Moloney AM Systems Financial Modelling Program
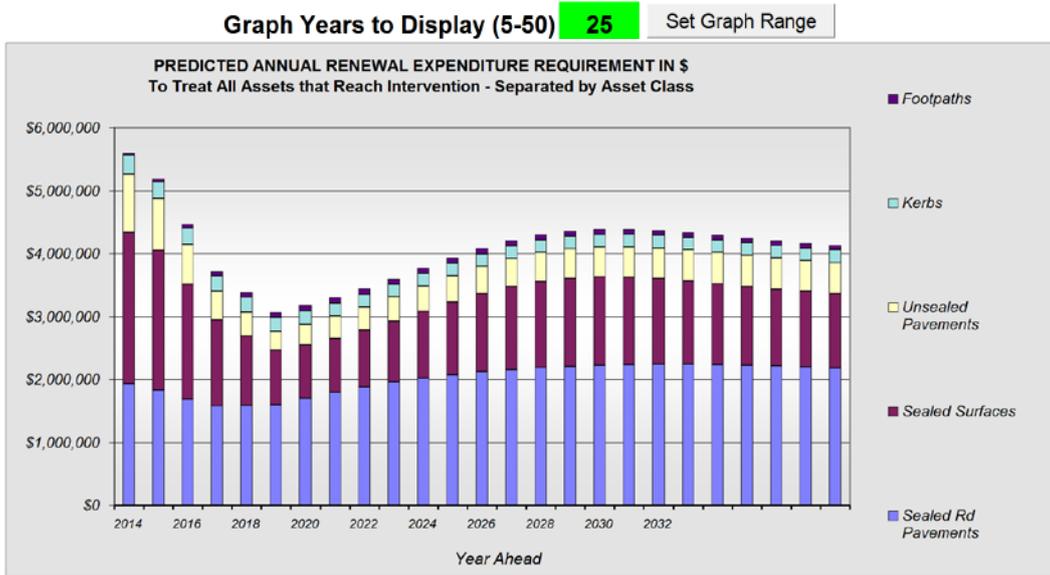
Predicted Renewal demand to treat all over intervention assets

Training and Explanation Document

Recommended funding profile to reduce over intervention assets over 20-Years

May 2023

TABLE OF CONTENTS

1.0   Introduction:

The Moloney Financial Modelling software delivers a prediction of the ongoing annual renewal demand to maintain an existing set of infrastructure assets in perpetuity. Any asset that is built, decays with time and requires rehabilitation at some future point is suitable for running through the model.

The model has two distinct modelling paths. One predicts future asset condition based upon a proposed renewal expenditure profile (Model 1 Proposed Expenditure Model). The second predicts future renewal demand based upon a desired condition outcome (Model No 2 Required Expenditure Model). The renewal gap is not a primary modelling output, but is calculated as the difference between the predicted renewal demand (Model 2) and the actual renewal expenditure.

In 2013 some quite important amendments were made to the software that enabled the proposed expenditure model to be used in a kind of reverse way to deliver a recommended future expenditure profile. The existing "Model No 2 Predicted capital requirement" model is very limited in that once an intervention level is selected the model predicts the future cost to treat ALL over intervention assets straight away with no tolerance of any over intervention assets.

The latest amendment uses "Model No 1 Proposed expenditure" model, in a reverse engineered way to trial expenditure profiles that match a selected set of condition outcomes. So instead of treating ALL over intervention assets immediately you can choose to carry a selected extent of over interventions assets and to achieve the outcome within a nominated number of years. Hence lower initial expenditure and a far more realistic outcome.

1.1   Moloney modelling file - Menus

The Moloney modelling system uses its own unique menus to access the visual basic programs that are at the core of the system. Throughout this document we will say for example from the "modelling menu" choose. Here we are referring to the unique Moloney menu within the "Model All" file. Two of the 3 files within the Moloney modelling system have their own unique menus:

"Input Pro Forma" File   Menu Title – "Input Pro Forma"

"Model All' File   Menu Title – "Modelling"

There are dozens of program operations linked to these menus with some of the more commonly used ones having their own short cut key access as well. The menu item will list the short cut key operation.

1.1.1 Menu Locations

The unique menus are located as detailed below:

Excel 2003 and earlier: They appear at the top of the tool bar next to the "Help" Tab

Excel 2007 and later: They are under the Add-Ins ribbon next to the Developer Ribbon

Within Excel 2007 and later you will need to have the developer ribbon enabled as well as the macros enabled.

2.0   The Moloney Model:

The Moloney financial model is a network-based model (whole of asset set model) that has two modelling paths.

- Predicts future renewal demand based on a selected condition outcome - (level of service), Model 2

- Predicts condition outcome based on a proposed renewal expenditure profile, Model 1

The renewal gap program uses the first of these two models to deliver a renewal shortfall by taking the proposed renewal expenditure from the predicted one.

2.1   Individual Asset sets and Asset groups

The model operates at a whole of asset set level, for a single like performing set of assets. It is not designed to tell you which single asset will need attention, but rather how the whole set will perform with time. It is important that each asset set be made up of like performing assets.

The Moloney model caters for up to 40 individual data sets that can be organised into 10 user definable asset reporting groups. For example, there may be 4 individual data sets used for different footpath types, concrete, asphalt, brick paving and gravel, all of which have different unit renewal rates and life cycles and cannot therefore be modelled as a single data set. But once modelled individually can be reported upon as a single footpath group

The 10 possible asset groups are also reported upon at a whole of organization level. So reporting within the system starts at the individual asset set level, then moves to a group level and finally to a whole of organization level.

2.2   Input Requirements to Predict Future Renewal Demand

The model requires the following input data:

- The Present condition distribution of the asset set

- A Degradation or predicted future performance curve

- The unit renewal costs

- Renewal Intervention Condition – Level of service

If you have all of the above information then it really becomes a mathematical exercise to predict both future renewal demand and the predicted condition outcome for a selected future renewal expenditure profile.

PRESENT CONDITION DISTRIBUTION BY % OF ASSET BASE

% Within Condition	0	1	2	3	4	5	6	7	8	9	10
	3.00	14.00	25.00	28.00	21.00	7.00	2.00	0.00	0.00	0.00	0.00

0 Good   -   Condition   -   10 Poor
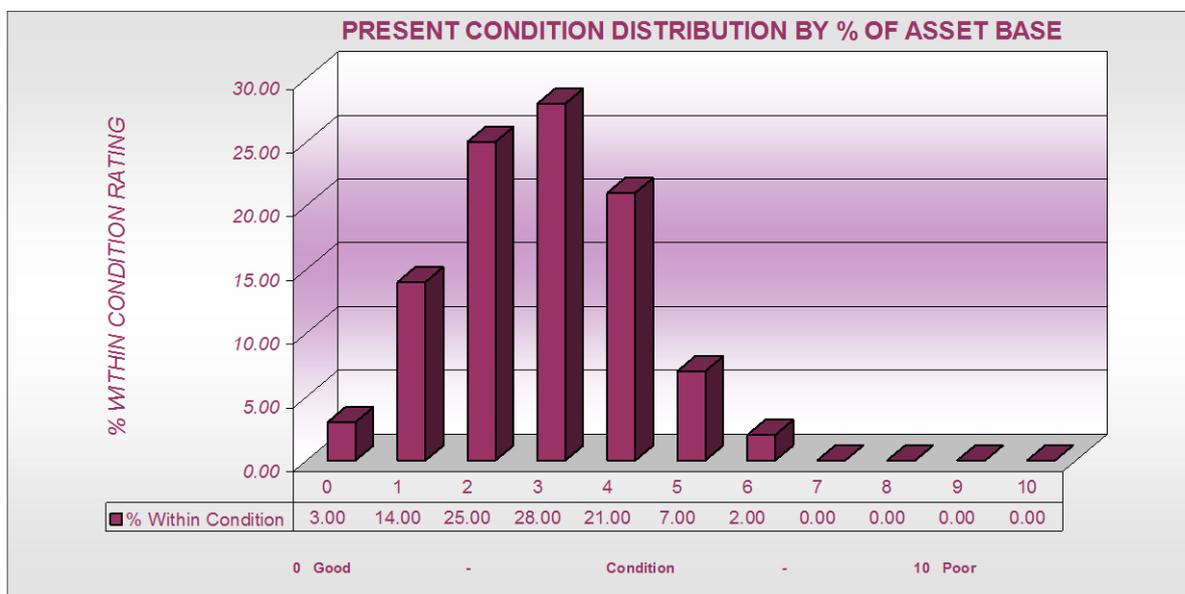
Fig 1 Present Condition Distribution of whole asset group

The Moloney system adopts a common 0 to 10 condition rating scale for all assets. Condition 0 being new with no faults and 10 being fully faulted and having no remaining value. This scale is considered to have sufficient scope and range for successful modelling as well as being easy to understand and should have strong links back to the financial system.

Figure 1 shows a typical condition distribution for a long life asset set that is in relatively good overall condition with no assets above condition 6. The condition 0 assets would have lost no more than 5% of value or service life. The loss of value within the condition 1 asset would be within the 5% - 15% range etc.
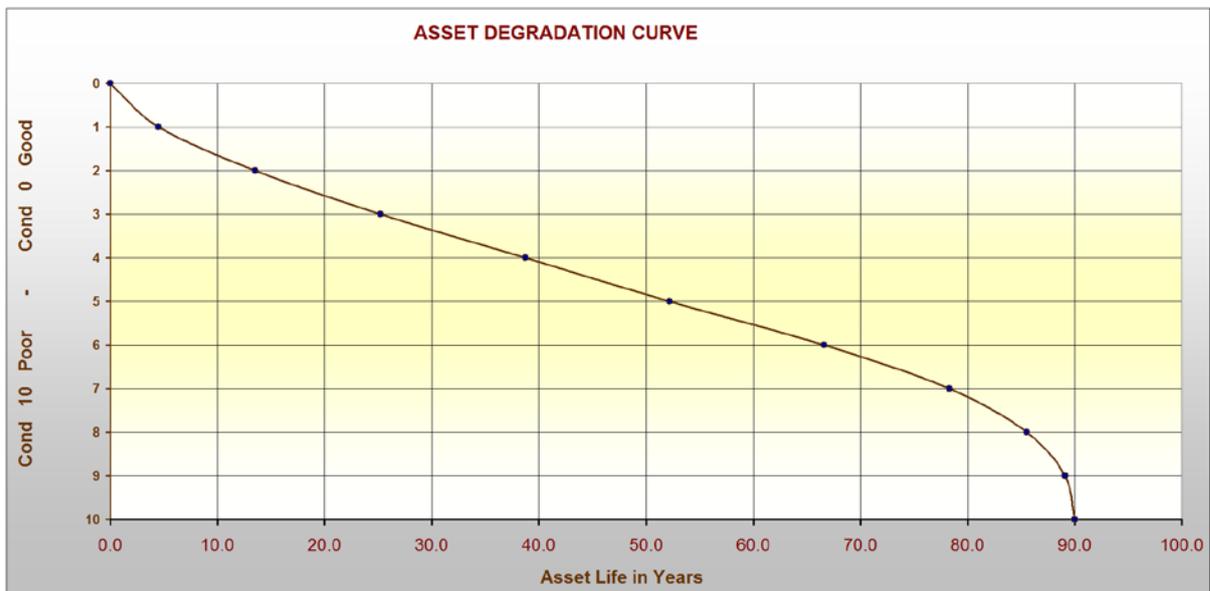
Fig 2 Degradation Curve for asset set

The Degradation curve represents the time - condition relationship and simulates the affect of the passage of time on an asset. Figure 2 above shown that this asset set starts in condition 0 at year zero, then after an average of 4.5 years the asset has reached condition 1. Finally after 90–years the asset is predicted to reach condition 10.

Degradation curves are developed via a statistical analysis of 2 or more consecutive and consistent condition assessments of an asset set some years apart. If the individual assets are lined up and the scope of the condition change measured, then the statistical probability of an asset moving from one condition to the next can be established. Hence the average life within each range is determined as illustrated within figure 2 above.

Unique curves developed by the analysis of condition change between surveys enhance the accuracy of modelling, but if unavailable the system has a set of 20 different default curves matched to 20 asset types.

2.3 Modelling path 1 "Proposed Expenditure Model"

Summary of modelling operation below:

- The model commences with a present condition distribution of the asset set (See Fig 1)

- A degradation process is applied to simulate assets performance with time

- The model takes a user defined 5 - 50-year proposed capital renewal expenditure profile and removes from the poor condition end an amount corresponding to the value of the proposed expenditure and returns that as new condition assets on an annual basis

- The above process goes on for the full 5 to 50-year modelling period.

