

Sustainable Safety

History, concepts, and implications
for street design

What is it?

'Duurzaam Veilig'

Literally – 'durable/lasting safety'

Intrinsic Safety







Makes life better for *everyone*, whatever mode of transport they are using.



Not just about 'cyclists' - easier to campaign for?

What's it all about?

In a nutshell -

- 1) Preventing crashes from occurring.
- 2) If crashes cannot be prevented, reduce crash severity.

“In a sustainably safe road traffic system, infrastructure design inherently and drastically reduces crash risk. Should a crash occur, the process that determines crash severity is conditioned in such a way that severe injury is almost excluded.”

Naar een duurzaam veilig wegverkeer [Towards sustainably safe road traffic], Koornstra et al., 1992

It is **human-focused**.

In two important ways -

- 1) Human **physical vulnerability**, and preventing us from being injured.
- 2) The 'human component' – our **behaviour** on roads and streets.

“The central issue is that people, even if they are highly motivated to behave safely while using the road, make errors that may result in crashes.”

Advancing Sustainable Safety, SWOV, 2005

“Since humans make errors and since there is an even higher risk of fatal error being made if traffic rules set for road safety reasons are intentionally violated, it is of great importance that safety nets absorb these errors. Behold the Sustainable Safety approach in a nutshell! A type of approach that, incidentally, has been commonplace in other transport modes for a much longer time under the name of ‘inherently safe’.”

Advancing Sustainable Safety, SWOV, 2005

“Sustainable Safety aims to ensure that road safety depends as little as possible on individual road user decisions. The responsibility for safe road use should not be placed solely on the shoulders of road users but also on those who are responsible for the design and operation of the various elements of the traffic system.”

Advancing Sustainable Safety, SWOV, 2005

From a *reactive* approach to a *preventive* approach

Anticipating what might happen, based on established human behaviour, and applying measures to prevent it from happening, and to mitigate severity of outcomes if it does.

Hierarchy of Controls

Most effective



Least effective



Why did the Netherlands adopt Sustainable Sustainable Safety?

In short – **economics.**

In 2004 it was estimated that road crashes still cost the Netherlands €9 billion per year.

Absolute safety is impossible.

So focus is on 'avoidable incidents', where

- 1) there is clear knowledge and evidence about how to prevent these kinds of incidents occurring in future, and to minimise their severity, and
- 2) it is cost-effective to do so.

How successful has Sustainable Safety been?

NL fatality rate is similar to the UK. But...

