OECD ENV/NMC

The FEASIBLE Model, Rural cost functions

User Manual

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Table of Contents

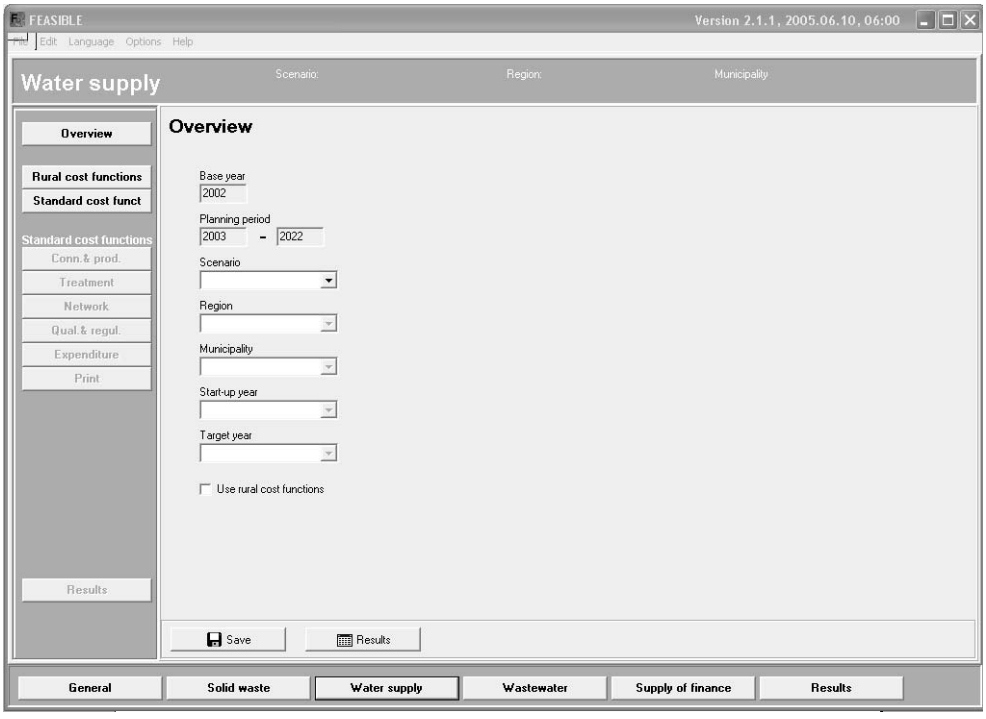
1 Methodological Considerations

The present chapter provides a brief introduction to the environmental financing strategy (EFS) methodology and describes the role of FEASIBLE. For a more detailed description of the EFS methodology, the reader is referred to the publications referenced at the end of this chapter.

2 Water supply

To enter the water supply module, select the *Water Supply* botton at the bottom of the screen.

In the *Overview* screen, specify scenario and municipality for which you want to enter data. For the first scenario, start by selecting one region and fill in data for each municipality or municipality group within that region. Then repeat the procedure for the remaining regions.



Press the *Rural cost functions* button in the left panel of the screen to activate the rural cost functions.

Click the "Use rural cost functions" checkbox to tell the model to use rural cost functions for the selected municipality.

After pressing the *Rural cost functions* button in the left panel the following screen appear bringing up the buttons for navigating in the rural cost function part of the model.

Overall, the rural cost function modules comprise the following screens:

- Connection
- Technology
- Treatment
- Default values
- Detailed results

Each of these screens is explained in detail below.

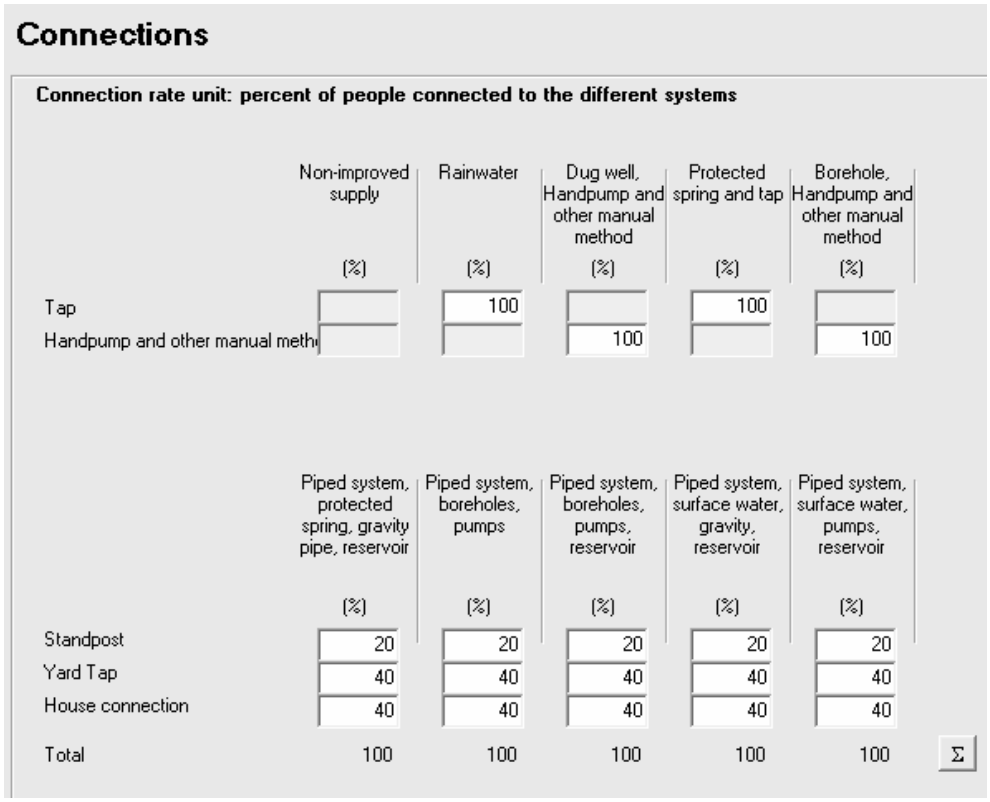
The general concept is that the user must fill in water connections, technologies and treatment (if any). Having done this, the user can see the detailed results in the Detailed Result screen. The default value screen need not to be changed to calculate results. Although, it is recommended that the user review the default values to check if the default values corresponds to the local situation.

2.1 Connection

Connection rate

Data on connection rates should be entered in percent of people connected to the different systems. The percentage is entered as numbers between 0 and 100.

Having entered the share of population connected to the different systems the user should click the sum button in the lower right part of the screen to make sure the shares sum up to 100%.



The user must enter the allocation where the water for the specific connections. There are five types of connection:

- Tap
- Handpump
- Standpost
- Yard Tap
- in House connection.

There are nine different types of water supply technologies to supply the water for these connections:

- Non-improved supply
- Rainwater
- Dug well and HP
- Protected spring and tap
- Borehole and HP
- Piped system, protected spring, gravity pipe, reservoir
- Piped system, boreholes, pumps
- Piped system, boreholes, pumps, reservoir
- Piped system, surface water, gravity, reservoir
- Piped system, surface water, pumps, reservoir

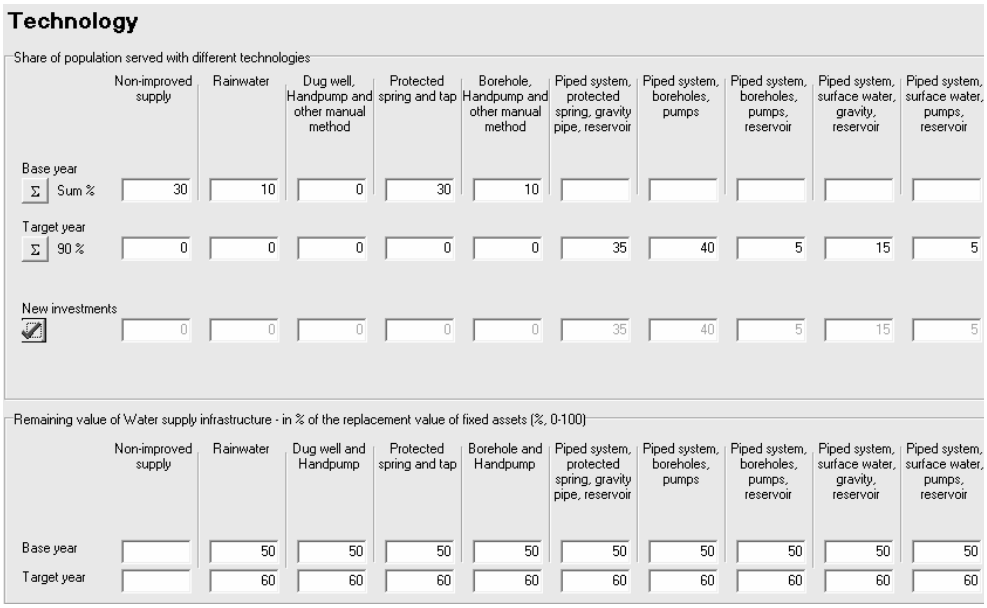
These systems are described in more detail in the documentation to the model.

2.2 Water supply technology

The water production may be allocated on nine different types of technologies.

- Non-improved supply
- Rainwater
- Dug well and HP
- Protected spring and tap
- Borehole and HP
- Piped system, protected spring, gravity pipe, reservoir
- Piped system, boreholes, pumps
- Piped system, boreholes, pumps, reservoir
- Piped system, surface water, gravity, reservoir
- Piped system, surface water, pumps, reservoir

In the Technology screen the user enter the allocation of water supply in base year and target year. Having done this, the user should click the "New investments" button to calculate the amount of new investments needed to meet the demand for water supply in the target year.



