**Transaction Time & Section Utilisation Analysis Manual**

**2017**



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# Transaction Time & Utilisation Analysis tool

<Written for members of the Corporate Development team who have access to the Train Performance Analysis Tool, Traxim and the Traxim Centreline tools>

## Description

The transaction time and utilisation tool was initially developed to determine the average transaction time of opposing coal trains in the Hunter Valley. The tool has grown to include the analysis of utilisation of each section.

Data from the NTCS train radio (often referred to as ICE data) system allows the ability to measure the actual train position and time. This creates the opportunity to provide greater precision in calculations of transaction time and section utilisation.

### How the data is processed

This tool reads the available data in as a text file and assigns each record to a train, which describes the train along its journey. Each train journey is then normalised by interpolating each train journey to a finer granularity, “Interpolation Interval (m)” (the default is 50 m). This allows the train to be evaluated at each point in the interpolated path.

The train location information obtained from the ICE data is unreliable, as the location is reported as the closest kilometre post. Therefore the geometry file, which contains a detailed description of the track geometry using latitude, longitude and elevation, is used. The Geometry file is used to map the train location using the latitude and longitude to the actual track kilometreage. In addition the geometry file is used to determine the loop location and clearance points (loop ends).

Where there are large gaps in the data, the data is interpolated only to gain insight into the time at each point. This reduces the accuracy of the train speed as the train performance through the gap is unknown, however, the timing associated will provide sufficient accuracy for section times. The transaction time calculations do not include the train journeys where there are large gaps as there needs to be accurate representation of deceleration and acceleration of the trains. Therefore the train journey information may be different for the transaction time calculations to the section utilisation calculations.

The ability to utilise this tool is dependent on the availability of an average speed file. This file is created using the TRAin Performance analysis tool (TRAP), and provides a representation of the average trains being examined. These are used to assist in determining the deceleration and acceleration times of each train entering and exiting a loop.

As a validation step, the program will write the resulting interpolated train data for the transaction time calculations to a file that can be examined and analysed independently.

#### Transaction Time

The transaction time is the time it takes for a train to be given a green light at an intersection and the time when the train has reached track speed.

The software searches for all trains that stop at a loop and tries to identify the opposing train. It must be noted that the trains that stop at a loop may not be due to an opposing cross, as they may be forced to stop to let a faster train pass. It is only the opposing crosses that are used to determine the average transaction time of a loop.

The transaction time is then determined from a number of calculated components of the interpolated trains;

1. The time it takes the stopped train to reach track speed
   1. The track speed is determined by the average train at the same location. There is a 10% buffer for the actual train to establish that the train is travelling close to track speed.
2. The distance the stopped train takes to reach track speed
   1. The distance is determined from the loop clearance point to the location that the train has reached track speed (1.)
3. The time it takes an average train to travel from the loop clearance point to the location the actual train reached track speed.
   1. This is the time that an average train travelling without interaction takes to get to the location where the actual train reached track speed. The time effectively starts at the loop clearance point.
4. Time between clearing the loop and the train restarting.
   1. The time taken between the opposing train clearing the loop and the stopped train restarting. This can be considered the reaction time of the driver, when they are given a green signal.

The components of the transaction time were then validated according to expectations;

1. The time between clearing a loop and the train restarting is positive
   1. A negative value was occasionally encountered due to the large gaps across a loop, where there was no corresponding time for a train restarting.
2. The distance the stopped train takes to reach track speed is less than a threshold.
   1. The maximum distance to reach track speed is required to be a reasonable number. This needs to be balanced with the buffer allowance of the actual train.
   2. If a train takes 50 km to reach the expected track speed, the transaction time will likely be in the order of hours. This is unreasonable.
3. The resulting transaction time is positive
   1. It is unreasonable to have a transaction time that is negative, as this would imply that a driver starts the train before the opposing train clears the loop, which is a major breach in operations.

The final transaction time must also be less than a max threshold, which has been set to be an unrealistic time. This has been taken as 10 minutes, however can be modified.

The transaction time is then aggregated to each loop as well as over the whole corridor of the data.

#### Section Utilisation

The utilisation is defined by the amount of time all trains spends in the section within a defined time period. This is typically a 24 hour period.

For the section utilisation calculations, the time at each point is critical. Therefore the train journeys that contained large gaps are interpolated through the gaps to obtain an expected time through the sections.

The section end points are located according to the loop clearance points. Each section is analysed individually for the full analysis period where each train occupying the section is found. The time each train spends within the section is then added to the section utilisation. Where there is an opposing cross, the section time accounts for a train in the loop waiting to enter the section. This effectively includes the transaction time of the interaction.

The section time is then aggregated to a rolling 24 hour period in hourly intervals and written to a file for analysis.

## Inputs

### Select Files

This section describes the files required for transaction time analysis. This includes the data file, the geometry file, and the average data file created from the Train Performance Analysis Tool.

#### ICE Data File

The ICE data file is the file that contains all the ICE radio train data for the desired region. The file must be in a comma separated format and can be a .csv or .txt file. This file does not need to be sorted in any particular order; however, the file is required to have a specific format, to allow the tool to read the appropriate fields.

The preference is to create the file using Tableau to ensure the fields are in the correct format. However, the data can be extracted from the data warehouse using Microsoft SQL Server Management Studio (SSMS) and the correct permissions. This also requires permissions and access to the appropriate database. See Create ICE Data File for more detail.

This data file should be the same file used to generate the average train data file described in section Average Train Data.

#### Geometry File

The Geometry file describes the geometry of the selected region. This will be a .csv file created using the Traxim Centreline tool.

The geometry file will contain the name of the region, the latitude, longitude, elevation, kilometreage, single line kilometreage and an identifier of loop locations. The loop locations need to be identified and manually entered into the geometry file. This should consist of the word ‘Loop’ corresponding to the single line kilometreage of the actual loop.

The corridor of interest may cross multiple geometry files; in this case, it will be necessary to create a new geometry file by stitching the existing files together. This will be a manual process and the geometry files need to be aligned together to be a single consistent alignment. The single line kilometreage must then be calculated using the Haversine formula. See Create Geometry File for instructions.

The single line kilometreage is the cumulative great circle distance between each point in the geometry file. This is used to provide consistent cumulative distance markers for the train position and may not necessarily agree with the actual track kilometreage.

#### Average Train Data

The average data file will be the output from the TRAin Performance Analysis Tool (TRAP). The average train performance file will be labelled AverageSpeed\_<YYYYMMdd>.xlsx, which will contain the aggregated average train for each category and direction. In addition the categories will be combined to form a weighted average train as well as the inclusion of the simulations for each direction. Refer to the Train Performance Analysis Tool Manual for instructions on how to generate this file.

This file will also contain some basic statistics for each category; This includes the number of trains in each sample, the average distance travelled, the average speed across the distance, the average power to weight ratio of the trains in the sample and the standard deviation of the power to weight ratio.

Additional supplementary information is included to describe the number of samples used for each speed calculation as well as the standard deviation. These values are provided for each analysis category and can be used to describe the robustness of the results.

This first sheet in the file contains the average train performance for each train category, and the second sheet consists of the parameters used to create the file.

