Tasmanian Aquatic Condition DSS Tutorials

This tutorial provides examples for how to use the Tasmanian Aquatic Condition DSSdescribing the adoption of riparian management practices in Tasmania. It covers:

- Viewing and interpreting results
- Developing BN scenarios
  - Estuary Model
  - River Health Model
- Developing WQ scenarios
  - Landuse and Hydrology scenarios in the WQ Simulator
  - WQ Simulator scenarios in conjunction with BN scenarios
- Generating Reports

Viewing and interpreting results

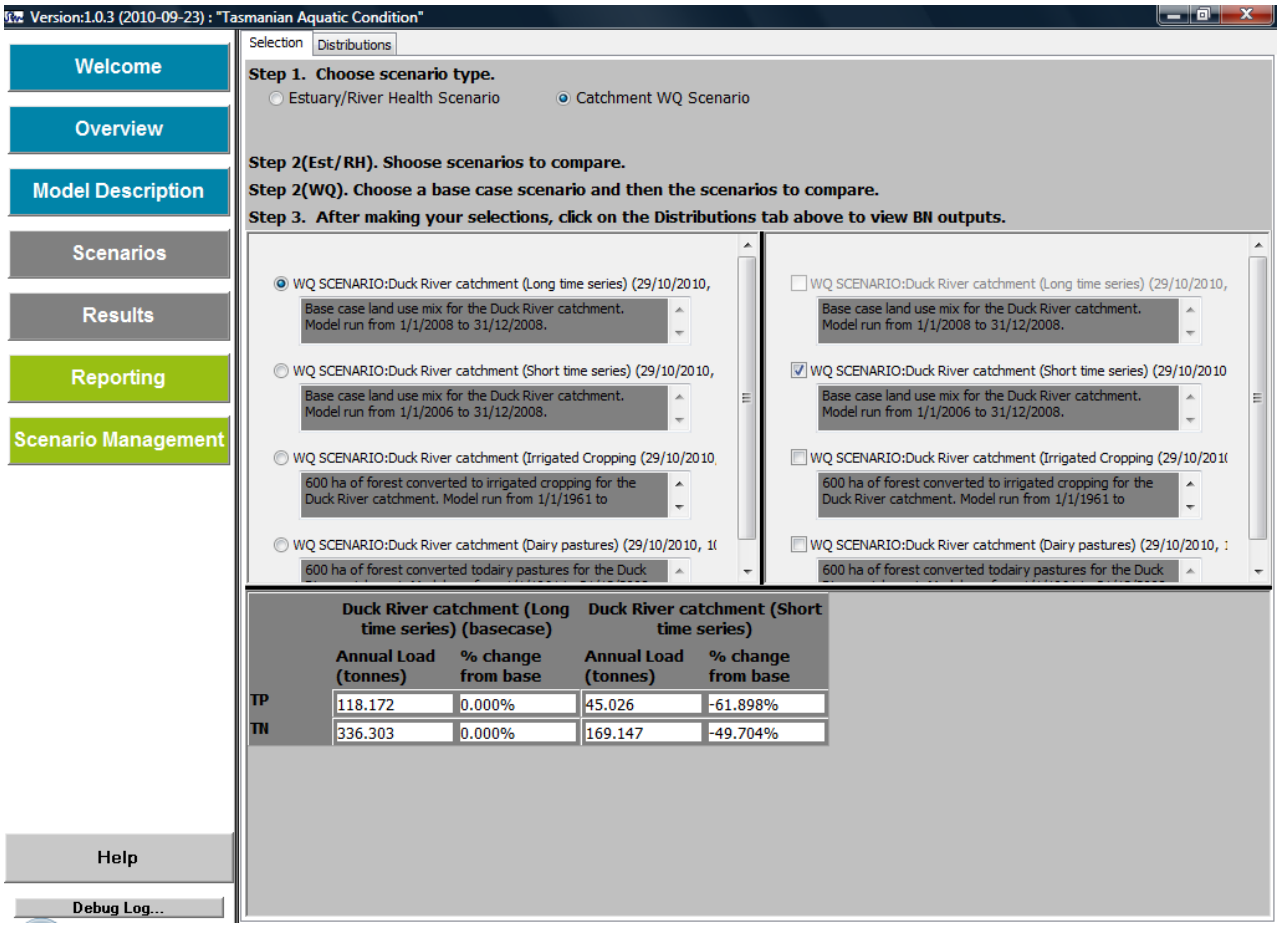
Here we will look at the results of some existing scenario runs.

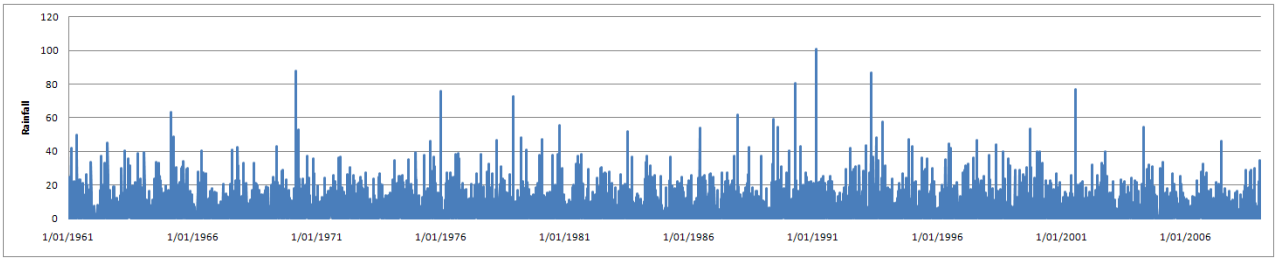
1. Double-click on *ICMSBuilder.exe* which is located in the top level of the LL_TasBN folder. Click on *File*, scroll down the menu and click *Open*. This will bring up a screen which you can use to browse for the *LL_TasBN_v1_September2010_Tutorials.icm* project file. This project is stored in the **LL_TasBN\ Projects** folder.

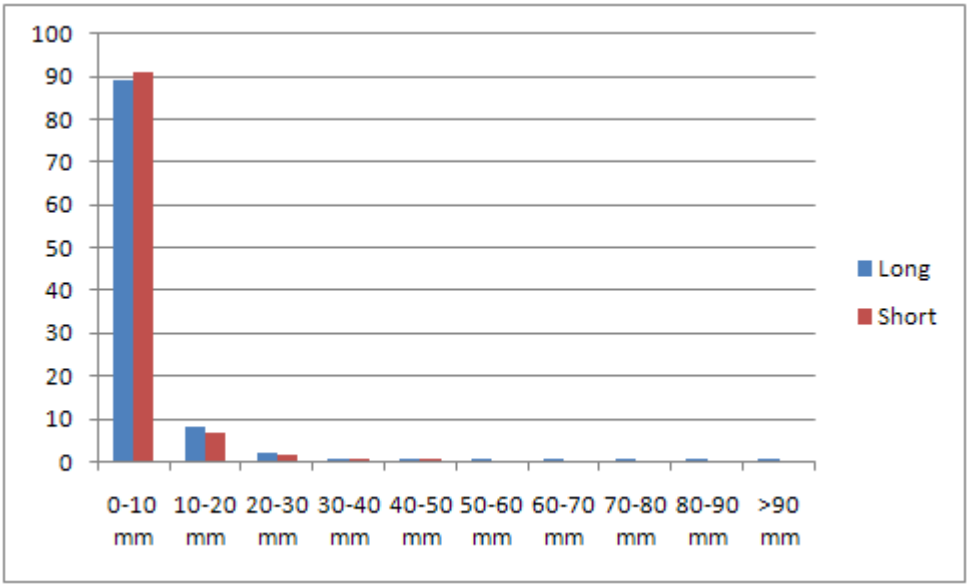
2. To open the DSS interface click on the *Plugins* icon (), click on *LL_TasBN (LL_TasBN.dll)* and then on *Open*.

3. What is the impact of the time series length on annual loads?
   a. Click on the *Results* page
   b. Select *Catchment WQ Scenario*
   c. Set *Duck Catchment (Long Time series)* as the base case scenario
   d. Set *Duck Catchment (Short Time series)* as the comparison scenario

Annual loads of total nitrogen (TN) and total phosphorus (TP) calculated by the WQ simulator can vary considerably depending on the time period you run.


