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User Manual
Module 1 – Pipe ranking

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INTRODUCTION

The Pipe Ranking Module is developed by the Monash Infrastructure Doctors to facilitate the ranking/prioritisation of water pipes for rehabilitation. This module consists of two sub-modules: (a). Monash pipe ranking model; (b). Utility specific pipe ranking approaches (Figure 1).

Figure 1. Overview of the pipe ranking module

For utilities without their own pipe ranking methods, the Monash pipe ranking model is a simple and straightforward model for ranking pipes based on past pipe failure history and it was developed as an outcome of the Smart Water Fund funded by South East Water, City West Water, Yarra Valley Water, and Melbourne Water.

If water utilities have their own pipe ranking methods/models, the Pipe Ranking Module will allow users to import their pipe ranking results into the platform for result checking and essential data extraction for subsequent analysis in the decision-making process for lining.

1 MONASH PIPE RANKING MODEL

The Monash Pipe Ranking Model uses the Bayesian simple model to rank pipelines based on their probability of failure determined from past failure history. For details of the model, please refer to Chik *et al.* (2017). This model may be further improved to consider some key parameters, such as stress and corrosion hotspots, etc, leading to different versions.

1.1 Model version selection

Before conducting pipe ranking to prioritise pipes for rehabilitation, users are allowed to select a version of the Monash pipe ranking model (Figure 2). The current default and available version is the Monash Simple Model. Other versions are not available at the moment but may be developed and implemented later.

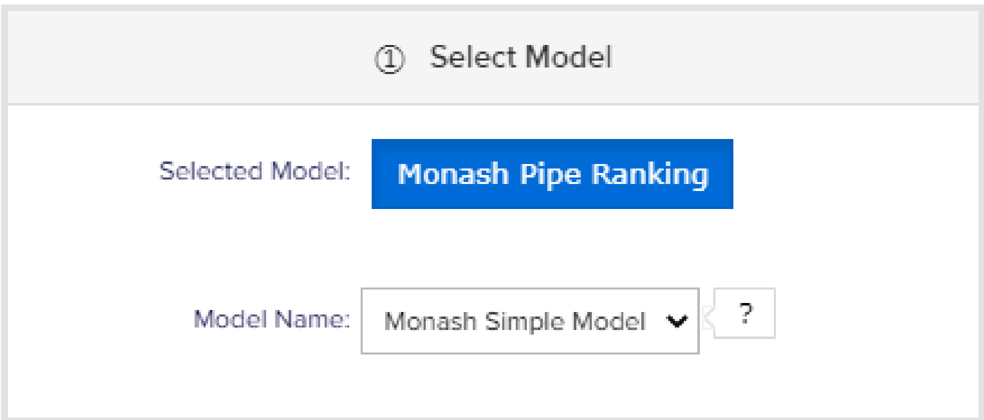


Figure 2. Selection of different versions of Monash simple model for pipe ranking

1.2 Data input

The input parameters are the pipelines to be ranked, their decommission date and failure dates if any, the failure observation period and the last training year. The output of the model is a list of pipelines ranked according to their probability of failure.

There are two input files together (Figure 3) with interface input.

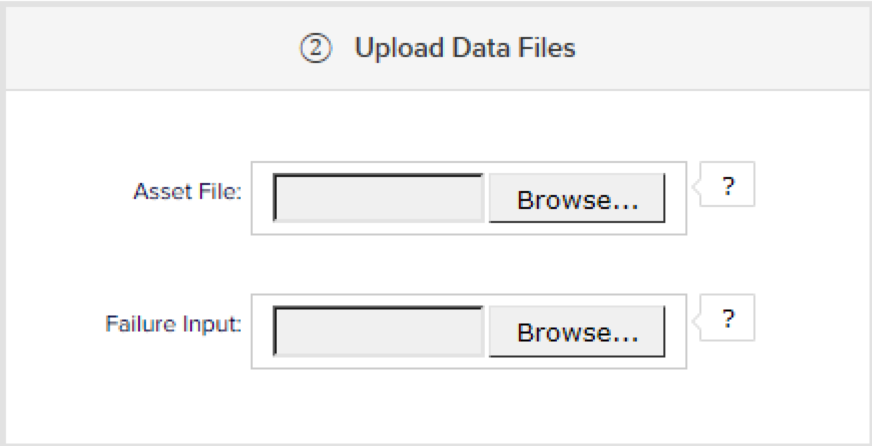


Figure 3. Data file import

1.2.1 Pipe Asset File

This input data can be extracted from the pipe library. The data format of this file is shown in Table 1.

Table 1. Data format of the pipe asset input

Pipe ID	Pipe decommission date		
	Year	Month	Day
31396	1980	09	12
31388	1965	06	08

1.2.2 Pipe Failure Input

The data format of this file is shown in

Table 2.