#### Aggregated Destination Directory

This allows the user to direct the output files to a specified directory.

#### Include Operators

A list of multiple operators can be selected to incorporate in to the analysis.

Selecting the combined Operators button will include an analysis of combining all train operators into one category, as well as each individual operator.

### Select Parameters

This section allows the user to specify additional parameters to describe the interpolation, and the analysis around the transaction time and section utilisation.

#### Date Range:

The supplied dates indicate the analysis period. The data will be filtered according to the train date and 12:00:00 AM of the day specified, i.e. to analyse data from the month of January 2017; the From date should be 01/01/2017; with the To date 01/02/2017.

It should be noted that the parts of the train journey that are outside the period will not be included.

#### Start Kilometreage

This is the starting point of the interpolated data and the start of the analysis for the transaction time and section utilisation. It should be greater than the lowest single line kilometreage in the geometry file. Ideally this should match the start kilometreage of the AverageSpeed file.

#### End Kilometreage

This is the end point of the interpolated data and the end of the analysis for the transaction time and section utilisation. It should be lower than the largest single line kilometreage in the geometry file. Ideally this should match the end kilometreage of the AverageSpeed file.

#### Interpolation Interval

This describes the granularity of the resulting interpolation data; it is the interval of interpolation, meaning that the interpolation will step by this distance from the start kilometreage until it reaches the end kilometreage. The default value is 50 metres, but can be modified. Ideally this should match the granularity of the AverageSpeed file.

#### Minimum Travel Distance

This describes the minimum distance a train must travel to be included in the analysis. This is typically around 60-70% of the interpolation distance. This ensures that all trains in the analysis contribute to the majority of the average train performance calculations. This can be reduced to 20-30% to allow the inclusion of trains that only travel part of the journey to be included in the analysis.

#### Data Separation

This describes the maximum allowable separation between consecutive data points to be included in the analysis. The default value is set to 4km, and should only be increased if the corridor has very few curves, as the interpolation assumes this gap to be a straight line.

If a train journey contains two consecutive points that are greater than the defined distance, the train will be excluded from the transaction time analysis, but not the section time analysis.

#### Time Separation

This describes the maximum time difference between consecutive record elements to identify the record as part of the current train journey. If the time between successive points is greater than this threshold while the train ID, and the loco ID are still the same, it is considered to be a new train journey, rather than a continuation of the current train journey. This is mainly aimed to correct for train drivers that forget to change the train codes when starting a new journey.

The default time has been set at 10 hours to account for long crew changes and refuelling of trains before continuing their journey. This may need to be adjusted according to the corridor under investigation.

#### Train Length

This is the default train length which assists the calculations to determine when a train clears a loop or section. The designated train length will apply to all trains in the data regardless of actual length.

#### Track Speed Factor

This is the factor applied to the average train speed to determine if the current train has reached track speed. The default setting is 90% and it is advised that the value should not exceed this.

The user will need to balance the value of the track speed factor with the value of the maximum distance to track speed to maximise the results.

#### Maximum Distance to Track Speed

This describes the maximum allowable distance a train is allowed to reach before it reaches track speed. If the train exceeds this distance and does not reach track speed, the corresponding results will not be included. The default value is 5 km, and may vary by a few km.

The user will need to balance this value with the track speed Factor value to maximise the results.

#### Maximum Transaction Time

This is the maximum allowable transaction time to be included in the aggregation of the results. If the transaction time is greater than this value, then it is considered to be unrealistic or does not represent a valid opposing cross.

It is suggested that this value be 10 min, and should be equal to the Through Train Time Separation.

#### Threshold for Stopping Speed

This describes the speed of a train that is expected to be stopping. When the train speed drops below this value, and is within a loop, the train is considered to be stopping in the current loop.

The default stopping speed is set at 5 kph and should not exceed this value by more than 2-3 kph.

#### Threshold for Restarting Speed

This describes the speed of a train that is expected to be restarting. When the train speed increases from below the stopping speed and exceeds the Restarting speed threshold, the train is considered to be restarting from the current loop.

The default restarting speed is set at 10 kph and should be at least a few kph above the stopping speed threshold

#### Through Train Time separation

This describes the time between trains at a loop that should be considered a cross. If a train is stopped at a loop, and there is a train passing through in the opposing direction within this time separation, the trains are considered to be in an opposing cross. This results in the transaction time being included in the section utilisation.

The default value is 10 min and is advised that this value should be equal to the Maximum transaction time value.

## Outputs

Up to 6 output files can be created by the software, however, one file is only available with expert assistance.

It is possible for the software to write a file that contains all the raw train data with speed and time in order to create a train graph. This is a specialised feature and will require modification of the code to be performed. The instructions to perform this are not included in this manual (feature may be added at a later date to be controlled from the user interface).

### Interpolated Train data

The software will write the interpolated train data used for the transaction time analysis to a file for validation and independent analysis. This file will provide the train id, operator, commodity, train date as well as the direction of travel along with the speed and time associated with each kilometreage.

### Transaction Time Data

The transaction time results are written to the destination directory in the form of two files:

1. The interpolated train data for each identified opposing cross at each loop.
2. The aggregated results of the transaction time analysis for each loop, this will contain additional statistics for information.

### Section Utilisation Data

The section utilisation results are written to two files:

1. The start and end time for each utilisation block for each section, indicating the data that is included in the overall section utilisation analysis.
2. The total section utilisation for a 24 hour period on a 1 hour rolling frequency. This can be used to determine the daily utilisation for the analysis period.

## Instructions

### Create ICE Data File

To collect all the data required, a user can query the DW\_PRN database using the SQL query language, through data warehouse or through the preferred option of Tableau. All cases are performing the same query using the SQL language. However, using the Data warehouse and SSMS may result in a large amount of records that are included which should not be included as the query may catch additional longitudinal and latitudinal coordinates outside the scope of the interested region.

Tableau offers a user interface that doesn’t require any knowledge of the SQL query language or any familiarity with SSMS queries. To perform the data collection, the user must have permission to access the DW\_PRN database and its subsequent tables. The instruction to access the data via SQL and SMSS have not been included as the preferred option is via Tableau.

Accessing the data via Tableau  
Open Tableau:

1. Connect to Microsoft SQL Server

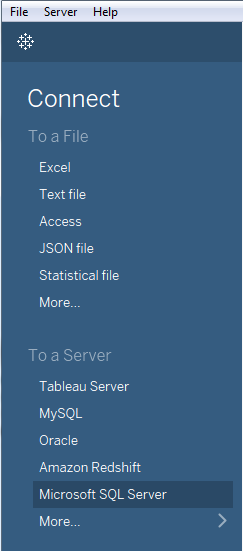


Figure 1. Tableau Connection menu.

1. Enter the server, database and login details
   1. Server: artc-dwcp01.database.windows
   2. Database: DW\_PRN
   3. Username: Tableau\_TO
   4. Password: IL0v3th3D@t@W@r3h0us3

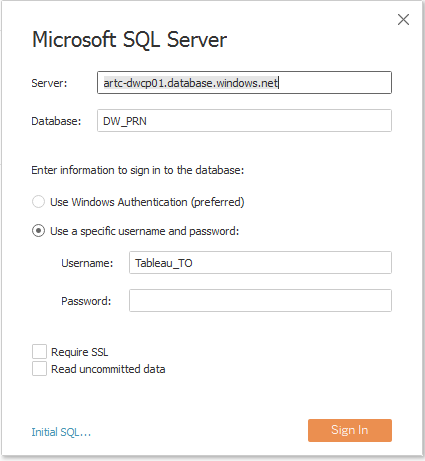


Figure 2. Tableau connection dialogue.