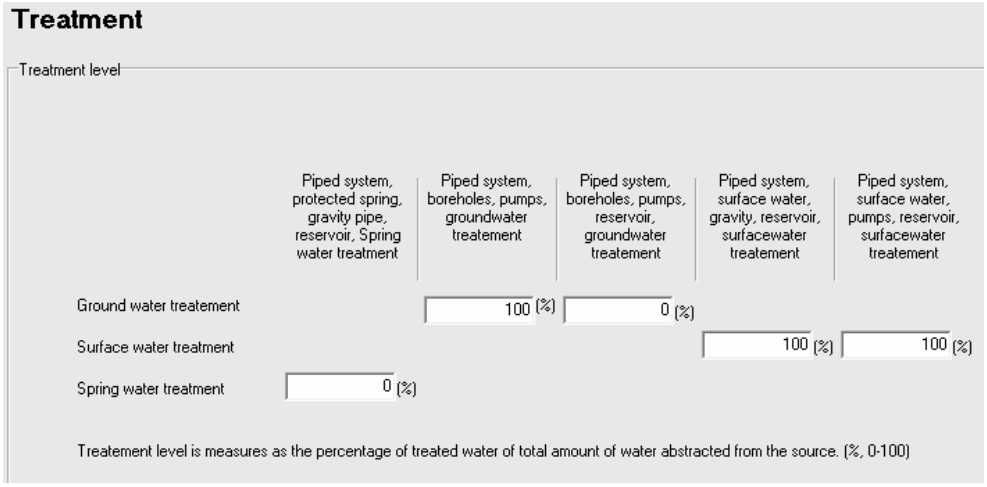
In the lower part of the screen the user must enter the depreciation level of the existing technology. These data are used for calculation of eventual renovation of the existing water production system.

Specify the best estimate of the remaining value of the treatment plant in % of the replacement value of a new plant. The value entered will influence the estimated need for renovations.

2.3 Water Treatment

The water treatment screen operates with three different types of treatement:

- Groundwater treatment
- Surface water treatment
- Spring water treatment



The user should enter the level of treatment for each of the piped water supply system.

The data entered in this screen control if there is water treatment or not, and how much. More detailed description of the treatment can be specified in the default values screen.

The model use the following treatment technologies for surface water

- Slow sand filter for spring water/clean stream water; and
- Conventional treatment (pre-treatment, coagulation/flocculation, sedimentation, filtration and disinfection).

The model use the following treatment technologies for ground water

- Pressure filter (in closed filter); and
- Open gravity filters.

2.4 Default values

The rural cost function module applies a rather detailed modelling of the rural cost function. These cost functions takes a large number of parameters (e.g. how deep down to get the water, transmission length, population density, population per unit etc.). It would be too much work for the user to enter these detailed data for each municipality. Instead there has been applied a large number of technical default values to enter into the cost functions. Then the user may change a few of these to make the cost calculations closer to the local situation.

The default values are specific for each municipality.

In general, the user should change the values to reflect the local situation.

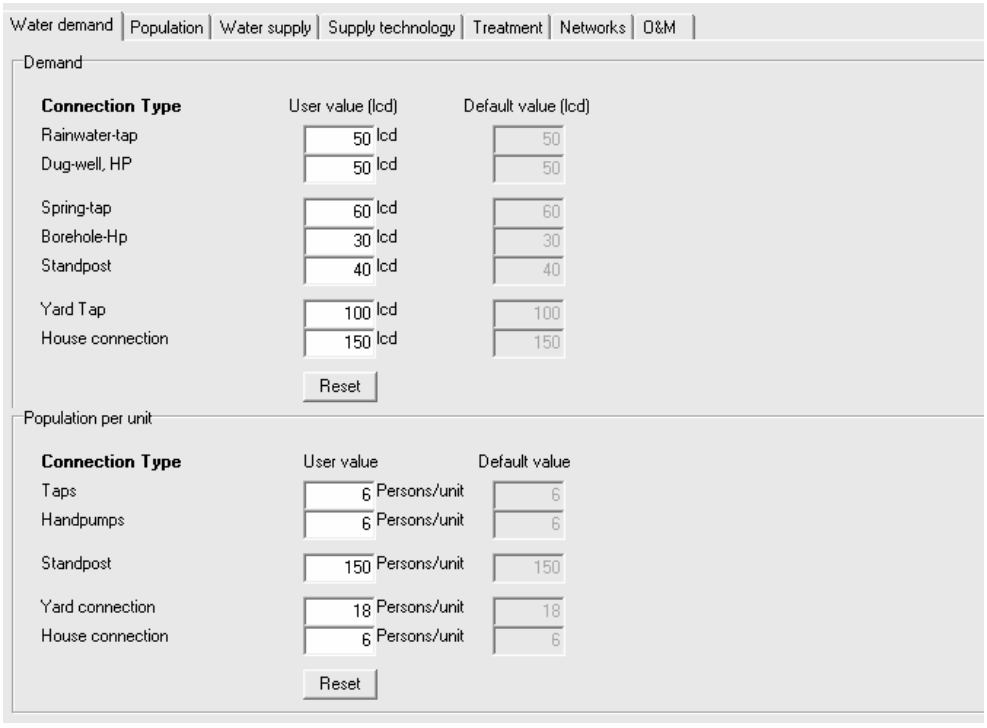
The model offers the opportunity for the user to re-establish original default values by clicking the "Reset"-button. However, this will of course delete eventual changes in the values above the button. It will however not affect values entered in other screens.

The default values are separated in seven categories:

- Water demand
- Population
- Water supply
- Supply technology
- Water treatment
- Network
- Operation and maintenance

Each of these categories has its own screen.

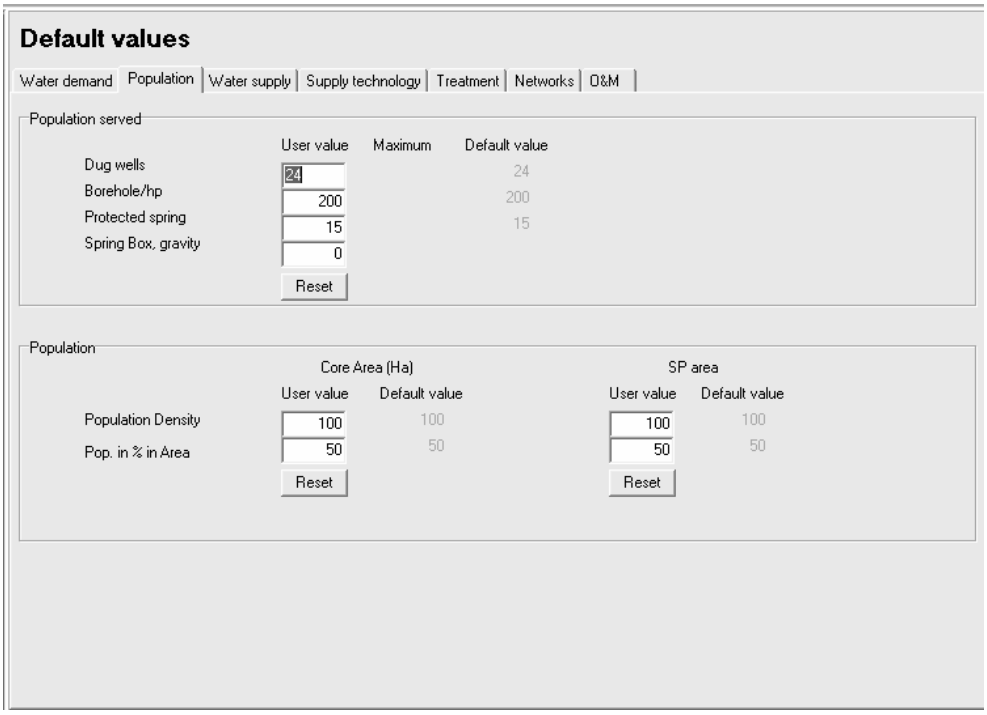
Water demand



In this screen the user can enter the average water consumption measured in litre per capita per day for the specific systems. The model uses this value to calculate total water consumption based on population, connection rates and lcd.

Furthermore, the user can enter average population per connection for the specific connection systems. These values are used for calculation of number of connections needed.

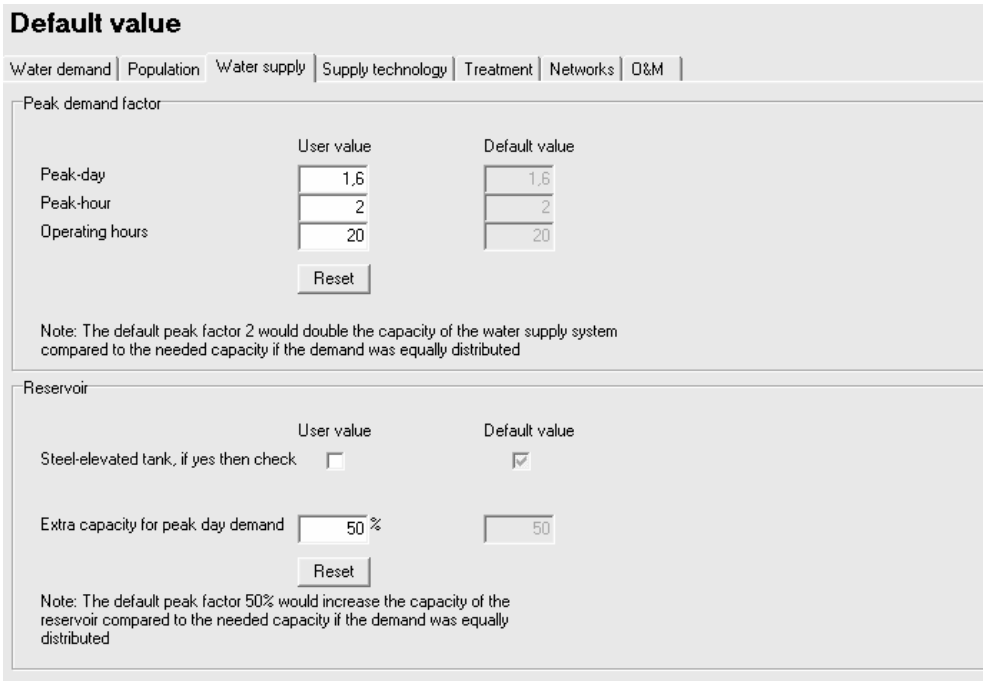
Population



In this screen the user can enter number of people served by the specific water sources. These values enter in the calculation of need for sources to cover water consumption.