- The primary output from the model is the predicted future asset condition (See Fig 3)

Figure 3 below illustrates one of the program outputs relating to the future prediction of asset condition. In this case it is the extent of the asset base that is predicted to rise above the selected intervention level (level of service). Note that proposed expenditure is low in early years and condition declines. As expenditure rises the extent of over intervention assets (OIA's) starts to decline.

The program has other predicted condition indicators, but the extent OIA's is considered to be the most useful.

This model is also used in a reverse engineered way within the "Model All" file to deliver a recommended funding strategy to meet certain user definable condition outcomes. See Section 5.1.3 below for details.
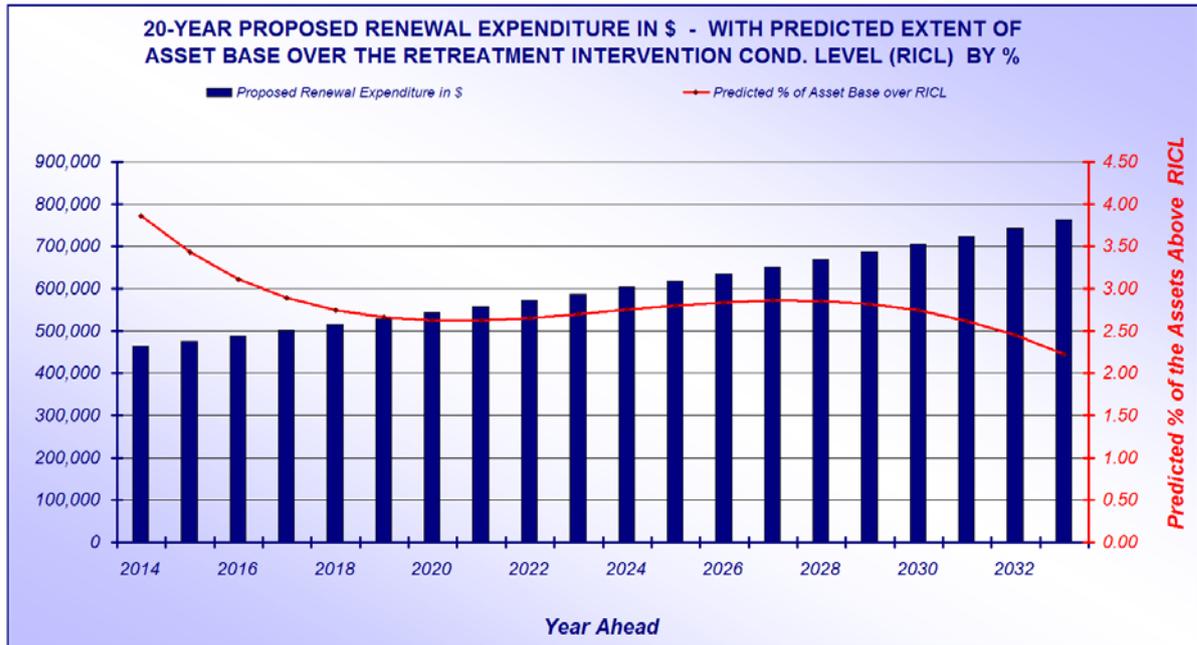
Fig 3 Basic Model 1 output – Predicted future asset Condition

2.4   Modelling path 2 "Predicted Renewal Requirement Model"

This is the basis of the Renewal Gap program

Summary of modelling operation below:

- The model commences with the present condition distribution of the asset set (See Fig1)

- A degradation process is applied to simulate asset performance with time

- From here the model requires the nomination of a Retreatment Intervention Condition Level RICL. That is the condition at which it is considered that an asset should be rehabilitated or replaced usually in the 7 – 9 condition Range.

- The model then returns a 5 – 50 year profile of the retreatment value to treat ALL assets that reach the RICL through the degradation process as a capital renewal expenditure requirement.

- This process continues on for the full 5 - 50-year modelling period, with the primary outcome being a 5 - 50-year required capital renewal expenditure profile to treat all assets that reach the RICL.

The Renewal Gap is simply the difference between the predicted renewal demand and the planned expenditure.

<u>The limitations with this model are</u>:

- Designed to treat ALL over intervention assets with no allowance for leaving a % untreated.

- Over intervention assets are treated over a very short time period often resulting in high early renewal demand as illustrated in figure 4 below.

20-YEAR PREDICTED RENEWAL REQUIREMENT in $ TO TREAT ALL ASSETS THAT REACH THE RETREATMENT INTERVENTION CONDITION LEVEL (RICL)
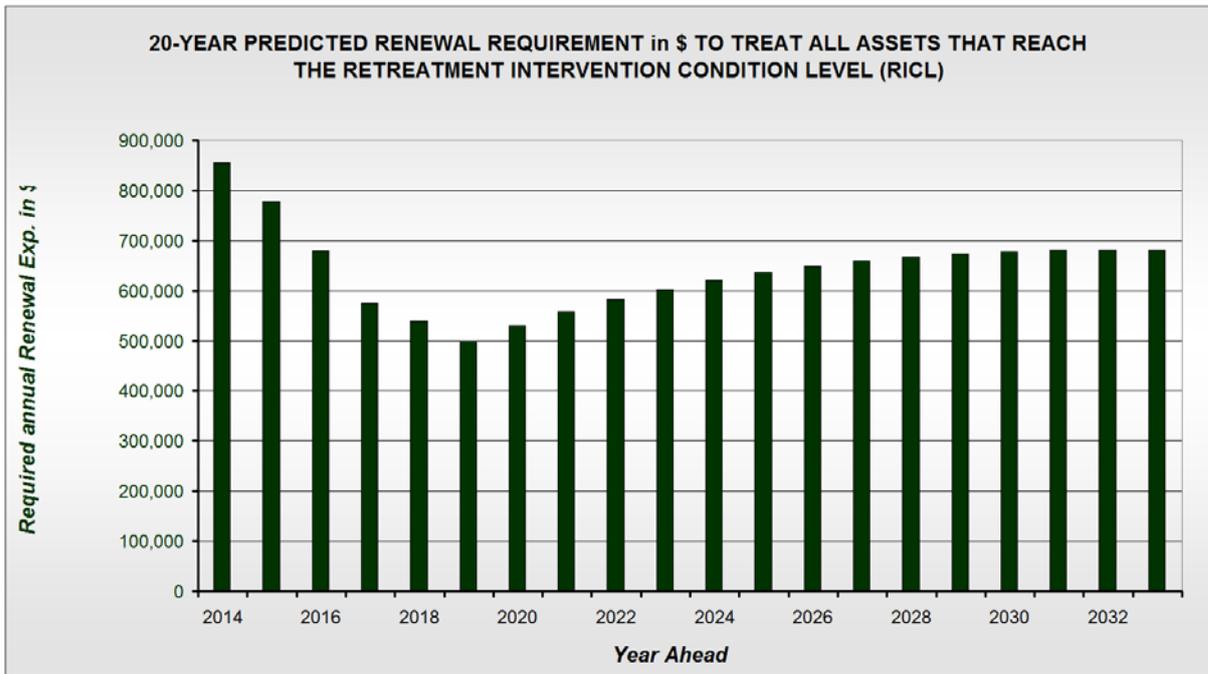
Fig 4   Model 2 output – Predicted future Renewal Demand

Figure 4 above provides a 20-year prediction of the annual renewal expenditure requirement to treat all assets that reach the selected intervention level. Note that there is a high early renewal demand suggesting a slight backlog in over intervention assets that need renewal now.

Note also that if the raw difference in renewal demand between year one and year two is greater than 30% then the model eases the difference in on a reducing scale over a five year period. This can be seen within figure 4 above with the reducing renewal demand over the first five years. Full details of this process can be found within the "Model All" manual.

2.5   Modelling outputs

There is a vast array of graphical outputs within the model, but the most basic outputs relating to the two modelling paths are as illustrated in figures 3 & 4 for the same data set.

Figure 3 provides a prediction of future asset condition based upon a proposed renewal expenditure profile. Condition here is expressed as the % of the asset base predicted to rise above the selected intervention level. Other depictions of the condition change are also available but this is considered the most useful. Note that increasing renewal expenditure is required to maintain the assets within a reasonable condition.

Figure 4 provides the predicted renewal demand profile to treat ALL assets that reach the intervention level through the degradation process. Here the same set of assets are in relatively poor condition and consequently early renewal demand is high.

Figure 4 indicates that a blind application of the "Predicted renewal demand" model, results in a year one demand of $855,000 to begin to treat all assets at and above the selected intervention level. However, Figure 3 illustrates that there is presently 4.44% of the assets already over intervention and that a far lower expenditure, slowly ramped up will move the extent of poor condition assets down with time.

This is a good illustration of how the program results can be quite misleading if not properly explained. Eg. Current spend is $450,000 and does need to rise. Present renewal demand is $855,000 resulting in a large renewal gap of $405,000. But a slow ramp up in expenditure (Figure 3) will address the problem in time.

3.0   The Moloney Financial Modelling Program:

The Moloney financial model is a modelling tool that was originally designed to operate in conjunction with other Moloney asset management software modules. The original system undertook all of the modelling

operations within the single ModelAll File. This one file can still be used in a stand alone way but the upgraded "Moloney Financial Modelling Program" adds far greater flexibility to the process, particularly in its level of reporting.

The system was re-designed to be used by non-Moloney asset management program users and as such two additional files were created, one to assist with the input of data and another to better display the modelling results.

An "Input Pro Forma" file was developed to assist in formatting data for use within the Moloney "Model All" file and an "Asset Graphs" file was developed to display the modelling results in a more flexible way.
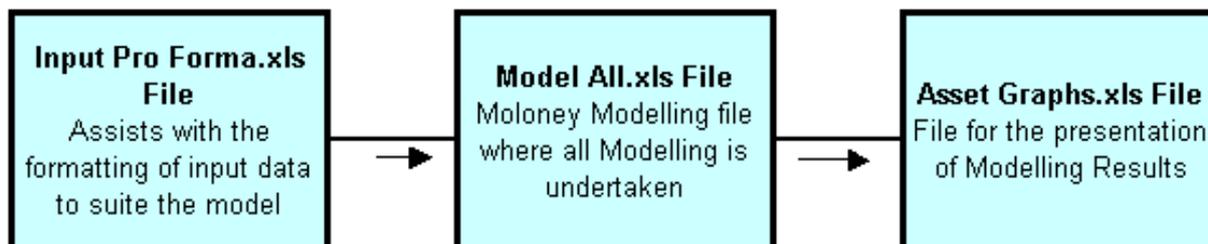
Fig 5 Overall data flow between the 3 Moloney Financial Modelling Files

In its simplest form all of the input data is places into the "Input Pro Forma" file and run from a single command. Data is processed through the Model All file with results sent to the Asset Graphs File for display. The basic user does not need to access the Model All file at all. However, as will be seen later, the Model All file has great strength and adaptability and really does help in the delivery of sound modelling results.

The display file "Asset Graphs" was developed for two reasons. Firstly the Model All file can only analyse 20 individual data sets at a time and more data sets were required to cover a larger range of assets.

Secondly the modelling results for the 40 individual data sets that are within the "Input Pro Forma" file can be grouped for display purposes within the "Asset Graphs" file in any user defined way that is required. Eg a footpath group can be established with 4 individual modelling data sets for concrete, asphalt, brick paving and gravel footpaths all with different life cycles and renewal rates with individual results also displayed at a footpath group level.

3.1 The Input Pro Forma File

This file was designed to assist with the formatting of data for use within the Moloney Model All file. The primary aim is to:

Populate all data within table's 1- 4 on the "Required Data" Sheet of the file, for all 40 data sets

Figure No 6 below illustrates the first of 4 tables on the "Required Data Sheet". The table covers the primary input requirements for each of the 40 data sets. It contains overall details relating to each asset set.

Note that Grey shaded cells are delivered via formulae from other cells within that same sheet. Purple shaded cells are delivered during the running of the program via visual basic code, or are formulae related cells linked to other sheets within the same file. The green shaded cells are the user definable cells and MUST all be appropriately filled in for all 40 data sets, even the ones you are not modelling.

