TRANSMAX

CAPABILITY STATEMENT

Transmax Data Science

Our team of data scientists specialise in identifying, prioritising and undertaking a range of research and analytical activities leveraging all available data assets.

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Transmax Data Science

As an Intelligent Transport Systems (ITS) solutions provider, Transmax offers STREAMS customers a range of services to enhance the sustainability and performance of customers' transport networks. This includes services available through the company's data science team.

Our team of data scientists specialise in identifying, prioritising and undertaking a range of research and analytical activities leveraging all available data assets to help solve complex business problems through the development and application of advanced statistical modelling techniques.

Areas of expertise

Data mining and statistical analysis

Exploratory data analysis to reveal patterns and trends in data. This includes investigating data for inconsistencies and outliers and calculating statistically based measures.

EXAMPLES INCLUDE:

- **Determining confidence measures in traffic related data by providing statistics including significance testing, histograms, boxplots and various other charts**
- **Estimating vehicle detector health based on speed, volume and occupancy measures and traffic related constraints**
- **Assessing intersection timing plans by comparing distribution of actual phase times with plan phase times**
- **Determining typical day statistics for single detectors or groups of detectors so that atypical days can be more easily identified**

Visualisations

Providing an accessible way to see and understand trends, outliers, and patterns in seemingly complex traffic related data. These include charts, tables, graphs, maps and dashboards.

EXAMPLES INCLUDE:

- **Using Power BI / Tableau to create information rich dashboards**
- **Interactive web-based visualisations**
- **Excel related visualisations with macro backend processing**

Big Data

Analysing and extracting information from traffic related data sets that are seemingly too large to be dealt with in a traditional sense. This typically involves cloud computing on Amazon Web Services (AWS).

EXAMPLES INCLUDE:

- **Aggregating large traffic related data sets to various time intervals based on 20-second data**
- **Visualising large aggregated data sets in various formats using cloud-based tools**

Machine Learning

Creating software that utilises data, and is capable of learning from past information, thereby offering actionable predictions.

EXAMPLES INCLUDE:

- **Cluster analysis to identify time-of-day traffic patterns**
- **Image recognition to determine speed limit signs by location using Google Maps**
- **Predict SVO time series variables based on historical data**