Furthermore, the user can specify population in core and fringe area. These values determine the size of the area and thereby the total pipe length.

Water supply



The water supply screen allows the user to control the need for extra capacity in the water supply due to peak demand.

The default peak factor 2 in the upper part of the screen would double the capacity of the water supply system compared to the needed capacity if the demand was equally distributed.

The default peak factor 50% in the lower part of the screen would increase the capacity of the reservoir compared to the needed capacity if the demand was equally distributed

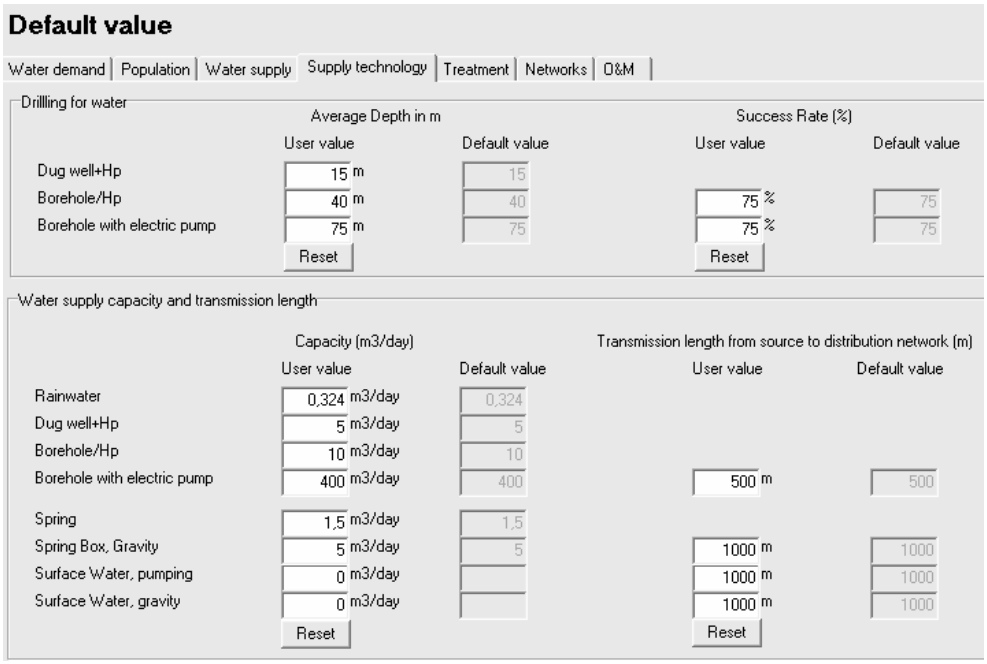
Supply technology

The supply technology screen offer the user the opportunity to describe the supply technology in more detail.

For instance the user can enter

- the depth in meter drilling for water
- capacity of the specific well; and
- the transmission length from source to network

All these values influence the investment and operation and maintenance cost of the individual water supply systems.

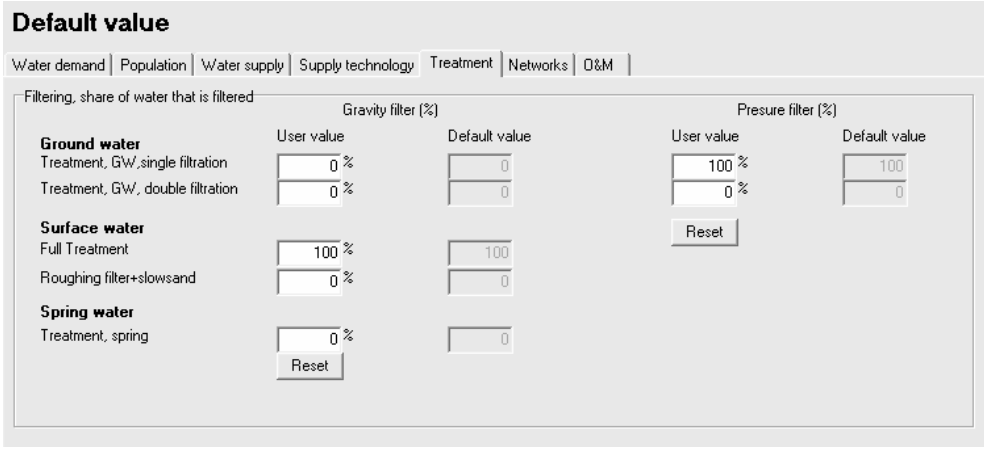


Treatment

The amount of water treatment is specified in the main treatment screen in the beginning of the document.

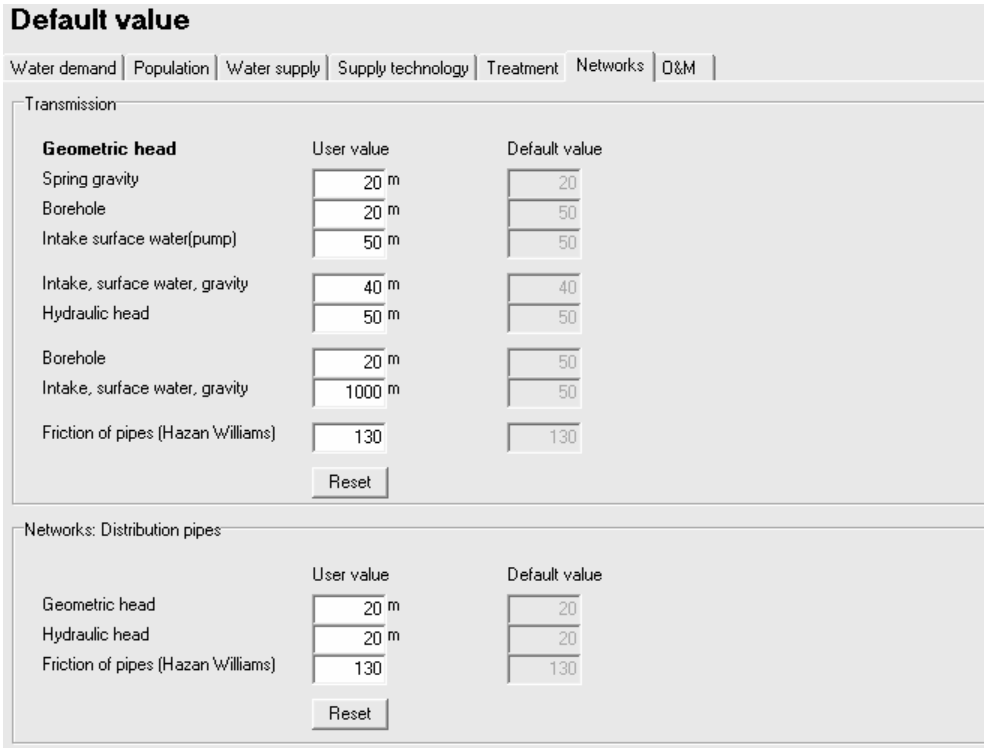
The default values treatment screen shown below allows the user to describe the treatment technology in more detail.

The user is referred to the technical report and annexes for more detailed description of the individual treatment technologies.



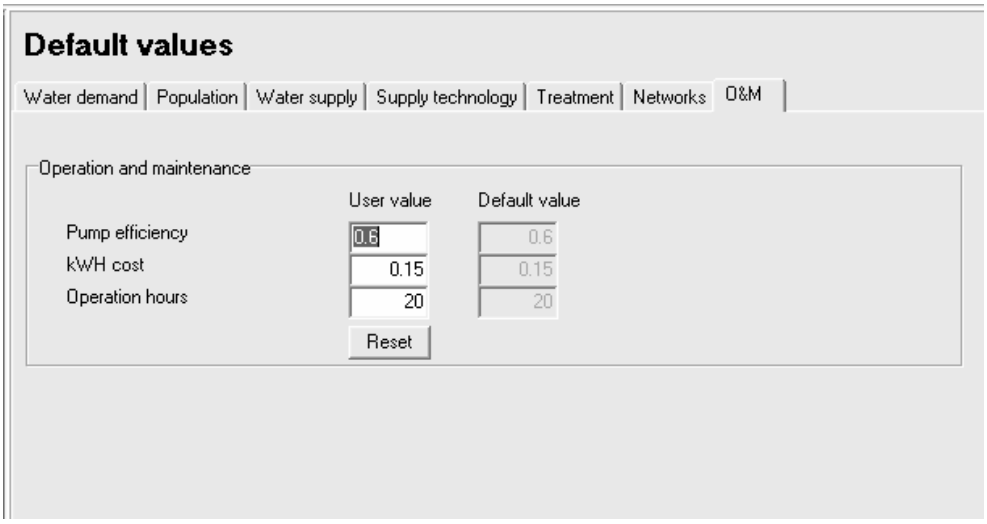
Network

The Networks allows the user to adjust the networks to reflect local conditions. These values influence the energy cost for pumping the water out through the network.