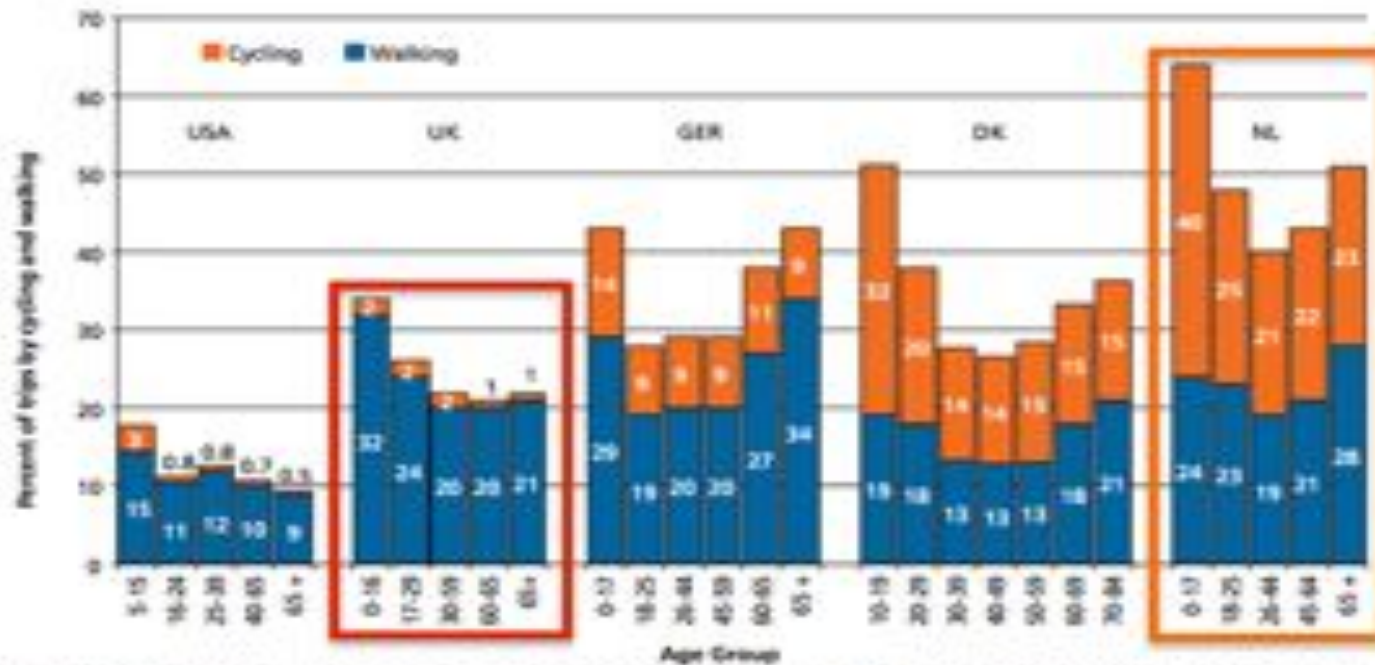
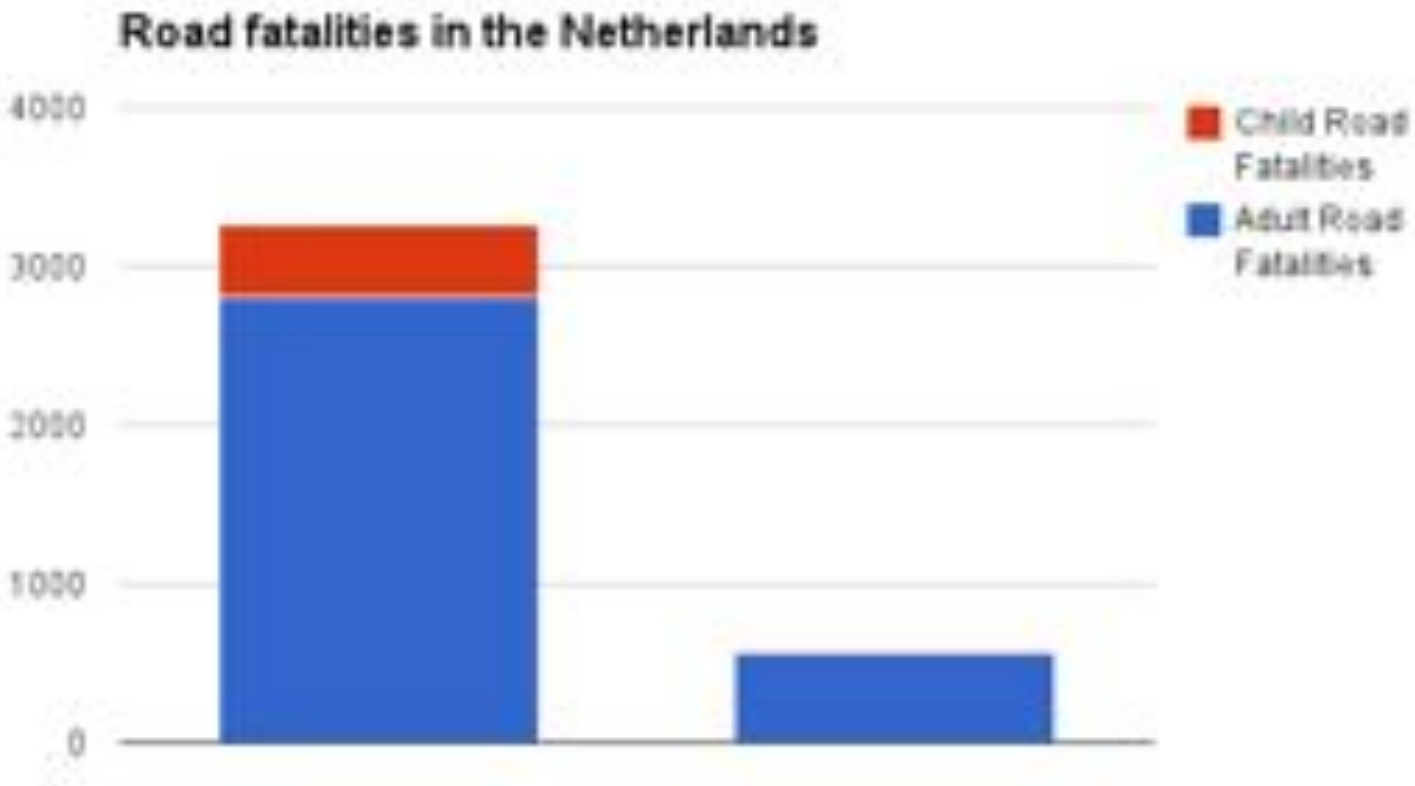
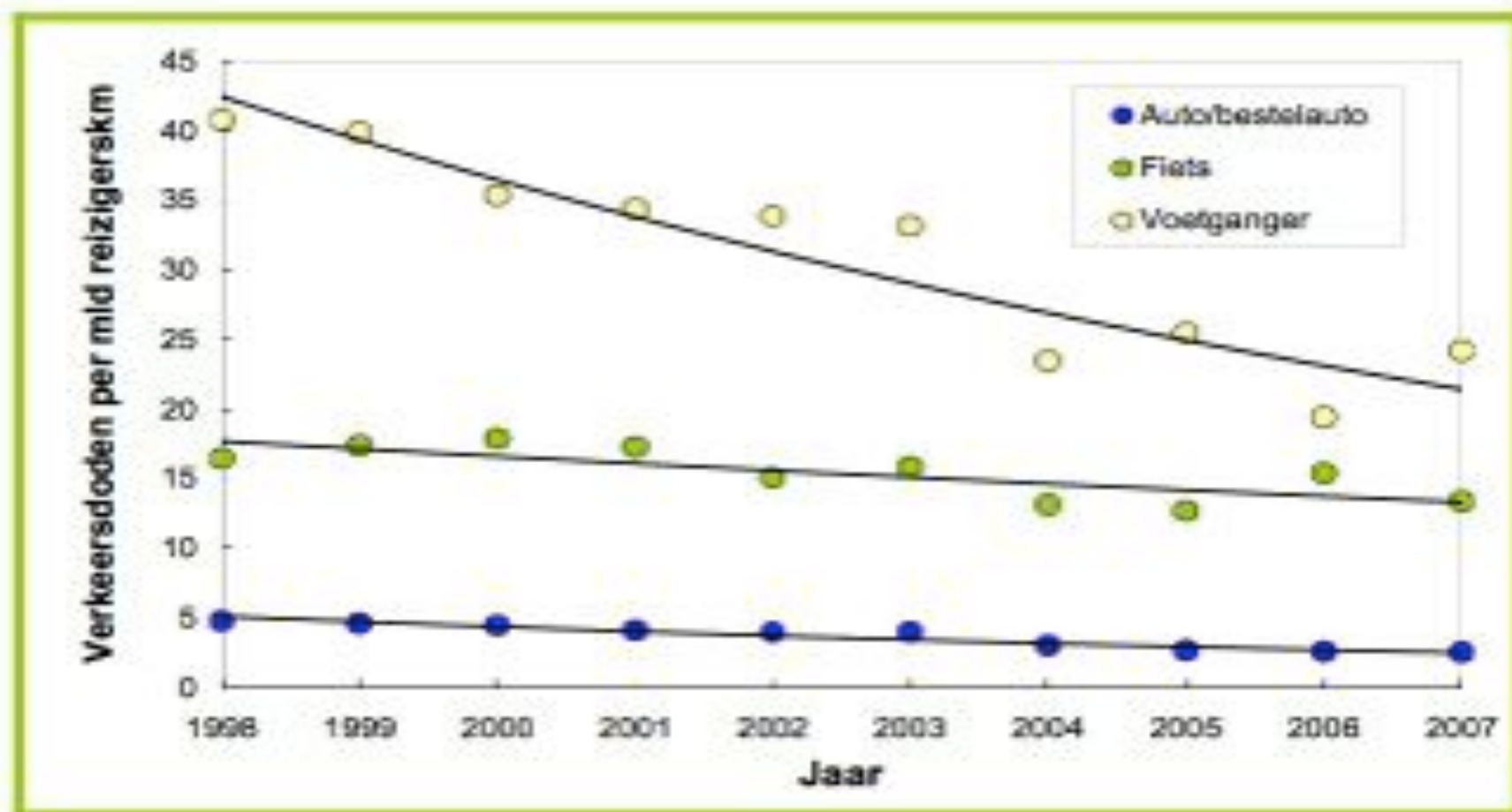


FIGURE 3 Cycling and walking share of trips within each age group in the Netherlands, Denmark, Germany, the United Kingdom, and the United States, 2009, as percent of trips by all modes for all trip purposes. Note: Each country uses somewhat different age categories in travel surveys. The percentages shown refer to the walking and cycling share of all trips made by persons within each age category. (Sources: Danish MOT, British DfT, German MOT, Netherlands MOT, and U.S. DOT.)