The login details may change in the future due to updates in Tableau.

1. Click the ‘Sign in’ button
2. Drag the DIM.Train table into the top view pane
   1. The actual table being used is not important as the next step makes the specific table selected redundant.
   2. The table is only required to construct the SQL template in Tableau

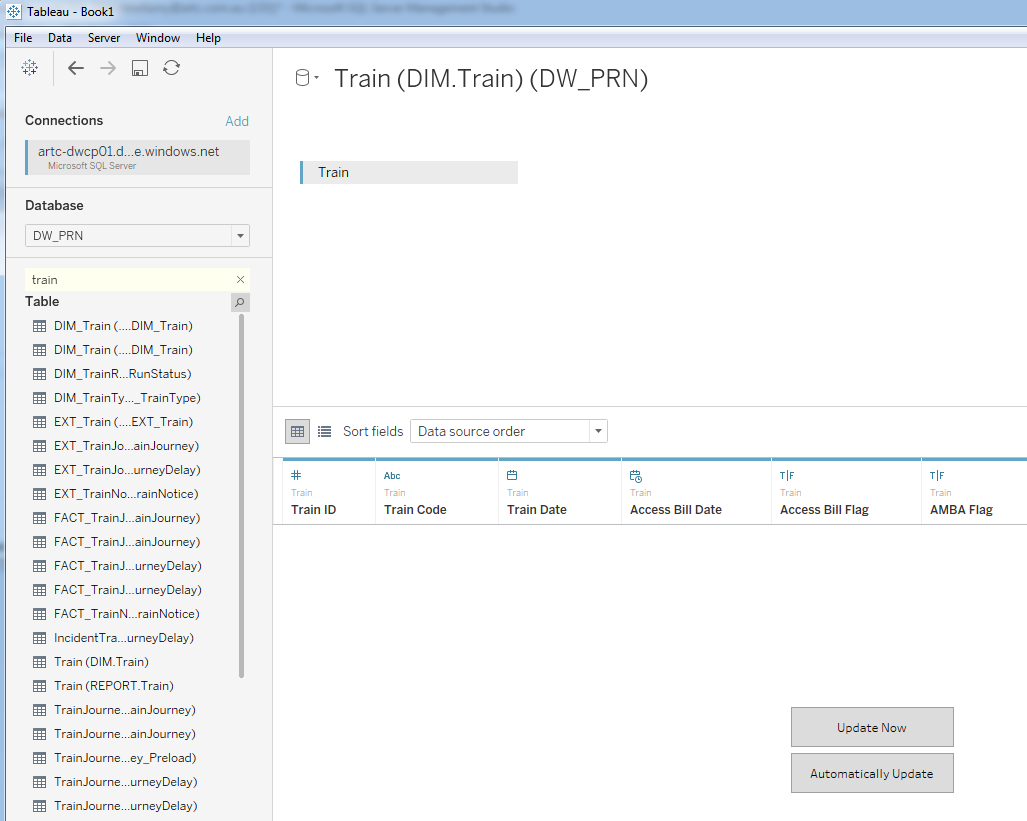


Figure 3. Tableau table configuration.

1. Select “Convert to Custom SQL” from the Data menu

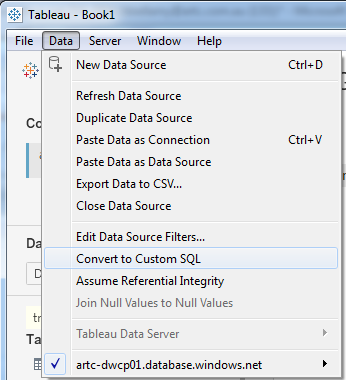


Figure 4. Create custom SQL query.

1. The track number corresponding to the desired corridor is required to be known at this point. Replace the contents of the dialogue box with the following SQL query:

SELECT

/\* Train Journey \*/

[TrainJourney].[ActualDepartureDateID] AS [ActualDepartureDateID],

[TrainJourney].[ActualDepartureTimeID] AS [ActualDepartureTimeID],

[TrainJourney].[ActualArrivalDateID] AS [ActualArrivalDateID],

[TrainJourney].[ActualArrivalTimeID] AS [ActualArrivalTimeID],

[TrainJourney].[ScheduledDepartureDateID] AS [ScheduledDepartureDateID],

[TrainJourney].[ScheduledDepartureTimeID] AS [ScheduledDepartureTimeID],

[TrainJourney].[ScheduledArrivalDateID] AS [ScheduledArrivalDateID],

[TrainJourney].[ScheduledArrivalTimeID] AS [ScheduledArrivalTimeID],

/\* Train Journey \*/

[PollMovement].[EventDateTime\_SA] AS [EventDateTime\_SA],

[PollMovement].[LocomotiveCode] AS [LocomotiveCode],

[PollMovement].[TrainDate] AS [TrainDate],

[PollMovement].[TrainCode] AS [TrainCode],

[PollMovement].[KMPost] AS [KMPost],

[PollMovement].[Speed] AS [Speed],

[PollMovement].[TrackNumber] AS [TrackNumber],

[PollMovement].[Latitude] AS [Latitude],

[PollMovement].[Longitude] AS [Longitude],

/\* Train details \*/

[Train].[FuelSaverFlag] AS [FuelSaverFlag],

[Train].[GrossMass] AS [GrossMass],

[Train].[HorsePower] AS [HorsePower],

[Train].[Length] AS [Length],

[Train].[TrainNumber] AS [TrainNumber],

[Train].[UnhealthyTrainFlag] AS [UnhealthyTrainFlag],

/\* Train commodity \*/

[Commodity].[RAMS\_CommodityDesc] AS [RAMS\_CommodityDesc],

/\* Train Operator \*/

[Operator].[OperatorName] AS [OperatorName]

FROM [REPORT].[TrainJourney] [TrainJourney]

/\* Joins \*/

INNER JOIN [REPORT].[PollMovement] [PollMovement] ON ([TrainJourney].[TrainID] = [PollMovement].[TrainID])

INNER JOIN [REPORT].[Train] [Train] ON ([TrainJourney].[TrainID] = [Train].[TrainID])

INNER JOIN [REPORT].[Commodity] [Commodity] ON ([TrainJourney].[CommodityID] = [Commodity].[CommodityID])

INNER JOIN [REPORT].[Operator] [Operator] ON ([TrainJourney].[OperatorID] = [Operator].[OperatorID])

/\* Filter by date, Track Number. \*/

WHERE [TrainJourney].[TrainDate] BETWEEN '20180101' AND '20190101' AND

[TrackNumber] = 36 OR [TrackNumber] = 38

This query selects the desired features of each table and filters on the date and track number

Here, the WHERE clause can be modified to suit the desired period and corridor. Depending on the corridor, there may be a single or multiple values for the TrackNumber feature. The date values should be represented as above in the same format, ie YYYYMMDD.

