalities can be found in the companion report, *The Effect of 20 mph Zones on Inequalities in Road Casualties.*

Figure 20: Percentage reductions in casualties in 20 mph zones in less deprived and more deprived areas

Figure 20a: All casualties **Figure 20b: KSI casualties**



Small 20 mph zones vs. Large 20 mph zones

There was some suggestion from the point estimates that the effect of small 20 mph zones on all casualties was greater than the effect of large 20 mph zones on all casualties. The point estimates on KSI casualties suggested that the effect of large zones on KSI casualties was greater than the effect of small zones. Formal statistical tests, however, indicated no evidence of different effects for small and large zones for all casualties (p=0.236) or KSI casualties (p=0.517) (figure 21).

Figure 21: Percentage reductions in casualties in small 20 mph zones and large 20 mph zones

Figure 21a: All casualties

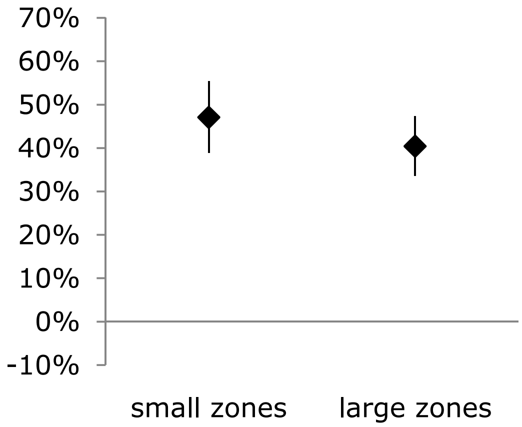
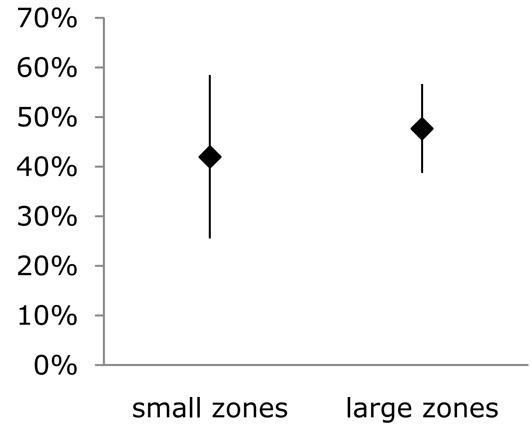


Figure 21b: KSI casualties



Surrounded 20 mph zones vs. Isolated 20 mph zones

Isolated 20 mph zones appeared to have a larger reduction in all casualties compared to surrounded 20 mph zones. A formal statistical test indicated weak evidence (p=0.080) that the effect of 20 mph zones on all casualties differed between surrounded zones and isolated zones. There was no evidence for different effects of surrounded and isolated zones on KSI casualties (figure 22).

Figure 22: Percentage reductions in casualties in surrounded 20 mph zones and isolated 20 mph zones

Figure 22a: All casualties

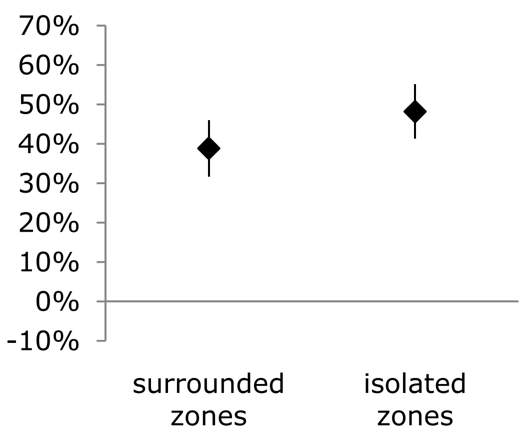
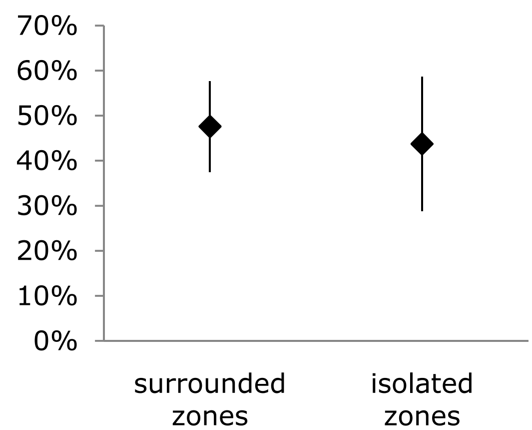


Figure 22b: KSI casualties



4. Further Analyses

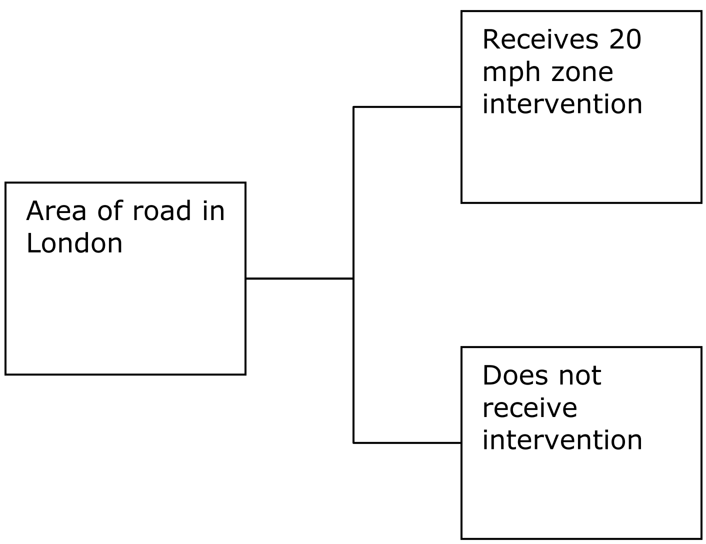
4.1 Are 20 mph zones cost effective?

Introduction

The results from the analyses in section 3.3 show that 20 mph zones are effective in reducing casualties. However, while zones may be effective, they are also more costly than some other potential casualty reduction measures. A comparison of the costs and benefits of 20 mph zones is necessary to inform decisions about efficient use of limited resources. In this section we compare the costs and benefits of implementing 20 mph zones to the costs and benefits of leaving roads untreated.

Methods

Model



The analysis used a simple model comparing intervention and non-intervention areas. Since 20 mph zones are an area-based traffic calming measure our unit of analysis is an area of road. According to the model, areas of road can either receive a 20 mph zone intervention or remain untreated. The model assumes that no other interventions (e.g. speed cameras) are implemented on untreated roads. Using time horizons of five and ten years we investigated the costs and benefits of implementing a 20 mph zone in an area of road and the costs and benefits of no treatment.

We examined all roads within areas covered by 20 mph zones implemented in or after financial year 2000. The results from section 3.3 indicate that the 20 mph zones have a larger effect on reducing KSI casualties in zones (compared to total casualties). Therefore, we examined the effects of 20 mph zones on casualties and the benefits of preventing casualties by severity.

Boundaries of the model

It is not possible to estimate all the costs and consequences of 20 mph zones in London. This evaluation focuses on one outcome, value of casualties saved, and only considers 20 mph zone building costs and consultation costs. It does not include staff time or maintenance costs.

High and Low Casualty areas

Casualty reduction is only one of many reasons local authorities choose to implement 20 mph zones. Therefore, we split our target areas of roads into three groups based on the average number of casualties of all severities per kilometre of road in the three years prior to 20 mph zone implementation. The 'no casualty' group had no casualties in the three years before zone construction; the 'low casualty' group had an average of less than 1 casualty per kilometre of road per year in the three years before zone construction; and the 'high casualty' group had an average of 1 or more casualties per kilometre of road per year in the three years prior to zone construction. We assumed that zones implemented in our target areas of roads with no casualties were implemented for reasons other than casualty reduction (safer routes to schools, neighbourhood coherence, etc.). Analysis was performed on low casualty and high casualty groups.

Table 9: Casualties per km in high and low casualty 20 mph zones

Casualty group	Severity	Casualties per kilometre	Number of zones	length of road in zones (km)
Low casualty group	Fatal	0.002	169	922
	Serious	0.075	169	922
	Slight	0.547	169	922
	Total	0.624	169	922
High casualty group	Fatal	0.010	145	844
	Serious	0.205	145	844
	Slight	1.443	145	844
	Total	1.658	145	844

Effects of 20 mph zones on casualties

To calculate the effects of 20 mph zones on casualties we ran regression models using data from financial year 2000 onwards for fatal, serious, and slight casualties on our dataset of all road segments in London including independent variables for 20 mph zone status and a linear time trend.

Table 10: Percentage reduction in casualties in 20 mph zones

Severity	Percentage reduction in casualties in 20 mph zones (95% CI)	Average annual percentage reduction in casualties (95% CI)
Fatal	56.5% (17.2% to 95.8%)	4.3% (1.5% to 7.0%)
Serious	26.2% (14.4% to 38.1%)	7.9% (7.2% to 8.6%)
Slight	21.7% (13.7% to 29.6%)	6.2% (5.6% to 6.7%)

In the first year of the model, casualties in areas of road that receive the 20 mph zone intervention decline by the percentage reduction attributable to 20 mph zones plus the annual reduction in casualties experienced on all roads in London (the background trend). In subsequent years, casualties in treatment areas decline according to the background trend only. Casualties in areas of roads that do not receive an intervention decline according to the background trend each year.

Costs

Of the 399 20 mph zones in London, cost estimates were available for 187 zones (47%). Cost estimates include the costs associated with 20 mph zone consultations. In this analysis we included cost estimates of zones completed in or after financial year 2002-03 because 1) there was complete data for a larger percentage of those; and 2) more recent zones would better reflect the contemporary cost of putting in a new zone.

In total, 276 20 mph zones were completed in or after the financial year 2002-03 and 159 (58%) of those had cost estimates. We excluded zones that were associated with a home zone (5) and zones which already had substantial traffic calming measures but needed work to meet 20 mph zone standards (10).

All cost data was adjusted for inflation using the Consumer Price Index (CPU) and are reported in 2005 £s. We calculated the cost per kilometre of road for each 20 mph zone as follows:
Mean: £59,334.16 per kilometre, SD: £72,985.81

Benefits
The Department for Transport (2007a) has estimated the average value of prevention per casualty saved (table 11). The DfT included lost output, human costs and medical and ambulance costs in their valuation. Values are reported in 2005 £'s.

Table 11: Estimated average value of prevention per casualty saved

Casualty severity	Value (£)
Fatal	1,428,180
Serious	160,480
Slight	12,370

Discounting is a way to compensate for the timing of outcomes (which occur over a long time horizon) allowing for comparisons in terms of a net present value. The value of casualties saved was discounted at a rate of 3.5% as recommended by NICE guidelines.

Uncertainty
The parameters used in the model are subject to uncertainty. In order to quantify uncertainty in the results associated with model parameters we conducted a probabilistic sensitivity analysis, running 10,000 simulations with parameter estimates randomly sampled from specified distributions. Based on recommendations from the literature (Fox-Rushby and Cairns 2005) the analysis employed the gamma distribution for costs, the beta distribution for the effect of 20 mph zones, and the normal distribution for the time trend.

Results from the model are presented in terms of Net Present Values using five and ten year time horizons, which indicate the sum of the costs and benefits of the zones after discounting. Positive Net Present values suggest societal benefits are greater than the costs.

Results

Five years after zones were implemented on roads in low casualty areas, they had prevented casualties worth £23,344 per kilometre. The net present value of introducing 20 mph zones in low casualty areas was -£36,117 per kilometre, meaning the cost of implementing the zone was greater than the value of casualties prevented. Our simulations suggested that after 5 years, 41% of zones implemented in low casualty areas had positive net present values (table 12).

Taking a time horizon of ten years, 20 mph zones provided benefits in terms of casualty reductions worth an average of £37,278. While the net present value was -£22,183, suggesting that on average costs of implementation was still greater than the average value of prevented casualties, our simulations suggest that benefits outweighed costs in 53% of zones implemented in low casualty areas, (table 12).

Table 12: Benefit per km, net present value and percentage of 20 mph that are cost effective in low casualty group

Time horizon	Benefit per km of road (£) (SD)	Net Present Value (£) (90% credible limits)	Percent of zones with positive Net Present Value*
5 year after implementation	23,344 (3,668)	-36,117 (-128,225-20,862)	41%
10 years after implementation	37,278 (5,905)	-22,183 (-114,292-35,289)	53%

*societal benefits outweigh costs

Taking a time horizon of 5 years in the high casualty areas, the value of prevented casualties was £78,940 per kilometre, which is £18,947 more than the average cost of implementation. Our simulations suggested that benefits outweighed costs in 74% of 20 mph zones implemented in high casualty areas after 5 years (table 13).

After ten years, the average value of prevented casualties of 20 mph zones implemented in high casualty areas was £127,299, which is £67,306 more than the average cost of implementation. Our simulations suggested that benefits outweighed costs in 85% of zones implemented in high casualty areas after 10 years (table 13).

Table 13: Benefit per km, net present value and percentage of 20 mph that are cost effective in high casualty group

Time horizon	Benefit per km of road (£) (SD)	Net Present Value (£) (90% credible limits)	Percent of zones with positive Net Present Value*
5 year after implementation	78,940 (14,660)	18,947 (-75,252-82,021)	74%
10 years after implementation	127,299 (24,232)	67,306 (-29,157-137,890)	85%

*societal benefits outweigh costs

The results suggest that implementing 20 mph zones in high casualty areas is a cost effective way to reduce road injury, however, costs of implementation outweigh benefits in low casualty areas. We calculated that, on average, after 10 years, the benefits of implementing a 20 mph zone will outweigh the costs in areas of road with a casualty frequency greater than 0.7 casualties per kilometre.

Limitations

The above analysis has some limitations. Our cost data are imperfect. Estimates of costs were missing for 42% of zones and while we attempted to eliminate zones with unusual cost circumstances, it is likely that some remain in our analysis. Therefore, local authorities considering implementing a 20 mph zone may find results on benefits per kilometre of road more useful.

As noted in the literature review, there are additional benefits of 20 mph zones beyond casualty reductions which were not considered here. While the sensitivity analysis was able to present the implications of parameter uncertainty, it was unable to deal with variability among subgroups. Subgroups of areas (for example those in residential or commercial areas, or areas of different deprivation types, inner vs outer London) may have different costs or effects on casualties.

Conclusion

The results indicate that 20 mph zones may be a cost effective way of reducing casualties in London in areas with more than 0.7 casualties per kilometre. In terms of casualty reduction, implementing zones in low casualty areas is likely to cost more than the value of prevented casualties. Economic evaluations like the one presented above provide a useful framework to assess interventions, particularly when resources are limited. However, the results of the 20 mph zone cost-effectiveness analysis cannot provide information useful for assessing the fairness, non-casualty benefits, or feasibility of implementing 20 mph zones in areas of London.

4.2 What would happen if 20 mph zones were introduced in all appropriate areas across London?

Introduction

The findings from section 3.3 have suggested that 20 mph zones are effective in reducing casualties, although results from section 3.4 indicate that the effectiveness of 20 mph zones may have decreased in more recent years. We explored what would happen to the number of casualties in London if 20 mph zones were implemented in all areas appropriate for the intervention.

Methods

This analysis applied point estimates of the effect of 20 mph zones from time series regression models (2000-2006) in section 3.4 to the number of casualties that occurred in financial year 2005/2006 on roads that may be appropriate for a 20 mph zone intervention. We defined appropriate roads in two ways: 1- using individual roads and 2- grouping minor roads within SOAs together.