Operation and maintenance

The operation and maintenance screen holds values to adjust pumping effeciency and operating hours. These are major elements in the operation and maintenance cost.



2.5 Results

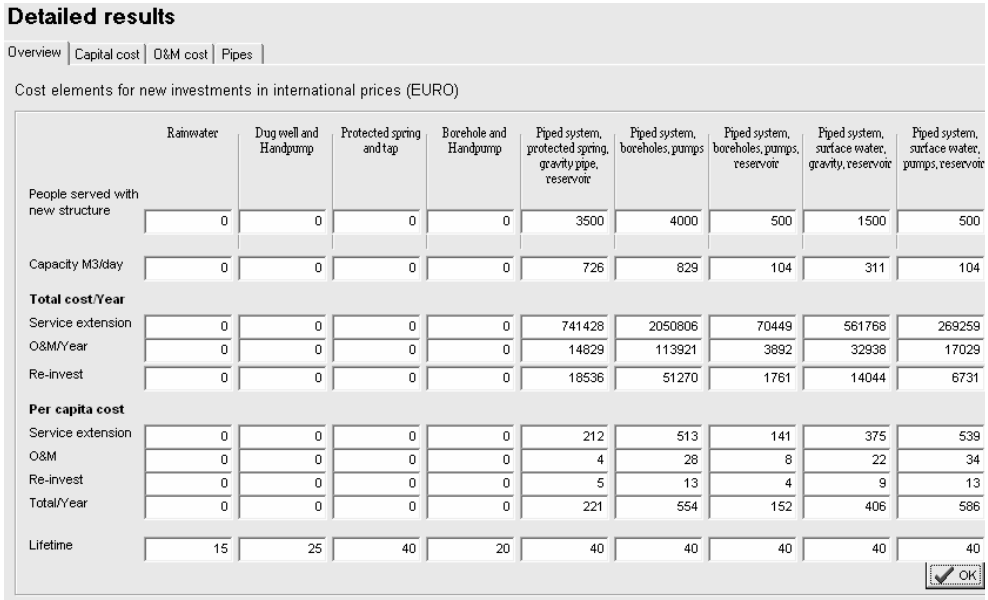
The results from the rural cost functions are integrated in the general feasible model and the user is referred to the user manual for information on reporting from the model.

However, to offer the user better opportunities for testing and understanding the results from the model the rural cost functions include a screen with more detailed results.

It should be noted that the detailed results here are given in EURO and that both investment cost and operation and maintenance cost only covers the new investments in the target year.

Results are calculated by pressing the OK button in the lower right corner of the result screens. This will also transfer data to the general result part of FEASIBLE, making data available for further analysis in parallel with other data in the FEASIBLE model.

The following screen shows the overall detailed results from the rural water supply component of the model.



Detailed results

Overview | Capital cost | O&M cost | Pipes

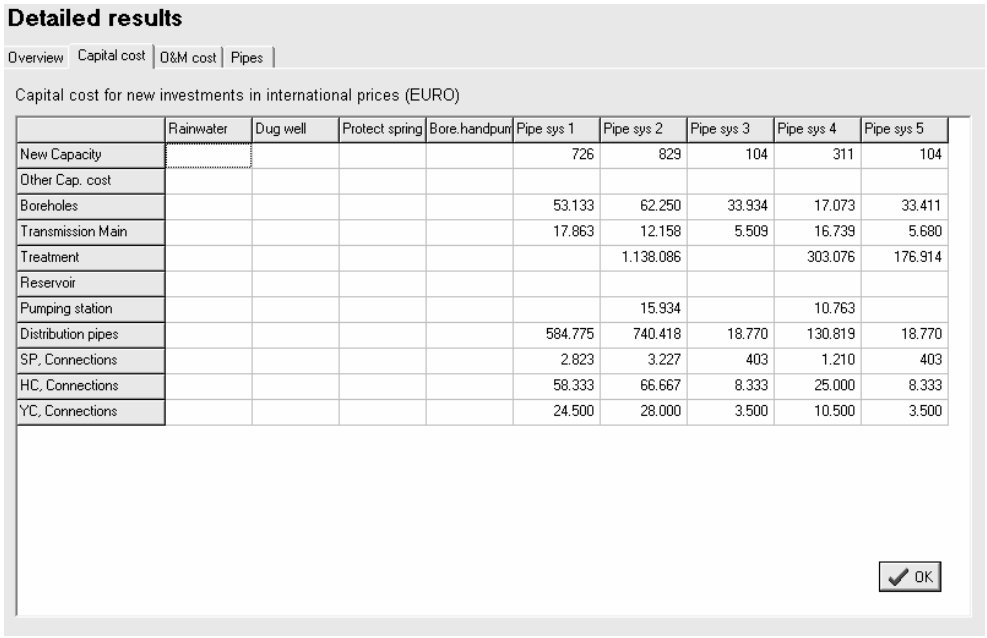
Cost elements for new investments in international prices (EURO)

	Rainwater	Dug well and Handpump	Protected spring and tap	Borehole and Handpump	Piped system, protected spring, gravity pipe, reservoir	Piped system, boreholes, pumps	Piped system, boreholes, pumps, reservoir	Piped system, surface water, gravity, reservoir	Piped system, surface water, pumps, reservoir
People served with new structure	0	0	0	0	3500	4000	500	1500	500
Capacity M3/day	0	0	0	0	726	829	104	311	104
Total cost/Year									
Service extension	0	0	0	0	741428	2050806	70449	561768	269259
O&M/Year	0	0	0	0	14829	113921	3892	32938	17029
Re-invest	0	0	0	0	18536	51270	1761	14044	6731
Per capita cost									
Service extension	0	0	0	0	212	513	141	375	539
O&M	0	0	0	0	4	28	8	22	34
Re-invest	0	0	0	0	5	13	4	9	13
Total/Year	0	0	0	0	221	554	152	406	586
Lifetime	15	25	40	20	40	40	40	40	40

OK

Two more screens shows these cost components in more detail. First

Investment cost for new investments



Detailed results

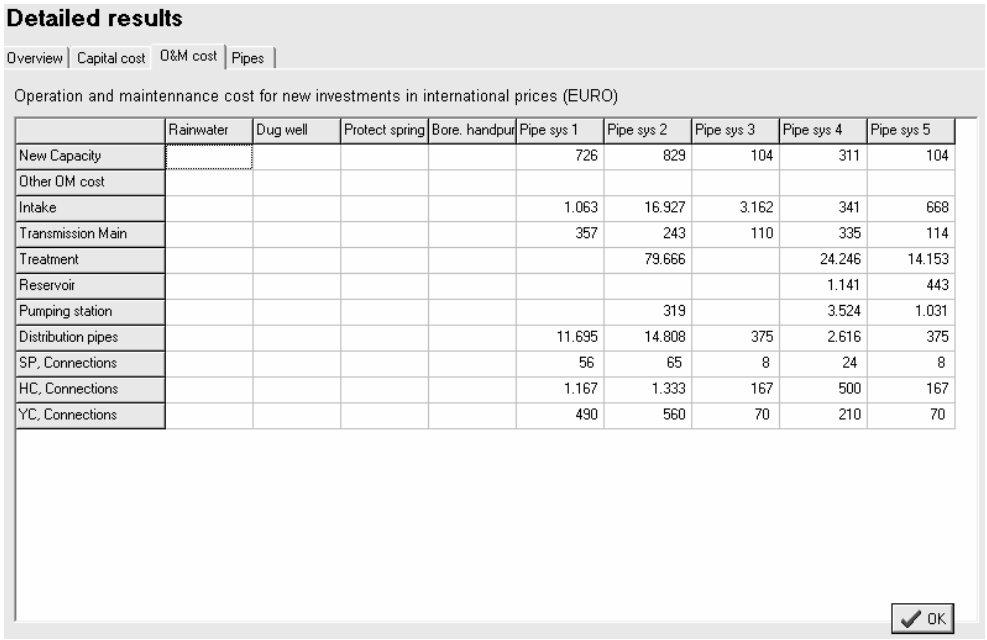
Overview | Capital cost | O&M cost | Pipes

Capital cost for new investments in international prices (EURO)

	Rainwater	Dug well	Protect spring	Bore.handpun	Pipe sys 1	Pipe sys 2	Pipe sys 3	Pipe sys 4	Pipe sys 5
New Capacity					726	829	104	311	104
Other Cap. cost									
Boreholes					53.133	62.250	33.934	17.073	33.411
Transmission Main					17.863	12.158	5.509	16.739	5.680
Treatment						1.138.086		303.076	176.914
Reservoir									
Pumping station						15.934		10.763	
Distribution pipes					584.775	740.418	18.770	130.819	18.770
SP, Connections					2.823	3.227	403	1.210	403
HC, Connections					58.333	66.667	8.333	25.000	8.333
YC, Connections					24.500	28.000	3.500	10.500	3.500