1. The View pane will change to represent that there is a custom SQL query being used.

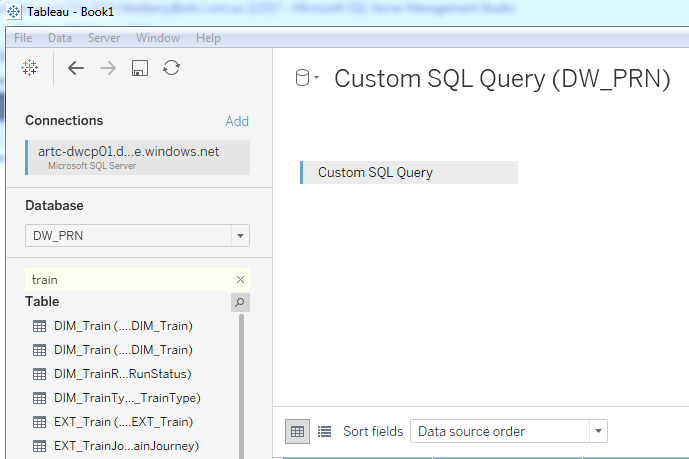


Figure 5. Custom SQL query view.

1. Select the Sheet 1 tab at the bottom to change view to the dashboard

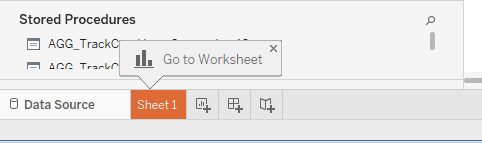


Figure 6. Tableau; switch to dashboard view.

1. Convert the latitude and longitude Measures to Dimensions by right clicking on the measure and selecting ‘Convert to Dimension’

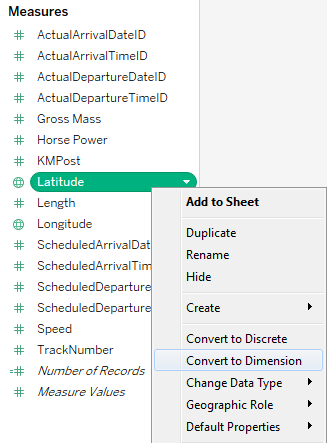


Figure 7. Tableau: Convert geographical measures to dimensions

1. Double click on the latitude and longitude to display the geographical region of the data on a map.

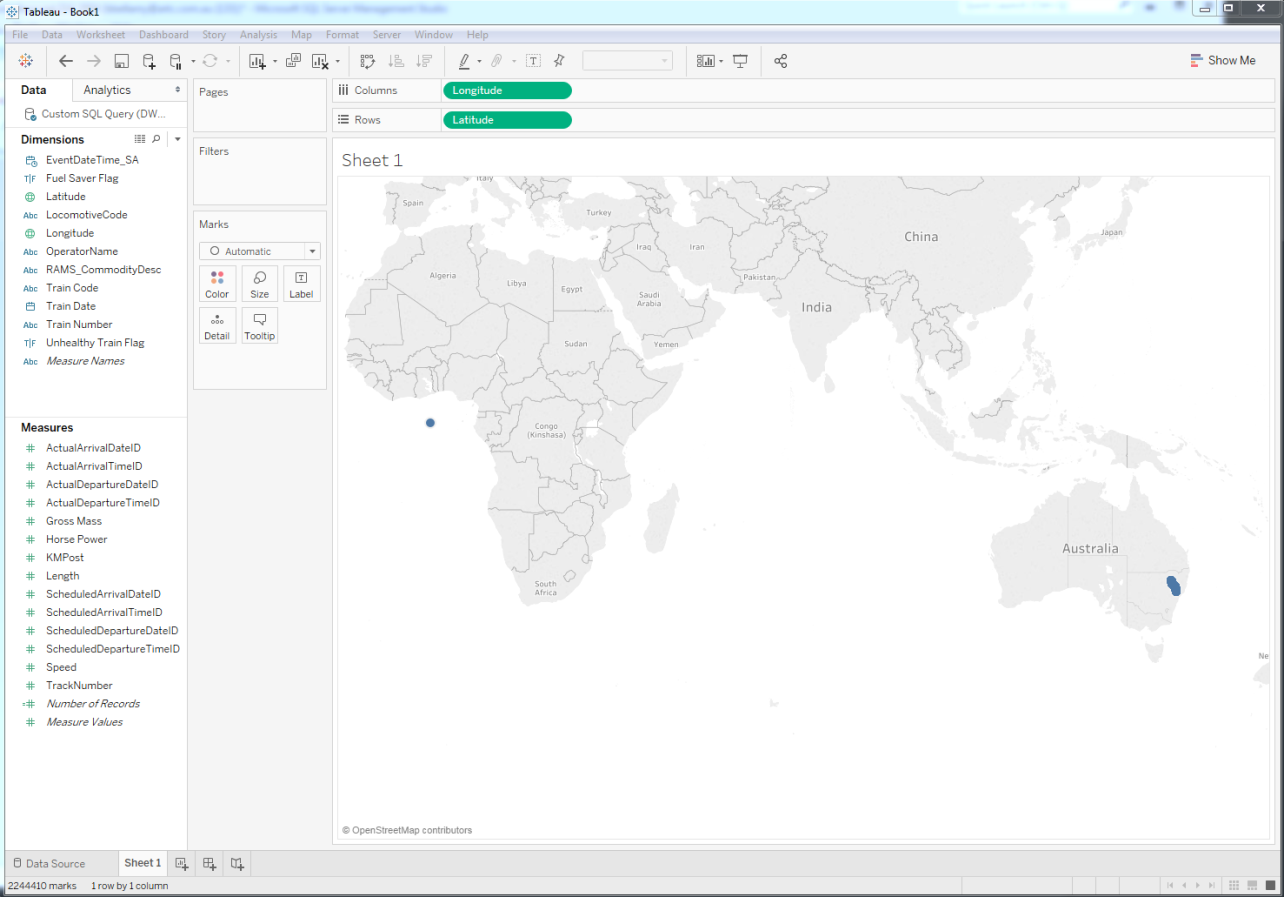


Figure 8. Map view of full data.

1. Select the zoom tool and zoom in on the desired section



Figure 9. Zoom to local region.

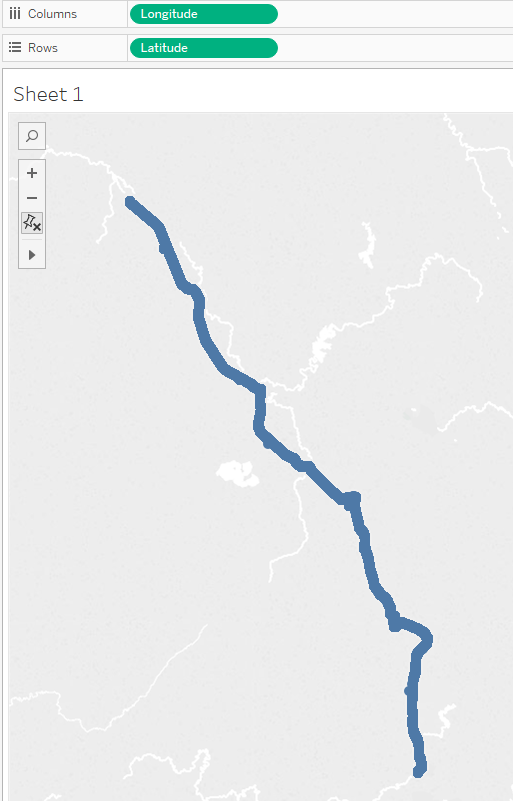


Figure 10. Tableau: Geographical view of the data.