Version:1.0.3 (2010-09-23) : "Tasmanian Aquatic Condition"
Welcome
Overview
Model Description
Scenarios
Results
Reporting
Scenario Management
Help
Debug Log...
Selection
Distributions
Step 1. Choose scenario type.
Estuary/River Health Scenario
Catchment WQ Scenario
Step 2(Est/RH). Shoose scenarios to compare.
Step 2(WQ). Choose a base case scenario and then the scenarios to compare.
Step 3. After making your selections, click on the Distributions tab above to view BN outputs.
WQ SCENARIO:Duck River catchment (Long time series) (29/10/2010,
Base case land use mix for the Duck River catchment. Model run from 1/1/2008 to 31/12/2008.
WQ SCENARIO:Duck River catchment (Short time series) (29/10/2010,
Base case land use mix for the Duck River catchment. Model run from 1/1/2006 to 31/12/2008.
WQ SCENARIO:Duck River catchment (Irrigated Cropping (29/10/2010
600 ha of forest converted to irrigated cropping for the Duck River catchment. Model run from 1/1/1961 to
WQ SCENARIO:Duck River catchment (Dairy pastures) (29/10/2010, 1
600 ha of forest converted todairy pastures for the Duck
WQ SCENARIO:Duck River catchment (Long time series) (29/10/2010,
Base case land use mix for the Duck River catchment. Model run from 1/1/2008 to 31/12/2008.
WQ SCENARIO:Duck River catchment (Short time series) (29/10/2010
Base case land use mix for the Duck River catchment. Model run from 1/1/2006 to 31/12/2008.
WQ SCENARIO:Duck River catchment (Irrigated Cropping (29/10/201
600 ha of forest converted to irrigated cropping for the Duck River catchment. Model run from 1/1/1961 to
WQ SCENARIO:Duck River catchment (Dairy pastures) (29/10/2010,
600 ha of forest converted todairy pastures for the Duck
Duck River catchment (Long time series) (basecase)
Duck River catchment (Short time series)
Annual Load (tonnes)
% change from base
Annual Load (tonnes)
% change from base
TP 118.172 0.000% 45.026 -61.898%
TN 336.303 0.000% 169.147 -49.704%

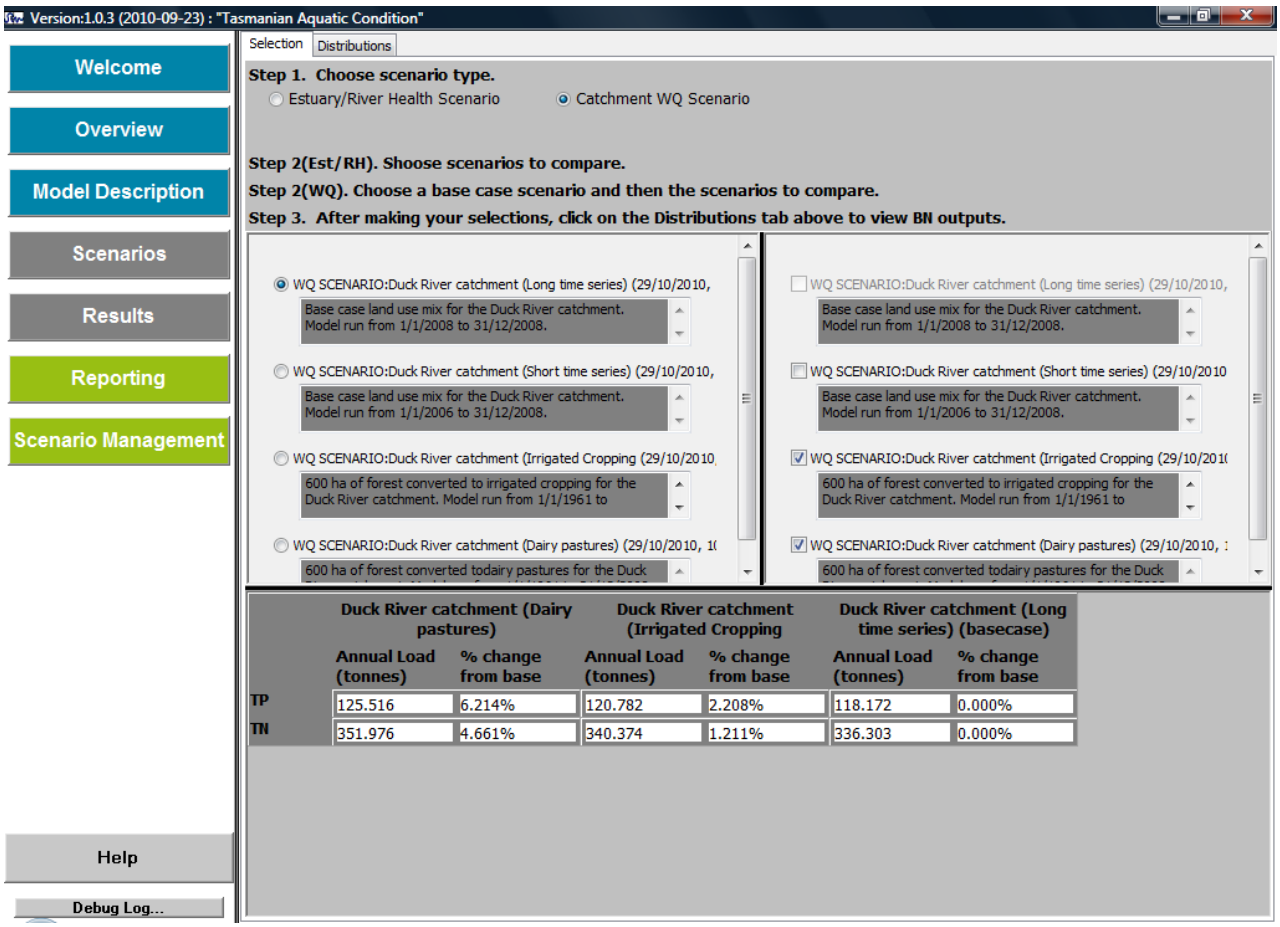

Rainfall
120
100
80
60
40
20
0
1/01/1961
1/01/1966
1/01/1971
1/01/1976
1/01/1981
1/01/1986
1/01/1991
1/01/1996
1/01/2001
1/01/2006


100
90
80
70
60
50
40
30
20
10
0
0-10 mm
10-20 mm
20-30 mm
30-40 mm
40-50 mm
50-60 mm
60-70 mm
70-80 mm
80-90 mm
>90 mm
Long
Short

4. What is the impact of the land use mix on annual loads?
    a. Click on the *Results* page
    b. Select *Catchment WQ Scenario*
    c. Set *Duck Catchment (Long Time series)* as the base case scenario
    d. Set *Duck Catchment (Irrigated Cropping)* and *Duck Catchment (Dairy Pastures)* as the comparison scenarios

These scenarios are hypothetical (and unrealistic!!!) scenarios where 600 hectares of native forest in the Duck River catchment is converted to Irrigated Cropping or Dairy Pastures.

Both scenarios have higher modelled loads of TN and TP. However, conversion of 600 ha of forest to grazing pastures is predicted to lead to a >6% increase in TP loads and a >4% increase in TN loads from the catchment.



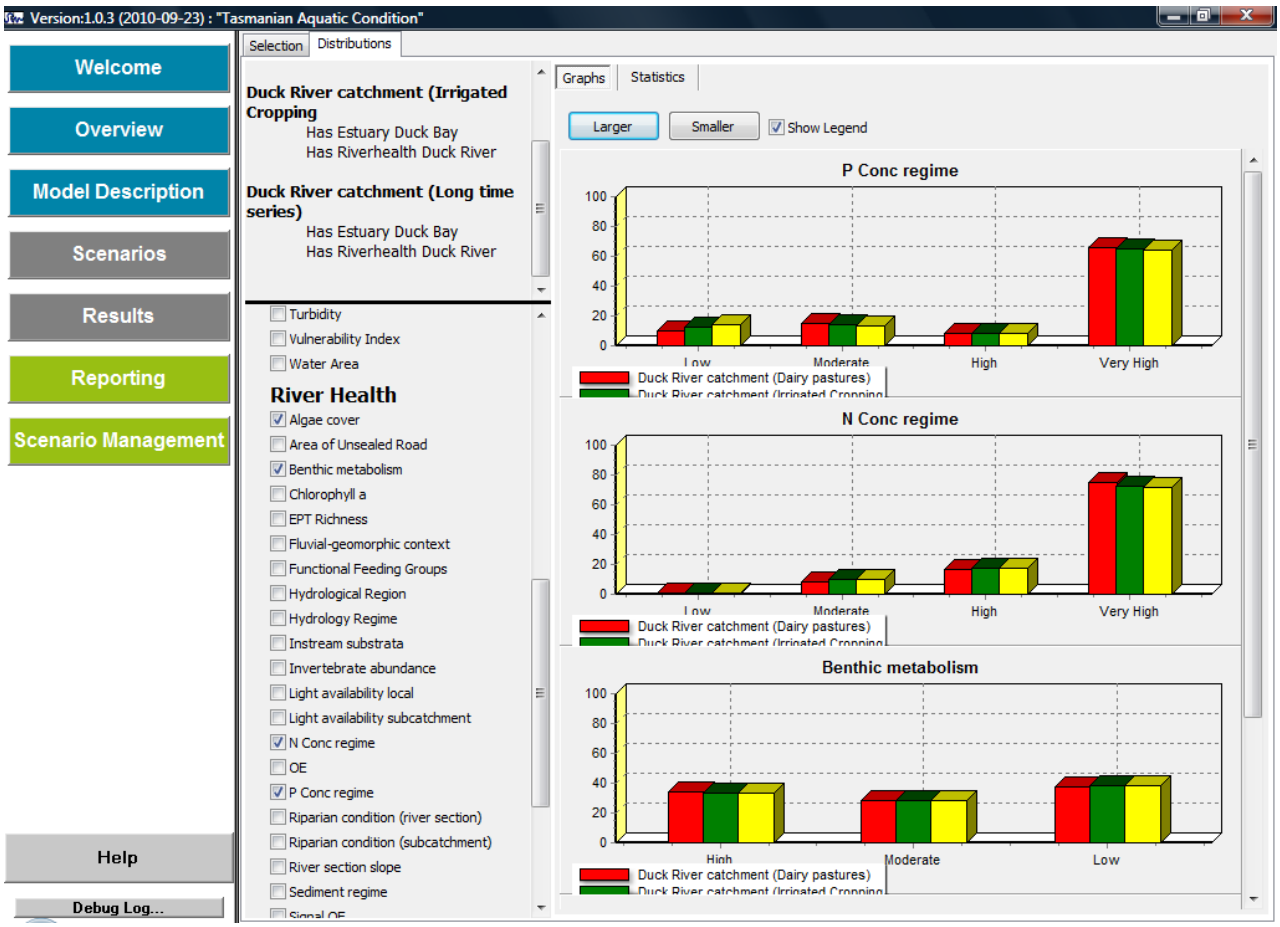
	Duck River catchment (Dairy pastures)		Duck River catchment (Irrigated Cropping		Duck River catchment (Long time series) (basecase)	
	Annual Load (tonnes)	% change from base	Annual Load (tonnes)	% change from base	Annual Load (tonnes)	% change from base
TP	125.516	6.214%	120.782	2.208%	118.172	0.000%
TN	351.976	4.661%	340.374	1.211%	336.303	0.000%