OK

Operation and maintenance cost for new investments



Detailed results

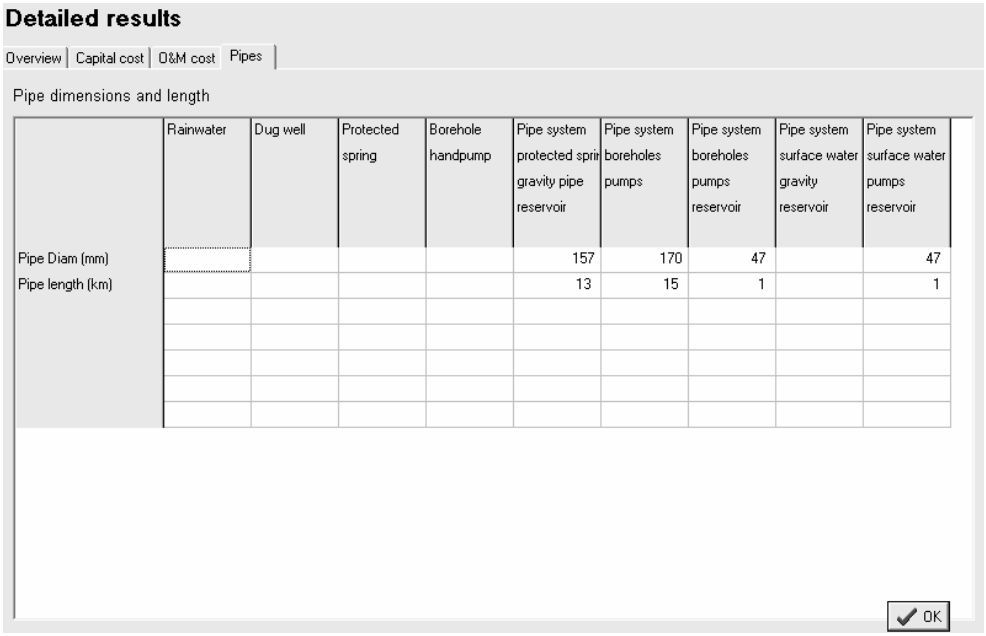
Overview | Capital cost | O&M cost | Pipes

Operation and maintennance cost for new investments in international prices (EURO)

	Rainwater	Dug well	Protect spring	Bore. handpur	Pipe sys 1	Pipe sys 2	Pipe sys 3	Pipe sys 4	Pipe sys 5
New Capacity					726	829	104	311	104
Other OM cost									
Intake					1.063	16.927	3.162	341	668
Transmission Main					357	243	110	335	114
Treatment						79.666		24.246	14.153
Reservoir								1.141	443
Pumping station						319		3.524	1.031
Distribution pipes					11.695	14.808	375	2.616	375
SP, Connections					56	65	8	24	8
HC, Connections					1.167	1.333	167	500	167
YC, Connections					490	560	70	210	70

OK

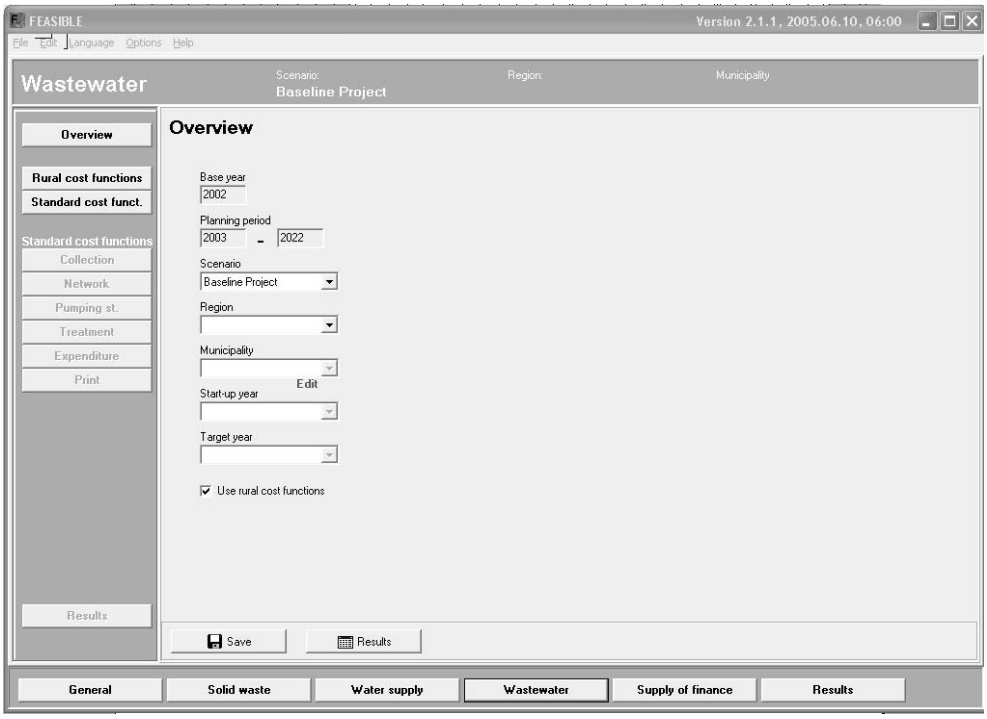
Finally the pipe screen shows the length and dimension of the water supply network.



3 Wastewater

The structure of the wastewater module is very similar to that of the water supply module. The opening screen is the same.

In the *Overview* screen, specify scenario and municipality for which you want to enter data. For the first scenario, start by selecting one region and fill in data for each municipality or municipality group within that region. Then repeat the procedure for the remaining regions.



Press the *Rural cost functions* button in the left panel of the screen to activate the rural cost functions.

Click the "Use rural cost functions" checkbox to tell the model to use rural cost functions for the selected municipality.

After pressing the *Rural cost functions* button in the left panel the following screen appear bringing up the buttons for navigating in the rural cost function part of the model.

Overall, the rural cost function modules comprise the following screens:

- Collection
- Technology
- Treatment
- Default values
- Detailed results

Each of these screens is explained in detail below.

The general concept is that the user must fill in water collections, technologies and treatment (if any). Having done this, the user can see the detailed results in the Detailed Result screen. The default value screen needs not to be changed to calculate results. Although, it is recommended that the user review the default values to check if the default values corresponds to the local situation.

3.1 Wastewater collection rates

Connection rate

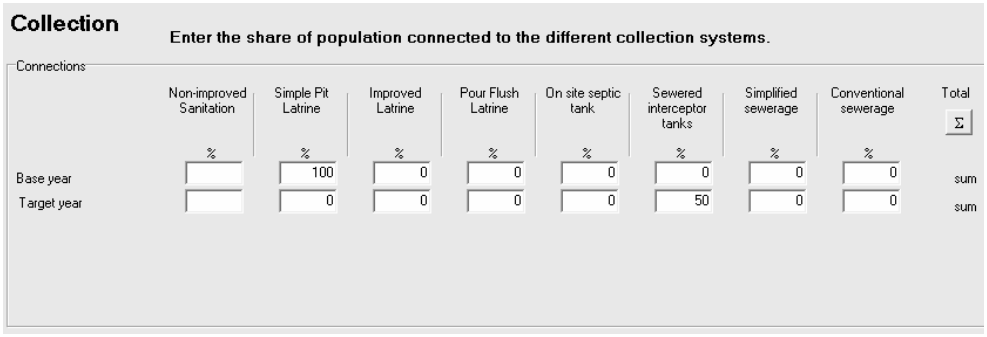
Data on collection rates must be entered in percent, i.e. in this screen numbers between 0 and 100. In other screens the user might need to use negative values as well as numbers above 100.

The model offers eight specific collection technologies:

- Non-improved Sanitation
- Simple Pit Latrine
- Improved Latrine
- Pour Flush Latrine
- On site septic tank
- Sewered interceptor tanks +/- treatment
- Simplified sewerage +/- treatment
- Conventional sewerage +/- treatment

The collection systems are described in more detail in the documentation of the model.

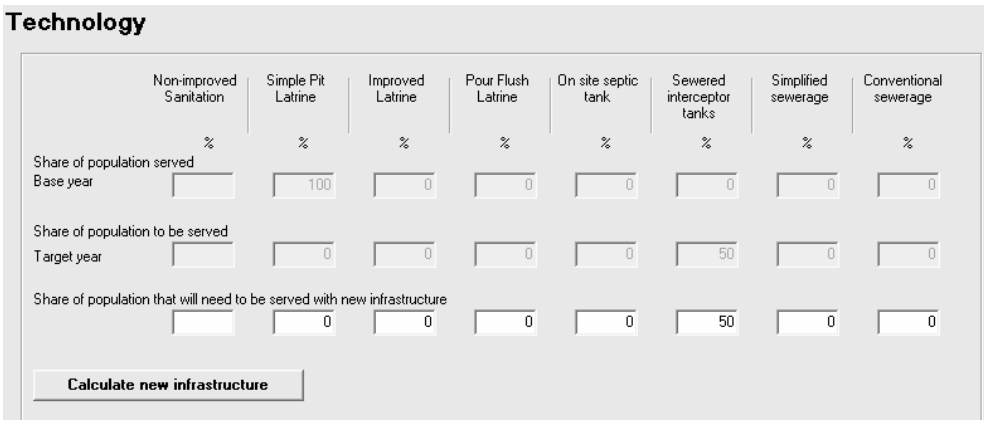
The user must enter the share of population covered by each specific collection system in both base year and target year. This is done in the wastewater collection screen.