Scenario 1- Individual roads

The 20 mph zone intervention was deemed appropriate for an individual road if the road met the following criteria:

- The road was a minor road;
- The road was in a residential area;
- The road was not already part of a 20 mph zone.

Scenario 2- Groups of roads within SOAs

When choosing the location for future 20 mph zones, local authorities are able to analyse the patterns of casualties in a detailed way that is not possible in a London-wide study. In this part of the analysis we used SOA boundaries to define areas and considered the impact of implementing 20 mph zones on all minor roads in an SOA. The intervention was deemed appropriate for an SOA if:

- The SOA did not already contain part of a 20 mph zone;
- The SOA was classified as residential;
- The intervention would be cost effective. Section 4.1 identified that the benefits of a 20 mph zones would outweigh the costs over a 10 year time horizon, if an area experienced greater than 0.7 casualties per kilometre of road. We calculated the

average number of casualties occurring on minor roads within an SOA from 2004-2006 and selected SOAs where the average number of casualties per year per kilometre was greater than 0.7.

Results

Scenario 1- Individual roads

13,183 kilometres of road in London met our criteria. There were 5,237 casualties on those roads in the financial year of 2005/06. Table 14 shows the number of casualties on London's roads by eligibility status and user mode.

Table 14: Number of casualties by eligibility status, 2006

Outcome	Total number of casualties 2006	Casualties on non-suitable roads	Casualties on roads already in 20 mph zones*	Casualties on eligible roads
All Casualties	31,202	24,847	1,118	5,237
KSI Casualties	3,978	3,231	111	636
Pedestrians	5,938	4,717	287	934
Cyclist	2,929	2,322	163	444
Powered 2 Wheelers	4,989	4,538	151	300
Car	14,402	10,403	459	3,540

*including 20 mph zones under construction

Applying the estimates from Appendix table C2 to the number of casualties on eligible roads listed in table 14, our model predicts that 1,118 casualties would be prevented by implementing new 20 mph zones on all eligible minor roads in London (table 15). There would be casualty reductions for all user groups except cyclists.

Table 15: Predicted casualty reductions from expansion 20 mph zones to all minor residential roads in London

Casualty type	Number of casualties in 2006	Percentage reduction (95% CI)	Reduction in casualties (95% CI)
All Casualties	5,237	23% (15% to 30%)	1,188 (801 to 1576)
KSI casualties	636	28% (18% to 39%)	181 (113 to 248)
Pedestrians	934	22% (13% to 30%)	202 (120 to 283)
Cyclist	444	-1% (-22% to 20%)	-6 (-99 to 87)
Powered 2 Wheelers	3,540	23% (9% to 37%)	821 (332 to 1313)
Car occupants	300	29% (14% to 44%)	86 (41 to 131)

Scenario 2- Groups of roads within SOAs

880 out of 4,765 SOAs in London met our criteria (table 16). The 880 SOAs eligible for the analysis contain 2,564 kilometres of minor roads.

Table 16: SOA eligibility for 20 mph zones

Eligibility Status		Number of SOAs
Total		4,765
	SOA already contains part of a 20 mph zone	1,464
Ineligible	SOA is not residential area	372
	Less than 0.7 casualties per km	2,049
Eligible		880

We estimate that implementing 20 mph zones in appropriate areas would prevent 692 casualties the following year, including 100 KSI casualties (table 17).

Table 17: Percentage reduction in casualties, 20 mph zone expansion to eligible SOAs

Casualty type	Number of casualties in 2006	Percentage reduction (95% CI)	Reduction in casualties (95% CI)
All Casualties	3,047	23% (15% to 30%)	692 (466 to 917)
KSI casualty	353	28% (18% to 39%)	100 (63 to 138)
Pedestrian	529	22% (13% to 30%)	114 (68 to 161)
Cyclist	257	-1% (-22% to 20%)	-3 (-57 to 51)
Power - 2 Wheelers	365	23% (9% to 37%)	85 (34 to 135)
Car occupants	1,686	29% (14% to 44%)	486 (231 to 740)

Limitations

The above analysis has some limitations. The model does not assess changes in casualties on what would become adjacent roads. Although the models presented in section 3.4 estimate a casualty *reduction* for most outcomes on adjacent roads, the uncertainties and fact that many adjacent roads are A roads, make it unrealistic to include these estimates in the model.

We also cannot predict whether the effects of 20 mph zones on casualties would change substantially if large areas of London became 20 mph zones. Findings from section 3.5 indicated that isolated 20 mph zones have greater casualty reduction effects compared to surrounded 20 mph zones. This suggests that the predicted casualty reductions from the scenarios may be overestimated.

Conclusion

We predict that expanding 20 mph zones to appropriate areas in London would result in substantial casualty reduction benefits. Scenarios such as this are one tool to illustrate possible benefits, and inform planning, but clearly cannot provide a comprehensive assessment of all costs and benefits. To improve the results from predictive models, fuller studies are needed which can take into account other factors such as the effects of other road safety interventions, future background declines in casualties and the differential effects of converting whole areas into 20 mph zones instead of small distinct areas. However, the vast majority of casualties take place on roads that are unsuitable for a 20 mph zone intervention. So any strategy based on 20 mph zones alone would have limited effect on casualty reduction in London as a whole.

4.3 Can we use a before and after analysis to monitor the relationship between 20 mph zones and casualties?

Introduction

Traditionally, the casualty reduction effects of 20 mph zones have been estimated using a before and after methodology (Mackie 1996; Webster & Layfield, 2007). While we feel that time series regression analysis is the most robust method to investigate the relationship between 20 mph zones and casualties, it is a relatively lengthy and computationally intensive process. We investigated whether a simple before and after analysis would provide similar results to the time series regression results reported in section 3.3.

Methods

In the before and after analysis we compared the number of casualties per year 3 years before the 20 mph zone was built to the number of casualties per year 3 years after implementation of the zone. The analysis was restricted to the 152 20 mph zones implemented between 1991 and 2003, to ensure that 3 years of casualty data after 20 mph zone implementation was available (table 18).

Table 18: Number of 20 mph zones included in before and after analysis

Included 20 mph zones	Number of 20 mph zones
Total number of 20 mph zones	399
20 mph zones with unknown implementation dates	14
20 mph zones with at least 3 years of casualty data after implementation	152

Estimates were then adjusted to take into account background changes in casualties on outside roads. We calculated trends on outside roads using only B roads and unclassified roads that have never been inside, nor adjacent to a 20 mph zone in two ways.

- Method 1: We calculated a different trend (percentage change in casualties) for each year using the total number of casualties on outside roads in the 3 previous years compared to the number of casualties in the 3 subsequent years. For example, to calculate the trend on outside roads in 1999, we calculated the percentage change in the number of casualties that occurred on outside roads between 1996 and 1998 compared to the number of casualties that occurred between 2000 and 2002. Background changes were calculated separately for each outcome.

- Method 2: We calculated the percentage change in number of casualties that occurred on outside roads between April 1989 and March 1995 compared to the number of casualties that occurred between April 1996 and March 2002. This method is similar to the method used to calculate background trends in other research (Webster & Layfield, 2007).

Results

Background trends

Table 19 shows the estimates of background trends (percentage reduction in casualties on outside roads) for key outcomes using the two methods. Negative reductions represent an *increase* in casualties on outside roads.

Table 19: Percentage reduction in casualties on outside roads 1990-2003

Year	Total Casualties		KSI Casualties		Pedestrian Casualties		Total Collisions	
	Method 1	Method 2	Method 1	Method 2	Method 1	Method 2	Method 1	Method 2
1990/91	10.0	7.0	22.2	13.9	12.8	18.3	10.0	8.2
1991/92	11.4	7.0	27.8	13.9	17.5	18.3	11.7	8.2
1992/93	9.6	7.0	26.5	13.9	17.2	18.3	10.1	8.2
1993/94	5.5	7.0	17.9	13.9	13.5	18.3	5.5	8.2
1994/95	1.0	7.0	1.5	13.9	8.3	18.3	1.0	8.2
19995/6	-1.4	7.0	-12.0	13.9	4.5	18.3	-1.3	8.2
1996/97	-0.8	7.0	-5.9	13.9	4.7	18.3	-0.2	8.2
1997/98	0.5	7.0	5.1	13.9	6.3	18.3	2.1	8.2
1998/99	5.8	7.0	19.4	13.9	12.7	18.3	7.9	8.2
1999/00	10.3	7.0	20.5	13.9	16.2	18.3	12.3	8.2
2000/01	15.9	7.0	20.2	13.9	19.5	18.3	16.9	8.2
2001/02	19.5	7.0	24.1	13.9	21.4	18.3	19.2	8.2
2002/03	21.8	7.0	26.1	13.9	22.0	18.3	20.6	8.2

Casualty reductions inside 20 mph zones

Table 20 shows the number of casualties in the before and after periods by year. It shows that the difference between the number of casualties in the before and after periods for all casualties has been declining over time.

Table 20: Unadjusted percentage reduction in all casualties in 20 mph zones by year.

Year	Number of new 20 mph zones	Casualties in 20 mph zones: before period	Casualties in 20 mph zones: after period	Percentage difference between before & after period
1990/91	1	6	0	100.0
1992/93	1	34	12	64.7
1994/95	7	105	33	68.6
1995/96	3	37	21	43.2
1996/97	4	35	22	37.1
1997/98	7	60	39	35.0
1998/99	11	149	114	23.5
1999/00	10	166	108	34.9
2000/01	24	356	226	36.5
2001/02	41	479	297	38.0
2002/03	43	676	377	44.2

To calculate the percentage reduction in casualties that can be attributed to 20 mph zones the background trend (table 19) must be subtracted from the overall unadjusted percentage reduction in casualties in 20 mph zones (table 20). Table 21 shows the percentage reduction in all casualties after adjusting for background trend using both methods. The table shows clear differences in the results. Table 22 shows percentage casualty reductions in 20 mph zones by outcome measure over the 1991-2003 period using the two methods of calculating the background trend. We used a chi-squared test to determine whether the effect of 20 mph zones on casualties was statistically different from zero. The results using the two methods of calculating background trends differ for many of the outcomes. The largest difference in results calculated using method 1 compared to method 2 is among powered-2-wheelers (18.4%), and the smallest difference is among pedestrian casualties (0.2%, table 22).

Table 21: Percentage reduction in all casualties in 20 mph zones, after adjusting for background trends, by year.

Year	Percentage difference between before & after period	Using trend from method 1: Percentage reduction in casualties on outside roads	Using trend from method 1: Percentage reduction due to 20 mph zones	Using trend from method 2: Percentage reduction in casualties on outside roads	Using trend from method 2: Percentage reduction due to 20 mph zones
1990/91	100.0	10.0	90.0	7.0	93.0
1992/93	64.7	9.6	54.7	7.0	57.7
1994/95	68.6	1.0	67.6	7.0	61.6
1995/96	43.2	-1.4	44.2	7.0	36.2
1996/97	37.1	-0.8	38.1	7.0	30.1
1997/98	35.0	0.5	35.0	7.0	28.0
1998/99	23.5	5.8	17.5	7.0	16.5
1999/00	34.9	10.3	24.9	7.0	27.9
2000/01	36.5	15.9	20.5	7.0	29.5
2001/02	38.0	19.5	19.0	7.0	31.0
2002/03	44.2	21.8	22.2	7.0	37.2

Table 22: Percentage reduction in casualties in 20 mph zones, after adjusting for background trends.

Outcome	Unadjusted percentage reduction	Adjusted percentage reduction Method 1	Adjusted percentage reduction Method 2
Total casualties	40.6 *	25.1 *	33.7 *
KSI casualties	44.1 *	23.5 *	30.2 *
Pedestrian casualties	35.5 *	17.1 *	17.3 *
Pedestrian KSI casualties	40.2 *	19.4 $^{+}$	10.3
Pedal cycle casualties	26.6 *	4.8	16.5 ^{1}
Pedal cycle KSI casualties	48.6 ^{1}	26.2	35.1
Powered 2-wheeler casualties	28.7 *	19.1 ^{1}	37.5 *
Powered 2-wheeler KSI casualties	42.2 ^{1}	42.2 ^{1}	36.9 $^{+}$
Car casualties	50.5 *	35.4 *	47.4 *
Car KSI casualties	55.4 *	26.3 $^{+}$	54.9 *
Child casualties	46.6 *	19.7 *	28.4 *
Child KSI casualties	44.0 *	14.1 $^{+}$	21.8 $^{+}$
Child pedestrian casualties	41.3 *	14.1 ^{1}	19.3 *
Child pedestrian KSI casualties	41.1 ^{1}	11.2	9.7
Total collisions	38.2 *	22.4 *	30.0 *
KSI collisions	42.1 *	21.6 *	27.4 *

*$p<0.0001$ $^{1}p<0.001$ $^{+}p<0.05$

Discussion

The results of the before and after analysis are sensitive to the method used to calculate the background trend. Without confidence intervals, it is difficult to assess whether the differences in results are statistically significant, and it is unclear which background trend would be most appropriate to use.

Table 23 compares the results of the before and after analyses with the time series regression estimates from section 3.3, as well as estimates from two other studies of 20 mph zones that used a before and after methodology. Results from our before and after analyses, using both methods of background trend calculation, are noticeably different (mostly smaller) from the time series regression analysis results for most outcomes. They also vary considerably from the results from other studies that used a before and after methodology. We would expect some difference between our before and after analyses and other research as each study covered a different time period and defined the 'before' and 'after' periods differently, however, our before and after analysis found much smaller effects of 20 mph zones compared to previous research. Before and after methodologies may be less appropriate for long time periods.

Table 23: Comparison of reduction in casualties due to 20 mph zones

Outcome	Results from this report			Webster & Mackie (1996)	Webster & Layfield (2007)
	Before and After Method 1	Before and After Method 2	Time series regression		
All casualties	25%	34%	42%	61%	45%
KSI casualties	24%	30%	46%		54%
Child casualties	20%	28%	48%	67%	42%
KSI casualties	14%	22%	50%		45%
Pedestrian casualties	17%	17%	32%	63%	36%
Pedestrian KSI casualties	19%	10%	35%		39%
Pedal cyclist casualties	5%	17%	17%	29%	21%
Pedal cycle KSI casualties	26%	35%	38%		30%
Powered 2-wheeler casualties	19%	38%	32%	73%	58%
Powered 2-wheeler KSI casualties	42%	37%	39%		79%
Time period	1988-06	1988-06	1987-06	1986-96	1986-02
Number of zones	152	152	385	72	78
Area covered	London	London	London	England	London
'Before' period	3 years	3 years	-	Up to 5 years	5 years
'After' period	3 years	3 years	-	At least 1 year	Between 1-5 years

Conclusions

Choosing an appropriate method to calculate background changes in casualties on outside roads is difficult and results appear to be sensitive to the method chosen. Before and after methodologies are likely to be most appropriate when investigating the effect of 20 mph zones over shorter time periods. Considerable care would need to be taken if before and after analyses were to be used over long time periods.

4.4 Do 20 mph zones change the distribution of casualties among local residents and non-local travellers?

Introduction

The results from both the time series regression models and before and after analyses suggest that implementing a 20 mph zone will reduce the number of casualties in an area. However, 20 mph zones have the potential to change the distribution of injuries to local residents and non-local travellers in a number of ways. Residents that live in or near 20 mph zones may be more familiar with the road environment and take less care when travelling. If 20 mph zones have succeeded in reducing rat-running, then roads in 20 mph zones will mainly be used by local residents, decreasing the proportion of injuries occurring to non-local travellers. This analysis examined the distance from home of casualties occurring in 20 mph zones compared to casualties on outside roads.

