

**POLIS**

CITIES AND REGIONS FOR TRANSPORT INNOVATION

ANNUAL  
CONFERENCE

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Brussels, Belgium



#POLIS2022

# ROAD DANGER REDUCTION THROUGH ARTIFICIAL INTELLIGENCE

2D. SQUEEZING INSIGHT FROM SAFETY DATA

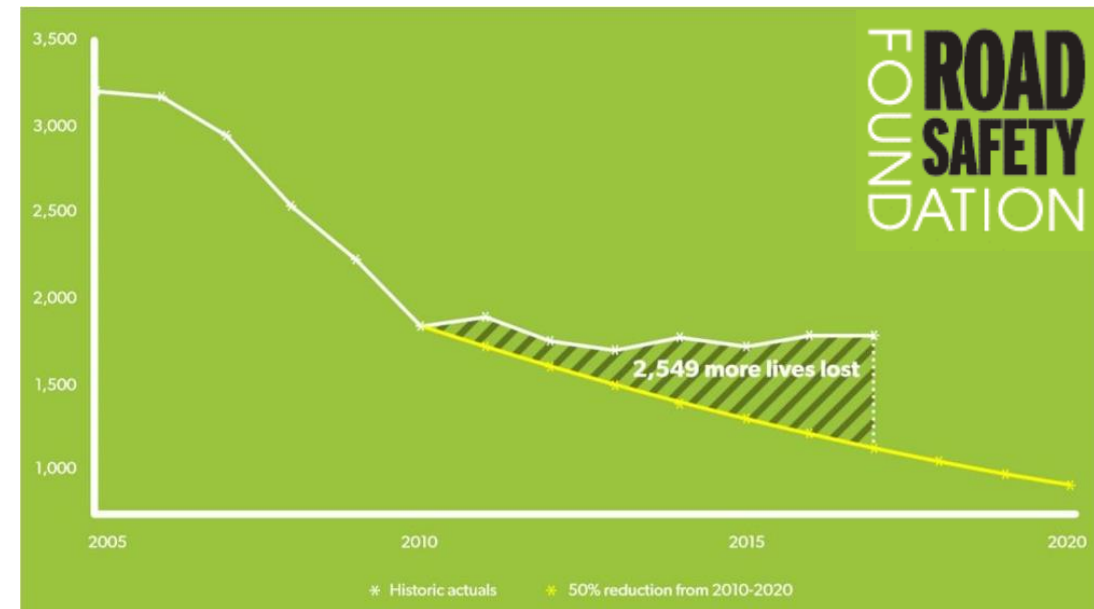
- *Dr Craig Smith, Agilysis*



- Multi-national road safety target
- To achieve a highway system with no fatalities or seriously injured casualties
- Transport for London (TfL) aim to achieve this by 2041

# VISION ZERO

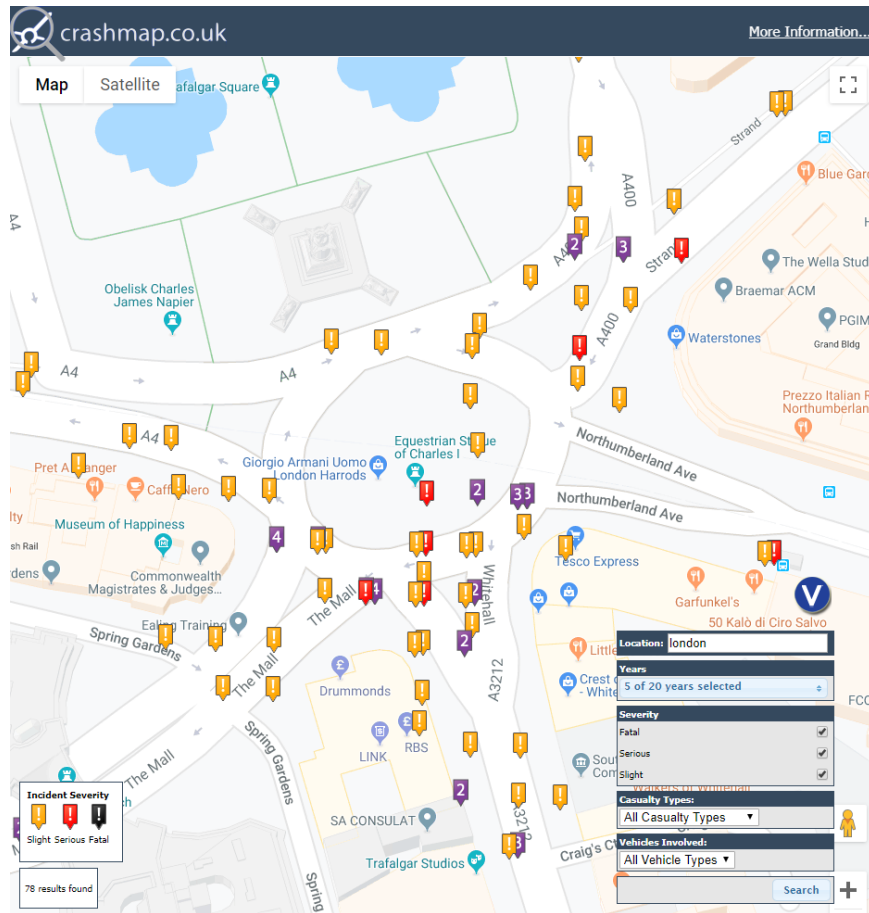
- Fatality reductions have stagnated in recent years
- Particularly in urban environments, where modal shifts to sustainable transportation increases the number of vulnerable road users
- Safe systems approach aims to reduce road danger, resulting in an environment that is more forgiving of mistakes
- Difficult to assess road danger in complex urban areas