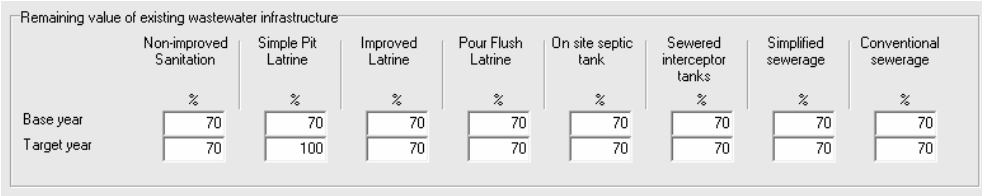
Click the sum button to verify that the connection rates sum up to 100%.

3.2 Wastewater collection technology

Based on information on connection rates and water supply, the model can calculate the amount of necessary investments for each technology. To do that the user should press the "Calculate new infrastructure" - button.



In the lower part of the screen, shown below, the user must enter the depreciation level of the existing technology. These data are used to calculate eventual renovation of the existing water production system exactly as for the water supply module.

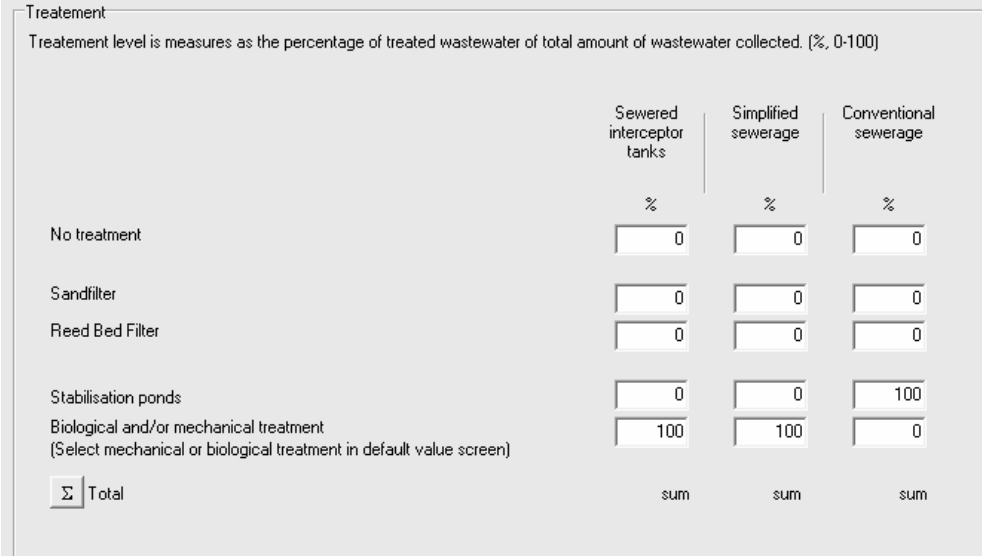


Specify your best estimate of the remaining value of the treatment plant in % of the replacement value of a new plant. The value entered will influence the estimated renovation need.

3.3 Water Treatment

The water treatment screen operates with four different types of treatement:

- No treatment
- Sandfilter
- Reed Bed Filter
- Stabilisation ponds
- M&B treatment



The user should enter the level of treatment for each of the three advanced wastewater collection systems. Since the options include "No treatment" the horizontal sum should equal 100.

The treatment technologies are described in more detail in the main documentation of the model.

3.4 Default values

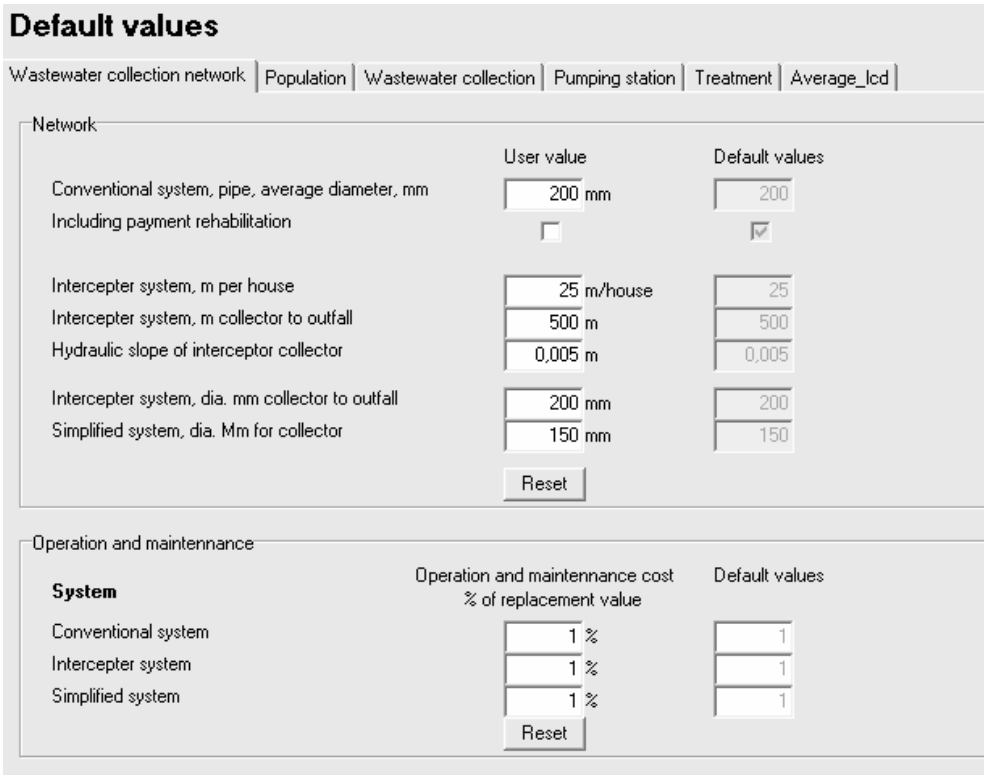
As mentioned before, the rural cost function module apply a rather detailed modelling of the rural cost function. These cost functions takes a large number of parameters (e.g. Intercepter system, m per house, Intercepter system, m collector to outfall, population density, population per unit etc.). It would be too much work for the user to enter these detailed data for each municipalities. Instead there has been applied a large number of technical default values to enter into the cost functions. Then the user may change a few of these to make the cost calculations closer to the local situation. The default values are specific for each municipality. The default values are separated in six categories:

- Wastewater collection network
- Population
- Wastewater collection
- Pumping station
- Wastewater treatement

Each of these categories has its own screen.

Wastewater collection network

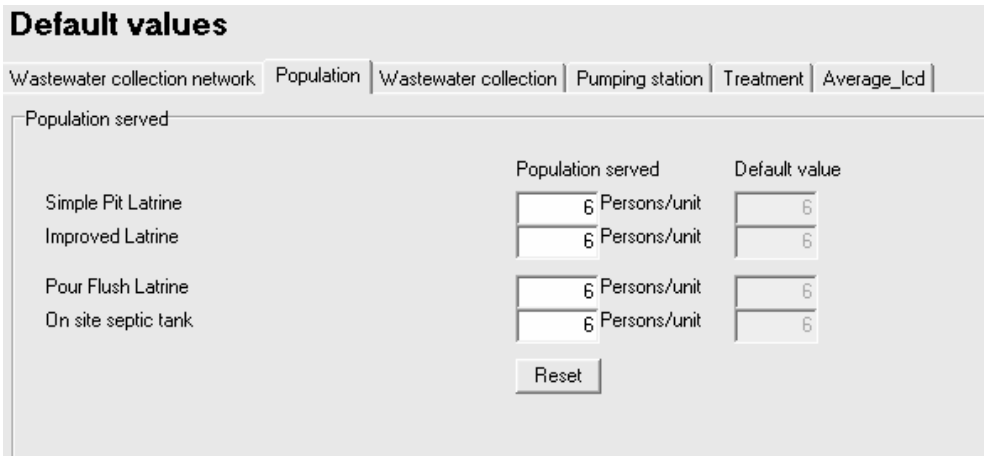
The wastewater collection screen allows the user to adjust the dimensions and length of the collection network to reflect local conditions.



Furthermore, in the lower part the user may insert local values for calculation of operation and maintenance from the replacement value.

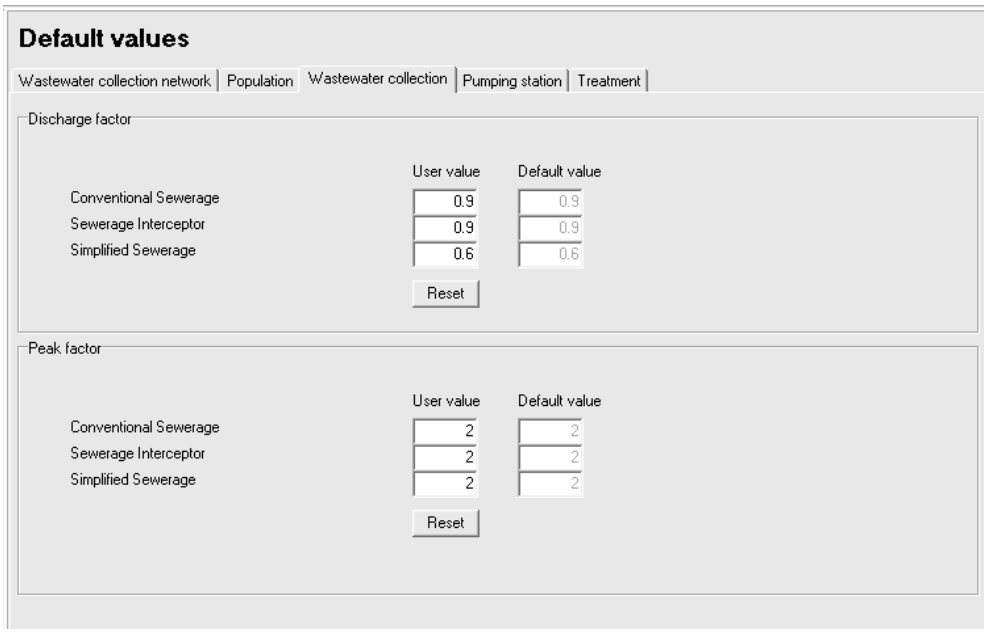
Population

In this screen the user can enter number of people served by the specific water collection systems. These values enter in the calculation of need for number of wastewater collection units and affect both investment cost and operation and maintenance cost.