Methods

From 1999 police have collected information on the postcode of residence of each casualty and vehicle involved in road collisions in the STATS19 data. Using this information, we calculated the distance from site of collision to postcode of residence for each casualty and vehicle with valid postcode of residence information. Since persons living well outside London may be injured while visiting London, distances were top-coded at 100 kilometres.

Results

Table 24 shows that pedestrians, cyclists, powered 2-wheeler riders, and car occupants injured in 20 mph zones tend to be injured closer to home than persons injured outside 20 mph zones.

Table 24: Mean distance by area type (km)

Road user	In 20 mph zones		Outside	
	Mean distance from home	Median distance from home	Mean distance from home	Median distance from home
Pedestrian	3.2	0.4	5.4	0.9
Cyclist	3.7	1.1	3.7	1.5
Powered 2-wheeler	5.8	2.1	7.4	3.3
Car	5.3	1.5	6.3	2.3

We plotted the cumulative distribution of the log of the distance from postcode of residence to site of collision for casualties/collisions occurring within 20 mph zones and outside roads. A roads and motorways were excluded from the analysis.

The results for all casualties (figure 23) and pedestrians (figure 24) further illustrate that casualties occurring in 20 mph zones occur closer to home, compared with casualties on outside roads. Results are similar for cyclists, powered 2-wheeler riders and car occupants.

Vehicle drivers injured in 20 mph zones also tend to be injured closer to home than drivers injured outside zones (figure 25).

Figure 23: Distribution of distance from home to place of collision for all casualties (km)

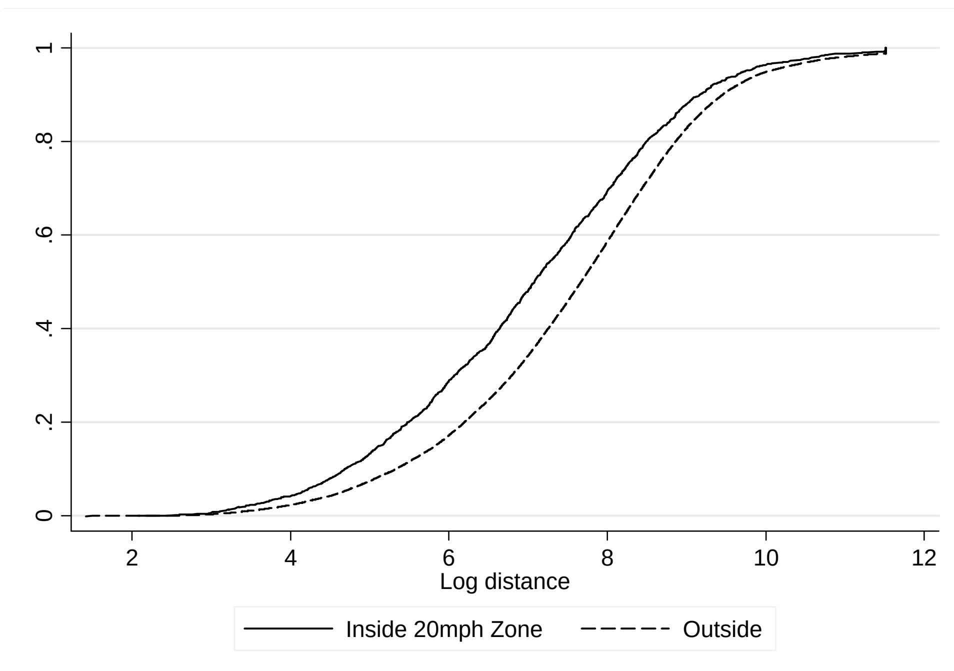
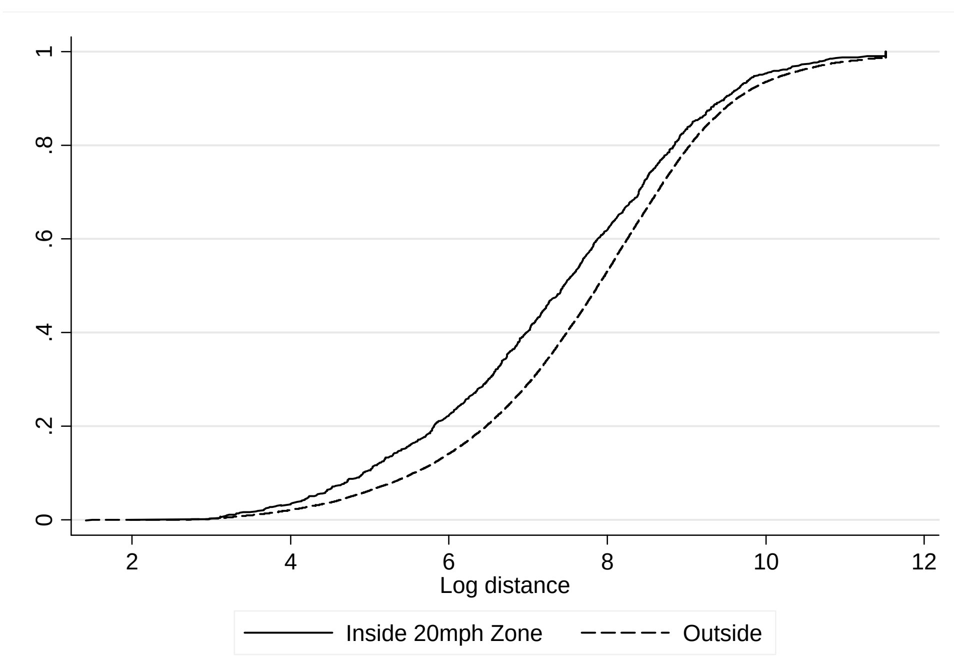


Figure 24: Distribution of distance from home to place of collision for pedestrians (km)

Figure 25: Distribution of distance from home to place of collision for vehicle drivers (km)



Discussion

We have found that across all road user groups, casualties occurring in 20 mph zones occur closer to home. This could suggest that 20 mph zone have been successful in reducing rat running. Pedestrian findings are harder to explain, although, as we found that 20 mph zones decrease pedestrian casualties, it is possible that this represents a greater exposure of pedestrians as they are more likely to be using traffic calmed local streets.

5. Discussion

Since 1991 a total of 399 20 mph zones have been implemented in London, with some boroughs utilising them more extensively than others. A review of the literature suggested that there is good evidence for the effect of traffic calming measures on casualty reduction in general, and a previous study in London, using a before and after study design (Webster and Layfield 2007), had found evidence of large reductions in casualties for all user groups within 20 mph zones. The literature and discussions with stakeholders suggest that casualty reduction is not the only factor that influences decisions around whether to introduce traffic calming schemes, and if doing so, whether these should be 20 mph zones. Other factors include local community and local councillor views, policy aims around increasing pedestrian activity and the need to preserve or change particular streetscapes. However, for most boroughs, casualty reduction is the key rationale for considering and prioritising 20 mph zones, and there is a need for up to date robust evidence on not only the safety gains that have been made, but those predicted for the future. As a greater area of many boroughs is now covered by 20 mph zones, there are concerns about whether previous casualty reductions are likely to continue, whether further implementation is likely to be cost-effective, and (if there is a need to prioritise schemes), where future 20 mph zones are most efficiently sited for safety gain.

Our analyses of the effects of 20 mph zones confirmed that, overall, they have been very effective in reducing collisions and casualties at a greater rate than would be expected from the background declines, and that there is no evidence of significant migration of collisions to adjacent areas.

To take full account of all variables, we carried out a time series regression analysis that enabled us to model reductions in collisions and casualties in 20 mph zones and outside areas, while adjusting for background changes, potential borough level effects, and also to examine a range of differential 20 mph zone effects. Using these models, we found that the effect of 20 mph zones was to reduce all casualties by 42% within the 20 mph zones, compared with roads outside.

There was no good evidence of collision migration to adjacent roads as a result of 20 mph zone implementation. The time series analysis identified an 8% (95% CI 4%, 12%)

decrease in all casualties in roads adjacent to 20 mph zones. Adjacent roads include a higher proportion of A roads, and tend to have higher numbers of collisions per kilometre. These roads may therefore be subject to other remedial measures such as safety (speed) cameras, or other traffic calming measures. If these other road safety interventions are disproportionately located on roads adjacent to 20 mph zones, then our model may have overestimated the effects of 20 mph zones on reducing casualties in adjacent areas.

The analysis found evidence that, over time, the effectiveness of 20 mph zones appears to have decreased. This is perhaps unsurprising, as early 20 mph zones were likely to have been implemented to include roads with high collision histories, with more scope for benefit than those implemented in later years. However, restricting the analysis to 20 mph zones implemented most recently (between 2000 and 2006) still resulted in an estimated 23% reduction in all casualties within 20 mph zones, with reductions identified for all road user groups apart from cyclists. There are still significant gains to be made from implementing new zones. A model of the predicted effect of implementing 20 mph zones to include all minor residential roads in London not currently covered estimated that 1,188 casualties could be prevented in one year.

The analysis showed that the effectiveness of 20 mph zones in reducing collisions and casualties is changing over time. Making exact comparisons with previous studies is difficult without using the same time periods. However Webster & Layfield (2007) reported a 45% reduction in all casualties and 54% in KSIs, compared to the reductions of 42% and 46% reported here (table 24). For all pedestrian casualties Webster & Layfield found a 36% reduction and 39% for pedestrian KSIs, compared to 32% and 35% reported here. Given that this study includes 20 mph zones introduced after the end of their study period, we would expect the results to be slightly lower than those reported by Webster & Layfield.

The costs of building a 20 mph zone are, though, relatively high. Although the cost-effectiveness analysis suggested that they were a cost effective way of preventing casualties in high casualty areas, the financial costs are likely to outweigh the (cost) benefits in low casualty areas. A pre-intervention casualty rate of over 0.7 casualties per km per year is required to make a 20 mph zone cost effective over 10 year period.

The effect of 20 mph zones on casualties seems robust, and there was no evidence of different magnitude of effect in Inner or Outer London, nor for large or small 20 mph zones.

There was some evidence that more isolated 20 mph zones may have larger effects on reducing all casualties than 20 mph zones that are surrounded by other 20 mph zones. There was also weak evidence that 20 mph zones may be less effective in reducing KSI casualties in more deprived areas. Full analysis of differential effects of zones on socio-economic and ethnic inequalities can be found in the companion report, *The Effect of 20 mph Zones on Inequalities in Road Casualties.*

In terms of implications for policy, an analysis focused solely on casualty reductions and cost savings cannot address all factors that need to be taken into account when deciding on whether, or how, to introduce traffic calming measures, or on how to prioritise them. Potential benefits of 20 mph zones such as increased mobility in children, or increased community cohesion have not been included in our analysis, nor have additional costs such as maintenance of 20 mph zone schemes.

Limitations

A limitation of these models is that we cannot include data on risk exposure. The introduction of a 20 mph zone may change the amount and modality of traffic within the 20 mph zone and adjacent areas. If more pedestrians are using 20 mph zones, for instance, compared with outside areas, the declines in casualty rates may be under-estimated. This is a plausible explanation for some of the differential effects of 20 mph zones on different road user groups. It is possible that cycling journeys through 20 mph zones have increased compared with outside areas, given that cycle routes take in such areas, and speed restrictions are an unlikely reason for cyclists to avoid 20 mph zones. Car journeys, however, may have declined, and our estimate of the effect on car occupants may be over-estimated.

There are potentially roads which have ceased to be 20 mph zones, as some traffic calming measures have been removed by boroughs over the time period of this study. As these are relatively rare, they are, however, unlikely to have made a significant effect on the results.

This study was not able to take into account other road safety initiatives such as reduced speed limits and road safety cameras on other roads. While it may have been possible to identify sections of road subject to traffic calming measures, information on date of implementation was unavailable. In our time series regression analyses the introduction of other road safety initiatives will only affect estimated reductions in casualties on roads in adjacent areas. As the time series regression analyses estimate step changes in casualties in adjacent areas at the time of 20 mph zone implementation, only other road safety initiatives implemented at roughly the same time will affect our estimates. However, when 20 mph zones are a part of a larger area based programme of road safety initiatives, including 20 mph zones on minor roads and other traffic calming measures (such as road safety cameras) on A roads implemented at the same time, we will have overestimated the effects of 20 mph zones on casualties in adjacent areas. Particular care must therefore be taken when interpreting the results for adjacent areas.

However, using the most robust methods available, we have confirmed that 20 mph zones have an effect on reducing casualties. We have found no evidence that 20 mph zones increase collisions or casualties in other areas and we have found no evidence that the estimated reductions in casualties and collisions are an artefact from 'regression to the mean'.

6 Conclusions

The main conclusions are:

- On average, between 1991 and 2006, there has been a 1.7% decline in all casualties each year on London's roads.
- Historically, 20 mph zones in London have reduced overall casualties within zones by 42% above this background decline.
- In 20 mph zones there have been reductions for all casualty groups and severities.
- In recent years, the effectiveness of 20 mph zones appears to have decreased, but those implemented between 2000 and 2006 still reduced casualties by 23% compared with areas outside 20 mph zones.
- There was no evidence of significant migration of collisions or casualties to areas adjacent to 20 mph zones.
- For areas with high casualty histories, the benefits of implementing a 20 mph zone are greater than the costs of implementation. However, in areas with low casualty histories, building costs are greater than the value of preventing casualties.

7 Policy implications

1) 20 mph zones are an effective way of reducing casualties and worthwhile gains can be made by implementing further 20 mph zones.

Over the last 15 years, the implementation of 20 mph zones has reduced casualties by around 42% above background changes. Although gains in recent years have been less dramatic, the evidence suggests that further reductions are possible by implementing 20 mph zones in remaining suitable residential areas.

In terms of making the most cost-effective use of resources, prioritisation of future implementation should be those areas with a high casualty history.

However, the implementation of traffic calming measures does not just meet casualty reduction targets. Implementing 20 mph zones is likely to contribute to other important policy goals, such as increasing the amount of cycling and walking in London, and improving perceptions of community safety and 'liveability' that have not been addressed in this study. These other effects of implementation may impact on road safety indicators if, for instance, more road users are cycling and walking, and are thus more at risk. This has two policy implications. First, to take into account the impact of 20 mph zones on road danger, as well as on crude numbers of casualties, will require monitoring other indicators, such as the confidence local residents feel in cycling or walking (as recommended in our previous report, *Deprivation and Road Safety in London*). Second, further research is needed to understand the relationships between exposure and casualty risk.

2) Further research is needed on how traffic calming measures affect behaviour and exposure

The role of exposure (how far different population groups are 'exposed' to the risk of injury) has remained relatively under-researched. Understanding the relationships between road engineering interventions, perceived safety, transport mode choice and exposure to the road environment is essential if we are to improve predictions of the impact of particular interventions on road safety and other transport goals. Further research is needed on other effects of 20 mph zones (including changes in walking and cycling rates). This research should also focus on the potential different effects of 20 mph zones and other measures on different population and road user groups. Our companion report, *The Effect of 20 mph*

Zones on Inequalities in Road Casualties in London, notes the lack of evidence on how implementation might have differential effects on behaviour across population groups.