5. What is the impact of annual loads in the River Health BN?
    a. Click on the *Results* page
    b. Select *Catchment WQ Scenario*
    c. Set *Duck Catchment (Long Time series)* as the base case scenario
    d. Set *Duck Catchment (Dairy Pastures)* as the comparison scenario
    e. Click on the *Distributions* tab at the top of the page and select *Graphs*
    f. From the side menu, select the following River Health BN variables: *Algae cover*, *Benthic Metabolism*, *N Conc regime* and *P conc regime*.
    g. To view the graphed results shown below, select the 'graph' tab in the middle of the top of the page.

Under the increased dairy scenario, the likelihood of very high P increases from 64% to 66% and the likelihood on very high N increases from 72% to 75%.

This leads to an increase in the benthic metabolism (relative gross primary productivity). Note that the distribution of benthic metabolism is quite flat meaning that there is a reasonable chance of being in any of the three possible states.

The increased nutrient concentrations lead to an increase likelihood of high % algal cover. The pattern of distribution across each possible state is similar (the mode is the same) but there is <12% chance of low or very low algal cover compared to the base case where there is about a 15% chance of low or very low algal cover.



Developing BN Scenarios

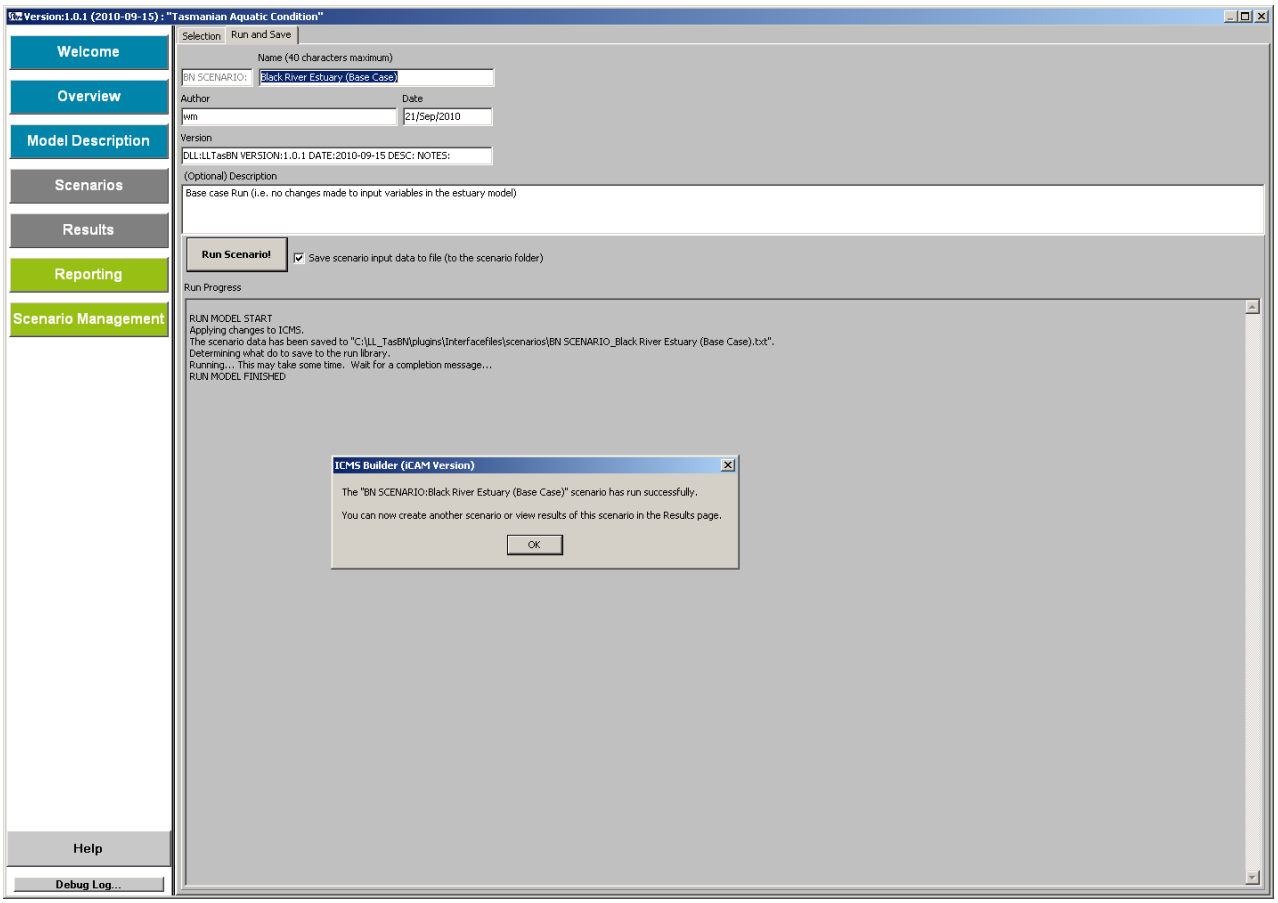
BN Scenarios look at changes in the input variable of the Estuary and/or River Health BNs in isolation from the WQ simulator.

Estuary Model

6. Go the *Scenarios* screen of the DSS, press the *New Scenario* button and set the scenario type to *Estuary / River Health scenario*

7. Select the *Black River Estuary* from the *Estuary* drop down menu (or another estuary you are interested in).

8. Go to the *Run and Save* tab at the top of the page (click the tab at the top of the page) and enter a name for the scenario: (e.g. Black River Estuary [Base Case]). Enter an author name and (optionally) a description. Click *Run Scenario* to run the base case scenario. When the model has run the interface returns to the *Selection* tab.