If we zoom in a little closer, we find that there are additional track sections that need to be removed. These sections are typically balloon loops or mine branches that are labelled as the main corridor track, as seen below.

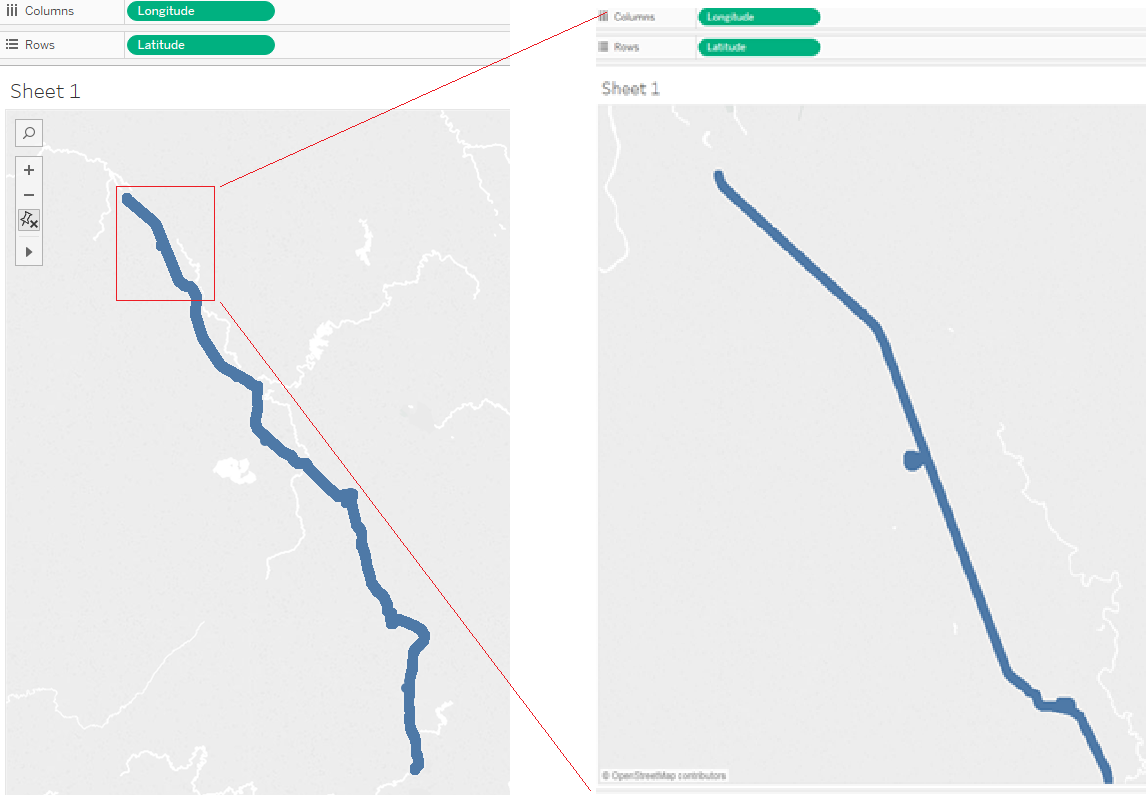


Figure 11. Zoomed in on the extraneous balloon loop locations.

1. Zoom in closer to see the balloon loops in more detail.

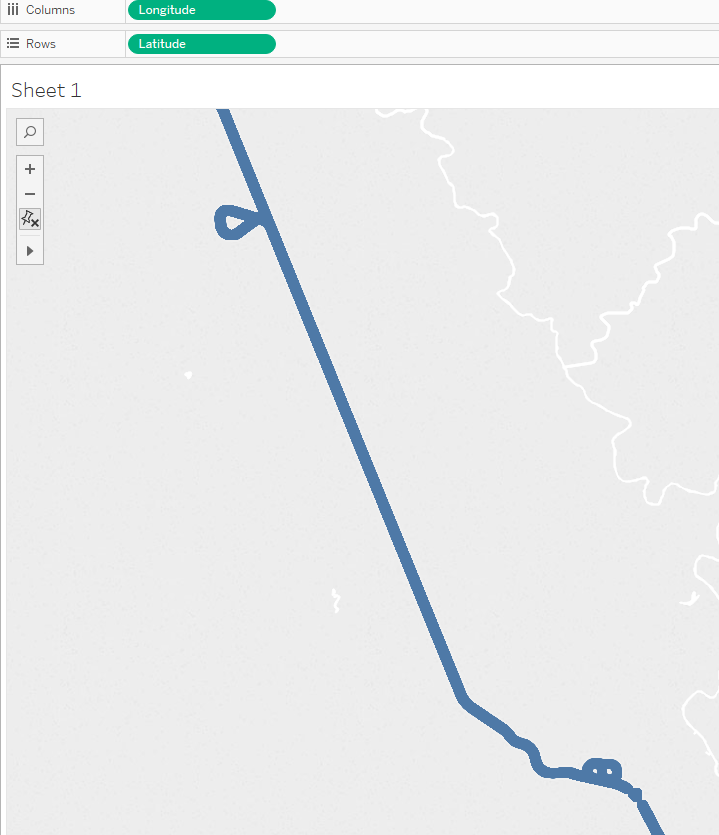


Figure 12. Ballon Loops become vissible.

1. Select the lasso selection tool in the top left corner of the map.

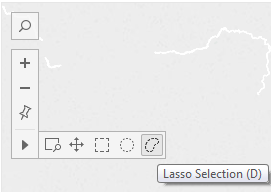
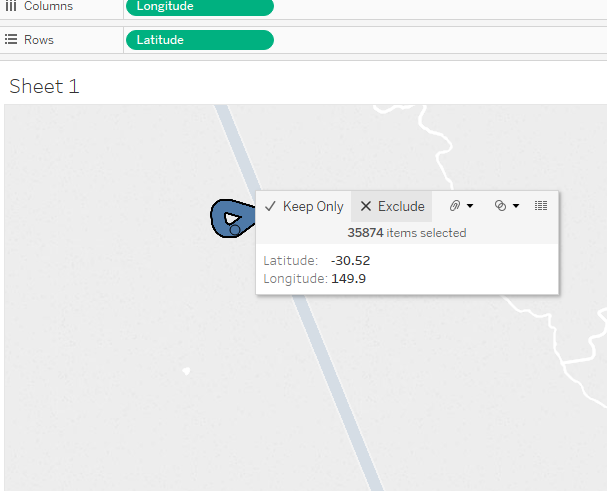


Figure 13. Tabelau: Available selection tools.

1. Draw a shape around the undesired regions to exclude them from the data set.
   1. Right click the highlighted section, just selected, and select ‘exclude’.