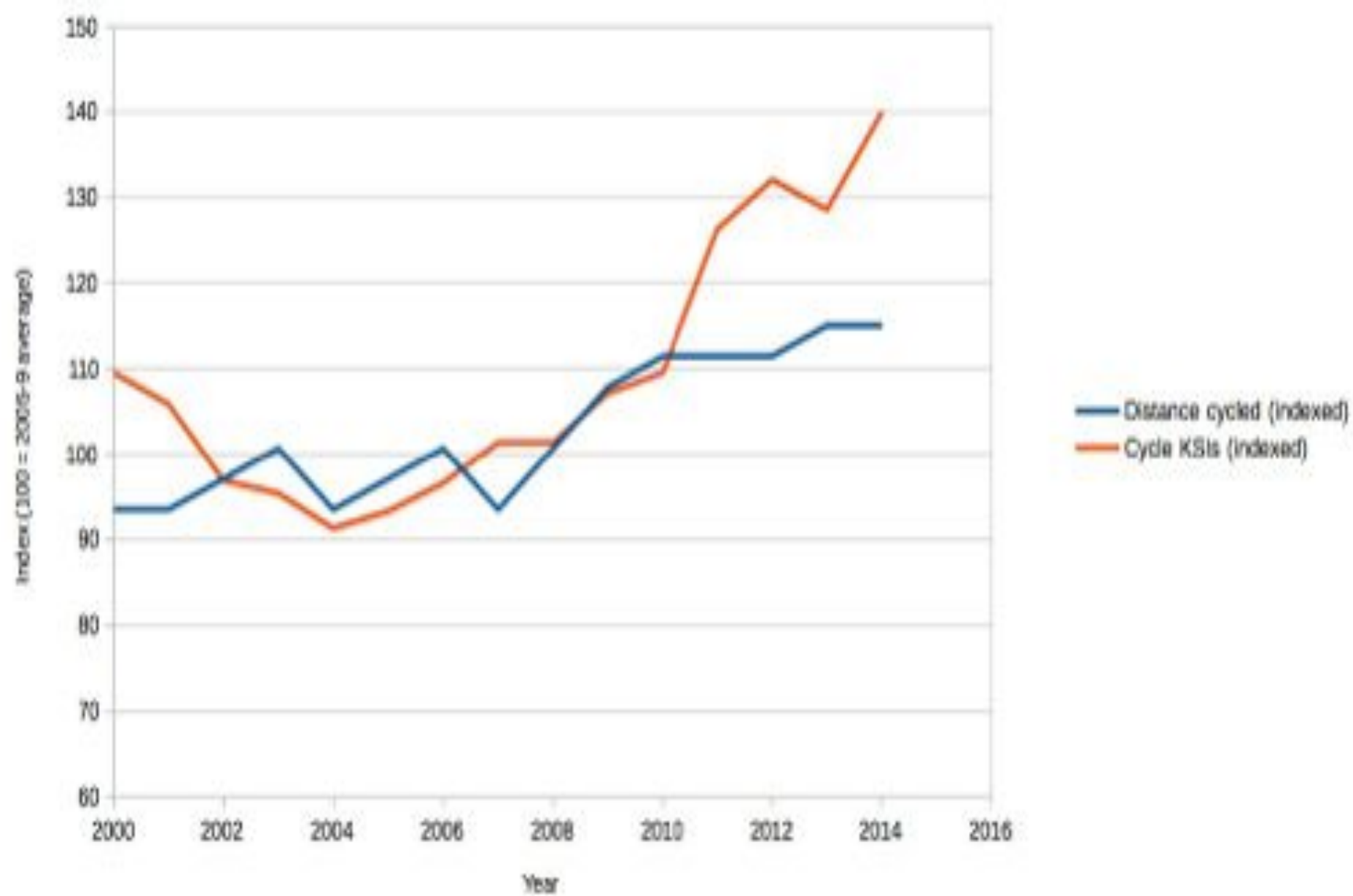
Despite increase in motor traffic, and child cycling rates maintained -



1972 vs. 2013 www.aviewfromthecyclepath.com



Afbeelding 8.4. *Trendmatige ontwikkeling in het aantal verkeersdoden per miljard reizigerskilometer voor voetgangers, fietsers en inzittenden van auto's en bestelauto's (bronnen: DVS, CBS).*



Not *just* due to Sustainable Safety. Over same period cycle network has been developed, improved, and extended.



It's not old!

1992 – First 'Sustainable Safety' document appears.

1997 – 'Start up programme'

2005 – 'Advancing Sustainable Safety'

The principles of Sustainable Safety

- (Mono) functionality
 - Homogeneity
 - Predictability
 - **Forgivingness**
 - **State awareness**

(Mono) functionality

Or, 'single function roads', in plain English!

Since the 1990s, all Dutch roads and street have to be classified, by law, according to their function. Whether they are an

- access road (ETW)
- distributor road (GOW)
 - or through road

(Mono) functionality

Through roads are for fast traffic, travelling longer distances, in large volumes. Motorways, trunk roads, bypasses, and so on. Roads humans won't 'engage with', by design.



(Mono) functionality

Access roads are the 'end destinations' for journeys – places where people live, work, shop, relax, and so on.



(Mono) functionality

Crudely, through roads are about facilitating traffic flow, while access roads are about daily life. They are 'rooms'.