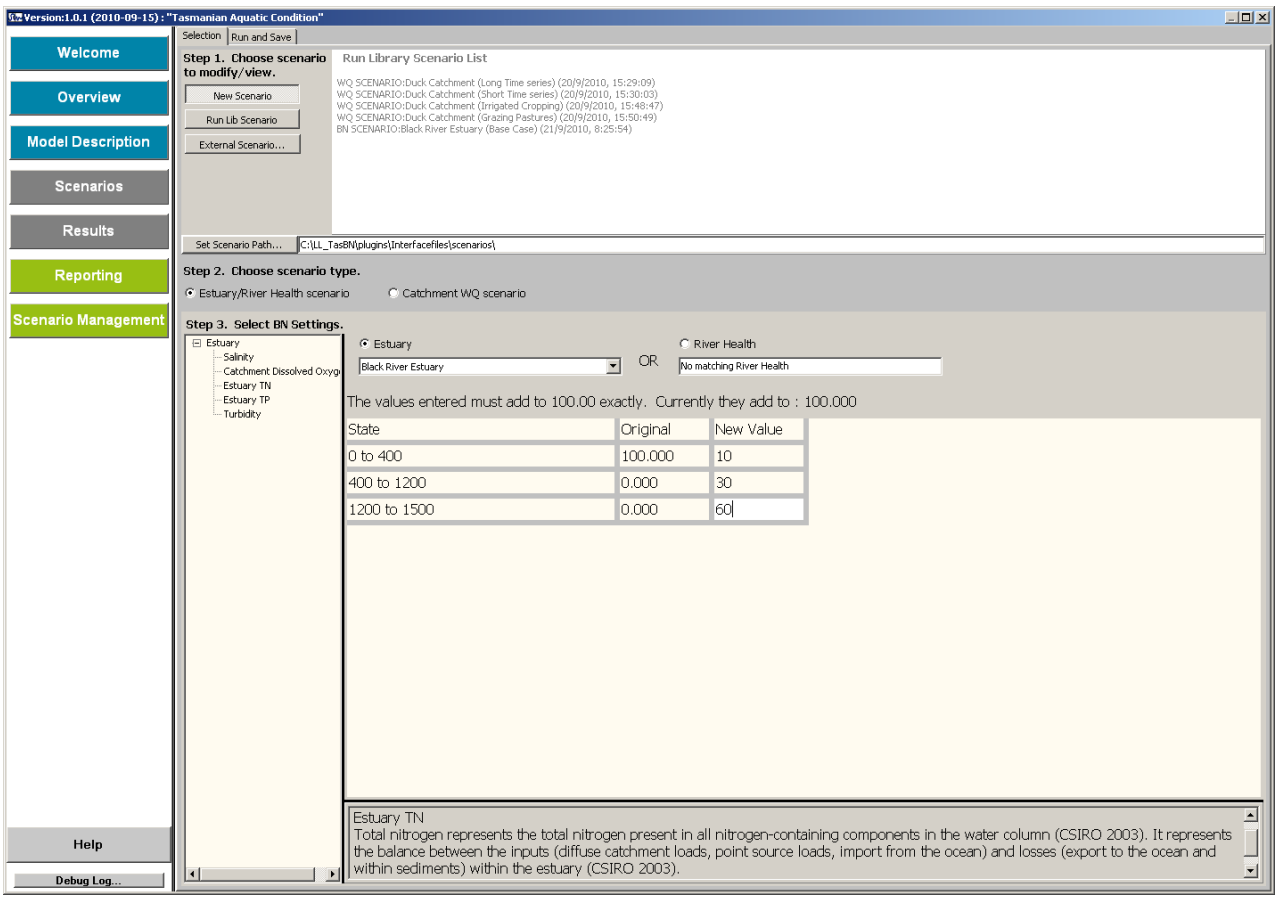


9. Click on the *Estuary TN* variable in the drop-down menu. In the base case (current situation) the Black River Estuary has low TN concentrations (100% likelihood of being within 0 to 400 mg/m^3. Enter the new values from the tables over the page. Repeat for the *Estuary TP* and *Turbidity* variables.

Estuary TN	New Values
0 to 400	10
400 to 1200	30
1200 to 1500	60

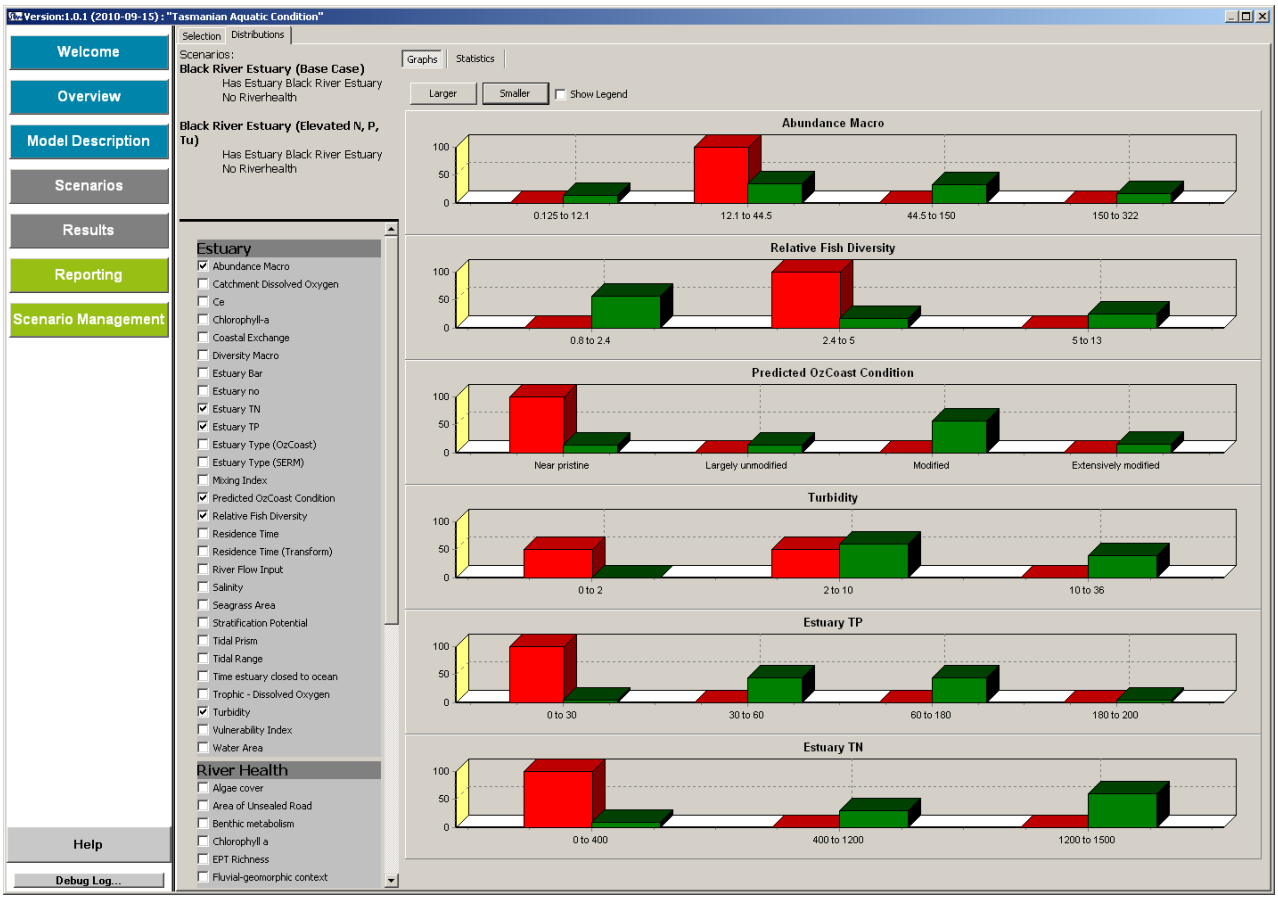
Estuary TP	New Values
0 to 30	5
30 to 60	45
60 to 180	45
180 to 200	5

Turbidity	New Values
0 to 2	0
2 to 10	60
10 to 36	40



10. Go to the *Run and Save* tab at the top of the page (click the tab at the top of the page) and enter a name for the scenario: (e.g. Black River Estuary [Elevated N, P, Tu]). Enter an author name and (optionally) a description. Click *Run Scenario* to run the base case scenario. When the model has run the interface returns to the *Selection* tab.

11. What is the impact of these changes on the Estuary BN?
    a. Click on the *Results* page
    b. Select *Estuary / River Health Scenario*
    c. Select the two scenarios you created in steps 8 to 10.
    d. Click on the *Distributions* button and select *Graphs*
    e. From the side menu, select the following Estuary BN variables: *Estuary TN, Estuary TP*, *Turbidity*, *Predicted OzCoast Condition*, *Relative Fish Diversity* and *Abundance Macro*.



The increased TN and TP concentrations and turbidity have a marked impact on predicted condition in the Black River Estuary. Estuary condition changes from near pristine to more modified states (~57% likelihood of being in a Modified state).

The increased TN and TP concentrations and turbidity result in an increased likelihood of being in a reducing in fish diversity, as shown by the dominance of the lowest fish diversity state, as compared with the Base Case (57% compared with 0%). The model also reflects some uncertainty in this outcome, where there is a chance of increased diversity compared with the base case (26% compared with 0%).

Under the scenario of increased TN and TP concentrations and turbidity, the bulk of the distribution for the Abundance of Macroinvertebrates sits in the middle 2 categories, although there is considerable uncertainty in the likely outcome. This reflects the limitations associated with the data set on which this model is based.

River Health Model

12. Go to the *Scenarios* screen of the DSS, press the *New Scenario* button and set the scenario type to *Estuary / River Health scenario*

13. Select the *Duck River* from the *River Health* drop down menu.

14. Click on the Subcatchment *Land Use* variable in the drop down menu. Enter the distributions from the table below. Repeat for *Riparian condition (river section)* and *Riparian condition (subcatchment)*.