Table No 1   Asset Quantity - Description and Expenditure details

Asset Group No	1	1	1	2	2	2	2
Asset Set No.	1	2	3	8	9	10	11
% of the Required Exp Being Met	59	91	65	59	91	59	78
Av Unit Renewal Cost $	$30.4	$30.4	$14.5	$30.4	$30.4	$7.1	$7.1
Asset Group Name	Urban Roads Group	Urban Roads Group	Urban Roads Group	Rural Roads Group	Rural Roads Group	Rural Roads Group	Rural Roads Group
Asset Set Description	Pavement (High Traffic) Urban	Pavement (Low Traffic) Urban	Asphalt Seal (High Traffic) Urban	Pavement (High Traffic) Rural	Pavement (Low Traffic) Rural	Spray Seals (High Traffic) Rural	Spray Seals (Low Traffic) Rural
Asset Quantity	1,249,468	1,917,093	913,683	351,055	888,972	199,693	376,220
Units	sqm	sqm	sqm	sqm	sqm	sqm	sqm
Total Asset Group Renewal Cost $	$37,961,827	$58,245,871	$13,275,814	$10,665,891	$27,009,096	$1,409,833	$2,656,113
Annual Renewal Exp.	$346,715	$531,974	$430,028	$97,414	$246,680	$55,175	$103,948
Annual Maintenance Exp.	$100	$100	$479,264	$100	$100	$50,640	$95,406
Retreat. Intervention Condition	7.5	8.0	7.5	7.5	8.0	8.0	8.0
Return Cond after Renewal	0	0	0	0	0	0	0
Life to Condition 10 in Years	65.0	100.0	20.0	65.0	100.0	15.0	20.0
Life in years to Intervention Level	64.7	99.6	19.9	64.7	99.6	15.0	20.0

Fig 6 Table 1 Required Data Sheet

The grey shaded cells are formulae generated and should not be amended. They provide a quick check on the unit renewal rate and the % of long-term demand being met (based on your input data). They are provided as a quick check of the overall accuracy of some of the input data. You MUST fill in all green shaded cells within the table for all 40 data sets. The purple shaded cells at the bottom of the table are populated via visual basic code when the program is run from the "Run and Review Sheet"

Table No2: Contains the present condition distribution for the asset sets. Note that a distribution is required for all 40 data sets even the ones that are not being modelled (any distribution will do). In this case we have used inbuilt default distributions (see bottom line of table).

Table No 2   Present condition Distribution of assets

Asset Group	Roads Group	Roads Group	Roads Group	Roads Group	Roads Group	Roads Group
Condition Rating 0 Good - 10 Poor	Pavement (Sealed Link Rds)	Pavement (Sealed Collector Rds)	Pavement (Sealed Access Rds)	Data Set 04 Not Modelled	Unsealed Pave Med Traffic	Unsealed Pave Low Traffic
10	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	3.00	0.00	0.00
8	2.00	1.00	0.00	7.00	3.00	1.00
7	7.00	4.00	1.00	11.00	4.00	3.00
6	12.00	10.00	8.00	12.00	8.00	6.00
5	26.00	23.00	14.00	13.00	14.00	9.00
4	26.00	25.00	20.00	16.00	20.00	12.00
3	18.00	23.00	25.00	14.00	21.00	12.00
2	7.00	10.00	18.00	12.00	13.00	17.00
1	2.00	4.00	12.00	10.00	12.00	20.00
0	0.00	0.00	2.00	2.00	5.00	20.00
	100	100	100	100	100	100
Custom or Default Distribution	Below Average	Average	Good	Average	Custom	Very Good

Fig 7 Asset Condition Distributions

It is best to have a custom distribution based upon your actual asset condition. If reliable condition information is not available you can select one of 6 default condition distributions that best describes the particular data set. There is a pick list at the bottom of the table within row 36 based in an overall asset set condition of (Very Good, Good, Above Average, Average, Below Average and Poor). Note that there are different inbuilt distributions for the different asset types (See notes relating to Table 4 Below).

Standard distributions are stored within the file if using your own custom distributions check the distribution shape against the default distributions on the "Graphs" sheet (Data set 5 in Figure 7 above is a Custom distribution).

Table No 3 Contains the asset Degradation Curve and Table 4 Identifies the Asset Type

Table No 3 Degradation Curve - % of total life within each condition rating - The only Essential field						
Asset Group	Roads Group	Roads Group	Roads Group	Roads Group	Roads Group	Roads Group
Asset Set No.	**1**	**2**	**3**	**4**	**5**	**6**
Asset Set Name	Pavement (Sealed Link Rds)	Pavement (Sealed Collector Rds)	Pavement (Sealed Access Rds)	Data Set 04 Not Modelled	Unsealed Pave Med Traffic	Unsealed Pave Low Traffic
Condition Rating 0 Good - 10 Poor	% of Total Life in Cond.	% of Total Life in Cond.	% of Total Life in Cond.	% of Total Life in Cond.	% of Total Life in Cond.	% of Total Life in Cond.
10	0.00	0.00	0.00	0.00	0.00	0.00
9	1.00	1.00	1.00	1.00	1.00	1.00
8	4.00	4.00	4.00	4.00	4.00	4.00
7	8.00	8.00	8.00	9.00	9.00	9.00
6	13.00	13.00	13.00	11.00	11.00	11.00
5	16.00	16.00	16.00	11.00	11.00	11.00
4	15.00	15.00	15.00	11.00	11.00	11.00
3	15.00	15.00	15.00	11.00	11.00	11.00
2	13.00	13.00	13.00	12.00	12.00	12.00
1	10.00	10.00	10.00	15.00	15.00	15.00
0	5.00	5.00	5.00	15.00	15.00	15.00
Total % of Life Must = 100	100	100	100	100	100	100
Custom or Default Distribution	Default	Default	Default	Default	Custon	Custon

Table No 4 Selection of Asset Type						
Standard Asset Type Name	Sealed Rd Pavements	Sealed Rd Pavements	Sealed Rd Pavements	U/S Rd Pavements	U/S Rd Pavements	U/S Rd Pavements

Fig 8 Asset Degradation Curves

If you have your own performance - degradation curves then use them, if not you can select a default distribution from row 54 at the bottom of Table 3. The sealed Rd pavement data sets in asset sets 1 – 3 above have been matched to the default degradation curve for sealed road pavements. Note that data set 4 is also a default degradation curve but being an unsealed pavement it has a different degradation curve to data sets 1 – 3. Data sets 5 + 6 have used custom distributions.

If adopting default degradation curves at the bottom of table 3, the program will check for the asset type nominated within Table 4 and then allocate the appropriate degradation curve matched to that asset type. Table 4 has 20 preset asset types to select from with matched degradation curves and condition distributions. If there is no obvious match you could choose the miscellaneous category, or develop your own curve.

You can adopt a default curve and then modify it to better reflect your situation. If you do this be sure to amend the setting at the bottom of tables 2 & 3 to "Custom" so that your amended distributions will not be overridden when you bring in the default distributions again from the "Input Pro Forma" Menu.

3.1.1 Populating the "Required Data" Sheet

The aim is to populate the green shaded cells on the "Required Data" sheet within the 4 tables for all 40 data sets. You can model as little as 1 data set (most unlikely) and put the minimum information within the other 39.

The data required for table 1 should be readily available within most organizations. Table 2 can present more of a problem, as not all authorities have sound condition information for their assets. It is rare to find an authority that has developed unique degradation curves, as required in table 3.

To assist with the populating of the "Required Data" Sheet and particularly tables 2 and 3, two further methods have been built into the file to assist. Thus there are 3 ways of populating the "Required Data" sheet and often the one organization will use all 3 methods over the whole of the 40 data sets.

- Direct input of data from some external source
- Use of default distributions with your overall figures.
- Use of the File Worksheets

3.1.1.1   Direct Population of the Required Data Sheet

This is generally the best method if there is high quality condition information available. If the existing data is poor then one of the other methods should be considered. Just because there is condition information available does not mean it is sound and often the modelling process is the first time the data will be closely scrutinised and it can be found wanting.

If using custom condition distributions look at their shape within the "Graphs" sheet of the file once they have been entered. Toggle between the 40 data sets at cell L1. If a condition distribution looks questionable then it probably is of a low quality and should be further investigated.

Note that for users of other Moloney Modules there is a direct import facility available. This is done via a file called "Import Filtered Data". Check with MAMS for more details.

3.1.1.2   Default Distributions

The program has a set of in-built condition distributions for 20 different asset types. The condition distributions cover the following overall asset set descriptions,

- Very Good
- Good
- Above Average
- Average
- Below Average
- Poor.

To use this method, populate table 1 and then select the best matched description for each asset set from the pick list at the bottom of table 2 (Row 36). You would normally also pick the default degradation curve at the bottom of table 3 (Row 54). Be sure to also select the most appropriate asset type from the pick list in table 4 (Row 58).

With all default distributions selected go to the "Input Pro Forma" menu at the top of the page or within the "Add Ins" tab in Excel 2007 and later, choose "Required Data Sheet Operations" and then "Bring in Nominated Default Distributions within Tables 2 and 3"

3.1.1.4   The Worksheets

Three different types of worksheets have been placed within the system, which are designed primarily to deliver an asset condition distribution based upon your entered data. The 3 types of work sheets are as listed below.

- Split Asset Sheet
- List Sheet
- Construction Date Sheet

Full details of how the 3 work sheets operate are available within the "Financial Modelling Manual" Formally the "Renewal Gap Manual" and a brief explanation only is provided below.

The "Split Asset" worksheet allows you to list assets such as buildings with a single renewal value for each whole building. Then you rate individual sub asset components of the total building such as (Structure, Roof, Mechanical Services and Fit Out) with an individual 0 – 10 condition rating. The program then delivers unique condition distributions for the building sub components that can all be modelled with appropriate life cycles and intervention levels that match their expected performance. The sheet allows for up to 10 user defined sub asset components. A single building may have a condition 1 structure and a condition 9 fit out so they can't be modelled as a single asset. But by splitting the assets into sub groups all the condition variation can be accounted for within the delivered condition distributions. A user-defined percentage of the total building cost is also distributed to the various sub components.

The sheet splits the total single valuation for the asset into the user definable percentages that you have allocated. Using buildings as the example you may allocate 40% to the Structure 5% to the roof, 5% to the mechanical services and 50% to the fit out. The total MUST come to 100% and if for example you had no mechanical services, then that 5% would be allocated to the other components in the nominated ratios.

The "list" worksheet as the name implies allows you to list like performing assets with renewal values and conditions. The program then delivers the condition distribution for the total asset set. Note that the assets within each single group MUST be like performing assets with the same or close total service lives.

The **"Construction Date" worksheet** delivers a condition distribution based on the percentage of the asset base that was built over 10 user definable time frame intervals. It is often used for assets such as underground drainage where condition is difficult to assess but the age profile is known.

Common functions to all worksheets All worksheets have inbuilt data checking programs that are accessed off the "Input Pro Forma" Unique menu. These should be activated before the operation that creates the unique condition distribution is engages (Done off the same Menu as above).

Check all data on the "Required Data" Sheet Before attempting to run the program use the inbuilt data checking mechanism of the "Input Pro Forma" Menu to validate your data. This check may not be perfect but it will generally find around 98% of the data entry errors.

3.1.2   Running the program

With the Required Data Sheet completed the program can be run from the "Run and Review" Sheet within the "Input Pro Forma" file. Before running the program, data should be validated on the "Required Data" Sheet. From the "Input Pro Forma" Menu Choose "Required Data Sheet Operations" then "Check all data on Required Data Sheet before Running".

Data errors and missing information will be shaded red after this operation. Fix all errors and run the check again till you get the OK.

There is also a check for the proper set up of the asset group number and names from Button 6 of the "Run and Review" Sheet. It is a good idea to run this check as well if you have amended the asset reporting group set up.