Case Study

TRANSPORT AND MAIN ROADS PROJECT

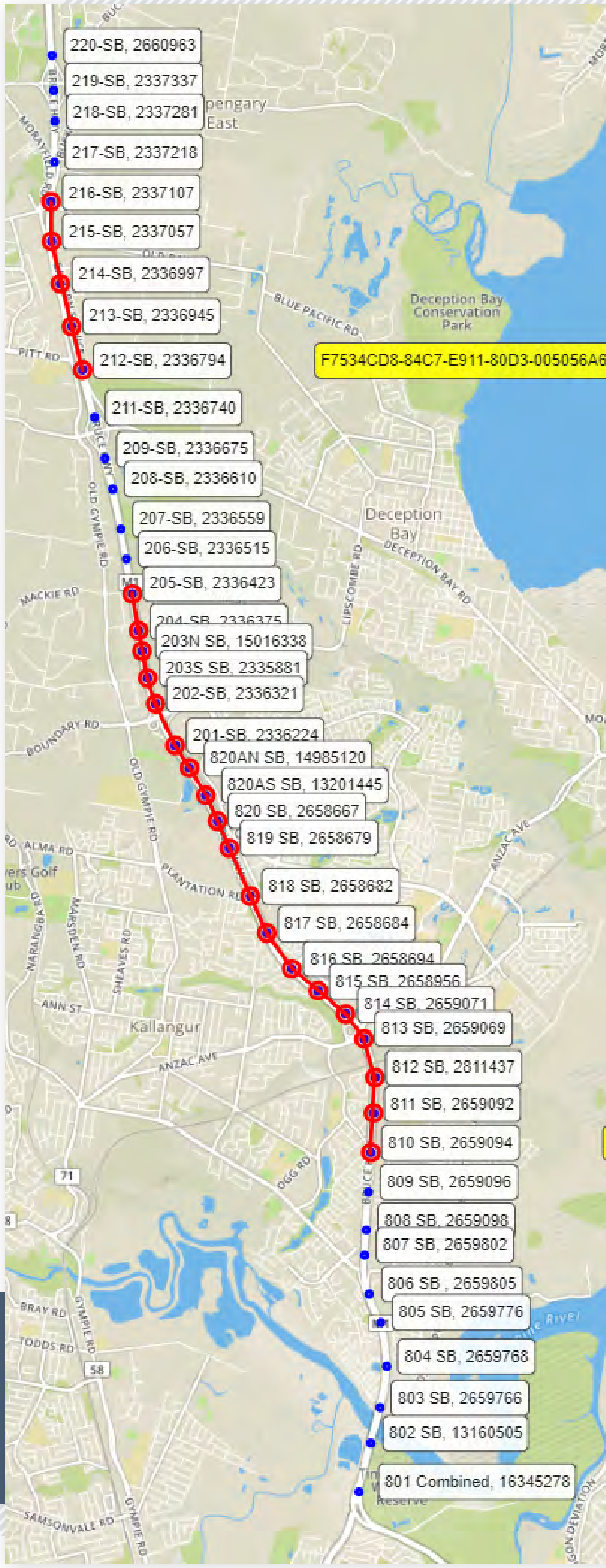
Automating queue detection

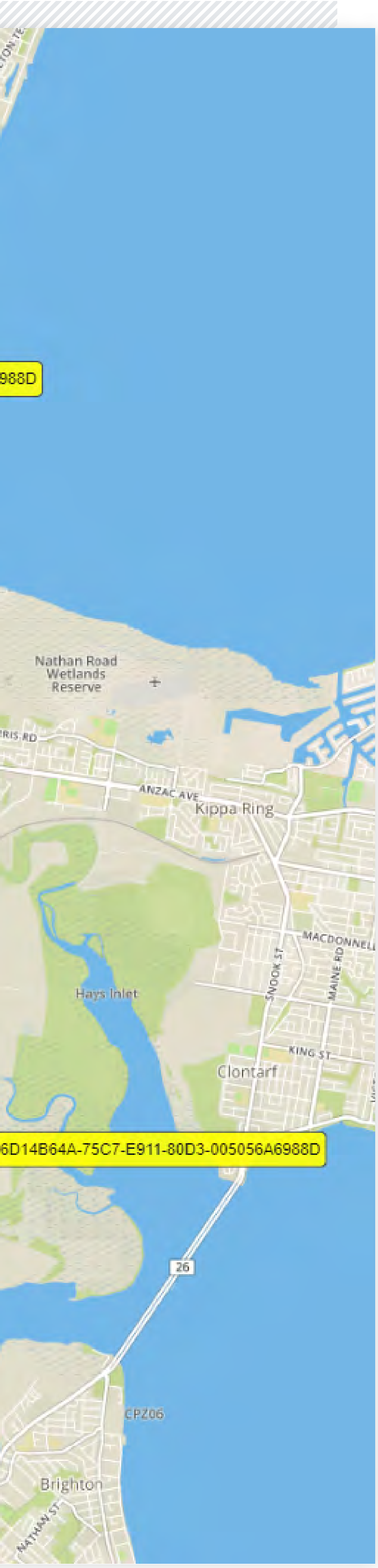
STREAMS contains services designed for the detection and protection of freeway queues. The Queue Detection module detects the presence and extent of queues based on detector site measures. The aim of the Queue Protection module is to protect vehicles at the tail of a detected queue by reducing the speed limit upstream of the queue using variable speed-limit signs.