A challenge in investigating the role of single interventions (such as 20 mph zones) is that of accounting for potential confounders, including contemporaneous interventions (safety/speed cameras; other road engineering measures), and the interactions between interventions and road safety behaviour (such as the potential for increased exposure following traffic calming schemes as residents feel safer). An example is the apparent effect of 20 mph zone implementation on casualties in adjacent areas, where there are likely to have been additional road safety measures not taken into account in this analysis. There is a need to develop robust methodologies for evaluating the implementation of road safety initiatives in ways which account for this complexity. This research is likely to be of benefit to road safety planners nationally, as well as researchers studying other complex policy interventions, and appropriate funding should be sought from national bodies

3) Additional strategies will be needed to make future major gains in road safety

While 20 mph zones are effective in reducing collisions, their overall effect on casualties in London is limited, simply because the majority of collisions occur on A roads which are often inappropriate candidates for 20 mph zone traffic calming. While 20 mph zones should continue to play a part in casualty reduction in London, their role in reducing casualty numbers is likely to decrease with time, with future major gains likely to come from other initiatives that reduce collisions on A roads.

4) Implications for monitoring

The regression models used in this study are the most robust available for evaluating the effect of 20 mph zones over time, but are inappropriate for routine monitoring. The more traditional before and after comparison methods can provide a broad indication of the effect of 20 mph zones but we recommend caution in using them as evidence of effects over long time periods, and suggest as much information as possible is taken in to account on the background trends in casualty numbers.

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Appendix A: 20 mph zone descriptions

Introduction

At the start of our work the London Road Safety Unit (LRSU) at TfL provided a MAPINFO dataset of all 20 mph zones in London, including the 20 mph zone boundaries, implementations dates, and other variables. These data were created by TRL and TfL using information from London boroughs. This section describes the checking and cleaning carried out on the 20 mph zone dataset and provides additional details on the data.

Cleaning the 20 mph zones dataset

There are several potential threats to the reliability of the 20 mph zones dataset. First, the 20 mph zones dataset covered a large time period. Second, data and was supplied from a variety of different sources. To ensure we could include as many 20 mph zones as possible in the analysis, the data were cleaned in the following ways:

- *Boundary editing*
  - Because the data were supplied by different groups as independent areas, there were several sources of uncertainty around actual 20 mph zone boundaries. In some cases roads that formed the edge of the 20 mph zone were included in the 20 mph zone, instead of being outside. It was not possible to check the exact boundaries of each area individually. However, 20 mph zones often end at more major roads, and we were able to alter the boundaries to exclude obviously inappropriate roads. Some 20 mph zone boundaries overlapped. In some cases boundaries overlapped when two independent 20 mph zones were adjacent to each other. In other cases boundaries overlapped when a 20 mph zone was extended. Often the new extension also included the area of the original 20 mph zone. These errors were corrected by altering boundaries so that the adjacent 20 mph zones share boundaries where appropriate. Extensions to 20 mph zones were defined as two independent areas, the original area and extension.
  - Finally some 20 mph zones were split over two sites, either in two discrete locations or intersected by a major road (not included in the 20 mph zone). In the initial dataset the separate parts of 20 mph zones were connected by a thin area running between them. This was removed to avoid problems when carrying out some GIS functions. This meant some 20 mph zones now covered two independent areas. This is not a problem

with GIS programs, and as far as the analysis and dataset is concerned these still appear as only one 20 mph zone.

- *Construction and Implementation Dates*
  - The 20 mph zones in the dataset cover a large period of time and the date information provided was incomplete. Without construction and implementation dates it is not possible to examine casualty reduction effects of 20 mph zone, therefore a major part of the cleaning process was ensuring we had construction and implementation dates for as many 20 mph zones as possible. It was agreed with LRSU that we would use full financial years for the analysis, consistent with local authority budgets. Where all this information was provided in the dataset, this data was used. In many cases the dates provided were the financial year dates. Where only a start date or end date was provided, the missing date was assigned as the start or the end of the financial year, unless this was less than 3 months from the known start or end date. Where no dates were available LRSU contacted boroughs to obtain dates.
  - We added a new variable to the dataset indicating how the start and end date were defined.

Out of the 399 20 mph zones in the dataset it was possible to find dates for all but 14 20 mph zones. Table A1 shows what date information was present in the original dataset

Table A1: Data information present in the 20 mph zones dataset

Type of date information provided	Number of 20 mph zones
Both Start of construction and Date of completion present as full dates.	103
Date provided was Financial year	181
Only one date provided, second date generated automatically	101
No date information found	14

- *Residential status*
  - We defined a residential status variable for each 20 mph zone using the percentage of delivery points that are business from the All Fields Postcode Directory; residential (≤ 10% business), Mixed (11 - 25 %) or Commercial (> 25%). Each 20 mph zone was assigned a residency status by creating an average proportion of business score from road segments

weighted by length in each zone. This generated residential status was compared to information on residency status obtained on the 20 mph zone file supplied by the LSRU. The majority of zones had the same residency status in our calculations and the LRSU data file The majority of 20 mph zones (345) are in residential areas, 47 are in mixed areas and 7 in commercial areas.

Data description

Table A2 describes the final 20 mph zone dataset, including completeness of key variables. The full dataset and data dictionary have been provided to TfL for further use.

Table A2: Description of the 20 mph zones dataset

Variable	Description	Completeness	Coding
IN20_code	The unique zone code	399 (100%)	
Zone type	The type of zone	399 (100%)	1 = 20 zone 2 = 20 limit 3 = 20 zone & home zone
Borough name	The name of the borough	399 (100%)	
Borough code	The Borough code	399 (100%)	
Scheme name	The name for the scheme	399 (100%)	
Borough scheme number	The Boroughs number for the scheme	399 (100%)	
Old TRL ref	If the zone was in old TRL dataset	146 (37%)	
Original TADS ref (RMON)	The TADS ref ,version RMON	65 (16%)	
Original TADS ref (BSZO)	The TADS ref, version BSZO	72 (18%)	
Original TADS ref (BZZO)	The TADS ref, version BZZO	21 (5%)	
Zone type description	A mixed description of the zone, including type of area, type of zone	331 (83%)	
Education services	If there is a school or not	304 (76%)	1 = Yes 2 = No 99 = No data
Type of zone	If the zone if a single road or an area	302 (76%)	1 = Linear 2 = Area 99 = No data
Landuse	If the zone covers residential or commercial areas	302 (76%)	1 = Residential 2 = Mixed 3 = Commercial
Boundary description	The text description of the boundary roads	399 (100%)	
Start date	The date construction started on the zone	127 (32%)	
Finish date	The date the construction finished on	337 (84%)	

Variable	Description	Completeness	Coding
	the zone		
Implementation date	The date the Zone official started		
Cost (£k)	The cost of the zone	193 (48%)	
Source of funding	The source of funding	203 (58%)	Not defined
Reason for installation	The reason for installing the zone, many are filled out the same for each zone in the borough	164 (41%)	
Comments	Any additional comments	120 (30%)	
Cost issues	Any issues relating to the cost of zone	12 (3%)	1 = Some measures in place 2 = Home Zone 3 = Other

Location of 20 mph zones

Road type

The 20 mph zones included in the database cover 2006 km of roads in London. Table A3 shows the length and percentage of each type of road in 20 mph zones, adjacent areas and outside areas in London.

Table A3: Length of roads by road type

Road	In Zone		Adjacent		Outside		Total	
Type	Km	%	Km	%	Km	%	Km	%
Motorways	0	0%	3	2%	130	98%	133	100%
A roads	14	1%	584	25%	1,732	74%	2,330	100%
B roads	39	7%	111	21%	386	72%	536	100%
Minor	1,953	13%	1,518	10%	11,666	77%	15,137	100%
Total	2,006	11%	2,216	12%	13,913	77%	18,135	100%

Borough

Table A4 shows the area and length of roads included in 20 mph zones by London borough. Table A5 shows the percentage of roads that are in 20 mph zones by deprivation in each London borough.

Table A4: Area and length of 20 mph zones by borough

Borough	# of 20 mph zones	Area (square km) Borough	20 mph zones	% in 20 mph zone	Road Length (km) Borough	20 mph zones	% in 20 mph zone
Barking & Dagenham	22	37.78	3.98	10.53	416.10	67.93	16.32
Barnet	7	86.74	1.39	1.61	1032.90	22.00	2.13
Bexley	6	64.26	1.67	2.60	746.80	30.65	4.10
Brent	4	43.24	1.28	2.96	600.55	22.41	3.73
Bromley	9	150.15	2.45	1.63	1170.33	33.74	2.88
Camden	23	21.80	5.12	23.49	369.49	94.99	25.71
City of London	1	3.15	0.01	0.17	70.76	0.22	0.31
Croydon	8	86.52	2.03	2.34	977.05	37.28	3.82
Ealing	10	55.53	4.28	7.70	814.24	70.09	8.61
Enfield	9	82.20	2.83	3.44	893.71	53.79	6.02
Greenwich	22	50.38	10.12	20.10	664.82	177.92	26.76
Hackney	18	19.06	6.82	35.77	340.72	129.02	37.87
Hammersmith & Fulham	7	17.16	1.92	11.21	275.88	39.07	14.16
Haringey	19	29.59	5.47	18.48	439.65	97.66	22.21
Harrow	5	50.47	0.61	1.20	617.97	9.90	1.60
Havering	10	114.47	1.34	1.17	867.53	23.46	2.70
Hillingdon	9	115.70	0.78	0.68	1054.86	16.30	1.55
Hounslow	5	56.59	0.68	1.20	728.42	12.21	1.68
Islington	18	14.86	7.15	48.12	301.81	137.82	45.67
Kensington and Chelsea	0	12.39	0.00	0.00	262.83	0.00	0.00
Kingston-upon-Thames	34	37.25	4.94	13.26	461.94	90.75	19.64
Lambeth	7	27.25	3.20	11.74	514.08	58.15	11.31
Lewisham	15	35.32	12.48	35.34	571.66	216.45	37.86
Merton	3	37.61	0.23	0.62	519.19	5.87	1.13
Newham	19	38.68	9.00	23.27	534.86	151.96	28.41
Redbridge	25	56.44	0.72	1.27	663.66	17.58	2.65
Richmond-upon-Thames	9	58.77	0.41	0.70	575.01	9.56	1.66
Southwark	15	29.90	11.27	37.71	521.27	199.46	38.26
Sutton	3	43.85	2.37	5.40	552.71	33.63	6.08
Tower Hamlets	31	21.57	10.75	49.82	419.31	214.31	51.11
Waltham Forest	8	38.82	3.81	9.81	519.22	64.59	12.44
Wandsworth	18	35.22	2.38	6.76	562.77	47.36	8.42
Westminster	0	22.03	0.00	0.00	446.79	0.00	0.00
Total	399	1594.72	121.48	7.62	18137.17	2006.23	11.21

Table A5: Percentage of roads in each borough that are in 20 mph zones by deprivation quintiles

Borough	quintile 1	quintile 2	quintile 3	quintile 4	quintile 5
Barking & Dagenham	-	28.68	9.42	16.02	17.71
Barnet	2.68	1.53	2.60	0.70	4.51
Bexley	0.31	5.49	6.39	9.65	19.31
Brent	0.00	4.96	4.98	4.60	0.00
Bromley	0.29	3.54	15.59	5.88	13.07
Camden	-	4.58	11.19	26.25	45.92
City of London	0.00	0.37	-	0.00	-
Croydon	0.64	1.33	4.05	10.10	17.52
Ealing	8.08	3.83	12.87	10.98	6.84
Enfield	0.10	0.71	6.94	13.11	11.35
Greenwich	30.14	22.38	22.33	33.47	26.62
Hackney	-	-	21.74	40.91	37.65
Hammersmith & Fulham	0.00	14.20	11.72	20.51	8.69
Haringey	0.00	14.60	13.28	24.99	26.04
Harrow	1.13	0.59	3.03	10.21	0.00
Havering	1.11	2.08	8.43	1.74	0.00
Hillingdon	0.26	1.15	2.69	0.96	3.82
Hounslow	0.00	1.56	2.16	1.83	0.07
Islington	-	-	4.34	52.90	47.12
Kensington and Chelsea	0.00	0.00	0.00	0.00	0.00
Kingston-upon-Thames	16.49	21.63	33.24	-	79.46
Lambeth	-	33.12	19.14	7.84	5.66
Lewisham	1.79	45.31	35.10	39.26	36.54
Merton	0.48	3.39	0.44	0.00	-
Newham	-	-	29.40	37.89	24.20
Redbridge	0.80	2.97	3.34	3.53	5.97
Richmond-upon-Thames	1.88	1.47	0.00	0.00	-
Southwark	0.00	41.25	31.57	37.12	43.01
Sutton	7.83	6.21	0.99	0.28	0.00
Tower Hamlets	-	16.34	47.50	44.31	56.45
Waltham Forest	0.00	3.37	7.67	17.13	16.87
Wandsworth	7.38	10.86	5.59	9.76	11.01
Westminster	-	0.00	0.00	0.00	0.00
Total	2.52	5.95	9.79	17.76	27.78

Schools

Not all 20 mph zones are sited in areas with a high casualty history; some implemented around schools or areas with a high casualty potential. Table A6 shows that 252 20 mph zones contain at least one school and most have a school within 100m.

Table A6: Schools and 20 mph Zones

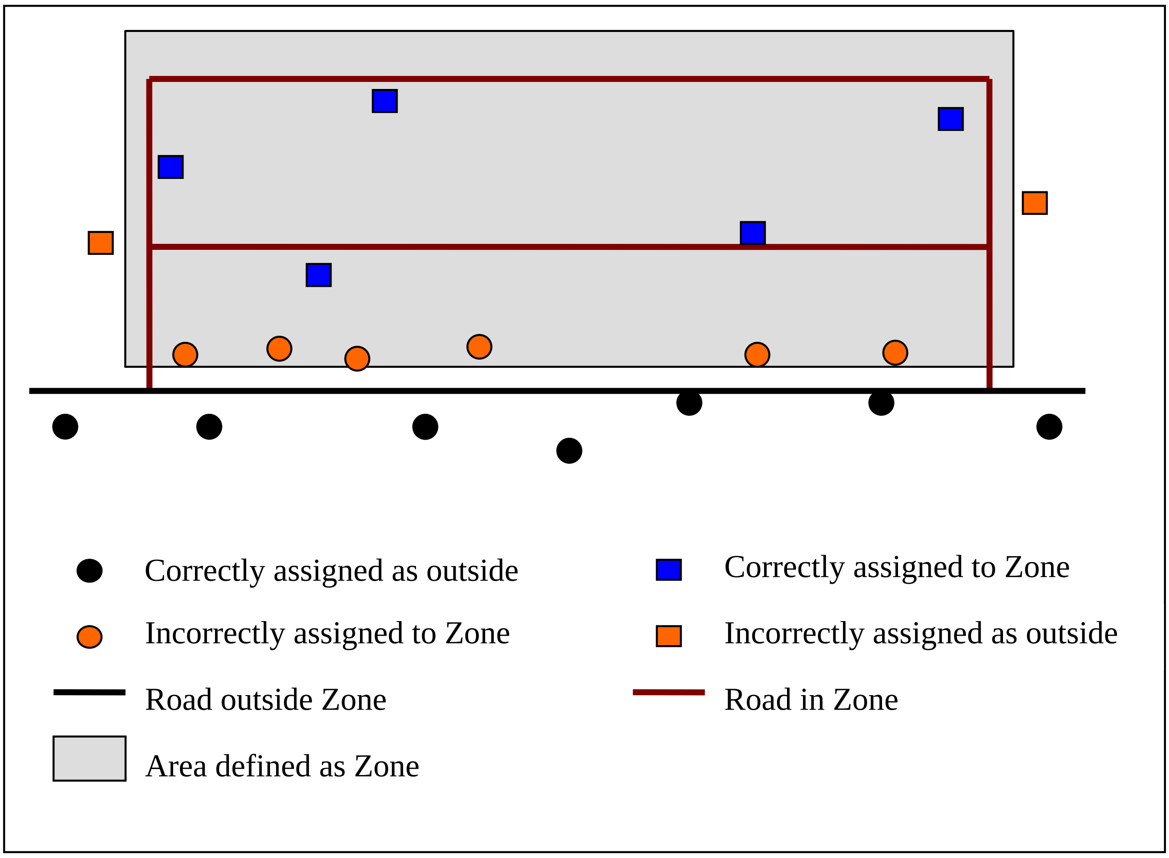
School location	Number of 20 mph zones
20 mph zone contains a school	252
20 mph zone is within 10 meters of a school	1
20 mph zone is within 100 meters of a school	92
20 mph zone is not close to a school	54

Appendix B: Assigning collisions to 20 mph zones using coordinates in STATS19

Introduction

Local Authorities and TfL monitor collisions in 20 mph zones by assigning collisions to 20 mph zones based on the coordinates provided in STATS19. We hypothesized that assigning collisions in this way would overestimate the number of collisions in 20 mph zones because many collisions occur on the boundary road and would incorrectly be assigned as occurring in a 20 mph zone, as shown in Figure B1.