The program is run from the "Run and Review" Sheet. The whole of the program can be run from button 5 on that sheet.
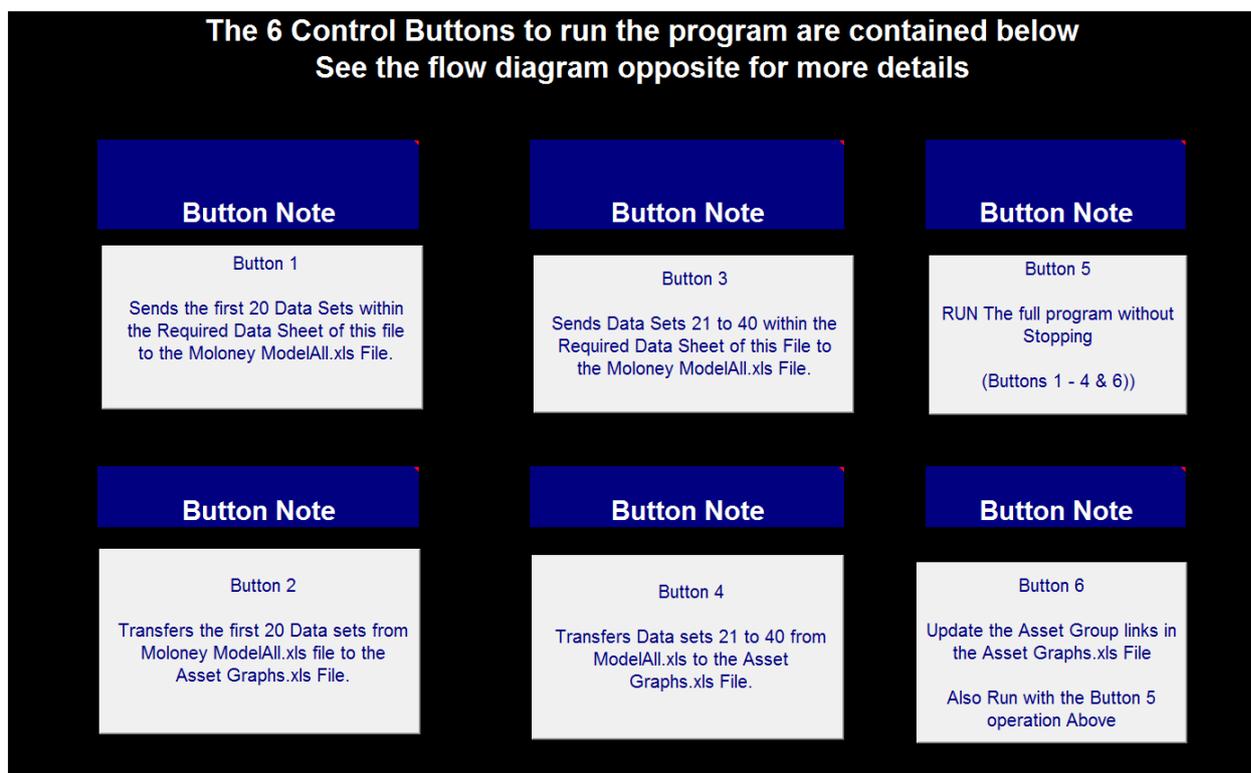
Fig 9 Running the Moloney Financial Modelling Program

Buttons 1 – 4 allow you to load the "Model All" file. Review and amend results in the Model All file and then send the modified results to the "Asset Graphs" file upon completion. This process is used by the more advanced user and has the great advantage of checking the sensitivity within the model of changes to the input variables. It is strongly recommended that users go to this stage after gaining a basic understanding of the model.

Button 1 takes the first 20 data sets in "Input Pro Forma" to the "Model All" file runs them all and displays results within Model All. You can then review the results one asset set at a time in "Model All" and fine tune

the 7 modelling variables within "Model All" to optimise your results. "Model All" is a great place to do this as the individual results can be delivered very quickly. The sensitivity of variables such as the intervention level can be extreme and this process allows you to check this and achieve the best results.

Button 2 transfers the modelling results for the first 20 data sets from Model All to Asset Graphs. Buttons 3 and 4 do the same thing for data sets 21 – 40 within the Input Pro Forma File.

Button 5 is used if you do not want to review anything but just run the whole program form the one location.

Button 6 sets up the asset group display within the asset graphs file based upon asset set groupings you have selected within rows 6 & 10 of the required data sheet. Note here that for the same number groups within row 6 you MUST have a matching identical asset group name within row 10. That is, all the group 1 numbers in row 6 MUST have the same group name within row 10 etc.

There is a maximum of 10 asset groups and no more than 19 asset sets in any one asset group.

3.1.3 Updating "Model All" amendments through the system – IMPORTANT NOTE

- After amending an individual data set in the "Model All" file, Button MV 1 on "Modelling Variables" sheet will store your amendments for that 1 data set within the Model All file and allow you to move onto a second data set.

- Once you have amended all 20 data sets (or just the ones you need to), Button MV 2 on the "Modelling Variables" sheet will transfer all amendments back to the "Input Pro Forma" file

- Activate button No 2 on the "Run and Review Results" sheet of the "Input Pro Forma" file to transfer the amended "Model All" results to the "Asset Graphs" file (when dealing with data sets 1 – 20)

- Similar process applies for data sets 21 – 40 in the "Input Pro Forma" file. Use button 4 to transfer data to asset graphs in this case.

- Button MV3 brings to Cell Range B36 – AY36 (on the modelling variables sheet) the required renewal expenditure from the "Predicted Capital Requirement" model (this expenditure treats all assets that reach the intervention level). This may be used if you have one data set that you want fully funded.

- Button MV 4 is used to create a recommended expenditure profile (see section 5.1.3 for more details)

Button NOTE	Button Note	Button Note	Button NOTE
BUTTON MV 1 Copies Current Modelling Variables to"Data Storage " and updates Aggregate Sheets	**BUTTON MV 2** Transferres all variables for the full 20 Data Sets back to "Input Pro Forma"	**BUTTON MV 3** Copies the 50 Year required Exp from Model 2 to Table MC 2 Below	**Button MV 4** Deliver 20 - Year Recommended Expenditure Profile
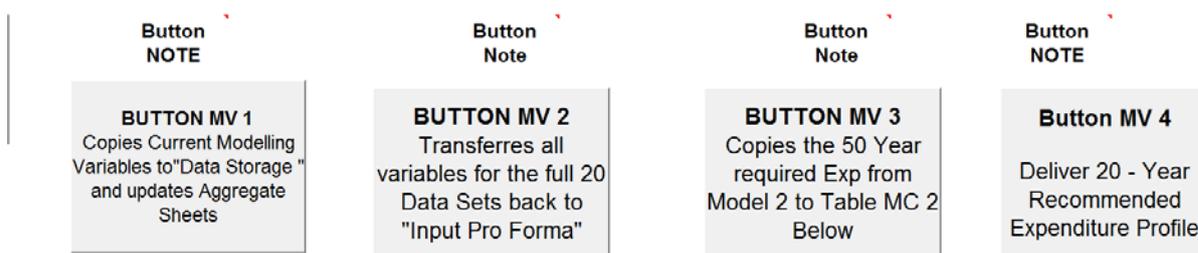
Fig 10 The 4 Buttons at the top of the Modelling variables Sheet (Model All File)

See also the quite extensive excel notes within the Modelling Variables Sheet of the Model All file relating to the buttons within Cells M1 – U1
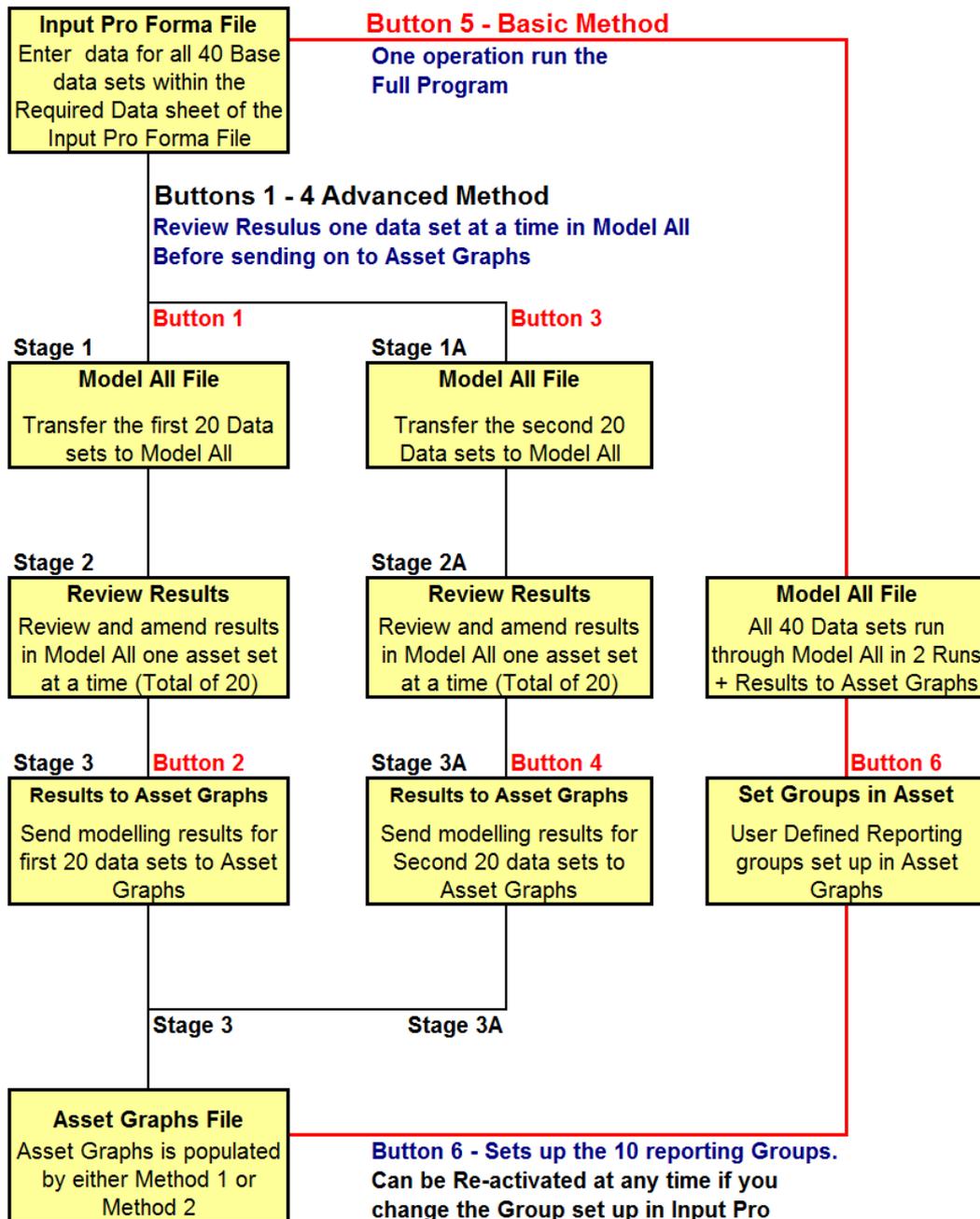
Fig 11 Flow Chart of Data from Input Pro Forma to Asset Graphs – The 2 paths Basic and Advanced

Figure 11 above shows how the flow of data operates through the system when using the "Run and Review" sheet. Run the whole program from Button 5 via the basic method, or use the advanced method by transferring 20 of the 40 data sets to Model All in two runs. Then within Model All, load the single data sets one at a time and make amendments as required before transferring the modified results to Asset Graphs. This process is then repeated for the second batch of 20 data sets.

3.2   The Model All File

To use the software in its simplest form there is no need to access this file. However, if you want to get the most out of the package then it is recommended that you gain an understanding of how the "Model All" file (engine room of the application) operates.

The Model All file can be used on its own to undertake the whole of the modelling process. It is in fact a mini version of the 3 File "Moloney Financial Modelling" Program, with the following Correlations.

Input pro Forma file:-   Represented by Data Storage Sheet
Model All File:-   Represented by the Individual Modelling sheets (4 Number)
Asset Graphs:-   Represented by the 3 Aggregate Sheets

Limitations within the Model All File:

- Max of 20 individual Data sets can be modelled in Model All and aggregates
- The aggregated results for all 20 data sets are all displayed together (No sub groups)

Advantages of Use of Model All within the Broader Moloney Financial Modelling Program:

- Easy to amend input variables and view results quickly
- Enables a check of the sensitivity of the input variables such as intervention level very quickly
- Provides additional graphical outputs
- Can be used to create a planned renewal expenditure profile that will deliver a desired condition outcome (see section 5.1.3 for more details)

3.2.1 Using the Model All File within the Moloney Financial Modelling Program

Figure 11 above that illustrate how the first 20 and the second 20 data sets within "Input Pro Forma" are transferred to Model All from Buttons 1 & 3. With results then transferred to the "Asset Graphs" file from buttons 2 & 4.

- Run Button 1 from the "Run and Review sheet of the "Input Pro Forma" file to load the first 20 data sets into Model All.

- From the "Modelling" Menu within the "Model All" File load data set No 1 from the first menu level.

- Check results and amending the Modelling variables on the "Modelling Variables" sheet before re running the model within "Model All" via a "ctrl k" command or off the modelling menu.

- When satisfied with the result hit Button MV1 on the "modelling variables" sheet to store your amended results for that single data set at this stage only within the "Model All" File.

- Repeat the above 3 steps for all 20 data sets or just the ones you wish to review

- Hit Button MV 2 on the "Modelling Variables" Sheet to transfer the amended variable data for all 20 data sets in the "Model All" file back to the "Input Pro Forma" file

- Switch back to the "Run and Review sheet of the "Input Pro Forma" file and activate Button 2 to transfer the amended modelling results within "Model All" to the "Asset Graphs" file for the first 20 data sets

- Repeat the above 6 steps for data sets 21 – 40 via buttons 2 and 4 on the run and review sheet.