Landuse	**New Values**
Non-production	100
Grazing All	0
Low Intensity Production Forestry	0
Plantation Forestry	0
High Intensity Production Forestry	0
Dairy / Horticulture / Cropping	0

River Section Riparian Condition	**New Values**
Very Poor	0
Poor	0
Moderate	0
Good	100

Subcatchment Riparian Condition	**New Values**
Very Poor	0
Poor	0
Moderate	0
Good	100

15. Go to the *Run and Save* tab at the top of the page and enter a scenario name, author name (optionally) a description. Click *Run Scenario*.

16. Repeat steps 14 and 15 for the 50% grazing scenario tabled below.

Landuse	**New Values**
Non-production	50
Grazing All	50
Low Intensity Production Forestry	0
Plantation Forestry	0
High Intensity Production Forestry	0
Dairy / Horticulture / Cropping	0

River Section Riparian Condition	**New Values**
Very Poor	0
Poor	0
Moderate	100
Good	0

Subcatchment Riparian Condition	**New Values**
Very Poor	0
Poor	0
Moderate	100
Good	0

17. Repeat steps 14 and 15 for the 100% grazing scenario tabled below.

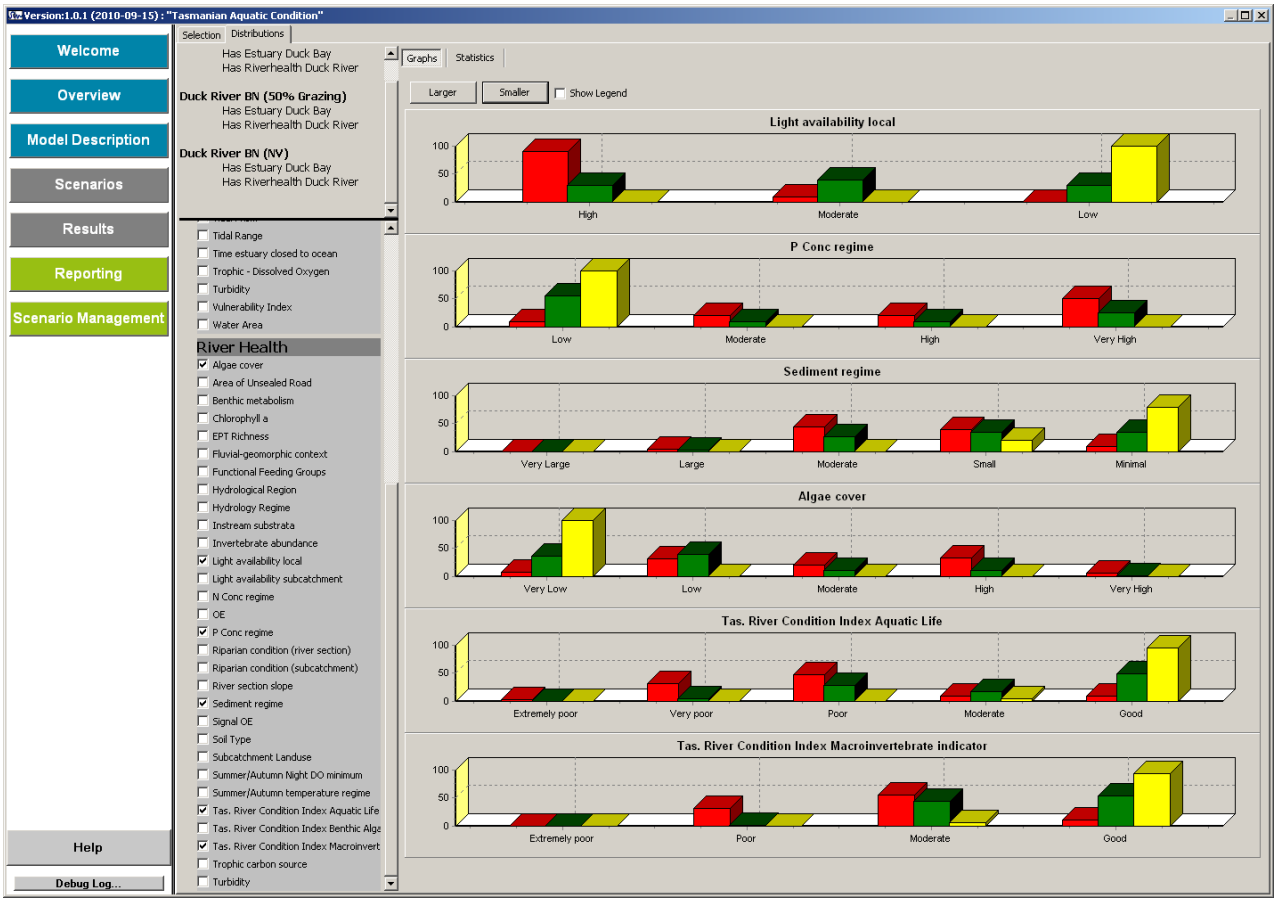
Landuse	**New Values**
Non-production	0
Grazing All	100
Low Intensity Production Forestry	0
Plantation Forestry	0
High Intensity Production Forestry	0
Dairy / Horticulture / Cropping	0

River Section Riparian Condition	**New Values**
Very Poor	100
Poor	0
Moderate	0
Good	0

Subcatchment Riparian Condition	**New Values**
Very Poor	0
Poor	0
Moderate	100
Good	0

18. What is the impact of grazing on the Duck River in the River BN?
    a. Click on the *Results* page
    b. Select *Estuary / River Health Scenario*
    c. Select the three scenarios you created in steps 14 to 17.
    d. Click on the *Distributions* button and select *Graphs*

e. From the side menu, select the following River Health BN variables: *Tas. River Condition Index Aquatic Life, Tas. River Condition Index Macroinvertebrate Indicator*, *Algae Cover*, *Sediment Regime*, *P Conc Regime*, *Light Availability local*.



River ecological condition is predicted to decline in catchments with a high proportion of grazing in the upstream catchment.

Under the 50% grazing scenario there is a 50% chance of being in a good ecological condition (based on the Tasmanian River Condition Index (TRCI) for Aquatic Life indicator) compared with a 94% chance under a 100% non production native vegetation scenario. Under the 100% grazing scenario there is a 9% chance of being in a good ecological condition.

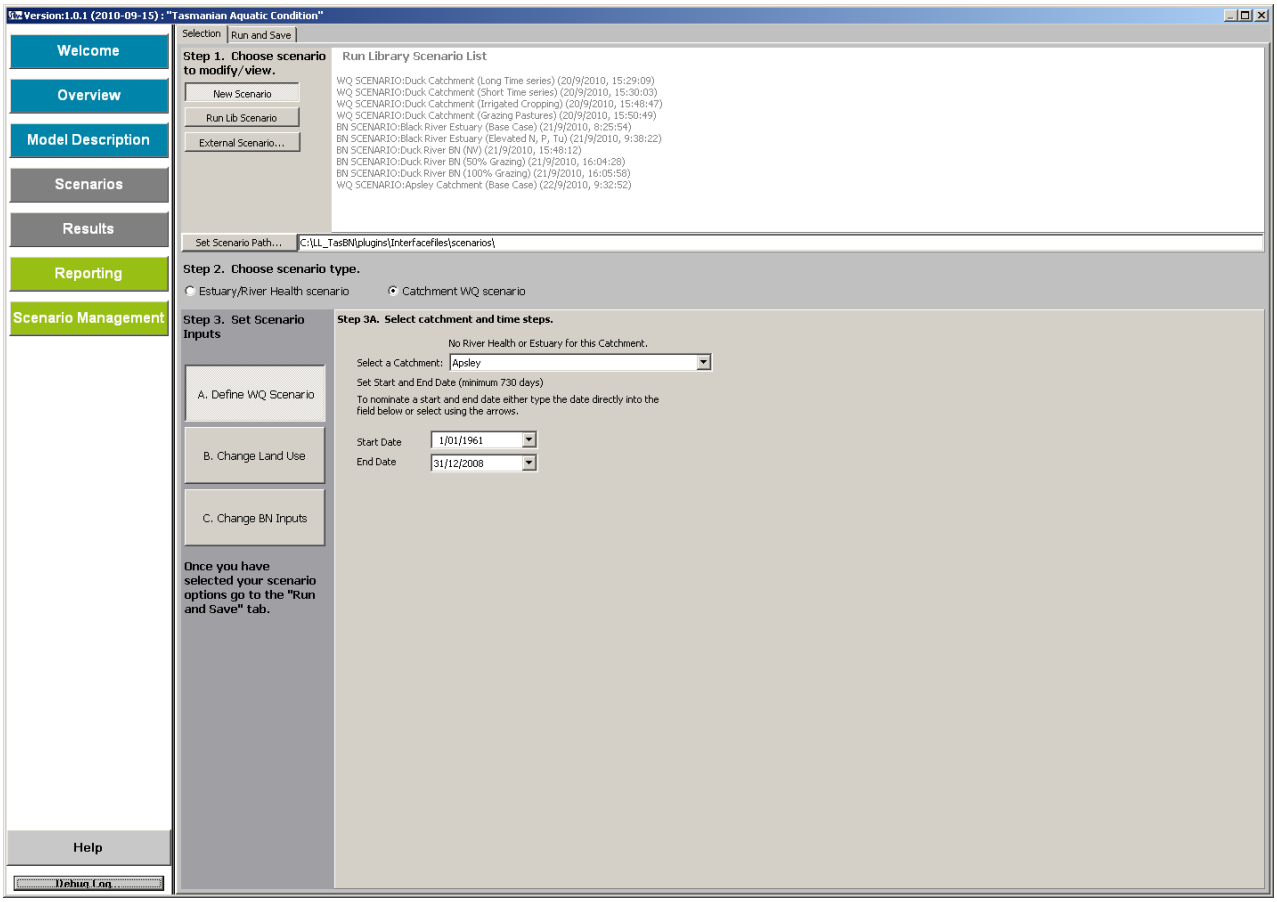
Under the grazing scenarios, increased nutrient concentrations and sediments in the river and decreased shading from riparian vegetation are associated with an increase in the cover of algae and a reduction in macroinvertebrate diversity. This causes the reduction in overall ecological condition.