Table 2. Data format of the pipe failure input

Pipe ID	Pipe failure date		
	Year	Month	Day
31396	1980	09	12
31396	1988	03	12
31388	1998	08	22

1.2.3 Interface input

In addition to the above two files, three more parameters are required to be input by users as shown Figure 4.

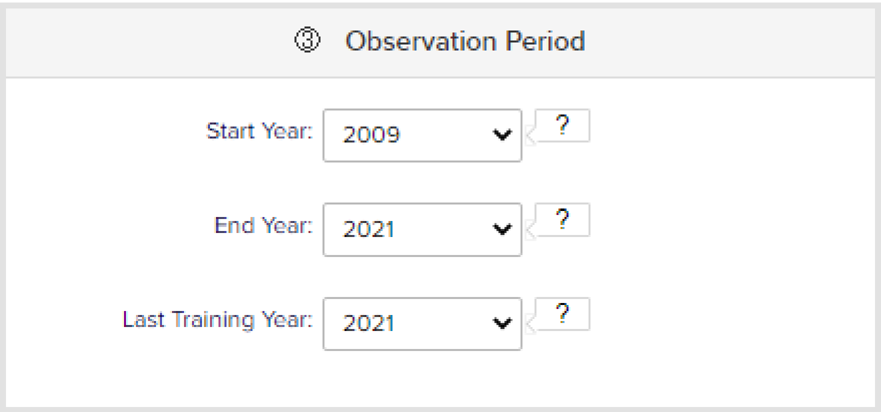


Figure 4. Interface input of additional parameters

Start Year is the year from which pipe failure data were recorded.

End Year is the year until which pipe failure data were recorded.

Last Training Year should be no earlier than the Start Year and no later than the End Year. Normally, the last training year is selected to be the End Year.

1.3 Output

The output of the Monash Pipe Raking model is a list of pipes ranked according to their calculated probability of failure as shown in Figure 5. The users can also export the pipe ranking results to a CSV file.

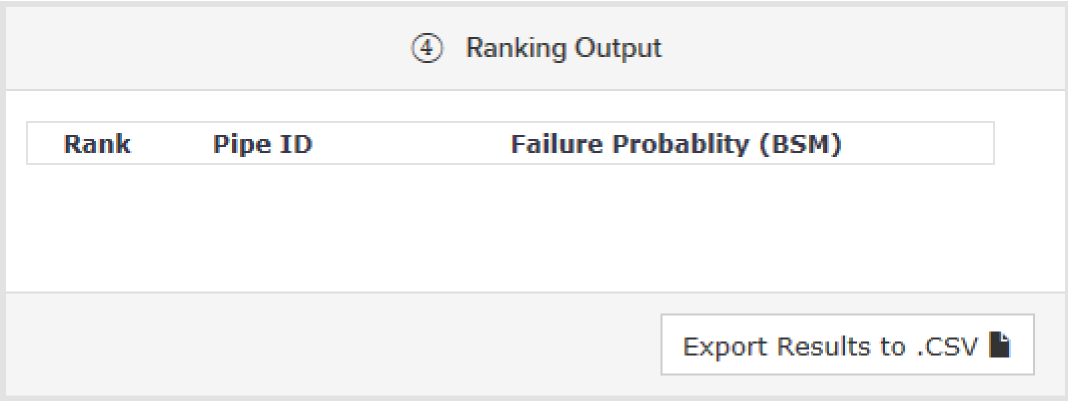


Figure 5. Output of the Monash Pipe Ranking Model

2 UTILITY SPECIFIC APPROACHES

The pipe ranking module allows users to select utility specific approaches for pipe ranking. The main purpose of this option is to check the ranking results from the methods/models used by water utilities and extract necessary information for further analysis in the decision-making process for lining. Please note that **the methods/models currently used by water utilities for pipe ranking/prioritisation will not be implemented in the platform due to limited time**. Only the ranking results from these methods/models will be allowed to be imported.

2.1 Model selection

In the model selection step, uses are required to select their utility name(s) (Figure 6), which will be corresponding to their specific pipe ranking models.