3.3   The Asset Graphs File

The "Asset Graphs" file is used to display the modelling results at 3 different levels. Results can be viewed at Whole of organization level, Asset group level or individual asset set level (each of the 40 individual data sets).
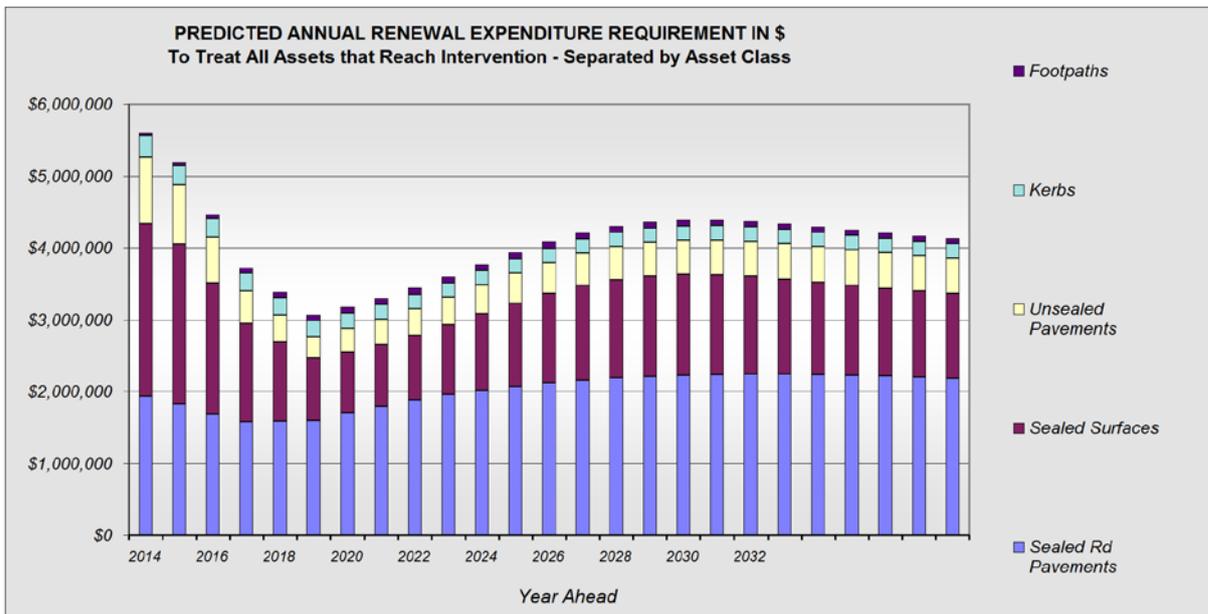
Fig 12 Asset Graphs file Predicted Renewal demand for whole organization
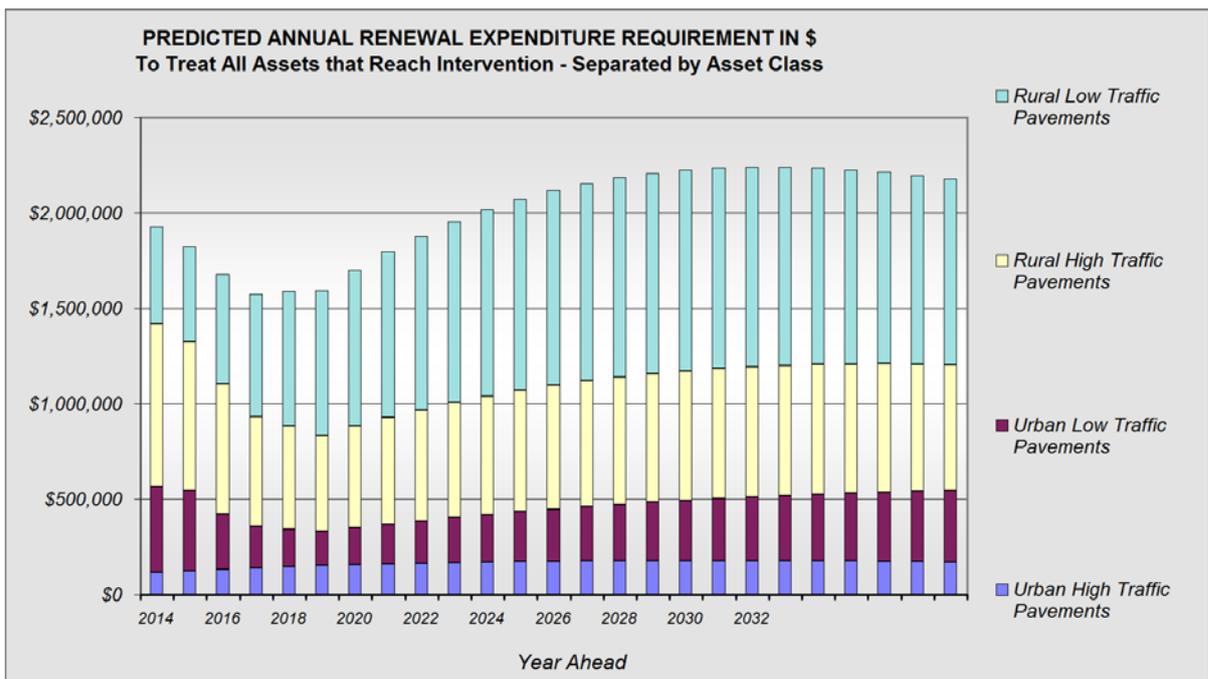
Fig 13 Asset Graphs file - Predicted Renewal demand at Asset Group Level – Sealed Rd Pavements
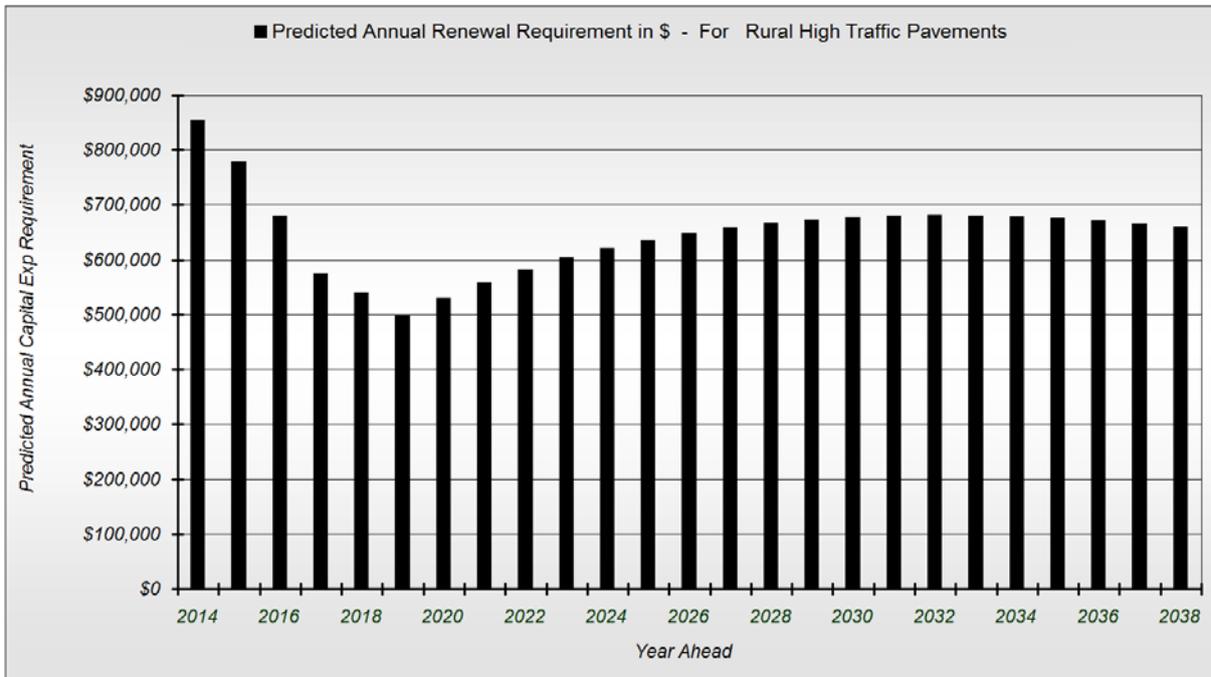
Fig 14 Asset Graphs file - Predicted Renewal demand for a single asset set Level

The above 3 graphs cover one of the modelling outputs for the 3 levels of reporting within the Asset Graphs File. (Asset set level, Asset Group Level and Whole of Organization level).

4.0   The Renewal Gap Approach to Modelling:

The Moloney Financial Modelling software is sometimes referred to as the "Renewal Gap Model". This name came about because the model was used at a statewide level within Victoria by the Municipal Association of Victoria and their aim was to quantify the renewal shortfall or (Renewal Gap) for each Council. In addition to this the same process was undertaken at a state wide level in Queensland, Tasmania and Western Australia

Sections 2.3 and 2.4 above provide details of the two modelling paths that run side by side within the model. One predicts the future renewal demand to maintain all assets at or below a selected intervention level (a desired level of service). The other predicts future asset condition based upon a proposed expenditure profile.

The renewal gap program uses the first model above to predict the future pattern of renewal demand, (based on a desired condition outcome). It then takes from that, the planned renewal expenditure, the result being the gap between the predicted renewal demand and the planned renewal expenditure. Hence the term "Renewal Gap" was established to identify the future shortfall in planned renewal expenditure as compared to the required renewal level.

The Renewal Gap is a very useful concept that quantifies the additional renewal expenditure that is required to have all assets maintained to a desired service level. It is a great starting point for understanding your financial position. But it does have limitations in that the assumption is that you want nothing over the intervention level.

5.0   The Proposed Expenditure approach to Modelling

While the Renewal Gap method represents a good starting point for the financial modelling of infrastructure assets, it does have limitations. The main problem is that it can report very high early shortfalls in renewal expenditure if there is a present backlog of poor condition assets.

The real problem is that an existing backlog is fixed up virtually straight away in this model resulting some times in some very high early demand. The demand is real but you may be at an acceptable level of over intervention assets (OIA's) and this model assumes that you want a zero level of OIA's

5.1 Case study of modelling outcome from the 2 Modelling Paths

This section will provide a brief analysis of a single asset set that has a current backlog in relation to its renewal demand. Firstly there will be an examination of the asset set using the Required Expenditure – Renewal Gap approach; this will be followed by an analysis using the Proposed Expenditure model to deliver a recommended expenditure profile.

The asset set to be modelled is a set of sealed road pavements with the following basic statistics.

- Asset Quantity   1,023,000 sqm
- Total Asset set Replacement Value $35,820,000
- Intervention Level   8.0
- Current Renewal Expenditure level $450,000 pa
- Predicted Present renewal Demand $855,000
- Reported Year 1 Renewal Gap $405,000
- Service Life   80 years

The above scenario is a common one found with long-term assets that have a slight build up of over intervention assets. The reported renewal demand is close to twice the present renewal expenditure and the renewal gap is high.

At a first glance the situation appears quite serious. There is no way the present renewal expenditure at $450,000 can be raised to match the present renewal demand of $855,000. This can results in a loss of confidence in the model as well as a misunderstanding of how to address the problem.

The next 2 subsections will illustrate how the asset set can be managed through the 2 different modelling paths.

5.1.1 The Predicted Requirement – Renewal Gap Model

This section will deal with the way in which the asset set is modelled through the Predicted Capital Requirement model (Moloney Model No 2) – Renewal Gap

PRESENT CONDITION DISTRIBUTION BY % OF ASSET BASE

% Within Condition	0	1	2	3	4	5	6	7	8	9	10
	0.00	0.00	3.65	12.29	28.83	27.07	19.11	4.61	0.95	2.75	0.74

0 Good   -   Condition   -   10 Poor
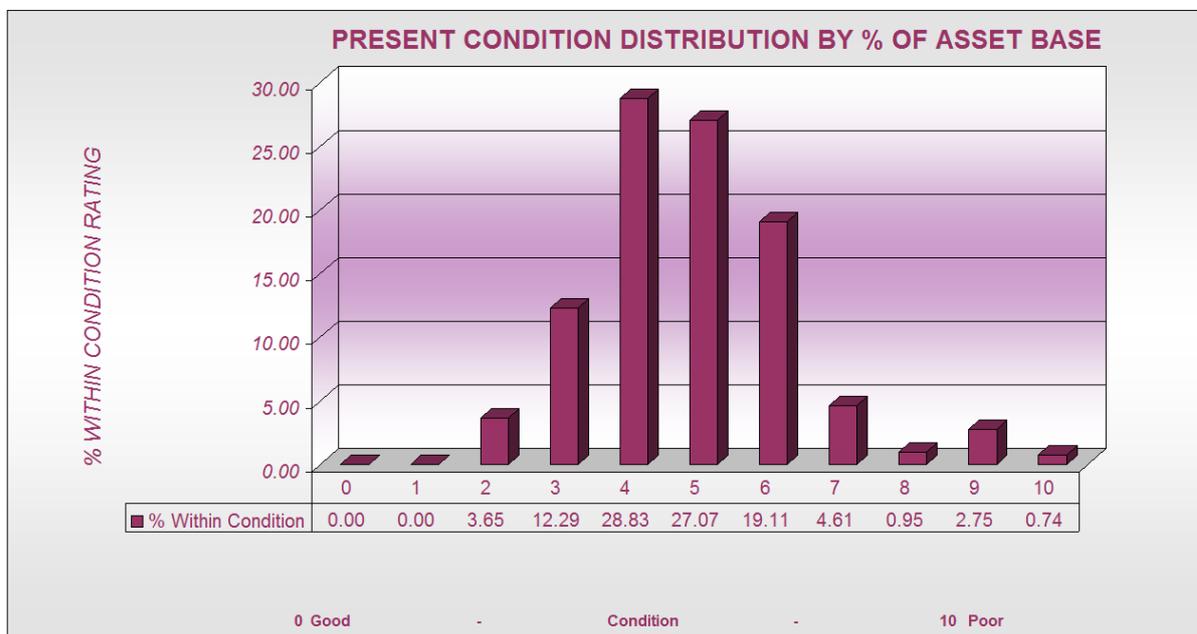
Fig 15 Present Condition Distribution of the asset set to be modelled

Figure 15 is a graphical representation of the % of the asset base within each of the condition ratings. With the intervention level set at condition 8 the asset set already has 4.44% of the total asset base at and above that level. Thus all of this, plus the amount of asset that degrades from condition 7 to 8 in the first year all needs to be treated in year 1.