Repeat this step for all unwanted track sections.

Figure 14. Tableau; Removing extraneous data regions.

1. Select Locomotive Code and move it to the Colour square on the Marks pane.

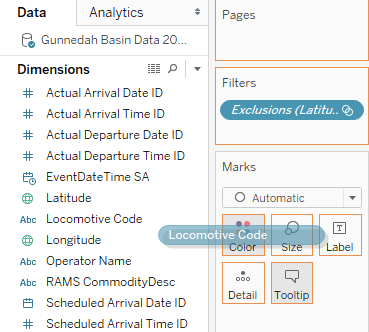


Figure 15.Tableau: Configuration of the data view

1. Select Train Code dimension and move it to the Tool tip square on the Marks Pane.

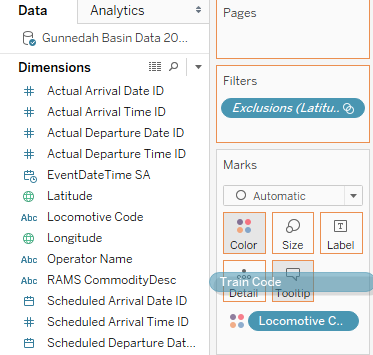


Figure 16. Tableau: Configuration of the data view

1. Repeat step 16 with the remaining Dimensions and Measures, expect for:
   1. Dimension: Latitude
   2. Dimension: Longitude
   3. Dimension: Table Name
   4. Dimension: Measure Names
   5. Dimension: Train Number
   6. Measure: Number of Records
   7. Measure: Measure Values
2. Right click on the dashboard and select ‘View Data’.

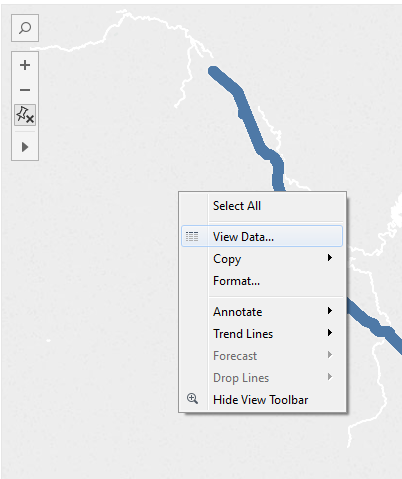


Figure 17. Tableau: View data dialogue.

1. Select the Full Data tab.

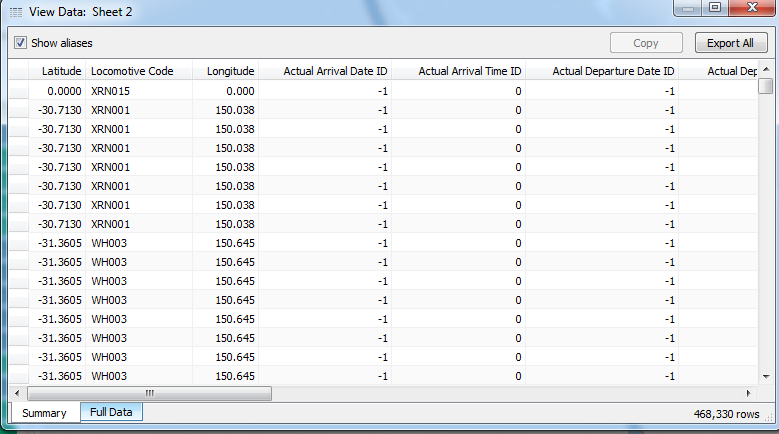


Figure 18. View full data

There should be 24 fields available in the Full Data tab.

1. Select the text box with the number of rows shown and modify this to include all available data.
   1. It is acceptable to choose a significantly large number that will exceed the number of rows in the data, eg. 3,000,000.
   2. If there are more than ~3,000,000 rows within the data period, the data will need to be filtered by a smaller date range.

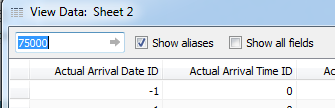


Figure 19. Increase the number of rows to view.

1. Select all the data and press ‘Copy’, paste the clipboard into a text file and save as a .txt file. This will be the ICE data file.
   1. It is possible to press ‘Export All’ to export the data to a .csv file if there are no more than 1,048,576 records, otherwise the only method is to copy the data and paste into a text file.

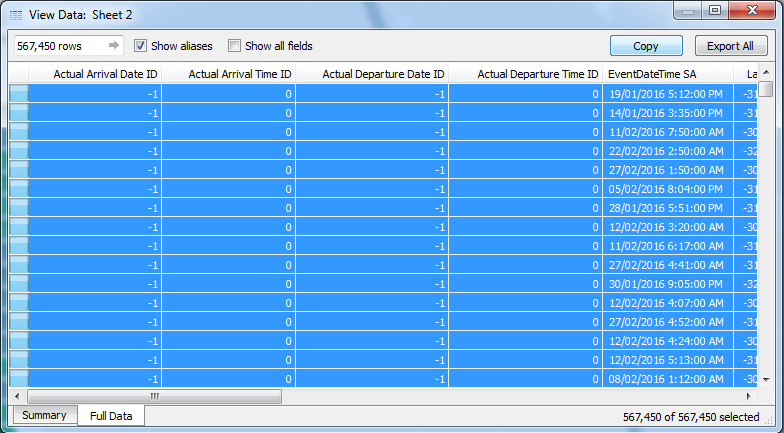


Figure 20. Tableau; Data view

**Note:** It is important that all fields are collected in the specified order below. The Train Performance Tool software depends on the correct order. The fields should be in the following order, with labels for each column on the first row as a header line:

1. Actual Arrival Date ID
2. Actual Arrival Date Time ID
3. Actual Departure Date ID
4. Actual Departure Time ID
5. EventDateTime SA
6. Latitude
7. Locomotive Code
8. Longitude
9. Operator Name
10. RAMS Commodity Desc,
11. Scheduled Arrival Date ID
12. Scheduled Arrival Time ID
13. Scheduled Departure Date ID
14. Scheduled Departure Time ID
15. Track Number
16. Train Code
17. Train Date
18. Fuel Saver Flag
19. Gross Mass
20. Horse Power
21. KM Post
22. Length
23. Speed.
24. Unhealthy Train Flag
25. Save the text file as an appropriate name with .txt as the extension in the desired location.

### Create Geometry File

Using the existing geometry files used for Traxim simulations, combine any files so that you have a single geometry file for the desired region. The files should be stitched together using the latitude and longitude.

In column I, define the single line kilometreage. The first value should be the kilometreage of your preferred starting point. The sequential values should be calculated using the great circle distance from the previous points (also referred to as the Haversine formula).