Figure B1: Example of issues of assigning collisions to zones based on STATS19 coordinate



While Local Authority engineers are likely to manually examine all collisions in the area to ensure only collisions that actually occurred in the 20 mph zone are included, this is not possible to repeat for the whole of London, and it is not done when TfL examine the data using TADS. To avoid over-estimation of collisions in

20 mph zones, collisions were first linked to specific roads, and then roads linked to 20 mph zones.

In this analysis we use the assignment method used in TADS, to re-run a simple before-after analysis to compare the results from the two methods of assigning collisions to 20 mph zones. These results can then be used to inform decisions on the use of these methods in future work.

Methods

All collisions were linked to 20 mph zones by overlaying the x and y coordinate of the collision on top of the 20 mph zone boundaries in ArcGIS. If a collision fell within the boundaries of a 20 mph zone, we compared the financial year (April-March) in which the collision occurred to the building and implementation dates of the 20 mph zone to assign a intervention status. Similarly, if a collision fell with 150 meters of a 20 mpg zone we compared the financial year in which the collision occurred to the building and implementation dates of the zone the collision was adjacent to in order to assign an adjacency status.

The first analysis used simple tabulations to compare the numbers assigned to each 20 mph zone. Further analysis used collisions in the 3 years before and 3 years after the building and implementation dates to examine changes to the results. Analysis was carried out for collisions and for all, KSI and pedestrian casualties.

Results

Looking at the number of collisions assigned as occurring inside a 20 mph zone in the 3 years before and after the zone implementation dates, 7632 collisions occurred when assigned by road segment, while 8620 were assigned by STATS19 location, with 988 more collisions (13%) when assigned by location (Table B1). The average difference between the two methods was small (1.68 collisions in the before period with a standard deviation of 5.52, and 0.79 collisions in the after period with a standard deviation of 2.86). There were, however, some large difference for individual 20 mph zones, the largest being differences of 52 in the before period and 25 in the after period. 20 mph zones with large differences were checked and assignments by both methods were correct.

For comparisons of the before and the after periods, there was little difference in results between the two methods of assignation. Table B2 shows the results for key outcomes, showing no difference in results for all casualties and all collisions, and a 1% difference for KSI and pedestrian casualties. For pedestrian and KSI casualties assigning collisions based on STATS19 location underestimated the effect of zones.

Table B1: Difference in number of collisions assigned in the 3 years before and 3 years after 20 mph zone implementation dates.

	All Collisions	
	Before	After
Assigned using road type	5433	2199
Assigned using STATS19 location	6105	2515
Difference	-672	-316
% Difference	-12%	-14%
Average difference per zone	-1.68	-0.79
SD of average difference per zone	5.52	2.86
Maximum Difference	-52	-25

Table B2: Difference in the effect of 20 mph zones in the 3 years before and after by method of assigning collisions to 20 mph zones.

Outcome measure	Percentage change between before and after periods	
	Road type	Location
All casualties	41	41
All collisions	38	38
KSI casualties	44	43
Pedestrian casualties	36	35

Discussion

The difference in number of collisions assigned to 20 mph zones had little effect on the analysis. The differences in effects for all outcomes were minimal. However, assigning collisions based on STATS19 coordinates slightly underestimated the effect of 20 mph zones on pedestrian and KSI casualties. This underestimation is to be expected as more collisions will be incorrectly included from outside the zones, where the reduction in collisions is less.

While using the STATS19 location of collision does not alter the result for grouped data, it can alter the results dramatically when looking at individual zones. This would be important if the data were used without validation, both in terms of reporting the impact of the zone, and in planning new zones. However, as Local Authorities tend to check the data, this is unlikely to cause problems.

Conclusions

Assigning data to zones by linking collisions to the road they occur on is the most accurate method. This allows routine methods to be used and, while not perfect, far better represents those collisions that truly occur within a zone. Where it is not possible to use this method, assigning collisions based on the coordinates provided in STATS19 if adequate for London as a whole, but inappropriate for individual sites without thorough checking.

Appendix C: Regression model results

Table C1: Effects (95% CI) of 20 mph zones and adjacent roads on casualties and collisions

Outcome	Percentage reduction (95% C.I.) in 20 mph zones	Percentage reduction (95% C.I.) in adjacent areas	Annual background reduction (95% C.I.)
All casualties	41.9% (36.0% to 47.8%)	8.0% (4.4% to 11.5%)	1.7% (1.5% to 1.9%)
All casualties (0-15)	48.5% (41.9% to 55.0%)	9.7% (4.5% to 14.9%)	3.4% (3.1% to 3.7%)
KSI	46.3% (38.6% to 54.1%)	7.9% (2.2% to 13.5%)	3.8% (3.4% to 4.1%)
All casualties (0-15 KSI)	50.2% (37.2% to 63.2%)	5.4% (-8.1% to 18.8%)	5.2% (4.7% to 5.8%)
Killed	35.1% (-1.9% to 72.0%)	-21.1% (-52.3% to 10.2%)	4.0% (3.4% to 4.6%)
Pedestrians	32.4% (27.1% to 37.7%)	4.3% (-1.0% to 9.6%)	3.4% (3.2% to 3.6%)
Pedestrians (KSI)	34.8% (22.1% to 47.5%)	-2.1% (-13.6% to 9.3%)	5.5% (5.2% to 5.9%)
Pedestrians (0-15)	46.2% (36.8% to 55.5%)	5.3% (-1.3% to 11.9%)	3.9% (3.6% to 4.3%)
Pedestrians (0-15 KSI)	43.9% (26.6% to 61.3%)	-4.5% (-23.0% to 14.0%)	6.1% (5.5% to 6.7%)
Pedestrians (0-5)	47.0% (28.7% to 65.2%)	9.9% (-11.8% to 31.6%)	4.0% (3.5% to 4.5%)
Pedestrians (6-11)	50.8% (40.9% to 60.8%)	3.7% (-8.5% to 16.0%)	4.8% (4.3% to 5.2%)
Pedestrians (12-15)	26.3% (5.9% to 46.7%)	6.3% (-4.1% to 16.7%)	2.8% (2.5% to 3.1%)
Cyclists	16.9% (4.8% to 29.0%)	4.6% (-2.5% to 11.7%)	2.0% (1.3% to 2.7%)
Cyclist (KSI)	37.6% (14.4% to 60.9%)	-2.1% (-19.5% to 15.2%)	3.1% (2.2% to 4.0%)
Powered 2w	32.6% (21.7% to 43.4%)	9.4% (2.7% to 16.1%)	0.6% (0.2% to 1.0%)
Powered 2w (KSI)	39.1% (19.0% to 59.1%)	3.2% (-10.2% to 16.6%)	2.4% (1.9% to 3.0%)
Car occupant	52.5% (42.5% to 62.4%)	11.5% (6.4% to 16.5%)	1.1% (0.8% to 1.5%)
Car occupant (KSI)	61.8% (52.0% to 71.7%)	24.4% (15.7% to 33.0%)	2.8% (2.2% to 3.5%)
All collisions	37.5% (31.6% to 43.4%)	7.4% (3.8% to 11.0%)	1.8% (1.6% to 2.0%)
Collisions (KSI)	44.2% (36.6% to 51.7%)	7.5% (2.0% to 13.1%)	3.8% (3.4% to 4.1%)
Collisions (≥1 ped)	30.1% (23.5% to 36.7%)	4.1% (-1.3% to 9.4%)	3.4% (3.2% to 3.6%)
Collisions (≥1 cyclist)	16.6% (5.6% to 27.7%)	4.4% (-2.7% to 11.5%)	2.0% (1.3% to 2.7%)
Collisions (≥1 p2w)	31.7% (21.2% to 42.3%)	9.8% (2.8% to 16.8%)	0.6% (0.1% to 1.0%)

Table C2: Main effects of 20 mph zones and adjacent roads on casualties and collisions (2000-2006)

Outcome	Percentage reduction (95% C.I.) in 20 mph zones	Percentage reduction (95% C.I.) in adjacent areas	Annual background reduction (95% C.I.)
All casualties	22.7% (15.3% to 30.1%)	3.1% (-1.0% to 7.2%)	6.3% (6.1% to 6.5%)
KSI	28.4% (17.8% to 39%)	7.1% (-1.2% to 15.4%)	7.5% (7.0% to 8.0%)
Pedestrians	21.6% (12.9% to 30.4%)	-1.4% (-6.9% to 4.2%)	6.6% (6.1% to 7%)
Cyclists	-1.3% (-22.3% to 19.8%)	-6.3% (-14% to 1.4%)	5.3% (4.7% to 6%)
Powered 2w	23.2% (9.4% to 37.1%)	9.9% (3.2% to 16.7%)	6.6% (6.1% to 7%)
Car occupant	28.8% (13.7% to 43.9%)	5.8% (-0.5% to 12.2%)	6.5% (6.2% to 6.7%)
All collisions	19.3% (13% to 25.6%)	2.4% (-1.4% to 6.1%)	6.1% (5.9% to 6.3%)

Table C3: Estimates* of the effect of 20 mph zones on selected casualty groups excluding data for 3, 4 and 5 years preceding the introduction of the zones.

	Percentage (95% confidence interval) reduction in casualties			
	Estimates based on data for all years	**Estimates after excluding data for the following periods before the start of the 20 mph zones**		
		3 years	**4 years**	**5 years**
All casualties	41.5% (35.6%, 47.5%)	43.5% (40.9%, 45.9%)	43.1% (40.5%, 45.6%)	42.2% (39.6%, 44.8%)
KSI	46.0% (38.3%, 53.8%)	47.9% (40.8%, 54.1%)	48.0% (40.9%, 54.3%)	47.2% (40.0%, 53.6%)
Pedestrian injuries	32.1% (26.9%, 37.4%)	33.2% (27.5%, 38.5%)	33.3% (27.5%, 38.6%)	32.7% (26.9%, 38.1%)

* – All estimates based on models which assume a linear decline in background number of casualties over time

Table C4: Estimates of the effect of 20 mph zones by selected factors

Outcome		*20 mph zone*	Adjacent roads % (95% CI)	Annual trend % (95% CI)
	Inner London % (95% CI)	**Outer London % (95% CI)**		
All Casualties	36.9% (30.2% to 43.5%)	48.4% (36.4% to 60.4%)	8.0% (4.4% to 11.5%)	1.7% (1.5% to 1.9%)
KSI Casualties	41.8% (29.2% to 54.3%)	52.2% (41.7% to 62.7%)	7.9% (2.2% to 13.5%)	3.8% (3.4% to 4.1%)
Pedestrian Casualties	30.5% (24.5% to 36.5%)	35.1% (22.9% to 47.3%)	4.3% (-1.0% to 9.6%)	3.4% (3.2% to 3.6%)
All Collisions	33.5% (27.5% to 39.6%)	42.5% (27.0% to 58.1%)	7.4% (3.8% to 11.0%)	1.8% (1.6% to 2.0%)

		20 mph zone		
Outcome	**Less residential % (95% CI)**	**More residential % (95% CI)**	**Adjacent roads % (95% CI)**	**Annual trend % (95% CI)**
All Casualties	40.7% (27.7% to 53.7%)	42.1% (36.3% to 48)	8.0% (4.4% to 11.5%)	1.7% (1.5% to 1.9%)
KSI Casualties	52.9% (39.2% to 66.6%)	45.0% (36.0% to 54.0%)	7.9% (2.2% to 13.5%)	3.8% (3.4% to 4.1%)
Pedestrian Casualties	30.1% (16.5% to 43.8%)	32.9% (26.8% to 39.0%)	4.3% (-1.0% to 9.6%)	3.4% (3.2% to 3.6%)
All Collisions	37.1% (24.6% to 49.6%)	37.6% (31.2% to 44.1%)	7.4% (3.8% to 11.0%)	1.8% (1.6% to 2.0%)

		20 mph zone		
Outcome	**Less deprived % (95% CI)**	**More deprived % (95% CI)**	**Adjacent roads % (95% CI)**	**Annual trend % (95% CI)**
All Casualties	44.9% (35.8% to 53.9%)	40.8% (34.2% to 47.4%)	8.0% (4.4% to 11.5%)	1.7% (1.5% to 1.9%)
KSI Casualties	55.4% (43.8% to 66.9%)	42.7% (33.7% to 51.7%)	7.9% (2.2% to 13.5%)	3.8% (3.4% to 4.1%)
Pedestrian Casualties	36.4% (24.8% to 47.9%)	31.3% (25.5% to 37.0%)	4.3% (-1.0% to 9.6%)	3.4% (3.2% to 3.6%)
All Collisions	41.0% (31.7% to 50.4%)	36.3% (30.2% to 42.4%)	7.4% (3.8% to 11.0%)	1.8% (1.6% to 2.0%)

Outcome	Small zones % (95% CI)	*20 mph zone* Large zones % (95% CI)	Adjacent roads % (95% CI)	Annual trend % (95% CI)
All Casualties	47.1% (38.8% to 55.3%)	40.4% (33.6% to 47.3%)	8.0% (4.4% to 11.5%)	1.7% (1.5% to 1.9%)
KSI Casualties	41.9% (25.5% to 58.4%)	47.6% (38.7% to 56.6%)	7.9% (2.2% to 13.5%)	3.8% (3.4% to 4.1%)
Pedestrian Casualties	34.8% (23.2% to 46.4%)	31.7% (25.9% to 37.6%)	4.3% (-1.0% to 9.6%)	3.4% (3.2% to 3.6%)
All Collisions	43.5% (35.7% to 51.3%)	37.2% (31.1% to 43.2%)	7.5% (3.9% to 11.0%)	1.8% (1.6% to 2.0%)

Outcome	Surrounded zones % (95% CI)	*20 mph zone* Isolated zones % (95% CI)	Adjacent roads % (95% CI)	Annual trend % (95% CI)
All Casualties	38.8% (31.7% to 46.0%)	48.2% (41.3% to 55.0%)	8.0% (4.4% to 11.5%)	1.7% (1.5% to 1.9%)
KSI Casualties	47.6% (37.5% to 57.7%)	43.7% (28.8% to 58.7%)	7.9% (2.2% to 13.5%)	3.8% (3.4% to 4.1%)
Pedestrian Casualties	30.2% (22.9% to 37.5%)	37.5% (27.0% to 48.0%)	4.3% (-1.0% to 9.6%)	3.4% (3.2% to 3.6%)
All Collisions	35.8% (29.7% to 41.9%)	44.2% (36.9% to 51.5%)	7.5% (3.9% to 11.0%)	1.8% (1.6% to 2.0%)