Condition 8 may well be an appropriate level to rehabilitate or renew the assets. But we are in effect asking for a far better condition outcome than currently exists. Hence the very high early renewal demand predicted in Fig 16 below. In the longer term the average renewal demand is around $600,000 pa. The

higher levels over the first 5 years are a direct consequence of the present 4.44% backlog in over intervention assets that are fixed up over that period within this model.
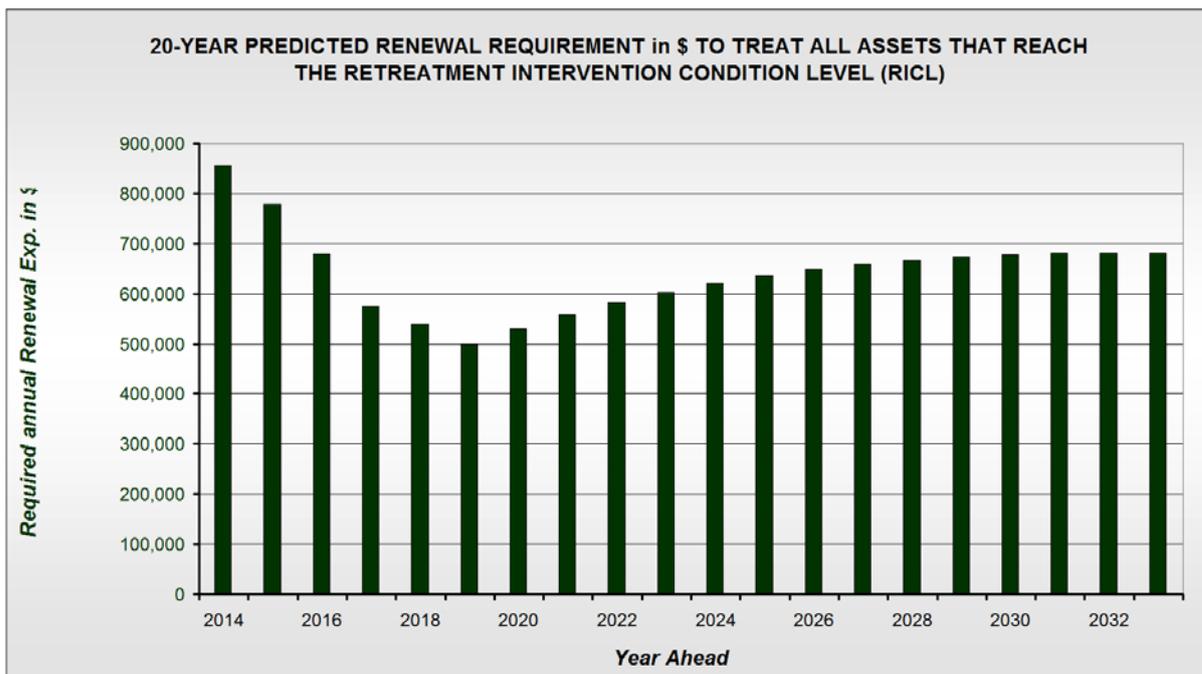
Fig 16 Predicted Renewal demand to treat all assets that reach condition 8

By asking for a better condition standard than currently exists in figure 15, Figure 16 from the Required Expenditure model has delivered a high early demand. If the raw difference between the year 1 and year 2 demand is greater than 30% then the model spreads the demand out over 5 years on a reducing scale each year. That's why the very high early renewal demand appears to be falling away over the first 5-years.

The only avenue available to reduce the early demand within this model is to raise the intervention level and by so doing accept a lower level of service as is illustrated within figures 17 and 18 below.
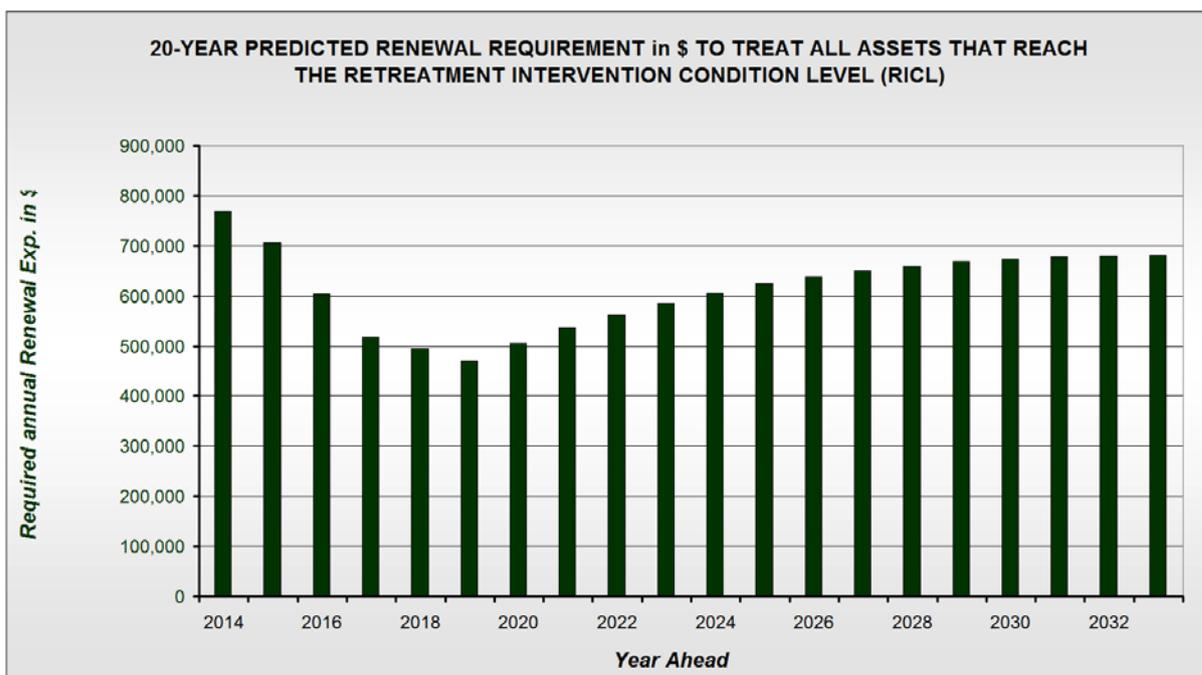
Fig 17 Predicted Renewal demand to treat all assets that reach condition 8.5
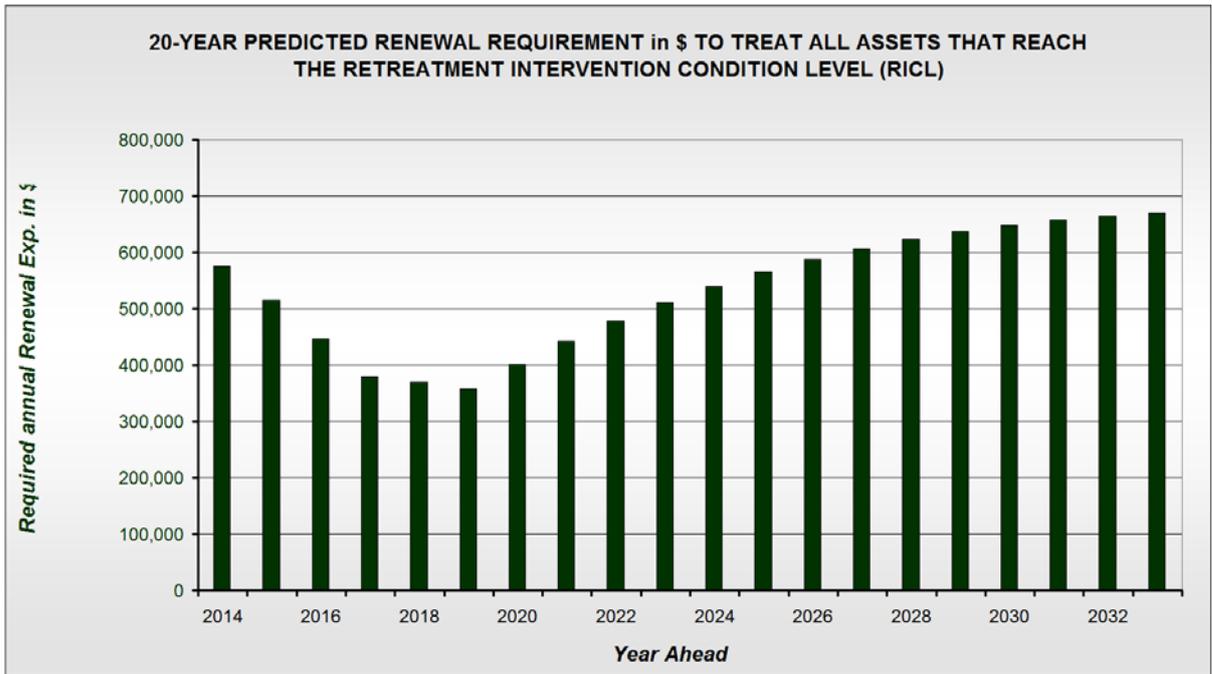
Fig 18 Predicted Renewal demand to treat all assets that reach condition 9.0

To get any real reduction in renewal demand, it was necessary to raise the intervention level to condition 9.0. The problem with this strategy is that there is absolutely no control over the extent of the asset base in the condition 8 – 9 range. This could pose a real problem if condition 8 represents an appropriate intervention level.