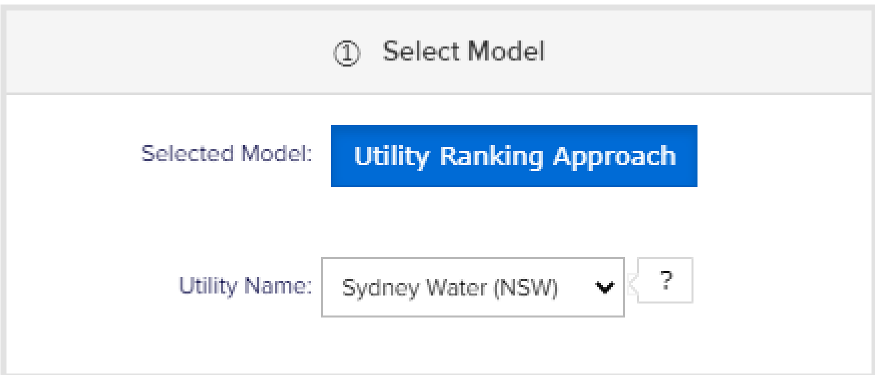


Figure 6. Selection of models by utility names

2.2 Data input

After the users select their utility name, they can import the results from their utility specific pipe ranking methods/models into the platform for further processing (Figure 7).

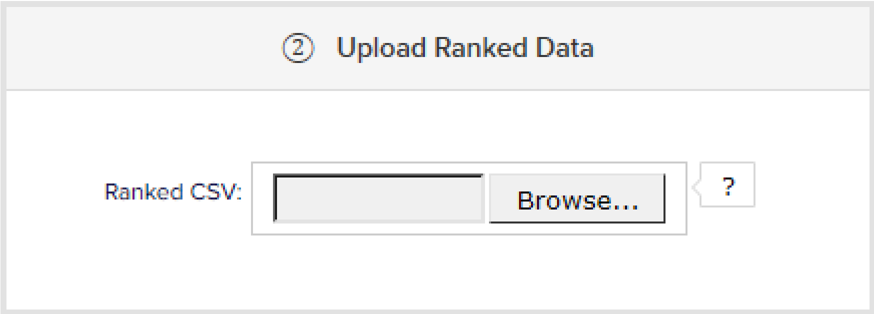


Figure 7. Importing pipe ranking results from utility specific approaches

2.3 Output

The output of the Utility Specific Ranking Approaches includes an updated pipe library with information extracted from the pipe ranking results and a list of pipes ranked according to their calculated probability of failure as shown in Figure 8. The users can also export the pipe ranking results to a CSV file.

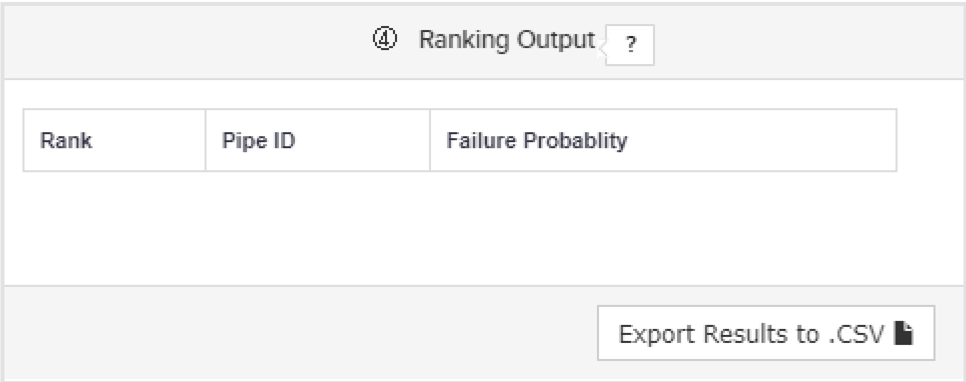


Figure 8. Output of the extracted ranked pipe information from Utility Specific Approaches

3 TUTORIAL EXAMPLES

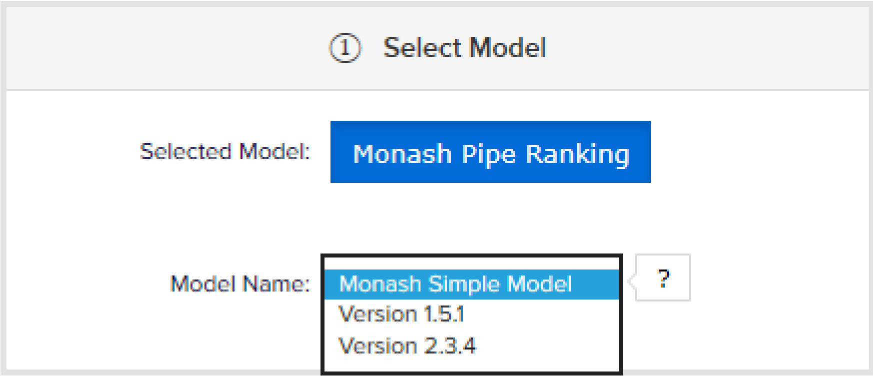
Two worked examples will be employed to demonstrate the use of Monash Pipe Ranking module and the Utility Specific Approaches, respectively.