(Mono) functionality

Distributor roads connect up access roads, and link them to through roads (and vice versa). These are actually the most problematic of the three types in terms of safety, due to this (slightly) mixed function. However distributor roads are still clearly defined.



Homogeneity

The **mass**, **speed** and **direction** of users should be equalised as much as is possible.

Intention (as with monofunctionality) is to minimise number of interactions, and their severity.



Homogeneity

Implications – cycling not mixed with heavy vehicles, or fast moving ones. No cycling accommodated in bus lanes.



Homogeneity

And where users of very different mass *have* to share space (e.g. on access roads) the speed of the object of large mass should be set so that, if a collision were to occur, serious or fatal injuries should not be sustained.



Predictability

Or – **instantly recognisable road design.**

About the message road environment sends to user.



Predictability

Design should make sense. The behaviour that is expected should be obvious.



Predictability

“Speed limits have to be credible for the road user; that is: they have to be seen as logical in the given circumstances.”

“a sustainably safe road traffic system benefits from road users who spontaneously obey traffic rules from a normative point of view. To achieve this, traffic regulations have to fit with the environment.”

Advancing Sustainable Safety, SWOV, 2005

Predictability

Finally – about **consistency** and **continuity**. Same design types and rules; no surprises.



Forgivingness

About accommodating human fallibility.

We will all make mistakes. Some of us will even *intentionally* break rules.

Forgivingness aims to minimise consequences of honest mistakes *and* deliberate rule-breaking.

Forgivingness



Forgivingness



Forgivingness



Forgivingness

And also about the small details.



State awareness

In essence – **education**.

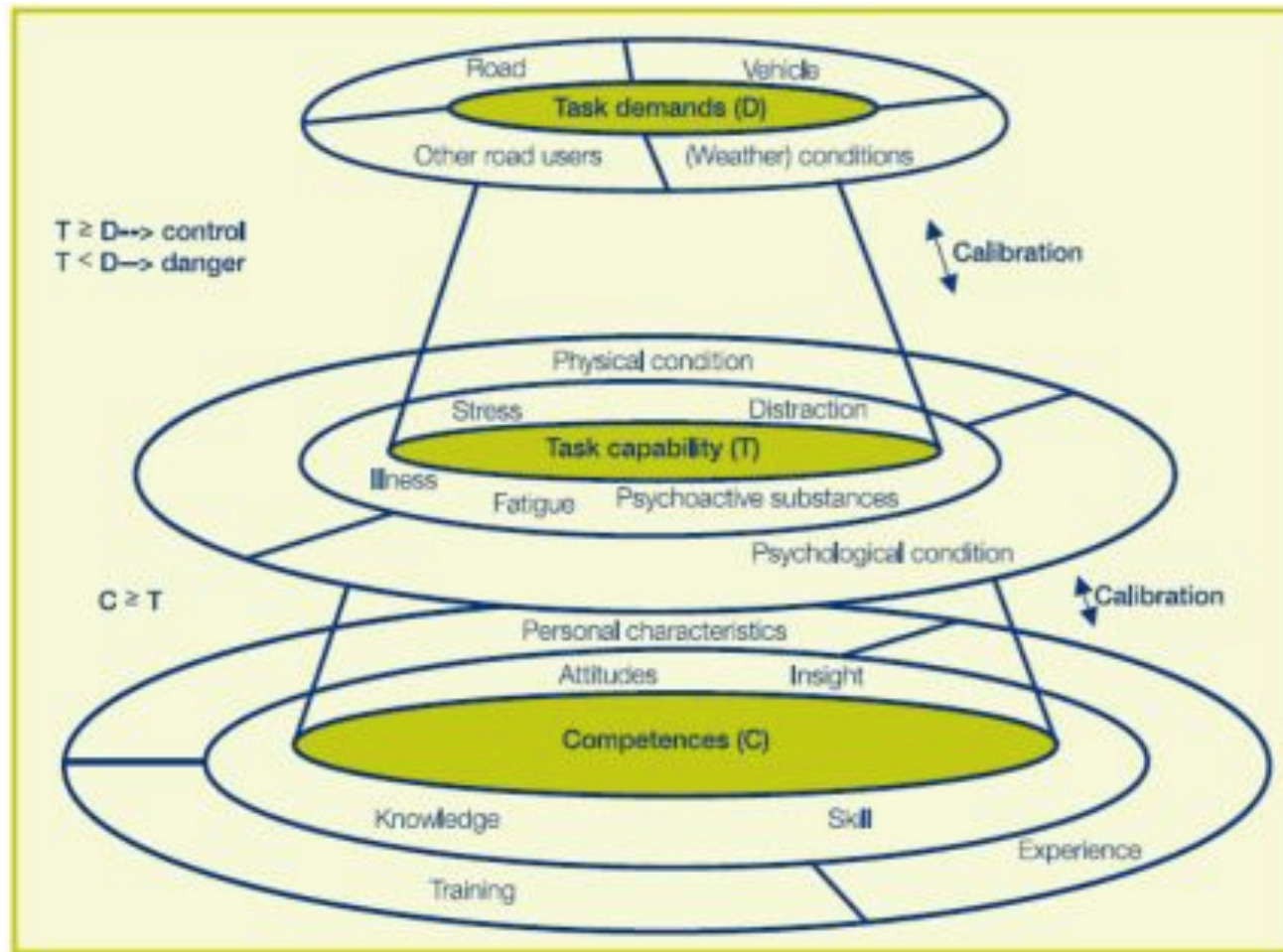
Recognition that not all human beings are the same. Some may be more prone to risk taking; some not so good at processing information, determining speeds, and so on (e.g. children, the elderly).

State awareness

“Education is not a panacea, it cannot be a substitute for other interventions (a sustainably safe road user environment), but it does provide an essential complement to them.”