To investigate the possibility of automating queue detection and removing the need for operator assistance, the Department of Transport and Main Roads (TMR) engaged the help of the data science team at Transmax to analyse the current state of the algorithm. In retrospect, when a queue is recognised by STREAMS, an operator is alerted to the fact. The operator then determines whether a queue has actually been formed via CCTV. If a queue is not visually confirmed, the operator tags the alert as a false alarm.

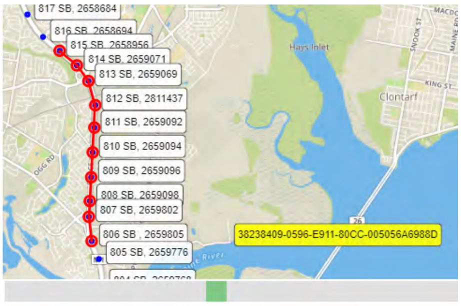
The question postulated was whether the false alarm rate of the Queue Detection algorithm was, or could be made to be, low enough for Queue Protection to be automated. This could be achieved by setting it to an enabled state, thereby decreasing operator time to respond at the expense of an increased system time to respond.

The area of investigation was **NCD/M1 NBH/ Bruce Hwy SB (IB)**. Note that two queue examples are shown in red extending across several vehicle detector sites in blue.

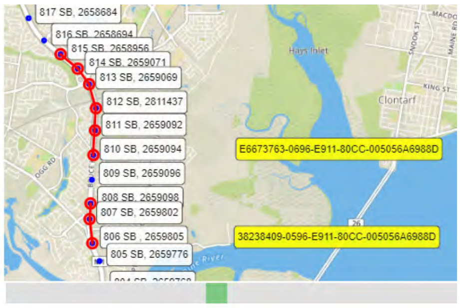




As a precursor to the investigation, queue formations were investigated via the creation of a web-based visualisation tool. This allowed queue formations, including merges and splits, to be visualised at each time step. The diagrams below illustrate this visualisation tool from the perspective of a queue on 24 June 2019 at 08:29:20 splitting into two queues 20 seconds later.

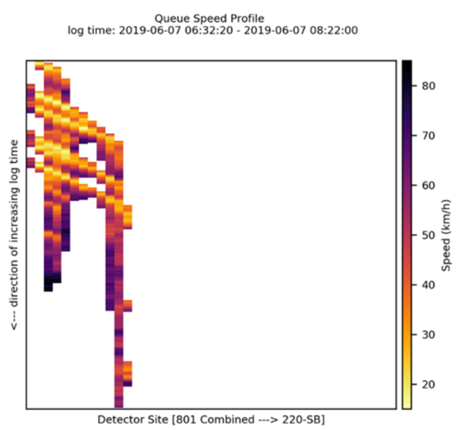


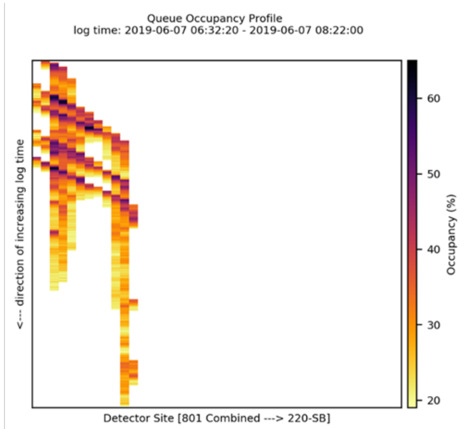
Time[5139][UTC+10]: 2019-06-24 08:29:20



Time[5140][UTC+10]: 2019-06-24 08:29:40

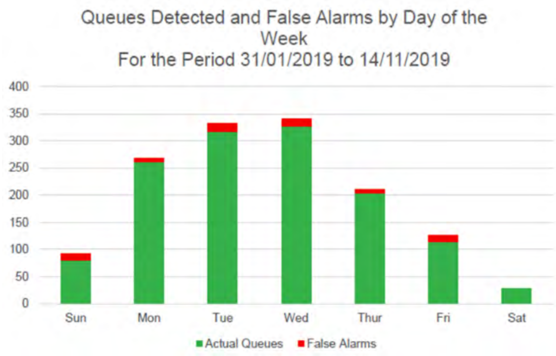
In addition, other visualisations were constructed to help with queue analysis, including queue entity space-time diagrams. These allowed the analysis of speed and occupancy measures as represented by heatmaps.