Developing WQ Scenarios

Landuse and and Hydrology scenarios in the WQ Simulator

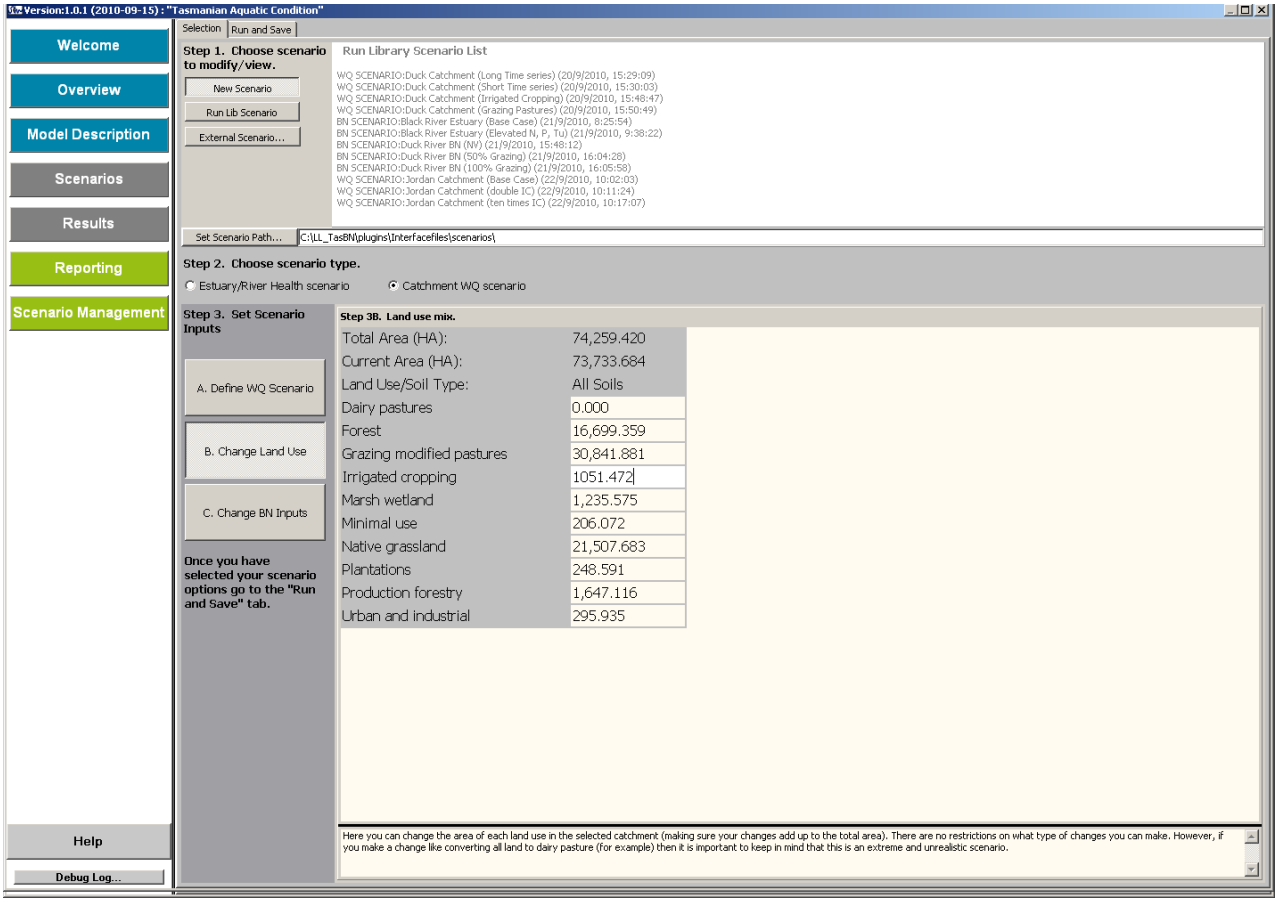
19. Go the *Scenarios* screen of the DSS, press the *New Scenario* button and set the scenario type to *Catchment WQ scenario.*

20. Select the *Jordan* from the *Select a Catchment* drop down menu.



21. Go to the *Run and Save* tab at the top of the page, enter a name for the scenario, and author and (optionally) a description. Click *Run Scenario*.

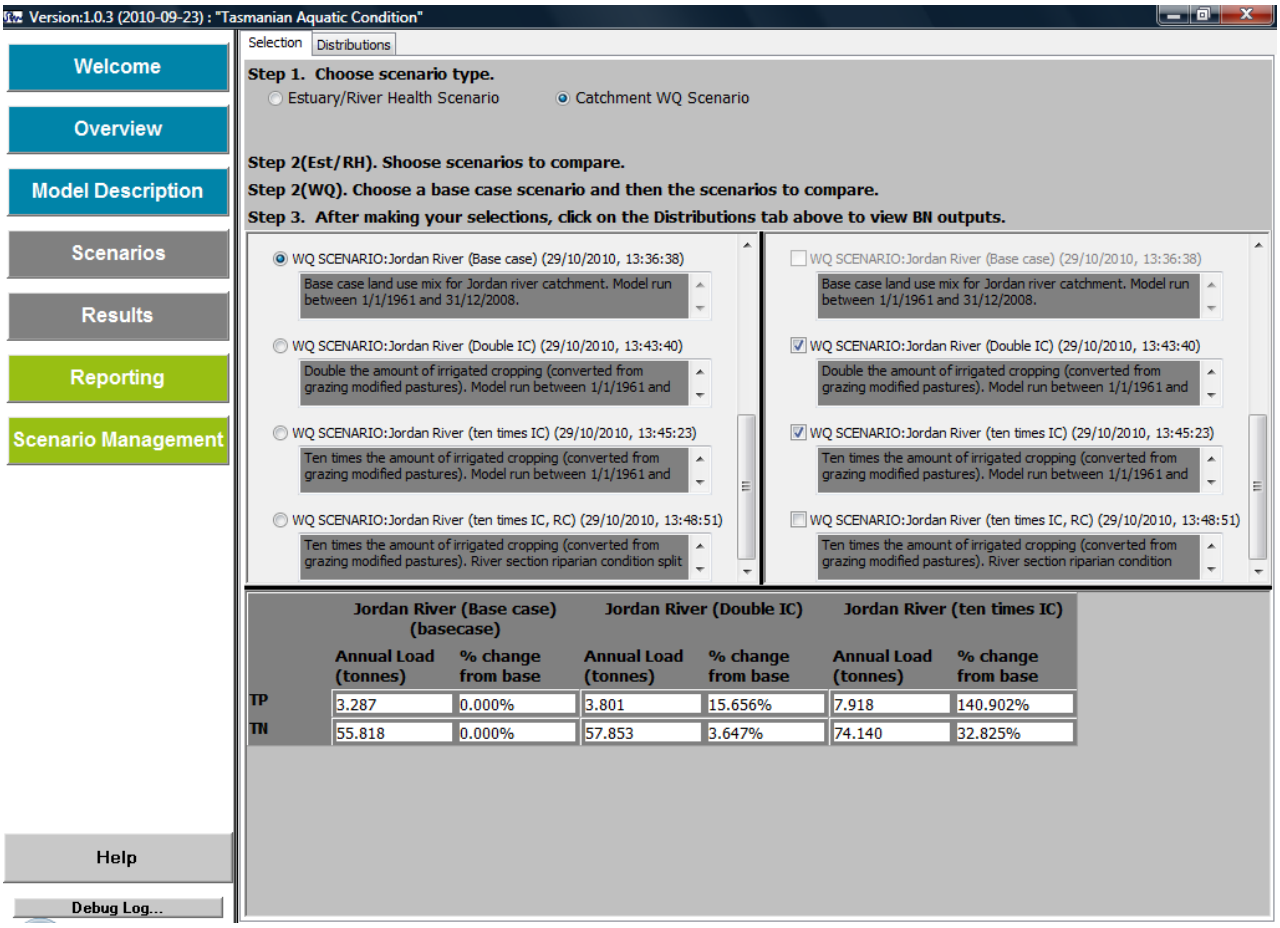
22. When the model has run the interface will return to the *Selections* page (shown above) showing the catchment and time-series period you ran. Click on the *B. Change Land Use* button. Enter the land use mix for the double irrigation cropping scenario tabled below. Go to the *Run and Save* tab at the top of the page, enter a name for the scenario, and author and (optionally) a description. Click *Run Scenario*.