Where: *RadiusEarth* is the radius of the Earth in kilometres (6371 km),

,

φ is Latitude in radians, ω is Longitude in radians

1. Populate cell I2 with the starting kilometreage value
2. Paste the following formula in to cell I3 and copy down to the end of the file.
   1. =ATAN2(SQRT(1-SIN(RADIANS((B3-B2)/2))\*SIN(RADIANS((B3-B2)/2))+COS(RADIANS(B2))\*COS(RADIANS(B3))\*SIN(RADIANS((C3-C2)/2))\*SIN(RADIANS((C3-C2)/2))),SQRT(SIN(RADIANS((B3-B2)/2))\*SIN(RADIANS((B3-B2)/2))+COS(RADIANS(B2))\*COS(RADIANS(B3))\*SIN(RADIANS((C3-C2)/2))\*SIN(RADIANS((C3-C2)/2))))\*6371\*2+I2

This will populate the single line kilometreage based on the Haversine formula and starting from the initial kilometreage of the starting point in cell I2.

In column G, identify where each loop is located. The loop locations can be obtained from the network diagram in Traxim and mapped to the effective single line kilometreage of the corresponding geometry region.

Table 1. Extract from a geometry file for the Gunnedah basin, i.e. From Muswellbrook to Narrabri.



1. Save the file as “<region> geometry.csv” in the same location as the ICE Data file.

### Create Average Data File

The Train Performance Analysis Tool will generate the Average Data file for the transaction time analysis. Refer to the Train Performance Analysis Tool Manual for instructions.

The general steps to create the Average Data File are:

1. Create ICE Data file as in section Create ICE Data File, above.
2. Create a Geometry file as in section Create Geometry File, above
3. Create a TSR File
4. Create a Train list file, if required
5. Enter Train Performance analysis parameters
6. Enter the power to weight boundaries, if required
7. Calculate the average power to weight ratio of trains in the data, if required.
8. Run simulations on Traxim
9. Select the analysis category
10. Select the simulation files
11. Select the aggregation directory
12. Execute the analysis tool.

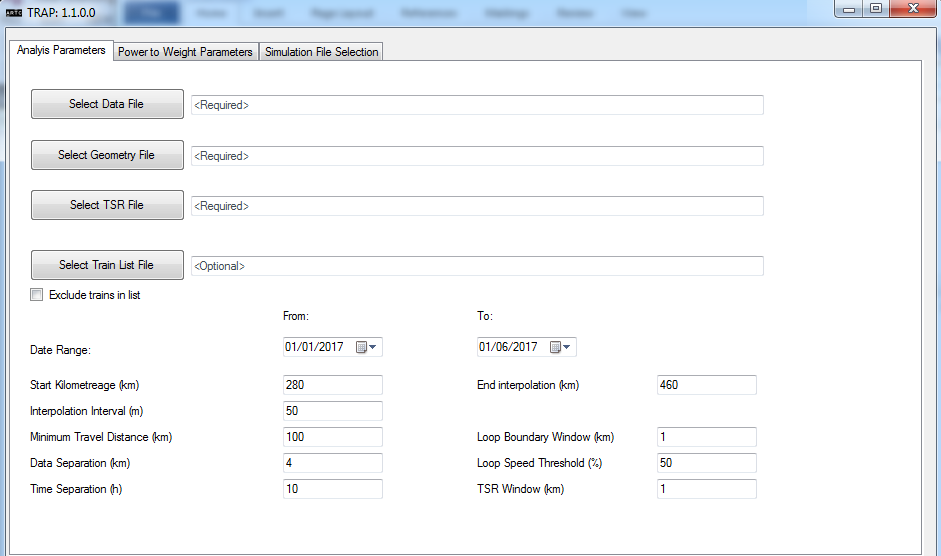


Figure 21. Train Performance Analysis Tool form

Once the program is complete, a file representing the average train of each category selected will be available.

For the purposes of the Transaction Time & Utilisation tool, the average train file needs to be saved as a csv file.

1. The user will need to open the file and select the tab that contains the average train data. This should be labelled ‘Sheet 1’.
2. Save this file as a .csv format as the tool is not able to read .xlsx files.
   1. This will save the current tab to the file in a comma separated format which will be accessible from the tool.

## Transaction Time & Section Utilisation

### Select Files

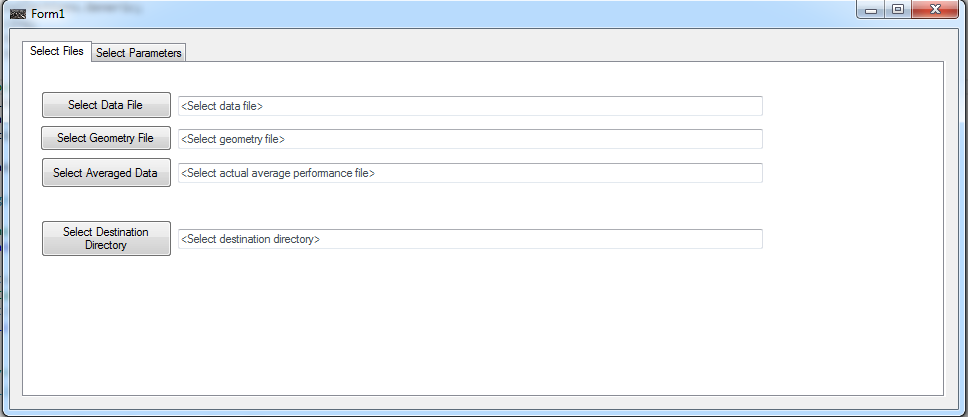


Figure 22. Transaction Time Analysis, Select Files tab.

1. Click on the ‘Select Data file’ button to select the ICE data file created in step 20 of the Create ICE Data File Section above.

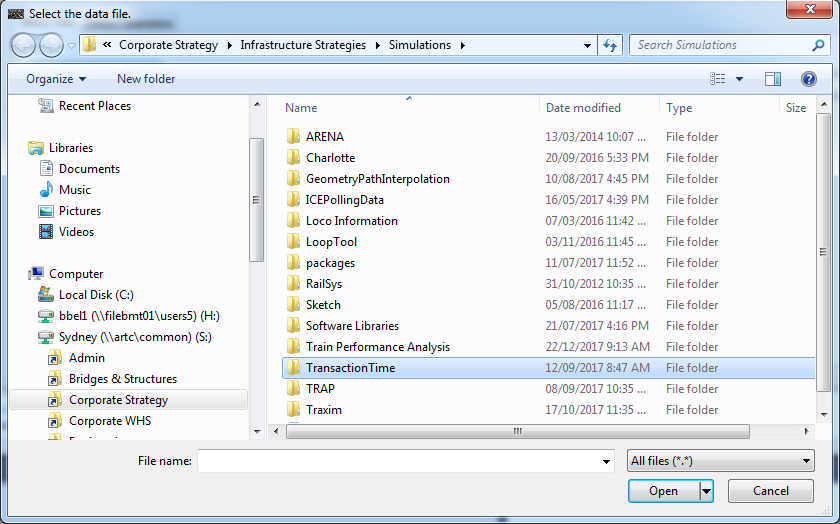


Figure 23. File Selection dialogue

1. Repeat step 1 to select the geometry file created in step 3 of the Create Geometry File section.
2. Repeat step 1 to select the average Data file created in Create Average Data File section.