Appendix D: Collisions by year, type of road for 20 mph zones, adjacent and outside areas

Table D1a: Collisions by type of road and year, for outside roads

Year	Motorways		A Roads		B Roads		Minor Roads		Other		Total	
	%	Collision / km	%	Collision / km	%	Collision / km	%	Collision / km	%	Collision / km	%	Collision / km
86/87	0.98%	2.18	59.64%	9.93	8.30%	6.20	30.01%	0.91	1.07%	0.14	100%	2.09
87/88	1.11%	2.47	59.32%	9.84	8.33%	6.20	30.18%	0.91	1.06%	0.14	100%	2.08
88/89	1.28%	2.80	58.73%	9.65	8.24%	6.08	30.77%	0.92	0.99%	0.13	100%	2.07
89/90	1.33%	3.12	58.70%	10.30	8.24%	6.49	30.74%	0.98	0.99%	0.14	100%	2.20
90/91	1.35%	2.95	57.73%	9.48	8.35%	6.16	31.53%	0.94	1.04%	0.14	100%	2.06
91/92	1.44%	2.97	58.73%	9.07	8.16%	5.66	30.64%	0.86	1.02%	0.13	100%	1.94
92/93	1.43%	2.85	58.59%	8.74	8.42%	5.64	30.76%	0.83	0.79%	0.10	100%	1.88
93/94	1.59%	3.24	59.03%	9.02	8.58%	5.89	29.99%	0.83	0.80%	0.10	100%	1.92
94/95	1.63%	3.31	59.31%	9.04	8.43%	5.76	29.76%	0.82	0.88%	0.11	100%	1.91
95/96	1.28%	2.53	59.09%	8.79	8.29%	5.54	30.53%	0.83	0.82%	0.10	100%	1.87
96/97	1.41%	2.82	58.86%	8.82	8.07%	5.43	31.07%	0.85	0.59%	0.07	100%	1.88
97/98	1.29%	2.63	58.78%	8.99	8.30%	5.70	30.83%	0.86	0.81%	0.10	100%	1.92
98/99	1.21%	2.40	57.89%	8.65	8.46%	5.68	31.70%	0.86	0.75%	0.09	100%	1.88
99/00	1.23%	2.41	60.23%	8.88	8.01%	5.30	29.77%	0.80	0.76%	0.09	100%	1.85
00/01	0.79%	1.53	60.41%	8.76	8.29%	5.40	29.84%	0.79	0.66%	0.08	100%	1.82
01/02	1.30%	2.38	60.58%	8.31	8.03%	4.95	29.35%	0.73	0.74%	0.08	100%	1.72
02/03	1.30%	2.26	59.74%	7.79	8.16%	4.78	30.07%	0.71	0.73%	0.08	100%	1.64
03/04	1.36%	2.16	60.35%	7.20	8.03%	4.30	29.69%	0.64	0.57%	0.05	100%	1.50
04/05	1.33%	1.98	59.15%	6.61	8.11%	4.07	30.65%	0.62	0.76%	0.07	100%	1.41
05/06	1.39%	1.90	58.20%	5.97	8.01%	3.69	31.68%	0.59	0.71%	0.06	100%	1.29
Total	1.30%	2.55	59.13%	8.69	8.25%	5.45	30.48%	0.81	0.84%	0.10	100%	1.85

Table D1b: Collisions by type of road and year, for roads before they become 20 mph zones

Year	Motorways %	Motorways Collision / km	A Roads %	A Roads Collision / km	B Roads %	B Roads Collision / km	Minor Roads %	Minor Roads Collision / km	Other %	Other Collision / km	Total %	Total Collision / km
86/87	0.00%	0.00	6.68%	11.43	12.71%	7.85	77.97%	1.12	2.64%	0.31	100%	1.24
87/88	0.00%	0.00	6.52%	11.22	11.60%	7.22	79.67%	1.15	2.21%	0.26	100%	1.25
88/89	0.00%	0.00	6.75%	12.27	10.97%	7.22	80.30%	1.22	1.98%	0.25	100%	1.32
89/90	0.00%	0.00	6.49%	12.20	11.22%	7.62	80.44%	1.27	1.84%	0.24	100%	1.36
90/91	0.00%	0.00	5.82%	9.88	10.98%	6.73	81.32%	1.16	1.87%	0.22	100%	1.23
91/92	0.00%	0.00	6.42%	10.30	12.05%	6.99	79.86%	1.07	1.67%	0.18	100%	1.17
92/93	0.00%	0.00	7.17%	10.65	11.16%	5.99	79.76%	1.00	1.90%	0.20	100%	1.09
93/94	0.00%	0.00	7.71%	11.29	12.05%	6.45	78.69%	0.98	1.54%	0.16	100%	1.08
94/95	0.00%	0.00	7.25%	9.88	12.27%	6.14	79.24%	0.93	1.24%	0.12	100%	1.02
95/96	0.00%	0.00	7.34%	9.52	12.77%	6.09	78.70%	0.89	1.20%	0.11	100%	0.98
96/97	0.00%	0.00	7.65%	9.95	11.39%	5.44	79.72%	0.91	1.25%	0.12	100%	0.99
97/98	0.00%	0.00	7.92%	10.09	12.35%	5.77	78.29%	0.90	1.44%	0.14	100%	0.99
98/99	0.00%	0.00	6.61%	8.61	12.78%	6.25	79.74%	0.96	0.87%	0.09	100%	1.04
99/00	0.00%	0.00	5.89%	7.93	12.66%	6.10	80.41%	0.97	1.05%	0.10	100%	1.04
00/01	0.00%	0.00	8.46%	11.50	14.00%	6.42	76.59%	0.91	0.95%	0.09	100%	1.03
01/02	0.00%	0.00	9.54%	11.68	12.23%	5.21	77.62%	0.92	0.60%	0.06	100%	1.02
02/03	0.00%	0.00	6.42%	7.76	13.10%	5.78	79.62%	0.89	0.87%	0.08	100%	0.97
03/04	0.00%	0.00	3.35%	4.16	15.62%	6.42	80.33%	0.77	0.70%	0.06	100%	0.84
04/05	0.00%	0.00	4.78%	3.97	17.98%	6.72	76.69%	0.66	0.56%	0.04	100%	0.75
05/06	0.00%	0.00	4.72%	5.82	21.26%	6.99	73.23%	0.79	0.79%	0.12	100%	0.97
Total	0.00%	0.00	6.91%	10.12	12.20%	6.46	79.36%	1.01	1.54%	0.16	100%	1.10

Table D1c: Collisions by type of road and year, for roads after they become 20 mph zones

Year	Motorways		A Roads		B roads		Minor Roads		Other		Total	
	%	Collision / km	%	Collision / km	%	Collision / km	%	Collision / km	%	Collision / km	%	Collision / km
86/87	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	100%	0.00
87/88	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	100%	0.00
88/89	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	100%	0.00
89/90	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	100%	0.00
90/91	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	100%	0.00
91/92	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	100%	0.00
92/93	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	100%	0.00
93/94	0.00%	0.00	0.00%	0.00	0.00%	0.00	100.00%	0.12	0.00%	0.00	100%	0.10
94/95	0.00%	0.00	0.00%	0.00	0.00%	0.00	100.00%	0.04	0.00%	0.00	100%	0.04
95/96	0.00%	0.00	0.00%	0.00	12.50%	3.33	87.50%	0.19	0.00%	0.00	100%	0.19
96/97	0.00%	0.00	0.00%	0.00	11.76%	3.33	88.24%	0.20	0.00%	0.00	100%	0.20
97/98	0.00%	0.00	0.00%	0.00	0.00%	0.00	100.00%	0.13	0.00%	0.00	100%	0.12
98/99	0.00%	0.00	0.00%	0.00	2.13%	0.68	97.87%	0.29	0.00%	0.00	100%	0.26
99/00	0.00%	0.00	0.00%	0.00	4.11%	1.96	93.15%	0.37	2.74%	0.08	100%	0.35
00/01	0.00%	0.00	0.00%	0.00	5.71%	2.29	93.33%	0.36	0.95%	0.03	100%	0.33
01/02	0.00%	0.00	6.47%	5.46	5.29%	2.12	85.88%	0.33	2.35%	0.08	100%	0.34
02/03	0.00%	0.00	5.33%	2.80	3.69%	0.69	89.75%	0.33	1.23%	0.04	100%	0.32
03/04	0.00%	0.00	9.69%	4.04	8.55%	1.38	80.06%	0.30	1.71%	0.05	100%	0.32
04/05	0.00%	0.00	13.17%	7.68	9.71%	1.89	74.87%	0.34	2.25%	0.08	100%	0.39
05/06	0.00%	0.00	10.56%	5.48	9.38%	1.81	78.01%	0.34	2.05%	0.07	100%	0.37
Total	0.00%	0.00	8.94%	5.07	7.90%	1.62	81.29%	0.32	1.87%	0.06	100%	0.34

Table D1d: Collisions by type of road and year, for roads before they become adjacent to 20 mph zones

Year	Motorways		A Roads		B Roads		Minor Roads		Other		Total	
	%	Collision / km	%	Collision / km	%	Collision / km	%	Collision / km	%	Collision / km	%	Collision / km
86/87	0.00%	0.00	76.72%	14.68	8.62%	8.70	14.65%	1.21	0.39%	0.20	100%	4.94
87/88	0.02%	1.86	75.91%	14.60	9.26%	9.39	14.81%	1.23	0.50%	0.26	100%	4.96
88/89	0.01%	0.93	76.26%	14.78	8.80%	9.00	14.93%	1.25	0.37%	0.19	100%	5.00
89/90	0.03%	2.79	75.54%	15.67	8.78%	9.61	15.65%	1.40	0.25%	0.14	100%	5.35
90/91	0.04%	3.72	74.98%	14.12	8.80%	8.80	16.18%	1.32	0.29%	0.15	100%	4.87
91/92	0.03%	2.79	76.18%	13.77	8.51%	8.16	15.29%	1.20	0.40%	0.19	100%	4.67
92/93	0.03%	2.79	76.67%	13.51	8.95%	8.31	14.35%	1.09	0.36%	0.17	100%	4.56
93/94	0.03%	2.79	76.93%	13.70	8.26%	7.72	14.77%	1.14	0.39%	0.19	100%	4.61
94/95	0.01%	0.93	76.82%	13.66	8.66%	7.99	14.51%	1.12	0.31%	0.15	100%	4.61
95/96	0.03%	2.79	76.86%	13.53	8.73%	8.05	14.39%	1.11	0.25%	0.12	100%	4.59
96/97	0.01%	1.55	76.51%	13.19	8.96%	8.12	14.51%	1.10	0.23%	0.11	100%	4.51
97/98	0.01%	1.55	76.40%	13.86	8.72%	8.07	14.86%	1.16	0.27%	0.14	100%	4.67
98/99	0.01%	1.55	77.44%	14.28	8.66%	8.16	13.89%	1.11	0.25%	0.13	100%	4.76
99/00	0.03%	4.64	77.27%	14.34	8.25%	7.81	14.45%	1.17	0.20%	0.11	100%	4.83
00/01	0.00%	0.00	77.78%	14.56	9.01%	8.44	13.21%	1.09	0.21%	0.11	100%	4.89
01/02	0.00%	0.00	79.95%	13.53	7.88%	7.58	12.17%	0.97	0.28%	0.14	100%	4.66
02/03	0.00%	0.00	79.68%	12.20	7.68%	7.57	12.64%	0.94	0.24%	0.11	100%	4.30
03/04	0.00%	0.00	82.57%	11.82	5.08%	6.02	12.35%	0.85	0.31%	0.13	100%	4.06
04/05	0.00%	0.00	80.90%	8.83	5.80%	6.05	13.30%	0.77	0.15%	0.06	100%	3.34
05/06	0.00%	0.00	83.40%	7.24	2.32%	2.62	14.29%	0.92	0.39%	0.31	100%	3.42
Total	0.02%	2.18	76.91%	13.90	8.56%	8.31	14.51%	1.15	0.31%	0.16	100%	4.73

Table D1e: Collisions by type of road and year, for roads before they after adjacent to 20 mph zones

Year	Motorways		A Roads		B Roads		Minor Roads		Other		Total	
	%	Collision / km	%	Collision / km	%	Collision / km	%	Collision / km	%	Collision / km	%	Collision / km
86/87	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	100%	0.00
87/88	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	100%	0.00
88/89	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	100%	0.00
89/90	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	100%	0.00
90/91	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	100%	0.00
91/92	0.00%	0.00	0.00%	0.00	50.00%	4.67	50.00%	0.89	0.00%	0.00	100%	1.43
92/93	0.00%	0.00	0.00%	0.00	100.00%	1.56	0.00%	0.00	0.00%	0.00	100%	0.24
93/94	0.00%	0.00	77.27%	12.59	9.09%	9.34	13.64%	0.79	0.00%	0.00	100%	3.20
94/95	0.00%	0.00	81.03%	11.61	3.45%	3.11	15.52%	0.79	0.00%	0.00	100%	2.82
95/96	0.00%	0.00	75.10%	10.81	3.16%	4.85	19.76%	1.07	1.98%	0.44	100%	3.27
96/97	0.00%	0.00	75.15%	12.02	5.39%	6.52	18.56%	0.99	0.90%	0.22	100%	3.35
97/98	0.00%	0.00	72.19%	14.88	6.34%	7.18	21.06%	1.29	0.41%	0.13	100%	3.95
98/99	0.29%	4.67	75.99%	13.48	7.22%	7.94	15.76%	1.05	0.74%	0.25	100%	4.08
99/00	0.44%	9.34	72.91%	11.71	7.27%	8.10	19.27%	1.32	0.11%	0.04	100%	4.08
00/01	0.56%	14.01	75.88%	11.46	6.52%	7.38	16.48%	1.07	0.56%	0.18	100%	3.83
01/02	0.06%	0.93	77.19%	12.05	5.58%	6.00	16.60%	1.03	0.56%	0.20	100%	3.80
02/03	0.38%	8.38	72.31%	11.81	8.95%	6.81	18.15%	1.06	0.21%	0.07	100%	3.64
03/04	0.00%	0.00	72.70%	11.22	8.92%	6.35	18.07%	1.05	0.31%	0.11	100%	3.58
04/05	0.09%	3.72	74.42%	10.00	8.87%	5.11	16.43%	0.90	0.19%	0.06	100%	3.28
05/06	0.02%	0.93	71.94%	9.18	9.13%	5.21	18.72%	0.98	0.20%	0.06	100%	3.13
Total	0.13%	4.06	73.54%	10.66	8.26%	5.82	17.76%	1.01	0.31%	0.10	100%	3.45

Appendix E: What would happen if we used a variable background trend?

Introduction

The analyses presented in section 3.3 assumed a constant background decline (trend) in casualties over time. The actual background change in casualties, however, varies from year to year. To explore the sensitivity of our results to assumptions about the background trend in casualties, we repeated the analyses for key outcomes allowing the background trend to vary from year to year.

Results

Results using a variable background trend were 4% to 5% lower than results using a constant background trend. The reduction in all casualties in 20 mph zones using the model using a variable background trend was 37% (95% CI 34%, 39%) compared with 42% (95% CI 36%, 48%) from the model using a constant background trend. Table 9 shows the results for key outcomes.