Advancing Sustainable Safety, SWOV, 2005

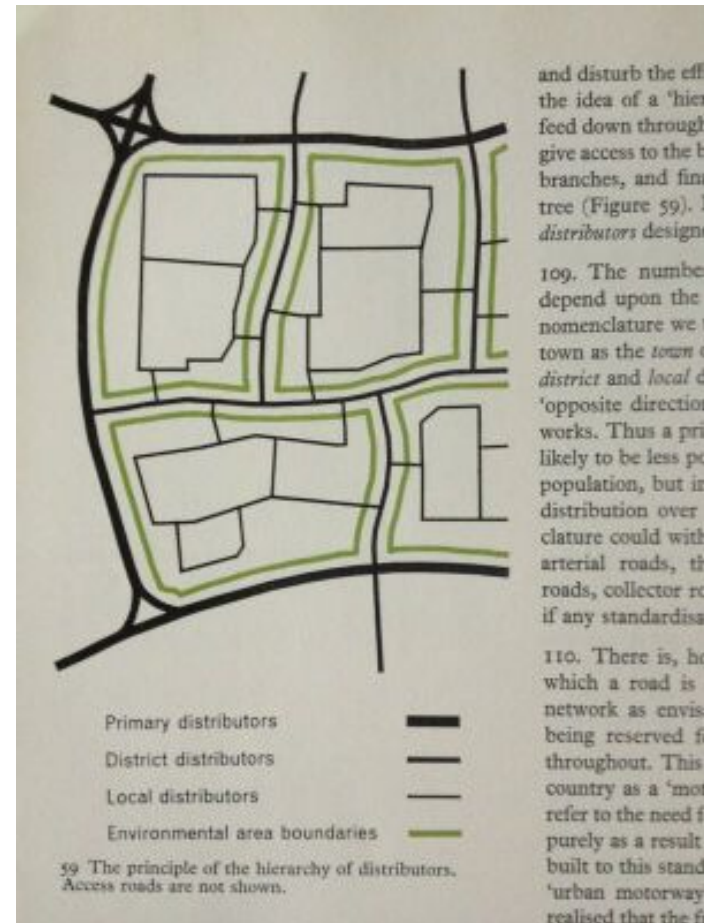
State awareness



Monofunctionality, and its implications

This is actually a British idea!

'Functionality' originates with 1963's *Traffic in Towns* report



*“The need for a hierarchy of distributors. The function of the distributory network is to canalise the longer movements from locality to locality. The links of the network should therefore be designed for swift, efficient movement. This means that they cannot also be used for giving direct access to buildings, nor even to minor roads serving the buildings, because the constant frequency of the junctions would give rise to traffic dangers and disturb the efficiency of the road. It is therefore necessary to introduce the idea of a 'hierarchy' of distributors, whereby important distributors feed down down through distributors of lesser category to the minor roads which give access to the buildings... **Basically, however, there are only two kinds of roads – distributors designed for movement, and access roads to serve the buildings.**”*

Traffic in Towns, 1963

Why was dividing roads up by type seen as necessary?

“It is being seriously suggested here that the time is fast approaching when hundreds of streets in hundreds of towns and villages, will have to be classified for their primary function, and if it is an environmental function (e.g. shopping, residential) then the yardstick for all planning and improvement works must be the environmental capacity. Otherwise streets will steadily become more unpleasant, and people will begin to forsake them for places where comprehensive development has been undertaken and far better conditions are offered.”

Traffic in Towns, 1963

High streets that are 4 lane trunk roads...



... Quaint villages blighted by through traffic...



... Residential streets used as through routes...



... And so on!

The 'environmental capacity' of so many roads in Britain has been exceeded, and their quality has been destroyed, precisely as Buchanan predicted would happen if no action was taken.

“The several ways in which motor vehicles menace environment are through danger and intimidation, noise, fumes, vibration, severance, and visual intrusion...They are largely experienced on account of the ubiquitous presence of the vehicular urban street, a form of development which now seems as though it were specially designed to produce these adverse effects. **If we could get rid of such streets many of these problems would disappear.**”

Traffic in Towns, 1963

“Environmental areas... are the 'rooms' of the town; they are the areas or groups of buildings and other development in which daily life is carried on, and where, as a consequence, it is logical that the maintenance of a good environment is of great importance... **There [should be] no extraneous traffic, no drifts of traffic filtering through without business in the area.**”

Traffic in Towns, 1963

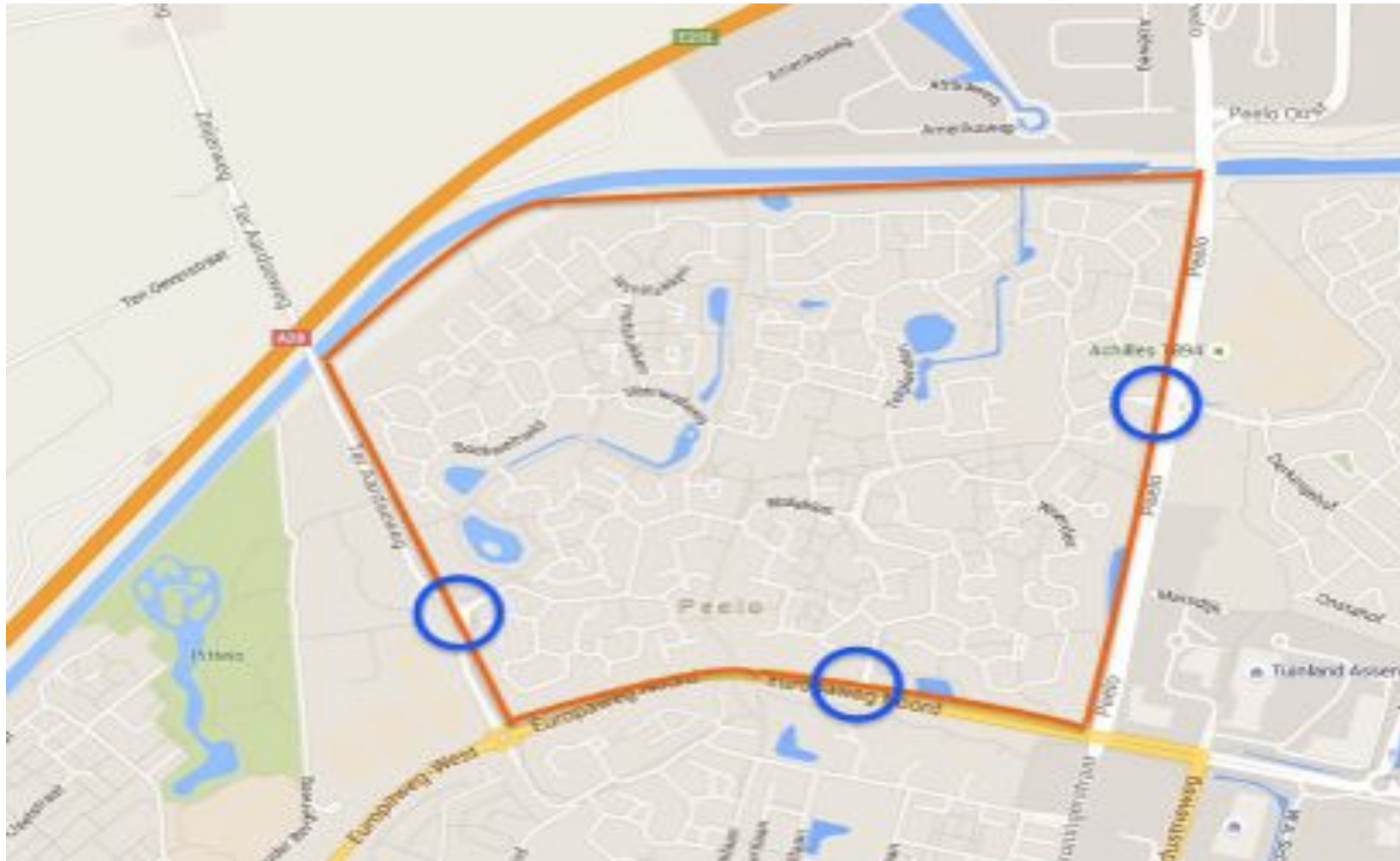
How big should 'environmental areas' be?