5.1.2 The Proposed Expenditure Model

A better alternative is to use the Proposed Expenditure model. Here we commence with the present renewal expenditure level and then lift it gradually while monitoring the extent of the asset base predicted to rises over the intervention level. In this way we can view the trend in the extent of the asset base over the intervention level and keep it within acceptable limits by adjusting our proposed expenditure level.
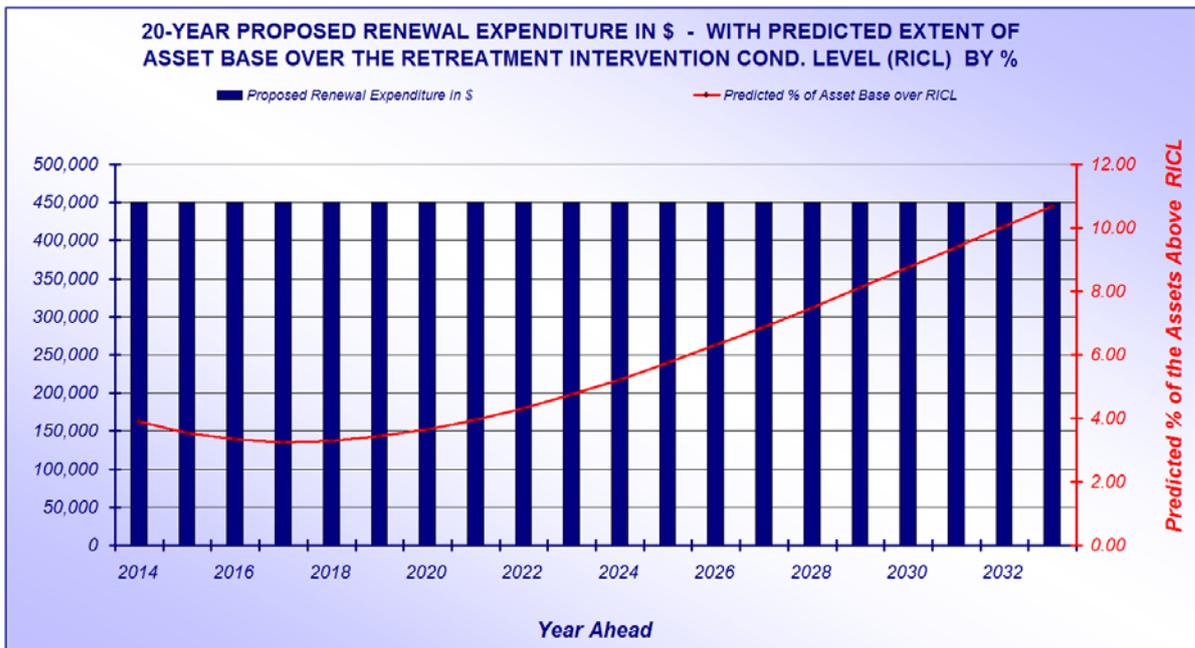
Fig 19 Proposed Expenditure Model with Intervention Level at 8 and Maintain present Spend
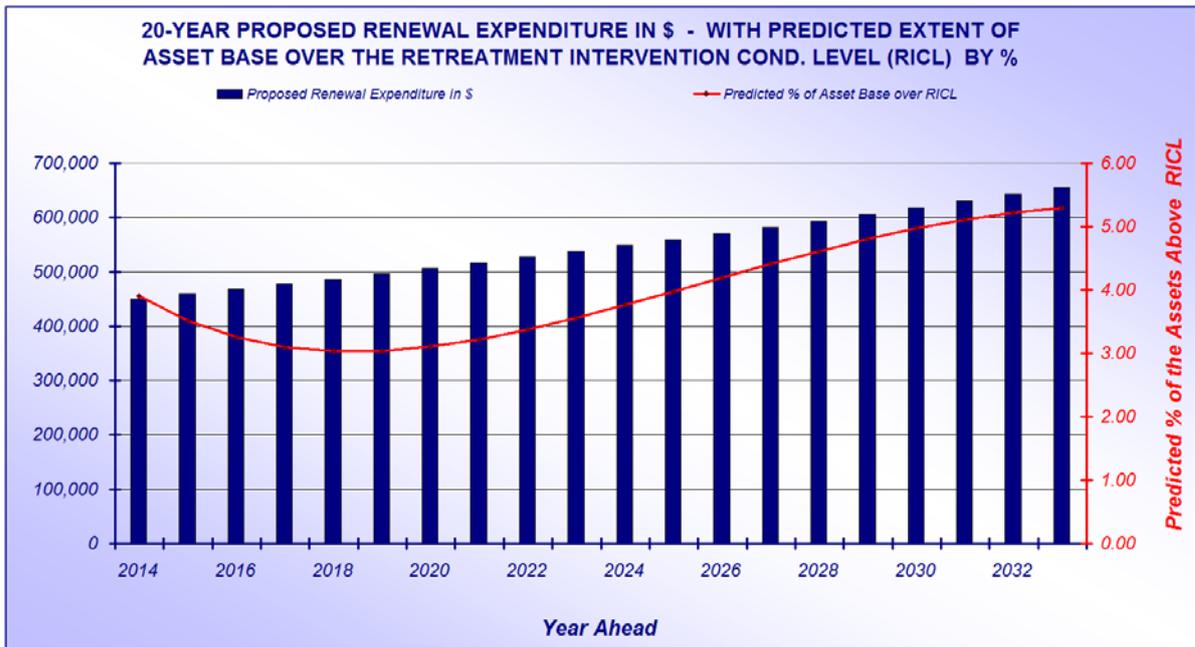
Fig 20 Proposed Expenditure Model – Intervention 8 and 2.0% pa annual increase in Spend
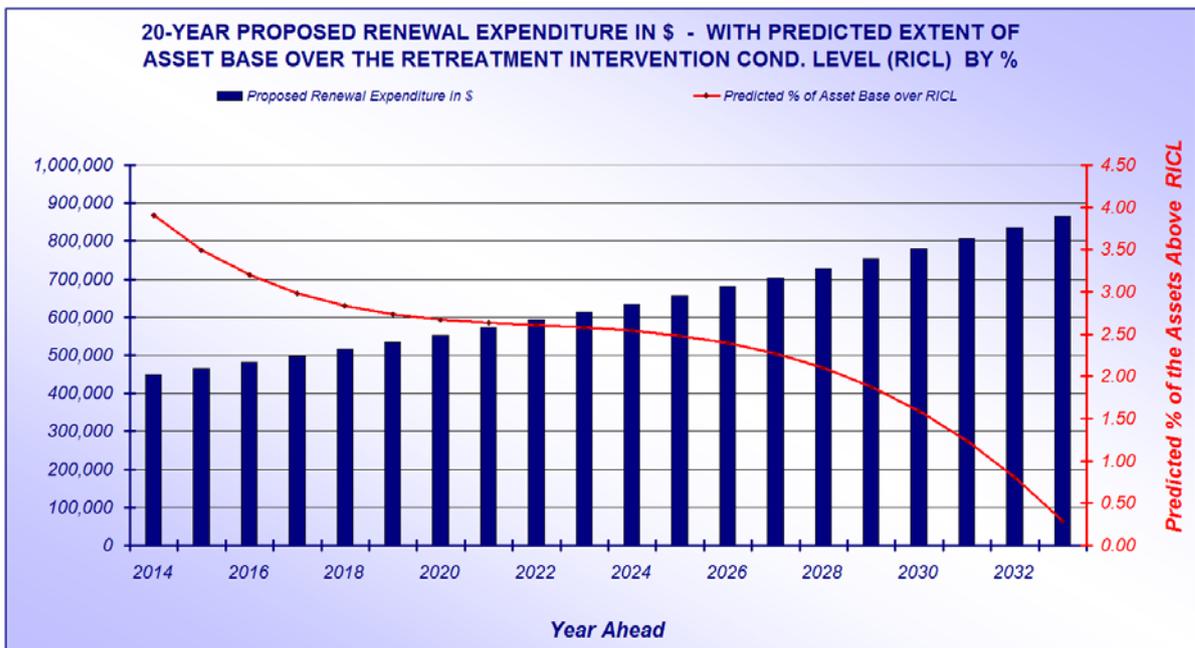
Fig 21 Proposed Expenditure Model – Intervention 8 and 3.5% pa annual increase in Spend

Within the Proposed Expenditure model we are able to observe the extent of the asset base that is predicted to rise above the intervention level based on an adopted renewal expenditure profile.

Figure 19 tracks the extent of the asset base above intervention based on the continuation of the present renewal expenditure of $450,000 pa. Note that even with the spend at only $450,000 pa the extent of over intervention assets remains at or below the present level of 4.44% for the first 9-years. In other words overall condition has not declined. So continuation of the current level of renewal expenditure may be an option for several years.

In Figure 20 we lift the annual renewal expenditure by 2.0% compounding for 20-years. Here the extent over intervention peaks at 5.29% after 20-years and remains at or below the present level of 4.44% for 15-years

In Figure 21 we lift by 3.5% compounding for 20-years. Here the extent over intervention assets continue to reduce and are close to Zero after 20-years.

The Proposed Expenditure model enables us to develop a solution to the problem, in contrast to the Predicted Capital Requirement - Renewal gap model that makes us aware that we have a problem but delivers no solution.

5.1.3 Using the Funding scenario finder

The two models that run within the "Model All" file are broadly as follows:

- Required Expenditure Model – Predicts Money needed to treat ALL over intervention assets
- Proposed Expenditure Model – Predicts future condition based on a proposed spend

The "Proposed Expenditure" Model can be used as illustrated within Figures 20 and 21 above to create a planned expenditure that will deliver a desired condition outcome. The "Funding Scenario Finder" was created within the "Model All" File to automate this process using the "Proposed Expenditure Model"

What we have done within the "Funding Scenario Finder" is to utilise the "Proposed Expenditure Model" through an iterative process to set a desired condition outcome and to then trial different expenditure profiles until we arrive at the result we want.

In 2016 we created a program within the "Model All" File that undertook this iterative process to deliver a Recommended Funding Scenario based upon the 3 input criteria below.

- Desired percentage of OIA's

- Yeas to achieve this

- Annual compounding Increase in Expenditure

This was fine for a single asset set with a single service life. But when we wanted to use the modelling function across several asset sets with different service lives within the one operation, setting a single required extent of OIA's as a percentage of the total network fell down.

Consider 2 asset sets, one with a 100 year service life and the other with a 10 year service life. if we set the required level of OIA's based on the 10 year life then a percentage of 10% would be appropriate as on average we would be consuming the assets at 10% each year and so would never have more than one years backlog of OIA's. However, for the 100 year life assets which are being consumed at 1% pa the 10% target would represent 10 years of average renewal requirement and this would be a disaster.

Thus we came up with a formulae that delivered the desired percentage of OIA's for varying asset lives based upon the number of years of annual consumption that the service life represented.

Fig 22 Input Criteria for Funding Scenario Finder

Figure 22 contains the 3 input criteria (Shaded Green) for the "Funding Scenario Finder"

    1   The Number of years worth of annual Liability (or Consumption)

    2   The time in years by which you wish to achieve this

    3   The annual % increase in renewal funding you want (use 0 for no increase)

While variable No, 1 is expressed in years worth of annual liability at 1.2. The model required the percentage of OIA's that you want as it's variable. This figure is calculated within the same row and in this case is 1.03% (shaded Grey for formulae derived). The 1.03% is derived by dividing the 1.20 years of annual liability by the service life to the intervention level of 116.4 (in cell B27 on the same sheet) and multiplying the result by 100.

Variable 2 is 20 years

Variable 3 is a 5% compounding annual increase in renewal expenditure that will lower the year 1 requirement.
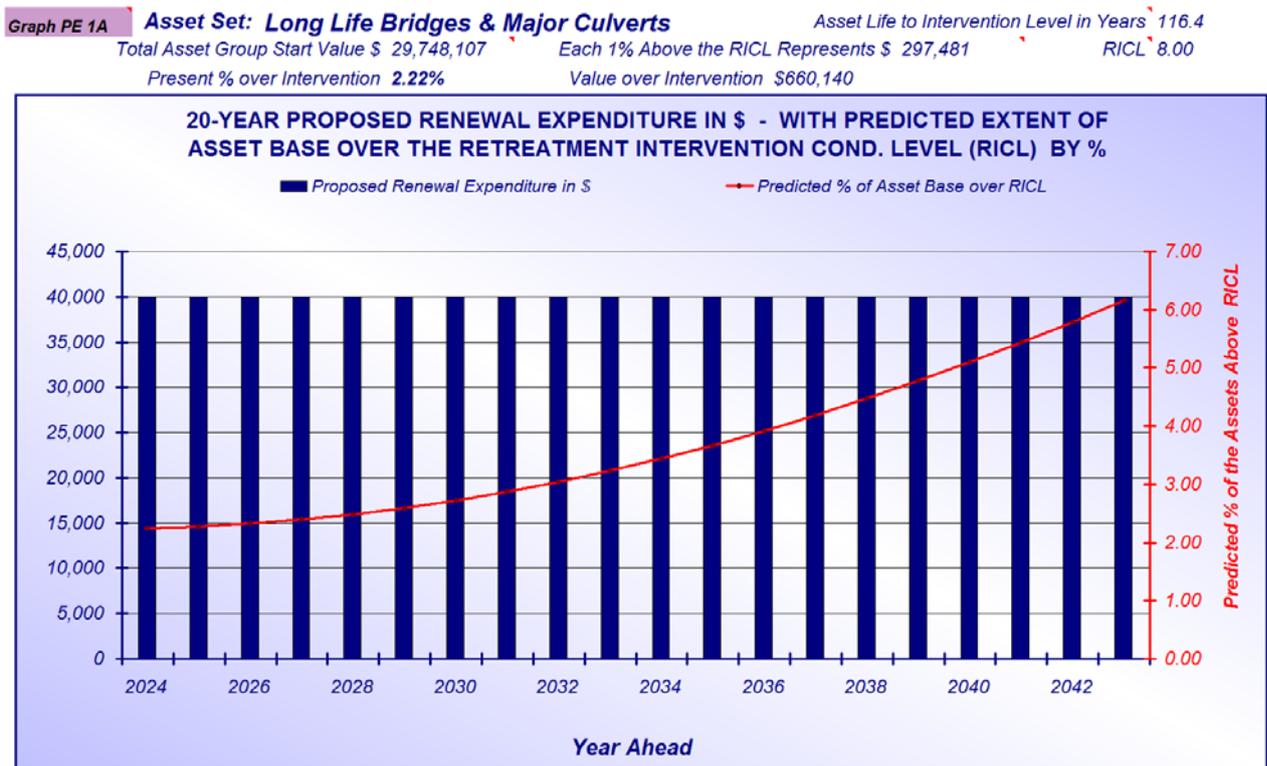
Fig 23 Results for present spend over 20 years