## *What is Road Danger?*

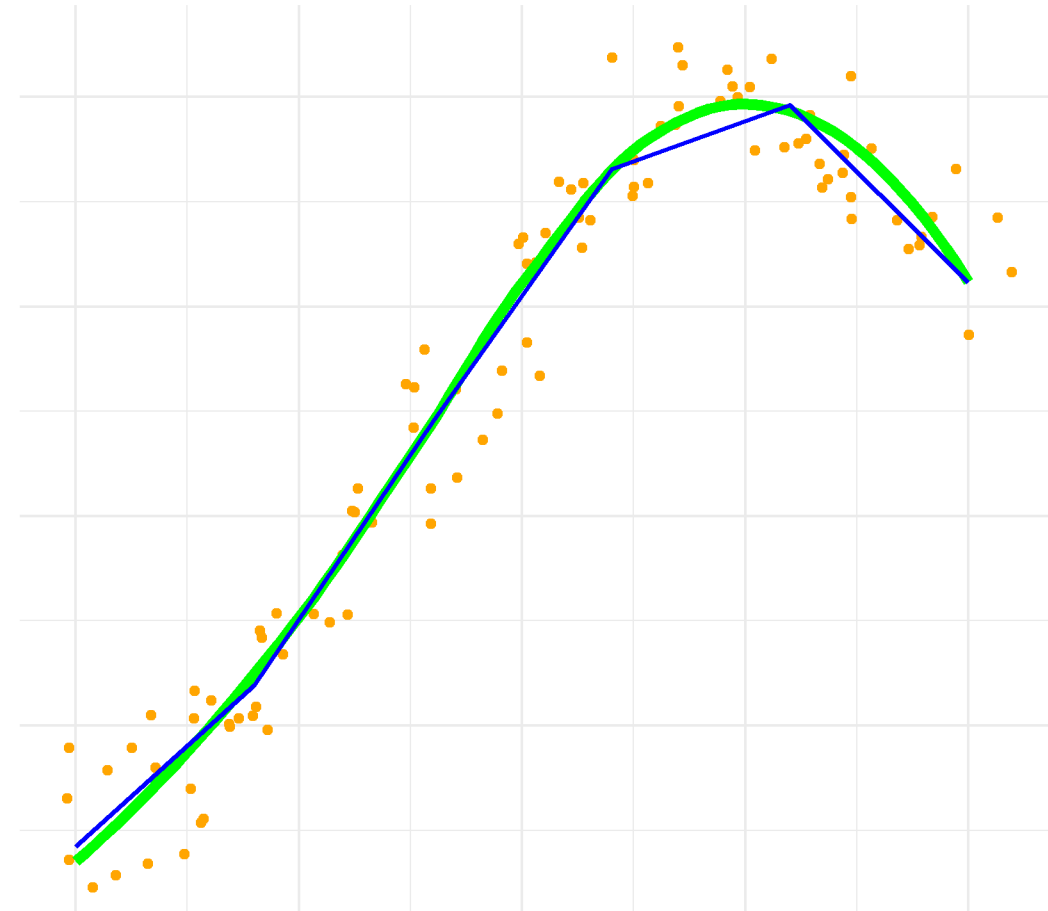
### Axiomatic definition:

1. **Road Danger** depends only on the road infrastructure, the surrounding environment, and the level of usage by different groups (drivers, pedestrians, cyclists, etc.)
2. **Road Danger** correlates with recorded measures of observed risk



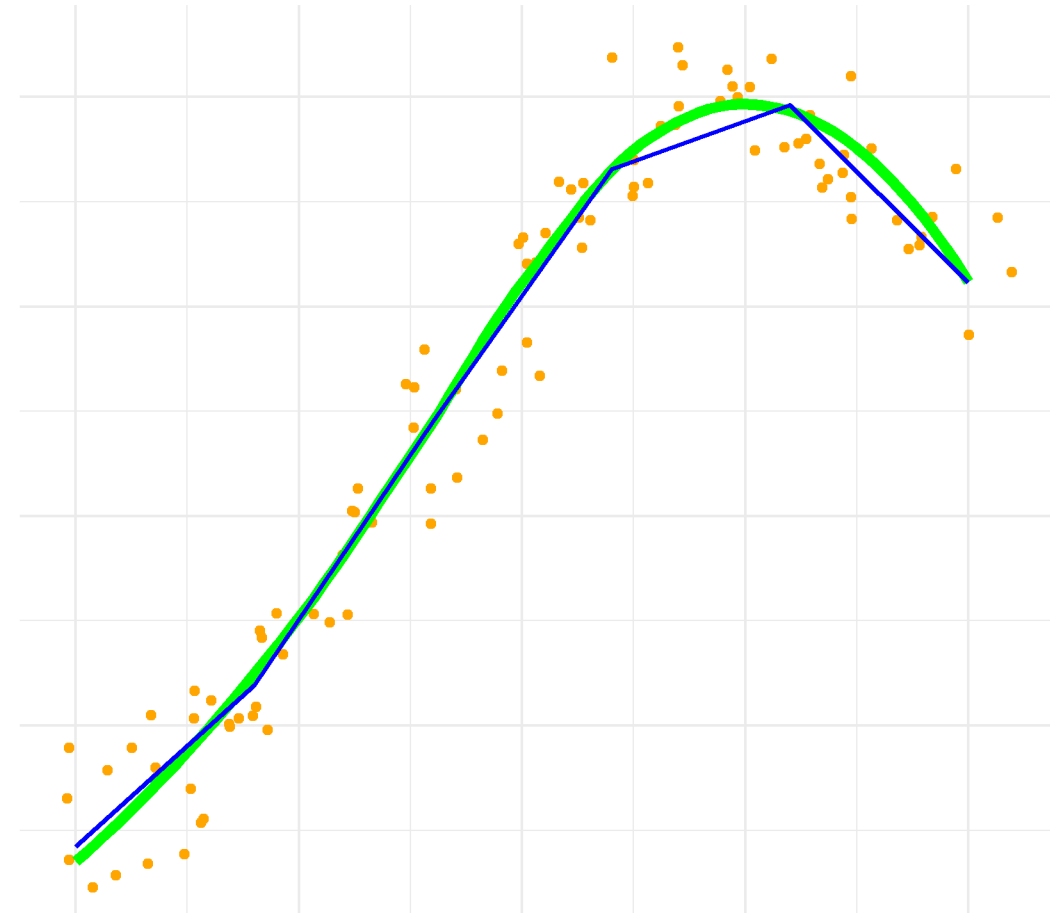
- Use historic STATS19 collision data, matched to a granular road network to calculate measures of risk:
  - *Collisions per km of road*
  - *Collisions per vehicle-km travelled*
  - *Pedal cyclist collisions per km*
  - *Pedal cyclist collisions per cyclist-km travelled*
  - *Pedestrian collisions per km*
- Match this to data on road infrastructure, local environment, and usage provided by Transport for London

- Train an Artificial Neural Network
  - *ReLU activated*
  - *AdaDelta optimized*
  - *Minimizing Mean Average Error*
- To predict observed measures of risk using data on road infrastructure, local environment, and usage





- The result is a piecewise-linear function on the space of infrastructure, environment and usage data
- Values for each road segment correlate with observed risk
- The outputs of this function are, by definition, our measures of *Road Danger*



## Infrastructure data:

- Length, carriageway type and directionality
- Speed limits
- Pedestrian crossings
- Bus lanes and road markings
- TfL's Cycling Infrastructure Database (cycle lanes, segregation, signage)
- Traffic calming infrastructure
- Pavement space and road width