Table E1: Comparison of results from linear trend model and individual year effects model

	Reduction in casualties in 20 mph zones using a constant background trend (95% CI)	Reduction in casualties in 20 mph zones using a variable background trend (95% CI)
All casualties	42% (36% – 48%)	37% (34% – 39%)
KSI	46% (38% – 54%)	42% (34% – 49%)
Pedestrians	32% (27% – 37%)	28% (22% – 34%)
All Collisions	37% (31% – 43%)	32% (29% – 35%)

Discussion

Results from models using a variable background trend fall within the confidence intervals of results from models using a constant background trend. The two models give compatible estimates of reductions in casualties; however which point estimate to use is less clear. We have chosen to use a model with a constant background trend for transparency and ease of interpretation.

Appendix F: List of 20 mph zones by Borough

Table F1: List of all 20 mph zones, by Borough

Scheme name	Borough	Start Date	Length of road (km)
1. Watling Street	City of London	1997	0.22
1. St Andrews	Camden	1995	1.68
1. St Andrews (extension)	Camden	2005	1.19
2. Regents Park	Camden	2001	6.77
2. Regents Park extension	Camden	2004	3.88
3. Somers Town	Camden	2002	5.60
4. Dartmouth Park	Camden	2002	11.07
5. Burghley Road area	Camden	2002	2.03
6. Lady Margaret Road area	Camden	2002	5.00
7. Grafton Road area (original name West Kentish Town area)	Camden	2002	10.98
8. Camden Square	Camden	2003	5.83
9. Kingsgate	Camden	2004	4.73
10. Birchington Road area	Camden	2004	1.02
11. Fordwych Road area	Camden	2004	1.94
12. Iverson Road area	Camden	2003	4.36
13. Lymington Road area	Camden	2004	2.21
14. Maitland Park area	Camden	2004	3.27
15. Bartholomew Road area	Camden	2004	5.81
16. West Euston	Camden	2004	2.31
17. Kilburn Priory area	Camden	2005	1.74
18. Mansfield Road area	Camden	2005	3.05
19. Castlehaven	Camden	2005	4.14
20. Hatton Garden area	Camden	2006	3.95
21. Royal College Street area	Camden	2005	2.75
1. Hazellville	Islington	2006	2.14
2. Dartmouth Park Hill	Islington	2004	6.64
3. Cornwallis	Islington	2005	9.90
4. Hilldrop (Holloway School)	Islington	2005	2.57
5. Barnsbury (original)	Islington	2003	2.62
5. Barnsbury (extension)	Islington	2006	35.91
6. Highbury New Park	Islington	2005	8.46
7. Mildmay	Islington	2004	7.63
8. Canonbury West	Islington	2003	7.72
9. Canonbury East	Islington	2003	6.72
10. Ten Estates (Copenhagen & Blessed Sacrement)	Islington	2004	4.00
11. St Peters (original)	Islington	2004	14.25
11. St Peters (extension)	Islington	1998	1.57
12. Amwell	Islington	2004	7.22

Scheme name	Borough	Start Date	Length of road (km)
13. Gillespie	Islington	2004	3.20
14. Riversdale Road area	Islington	2003	0.89
16. Hillrise West	Islington	2006	9.29
17. Moray	Islington	2007	7.32
1. New River (Bethune) Area	Hackney	2006	9.09
2. Powerscroft area	Hackney	2007	4.31
3. Lower Clapton area	Hackney	2005	6.34
4. Hoxton Street area	Hackney	1999	5.75
5. Forest Road area	Hackney	2006	9.09
6. Napier Grove area	Hackney	2006	8.27
7. Victoria Park area	Hackney	2007	7.68
8. Whiston Road area	Hackney	2005	7.30
9. Cazenove (or Triangle) area	Hackney	2007	13.70
10. Gillett Square	Hackney	2006	1.96
11. Stoke Newington	Hackney	2005	14.62
12. Hackney Downs (original) - then Brooke Road area	Hackney	2006	3.42
12. Hackney Downs (extension)	Hackney	2006	9.66
13. Queensbridge (Middleton Road) area	Hackney	1999	9.44
14. Wilton Road area	Hackney	2005	4.74
15. Falkirk	Hackney	2006	8.33
16. De Beauvoir	Hackney	2007	1.47
17. Northchurch	Hackney	2007	3.17
1. Wapping Area	Tower Hamlets	2005	16.75
2. Royal Mint Area	Tower Hamlets	2008	2.83
3. Cable Street Area	Tower Hamlets	2005	19.34
4. Narrow Street Area	Tower Hamlets	2007	7.63
5. Poplar High Street	Tower Hamlets	2004	7.51
6. Abbott Road Area	Tower Hamlets	2004	7.59
7. St Leonards Area (LBTH no 7N)	Tower Hamlets	2003	6.58
8. Teviot Area (LBTH no 7S)	Tower Hamlets	2007	7.05
9. Thomas Road Area (LBTH no 8N)	Tower Hamlets	2005	2.74
10. Chrisp Street Area (LBTH no 8E)	Tower Hamlets	2003	6.42
11. Salmon Lane Area (LBTH no 9)	Tower Hamlets	2004	9.08
12. Stepney Way Area (LBTH no 10)	Tower Hamlets		5.79
13. Whitechapel East (LBTH no 11)	Tower Hamlets		5.96
14. Whitechapel West (LBTH no 12)	Tower Hamlets	2003	2.68
15. Stepney Green Area (LBTH no 13)	Tower Hamlets	2002	3.56

Scheme name	Borough	Start Date	Length of road (km)
16. Ben Jonson Road / Harford Street Area (LBTH no 14)	Tower Hamlets	2004	8.51
17. (no name) (LBTH no 15)	Tower Hamlets	2004	6.44
18. (no name) (LBTH no 16). Includes Lincoln Neighbourhood HZ.	Tower Hamlets	2004	8.98
19. Fairfield Road Area (LBTH no 17)	Tower Hamlets	2004	1.36
20. Coburn Road/ Tredegar Square Area (LBTH no 19)	Tower Hamlets	2004	4.20
21. Old Ford - includes Parnell Road (LBTH no 19)	Tower Hamlets	2003	10.94
22. (No name) LBTH Zone 20N - includes Chisendale Rd	Tower Hamlets	2004	1.50
23. (no name) (LBTH no 20S) - includes Medway Road	Tower Hamlets	2004	2.68
24. Bancroft Road Area (LBTH no 21)	Tower Hamlets		8.45
25. Cephas Area (LBTH no 22)	Tower Hamlets	2003	7.42
26. St. James Area (LBTH no 23)	Tower Hamlets	2003	10.94
27. (no name) (LBTH no 24)	Tower Hamlets		1.81
28. Old Bethnal Green [East] (LBTH no 25)	Tower Hamlets	2004	7.91
29. Old Bethnal Green [West] (LBTH no 26)	Tower Hamlets	2004	10.91
30. Commercial Street [West] (LBTH no 29)	Tower Hamlets	2005	3.75
31. Isle of Dogs [Spindrift Avenue Area] (LBTH no 32)	Tower Hamlets	2007	6.46
1. East Greenwich Council	Greenwich	2004	19.06
2. Westcombe Park/Vanbrugh Park	Greenwich	2003	15.13
3. Maryon Park	Greenwich	2004	7.92
4. West Woolwich	Greenwich	2003	9.72
5. Thamesmead Waterfield	Greenwich	1999	2.84
6. Thamesmead Moorings	Greenwich	1999	2.44
7. Eynsham Estate (Phase 1)	Greenwich	2003	6.72
8. Brewery Road (Phase 2)	Greenwich	2000	11.38
9. Brewery Road (Phase 1)	Greenwich	2000	9.28
10. North of Plumstead High Street	Greenwich	2003	7.59
11. Herbert Road area (Phase 1)	Greenwich	1999	15.86
12. Herbert Road area (Phase 2)	Greenwich	1999	8.94
13. Dothill Area (Phase 1)	Greenwich	2001	6.65
14. Dothill Area (Phase 2)	Greenwich	2001	9.92
15. Middle Park Estate	Greenwich		9.91
16. South of Plumstead High Street	Greenwich	2004	3.17

Scheme name	Borough	Start Date	Length of road (km)
17. Woolwich Arsenal (original area)	Greenwich		5.42
17. Woolwich Arsenal	Greenwich	2005	5.28
18. South Central Greenwich	Greenwich	2005	9.15
19. Deptford Home Zone	Greenwich	2004	1.40
20. Eltham Park area	Greenwich	2006	6.71
21. Ashburnham Triangle	Greenwich	2006	2.55
1. Blackheath Village	Lewisham	2006	2.78
2. Brockley and Ladywell	Lewisham	2006	36.96
3. Catford South and Whitefoot	Lewisham	2007	38.54
4. Downham North	Lewisham	2002	16.61
5. Evelyn	Lewisham	2004	38.42
6. Glenbow Road area	Lewisham	2002	5.95
7. Honor Oak	Lewisham	2004	2.75
8. Manor Lee	Lewisham	2002	13.94
9. New Cross West	Lewisham	2005	9.47
10. Perry Vale North	Lewisham	2007	13.14
11. Rushey Green East	Lewisham	2003	4.92
12. Rushey Green West	Lewisham	2002	5.29
13. St Johns	Lewisham	2002	8.19
14. Telegraph Hill	Lewisham	2006	17.68
15. Rushley Green East Original (Now incorporated in Catofrd South and Whitefoot Area)	Lewisham	2003	2.70
1. West Walworth (formerly Surrey Gardens)	Southwark	2003	16.72
2. Barset	Southwark	2004	17.51
3. Waverley	Southwark	2004	21.62
4. Southwark Park Road	Southwark	2003	7.93
5. Sydenham Hill	Southwark	2004	11.18
6. East Dulwich	Southwark	2004	7.01
7. Willowbrook	Southwark	2004	5.10
8. Peckham Park	Southwark	2004	2.61
9.. Harper Road	Southwark	2006	3.33
10. Peckham West 2 (incorporating Bellenden)	Southwark	2006	36.69
11. The Hamlets	Southwark	1998	12.29
13. Newington	Southwark		2.28
14. East Walworth	Southwark	2007	29.67
15. Peckham North West	Southwark	2007	15.48
16. Bermondsey 1	Southwark	2007	9.61
1. Larkhall area	Lambeth	2006	10.49
2. Streatham area	Lambeth	2006	14.02
3. Abbeville area	Lambeth		2.73
3. Abbeville area (2)	Lambeth	2005	15.41
4. Woodmansterne area	Lambeth	2004	6.41

Scheme name	Borough	Start Date	Length of road (km)
5. Chatsworth area	Lambeth	2004	7.14
6. Upper Ground/Belvedere Road	Lambeth/Southwark	1998	2.43
1. Tooting	Wandsworth	1996	7.07
2. Balham	Wandsworth	1997	1.61
3. Lytton Grove	Wandsworth	1999	0.95
4. Cabul Road area	Wandsworth	2000	0.38
5. Beaumont Road/Castlecombe Drive	Wandsworth	2000	0.70
6. Magdalen Road	Wandsworth	2001	0.15
7. Broomwood Road	Wandsworth	2001	1.42
8. Magdelen Road area	Wandsworth	2001	11.86
9. Alton Road/Bessborough Road	Wandsworth	2003	1.73
10. Arnal Crescent	Wandsworth	2003	0.72
11. Hardwicks Way	Wandsworth	2006	0.33
12. Belleville Road	Wandsworth	2005	1.77
13. Erpingham Road	Wandsworth	2004	0.83
14. Allfarthing Lane	Wandsworth	2003	3.49
15. Albert Drive	Wandsworth	2002	5.15
16. Brenda Road area	Wandsworth	2002	0.60
17. Prince of Wales Drive area	Wandsworth	2000	3.74
18. Culvert Road area	Wandsworth	2000	4.83
1. Emlyn Road	Hammersmith & Fulham	1995	0.97
2. College Park Home Zone	Hammersmith & Fulham	2003	1.47
3. Grove Home Zone	Hammersmith & Fulham	2004	10.70
4. Brook Green Home Zone (original)	Hammersmith & Fulham	2003	8.56
4. Brook Green Home Zone (1st extension)	Hammersmith & Fulham	2005	3.37
4. Brook Green Home Zone (2nd extension)	Hammersmith & Fulham	2006	2.72
5. Wormholt (Sawley Road area)	Hammersmith & Fulham	2006	11.30
1. Queens Road Area	Waltham Forest	2006	15.59
2. Winns Avenue Area	Waltham Forest	2005	12.07
3. Ferndale Road Area	Waltham Forest	2004	2.99
4. Grove Road Area	Waltham Forest	2005	11.42
5. Greenleaf Area	Waltham Forest	1995	6.47
6. Coppermill Lane Area	Waltham Forest	2004	6.10
7. Low Hall Area	Waltham Forest	2005	2.58
8. Vicarage Road Area	Waltham Forest	2004	7.37
1. Cleveland Junior & Infants School, Ilford	Redbridge	1999	1.77
2. St Peter & St Paul R.C Primary School & Gordon Infants School, Ilford	Redbridge	1999	0.23
3. Wanstead Church of England Primary School, Wanstead	Redbridge	2001	0.55
4. Manford Primary School,	Redbridge	2001	1.02

Scheme name	Borough	Start Date	Length of road (km)
Hainault			
5. Mossford Green Primary School, Barkingside	Redbridge	2002	0.58
6. Glenarm College & Park School for Girls, Ilford	Redbridge	2002	0.57
7. Eastcourt Independent School & Ilford Preparatory School, Goodmayes	Redbridge	2002	0.46
8. Cranbrook College, Ilford	Redbridge	2002	0.29
9. Oaks Lane, Newbury Park	Redbridge	2002	0.75
10. Water Lane	Redbridge	2003	0.50
11. Fairlop Primary School	Redbridge	2003	0.27
12. Uphall Primary School	Redbridge	2003	0.55
13. Newbury Park Primary School	Redbridge	2003	0.24
14. Woodlands Infants & Junior School	Redbridge	2004	0.54
15. Christchurch Primary School	Redbridge	2004	0.49
16. Goodmayes Primary School	Redbridge	2004	0.42
17. St Aidans R.C. Primary School	Redbridge	2004	0.33
18. St Bedes R.C. Primary School	Redbridge	2004	0.45
19. Gearies Infants & Juniors School	Redbridge	2004	1.14
20. St Augustines Catholic Primary School	Redbridge	2006	0.44
21. Highlands Primary School	Redbridge	2006	0.87
22. Churchfields Infant & Junior School	Redbridge	2006	1.57
23. Snaresbrook Primary School	Redbridge	2006	0.91
24. Aldersbrook Primary School	Redbridge	2006	1.66
25. South Park Infants & Juniors	Redbridge	2007	1.00
1. Ardleigh Green schools	Havering	2002	1.04
2. Ayloff School	Havering	2002	1.23
3. Barnstaple Road	Havering	2003	0.52
4. Benhurst School	Havering	2002	1.37
5. Brady School	Havering	2003	0.42
6. Brittons & Whybridge Schools	Havering	2004	7.44
7. Cedar & Beulah Road	Havering	2006	0.30
8. Como Street	Havering	2007	2.15
9. Rainham Village Primary School	Havering	2002	0.96
10. Grange Road	Havering	2007	8.02
1. Leys Avenue, Dagenham	Barking & Dagenham	2001	0.42
2. Oval Road North & South	Barking & Dagenham	2001	1.63
3. Heathway/Alibon Road area	Barking & Dagenham	2004	6.44
4. Downing Road	Barking & Dagenham	2005	2.18
5. Ford Road	Barking & Dagenham	2005	1.36
6. Frizlands Lane	Barking & Dagenham	2005	0.30