Figure 23 above provided the results for the planned $40,000 pa spend over the next 20 years. These assets have a 116 year service life to condition 8 and $40,000 pa is simply not enough to do the job. There will be in excess of 6.0% OIA's after 20 years. Up from the present level of 2.22%

The Funding Scenario Finder can be used within the Model All file to deliver a recommended future funding strategy. The variables within figure 22 above were applied to the same date set and the results are contained within figure 24 below.
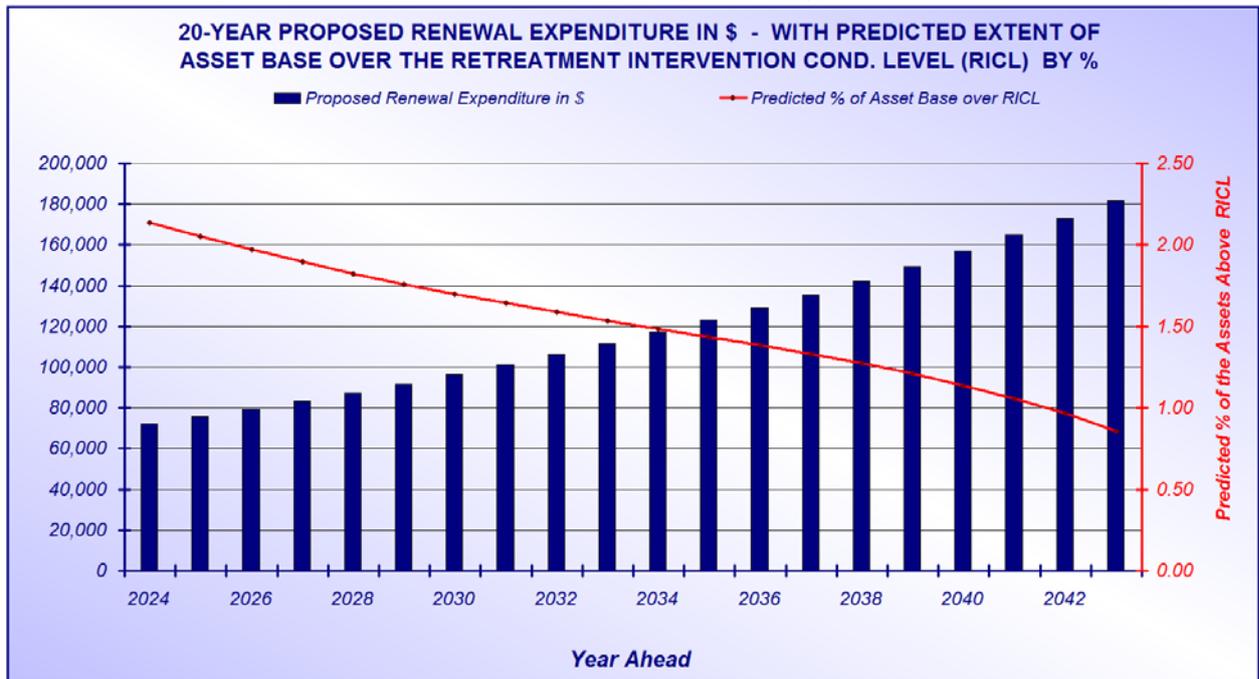
Fig 24 Results for Funding Scenario Finder over 20 years

The Funding Scenario Finder delivered a year 1 commencing renewal requirement of $72,000 rising by 5.0% compounding for the nest 20 years to $181,000 pa. Note that the extent of OIA's is continually decreasing over the modelling period. The Funding scenario finder can be accessed with a (Ctrl j) command or as detailed below off the Moloney "Modelling" Menu.

Modelling / 2. Modelling Variables Sheet / 2. Create Proposed Expenditure Profile (Ctrl j)

This program can be used as illustrated above for a single data set with any of the variables you choose to place within Table MV6 of the Modelling Variables Sheet. It can also be used across all 20 data sets within the Model All file in the one operation.

This is it's real advantage as not only does it deliver a funding solution for each asset set but it effectively optimises the renewal spend between 20 data sets by achieving the same level of OIA's for each based on a selected number of years of annual liability that you want for each asset set.

5.1.4 Comment on the best use of the Modelling Tool

Clearly the use of the Proposed Expenditure model, particularly now that it can be used indirectly to deliver a recommended expenditure profile, delivers solutions rather than simply highlighting a problem.

The modelling outcome should be an important part of decision making, as the consequences of under funding become more fully understood.

5.1.5 Funding solutions for multiple data sets - "Funding Scenario Finder"

The process described within 5.1.3 above that delivers a funding solution for a single asset set, can be extended to operate on all 20 data sets within the "Model All" file in the one operation.

The key to running several data sets through the model in the one operation is to get the extent of the asset base that you will accept as over intervention correct (see Item 1 in Figure 22 above). Item 1 within Cell J25 of the "Modelling Variables" sheet of the "Model All" File is linked by formulae to the extent of over intervention assets within Cell H28.

Within Figure 25 below we have modelled 20 separate asset sets and then grouped them into 6 reporting groups within the "Asset Graphs" file.
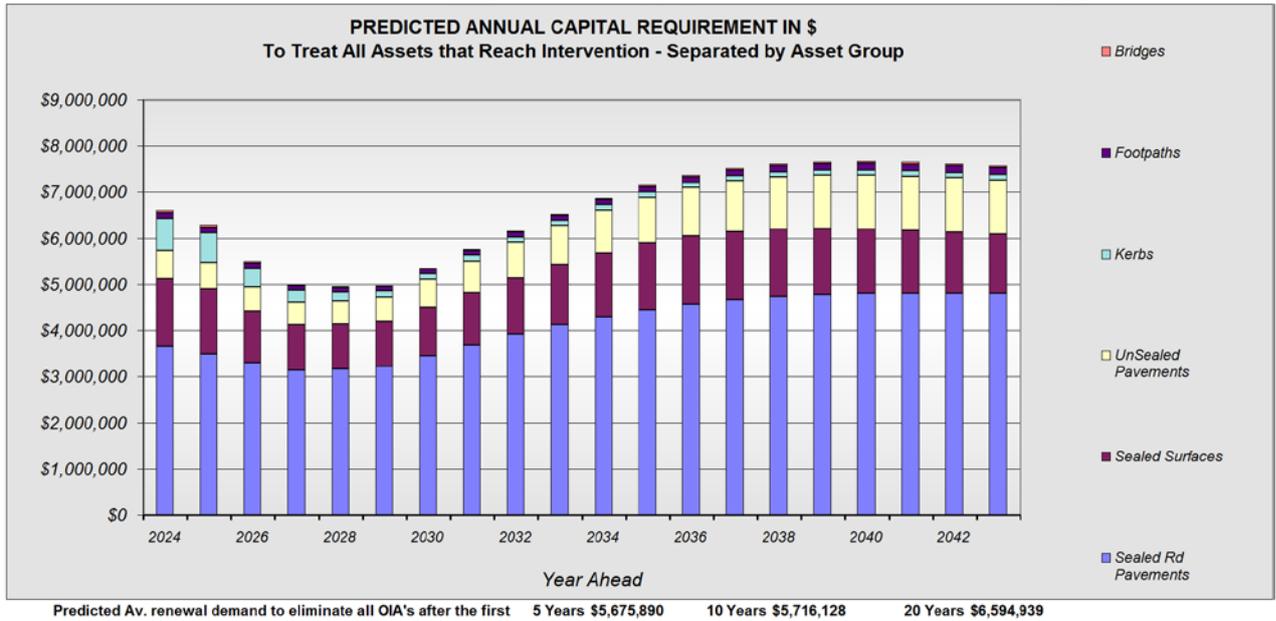
Fig 25 All Road assets – Raw demand to treat all over intervention assets $6,600,000 in Year 1

Figure 25 represents the predicted annual renewal demand to treat ALL assets across all 6 asset groups that are predicted to reach the intervention level over the next 20 years

Fig 26 All Road assets – Predicted extent over intervention with planned spend

Figure 26 plots the predicted level of OIA's (Red Line) based on the planned total renewal spend (Blue Bars) over the next 20 years. It also displays within the grey bars the expenditure requirement to eliminate all OIA's (same gross values as figure 25).

The planned spend appears to be OK for the first decade. But what we can do with the 20 individual data sets is set some basic parameters and run the whole 20 through the "Funding Scenario Finder" based on the same set of parameters as outlined in figure 22 above. In this case we have used the following criteria within Table MV 6 on the Modelling variables sheet.

- Variable 1 - Percentage over intervention - 95% of one years level of Annual Liability
- Variable 2 - Years to achieve this – 10 years
- Variable 3 - Annual % funding increase – 0.0%

Fig 27 All Road assets – 10 Year Funding scenario

The above 3 parameters were placed into Table MV6 on the modelling variables sheet then Button MV 4 around Cell U2 is activated. This runs all 20 data sets within the Model All file through the model, to create a proposed expenditure profiles for each. The results are as detailed within Figure 27 above

Fig 28 All Road assets – 10 Year Funding scenario - split by asset group

Figure 28 is essentially the same as the blue shaded bars within Figure 27. But here the graph displays the renewal requirement based on the adopted 6 asset groups. The Funding scenario finder has optimised the $5,000,000 spend between the 6 asset groups.

All Asset Groups   **Present % of OIA's**   **Present Value OIA's**   **Present level of OIA's as % of 1-years Annual Liability**
1.61% $7,103,988   95.11%

Predicted Av. renewal demand to eliminate all OIA's after the first   5 Years $5,675,890   10 Years $5,716,128   20 Years $6,594,939

Fig 29 All Road assets – 20 Year Funding scenario

Figure 29 was generated through the "Funding Scenario Finder by setting the following 3 criteria.

- Variable 1 - Percentage over intervention - 95% of one years level of Annual Liability
- Variable 2 - Years to achieve this – 20 years
- Variable 3 - Annual % funding increase – 2.25%

We set the same desired level of OIA's as the required end result, but we extended the time to deliver out to 20 years. In order to get the commencing spend down to the present level of $5,,000,000 it was necessary to adopt a compounding annual increase in the renewal spend of 2.25% pa.

The 2.25% annual increase is predicted to deal with the growing renewal demand over the second decade. In practice a 10 year modelling period is probably more appropriate but this 20 year one does provide some forecast for the longer term.

Conclusion:

The renewal gap program represented a very sound commencing point of awareness in relation to the long term funding requirements of infrastructure assets. However, it failed to allow for a small but manageable extent of OIA's that most authorities will always carry forward.

With the acceptance of a small level of OIA's that can be carried the equation can change dramatically.

The big difference between the Funding Gap and the Proposed Expenditure approach is the ability to carry on with some over intervention assets and not to have to fix everything immediately.

6.0   Moloney Financial Modelling Summary:

Detailed below is a summary of the main functions to the Moloney Financial Modelling program.

- The Moloney model is a network level model that has 2 modelling paths. One predicts future asset condition based on a proposed expenditure profile. The second predicts future renewal demand based on a desired condition outcome.

- You can also use the program to create a funding solution using the proposed expenditure model that controls the extent of over intervention assets and the time to get to your goal.

- The Renewal Gap Method uses the required expenditure model and takes from the result the proposed expenditure, leaving the renewal or funding gap

- There is a "Funding Scenario Finder" function built into the "Model All" File that not only delivers a recommended funding strategy but it also optimises the spending between all asset sets.

- Up to 40 individual data sets can be modelled through the system

- The 40 Individual data sets can be grouped for display in the Asset Graphs file in up to 10 user definable asset groups

- Worksheets in 3 different formats are provided to assist with the creation of present condition distributions for your assets which are at the heart of the modelling process

- Default condition distributions and degradation curves can be selected in all 40 data set locations from a pick list of 20 standard data set types if no condition information is available.

- Data validation is provided within the Input Pro Forma file on all worksheets as well as the Required Data sheet that holds all input information

- Individual data sets can be fine tuned within the Model All file and results passed on through the program to "Asset Graphs" when completed

5.0 Further Information:

There are 3 further, more detailed documents available from our web site at www.moloneys.com.au the first deals with the N3 version of the Moloney Financial Modelling software and the second deals with just the Model All File. The documents are as detailed below.

- Moloney Financial Modelling Software version N3 Manual
- Moloney Model All Manual

- The Funding Scenario Finder

These documents will go into more detail than this outline has, and it is strongly recommended that you access them as reference material.

Finally if you are a party to our software maintenance agreement plan then please do not hesitate to contact us with any queries you may have regarding the use and functionality of the software.

Peter Moloney

MIEAust

Moloney Asset Management Systems

PH 0354721004

Mobile 0419 529 743

peter@moloneys.com.au