# DATA RICH ENVIRONMENT



Local environment data:

Presence of

- Stations
- Bus Stops
- Recreational spaces
- Social centres, sport centres
- Schools, colleges, universities
- Places of worship
- Offices
- Industrial areas
- Retail centres
- Monuments, museums
- Hospitals, GP surgeries, dentists
- *etc.*

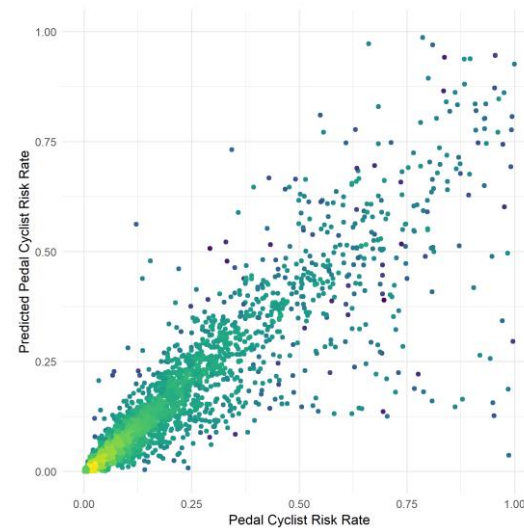
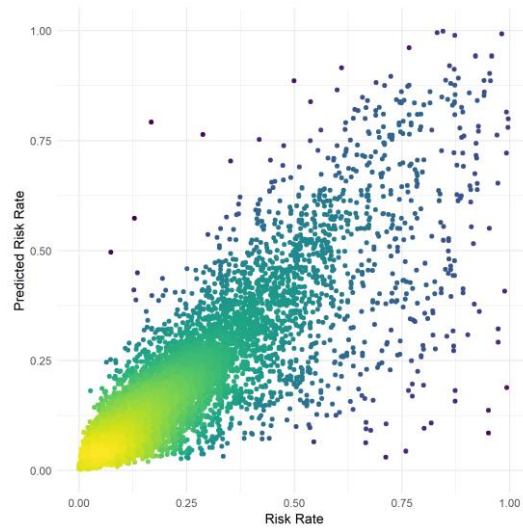
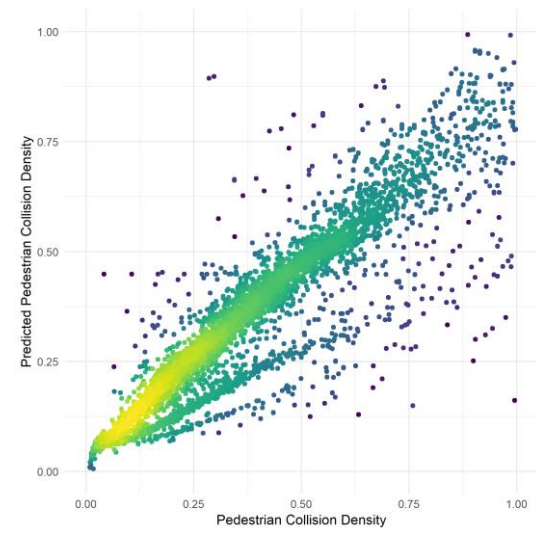
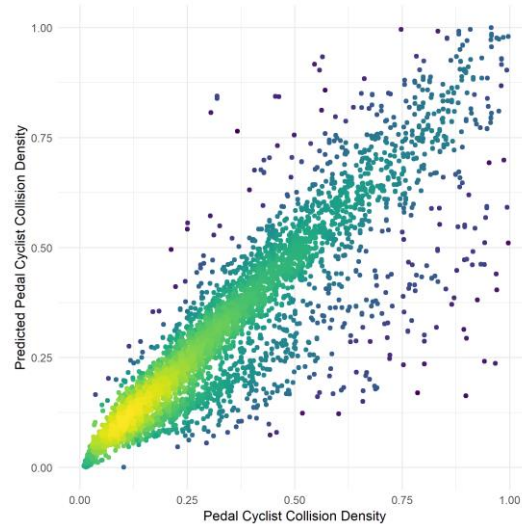
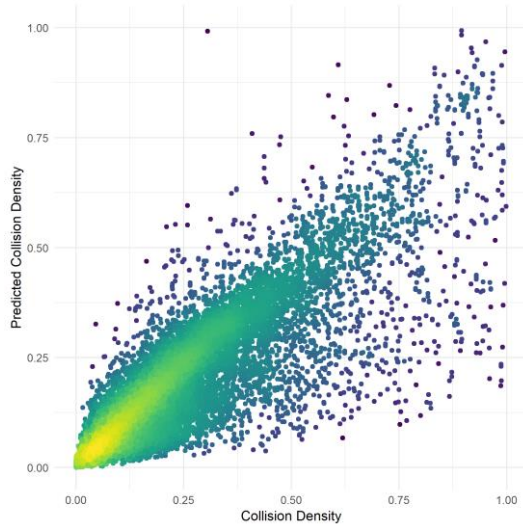
# DATA RICH ENVIRONMENT