Conditional on the amount of motor traffic generated (or expected) within that environmental area.

'The maximum size of an environmental area is governed by the need to prevent its own traffic building up to a volume that in effect necessitates sub-division by the insertion of a further distributory link in the network... **Any environmental area must have a maximum acceptable level of traffic.** [Consider] the case of an area of terraced houses in conventional streets with narrow pavements. The amount of traffic within such an area would obviously have to be curtailed if reasonable standards of environment were to be secured.'

Traffic in Towns, 1963

Dutch 'environmental areas' are large.



Why is this desirable?

- Large environmental areas mean large amounts of **access** road, and not much length of **distributor** road.
- **Access** roads are safe, compared to distributor roads. Only 6% of severe injuries to NL cyclists occur on access roads.
- **Distributor** roads have a disproportionate amount of crashes in NL, because they have the most 'mixed' functions.

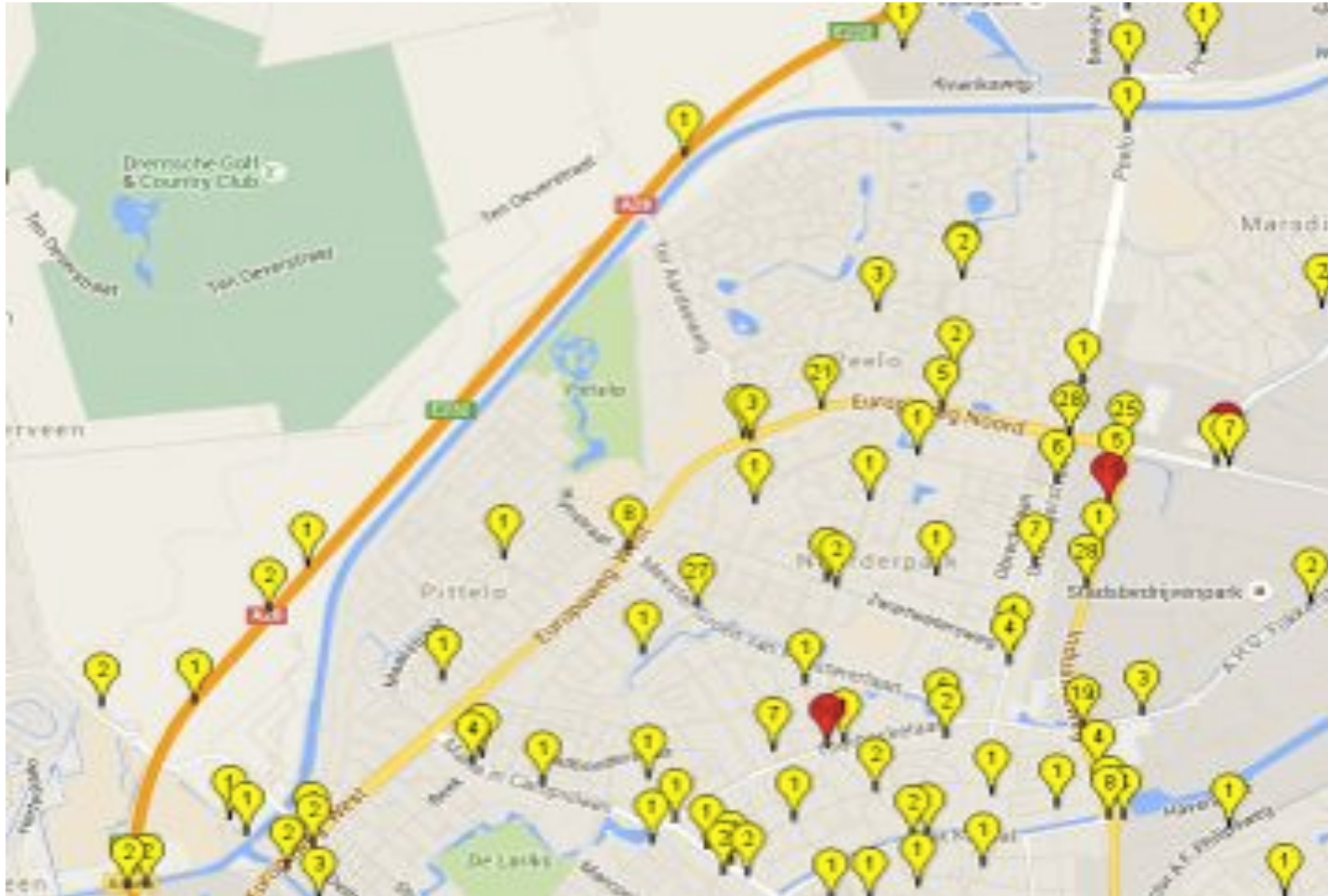
CROW Manual bicycle safety requirements, derived from Sustainable Safety -

- “Construction of as extensive tracts of uninterrupted residential area as possible”
- “A minimum part of the journey on relatively dangerous roads”

Intention is to minimise potential for conflict,
and the overall number of severe collisions.