#### Select Parameters

##### Interpolation Paramters

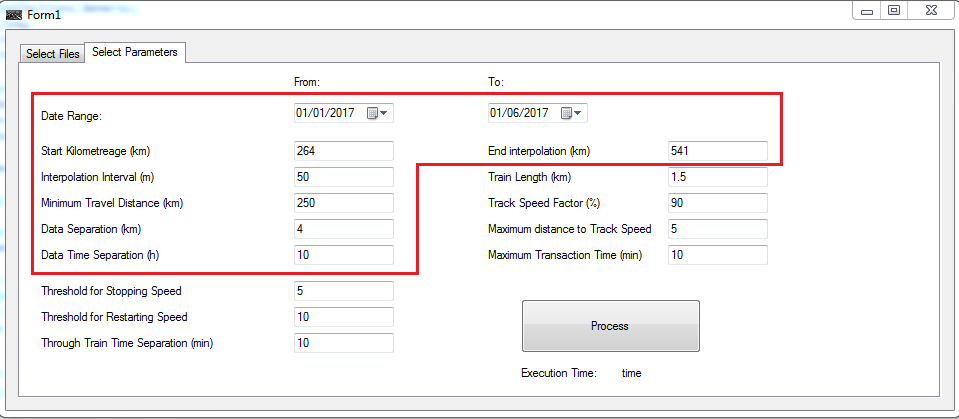


Figure 24. Setting Interpolation Parameters

1. **Date range:** Select the date ranges from the drop down calendar in the From and To section. The dates are exclusive at 12:00:00 AM, such that the To date should represent the day after the last day of analysis. The date range should mimic the date ranges used in generating the average data file.
2. **Start Kilometreage:** Enter the starting kilometreage value for interpolation. This should be close to the lowest km post in the available data.
   1. It is advised that the start kilometreage should represent the same start kilometreage or greater as that used to generate the average data file in section Create Average Data File.
3. **End Kilometreage:** Enter the end kilometreage value for interpolation. This should be close to the highest km post in the available data.
   1. It is advised that the end kilometreage should represent the same end kilometreage or less than, that used to generate the average data fine in section Create Average Data File
4. **Interpolation Interval:** Enter the interval over which to interpolate, this is represented in metres. The default value is 50m, but could vary up or down, however, it is not advised to increase this value above 100m as this would distort the train speeds around curves.
   1. It is advised that the interpolation interval should represent the same interpolation interval as that used to generate the average data file in section Create Average Data File
5. **Minimum Travel Distance:** Enter the minimum distance a train must travel before it is included in the analysis.
   1. This is typically 60-70% of the interpolation distance and is in kilometres.
   2. It may be necessary to reduce the minimum distance travelled if there are trains to be considered that do not travel the entire analysis corridor. Ie trains that start/end within the interpolation corridor.
6. **Data Separation:** Enter the maximum allowable distance between successive points to be included in the analysis.
7. This is set to a default value of 4 km, and is not advised to exceed this value.
8. **Time Separation:** Enter the time in hours that a train is permitted to remain at rest until it is considered to be another train journey.
9. The default value is 10 hours and may vary depending on the corridor being analysed. The 10 hours is typical of the Gunnedah basin region.

##### Transaction Time Parameters

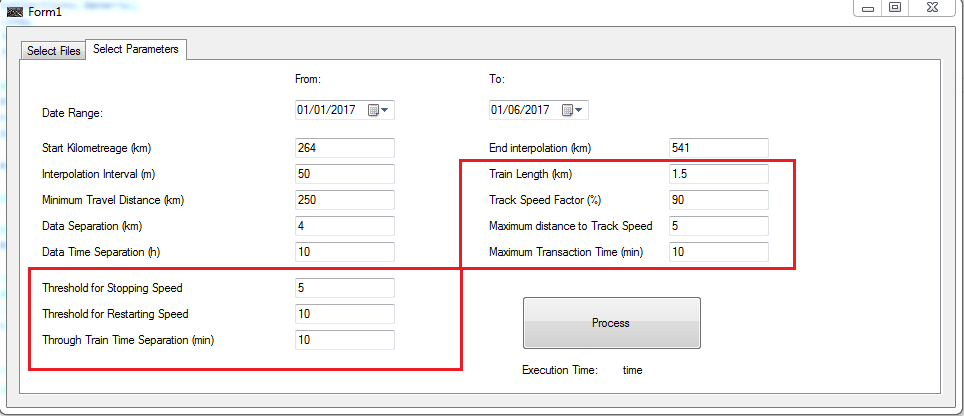


Figure 25. Selecting the transaction time parameters.

1. **Train Length:** Enter the length of the most common train. This is used to determine when a train clears the loop clearance point.
   1. This will depend on the corridor under analysis.
2. **Track Speed Factor:** Enter the Factor that should be used to determine when a train reaches the designated track speed.
   1. This will need to be balanced with the maximum distance to track speed to increase the robustness of the results.
3. **Maximum distance to Track Speed:** Enter the maximum distance a train is permitted to travel before it is required to have reached the track speed.
   1. If there are some loops close together, it is unlikely that the train will achieve track speed. These measurements will be excluded from the aggregated results.
4. **Maximum Transaction Time:** Enter the maximum permissible transaction time
   1. This is used to remove the extreme transaction times calculated.
5. **Threshold for Stopping Speed:** Enter the maximum speed a train is permitted to travel before it can be considered to have stopped.
   1. This needs to be above 0, but below a small speed to indicate that the train is slowing to stop.
6. **Threshold for Restarting Speed:** Enter the speed a train needs to reach before it is considered to have restarted from a loop.
   1. This will need to be above the threshold for the stopping speed, above.
7. **Through Train Time Separation:** Enter the maximum allowable time between a stopped train in a loop and a through train in an opposing direction.
   1. This will need to be the same as the maximum allowable transaction time as this is an effective description on the transaction time.

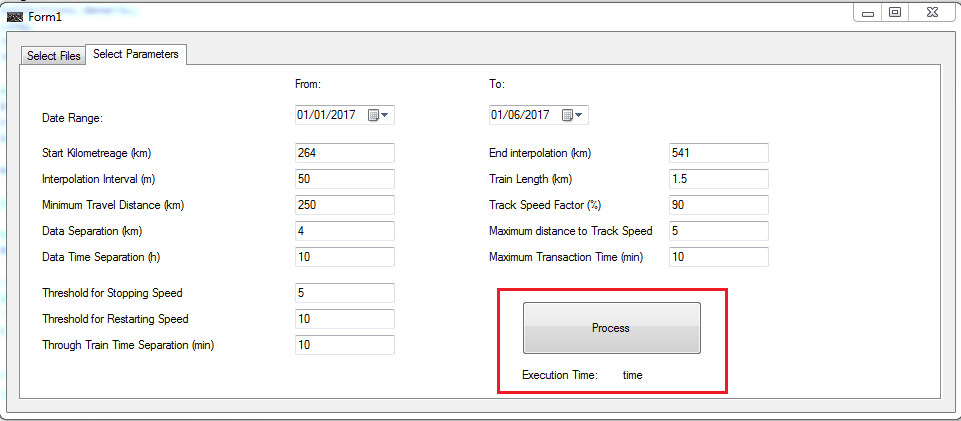


Figure 26. Process the data for transaction time and section utilisation analysis.

1. Press the “Process” button to begin the analysis.
   1. A timer will count up until the program is finished.
   2. The output files will be available in the destination directory.