3.1 Example 1

An example is used to demonstrate the use of the Monash Pipe Ranking Model. The following procedure should be followed to carry out the pipe ranking analysis.

3.1.1 Select Model

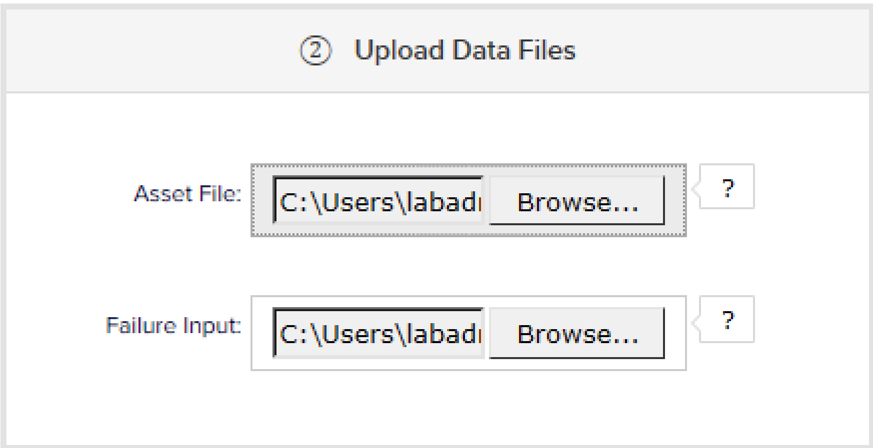
The first step of pipe ranking using the Monash Pipe Ranking Model is to select a version of the model. In this example, the Monash Simple Model is selected.



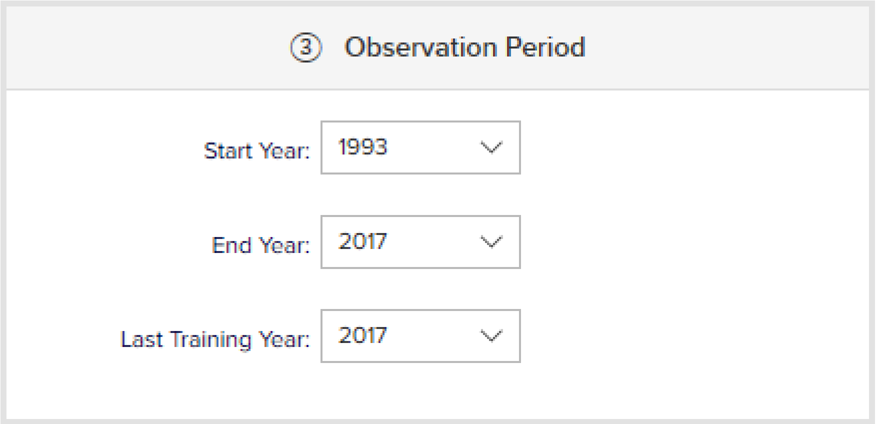
3.1.2 Upload Pipe Data

After model selection, click on “Step 2: Upload Pipe Data”.

Then import the asset file and failure input.



Then click on “Step 3: Enter Observation Period” and input the values for the “Start Year”, “End Year” and “Last Training Year”.



Then click on “Step 4: Rank Pipelines” and the list of the ranked pipes will be shown below.

Rank	Pipe ID	Failure Probablity(BSM)
1	86823	75.0%
2	1050124742	12.5%
2	160835	12.5%
4	161463	10.0%
4	68565	10.0%
4	23492	10.0%
4	59188	10.0%
8	66856	8.3%
8	1050098382	8.3%
8	160553	8.3%

Showing 1 to 10 of 10,469 entries

Previous 1 2 3 4 5 ... 1047 Next

Export Results to .CSV

Proceed to Pipe Analysis ⇨

After checking the results listed in the Table or exporting results to a CSV file, the users can choose to either **exit the platform** or proceed to "**Pipe Failure Analysis**".

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CONCLUSIONS

This document provided guidance to users on the user interface of the Pipe ranking module in the Monash Pipe Evaluation Platform.

DISCLAIMER

1. Use of the information and data contained within the Pipe Ranking Module is at your sole risk.

2. If you rely on the information in the Pipe Ranking Module, then you are responsible for ensuring by independent verification of its accuracy, currency, or completeness.

3. The information and data in the Pipe Ranking Module is subject to change without notice.

4. The Pipe Ranking Module developers may revise this disclaimer at any time by updating the Pipe Ranking Module.

5. Monash University and the developers accept no liability however arising for any loss resulting from the use of the Pipe Ranking Module and any information and data.

REFERENCE

Chik, L., Albrecht, D., and Kodikara, J. (2017). Estimation of the short-term probability of failure in water mains. *Journal of Water Resources Planning and Management*, **143**(2): 1–10.