Severe collisions unlikely to happen on access roads because of low design speed, and limited amount of motor traffic in general (access roads should be 'burdened minimally' with motorised traffic).

And it works.



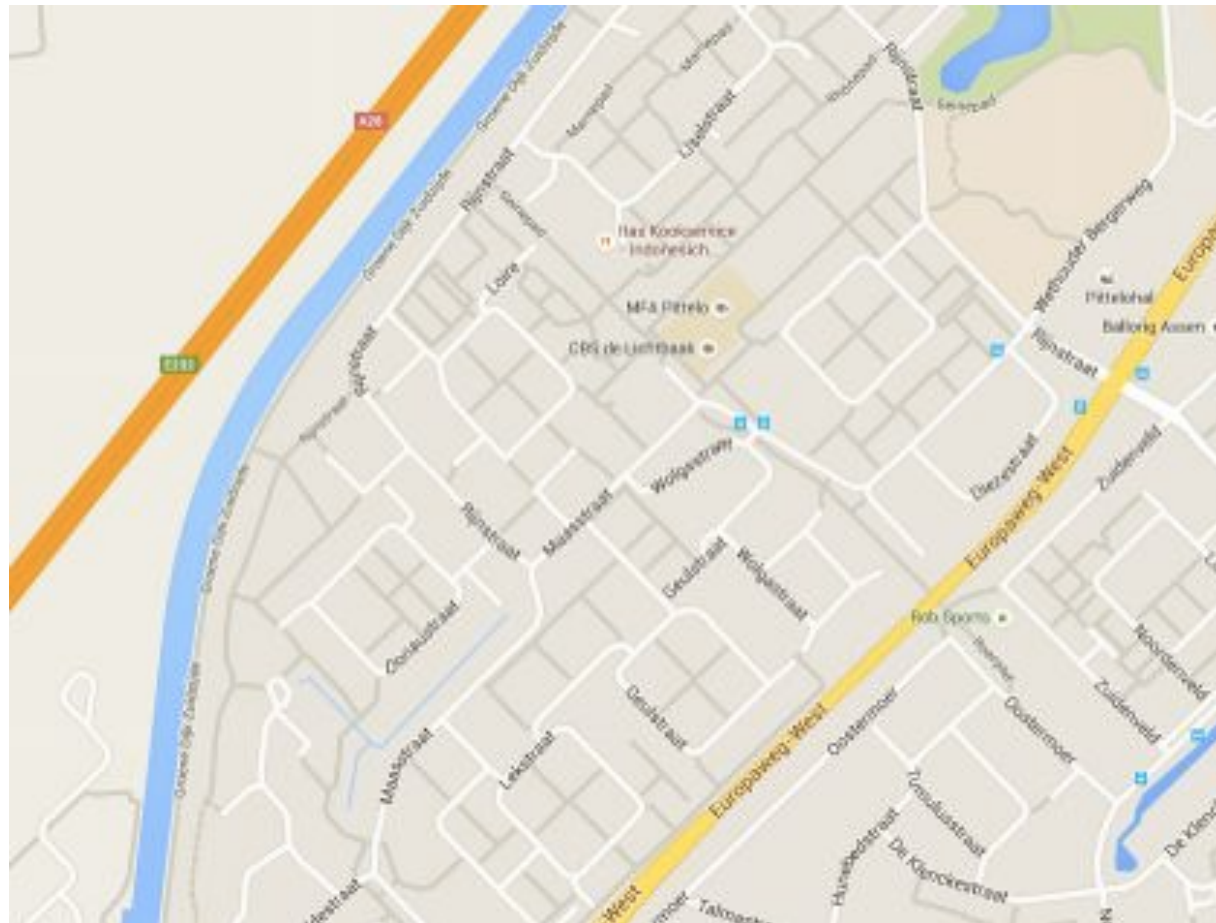
“Mixing functions leads to conflicting road design requirements and, hence, to unclear road design for road users, resulting in higher risks. A road network functions properly if function, design and usage (behaviour) are well tuned.”

Advancing Sustainable Safety, SWOV, 2005

'Unbundling'

Unbundling amounts to classifying roads according to one of the three types (access, distributor, through) **but also** into the first and last types as much as possible, which are the most safe, and enable the most separation between humans and motor traffic.