23. Repeat step 22 for the ten-fold increase in irrigated cropping scenario tabled below.

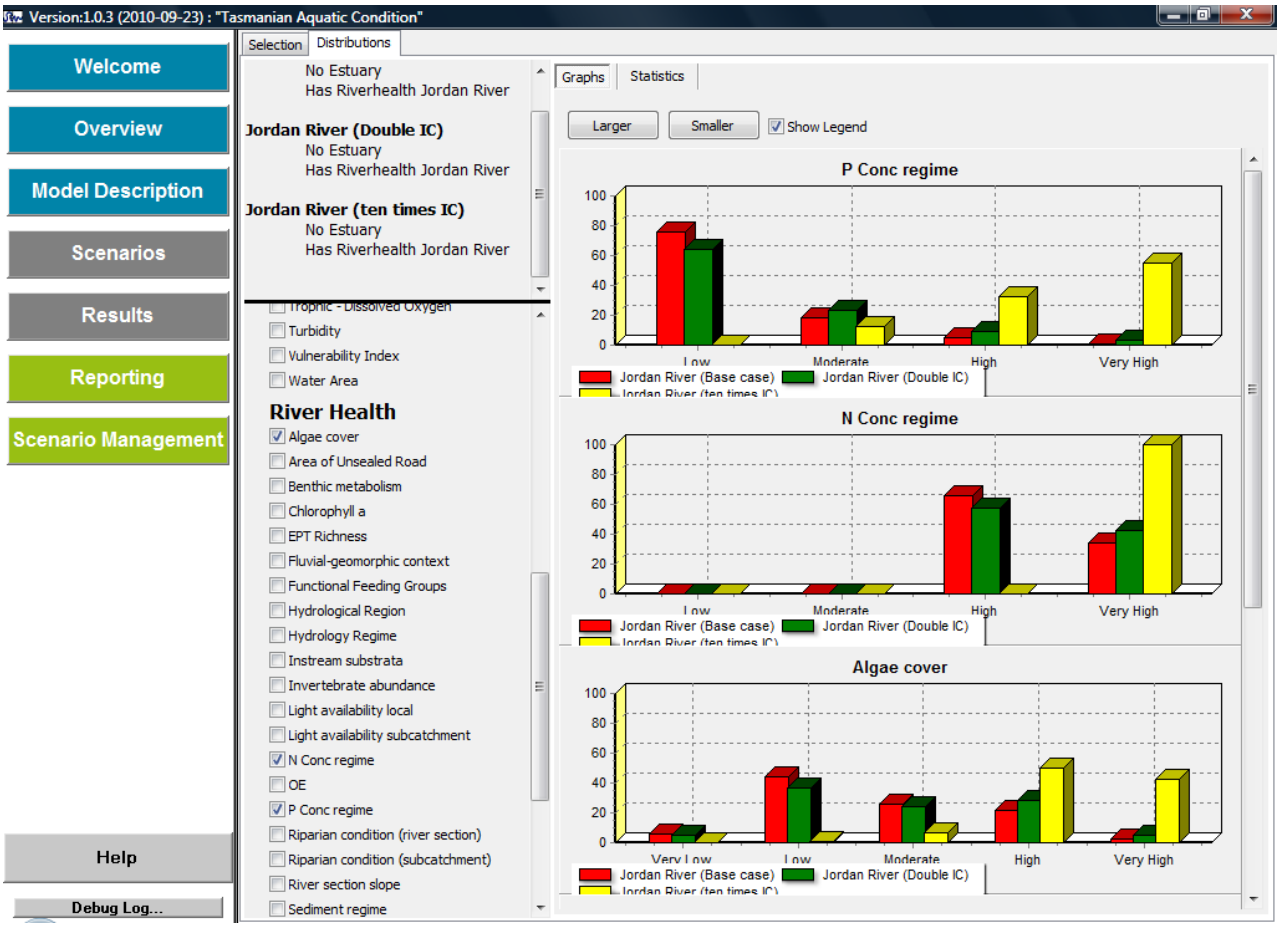
Land use	Area (hectares)	
	Doubled irrigated cropping	Ten-fold increase in irrigated cropping
Dairy pastures	0.000	0.000
Forest	16699.359	16699.359
Grazing modified pastures	31367.617	27161.729
Irrigated cropping	1051.472	5257.360
Marsh wetland	1235.575	1235.575
Minimal use	206.072	206.072
Native grassland	21507.683	21507.683
Plantations	248.591	248.591
Production forestry	1647.116	1647.116
Urban and industrial	295.935	295.935

24. What is the impact of increased irrigated cropping on annual loads in the Jordan catchment?
    a. Click on the *Results* page
    b. Select *Catchment WQ Scenario*
    c. Set *Jordan Catchment (Base Case)* as the base case scenario
    d. Set the other two Jordan catchment scenarios as the comparison scenarios



Increasing the amount of irrigated cropping in the Jordan catchment will increase annual loads of both total phosphorus and total nitrogen. A doubling of the irrigated cropping area is predicted to increase TP and TN by 15.6% and 3.6% respectively. A ten-fold increase in the area of irrigated cropping is predicted to increase TP and TN by 140.9% and 32.8% respectively.

25. What is the impact of increased irrigated cropping in the Jordan catchment on river ecological condition?
    a. Select *Catchment WQ Scenario*
    b. Set *Jordan Catchment (Base Case)* as the base case scenario
    c. Set the other two Jordan catchment scenarios as the comparison scenarios
    d. Click on the *Distributions* button and select *Graphs*
    e. From the side menu, select the following River Health BN variables: *Tas. River Condition Index Aquatic Life, Tas. River Condition Index Macroinvertebrate Indicator*, *Algae Cover*, *P Conc Regime*, N *Conc Regime.*



Increasing the amount of irrigated cropping in the Jordan catchment will increase annual loads of both total phosphorus and total nitrogen. The increase in TN and TP under the doubled area scenario shifts both N and P regimes away from low concentrations to moderate and high concentration. Under the ten-fold increase scenario the N conc regime is predicted to be very high (100%).

The impacts of irrigated cropping on the N conc regime mean a greater chance of high algae cover compared with the other scenarios. The impact on predicted river ecological condition based on the Tasmanian River Condition Index (TRCI) for Aquatic Life indicator and the TRCI Macroinvertebrates Indicator is smaller than on the base measures of nutrients and algal cover but there is still a substantial decrease in the likelihood of being in a good condition for each..

Note that this example used catchment averaged inputs to the River Health BN. Impacts from increased irrigated cropping may be higher in particular river sections in the Jordan catchment.