## Usage data:

- Vehicle speed and flow
- Modelled cyclist flow
- Cyclist speed
- Bus boarding and alighting
- Station entries and exits
- Bus speed and flow
- Pedestrian density
- Walkability and pedestrian severance

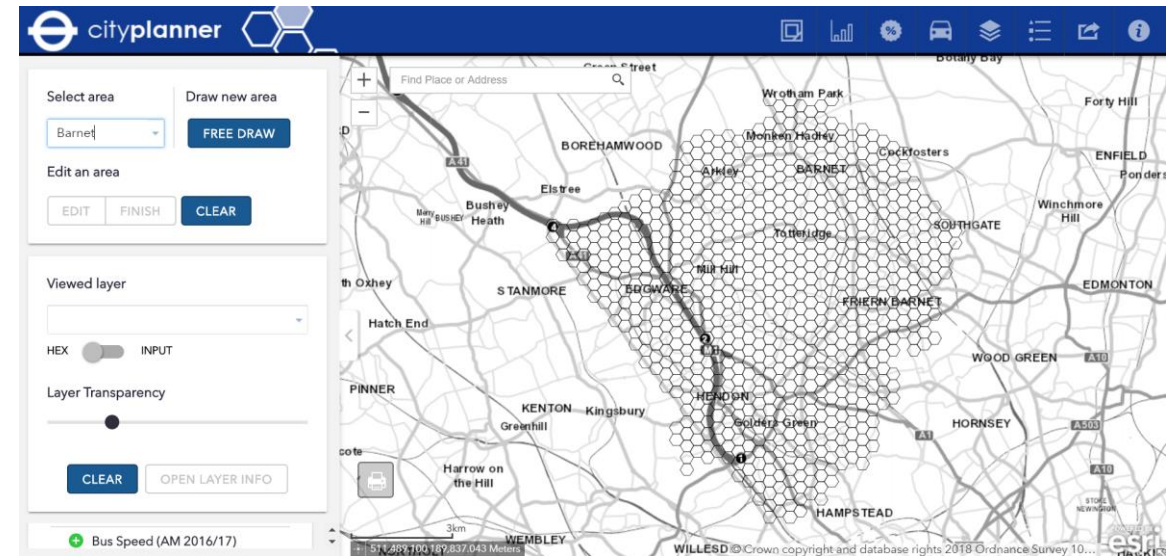
# ACCURACY



# APPLICATIONS



- Provides a measure of Road Danger
- To be used for prioritization of interventions
- Proactive mitigation of danger
- Integration within TfL's city planner tool