Dense cycle network grid should be retained



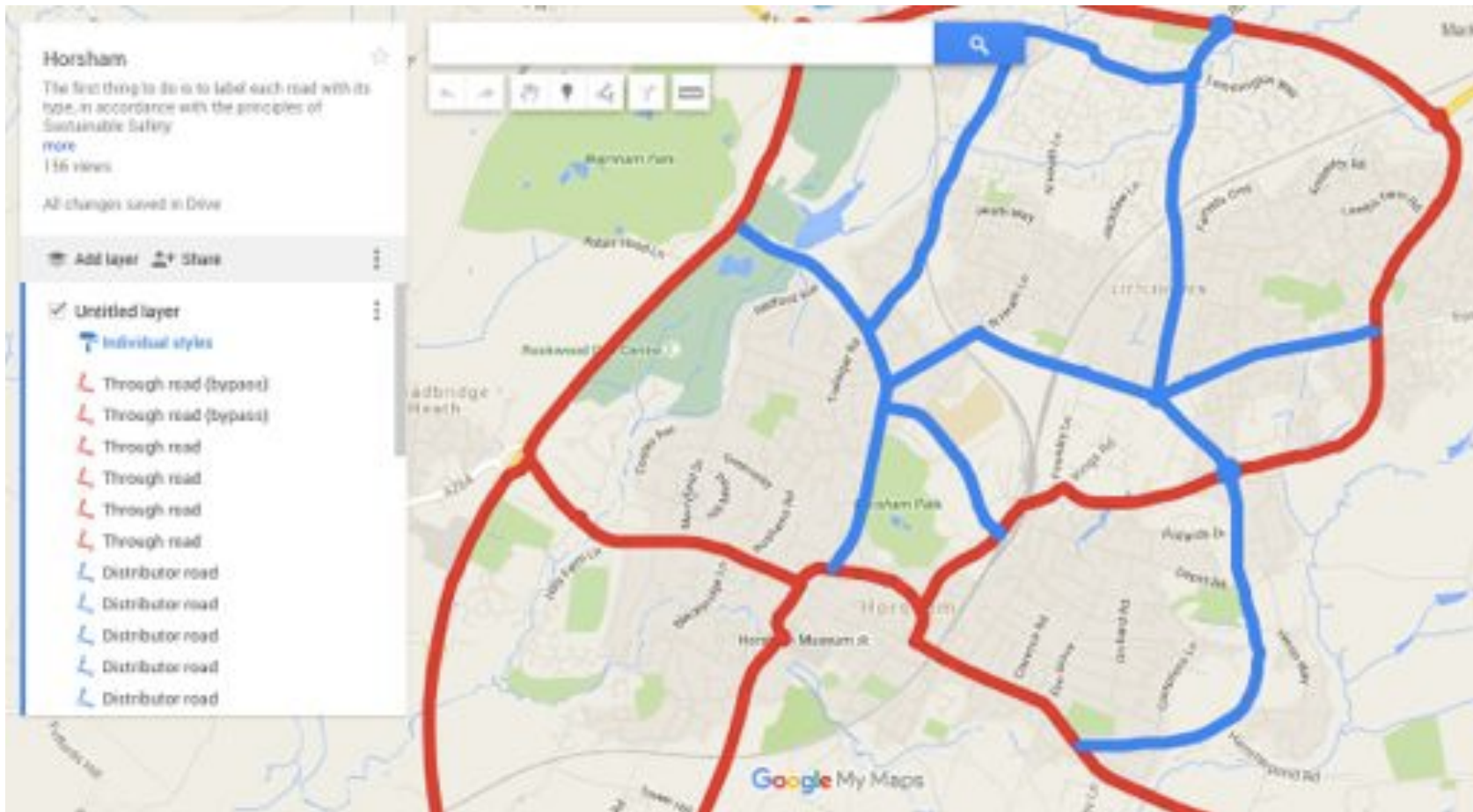




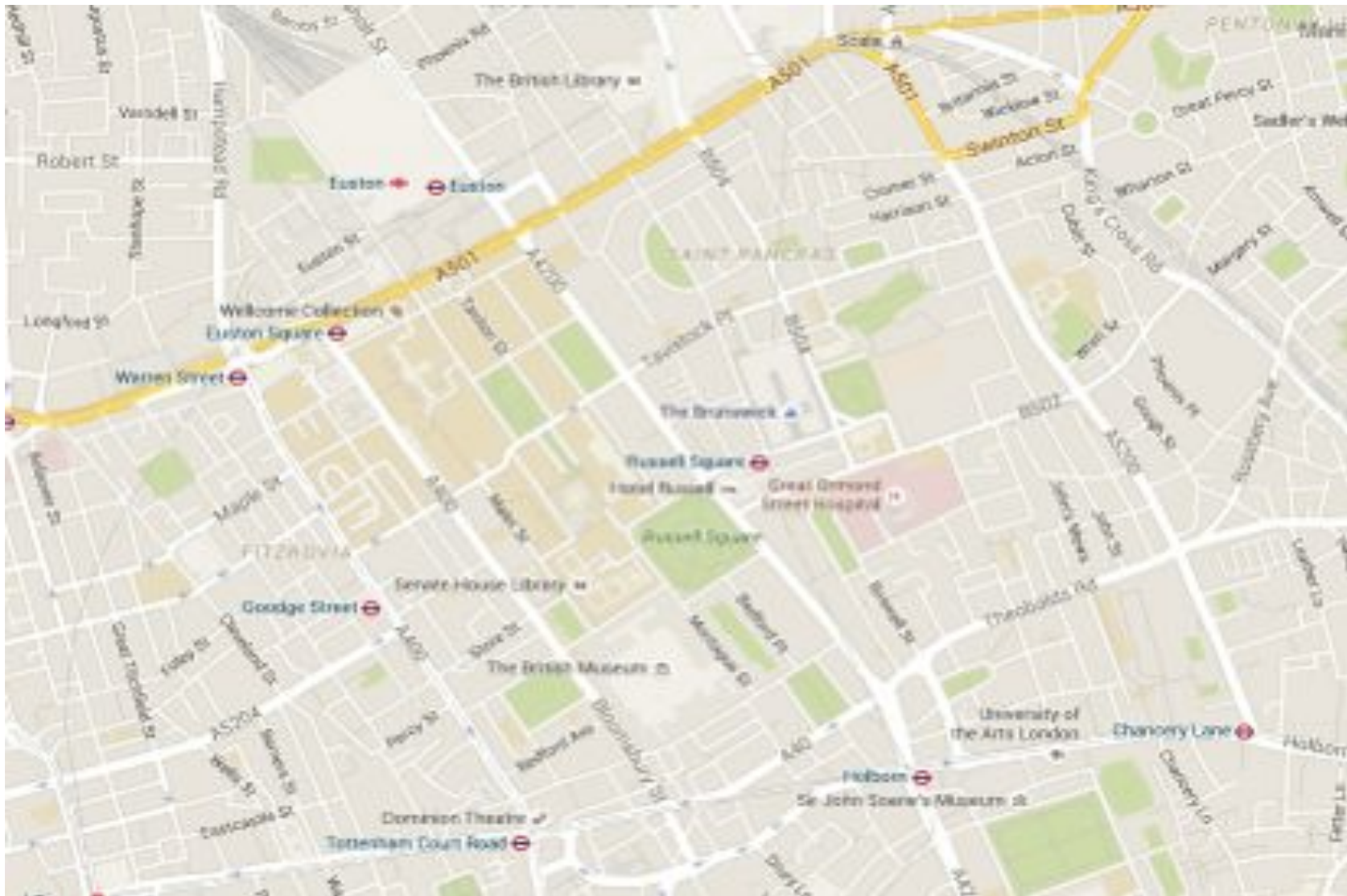
Motoring grid!



Motoring grid!



A Camden example



Planning ahead



'Grey roads'



Finally, what *not* to do.

Figure 1.3 Cycling infrastructure that may typically feature in each street type



Can we go this large?

Many areas of Dutch 'access streets' started small, and only expanded once Sustainable Safety was adopted.

Large 'environmental areas' might be impossible (or self-defeating) in areas with levels of high car use