WQ Simulator scenarios in conjunction with BN scenarios

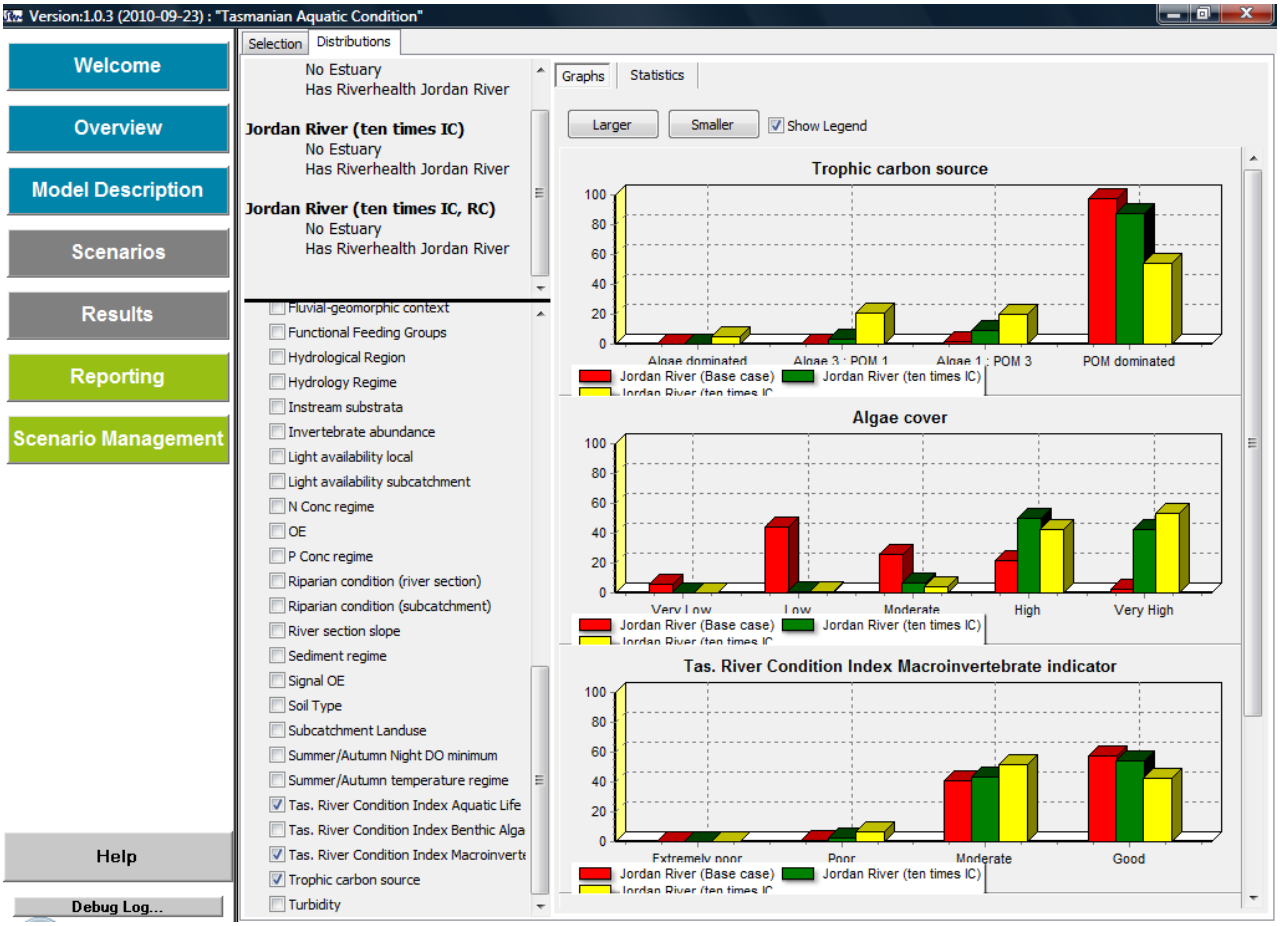
26. Go to the *Scenarios* screen of the DSS, press the *Run Lib Scenario* button and double-click in the right hand panel the *ten-fold increase in irrigation cropping* scenario created in step 23. This loads the input data for that scenario into the model (you can check this by clicking on the *B. Change Land Use* button and seeing that the land use mix reflects the scenario)

27. Click on the *C. Change BN Inputs* button. Click on *Riparian condition (river section)* in the drop-down

menu. In the *New Values* column of the table, set the value of both 'Very Poor condition' and 'Moderate condition' to 50.

28. Go to the *Run and Save* tab at the top of the page, enter a name for the scenario, and author and (optionally) a description. Click *Run Scenario*.

29. What is the impact of increased irrigated cropping **and** decreased riparian condition in the Jordan catchment on river ecological condition?
    a. Select *Catchment WQ Scenario* on the *Results* page
    b. Set *Jordan Catchment (Base Case)* as the base case scenario
    c. Set the two tenfold irrigation cropping scenarios as the comparison scenarios
    d. Click on the *Distributions* button and select *Graphs*
    e. From the side menu, select the following River Health BN variables: *Tas. River Condition Index Aquatic Life, Tas. River Condition Index Macroinvertebrate Indicator*, *Algae Cover, Trophic Carbon Source*.



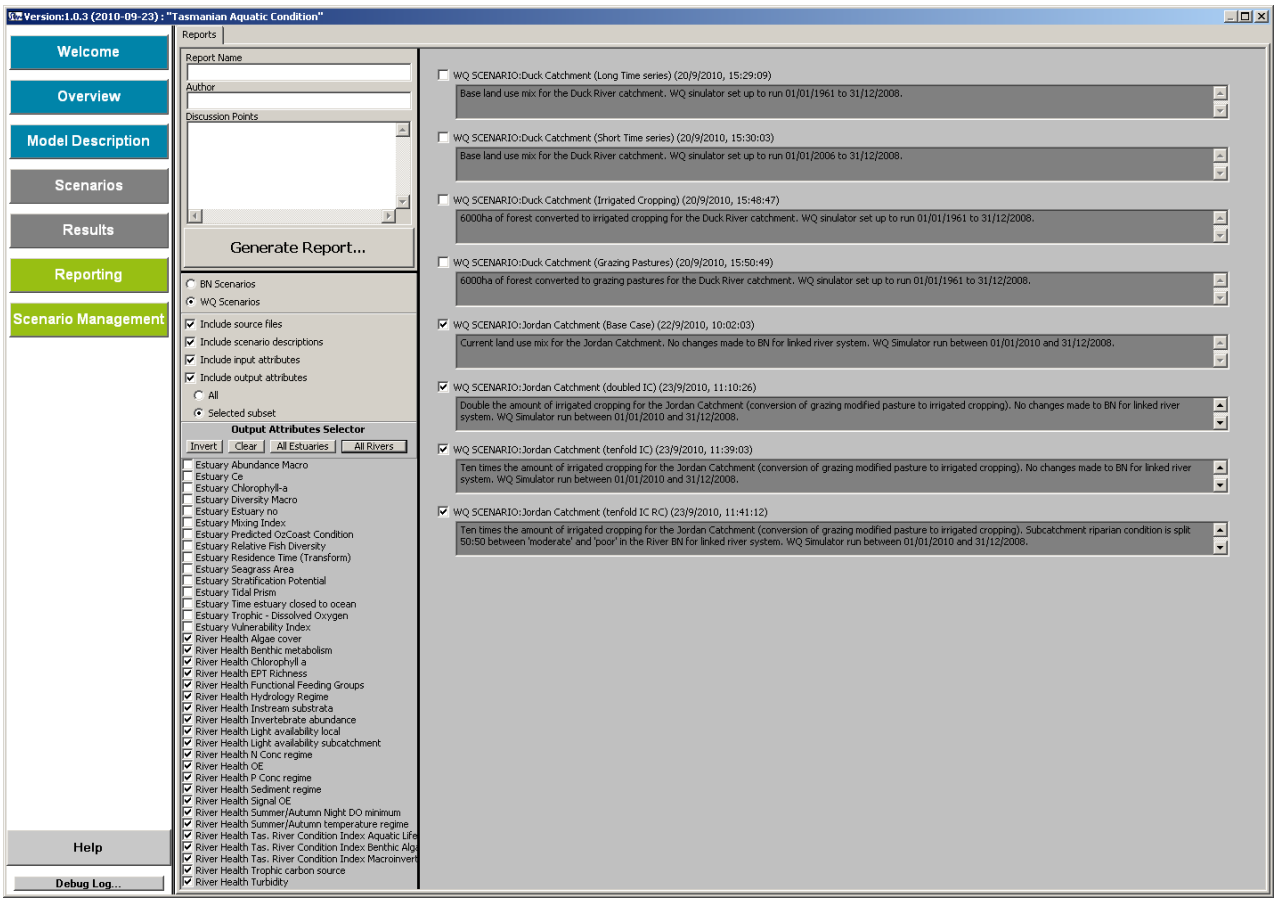
A reduction in subcatchment riparian condition (green in the above figure) negatively impacts the Trophic Carbon Source with over 40% lower chance of being in the particulate organic matter (POM) dominated state.

This change in riparian condition has a much stronger impact than the land use scenario where there is no impact on riparian condition (green). Compared with the base case (where there is a ~50% likelihood that the TRCI Aquatic Life indicator would be in a good state) the likelihood that the TRCI Aquatic Life indicator would be in a good state under the land use plus riparian condition scenario is 20%. With land use change only this likelihood is 33%.

Generating Reports

30. Go to the *Reporting* page and select WQ Scenarios (under the *Generate Report* button). In the main panel, select the four Jordan Catchment scenarios.

31. For the output attributes, change from the default (*All*) to *Selected subset*. The Jordan catchment model is linked only to the Jordan River (i.e. not linked to an estuary). Click on the *All Rivers* button to select all outputs of the River Health BN.



32. Enter a report name author and any discussion points. The click the *Generate Report* button and navigate to where you want to save the report.

33. The report is saved as a zip file. Outside of the DSS you can extract the scenario contents. Double-click on the html file to view the report

At the moment the input values for the Estuary BN are displayed even though an estuary model does not exist for the Jordan catchment. We need to implement functionality in the Reporting page for selecting input variables (similar to selecting output variables).

A CSS file has been set up which controls the look and feel of the generated report. This is VERY basic at the moment but could be made to look much nicer by someone familiar with CSS files (e.g. graphic designer)