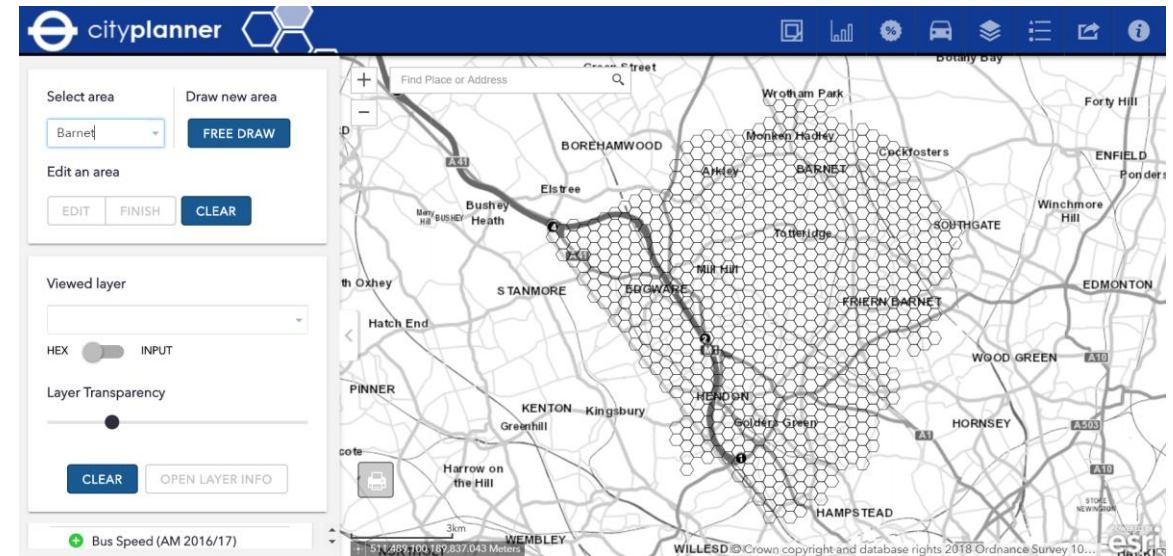




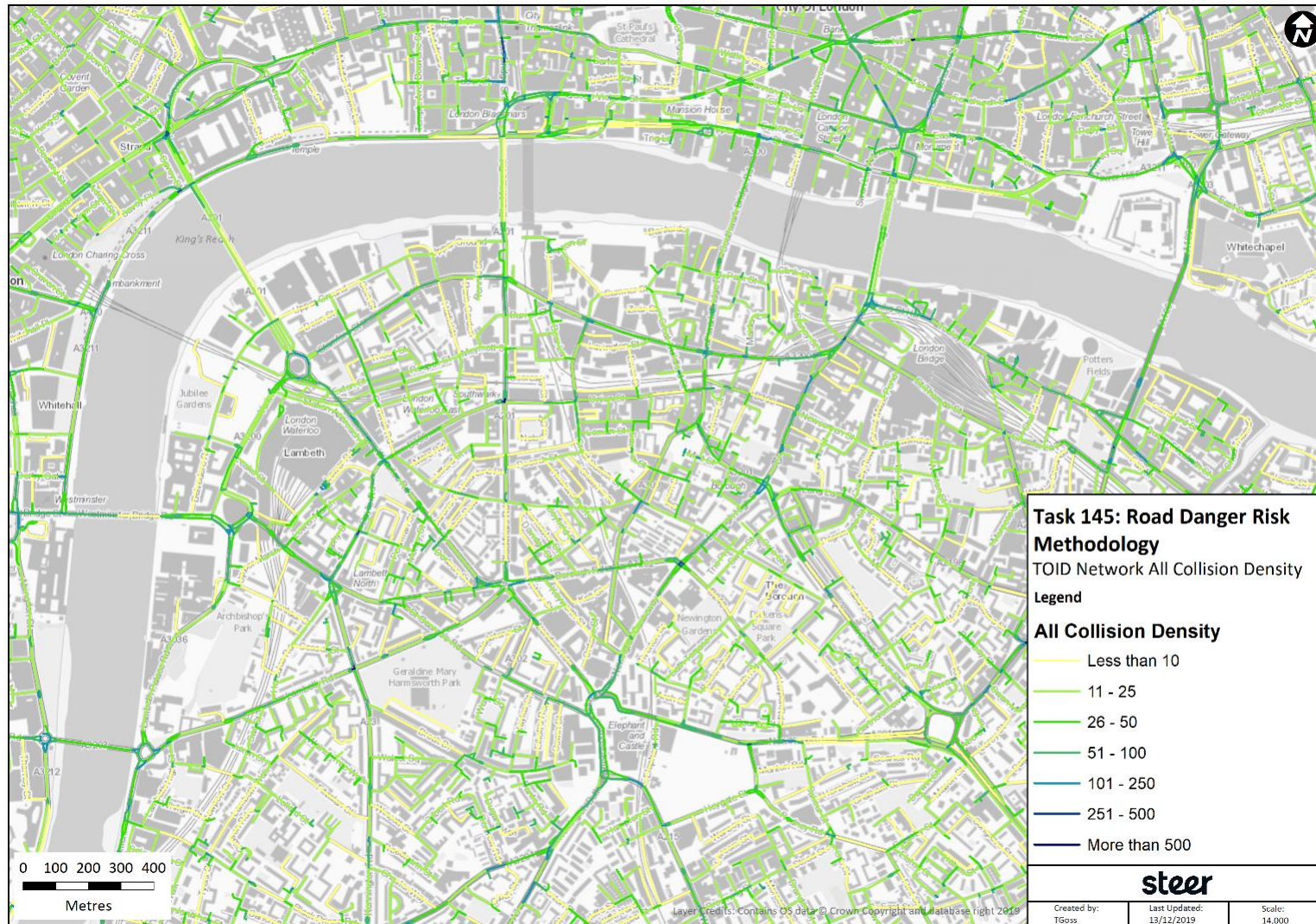
# APPLICATIONS



- Model can be used to simulate changes to infrastructure to determine the best intervention at each site
- Can be used to simulate how danger levels will change with projected road usage and modal shift