Wastewater collection

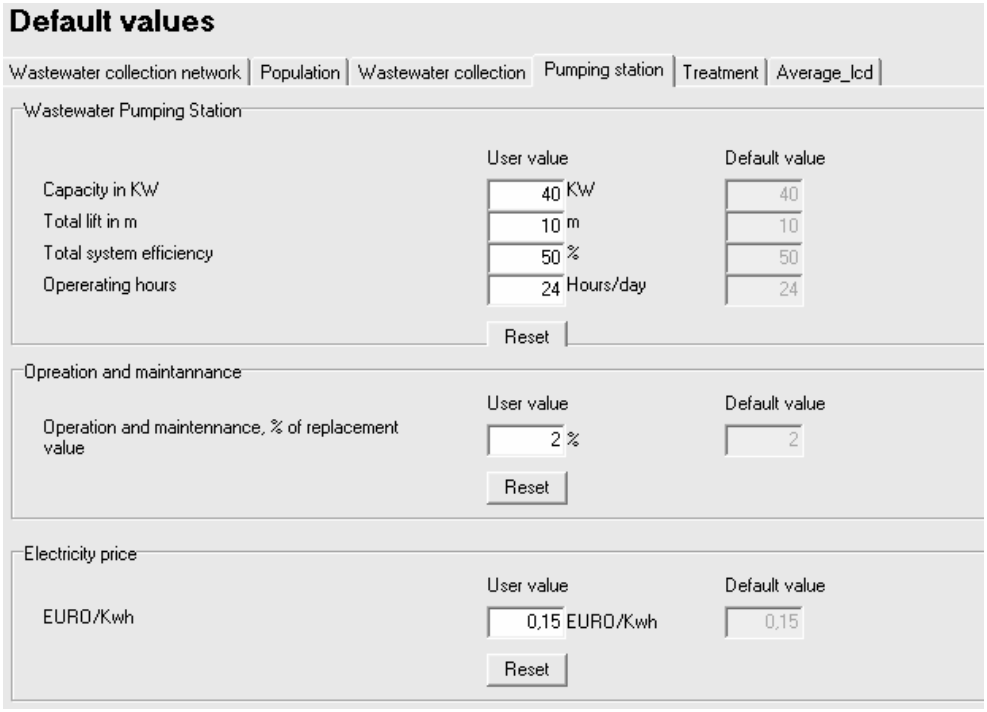
The upper part of this screen allow the user to change the share of water consumption is discheárged to the wastewater collection system.



The lower part allows the user to enter values to secure capacity for peak demand. The default peak factor 2 would double the capacity of the waste water system compared to the needed capacity if the discharge was evenly distributed

Pumping station

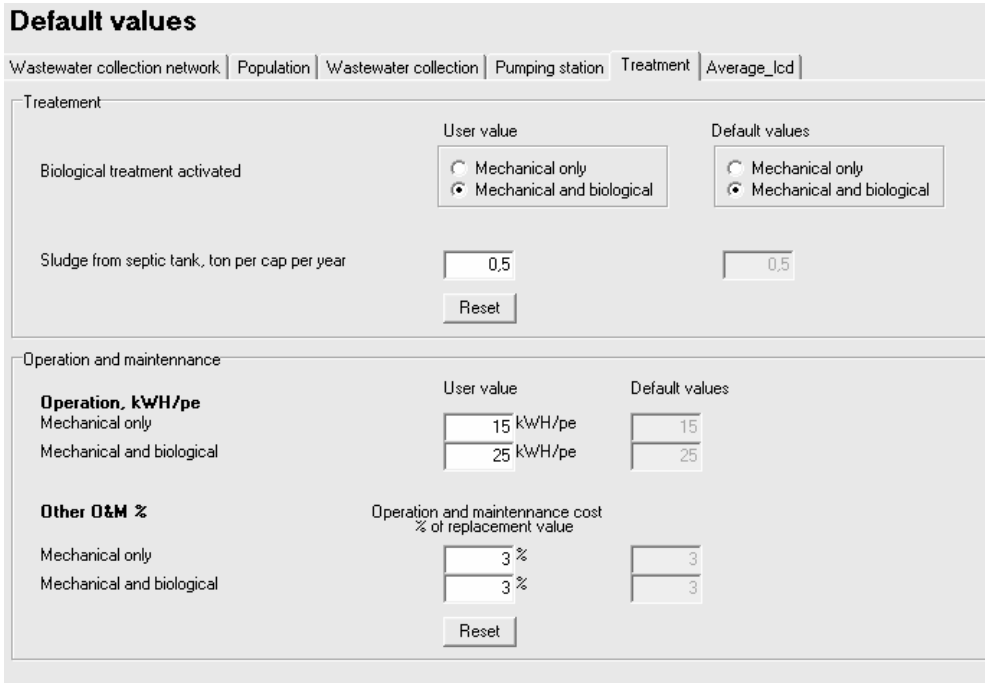
The "pumping station" screen contains data to describe pumping efficiency and operation and maintenance of pumping.



Since this is one of the major costs of advanced wastewater collection systems, it is recommended that the user verify that the default in this screen to a reasonable extent covers the local situation.

Treatment

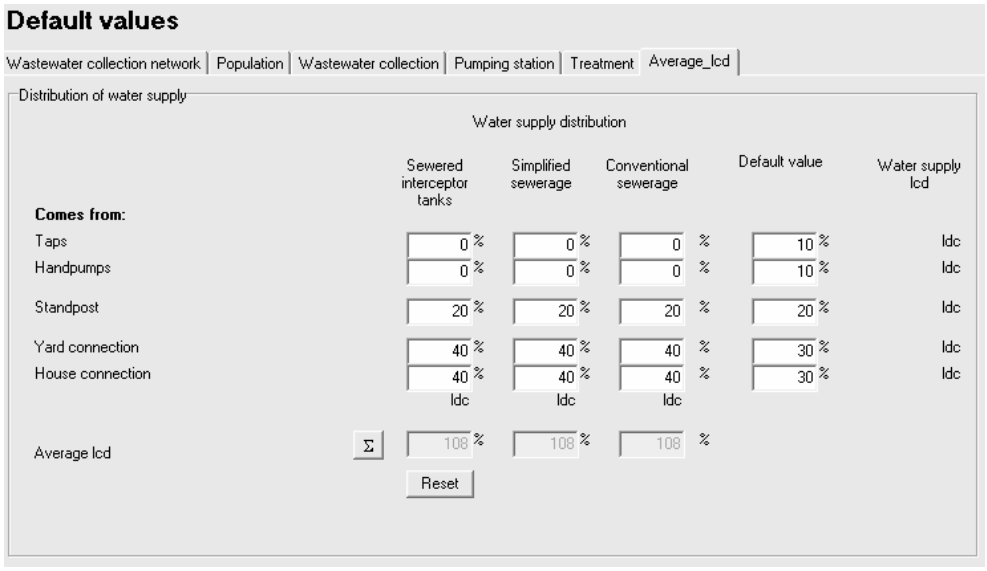
The treatment screen holds data to select the specific technology for wastewater treatment.



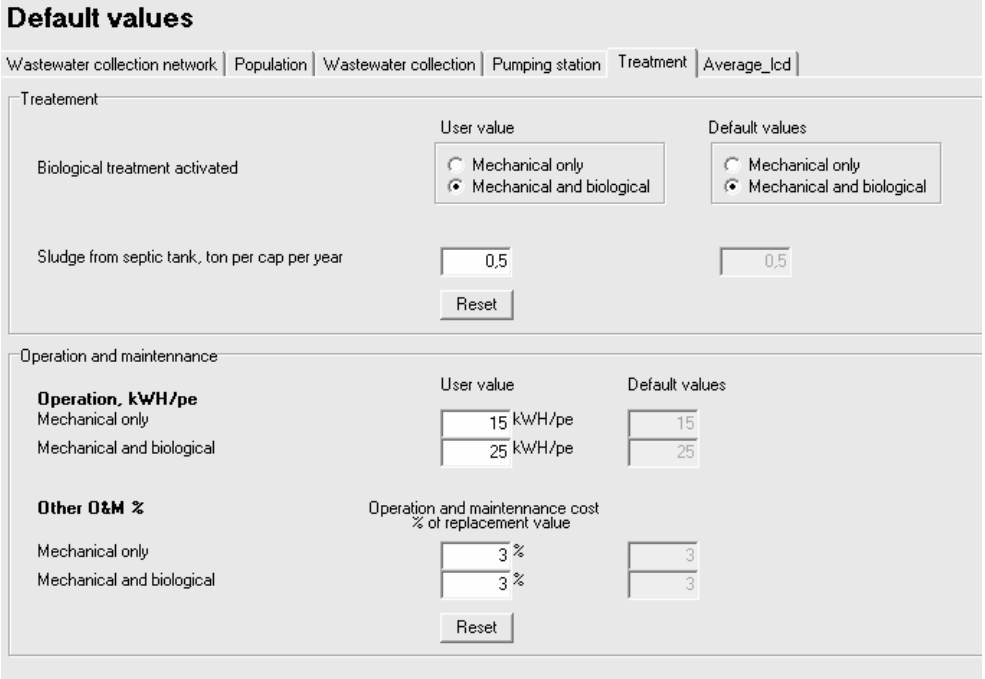
Furthermore this screen also contain data for operation and maintenance of wastewater systems.