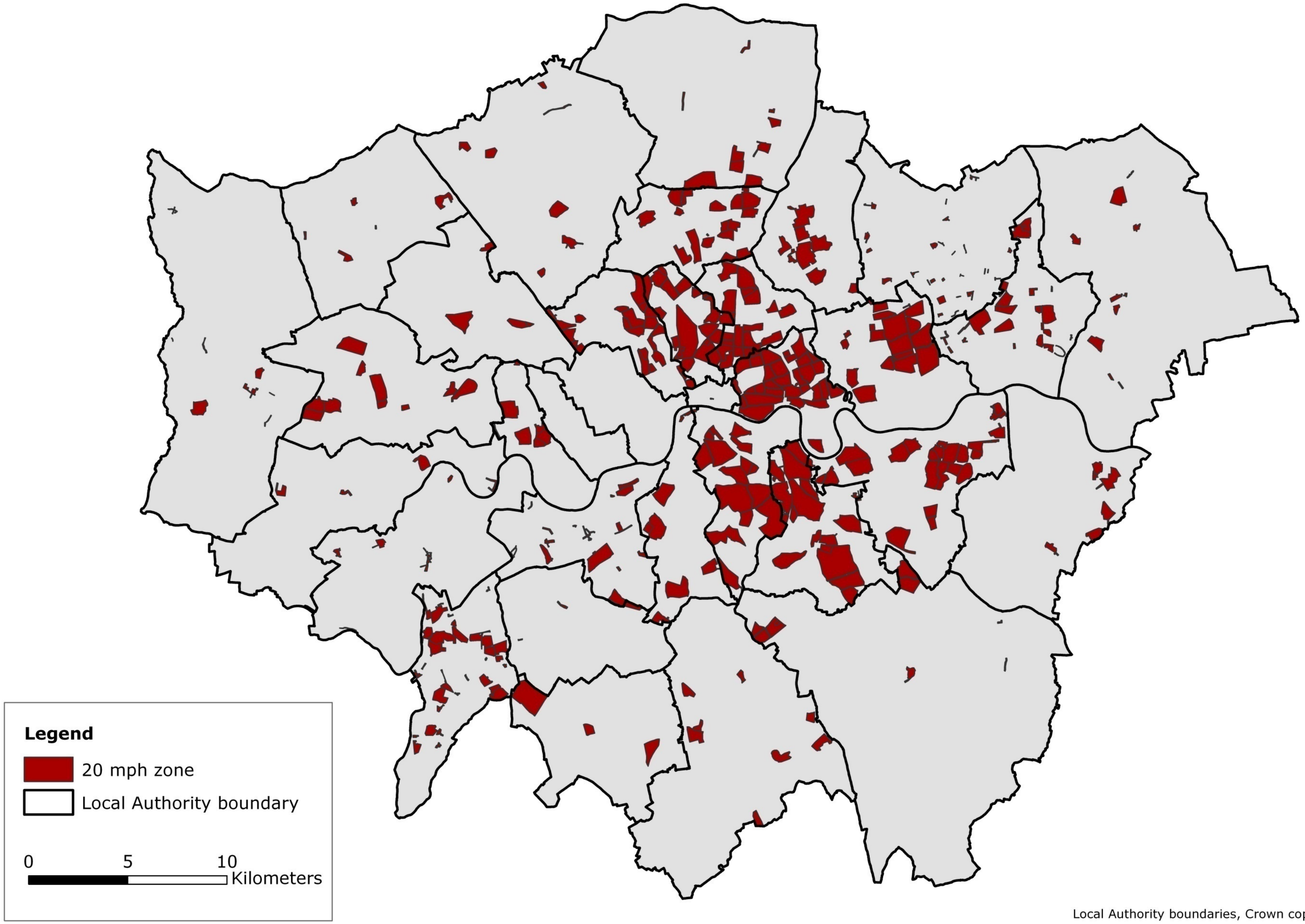
Scheme name	Borough	Start Date	Length of road (km)
7. Rose Lane	Barking & Dagenham	2005	9.13
7. Rose Lane (extension)	Barking & Dagenham		2.81
8. Westrow Drive	Barking & Dagenham	2005	16.39
9. Osborne Square	Barking & Dagenham	2005	1.09
10. Fitzstephen Road	Barking & Dagenham	2006	3.62
11. Grafton Road	Barking & Dagenham	2006	1.53
12. Gale Street	Barking & Dagenham	2006	0.44
13. Rosslyn Road	Barking & Dagenham	2006	1.40
14. Ripple School Zone	Barking & Dagenham	2006	0.42
15. Lichfield Rd	Barking & Dagenham	2006	5.54
16. Gascoigne Junior School	Barking & Dagenham	2006	0.77
17. Rugby Road	Barking & Dagenham	2006	5.03
18. Broadway, Barking	Barking & Dagenham	2006	2.04
19. Marsh Green	Barking & Dagenham	2006	1.63
20. Heathway (shopping centre/station)	Barking & Dagenham	2007	0.65
21. Stevens Road area	Barking & Dagenham	2001	3.12
1. Little Ilford area	Newham	2001	9.39
2. Upton area	Newham	2002	6.60
3. Plashet Road area	Newham	2004	20.08
4. Carlyle Road Area	Newham	2004	0.51
5. Kensington area	Newham	2004	8.25
6. Balmoral Road Area	Newham	2005	5.99
7. Forest Road Area	Newham	2004	0.95
8. Chaucer Road Area	Newham	2005	1.17
9. Vernon Road Area	Newham	2004	1.88
10. Hubbard, Mortham & Rokeby	Newham	2004	2.36
11. Wakefield area	Newham	2004	14.94
12. Central Park North	Newham	2006	3.87
13. Central Park South	Newham	2006	11.01
14. Kier Hardie area	Newham	2005	15.40
15. Tilney Road area	Newham	2007	4.50
16. Liverpool area	Newham	2008	8.51
17. New City Road area	Newham	2008	6.20
18. Wall End area	Newham	2007	14.24
19. Flanders Road area	Newham	2007	16.10
1. Arthur Street (Boundary Street) area	Bexley	1998	0.76
2. Barnes Cray area	Bexley	1999	6.27
3. Bexley Village	Bexley	2003	2.92
4. Reddy Road area	Bexley	2006	5.05
5. Heath Road area	Bexley	2006	5.81
6. Slade Green area	Bexley	2005	9.88
1. Marlow Road area	Bromley	2005	5.12
2. Selby Road area	Bromley	2006	2.27

Scheme name	Borough	Start Date	Length of road (km)
3. Mottingham Estate area	Bromley	2003	9.05
4. Mottingham Estate North	Bromley	2006	5.89
5. Birkbeck Road area (original - then Royston Road area)	Bromley		0.94
5. Birkbeck Road area	Bromley	2001	5.66
6. St Mary Cray area	Bromley	2002	1.10
7. Grays Farm Road	Bromley	2001	0.31
8. Magpie Hall Lane/Turpington Road area	Bromley	2006	3.36
1. Waddon South	Croydon	2002	6.85
2. Waddon North	Croydon	2003	3.13
3. Fieldway	Croydon	2003	5.05
4. Hamsey Green	Croydon	2004	3.39
5. Northway Road	Croydon	2004	2.64
6. Monks Hill	Croydon	2006	7.20
7. Shrublands	Croydon	2005	3.99
8. Broad Green	Croydon	2006	5.04
1. Worcester Park	Sutton	1993	22.33
2. Onslow Gardens	Sutton	2005	6.59
3. New Town area (Sutton Town)	Sutton	2006	4.71
1. North Mitcham	Merton	1995	4.34
2. Wimbledon Town Centre	Merton	2001	1.27
3. Lavender Fields	Merton	2004	0.24
1. Elm/Rhodrons	Kingston-upon-Thames	2002	4.21
3. Moor Lane/Buckland School	Kingston-upon-Thames	2007	1.59
4. St Mary's School	Kingston-upon-Thames	2007	0.85
5. Lovelace School	Kingston-upon-Thames	2004	0.52
6. Wimpey Estate (also known as Winey Park area)	Kingston-upon-Thames	2002	2.43
7. Tolworth Girl's School	Kingston-upon-Thames	2007	0.94
8. Tolworth West 20mph Zone	Kingston-upon-Thames	1995	5.76
9. Maple Road	Kingston-upon-Thames	2005	0.50
10. Balaclava Road Area	Kingston-upon-Thames	2006	1.20
11. Our Lady Immaculate School	Kingston-upon-Thames	2006	0.86
12. Grand Avenue School	Kingston-upon-Thames	2001	0.39
13. King Charles Road	Kingston-upon-Thames	2005	3.14
14. Roads in the vicinity of Kings Road	Kingston-upon-Thames	2006	6.88
15. Manorgate Home Zone (previously Carlisle Close area)	Kingston-upon-Thames	2004	0.79
16. Lower Ham Road Area	Kingston-upon-Thames	2003	2.45
17. Spring Grove Area	Kingston-upon-Thames	2003	5.42
18. Cambridge, Villiers and Fairfield Area	Kingston-upon-Thames	2006	11.54
19. Canbury Zone	Kingston-upon-Thames	2004	0.52
20. Kingston Town Centre	Kingston-upon-Thames	2004	4.07

Scheme name	Borough	Start Date	Length of road (km)
21. Latchmere Road	Kingston-upon-Thames	2004	0.34
22. Norbiton Estate	Kingston-upon-Thames	2006	5.24
23. Robin Hood School	Kingston-upon-Thames	2005	0.34
24. Clarence Avenue 20mph zone	Kingston-upon-Thames	2003	1.32
25. The Groves	Kingston-upon-Thames	1991	3.53
26. Mount Pleasant Road area	Kingston-upon-Thames	2006	3.71
27. Cambridge Road area	Kingston-upon-Thames	2002	3.19
28. Dukes Avenue area	Kingston-upon-Thames	1998	5.81
29. New Malden High Street	Kingston-upon-Thames	2006	0.87
30. Holy Cross School Safety Zone	Kingston-upon-Thames	2007	0.21
31. Cavendish Road Home Zone	Kingston-upon-Thames	2004	1.14
32. Blakes Lane 20mph zone	Kingston-upon-Thames	2005	0.37
33. Painters Estate 20mph zone	Kingston-upon-Thames	2004	3.38
34. The Manor Drive area	Kingston-upon-Thames	2006	5.12
35. Church Road 20mph zone	Kingston-upon-Thames	2004	2.14
1. Heatham Park	Richmond-upon-Thames	2000	2.94
2. Petersham 'Phase 1'	Richmond-upon-Thames	2001	2.25
2. Petersham 'Phase 2'	Richmond-upon-Thames	2002	0.60
2. Petersham 'Phase 3'	Richmond-upon-Thames	2003	0.48
2. Petersham 'Phase 4'	Richmond-upon-Thames	2004	0.07
3. Leyborne Park	Richmond-upon-Thames		0.65
4. Hampton Village	Richmond-upon-Thames	2004	0.98
5. Hospital Bridge Road (Bishop Perrin CE Primary School)	Richmond-upon-Thames	2002	0.13
Wykeham estate	Richmond-upon-Thames	2003	1.45
1. Dukes Meadows	Hounslow	1995	1.34
2. Brentford (original)	Hounslow	1998	0.69
2. Brentford (extension)	Hounslow		4.80
3. Alexandra School	Hounslow	2002	1.47
4. Berkeley Avenue area, Cranford	Hounslow	2005	3.91
1. Belmore Parade, Hayes	Hillingdon	2006	0.29
2. Coldharbour Lane, Hayes	Hillingdon	2006	0.56
3. Harefield village centre	Hillingdon	2005	1.01
4. Hayes Manor School	Hillingdon	2000	2.45
5. Hayes Park School area	Hillingdon	2001	1.87
6. Rockingham Parade, Uxbridge	Hillingdon	2006	0.17
7. Station Road, Uxbridge	Hillingdon	2001	0.25
8. Vine Lane, Hillingdon	Hillingdon	2005	1.19
9. Whitethorn Estate	Hillingdon	1996	8.50
1. Costons Lane area, Greenford	Ealing	2006	2.63
2. Ingram Way area, Greenford	Ealing	2006	10.43
3. Woodlands Road area, Southall	Ealing	2005	9.05
4. Dane Road/Carlyle Ave area,	Ealing	2005	8.36

Scheme name	Borough	Start Date	Length of road (km)
Southall			
5. Saxon Drive, Acton	Ealing	2006	8.39
6. Queens Drive / Princes Gardens area, West Acton	Ealing	2005	5.36
7. Poets Corner, Hanwell	Ealing	1999	2.94
8. Cuckoo Estate, Castle Bar Park	Ealing	2002	12.26
9. Five Roads, West Ealing	Ealing	2002	1.09
10. North Road/Dormers Wells area, Southall	Ealing	2007	9.58
1. Springfield Mount/Coniston Gardens area	Brent	2004	3.41
2. Oakington Manor Drive/Vivian Avenue area	Brent	2005	10.75
3. Chapter Road area	Brent	2006	6.62
4. St Paul's Avenue area	Brent	2004	1.62
1. Little Stanmore	Harrow	1996	4.66
2. West End Lane (West Lodge School), Pinner	Harrow	2005	0.58
3. Wealdstone High Street	Harrow	2003	0.25
4. Whittlesea Road (Cedars School)	Harrow	2005	1.35
5. Dorchester Avenue (Vaughan School)	Harrow	2004	3.07
1. Byng Road area	Barnet	2001	1.04
2. Broadfields Avenue-Bushfield Crescent area	Barnet	2001	2.84
3. Hampstead Garden Suburb	Barnet	2002	4.48
4. Mays Lane	Barnet	2002	2.76
5. St Mary's	Barnet	2002	6.36
6. Marble Drive	Barnet	2002	2.00
7. Mill Hill County	Barnet	2003	2.53
1. Gladesmore, Tottenham	Haringey	1996	7.16
2. North Tottenham Phase 1 (area A) or 'Spurs A'	Haringey	2001	8.29
Extension to N Tottenham Phase 1: Brantwood Road area	Haringey		0.99
3. North Tottenham Phase 2 (area B) or 'Spurs B'	Haringey	2001	6.94
4. North Tottenham Phase 3 (area C) or 'Spurs C'	Haringey	2002	5.75
5. Napier Road (original)	Haringey	1997	4.50
5. Napier Road (extension)	Haringey	1998	3.38
6. Linden Road home zone	Haringey	2006	0.10
7. Tower Gardens estate, Tottenham	Haringey	2006	6.40
8. Myddleton Road/Whittington Road area	Haringey	2002	8.07
9. The Ladder	Haringey	2003	9.83
10. West Green area	Haringey	2006	4.47

Scheme name	Borough	Start Date	Length of road (km)
11. Woodlands Park	Haringey	2004	4.99
12. South Tottenham	Haringey	2006	4.07
13. Muswell Road area, Muswell Hill	Haringey	2005	8.14
14. Barratt Avenue area, Wood Green	Haringey	2002	1.56
16. Woodside Road area	Haringey	2008	4.18
17. Stroud Green	Haringey	2007	7.59
15. Hornsey Lane	Haringey	2004	1.95
1. no name (Upper Edmonton area)	Enfield	1995	9.85
2. no name (Orchard Road area)	Enfield	2000	0.96
3. World's End Lane	Enfield	2001	1.37
4. no name (Cuckoo Hall Lane area)	Enfield	2000	4.92
5. Pymmes Park	Enfield	2001	6.39
5. Pymmes Park (extension)	Enfield		4.96
6. no name (Princes Avenue area)	Enfield	2001	18.07
7. Monmouth Road area	Enfield	2002	6.40
8. Forty Hill	Enfield	2004	0.94



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