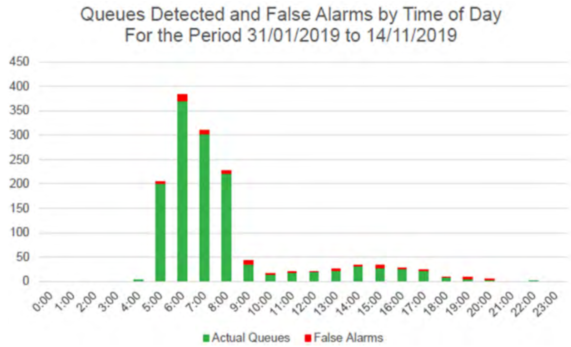




The above tools helped put into perspective the scope of the analysis, and the form of the underlying queue data that was to be investigated.

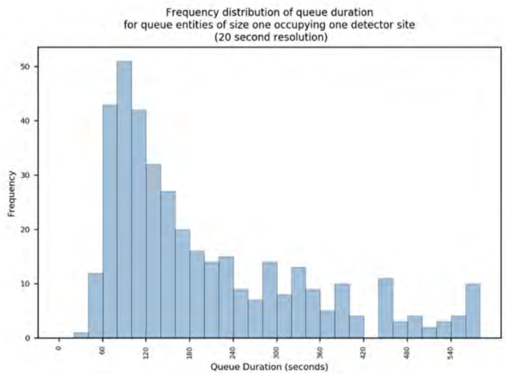
The next phase of work was to investigate existing operator logs and determine when most false alarms were recorded by constructing plots based on time of day and day of week, as shown on the right. In addition, an analysis of operator response time was also investigated, to determine how responsive operators were to queue notifications from STREAMS.

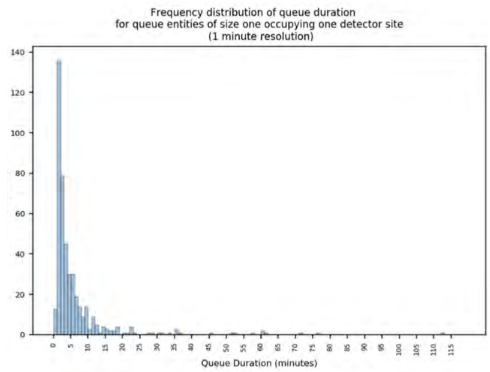




It was hypothesised that queues that only extend across one detector site during their lifetime would be the best candidates for investigating false alarms, as these would be the most short-lived queues and also the most likely to be false alarms. The frequency distribution of queue duration for queues extending across a single detector site showed that the majority of these queues have duration less than 5 minutes.