Average lcd

Finally, the "Average lcd" screen holds data for the distribution of water supply. These data are included to ensure consistency with the water supply.



The model calculate an average lcd for each specific wastewater technology based on the data in this screen. This figure and the population determine the amount of wastewater generated.



3.5 Results

As for water supply, the results from the rural cost functions are integrated in the general feasible model and the user is referred to the user manual for information on reporting from the model.

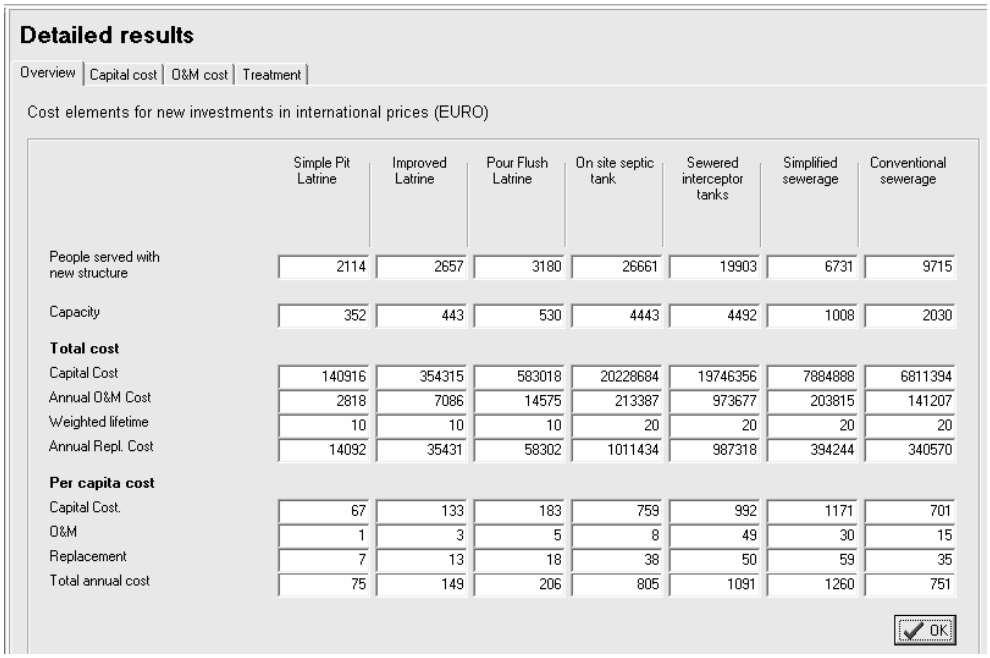
However, to offer the user better opportunities for testing and understanding the results from the model the rural cost functions include a screen with more detailed results.

It should be noted that the detailed results here are given in EURO and that both investment cost and operation and maintenance cost only covers the new investments in the target year.

Results are calculated by pressing the OK button in the lower right corner of the result screens. This will also transfer data to the general result part of

FEASIBLE, making data available for further analysis in parallel with other data in the FEASIBLE model.

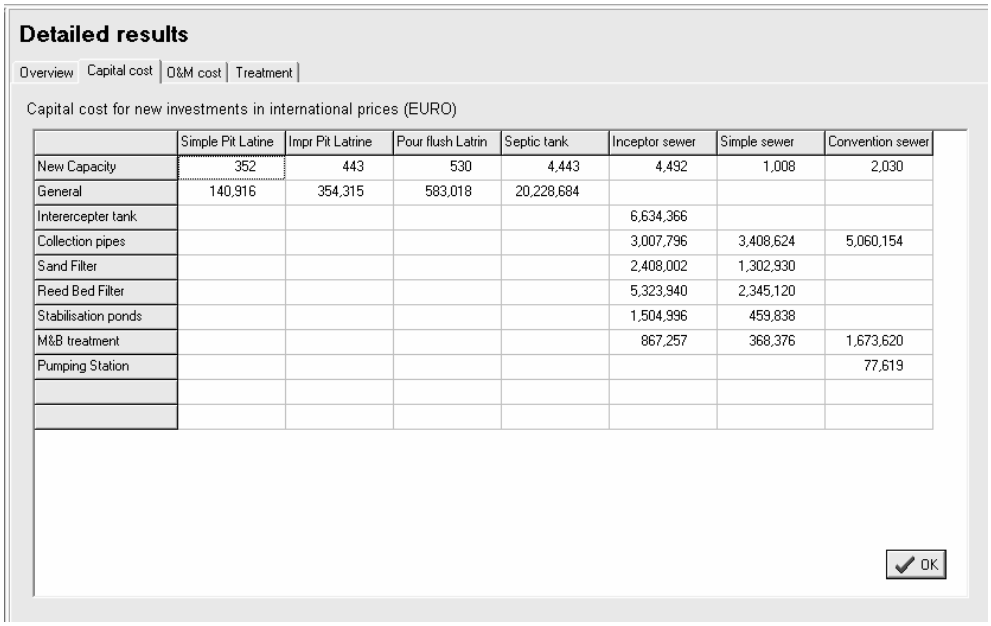
The following screen shows the overall detailed results from the rural wastewater component of the model.



	Simple Pit Latrine	Improved Latrine	Pour Flush Latrine	On site septic tank	Sewered interceptor tanks	Simplified sewerage	Conventional sewerage
People served with new structure	2114	2657	3180	26661	19903	6731	9715
Capacity	352	443	530	4443	4492	1008	2030
Total cost							
Capital Cost	140916	354315	583018	20228684	19746356	7884888	6811394
Annual O&M Cost	2818	7086	14575	213387	973677	203815	141207
Weighted lifetime	10	10	10	20	20	20	20
Annual Repl. Cost	14092	35431	58302	1011434	987318	394244	340570
Per capita cost							
Capital Cost.	67	133	183	759	992	1171	701
O&M	1	3	5	8	49	30	15
Replacement	7	13	18	38	50	59	35
Total annual cost	75	149	206	805	1091	1260	751

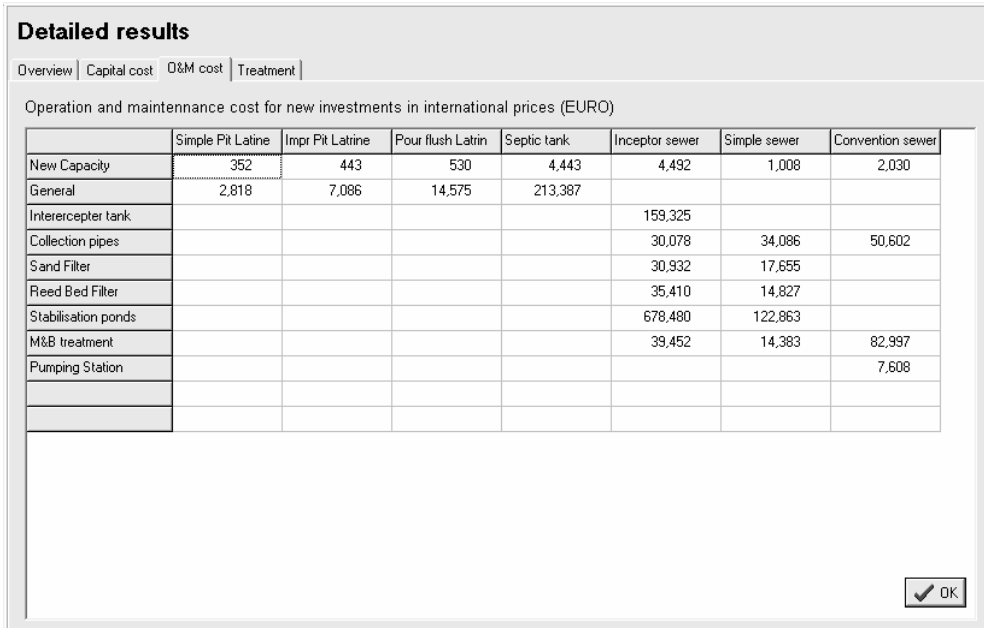
Two more screens shows these cost components in more detail.

Investment cost for new investments



	Simple Pit Latine	Impr Pit Latrine	Pour flush Latrin	Septic tank	Inceptor sewer	Simple sewer	Convention sewer
New Capacity	352	443	530	4,443	4,492	1,008	2,030
General	140,916	354,315	583,018	20,228,684			
Interercepter tank					6,634,366		
Collection pipes					3,007,796	3,408,624	5,060,154
Sand Filter					2,408,002	1,302,930	
Reed Bed Filter					5,323,940	2,345,120	
Stabilisation ponds					1,504,996	459,838	
M&B treatment					867,257	368,376	1,673,620
Pumping Station							77,619

Operation and maintenance cost for new investments



	Simple Pit Latine	Impr Pit Latrine	Pour flush Latrin	Septic tank	Inceptor sewer	Simple sewer	Convention sewer
New Capacity	352	443	530	4,443	4,492	1,008	2,030
General	2,818	7,086	14,575	213,387			
Interercepter tank					159,325		
Collection pipes					30,078	34,086	50,602
Sand Filter					30,932	17,655	
Reed Bed Filter					35,410	14,827	
Stabilisation ponds					678,480	122,863	
M&B treatment					39,452	14,383	82,997
Pumping Station							7,608