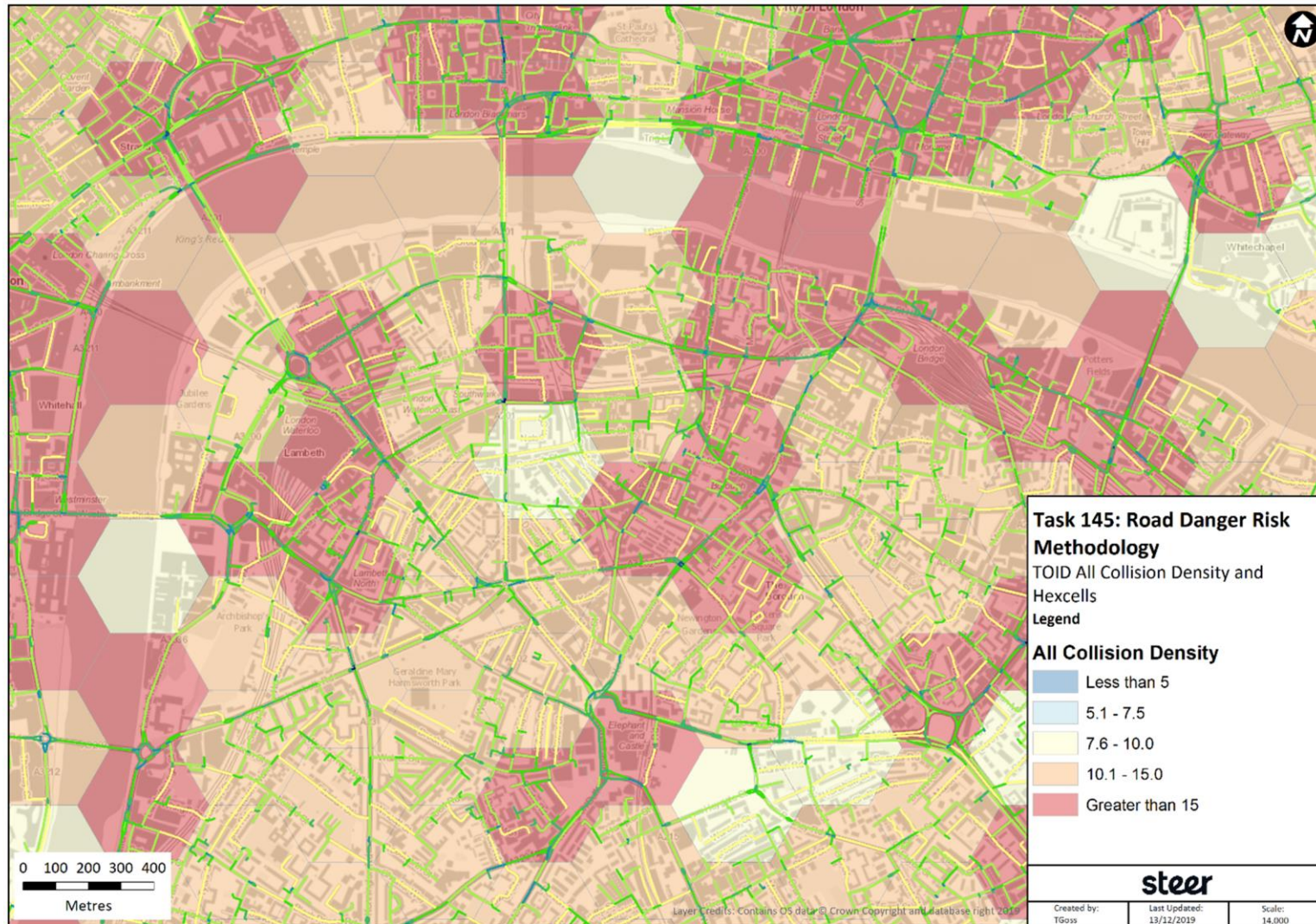


# OUTCOMES



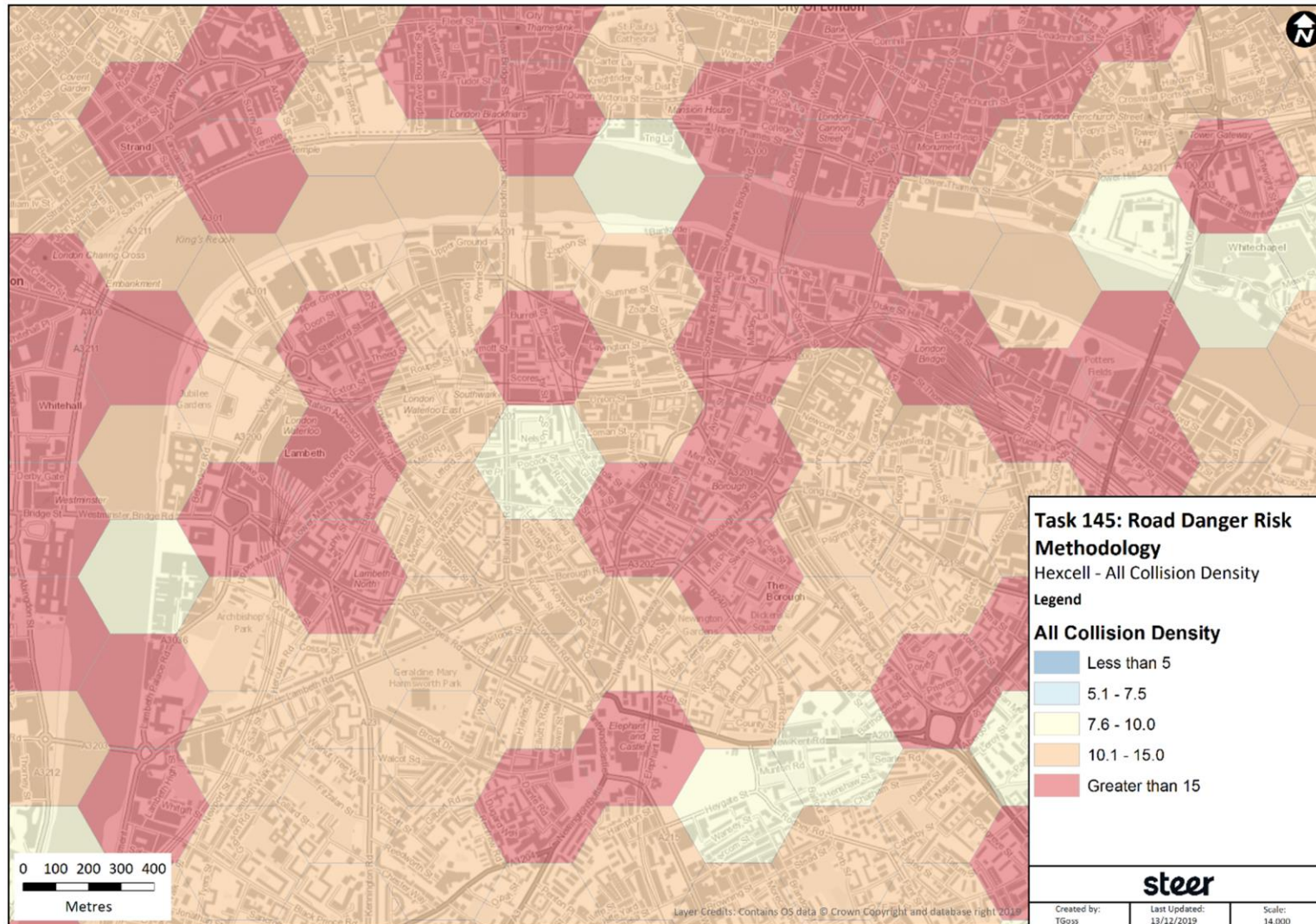


# OUTCOMES





# OUTCOMES



# FUTURE AMBITIONS



- Use techniques from Explainable AI (XAI) to provide additional insights
  - Feature importance
  - Feature interaction
  - Local feature effects

# FUTURE AMBITIONS



- Treat junctions separately to road segments
- More data:
  - Junction complexity and usage
  - More granular pedestrian density data
- Time series infrastructure data based on installation dates, used alongside time series usage data

# FUTURE AMBITIONS



- Continually update the model
  - Changing vehicle fleet
  - Changing infrastructure
  - Changing road usage and behaviour

# agilysis



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