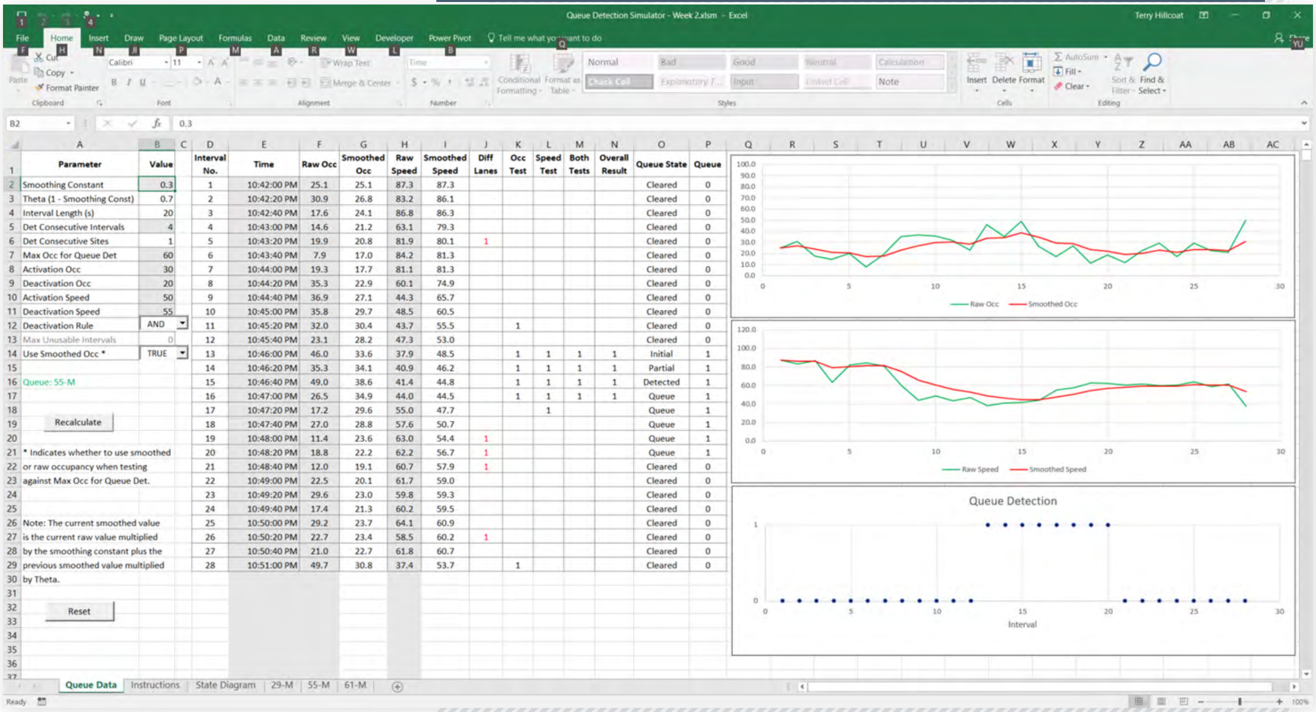
The above data was then correlated to operator response time data to determine situations where operator response was greater than queue duration, which could be indicative of a short duration queue being wrongly flagged by the operator as a false alarm.





In addition, the performance of the STREAMS Queue Detection algorithm was investigated by checking the effects of adjusting its configuration parameters and how they could be tuned for optimal performance of the algorithm. Queue state transitions were analysed based on existing queue data, and various recommendations were proposed to help decrease the registration of false alarms within the system.

This led to the creation of a queue detection simulator within Excel, utilising macros to emulate queue transitions using lane-based speed and occupancy measures.



Data science expertise utilised in this project

DATA MINING AND STATISTICAL ANALYSIS

- Pre-analysis of queue duration
- False alarms
- Operator responses

VISUALISATION

- Web-based queue visualisation
- Graphs and plots
- Queue detection simulator

BIG DATA

- Gathering and processing more than 125 million rows of 20 second vehicle detector data and queuing data across a range of timelines

Outcomes

The data science team was able to utilise a range of tools across various data sets as a means of analysing queue formations to help address false alarms within the system. This included the creation of graphs and visualisations to easily detect patterns, trends and outliers within the data. In addition, various tools were developed to help the traffic engineer optimise queue detection parameters with STREAMS.

Both our customer and the community is expected to benefit from this work. The project should lead to greater operator efficiency at traffic management centres (TMCs) by enhancing queue detection and speed sign recommendations on freeways enabling safer road journeys for the community.

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Please get in touch with Transmax for more information about our data science services and how our data scientists can support customers to solve complex business problems.

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